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Telling Ancient Tales to Modern Machines: Ontological Representation of Sumerian Literary Narratives

by

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ABSTRACT

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TELLING ANCIENT TALES TO MODERN MACHINES:

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Terhi Nurmikko-Fuller

This thesis examines the potential of semantic web technologies to support and complement scholarship in Assyriology. Building on prior research, it is unique in its assessment of the suitability of three existing OWL ontologies (CIDOC Conceptual Reference Model, FRBRoo and Ontomedia) to adequately capture and represent the heterogeneous and incomplete narratives published as composites by the Electronic Text Corpus of Sumerian Literature.

Its agenda sits firmly within the interdisciplinary context of the Digital Humanities and Web Science, and it describes a process centered on the development, implementation and valuation of an ontological representation system (mORSuL), designed to reflect the needs, desires, challenges and opportunities of Assyriological research paradigms. Underlying the process are two fundamental assumptions: firstly, that semantic technologies can be used to support academic endeavours in the Humanities, and secondly, that the benefits of doing so can be identified and evaluated.

The thesis culminates in the conclusion that these existing ontologies are mostly suitable for the representation of the narrative content of these ancient texts, requiring only a few additions and changes.

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DECLARATION OF AUTHORSHIP

I, TERHI NURMIKKO-FULLER, declare that this thesis titled

TELLING ANCIENT TALES TO MODERN MACHINES: ONTOLOGICAL REPRESENTATION OF SUMERIAN LITERARY NARRATIVES

and the work presented in it are my own and has been generated by me as the result of my own original research.

I confirm that:

1. This work was done wholly while in candidature for a research degree at this University;
2. Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;
3. Where I have consulted the published work of others, this is always clearly attributed;
4. Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work;
5. I have acknowledged all main sources of help;
6. Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself;
7. Parts of this work have been published as:

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Signed: ....

Date:...

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Definitions and Abbreviations

AO	Collection of Antiquités Orientales of the Musée du Louvre
ASOR	American School of Oriental Research
BANEA	British Association of Near Eastern Archaeology
BASOR	Bulletin of the American Schools of Oriental Research
BMO	British Museum Ontology
CBS	Babylonian Section of the University Museum, Philadelphia
CDLI	Cuneiform Digital Library Initiative
CDLJ	CDLI Journal
CSV	Comma-Separated Values (file format)
CIDOC CRM	Conceptual Reference Model for cultural heritage information
DTD	Document type definition (set of markup declarations)
ePSD	electronic Pennsylvania Sumerian Dictionary
ETCSL	Electronic Text Corpus of Sumerian Literature
FRBRoo	A formal ontology to represent bibliographic information
GLAM	Galleries, libraries, archives and museums
HTML	HyperText Markup Language
JAOS	Journal of the American Oriental Society
JCS	Journal of Cuneiform Studies
JNES	Journal of Near Eastern Studies

KR	Knowledge Representation
LAWDI	Linked Ancient World Data Initiative
LD	Linked Data
LOD	Linked Open Data
mORSuL	multi-Ontology for the Representation of Sumerian Literature
MySQL	Open-source relational database management system
NABU	Nouvelles Assyriologiques Bréves et Utilitaires
OB	Old Babylonian
OM	OntoMedia
OWL	Web Ontology Language
Oracc	Open Richly Annotated Cuneiform Corpus
RDF	Resource Description Framework
RDFS	RDF Schema
SAWS	Sharing Ancient Wisdoms
SPARQL	SPARQL Protocol and RDF Query Language
URI	Uniform Resource Identifier
W3C	World Wide Web Consortium
XML	Extensible Mark-up Language

Chapter 1: Introduction

1.1 Outline of the Research Agenda

This inherently interdisciplinary doctoral thesis examines the potential of Linked Data and semantic technologies to support and diversify academic investigation in the specialist field of Literary Sumerology, a niche with the discipline of Assyriology. Through collaboration with an online resource developed by the University of Oxford, the ETCSL (Electronic Text Corpus of Sumerian Literature, http://etcsl.orinst.ox.ac.uk/), the suitability of existing OWL (Web Ontology Language) ontologies to represent Assyriological data has been assessed and evaluated: The focus has been predominantly on the potential to represent the narrative structures that play out in ancient Sumerian literary compositions, but includes complementary data as published by the ETCSL.

This research has benefited from prior scholarship in two multi-disciplinary domains, the Digital Humanities and Web Science, both of which have made strides in bridging Computer Science and myriad specialist areas. It has culminated in the development, implementation and evaluation of an ontological representation system, known as mORSuL (multi-Ontology for the Representation of Sumerian Literature) using an open-source platform developed by Stanford University, the ontological editor Protégé. mORSuL has been inspired and influenced by liaisons with Assyriologists, members of the GLAM (galleries, libraries, archives and museums) and LAWDI (Linked Ancient World Data Initiative) communities, and validated through the representation of exemplar texts.

Preliminary analyses carried out at the beginning of this study included the review of existing online resources for Assyriology and the identification of those semantic technologies, which could be used to publish this data. The aim was to establish a strong understanding of the requirements and potential of Assyriology in the first instance, and then to apply that knowledge in the evaluation of existing ontological structures to accurately and sufficiently represent this data. The successful completion of those objectives required the evaluation of online resources and known projects from the spheres of the Digital Humanities in general and of Assyriology in particular, as well as acquiring an understanding of the ontologies in question.

Semantic technologies and ancient world datasets may at first seem like strange bedfellows but have proven to be compatible. As noted by Wilks and Brewster (2006:38), the traditional concerns of Linguistics (and thus, it could be easily argued, also Philology) are more in line with those of the Semantic Web (the logical and semantic representations of words and texts) than they are with the low level, pattern-matching techniques of current Information Extraction methodologies. This suitability has not been overlooked by the Digital Humanities or the Digital Heritage communities – even since the start of this doctoral research project (and indeed right until the final stages of the creation of this thesis) numerous new projects combining historical and ancient data with semantic technologies have been launched or instigated. These projects, whilst sharing similar underlying methodologies to the research described herein, are however predominantly focused on the publication of geographical and prosopographical data in a machine-readable format. It is in the context of applying ontological structures to represent the narrative structure of the ancient Sumerian texts, that the research documented and discussed in this thesis is innovative and unique.

1.2 Hypothesis

Preliminary scholarship within the wider context of this research agenda led to the formation of the following hypothesis:

> Existing, domain-specific ontologies, designed from omniscient perspectives are suitable for the representation of the heterogeneous, incomplete and un-known narratives, which play out in ancient Sumerian literary compositions.

From the onset a dichotomy is clear. Domain-specific ontologies are, in effect, the representation of a given domain to the greatest extent that is pragmatically possible and thus view the represented subject matter from an almost all-knowing and largely unambiguous perspective. Yet Sumerian literature has unknown elements – it may not be possible to identify the reason behind the creation of a particular piece, nor the time or place when it was first formulated in an ancient mind nor even when it was committed to clay. Accidents of preservation and discovery mean that only parts of some texts are known to modern scholars: broken tablets carry incomplete narratives which leave readers in the dark regarding the events that take place in the story. There is also the contradiction between; on the one hand, the fluid nature of the way in which a story is told, experienced and interpreted and on the other, the reductionist way the use of ontologies necessitates it must be represented.

Two underlying assumptions are maintained: Firstly, that regardless of these dichotomies, the use of existing ontologies to map out the content of Sumerian literary compositions is possible, and secondly, that there is a benefit to doing so. The research carried out for this doctoral thesis aimed to establish the extent to which these assumptions can be shown to hold true.

1.3 General background and terminology

In order to facilitate the following discussion and analysis, the terminology used throughout this thesis ought to be briefly defined. There are five broad concepts (Assyriology, Semantic technologies, the concept of Suitability, philology and the narrative), which lie at the heart of this scholarship. Each of these is multifaceted, and worthy of definition, explanation and description.

Assyriology

Assyriology is the linguistic, archaeological, cultural, historical and curatorial study of the material and literary culture of ancient Mesopotamia (for a timeline please see Appendix A), focusing on but not exclusively limited to the geographical area that constitutes modern day Iraq. In terms of temporal scope, the acceptable range of dates for research interests which fall under the umbrella term of Assyriology is vast, from the earliest of prehistoric periods, the Ubaid (ca. 6500 BC) to a limited number of modern ethnographic and comparative studies of the cities, peoples and living traditions of the Middle East today (consider for example Rost and Hamdani, 2011).

The majority of philological investigation has focused on material composed between the third and first millennia BC. The primary source material cited in this thesis is not anchored to a specific socio-cultural or temporal entity, phenomenon or phase. “Sumerian” is to be considered as neither an ethnic nor a spatio-temporal label nor as exclusively applying to a distinct and defined group of peoples (and their written material). Rather, at least for the purposes of this thesis, it is an exclusively linguistic one, with no limitations applied as to the ethnicity of those who composed these texts. Consequently, data used herein is not limited to sources with a proven provenance in Sumerian periods (Early Dynastic periods or possibly the Sumerian Renaissance of the Ur III), but also considers copies and versions produced by scribes as part of the formalised education system in later periods. Neither is the scope of the data limited to compositions found at specific geographical locations. Instead, it is the history of modern Assyriological scholarship and other influencing factors, which have determined the selection criteria for the dataset. These will be discussed in greater detail in Chapters 2 and 3. Suffice to say at this point, that since the majority of literary pieces cited in this thesis, including the case-study example of *The Three Ox-Drivers of Adab*, are known from Old Babylonian (twentieth to sixteenth centuries BC) contexts, (with the caveat that these may not represent the oldest exemplar), if a temporal anchor is necessary, the OB period is a suitable candidate.

Semantic Technologies

The semantic technologies utilised in the research process documented and analysed in this thesis are limited to OWL (Web Ontology Language) ontologies and the Linked Data (LD) paradigm for online publication of data. Originally a term coined for Philosophy, "ontology" was adopted and adapted by Computer Science to refer to a structural framework, which can be used to represent the "truth" (as far as it can be pragmatically ascertained) of a given domain; the set of concepts that constitute a universe of discourse and the relationships between them. The aim of ontologies is to represent data in machine-readable formats, and thus enable automated reasoning (the finding of implicit connections between explicitly declared facts). The online publication of data, with adherence to known and shared vocabularies and ontologies, as well as http://URIs (discussed further in Chapter 4) enables the inclusion of data from various separate data sets and helps enrich the knowledge of any one subject or domain with relevant information from another. It is hypothesised that existing ontologies, although not purposely designed to represent ancient world data, could nevertheless be suitable for that task.

Suitability

The issue of suitability has been at the centre of this research throughout the process. There are two major points of consideration; firstly, how to exactly define suitability, and secondly, whether or not it is measurable. For the purposes for this thesis, the issues of defining and measuring suitability are closely linked: Instances of high correspondence between the ontological structure and the Assyriological dataset (in this case, consisting of both the requirements of the data, and the needs and desires of the scholarly community) signify that a given ontology is suitable for the task – problems finding suitable classes and properties to map the content of the ancient narrative imply the opposite.

In order to be considered highly suitable to the task, the ontological structure must include three types of elements. These are:

- The types of entities and relationships which occur in the data,
- The research aims of Assyriological scholars, which consist of a range of topics that have been identified as suitable for past, current and potentially future academic investigations as determined from the publication record of well-known, international, peer-reviewed conferences and journals, and
- The potential limitations of available technologies.

It is from the foundation of understanding the main features of these three elements that the hypothesis was generated. The process for selection of the ontologies, and the criteria by which they are judged, are discussed in greater length in Chapters 4 and 5, and are further illustrated by the use of the case study example in Chapter 6.

Philology

Philology is the study of the content and language of ancient texts. In itself a multidisciplinary discipline, philological investigation consists of elements of historical and linguistic analysis, as well as an understanding of the material culture and general socio-cultural context from whence these compositions originate, and to which they refer. For cuneiform studies, this implies knowledge of the cultures, languages and history of Mesopotamia, supported by awareness of the implicit associations and connotations that are known to have been prevalent in the Mesopotamian view of the world (such as the intrinsic relationship between a god and his city). Since literary texts were written on clay tablets and not, for example, on public monuments, the focus of this thesis has been limited to philological analysis, rather than that of philology and epigraphy combined, or epigraphy alone. Philological analysis can be supported by, but is not synonymous with, archaeological investigation or museological research.

Philological annotations as they have been discussed in the course of this thesis consist of a number of different manifestations. In this category are group instances of **eme.sal** (a distinctive dialect of Sumerian, discussed in detail in Chapter 2), scribal errors, omissions and other similar features of the text. The existing norms and paradigms of philology concerning Sumerian language constitute the main body of Chapter 2, whist the discussion and description of literature has been separated out and allocated to Chapter 3.

Chapter 1

Narrative

In the course of this study, the use of the term “narrative” by various authors for a myriad different ideas has been encountered – most often used to convey the idea of an interpretative context, or the description of the biography of an (archaeological) object, or the systematic structure of a given piece of academic writing. The ‘narrative’ discussed in this thesis, however, is one defined in literary theory in general, and one examined from the perspective of structuralist narratology in particular (Hargood, 2009; Harman, 2005).

Much of Narratology traces its history to the work of Propp (1968), including works examining stories from other cultural and linguistic traditions (Dundes, 1968: xiv). The notions of the fabula (as the events of the story in chronological order) and the syuzhet (the actual employment of the narrative) are relevant for the analysis of Sumerian literary compositions. In the case of the 31 functions (actions defined by their place in the plot) many can be seen as applicable (e.g. Departure, Struggle, Return), although some are culturally specific and do not occur in the context of the earlier literary pieces, or are complicated by connotations and associations separate from literal meanings. A challenge is also presented by the frequency of the non-event, such as ‘Wedding’ – it may frequently be implied in ancient Mesopotamian literature, or predicted, but the actual festivity itself does not explicitly take place as a function in the arc of the story.[1]

Similarly, the eight types of character (hero, villain, donor, dispatcher, false hero, helper, princess, and her father) can be found if specifically looked for,

[1] It may be worth noting that in the fairytales of Russia in the 1920s, when Propp was carrying out his work, “wedding” could have been understood as a subtle euphemism for the act of sexual intercourse. The ancient Sumerian literary compositions do not however shy away from explicit details when telling of sexual acts, see for example the composition known as *Enki and Ninhursaga*.

but the nature of protagonists in Sumerian literary compositions appears rather more complex, and none comfortably sit into this criteria without much interpretation by the reader (consider for example Gilgameš, arguably the most well-known of Mesopotamian literary heroes, who, depending on the composition, perspective of the audience, and section with a piece, is equally cast as either hero or villain). This having been said, the further reduced six classifications (subject, object, sender, receiver, helper, and opponent) by Greimas (1983) offer insufficient detail, and enable little in terms of distinction.

Much of the ontological development work that has preceded this thesis, and on which it relies, has been influenced by the basics set by Propp (1968), and the schools-of-thought that prevailed in structuralist Narratology in the mid- to late 1900s (Barthes, et al, 1975; Herman, 2007). However, in order to adequately capture the content of the modern fiction for which it was designed (Lawrence, 2008), the small number of types as defined by Propp were expanded and diversified considerably. The size, complexity, and diversity of the resulting ontological structure (Ontomedia) is thus more suitable for the capture of Sumerian literary narratives than Propp's (or Greimas') classifications alone.[2]

Themes, as defined by Tomashevsky (1965), are given limited consideration within this thesis, the approach rather focusing on the identification and mapping of each specific motif as the smallest individual element of the narrative instead. This reductionist approach to the mapping of features of a narrative had the dual purpose of focusing the representation to the content of the Sumerian composition, and limiting the dangers of over-extension of

[2] Ontomedia is further described in Chapter 4 of this thesis.

interpretive contexts beyond their applicability as discussed by Herman (2007). The mark up is based on the original Sumerian text, rather than the English translation,[3] and the aim has been to capture the protagonist, locations, and events as they are described, minimising (contextual) interpretation.

The narrative, at the level of granularity that it is represented within this thesis, is a feature that can be shared by two or more versions of the same text, even if they differ in lexical semantics or have orthographic variants. It can also be (at least seemingly) shared by two entirely different types of pieces (the retelling of a story in another genre, or from another perspective). The question of granularity is intrinsically involved in the idea of comparing structures: where is the line drawn between the retelling of the same story in different context and having two disparate tales?

It is worth noting that these stages of prior academic and intellectual endeavours are likely to have in-built biases, which are now repeated. Certain elements of the narrative in the Mesopotamian pieces may seem more noticeable, or attention-grabbing, or interpreted in a context to fit an existing structure – that is to say, although a very conscious effort has been made to avoid it, events in the narrative that are expected to be found may be more likely to be noticed, than those that are not. This process may also lead to a type of false positive, whereby an event is interpreted as something it is not, due to inherent socio-cultural biases.

[3] Thus, for the case study example in Chapter 6, the eponymous ox-drives are described as being men, who have possessions, rather than through some interpretive context, for example, as agriculturists, or indeed, 'ox-drivers'.

1.4 Rationale of the Project

The unique element of this research project lies in representing the structure of a Mesopotamian literary piece. An ontology for representing narrative already exists (Ontomedia), but as it was designed and devised for the purposes of representing modern fictions (specifically content produced by fans and as published on online forums), and has as of yet never been applied to ancient compositions. Whilst the number of online resources for Assyriology has dramatically increased in the last decade, only a few examples incorporating semantic technologies can be cited and none which seek to map the literary narratives of the ancient Near East are known. This thesis is in an opportune position to engage in pioneering scholarship in the disciplines of Assyriology, Digital Humanities, the nascent Web Science, and potentially even the spheres of LD and Knowledge Representation (KR).

mORSuL

The research process has culminated in mORSuL, a new ontological structure for the representation of Sumerian literature. It is predominantly the combination of three pre-existing ontologies, the CIDOC Conceptual Reference Model (CIDOC CRM), FRBRoo and Ontomedia (OM), but also contains new classes, which have been deemed necessary additions. Implemented in the Stanford University developed ontological editor, Protégé, mORSuL was manually populated with the elements of a case-study text, the *Three Ox-Divers of Adab*. The functionality of mORSuL was confirmed via SPARQL queries.

1.5 Data

The dataset for this thesis is the content of the online resource, the Electronic Text Corpus of Sumerian Literature (ETCSL). The name accurately encapsulates the form and function of this resource, which Ebeling (2007: 37) so succinctly describes as a “diachronic, transliterated, annotated corpus of Sumerian literature and a Sumerian-English parallel corpus”. It is a digital, Web-based collection of Sumerian literary texts (a corpus), which can be examined and searched. It contains some 400 composite versions (in each case, a single cohesive whole, which is a modern product of the amalgamation of known, surviving ancient versions and fragments) and the content focuses exclusively on literary pieces (the genre is better defined in Chapter 3). The seven-part thematic structure mirrors the corpus created by Civil (published in Ebeling and Cunningham (eds), 2007).

In terms of philological analysis and the study of ancient texts, there are two main features of the ETCSL wherein modern interpretation has played a notable role. Firstly, it is a corpus of transliterations, that is to say, it is not the cuneiform glyphs or high-resolution photographs of the objects that have been provided, but a rendering in the Latin alphabet and using modern philological conventions. Secondly, it is a corpus of composite texts, each of them consisting of sections from two or more versions of the ancient text, merged together at the discretion of a present-day Assyriologist. Along with the transliterated Sumerian (displayed in a line per line format), the corpus also includes bibliographic data, listings of secondary sources, and an English translation (in prose and paragraphs).

Three key aspects of the ETCSL have been examined in terms of their needs, potential and presented challenges for publication in a machine-readable format: the bibliographic data, the philological annotations and the narrative content of the texts (expressed both via Sumerian transliteration and English translation).

1.6 Methodology

The interdisciplinary nature of this scholarly endeavour has brought together not only myriad data but also a number of different methodologies. Each of the main three concepts, which comprise the body of this thesis, had a distinctly different approach; the aim of this doctoral research was to establish and demonstrate cohesion between these different paradigms and illustrate not only inherent synergistic potential but also the benefits to be reaped from that synergy.

Assyriology

The Assyriological dataset is approached from a philological perspective of focusing on literary analysis and corpus linguistics. The applied methodology is also influenced by recent Assyriological literary criticism (along the lines of Delnero, 2006; Delnero 2012; Worthington 2012). Parallel to Gadotti (2014), this research is also set in the heuristic framework created by Alster (2006) for the analysis of Sumerian literature in general, and the subgenre of "wisdom literature" in particular.

The specifications and requirements of the discipline have been established through a combination of evidence in the form of recent and historical publications in the international, peer-reviewed journals of the field (BASOR, CDLJ, JAOS, JCS and JNES); topics and discussions at recent conferences and workshops; through an introspective analysis, based on earlier scholarship by the author involving the Sumerian language; informal conversations with members of the relatively small niche community of specialists, and extensive literary reviews concerning recent research and publication paradigms.

Semantic Web and Semantic Technologies

The semantic technologies section of this thesis has been informed by a number of recent publications, as well as papers and workshops within the sphere of Digital Humanities. Other projects have been considered from the perspective of suitability and lessons-learnt, with a critical eye being cast particularly over the aims and practical design decisions made. These are supported and enriched by papers, which analyse LD and ontologies from a more technological perspective (such as Alani, et al, 2002; Brewster and O'Hara, 2004; Segaran, et al, 2009; Allemang and Hendler, 2010).

This predominantly theoretical background helped support the pragmatic aspects of this work, which involved the use of the Stanford University ontological editor, Protégé, to develop and implement mORSuL. This part of the project involved the uploading of raw OWL files for the relevant sub-ontologies of OM (as found through various pages from http://www.contextus.net/ontomedia/model) into the editor, and expanding the ontological structure by the addition of the OWL2 encodings of CIDOC CRM (http://www.cidoc-crm.org/) and FRBRoo (http://www.cidoc-crm.org/frbr_inro.html). Finally, a few additional classes were manually added to mORSuL, using the editing functions of Protégé.

Assessing Suitability

Assessing the suitability of the existing OWL ontologies was closely linked to the processes of the development and implementation of mORSuL.

The design process began with the identification of the needs and desires of the Assyriological community, as far as could be pragmatically assessed from recent topics published in leading, peer-reviewed international journals (JCS, JNES) and conference proceedings (RAI, ASOR) as well as topics from smaller, local conferences (Oxford Postgraduate Conference in Assyriology, BANEA). Three primary factors contributed to the decision to collect qualitative rather than quantitative data regarding research topics, as well as to opt not to attempt to gather data via eliciting feedback and comments (e.g. through questionnaires):

Firstly, the absence of a shared, informal platform, such as a mailing list, which could be used to describe the topic and elicit feedback from the Assyriological community as a whole. Although a mailing list is known (Agade@listserv.unc.edu), the topics here range from Assyriology to (predominantly) Biblical Studies and Egyptology. The list is not open forum, but more akin to a service providing information: the content of the emails is generated through Jack Sasson's administration (rather than the list members directly) and since receivers cannot reply to the thread or individual posts. It does not seem entirely unreasonable to describe the list as less inviting than other, more collaborative examples (c.f. the Museums Computer Group). This is largely due not only to the restricted nature of the postings, but also the didactic method of delivery, and a closed list of members.

Secondly, informal conversations with a number of academics in Assyriology have helped highlight the dichotomy of knowledge sets between those with the ability to read cuneiform and those with knowledge or familiarity with the methods for machine-readable publication. Any meaningful feedback would necessitate extensive explanation and illustration of the LD and semantic web paradigms, meaning simple questionnaires were unlikely to result in meaningful replies from informed participants. Recent doctoral studies into the use of LD in Archaeology (Isaksen, 2011) highlighted the challenges encountered in the processes of collecting such data (constraints on experts' time, the difficulties of explaining complex issue sufficiently in a succinct manner to those with little prior knowledge) and any attempt to generate a large dataset of qualitative data seemed increasingly unlikely to prove to be a pragmatic solution.

The attempt to explain the potential of automated inference and semantic technologies, and to elicit anonymous feedback from the audience regarding their thoughts and research aims (at the British Association of Near Eastern Archaeology (BANEA) conference in January 2014, using the online resource https://www.mentimeter.com/) , was not entirely successful: (see Fig 1).

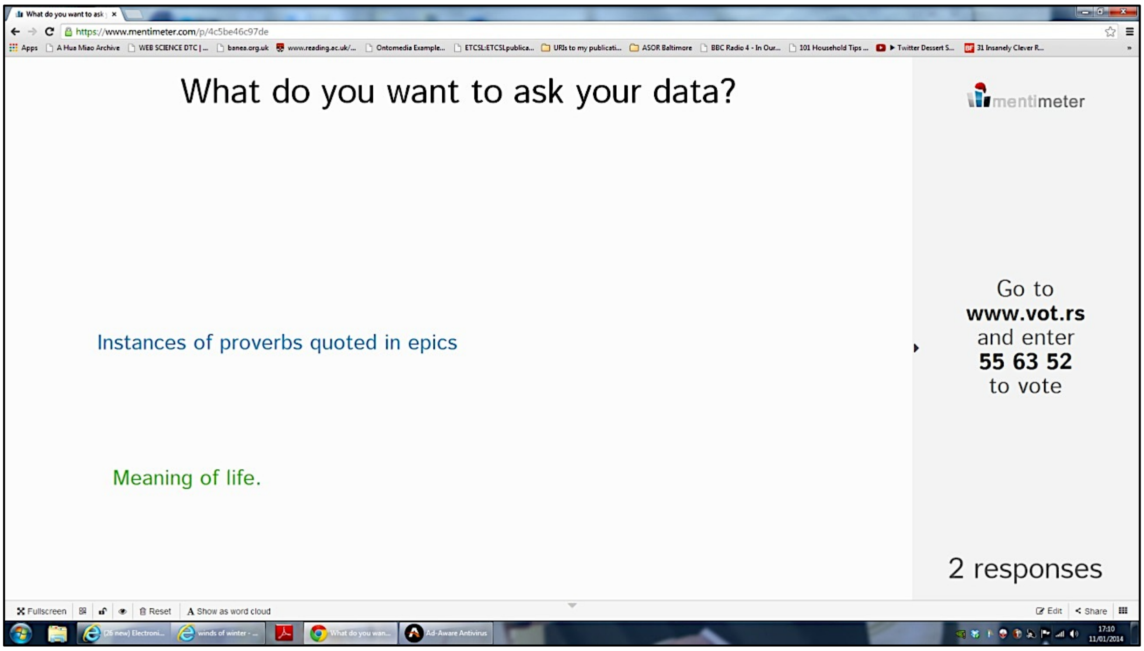

Figure 1 Illustration of the limited extent of feedback from BANEA 2014.

Participants chose not to actively engage with the online resource, but a traditional show of hands helped determine that the two types of research agendas and methodologies enabled by semantic technologies that were of most interest were:

- The ability to search for a specific phrase or identified entity, and
- An opportunity to gain complementary data from other disciplines.

Thirdly, since the focus was that of Sumerian literary compositions, it seemed plausible to extract information regarding typical research agendas by examining the history of this niche field. In the process of doing so, a historical parallel was discovered in the form of a story as accounted by Robson (2013): In the early days of decipherment of Sumerian, the preeminent Sumerologist Samuel Noah Kramer attempted to engage a number of his colleagues in an experiment to confirm the decipherment of that ancient tongue, particularly in the context of a cluster of proverbs (example of a subcategory of the wider genre of literary Sumerian). In 1952, Kramer sent a collection of forty-eight proverbs to twenty colleagues – only eight responded, and where the same proverbs had been translated (only ten were translated by each scholar), agreement ranged between “considerable disagreement about practically all of the proverbs, and no agreement whatsoever in the case of some” (Robson, 2013:47). It has seemed feasible to predict, that whilst knowledge has increased and methods have matured in the last half-century, the inherent complexities of the content, and the challenges that Sumerian presents as a language to some extent remain, and new interviews would be likely to unearth an equally diverse approach to the representation of Sumerian literature. Furthermore, explaining (often in the absence of tangible examples) the potential of semantic systems to laypersons would be time-consuming, and may deter many expert scholars from participating in what would inevitably be a lengthy interview process.

As a result, the development and implementation of mORSuL relied on recent publications in international and peer-reviewed journals and conference proceedings, as well as discussions with members of the Assyriological community. These painted a picture of topics and paradigms important to this scholarly community, and helped identify the CIDOC CRM, FRBRoo and OM as ontologies where the structure most closely matched the types of data that would trigger the most interest.

Once the ontologies had been implemented, mORSuL was validated using queries generated based on research questions voiced at conferences (RAI, ASOR, BANEA) and elicited from journal articles; those suggested by Assyriologists and members of the Linked Ancient World Data Initiative community as part of similar projects in other areas of the ancient Mediterranean; and finally, through the use of a case study example of a humorous but incomplete composition, known as *The Three Ox-drivers of Adab* (selected due to interesting narrative features and described in greater detail in Chapter 6). This validation process (see Fig. 2) helped identify missing elements of mORSuL, and prompted the repetition of the process of development, implementation and validation, which could be repeated, at least theoretically, *ad infinitum*. For the purposes of the thesis, the cycle was completed once, with further developments committed to future work (Chapter 7).

Even as new knowledge is unearthed and ideas emerge from the academic community, mORSuL will serve as a proof-of-concept of the suitability of existing ontological structures to adequately represent the content, the associated bibliographic data and the annotations of Sumerian literary compositions. The aim has not been to provide an upper-level ontology capable of mapping the entirety of Sumerian literature, or to capture all available documentation and secondary material.

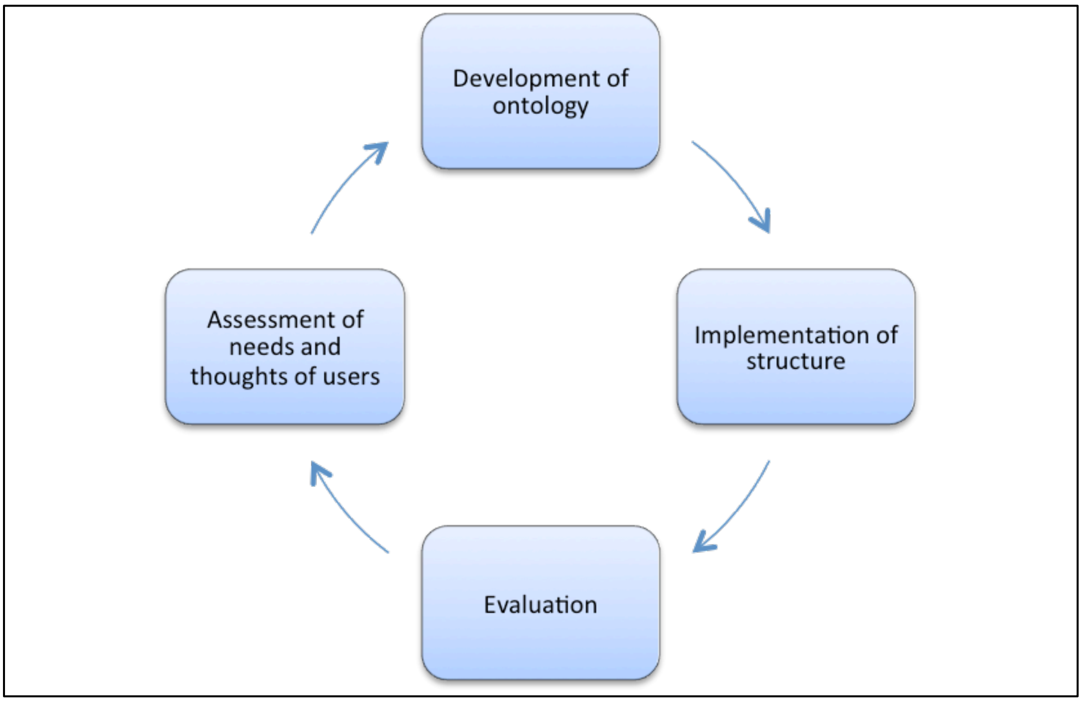

Figure 2 Cycle of Assessment, Development, Implementation and Evaluation as parts of the process of ontology design.

Rather, the aim has been to illustrate the suitability of mORSuL to adequately represent the narrative content of literary texts and their associated data, as published by the ETCSL specifically, and exclusively. Opportunities to link with other projects have been identified and fostered, but the focus has been on this online resource alone. This research has had two objectives:

- To assess whether the CIDOC CRM and FRBRoo adequately reflect the information available on the ETCSL, and thus lend themselves to the representation of data from projects which are not strictly in the cultural heritage domain (since it does not contain the type of museological metadata that the CIDOC CRM has been designed to represent), and,

- To test whether OM can truly be described as an upper-level ontology for the representation of (all) narrative structures, including ancient ones, as suggested by Lawrence (2008).

The necessary background information, illustrative examples and points of consideration relevant to this process have been outlined in the course of this thesis. Relevant sections can be identified from the Chapter Summary (below).

1.7 Conventions used in this Documen

number of formatting conventions have been applied to ensure clarity and standardisation of expression throughout the thesis:

- All words and syllables in Sumerian are expressed in **bold**,
- Akkadian equivalents, where applicable, in ***bold italics***,
- transliterations follow the system outlined by the ETCSL (see Appendix B),
- Cuneiform signs, where used, are represented using the Cuneiform Composite Unicode glyphs,
- Titles, works and text names are in *italics* (e.g. *The Three Ox- drivers of Adab*),
- Classes and properties in ontological structures and http://URIs are expressed in the Courier New font.

Sumerian and Akkadian, as well as their representations in both cuneiform and transliteration are discussed and illustrated in the course of this thesis (see

Chapter 2). Examples of words and phrases in these languages are in transliterations, followed by (where relevant) the glyphs, accompanied by translations in English. The conventions outlined above, and the Glossary (to be found at the end of this thesis) ensure that no specialist knowledge is required in order to understand the content of this thesis.

1.8 Chapter Summary

There are a total of eight chapters. In adherence to the co-constitutive nature of Web Science and the Digital Humanities, no main topic has been analysed exclusively within its own paradigm, but rather from the perspective of the other – that is to say, Assyriology is explained from a perspective of needs and challenges which semantic technologies could address, whilst those technologies are discussed with a deliberate avoidance of technical jargon and specifically in the context of tools and approaches which have the potential to support the Assyriological community.

Chapter 2 provides a heuristic framework in which Sumerian literature (further described and discussed in chapter 3) could be understood and the historical context whence it emerged. Rather than repeat these features for the benefit of those already deeply emerged in the discipline, the topic and content of this chapter have been approached from the perspective of a “working ontologist” (Allemang and Hendler, 2010) or semantic web practitioner. This chapter allows for the discussion of the current state of research in this specialist niche, summarising key features of the Sumerian language, and discussing the relationship between Sumerian and the cuneiform script.

Chapter 3 follows in line with the preceding chapter, but consists of a more detailed description of the transliteration process and modern philological conventions. The chapter discusses the notion of Sumerian literature, the phenomenon of the composite text and takes a close look at the ETCSL. It concludes with a review of existing projects for the digitization and dissemination of Assyriological data online.

Chapter 4 presents the picture from a complementary perspective: discussions about semantic technologies in terms familiar to educated laypersons, with examples specific to the interests of Assyriologists. This chapter contains a brief outline of the available tools such as URIs, XML, RDF and SPARQL and an evaluation of the used ontologies CIDOC CRM (cultural heritage data), FRBRoo (bibliographic data) and OM (the narrative). The discussion also incorporates a highly context-specific ontology created by Jaworski (2008; 2009) for economic tablets of the Ur III period and an "experimental" ontology for Sumerian grammar (Alivernini, et al, 2006:3). Vocabularies and existing use-cases are also discussed, including the British Museum's SPARQL Endpoint, the Text Encoding Initiative (TEI), and EpiDoc as well as a number of other projects from various institutions, brought together under the umbrella of the Linked Ancient World Data Initiative (LAWDI, renamed from "Institute" in 2013).

Chapter 5 consists of a discussion outlining the main features of mORSuL, including an outline of the classes and properties and the design decisions that went into the development of this ontology. Potential query types and user-aims are also discussed in this chapter, and the theoretical suitability of mORSuL as an upper-level ontology for Sumerian literature (as published by the ETCSL) is assessed.

Chapter 6 consists of a case study example to illustrate the suitability of mORSuL to represent a Sumerian literary composition, *The Three Ox-drivers of Adab*. It begins with a summary of the story and a rationale as to why this particular composition was chosen, with later sections dedicated to the description of the locations and protagonists, as well as of the main narrative features, including issues of scale and granularity. The transliteration and translation of the composite text, as published by the ETCSL, are to be found in the Appendix E.

Chapter 7 is the penultimate chapter of this thesis. It outlines the scope for future work. It includes possible use case-scenarios, and outlines ambitions as to the type of interdisciplinary, comparative analyses that will be possible with continuing research and implementation of an increasingly complex structure and dataset for mORSuL. The scope of this forthcoming research and the process of evaluating its successes are also outlined within the chapter.

Chapter 8 summarises the main arguments and findings of the research process. It returns to the original hypotheses and problem spaces, and culminates in the final presentation of the conclusion that these existing ontologies can be shown to be simultaneously both adequate and inadequate for the representation of the content and text metadata as published by the ETCSL.

Chapter 2: Assyriology and Sumerology

2.1 Background

In line with the philosophy of “Wittgensteinian opposition” (Wilks and Brewster, 2006:10), one of the underlying assumptions of this thesis is that, at least for the immediate future, the primary content of the Web will be natural language. Programs, algorithms and representation devices (no matter how technological determinist in nature) are essentially dependent on it, and as a result, representation (ontological or otherwise) cannot be disjoint from it. In terms of research such as that carried out for this thesis, where differences between the natural language of the content (Sumerian) and the language of annotation and interpretations (English) are considerable, an in-depth knowledge of the primary features of the former and the heuristic framework in which it sits is necessary. Furthermore, the dataset for this thesis is considered to be inherently bilingual in Sumerian and English, and as such, an understanding of the former is essential.

Sumerology is the less often used label for the study of the Sumerian language and written material. It sits within Assyriology, a multi-faceted, polyglot discipline. Scholars of Mesopotamian philology are expected to know several ancient tongues: Akkadian (including the sister-dialects of Babylonian and Assyrian) and Sumerian appear a staple minimum in requirements for academic posts at institutions across the globe, (evident from those advertised by the IAA (International Association for Assyriologists)), with many opportunities preferring additional knowledge of Anatolian languages (e.g. Hittite, Hurrian) or others (Elamite). In terms of modern languages, major professional entities, such as the IAA, accept submissions in English, French and German. Philology is but one aspect of Assyriology – it also encompasses archaeological and museological domains.

The contemporary situation in the Middle East being so problematic and the future of new archaeological discovery in the region being under threat, many researchers, by necessity, have often turned their attention turns to historically excavated material. Over a century ago, the practice of systematically carried out and recorded archaeological excavation was a non-entity: in many cases, knowledge of the provenance of a given tablet is by no means guaranteed, and historical collaboration between two or more institutions has played a major role in excavations of ancient sites in Iraq, leading to the division of material culture between two or more institutions. An example of this is Sir Leonard Woolley's excavations at the Royal Cemetery of Ur (Woolley, 1934), which span some 15 years in the earlier part of the twentieth century. The University of Pennsylvania and the British Museum funded the excavations jointly, and the material culture (even from a single archaeological context) is now divided between those two institutions, the National Museum of Iraq, and a number of other institutions. This data and the supporting archaeological data created in the 1930s are now accessible via the joint online project (Ur of the Chaldees: A Virtual Vision of Woolley's Excavations, http://www.penn.museum/sites/ur/) between the Penn Museum in Philadelphia and the British Museum in London (with future collaboration planned with the National Museum of Iraq). Nevertheless, object biographies remain complex, and limited access to data stored in other, closed-off, information siloes and even entirely off-line collections can complicate scholarship.

Complementary research agendas bridging the three specialisms (archaeology, philology and museology) should not be considered as a given: Archaeologist seem to rarely consult historical material as other than exclusively supporting evidence for an already formulated interpretation, and philologists are unlikely to have acquired extensive excavation experience. Those in the museum community bridge these two extremes but often have a preference or a background in one, specialising in either the written records or the material culture of a given period or region but not necessarily both in equal measures.[4] Keenly aware of these different aspects of Assyriological research, the focus of this thesis is on written material, with archaeological and museological data supporting what is, essentially, a Digital Humanities investigation into philological data.

2.2 Sumerian Language

Sumerian has been classified typographically and genetically as an agglutinative, split-ergative, verb-final linguistic isolate (Cunningham, 2013: 95). In the absence of identified linguistic ancestors, surviving relatives or known related languages, any examination of Sumerian becomes by necessity largely introspective. Individual characteristics can however be compared and discussed in the context of other languages, as there are virtually none that can be described as being unique to Sumerian alone (Black and Zólyomi, 2007: 26).

[4] In recent years, this intradisciplinary division between philological and other research agendas within Assyriology has become more loosely defined: the BANEA conference included, in 2013, a specific event for the discussion of cuneiform material (CuneiForum), although this was not repeated in 2014; for the RAI conference planned for 2015, an earlier date has been suggested, to better suit those archaeologists who would otherwise be on their excavations (the RAI having traditionally taken place during mid-to late summer); at the ASOR 2013 event, both philological and archaeological projects were discussed in the same sessions (Cyberinfrastructure I and II). The future of Assyriology may see a more cohesively intertwined, cohesive domain, with an increase in inter-and multi-disciplinary research topics and draw from each of the brain sections of the domain.

No discussion of the Sumerian language can be fully comprehensive without the acknowledgement of Akkadian influence. The decipherment of Sumerian around the turn of the twentieth century was through its Semitic neighbour, but this dependence on an Akkadian crutch to understand Sumerian is by no means exclusively modern phenomenon. Much of our understanding of Sumerian is seen "through an Akkadian glass darkly, because the values ("Lautwerte") of nearly all signs used in the Sumerian syllabaries of different places and periods have been identified by way of Akkadian syllabic spellings..." (Edzard, 2003: 7).

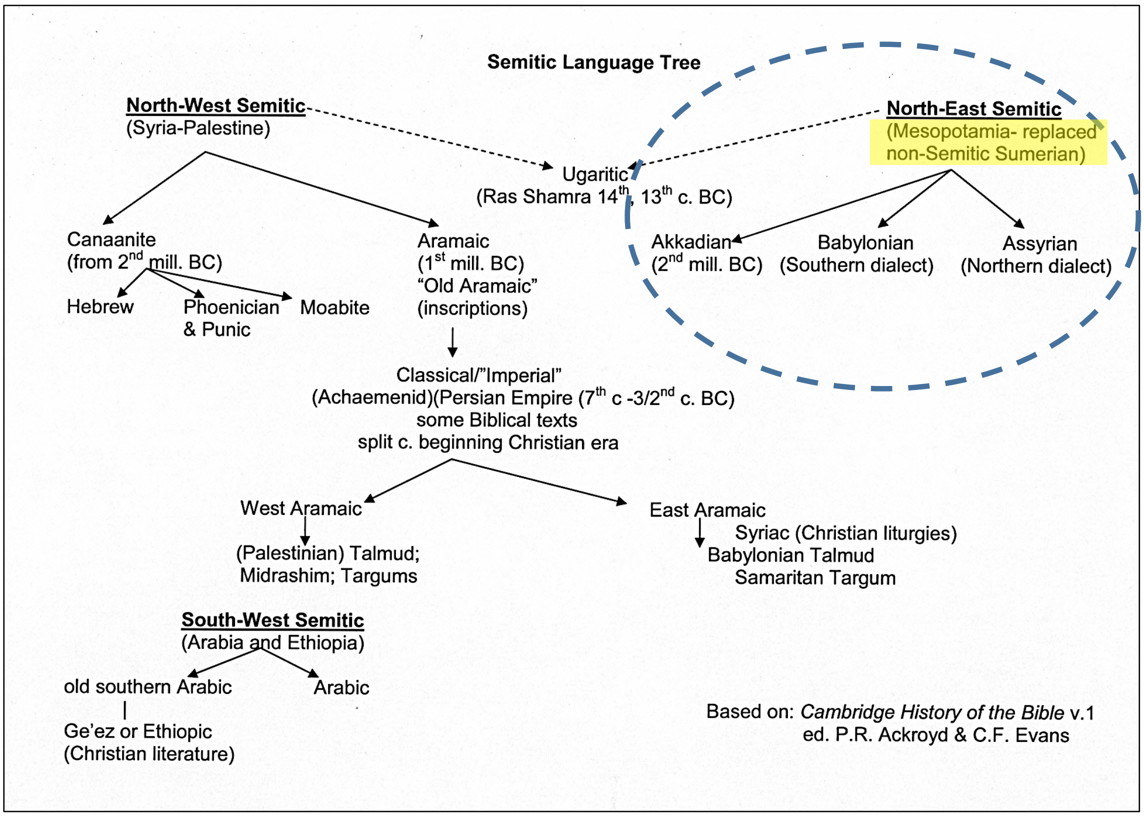

Figure 3 Family-tree of Semitic languages, illustrating the connection between them, and highlighting Sumerian as a non-Semitic language. Harrison, R. (2015). Available at: http://rharriso.sites.truman.edu/semitic-language-family/ .

The area that once was Mesopotamia is now, as it almost certainly always was, a multilingual entity, and it is likely that the vast majority of Sumerian sources were written by scribes whose world was anything but monolingual. This point is particularly relevant in the context of literary analysis. Many texts, although written in Sumerian, are thought to be no older than Old Babylonian (OB) in origin, produced either as copies of earlier pieces or composed by scribes whose native tongue was Akkadian. Recent publications by Taylor (2013:302) and Gadotti (2014) have reminded the Assyriological discipline that some compositions, such as the Instructions of Šuruppak, can be shown to be Early Dynastic in origin, whilst others "clearly derive from the Ur III period, although in most cases we have yet to find those manuscripts". The issue is complicated by the fact that "Sumerian" can be applied confidently only as a linguistic label – the majority of compositions which seem to have emerged in the OB or subsequent periods continued to be written in Sumerian, although it seems unlikely they were composed by native speakers (Brisch, 2013). For a timeline of ancient Mesopotamia see Appendix A.

The absence of Sumerian from administrative and legal documents, as well as letters, even from material unearthed at Nippur (the traditional stronghold of much of Sumerian literature) is evident from around 1730 BC onwards (Black and Zólyomi, 2007: 6). This supports the theory that by this point, Sumerian no longer survived as a spoken language at any of the urban centres. The use of Sumerian in what has been described as the "vernacular and informal registers" of personal correspondences and legal records had ceased some two centuries earlier (Black and Zólyomi, 2007: 6). Although enough of a consensus seems to exist as to the demise of Sumerian as a spoken language during the OB period to warrant the need to express some uncertainty as to the truth of it (Black and Zólyomi, 2007; Brisch, 2013), conclusive evidence may be impossible to come by. Languages have died, and continue to die, but the process is rarely instantaneous, and there seems to be no compelling evidence to exclude the possibility that Sumerian may have survived in isolated pockets. Furthermore, the material, which has survived the accidents of preservation and recovery, is a representation of the language(s) used by a small, literate minority. Although unlikely, Sumerian may have survived for a time among the illiterate masses of the major urban centres, or perhaps amongst one or more of the largely illiterate populations dwelling in isolated pockets on the periphery or far beyond urbanised centres.

The question as to the length of time that Sumerian survived may be an arbitrary one. What we can determine from the historical record is that during the Renaissance of the Ur III period, and for several subsequent centuries, Sumerian thrived as the *lingua sacra*, the language of religion and education. Knowledge of Sumerian remained a status symbol of the educated (Cunningham, 2013: 95), and the language survived even longer in the use of Sumerograms as a scribal 'short-hand' (Worthington, 2012: 244ff.). Indeed, an Assyriological axiom tentatively equates the role of Sumerian with that of Latin in Europe in the Middle Ages, and as an archaic tongue considered by those in the scribal profession to be worthy of study in its own right, Sumerian appears to have survived until the end of the cuneiform era and into the first few centuries when Greek scholars used lexical lists to learn this ancient tongue (Westenholtz, 2007).

This understanding of the history of the Sumerian language is crucial in achieving an appreciation of many of the challenges of philological Sumerology. Sumerian sources contain the same evidence for diachronic change, as do documents written in virtually any other language – none seem to remain unaltered across the passage of time. Certainly post-Ur III we are faced with a form that differs slightly from the classical Sumerian of the previous periods (Taylor, 2013).

Eme.sal

There are two dialects of Sumerian, **eme.gir$_{15}$** (the "native tongue") and **eme.sal**. The former is often described or implied to be the more dominant of the two, used widely across different genres of written material. The latter is often translated as "sweet language" or "high-pitched tongue": Whittaker's (2002) extensive analysis of the history of the study of **eme.sal** (𒅴 𒊩) spanning the final quarter of the twentieth century (AD) illustrates how it has been thought to have been a genderlect, a language exclusively of women (and perhaps the castrati), an interpretation not entirely undue to the use of 𒊩 (SAL), a sign for the feminine. It is also the dialect used by some female characters in some literary compositions. Whittaker (2002: 2) lists over twenty classifications suggested by scholars throughout the years, grouped into seven categories:

- Genderlect (specific to women),
- Stage of language development,
- Jargon of a particular profession,
- Regional dialect,
- Register or style of speech,
- Speech of non-Sumerians, and
- An artificially constructed language (an archaic conlang).

As interesting and engaging as these propositions might be, it is difficult to disagree with Whittaker's conclusion: **eme.sal** is an exclusively literary dialect, a specific rhetoric device. As such, it is relevant in the context of this thesis, and revisited in the course of Chapter 5.

A few notes on Grammar

Black and Zólyomi (2007) have criticized the notion of attempting to create a universally applicable grammar of Sumerian. The scarcity of extensive, complete pieces, and the scattered nature (across both time and space) of surviving tablets have led to the creation of an idea of a largely homogenous Sumerian, as gaps in our knowledge regarding one aspect of grammar in a given period are filled with evidence from another. The question arises: Is this an ubiquitous or inherent characteristic of Sumerology? There are echoes of this methodology in the creation of the composite text, which will be examined in greater detail in section 3.4. For the purposes of this thesis, such a generic overview of Sumerian grammar is sufficient (the focus is, after all, ultimately on the narrative structure). An understanding of the rules that govern the language is necessary, for the appreciation of the impossibility of an absolute equivalent line-per-line translation, the need for the process of lemmatization (the marking of words with their dictionary-equivalent) and the science behind modern philological conventions used to represent the transliterated Sumerian, when these ancient compositions are published not using the original cuneiform script, but translated (transliterated) into the Latin alphabet.

Sumerian is morphologically described as an agglutinative language. Lexical items consist of at least one free morpheme (the smallest possible morphological or grammatical unit), which may then be combined (or 'glued') with additional elements (Cunningham, 2013: 96). Agglutinative languages are known across the globe and all share a feature of forming words by joining together smaller lexical items such as a root with a prefix or suffixes or even the combination of nouns with other noun or adjectives. Examples of new words resulting from the combination of two existing nouns in English are "armchair", "birthday" and "timetable". For Sumerian, additions to the root morpheme can be numerous and varied. Consider for example line 1 of *The Three Ox-Drivers of Adab*:

gu$_5$?-li-li 3-am$_3$ dumu adab^{ki}-ke$_4$-ne

Friends, 3 to be, sons of the city of Adab.

An example of a root morpheme is **adab**, the name of the city of Adab. The subsequent elements are a grammatical element known as a determinative (**ki** signifying a place), the genitive suffix -**ak** and the plural indicator -**ene**. Philological paradigms of modern research express the determinative in superscript, and the number four (a convention to show, which cuneiform sign is used here, in this case the fourth most common sign used to write the phoneme /ke/) in subscript. Although attached in the transliteration to the morpheme **adab**, the plural refers to the word immediately preceding this cluster, **dumu** ("child"). There are many children of Adab, not many cities, nor many things that are called Adab. When presenting the text in machine-readable format, the question arises: How do we tag "children" (**dumu-ene**)? Online projects such as the ETCSL have solved the issue by utilising a process of lemmatization, whereby the uninflected (or "dictionary-form") of a word is provided, as is a translation (into English) of that particular term.

Other challenges presented by the language include the ergative-absolute system, which in itself occurs somewhat inconsistently; sometimes when we would expect the ergative-absolute case, a nominative-accusative has been used instead (Cunningham, 2013: 96). The ergative system highlights the subject of a transitive verb by expressing it in the ergative: this manifest as the addition of the **e**-suffix to the noun, e.g. **lugal-e** ("king"). Transitive verbs require an object, and are nonsensical without one – consider for example the English sentence "I opened the book".[5] In an ergative language, "the book" would acquire some identifying element. The marker would also apply to subjects of intransitive verbs. An example of such a verb in a sentence in English would be "He slept" (where "he" is the subject).

A final feature of Sumerian grammar is that it is a verb-final language (Cunningham, 2013: 96). Hence, in Sumerian, the grammatically simple phrase "E-ana-tum built the city-wall of Lagaš" is rendered as **e$_2$-an-na-tum$_2$-me bad$_3$ lagaš^{ki} mu-na-du$_3$**: E-ana-tum (+ ergative suffix -**e** since he is the subject), the city wall [of] Lagaš (determinative **ki** noting place) [he] built. The details of the Sumerian verb are complex and dominate a large section of a modern grammar of Sumerian (Edzard, 2003: 71- 154).

The issue of Sumerian grammar is particularly important because it is reflected not only in the translation (the comprehension) of the ancient texts but also in the TEI (Text Encoding Initiative) compliant XML encoding of the primary dataset, the ETCSL. There are essentially six possible tags to capture linguistic annotation that are used by the resource, namely word class, part of speech, lemma, label, type and determinative. Of these, the lemma is the dictionary form of a word, free of grammatical elements of inflections; the label is an "English gloss"; type is a subcategory of the word class and the determinative is a label to identify the particular group of Sumerian grammatical glyphs after which it is named (Ebeling, 2007: 34). An example of the determinative is the sign 𒀭, used in its grammatical element capacity, and read as **DINGIR**, to denote a divine name, e.g.: 𒀭 𒈹 for the goddess Inanna.

[5] In this example, "the book" is the object of the verb "to open".

In the ETCSL, the label, lemma and part of speech elements have been combined together to create a lexeme – "an uniquely identifiable unit of Sumerian grammar" (Ebeling, 2007: 38). Perhaps these lexemes are then the ideal level of granularity where the online publication of Sumerian content as LD is concerned? In order to do so, an understanding is required not just of the grammar of Sumerian, but also of the cuneiform script, which was used to express it.

2.3 Cuneiform

Assyriology, as has been noted, is a multilingual discipline that mirrors the linguistic landscape of ancient Mesopotamia. Throughout its history, the area saw the rise and fall of myriad cultures, centres of powers and several major languages, which at times alternated, at others simultaneously played a central role in the area. Although subject to diachronic change, the one clear unifying aspect carried across all periods was the use of the cuneiform script.

It is estimated that there are currently some 500,000 objects, which carry some form of cuneiform text that have been discovered to date (CDLI, 2013). Due to the limitations of accidents of preservation, and recovery, these known objects are almost certainly merely a minute fraction of the cornucopia of written material created in the ancient Near East.

This distinctive script emerged from a tradition of administration and recordkeeping that probably began sometime in the fourth millennium BC. Initially, these proto-records consisted of clay pieces of various shapes, but around 3400 BC, in Uruk in southern Mesopotamia, an innovation took the direction of individualised markings on clay tablets, which in turn gave birth to the transitional proto-cuneiform recording system (Taylor, 2013: 291).

These early administrative records are, in all pragmatic terms, language agnostic. The mother-tongue (or indeed any other) spoken by the accountants who recorded yields of grain and counted livestock so diligently five millennia ago remains a matter of some scholarly debate. What can be determined from the archaeological record is that, in the centuries that followed, once cuneiform develops into a true script capable of capturing natural language, it is used first and foremost to represent Sumerian (see Fig. 4). It was only later that it was adopted and adapted for the other languages of the Middle East.

Cuneiform receives its name from the Latin *cuneus* (meaning "wedge-like"), a nod towards the physical appearance or morphology of the signs, which were the result of pressing a stylus into clay, although other materials were also used. These tablets range in size and shape, and were, for the most part, left unbaked (although some were baked unintentionally when the storage units in which they were held were burned down and demolished). The prevalence of reed and clay in the area no doubt contributed to the use of these raw materials for writing. This method and choice of material, both of which can reasonably be described as resulting from pragmatic choices, would come to be intrinsically characteristic of this script for centuries, surviving diachronic and graphic changes, and semantic shifts alike.

The visual representation and photographic capture of cuneiform has proven to be challenging – traditionally scholars relied on hand-drawings, but these are problematic in particular regarding the difficulties of representing places where the script rolls over from the obverse to the lacuna or when the drawing is an interpretation by the scholar, rather than a truly unbiased rendering. Glyphs (generally referred to as "signs") consist of clusters of stylus impressions – the result is effectively a three-dimensional script on the convex surface of a three-dimensional object, which line drawings (see Fig. 5 and Fig. 35 in Chapter 6) often fail to capture.

Figure 4 ED IIIa record (P451695). Ashmolean Museum, University of Oxford.

If size is reliable as an indicator, many tablets could have been designed to be hand-held. The reader would then be able to tilt the object in order to the optimum interplay of light and shadow, to enhance the reading experience by improving sign clarity. It is this process of altering the direction of the light source, which digitization techniques such as Reflectance Transformation Imaging (Discussed in Chapter 4) have aimed to recreate and capture (see Nurmikko, et al., 2012 and Nurmikko, et al., 2013). Another tool, Unicode may be vulnerable to criticisms of being reductionist, technologically determinative and inadequate for the capture of the change and subtleties, which are essential in the understanding of the script. Whilst useful in some context (the Pennsylvania Sumerian Dictionary is an ideal example), the absolute rigidity of the formalised representation of a glyph may seem to hinder, rather than help, philological research. Since Unicode captures a snap-shot in time of a given sign, there can be no one given form which truly captures the diachronic and regional variation of a given sign (see Fig. 5), resulting in a number of different sets (of Unicode characters). Unicode, as a standardisation, seems unsuitable for the accurate capture of any text that has damaged signs or scribal errors, bringing in a level of (unnecessary) interpretation: whilst line drawings might be subject to the biases of an individual (modern) scholar, it is at least possible to highlight points of incomplete or unclear tablets. Representing such instances in a Unicode rendition of a text appears to be impossible.

Every script is tasked with recording and capturing the utterances of a language. Black and Zólyomi (2007: 2ff.) expand beyond the usual descriptions of the complexity of cuneiform to further argue that “the writing system reflected the morphological structure of the language in varying degrees [of accuracy] in the different stages of its history…it was probably never a completely adequate representation of the phonetic system of Sumerian (whose phonology can be demonstrated to have changed during its history, as would be expected of any language”.

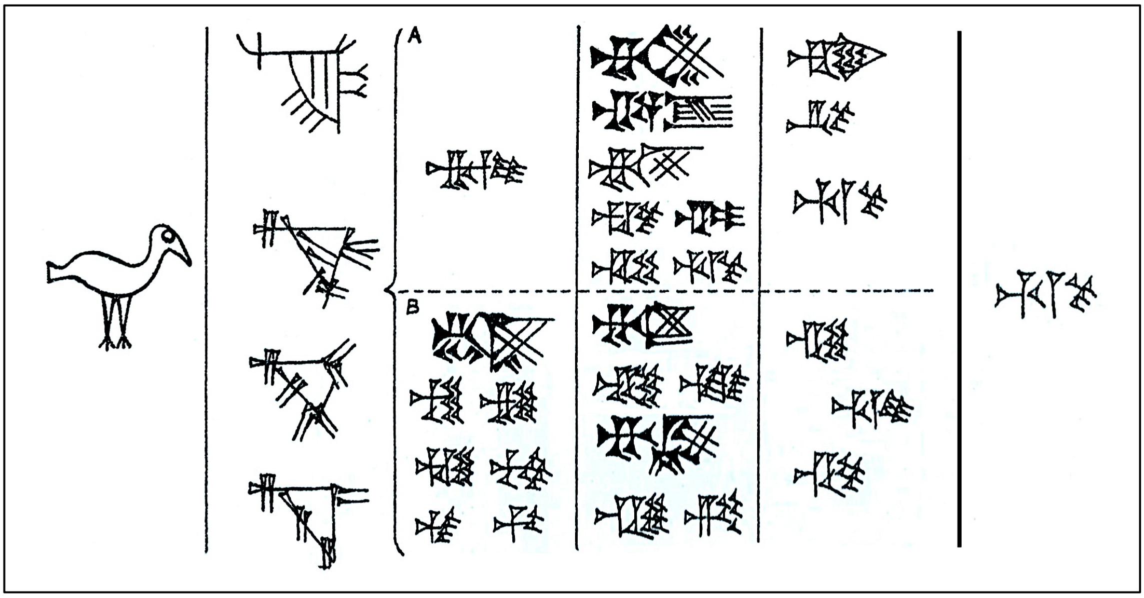

Figure 5 Diachronic changes of the sign NAM. Based on Labat, 1995:74.

Indeed, such uncertainty as to the level of accuracy at which Sumerian phonetics are captured have been questioned elsewhere, and as Cunningham (2013: 101) notes, the absence of the vowel /o/ in Akkadian makes it pragmatically impossible to identify it in Sumerian texts, although the high frequency at which the vowel sound /u/ appears would indicate that it did exist in Sumerian. Again, Sumerian is seen through that Akkadian lens, darkly (Edzard, 2003:7) or perhaps more aptly in this case, heard through Akkadian whispers.

The challenges of unsolvable phonetics aside, signs and sign clusters are, in themselves, remarkably complex. There are several different sign lists, (Labat, 1995; Borger, 1988; Borger, 2004 to name but a few famous examples, the ETCSL also incorporates a sign list, of more than 700 signs), and one of the main problems in attempts of classification is reaching agreement on the system of order of signs. In the case of Unicode, where a new visual representation is created, there is an additional need to represent several morphologically different versions of the script (for example, Classical Sumerian as a separate Unicode sign list from that of Neo-Assyrian).

2.4 Scribal Education

The role literature played in scribal education is significant in two aspects. Firstly, it is through scribal education that the majority of these texts are known, and secondly, it is for having been the product of learners that the literary corpora contain so many errors. Brisch (2013: 124) declares that the "overwhelming majority of Old Babylonian literature…[was] written in Sumerian" – this is worthy of note since it is "largely through the work of young trainee scribes [during the OB period] that we know most Sumerian literature" (Taylor, 2013: 302). As was noted by Black and Zólyomi (2007), not only does the use of literary compositions in scribal education explain the extensive morphological variation between copies of the same text, but may help determine whether those differences result from diachronic (across time) or synchronic (at one point in time) changes, are geographically-based or even representative of the idiolect (personal dialect) of an individual scribe.

Since the educational system in Mesopotamia was one of copying and repetition, scribes learnt many of the ancient compositions as a part of their training. When commissioned to write new pieces, scribes would deliberately add allusions, connotations and references to, as well as quotes from, other compositions to impress the audience (who almost certainly knew something of these stories) and to illustrate the extent of their knowledge and education.

Figure 6 Replica of a round OB school-tablet. From Nurmikko-Fuller, (2014b).

There are at least three clear categories of literary borrowing in the ancient Near East. The first, as illustrated by the development of the five poems of Bilgameš (as the eponymous character was referred to in third millennium BC texts) to *Šūtur eli šarrī* (eighteenth century BC) and later on to *Ša naqba īmuru* (13th to 10th centuries and again the seventh century BC), shows a diachronic change to the structure of a known story (which nevertheless maintains enough of its original character to be recognised as having a degree of similarity, and although it may be done with an appreciation for the problematic nature of doing so, is referred to as a manifestation of the same story). The second type is the deliberate quoting of elements, such as proverbs within a composition (e.g. http://etcsl.orinst.ox.ac.uk/cgi-bin/etcsl.cgi?text=t.6.1.03# in *Gilgameš and Aga*, and http://etcsl.orinst.ox.ac.uk/section1/tr1811.htm)[6]:

[6] For a modern Arabic equivalent of the same proverb, please refer to Chapter 7.

1. **gub-gub-bu-de$_3$ tuš-tuš-de$_3$**
2. **zib$_2$ anše dab$_5$-dab$_5$-be$_2$-de$_3$ dumu lugal-la de$_2$-de$_2$-de$_3$**
3. **a-ba zi-bi mu-un-tuku**

"To stand and to sit, to spur on the donkeys, to support (?) the prince: who has the breath for that?"

25. **gub-gub-bu-de$_3$ tuš-tuš-u$_3$-de$_3$**
26. **dumu lugal-la da ri-e-de$_3$**
27. **zib$_2$ anše dab$_5$-dab$_5$-be$_2$-e-de$_3$**
28. **a-ba zi-bi mu-un-tuku-e-še**

" "Standing on duty and sitting in attendance, escorting the king's son, and forever grasping the donkey's reins -- who has that much breath?", as the saying goes."

The third type is the deliberate retelling of known stories to reflect socio-political change. As Tinney (1999: 46) has commented, "scribes could consciously and unabashedly manipulate tradition to suit *ex tempore* needs", and so the mythology and literature of these ancient peoples ought to be considered not as canonised and rigid, but rather in a state of continuous flux, open to any changes necessary to more accurately reflect (often intertwined) social, political and religious powers and the *status quo*. For example, the rising in power of the city of Babylon and alongside that, the rise of the deity of Babylon, Marduk, to the top echelons of the Mesopotamian divine hierarchy (see Fig. 7, next page).

These literary borrowings enrich the corpus of Mesopotamian literature, but may also complicate the process of interpretation and analysis, particular so in the case of the creation of the composite text. This process often relies on identifying the same protagonists, locations or events within the content of the text, and might potentially be skewed by the appearance of a borrowed narrative within a composition.

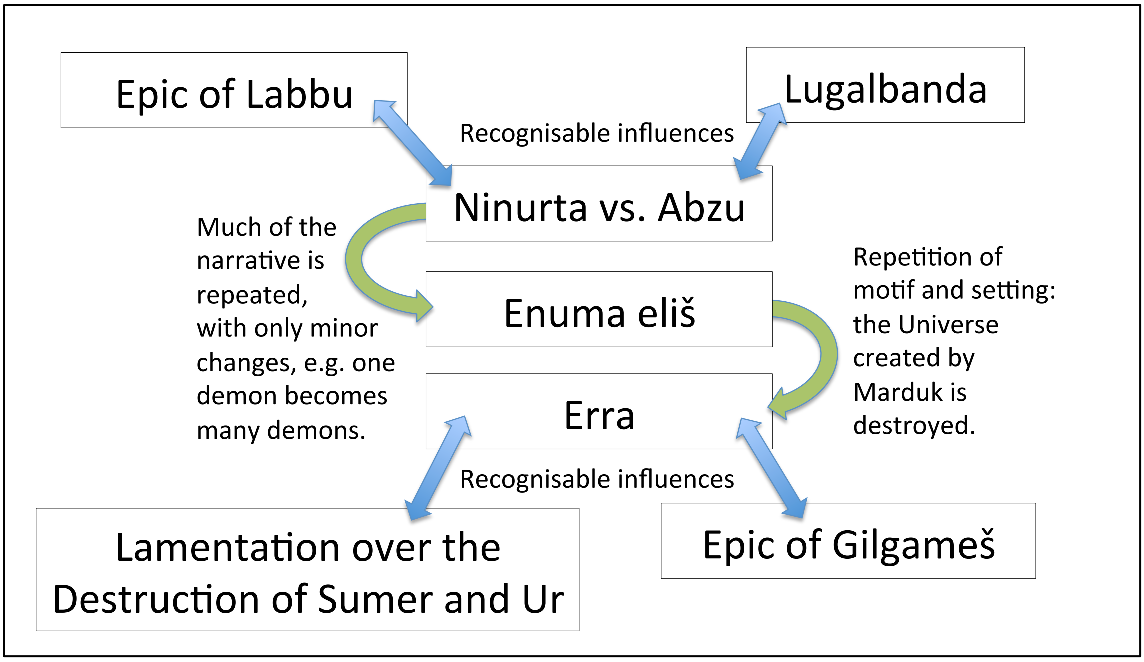

Figure 7 Illustration of intertextuality in the form of retellings and borrowings, as they appear in some Mesopotamian mythologies. Based on Wisnom, 2013.

Scribal Errors

The challenges presented by the cuneiform script are not the remit of modern scholars alone. Scribal errors (of which the ETCSL has a recorded 800 exemplar (Ebeling, 2007: 40)), whilst complicating the processes of reading and analysis can be (particularly where linked to phonological or semantic representations) examined as evidence of the sounds and meanings of particular words. The morphology of the script and the signs (their visual appearance), as well as the copious numbers in which they occur (in their thousands) mean mistakes based of the visual similarity of signs have crept into the textual records.

These errors have occasionally been reduplicated by scribes unfamiliar with the Sumerian language, and may even become accepted into the canonised version of a text: original words may have become replaced with synonyms, rather than identified as errors in the original, for example (Delnero, 2012).[7]

There is some evidence to support the theory that cuneiform was at least in part taught, and spread, by the scribes themselves. Taylor (2013: ff 299) cites examples such as lexical lists that feature things and places the local scribes could have had no knowledge of, which were found at Tell Brak – he also gives the example of two lists from Ebla where the colophons explicitly name the instance of young scribes visiting from Mari, seemingly providing conclusive evidence that people, as well as tablets, moved from one site to another. Prosopographical studies may well be possible as the names of scribes were sometimes recorded – indeed such a project already exists for a much later period in the form of the Berkeley Prosopography Services (BPS, http://berkeleyprosopography.org/), which initially started with a corpus of Hellenistic Babylonian legal texts.[8]

Identification of scribal mistakes and the tracing of the patterns of error adoption via various schools of scribal training throughout Mesopotamia can

[7] Scribal error types include complex mistakes as well as defective writings, grammatical, orthographical and free variants. Beyond this, there may be intentional or unintentional additions, omissions or sequence errors of entire lines, mistakes thus not limited exclusively to instances of dittography (unnecessary repetition) or haplography (omission of a sign that should be repeated) on the level of individual signs. Parablepsis (a type of scribal mistake which results from the scribe reading the incorrect line or part of a line when copying texts), visualization errors and substitutions all add to the menagerie of mistakes that can affect the cuneiform corpus.

[8] One of the main challenges of prosopographical research in general is the uncertainty of identifying and separating between individuals, especially in cases of ambiguous data. Consider for example determining whether a name occurring in two sources, neither of which can be absolutely placed in terms of chronology or geographical provenance, refer to the same individual. Are some names more popular than others (such as "John Smith")? Are professions as well as personal names are passed on through a single patrilineal family unit? Father and son may share a name, profession, geographical location, and it is entirely feasible to presume that, for at least some period of time, they existed in the world at the same time. How then, are we to differentiate between the two?

provide interesting insights into the patterns of knowledge exchange in the ancient world. It may also be possible to align prosopographical investigations (such as BPS) alongside those of literary cross-referencing based on idiosyncratic scribal mistakes, and to establish patterns or uncover details of the movements of ideas and individual scribes across a network of scholarly exchanges through the Mesopotamian world.

The ability to query these changes and developments to texts (be they accidental through scribal error or a deliberate representation of socio-political change in antiquity) and to the translations published in secondary literature has the potential to facilitate future scholarship in Assyriology. These may include, but are not limited to, having the ability to follow the career of a given individual, for instance, or to identify a reoccurring idiosyncrasy in the work of an ancient scribe, or perhaps recognising a particular register, dialect or similar appearing across genres or at specific geographical locations. These types of questions are not by any means super-human: given sufficient time and experience, as well as access to data, human experts are likely to solve such conundrums and find possible patterns. The benefit of utilising automated systems is in the reduction of the time necessary for the creation of a substantial dataset and the process of identifying, for example, occurrences of specific expressions or motifs.

2.5 Conclusion

Assyriology, alongside the subset of Sumerology, combines the analysis and interpretation of incomplete, ambiguous and heterogeneous data. What is known of each and any of these fields and subdomains is influenced by the sister-accidents of preservation and discovery of archaeological material culture, specifically cuneiform inscribed objects. Political instability has afflicted the region for decades, limiting modern excavations. Taking into consideration the sporadic nature of object-provenance, both in terms of geographical and socio-temporal origins, it would not seem unreasonable to conclude that even at best, known exemplar tablets reflect only a fragment of all that once was: The data is thus an incomplete representation with many unknowns.

In addition to the biases of time and place of origin of known Sumerian material, current understanding of the Sumerian tongue is further complicated by the lack of any other related languages. As a result, much of the analysis of Sumerian would be assumed to be introspective, if it was not for the ubiquity at which Akkadian infiltrates many Sumerian sources. Much of what is known has been learnt indirectly via Akkadian, be that during the decipherment process, the translation of words though bilingual lexical lists or the high likelihood of many of the texts having been written by Akkadian scribes.

The script presents a multitude of challenges: understanding the cuneiform writing system requires knowledge of numerous individual signs, and their polyvalent meanings, and compositions, where they have survived the preceding millennia, are often broken or incomplete, and many contain a range of different types of omissions, mistakes and orthographic variants, which complicate the processes of reading and interpretation. There is no true, absolute definitive sign list, and the morphology of signs (in terms of both visual appearance, as would be used by a Biologist, and the semantics, as would be implied by a Linguist) is inhospitable. Neither is there a definitive grammar, on which all Assyriologists could unanimously agree, although several modern scholars have made considerable strides in that field. Whilst various scholars in the field are developing typologies of tablet types, none are currently known that have been published, and accepted as an authority within the domain.

All these challenges aside, Sumerology remains a valid and interesting academic pursuit. It is rich in challenges but also in data, and an understanding of the language is key to two aspects of philological research: firstly, the processes of decipherment and translation, and secondly, the appreciation of the subtleties of language use and rhetoric, as manifests in the use of puns and plays on words which can only be seen once the language in which they are based in is understood.

The Sumerian language was used for several centuries even after it disappeared as the spoken language of the masses in the urban centres from which written material has been found. To know Sumerian has been the mark of the educated, one might even say of the privileged few. Philologists today benefit from the educational labours of young scribes, and even mistakes provide valuable insights into the (perhaps otherwise quite impenetrable) complexities of the semantics and phonetics of this ancient tongue.

Although used to produce myriad pieces in various genres of written material, it is in the richness of the Sumerian literary tradition that the complexities and subtleties of this language can be examined and appreciated.

Chapter 3: Sumerian Literature

3.1 Background

There are a number of different types or “genres” known from ancient Mesopotamia. Some can be comfortably classified as non-literary by content, structure and purpose. These include, for example, the ancient equivalents of modern day Excel-sheets; clay tablets with grid tables listing units and quantities in an undeniably pragmatic manner. Other documentary types are dedication plaques and nails for temples and palaces, law codes, astronomical observations, ration lists, royal correspondences and mathematical texts. Some, such as omen texts and medical manuscripts can be problematic to define. Felt to most accurately reflect the world-view of the ancient peoples, these texts are, for the purposes of this paper, considered to be factual, rather than fictional, and thus categorised as exempla of non-literary compositions. The lines between literary and non-literary do however remain fuzzy and undefined, and even predominantly non-literary pieces and genres may (and do) exhibit some literary devices.

Economic records, in their near-absolute rigour, lend themselves well to the types of representation tools currently available and have been used as a basis for a domain-specific ontology by Jaworski (2008). For the purposes of this thesis, they lack those narrative features that are so crucial to the research agenda – as such, focus will not be on them, but instead, attention is drawn to the types of literary texts, which more accurately reflect the types of structures under examination.

The scope of this research project has been deliberately limited to the material published in the ETCSL, the primary data source, context and focus of the study. Such a clearly defined limit on the dataset has inevitably meant the exclusion of interesting potential analysis, such as an in-depth discussion of the diachronic changes of the *Epic of Gilgameš* (in its Akkadian versions). Limitations to the scope of the thesis and the implemented ontological structure, mORSuL (discussed in greater length in Chapters 5 and 6) has meant that many of the opportunities to engage in intertextual analysis between compositions in the same literary genres is anecdotal, and instances of cross-genre borrowings are minor. The casting of an even wider net, one to capture instances of borrowed or surviving narratives in the traditions of the Iraqi and other Near Eastern peoples has been allocated to Chapter 7.

Even within the ETCSL there are several different subgenres (see Appendix D), many of which have not been included into the research agenda. Poems, hymns, literary letters, letter-prayers and proverbs all add to the miscellany of Sumerian literary pieces, but are only mentioned as complementary evidence or examples. For pragmatic reasons, the focus has been predominantly on historical and mythological narratives, as well as on those, which constitute examples of "Wisdom Literature" (sees below). Even so, the material spans several centuries, was copied by scribes who are speakers of unrelated languages and survives for the analysis of modern scholars sporadically and inconsistently.

In the case of multiple copies of a singular text surviving, the synoptic representation of all versions is paramount – much of philological analysis in literary Sumerian is based on the complementary and comparative readings of several versions. The context in which they occur can also affect the interpretation of a piece, as noted by Tinney (1999: 34ff), and the retelling of known narratives further blurs the boundaries between separate texts (see Chapter 2).

3.2 Philological Paradigms

Philology, as has been defined from the onset of this thesis, is the study of the content and language of ancient texts. Predominantly a form of linguistic analysis, the philological approach applied here has been greatly influenced by the "methodology" (described as such by Ebeling, 2007: 42) of corpus linguistics – the focus is, after all, exclusively on an electronic corpus of ancient texts. The literary pieces in the ETCSL originate from different time periods and geographical locations, and have been published in a range of different types of media over several decades of modern scholarship. In order to publish these texts in a corpus that is one cohesive whole, philological publication paradigms have been applied.

As with other ancient languages, these Sumerian texts (alongside a myriad of different types of epigraphic elements, errors, omissions and additions) are published with the aid of philological markers. An intra-discipline, homogenous system such as the Leiden Conventions, are currently lacking in Assyriology. Perhaps it is the result of literary Sumerology being relatively new within the sphere of Assyriology, having emerged only in the 1950s (Robson, 2013: 45), or perhaps due to those challenges that have resulted in the analysis of literary Sumerian remaining an area of niche specialisation, with small numbers of specialists. Regardless of the reason, what can be evidenced is that in the absence of such agreed upon criteria, throughout the history of Sumerian philology, publications have adopted different ways to express transliterated text. Consider for example, the opening line of *The Three Ox-drivers of Adab*:

> "There were three friends, citizens of Adab, who fell into a dispute with each other, and sought justice"[9]

Although the cuneiform is largely the same in each witness tablet (each however exhibiting damage at various points) the lack of homogeneity in expression across time has resulted in different forms of transliteration representation across modern publications:

Foster, 1974	**ku!-li-li eš$_5$-àm dumu adab^{ki}-ke$_4$-ne du$_{17}$ in-da-ab-tuk-uš-àm di-da ab-kin-kin-e**
Alster, 1991 - 1993	**ku(?)-li-li eš$_5$-àm dumu adab^{ki}-ke$_4$-ne di in-da-ab-tuku-uš-àm di-da ab-kin-kin-e**
Black, et al, 1998-2006	**gu$_5$$^?$-li-li 3-am$_3$ dumu adab^{ki}-ke$_4$-ne di in-da-ab-tuku-uš-am$_3$ di-da ab-kiĝ$_2$-kiĝ$_2$-e**

A set of philological conventions (ensuring homogeneity of expression) have been applied by the original theme of scholars throughout the transliterated content of the ETCSL (see Appendix B, cf. Appendix C, Leiden Conventions). Although not used across the whole of Assyriological scholarship, these rules are applied consistently throughout the resource, and across the dataset under consideration and investigation. These conventions have also been applied to all transliterated Sumerian text in the body of this thesis.

[9] Opening line of the *Three Ox-drivers of Adab*. [Online] Available at: http://etcsl.orinst.ox.ac.uk/cgi-bin/etcsl.cgi?text=t.5.6.5#

3.3 Sumerian Literature

Any discussion of Sumerian literature should begin with the reiteration of the point which has already been made in the course of this thesis: “Sumerian” is a linguistic label, and can be applied to the language in which a given text or manuscript is written, but cannot be unequivocally used to describe the ethnicity (Brisch, 2013: 111) of the authoring scribe, the commissioning patron or even the audience (intended or otherwise). What can be said is that for the vast majority of the span of the cuneiform culture(s), written Sumerian seems to have been the prerogative of the educated, literate minority.

The issue of applying modern definitions of genre to ancient material cannot be taken as given. Indeed, the terminology applied to the identification and discussion of ‘theme’ and ‘genre’ are becoming increasing debated by scholars of modern literature, the problem only increasing in complexity when applied to ancient contexts.[10] As Ebeling (2007: 33) notes, the classification of literary compositions is a modern convention, and there are but a few indicators that would support the (likely) theory that the people of ancient Mesopotamia thought of the varied collections of mythological and historical narratives, royal praise poetry, hymns and proverbs as one cohesive unit. Drawing a defining line between literary and historical pieces is more complicated still – even examples of the latter (written regarding people who are known to have existed) can contain seemingly fictional elements; consider for example the OB text of Gilgameš (a semi-mythical demigod at the very least, even if possible originally based around the personal cult of a real person), whom Šulgi (a genuine historical person) claims as his brother (Taylor, 2013: 301).

[10] This issue was extensively discussed at the SothDH Narrative Workshop, Southampton, UK, 28 February 2013.

The collection of written works that are classified as Sumerian literature consist of an exclectic mix of compositions written for myriad socio-political and cultural reasons. They share a number of characteristics, such as an narrative arc, or the capture of a verbal exchange between two or more entities. These texts undeniably have (at least some) non-pragmatic purpose – they are not lists, nor glossaries, nor recordings of units of agricultural produce, but rather the product of creative and artistic minds. Furthermore, they are classified by Black and Zólyomi (2007: 3) as consisting of exemplar texts which were, in antiquity, produced (and survive) in multiple versions – Ebeling (2007: 33) agrees, elaborating on their universal nature.[11] Many of the compositions in the ETCSL are also listed in ancient catalogues (Ebeling, 2007: 34), and played an important role in scribal education, not only as a vehicle for scribes to learn the cuneiform script, but also to teach the moral, cultural, historical and social values of their society (Taylor, 2013).

The primary sources for Sumerian literature known today come to us from a range of temporal, geographical and thus cultural settings (Westenholtz, 2013: 246). The discovery of literary pieces from third millennium BC contexts from sites as geographically diverse locations as "Abu Salabikh, Fara, Girsu, Nippur, Adab, Ebla and Mari suggests that the origins of written literature are to be found even earlier" (Taylor, 2013:298). The vast majority of the literary material known currently is thought to be of the OB period (from about the twentieth century BC onwards for some three or four centuries), be they copies of earlier compositions (*Instructions of Šuruppak*, from the Early Dynastic period, or others from the Ur III) or seemingly new ones created through

[11] Narrative pieces differ from administrative records, of which there is usually only one copy and are relevant to only one transaction that occurred at a given place at a specific point in time.

scribal innovation or the extensive modification of known material (*Lugalbanda*) during the OB period (Taylor, 2013:301ff). The separation of instances of deliberate variation, or those reflecting a particular scribal tradition from those that are exclusively within the remit of error can be difficult (Black and Zólyomi, 2007: 3).

A Comment on "Wisdom Literature"

Within this thesis, one of the most closely examined subgenres of ancient Sumerian literature is that of "Wisdom Literature", as this is the genre of the case study example in Chapter 6. In 1951, Kramer described this genre as consisting of five different types of compositions:

1) Proverbs,
2) Essays,
3) Instructions and precepts,
4) Compositions which discuss the ancient Mesopotamian educational system, and
5) Debate poems.

This classification remains more or less constant throughout the decades, with scholars such as Lambert (1996) echoing the categories as defined by Kramer, adding that there appears to have been much philosophical discussion on profound aspects of existence, the nature of suffering, and the moral codes of appropriate behaviour. Finkel's recent (2014:47) publication is one more volume to chime in with the same notion, although he adds that whilst the genre is attested in both Sumerian and Akkadian literature (and again in Abrahamic traditions), the "pithy, sardonic and cynical *mots* seem to flow naturally in Sumerian". A slightly different approach was taken by Civil, whose unpublished catalogue of compositions is the basis for the content of the ETCSL. Works within the "Other Literature" section have been divided into the separate categories of school stories, debates, scribal dialogues, female dialogues, diatribes, personal laments, reflective compositions, Lu-digira compositions, songs, didactic compositions, short tales, offering compositions, lexical compositions, animal fables and proverbs (Cunningham, 2007: 385ff.).

In the ETCSL, "Wisdom Literature" is a rather eclectic category consists of only three compositions (*Instructions of Šuruppag*, *The Farmer's Instructions* and *The Three Ox-drivers of Adab*)[12] all of which differ from one another in many respects. The other genres traditionally associated with "Wisdom Literature" are categorised separately (see Appendix D), and the homogeneity of these other subgenres (Proverbs, Debate Poem) is less clear for "Wisdom Literature". These three compositions are much longer in length to pieces in the other categories (cf. *The Three Ox-drivers of Adab* with any individual proverb, many of which span only one line), and in the form as they are published on the ETCSL, are examples of composite texts.

3.4 Composite Texts

A composite text is a version of a given text, which comprises of elements from different copies (see Fig. 8). Conceptually, one might compare this to a task of reconstructing pages from a book, where one segment is from one edition, others from another copy, and others stills from a later version,

[12] The ETCSL categorisation does not match Civil's catalogue exactly. The three compositions named here are from two separate categories in the catalogue: didactic compositions and short tales. Civil has listed three compositions in the first group, but only two of these are within the ETCL (*Counsels of Wisdom* has been omitted). Similarly, only one composition of the six listed by Civil is included in the category of "Wisdom Literature" in the ETCSL.

perhaps one produced by a different publisher. The process is complicated by the absence of covers, bindings, page numbers and the reconstruction is based on the content of the chapters. Delnero (2012:3) describes the composite as "[the result of] an attempt, based on certain theoretical presuppositions, to reconstruct a hypothetical original version of a composition, when none of the original sources of the text have survived."

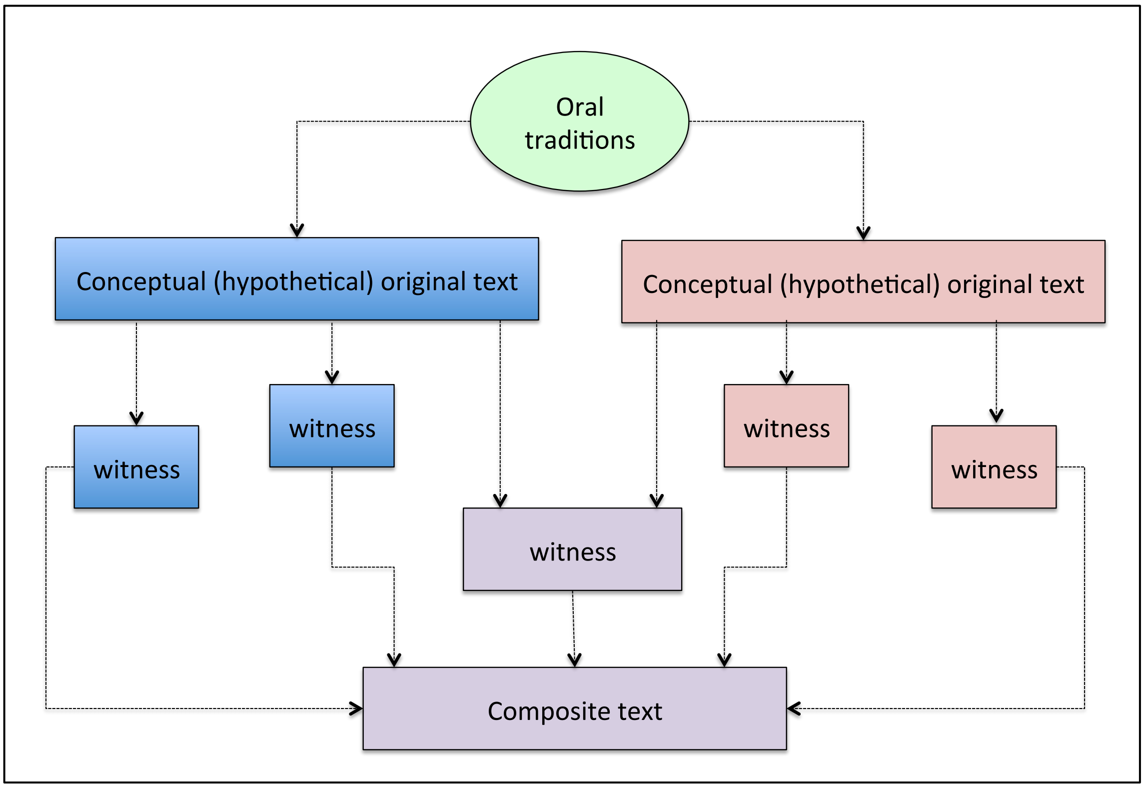

Figure 8 The formation of a composite text as an amalgamation of the content of several witness tablets, which in turn may be the result of several phases of interpretation.

Exemplars of a given text range from just one or two original witnesses, to those for which over a hundred manuscripts or fragments are known and consulted (Delnero, 2012: 1; Robson, 2013: 54). The process of deriving the composite from these fragments is not necessarily straightforward: Black and

Zólyomi (2007: 3) equate it to an attempt to solve a puzzle where the “jigsaw pieces […] may not overlap at all”. Whilst the shared characteristics, protagonists, story lines and even individual lines assure the matching of elements of the same story together, there is no true archetype of the composite text itself, and one almost certainly never existed in that specific form prior to the digital version published on the ETCSL. The differentiation of the modern composite from any ancient original is important for any philological or linguistic analysis, but in the context of Linked Data (LD), Knowledge Representation (KR) and automated inference, this distinction is particularly significant: reasoning should not occur with an assumption that the composite text ever existed in antiquity or has a direct archetype. It is paramount to appreciate that it is, by necessity, a product of a process of analysis and interpretation (Delnero, 2012:3).

To avoid the identified pitfalls of text analysis (as outlined by Delnero, 2012: 3ff.), all the available source material ought to be published in support of the composite text. This will allow the reader/user to verify the accuracy of the constructed whole, and to opt out of reasoning based on the composite, limiting queries to examples of transliterations and translations of the original sources instead.

Although practical limitations prevented the ETCSL from fully publishing each of the original witness transliterations, substantive variants (especially where they influence the English translation) are noted in the text. The online publication of these texts, even if falling short of the original research aim of the team to envision ETCSL (Robson, 2013:54), is nevertheless in many ways a unique and important contribution to Sumerian literary scholarship.

3.5 Online Resources for Sumerian

The list of online projects involving text corpora shows that Assyriology has, as a discipline, taken clear steps in disseminating content via the Web. These can be divided into three broad categories: visualisations, museological or collection data projects, and linguistic tools. Divisions are by no means absolute, in fact many projects incorporate aspects from (and provide benefits for) categories other than the one in which they are listed for the purposes of this thesis.

Visualisations

Since 2002, the British Museum has collaborated with the University of Mosul, Iraq on an extensive visualisation project, to digitally photograph cuneiform tablets from the Library of Ashurbanipal[13] and to publish them online (http://www.britishmuseum.org/research/research_projects/all_projects/ashurbanipal_library_phase_1.aspx). In June 2013, a joint project between them and the Penn Museum was launched for the digitization, transliteration and publications of material from Ur as well as the associated archaeological information from the 1930s (Ur of the Chaldees: A Virtual Vision of Woolley's Excavations, http://www.penn.museum/sites/ur/).

InscriptiFact (http://www.inscriptifact.com/index.shtml) provides access to high-resolution images of ancient texts from the cultures of the Near Eastern and the Mediterranean, ranging from the Dead Sea Scrolls to Egyptian papyri and includes Mesopotamian content. The image archive associated with the multi-institutional project contains over 250,000 images, and the project

[13] An international research collaboration between the Department of the Middle East of the British Museum and the CDLI, initially funded by the Andrew W. Mellon Foundation. For further details regarding this digitisation project, please see http://cdli.ucla.edu/collections/bm/bm.html.

also provides training in data capture via RTI (Reflectance Transformation Imaging). RTI uses computerised photography to create images that can be shown to be particularly useful for the study for cuneiform tablets (Nurmikko, et al, 2013). The ability of the user to determine and rotate the source of light on the object aids in the examination of the texts. The viewer can replicate (or at least to mimic), virtually, the effect of tilting it in one's hand so the light can hit the surface in such a way as to show a given sign in the clearest possible way, and thus maximise the potential of an accurate and clear reading (see Fig. 9). In the last decade or so, other RTI projects have used Mesopotamian material as case study examples (Manchester CHICC, 2012; Earl et al, 2010a; Earl, et al, 2010b; Hunt, et al, 2004; Malzbender, et al, 2001).

A number of projects of have also used Mesopotamian tablets as examples for 3D visualizations: Digital Hammurabi (Hahn, 2006) and iClay (Cohen, et al, 2004) of Johns Hopkins University; Unwrapping Cuneiform Tablets at Stanford (Anderson, et al, 2002) or projects such as GigaMesh and Gilgamesh by Breuckmann (http://www.breuckmann.com/en/arts-culture/applications/archaeology/cuneiform-scripts.html). The combination of the three dimensional script on the convex surface of a three dimensional object (and even more so in the case of more morphologically complex items (cylinders or nails) make the 2D representation of cuneiform problematic, and may contribute to the popularity of Assyriological case study examples for these projects. And this is by no means a one-way street: new technologies such as RTI and 3D scanning can help solve debates on some instances of unclear glyphs, supporting new interpretations of debated translations and transliterations. The usefulness of either RTI or 3D scans to support the currently non-illustrated ETCSL is clear.

Beyond making the identification of individual signs easier, new imaging technologies may also help in prosopographical research into the scribal profession. Projects such as the Cuneiform Digital Palaeography Project (http://www.cdp.bham.ac.uk/), which have sought primarily to establish palaeographical tools for Assyriology, are in a position to help identify individual scribes, based on idiosyncrasies in handwriting.

Museological projects

There are innumerable examples which could be classified as museological projects incorporating Assyriological data: each separate museum website, which enables the search of the museum's data would fit this description. Pragmatic limitations (scope and time) exclude the individual commentary of each such site, but there are two projects that can be singled out as significant and worthy of comment within the context of this thesis, albeit for different reasons: the (now no longer active) British Museum's SPARQL endpoint (http://collection.britishmuseum.org/sparql)[14] and the Cuneiform Digital Library Initiative (CDLI, http://cdli.ucla.edu/).

The former allows alternative access to the British Museum's collection. It is the access point to museological and object metadata (such as measurements, provenance, and current location as well as identifying numbers) but does not facilitate queries based on or related to the content of the texts. It is however worth noting that for this project, the British Museum used the CIDOC CRM as the underlying ontological structure.

[14] As of September 2014, the endpoint (at least at this http://URI) appears to no longer be active.

Figure 9 RTIs of AN1923.68. Ashmolean Museum, University of Oxford.

The Cuneiform Digital Library Initiative (CDLI) is an online resource, which published the data of more than twenty-five institutions. This includes data such as publication and author, provenance, museum number, object type and composite material. Although for the purposes of this thesis it has been classified as museological, rather than philological project, the CDLI straddles all these categories of museology, philology and visualisation.

The search criteria of the CDLI have provided a representation of the existing categories and query keywords currently used in the discipline. Personal communications with the Primary and Co-Investigators of the project have helped outline the practical systems underlying the website which serves as the public face of the project. CDLI data is contained and edited via a single table Filemaker 7 database, accessed and indeed accessible only to a limited group of scholars inside the hosting institution, UCLA and a small number of contributing partners in Europe.

Within UCLA, the data is accessible via a Drupal-based system, but for the majority of users (including all users outside of UCLA) the single point of access to the data is via the CDLI website which in turn queries the MySQL server (to which the data is automatically uploaded on a daily basis). It is unlikely that any system replacing Filemaker as the core for data storage and maintenance will be implemented in either the short or the long term. Although not each instance of the 290,000 tablets electronically catalogued by the CDLI includes images and transliterations, the CDLI is a significant philological tool for Assyriological research.

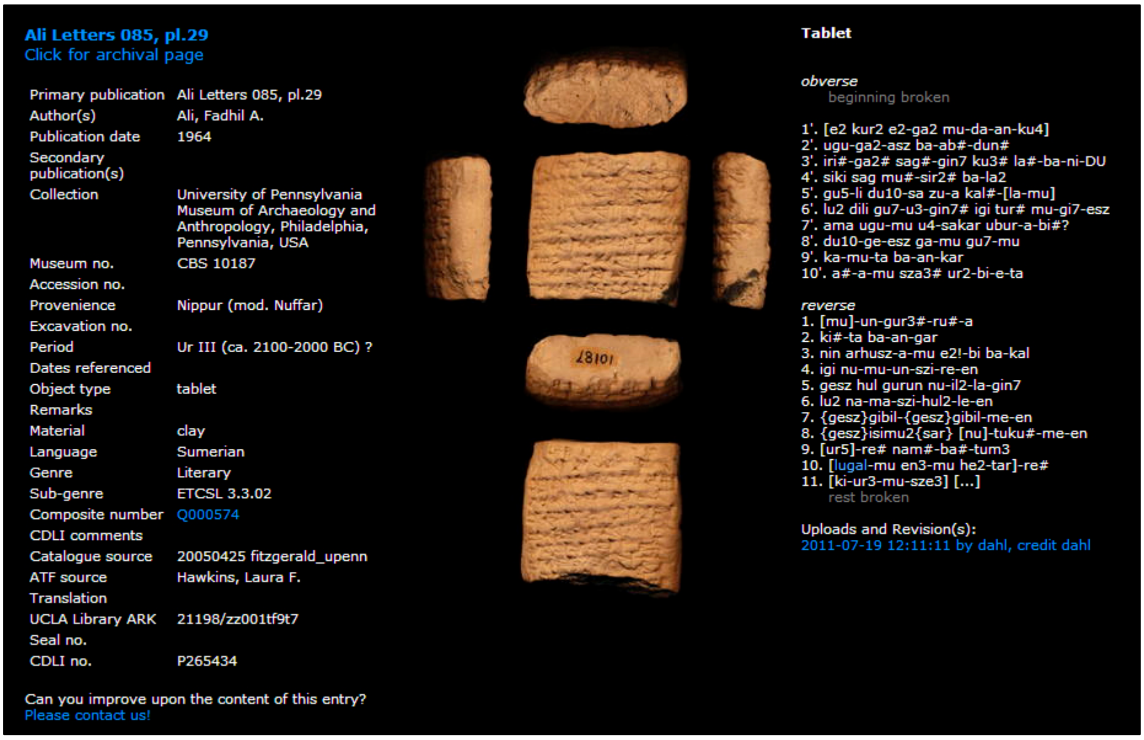

Figure 10 Example CDLI object record, illustrating object metadata, as well as the image, and in this case, the transliteration of the text.

Philological projects

Another prominent philological project is the Open Richly Annotated Cuneiform Corpus (Oracc, http://oracc.museum.upenn.edu/)[15], which can perhaps be considered as a second-generation example of an open (Creative Commons Attribution Share-Alike 3.0 License) and collaborative effort (incorporating over forty projects to date) to create a publicly and freely accessible Assyriological resource. It provides the workspace, toolkit and long-term storage necessary to support the scholarly endeavours of corpora-building academics and researchers. The standard is ATF (ASCII Transliteration Format), which supports multiple translations and enables lemmatization data

[15] Named, as the story goes, in homage to the supercomputer in the 1980s British science fiction series *Blake's 7*.

to remain synchronized, even when changes are made to the text. Whilst much of the ETCSL necessitated manual input, much of the lemmatization process in Oracc is automated, drawing from existing glossaries to lemmatise nascent projects. Behind the scenes is the XTF, the XML of the ATF (Nurmikko-Fuller, forthcoming; Oracc, 2014).

Created and steered by a group from a three institutions (University of Pennsylvania, University of Cambridge and University of California Berkeley), Oracc originally emerged from the CDLI and is a hub for bringing together a large number of other, predominantly Assyrio-Babylonian projects, with tools and conventions to promote inter-linking and searching between resources. Of these, three contain subprojects on niche subjects, the data of which is also accessible via Oracc: the Corpus of Ancient Mesopotamian Scholarship (CAMS), with five subprojects; the Royal Texts of the Neo-Assyrian period (RINAP), with three and the State Archives of Assyria online, including all eighteen subprojects. Oracc remains intrinsically linked to the CDLI, which publishes the object metadata and images (where available) of the tablets relevant to the Oracc-published projects. In 2012, a small number of geographical locations known form Oracc were added to the Pleiades gazetteer. Although these are limited to only 54 sites, Oracc is the main online resource for Assyriology to have taken any steps to truly engage with the paradigms of LOD publication.

Even with myriad online projects for Assyriological data, only two projects can be said to be exclusively concerned with Sumerian material: the aforementioned ETCSL and the Database of Neo-Sumerian Texts (BDTNS; http://bdts.filol.csic.es/) which collates (and thus publishes) its data with the aforementioned and described CDLI. It is the ETCSL, as the primary dataset for the research discussed in this thesis that warrants further discussion.

3.6 ETCSL

The Electronic Text Corpus of Sumerian Literature (henceforth ETCSL; http://etcsl.orinst.ox.ac.uk/edition2/general.php) is a project of the University of Oxford, which started in 1997. Although it has not been actively developed since 2006, it is a cited resource and in itself the focus of research (Ebeling and Cunningham, 2007; Crawford, 2013; Delnero, 2012), although it may not have yet had the chance to live up to its potential as a (r)evolutionary tool for literary Sumerology (Robson, 2013). It is the mode of publication for some 400 Mesopotamian literary compositions, all of which are written in Sumerian and have a provenance in the late third or early second millennium BC. The ETCSL provides an English translation, and the transliterations in both Unicode and ASCII. A specific section outlines the critical apparatus and explains the used philological conventions (see Appendices B and C).

Thematic categorisation within the ETCSL

The corpus has been thematically arranged (see Appendix D) into categories that follow the divisions made by Civil (as published by Cunningham, 2007: 351). These categorisations are an example of applied interpretation, and the notes on the full online catalogue acknowledge, "this assignment reflects modern perceptions and may raise misleading expectations concerning the nature of a composition and its relationship to other compositions and other genres" (Robson, 2001). Furthermore, design decisions have been made to exclude certain categories, such as lamentation songs in the **eme.sal** dialect (the exclusive repertoire of the gala-singers) and magical incantations (Robson, 2001). It has been explicitly noted that whilst the ETCSL "contains literary compositions, [it does not necessarily contain] samples of all kinds of Sumerian literary genres" (Ebeling, 2007:35).

For the current study, particular attention has been on the literary categories of Narrative and mythological compositions and the somewhat opaque "Wisdom Literature", as these contain of many of the examples cited herein. These sections were chosen as they are sufficiently long in length, (unlike the very short Proverbs for example) with complex structures, and include a myriad of protagonists, locations and events. The significance of the Mesopotamian literary corpora as utilised in the educational system has already been noted in Chapter 3: suffice to repeat that these texts were copied in the course of several centuries, allowing for commentaries and research based on diachronic changes to narrative structures. Instances of ancient literary borrowings and allusions to other well-known compositions by scribes are well-attested in the ancient Near East and are a subject of recent and on-going studies (see for example Ebeling and Cunningham (eds) 2007; Crawford (ed) 2013). It is in the use of semantic technologies to represent the contents that this thesis creates and interprets new knowledge, and not in the use of the ETCSL as a primary data source.

Linking to and from the ETCSL

The ETCSL provides external links to other related and complimentary projects. These include other online corpora, as well as resources for museological (concerned with object details) and palaeographical (mapping diachronic change in signs) data, and a dictionary. These projects, housed by a number of different institutions, are the:

- Diachronic Corpus of Sumerian Literature (http://dcsl.orinst.ox.ac.uk/),
- Database of Neo-Sumerian Texts,
- Cuneiform Digital Palaeography Project,

- Cuneiform Digital Library Initiative, and
- Pennsylvania Sumerian Dictionary (http://psd.museum.upenn.edu).

Of these, the Database of Neo-Sumerian Texts was previously limited to registered users, but since the autumn of 2014 is openly accessible. The Diachronic Corpus links to the transliterations published on the ETCSL, but cannot be accessed via it. The Pennsylvania Sumerian Dictionary (ePSD) links externally to it, providing a list of texts and a short passage, out of context, in which a specific lexical item occurs. The ETCSL record is presented in a pop-up window and can be compared with the original search results from the ePSD (see Fig. 11 for the example **kaš** “beer” on the next page).

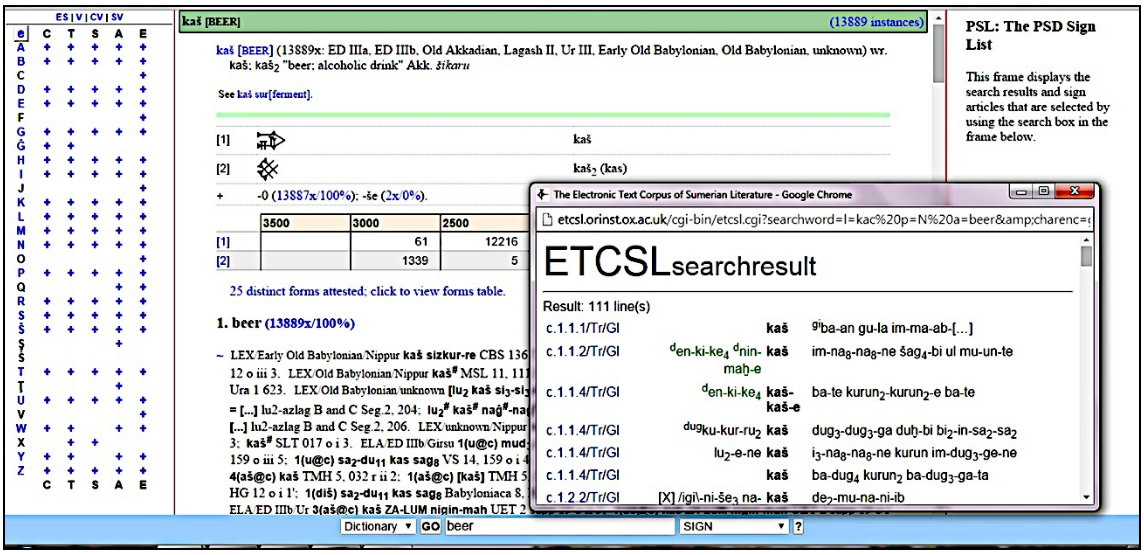

Figure 11 Collaboration between the ePSD and the ETCSL: texts that include the example word **kaš** (“beer”) are shown by the ETCSL (foreground), and the translation and philological notes are provided by the ePDS (background).

Thus, if aware of a specific lexical item, it is possible to identify instances of texts in which they occur – the user can then manually identify those most relevant to their original search. This linking does not work both ways – clicking on a word in the transliteration in the ETCSL does not link to an entry in the ePSD. Instead, the text is lemmatized (i.e. showing lexical items in the forms they can be found in dictionaries) and when the cursor hovers over the word, the English translation appears. Whilst this is useful in providing a translation, it does not provide all the information that is accessible via the ePSD. Additionally, as a dictionary form, the lemma provides only the translation for the root morpheme in the phrase. Additional grammatical elements receive no comment, and whilst in many ways a useful feature, the lemmatisation is perhaps not of extensive help to those with no prior knowledge of Sumerian grammar or sentence structure, especially since the translations are in paragraphed prose, rather than line per line (Fig. 12).

Pragmatic limitations set to the original ETCSL project meant some elements were not completed. As Robson (2013:54) describes:

> "While substantive textual variants in the sources (namely those that result in different English translations) are noted in the ETCSL's online editions, variants that reflect more subtle distinctions, particularly in the very complex morphology of the verb, are not. In the original grant application…it was proposed to edit a 'core corpus', comprising 5 to 10 per cent of the compositions, not just as composite texts but also as individual manuscripts. In the end, there was neither the technical set-up time nor the editing time to do that, but it would have enabled research in a variety of currently impossible directions."

Even if forced to stop short of this original aim, this was a pioneering project in Assyriology. Innovative particularly in the realm of study of Sumerian literature and characterised not only by free and unrestricted online access to the data but also for the aim of interlinking with different types of online resources (from dictionaries to sign lists and object photography), the ETCSL was a new breed of collaboration in the domain (Robson, 2013). It was also a project unafraid to engage with technology and new publication paradigms: the content (transliteration and an English translation alike) is exclusively output as XML, the entire corpus has been marked up in customised TEI (P4) (Black, et al, 1998 - 2006; Nurmikko-Fuller, 2014; Robson, 2013).

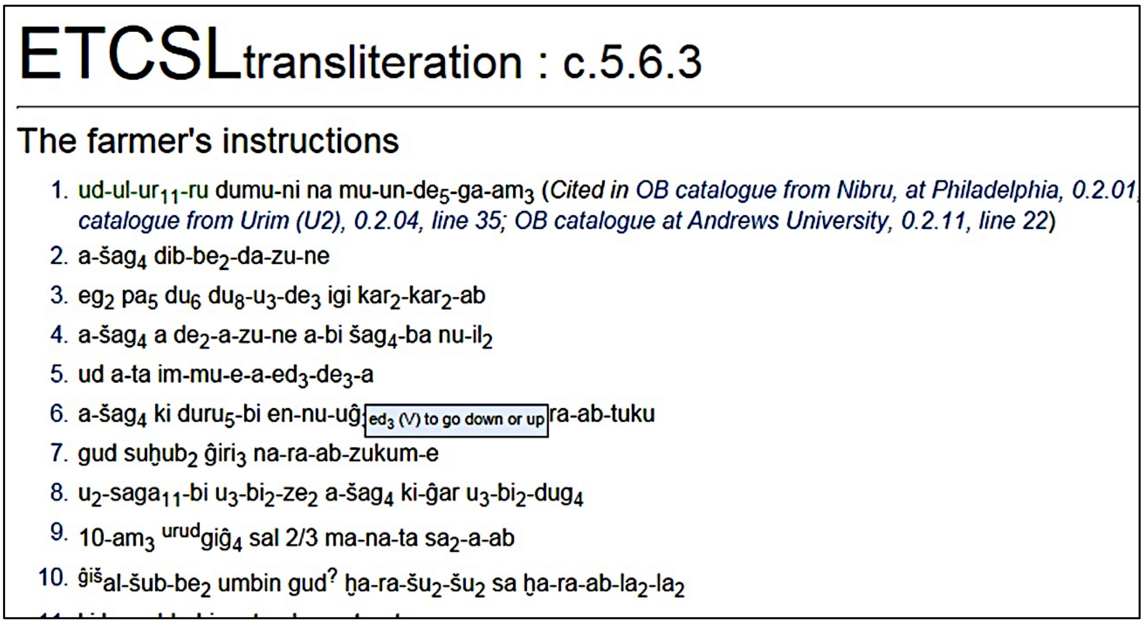

Figure 12 Lemmatization in the ETCSL, whereby the verb string **im-mu-e-a-ed3-de$_3$-a** is shown to contain the verb **ed$_3$** (“to go up or down”).

ETCSL as TEI/XML

The current site is published exclusively as HTML (Hypertext Mark-up Language) and JavaScript, although relevant existing XML files are available separately (upon request) from the Oxford Text Archive (http://www.ota.ox.ac.uk). The lemmatization of words is hard-coded into the HTML, and whilst the live site includes colour-coded identification of individuals and places (these occur consistently throughout the corpus), this has been achieved via span tags with a class name (e.g. span.emesal) in the HTML – the class itself is defined in a CSS file (a separate file containing style definitions such as font colour and size).

Discussions concerning the ETCSL voiced the possibility of automated re-mark up of the HTML in order to generate LOD-ready data. An automated script could be created and used on the existing HTML to parse out meanings and tagged instances of proper nouns (named individuals and places), but first, two important considerations need to be addressed:

- HTML is used for generating visual representations on a web page and personal design decisions can affect the structure of the HTML for any given site, making it difficult to create an automated script that could look for specific structures and simultaneously remain robust to future aesthetic changes to the site, and,

- The data generated from the HTML using this method is already encoded into the TEI files that are already in existence and the latter (the TEI) may contain additional information, which would not necessarily arise from the conversion of the HTML.

The existing TEI files are not entirely free of challenges. The TEI encoding for the ETCSL was a custom build, and deviates from the existing TEI standard to a considerable extent. With little other practical use, the TEI files have been used to generate lists of geographical locations and protagonists (be they human, demonic or divine). An automated process such as the one discussed above (one to generate new TEI files, for example) ought to access the original dataset – there seems to be little benefit of creating a script limited to the HTML of a site which may or may not change in the future.

Since the existing XML/TEI does not conform to existing TEI standards, it has been set aside by those responsible for the resource itself, and these files at first glance appear redundant. Yet, the list of proper nouns as published at http://etcsl.orinst.ox.ac.uk/cgi-bin/etcslpropnoun.cgi# may be easier and simpler to use as a basis of forming a list of geographical locations and named entities in the ETCSL. The Berkeley Prosopography Service (Schmitz, et al, 2013) contains the functionality to import TEI documents, and, based as it is at least to some extent on the corpora of Oracc, and developed by an expert in Hellenistic Babylonia (Dr Laurie Pearce), contains a deliberate corpus-agnosticism that would facilitate the adding of the ETCSL TEI material to the project. The issue of the TEI files can be defined as follows: whilst some of the content is redundant, other parts remain useful.

Whilst undeniably valuable as a source for publishing Sumerian literature and unique in many ways as a reference source, any analysis of the texts published by the ETCSL must also remain critical: the lack of clearly documented, methodologically sound processes for compiling the composite (as has already been noted by Delnero (2012). Even if the resource in its entirety is found to be above reproach, care should be taken whenever using transliterations as authoritative material, at all times remembering that composite texts in particular may disguise a multitude of editorial sins (Black and Zólyomi, 2007: 2ff.).

3.7 Conclusion

Sumerian literature has its roots in the very dawn of history. Cuneiform, the script developed to record quantities of barley, numbers of sheep, and vats of beer became the medium of artistic, literary expression sometime in the third millennium BC. Compositions which almost certainly had their origins in older oral traditions were recorded and copied from the Early Dynastic onwards, with the Ur III and OB periods seeing a renaissance of literary Sumerian and the development of its role as the *lingua sacra*, the language surviving for many centuries beyond its final utterances as a spoken language.

The study of literary Sumerian is a relatively new (since the 1950s), niche field. Even without the excuses or reasons of a long, multifaceted history of scholarship, or the richness arising from the work of many prolific researchers, the material, methodologies and paradigms for this topic are diverse. Tools for homogenising content are still absent, with publications, resources and even authors adhering to their own idiosyncratic systems. .

Growing from an academic culture of private scholarship and protected data, the last few decades have seen an increasing number of projects providing information online, free of restrictions. These projects, whilst aware of each other, seldom interlink in complex ways that could help propel Assyriology forward–they are responsive to known needs and requirements, rather than facilitating potential change and enabling new types of academic endeavour.

The cuneiform literary corpus is rich and complex, with potential for cross-referencing within the Mesopotamian literary tradition and with those of their immediate neighbours and successors. Assyriology as a domain has great potential for linking with external data streams from a number of different, diverse and disparate domains.

Chapter 3

An extensive review of existing online resources alongside an in-depth analysis of the ETCSL confirmed its suitability as the main focus for this PhD thesis. But rather than repeat the types of scholarship that this resource has been used for since its first launch, the aim is to 'push the boundary' of possible searches. Rather than focus on the retrieval of individual lexical items, semantic technologies can enable the types of comparative analysis already carried out in literary Sumerology on an ocean of ideas, concepts and word clusters.

Chapter 4: Semantic Technologies

4.1 Background

The Semantic Web (SW) is not a new concept. Knowledge Representation (KR), one of the cornerstones of the SW, has been discussed at least since the early 1980s (Levesque, 1984) in the context of Artificial Intelligence (which, in turn, has been a field of active research since the 1950s). Berners-Lee has discussed Web-facilitated machine interaction for at least two decades (since 1996), and his initial vision for a hypertext-based system already enabled connections which went beyond linking human-readable documents: machine-readability was an aimed for feature of his system from the beginning (Berners-Lee, 2000). Even the (interested) general public was introduced to the term over a decade ago (Berners-Lee, et al, 2001). This having been said, there may still be some distance to be travelled before the SW can be confidently described as 'having gone mainstream'.[16] In 2006, Wilks and Brewster (2006:1) described the SW as being "the core focus" of Web Science; whether or not this still remains true (almost a decade later), or whether the discipline has taken on a turn to be more closely concerned with Social Science-based research questions (especially in the wake of the popularity of social media) is an interesting topic but lies beyond the scope of this particular thesis.

In recent years, the SW has increasingly moved away from its roots in Artificial Intelligence and has become synonymous with the "Web of Data" (W3C,

[16] This is not to say that there will necessarily ever be a time where the underlying technologies that facilitate, for example, web browsing, will be generally known to the wider audience of users: Undoubtedly there are many who use Google's search engine without giving much thought to the algorithms that power it, or are unconcerned, uninformed and uninterested in both the technical applications and the theories of social media, but choose to engage with it via multiple separate platforms. To know and to use a service does not equate to knowing how and why it functions.

2013a).[17] Wilks and Brewster, 2006:1) describe the SW as a "more powerful, more functional and more capable version of [the] document and language-centric Web". Information is defined and given meaning, data is linked in ways that form the basis for its integration, discovery, and as a result, its reuse and reinterpretation. The Web as we know it today is a collection of documents, with predominantly written content that captures natural language: legible to humans but difficult for software agents. The SW is a step along the evolutionary ladder of the development of the Web, where the content of websites is published in machine-readable formats with semantics (meanings) that are "understood" and processed by automated systems (as well as people).

Existing semantic technologies lend themselves well for the online publication of Assyriological information and will (potentially, eventually) enable the types of complex queries as outlined previously. An extensive review of available technologies and pioneering projects has led to the identification of a number of technologies (such as XML or RDF), tools (software such as Protégé) and methods (the Five Star criteria for Linked Open Data publication, please see below), which can be seen to result in a clearly definable benefit and positive outcome and could be utilised to support and supplement Assyriological scholarship. The following discussion is not a comprehensive analysis of available methodologies, although those projects that initially appeared useful but proved otherwise are briefly discussed.

In this chapter, attention turns to the semantic technologies, which have played a significant part in the research agenda. The topic has been divided into two categories for the purposes of clarity of description: firstly, there are the topics of the SW and LD, both broad terms often illustrated with theoretical

[17] An extension of the existing Web where data, not documents, are the nodes in a network.

or metaphorical examples. Secondly, a more fine-grained, detailed and specific set of examples have been provided to illustrate those technologies (RDF and ontologies), which have utilised in the research described in this thesis. The aim of this chapter is to introduce and discuss these concepts and technologies in accessible terms, establishing a baseline of understanding and elaborating upon domain-specific jargon. Adopting this terminology allows for a move away from assumptions as to the existence and prevalence of techniques from the sphere of Artificial Intelligence, to a more pragmatic technological application – one, which is more likely to be within the scope of practical implementation of the LD paradigm (as outlined, for example, at http://linkeddata.org) by laypeople, web scientists and all others who inhabit an interdisciplinary research space.

4.2 Existing Technologies

Linked (Open) Data: LD and LOD

Two distinct (albeit related) terms are centre-stage in any discussion of the Semantic Web. These are Linked Data (LD) and Linked Open Data (LOD). The difference between the two is primarily one of accessibility.

LD may sometimes be used as shorthand for LOD, but the distinction is relevant and necessary to highlight. LD does not include the openness of LOD – data may indeed be *linked*, either internally within the dataset, or even to other resources and datasets via URIs, but it is not itself directly available, and a user can be prevented from accessing it directly, or without incurring costs. Similarly, data may be linked within a specialist silo, such as a triplestore with no publicly available endpoint through which the data could be queried. Even without links to other resources, authorities and data on the Web, data can be linked, but unless made freely available for access and reuse, it does not meet the criteria of LOD. Furthermore, LOD can be contrasted with Open Data (OD), in which case data is made openly available and accessible, but it is not yet internally or externally linked to other entities in external data streams. OD is however the prerequisite for any LOD project – as it currently stands, the ETCSL corpus is available by request only, and whilst the Oxford Text Archive (http://www.ota.ox.ac.uk) allows free downloads of the content, this method of storage and dissemination does not constitute an example of OD.

The aim of LOD is to combine knowledge held in disparate data sets online via the linking of identified co-occurring details or entities by the use of URIs. In order to do this, data is to be published in adherence to the Five Star criteria:

- As a pragmatic minimum, data needs to be published online, ideally under an open licence (e.g. the Creative Commons Attribution Share-Alike 3.0 licence used by Oracc),
- Data should be available as structured data, rather than a JPEG or PDF,
- Using non-proprietary formats (CSV file, not an Excel sheet),
- Assign http://URIs to identify, disambiguate, and differentiate: Adab (the city) as separate from an **adab** (a drum) and that all mentions of the city refer to the same place, and
- Adhering to standards such as RDF (as discussed below), and linking to other resources that use them.

LD and LOD are more than exclusively theoretical concepts; these are methods, online publication paradigms, which share much in common. They are a way of publishing data in machine (rather than human) readable formats, enabling automated systems, servers and search engines to identify datasets which refer to the same entities, and to differentiate between synonyms, homonyms and name-sakes. In the LOD publication paradigm, content is not under copyright restrictions or use-limitations, and free of financial costs (not hidden behind paywalls), although the owner of the site will incur the usual costs for hosting and transmission of the data (such as costs related to domain name registration and renewal as well as other possible costs from their Internet Service Provider).

LOD and semantic technologies facilitate the sharing of knowledge regarding identified entities. In this respect, they are not groundbreaking *per se* – certainly not in Assyriology, where non-LOD online resources such as the CDLI already collate data from a large number of different databases into one cohesive unit, which can be queried from a single point of entry. Where LOD differs from these existing models is that, rather than being limited to the content and structure of the selected databases, relevant information can potentially be identified anywhere online, and can be incorporated into the processes of automated inference.

There are several benefits to adopting LOD as a mode of publication. Data can be enriched by external sources and amalgamated across disparate siloes. The time required for data collection is reduced. LD also enables bidirectional linking, and allows for the creation of a RDF-triple graph of across an ocean of information. Using LD is likely to support future developments in the sphere of KR and the automated inference of new truths from explicitly declared facts. The benefits of adopting LOD specifically from the Assyriological perspective are the enrichment of data from other, external sources: not all known relevant data is published on resources even as wide-reaching as the CDLI, let alone that from currently unknown sources, which may complement existing knowledge and help highlight new connections and interpretations (for which there is no existing precedence). Such examples might include the addition of environmental data to historical sites to show periods of drought as associated with social turmoil in antiquity or perhaps the use of astronomical data to help determine the murky early chronologies of the ancient Near East. This type of inherently interdisciplinary research, whilst not unprecedented in modern scholarship, currently demands a great deal in terms of the limited resources of time and energy of an expert, as well as access to information, which lies beyond the scope of their own discipline.

URIs

URIs (uniform resource identifiers) are strings of characters used to identify a resource. Most Web-users are familiar with a specific type of URI: the URLs (uniform resource locators) that appear as the string of characters in the browser address-bar for any given website e.g. http://www.google.com or http://etcsl.orinst.ox.ac.uk/. These web-addresses are unique within the context of the Web – no two separate sites can have the same exact URI.[18] For the purposes of LOD, automated inference and KR, these unique identifiers are assigned not to web sites or pages containing data, but to specific instances of data: in a prosopographical dataset, an URI would be assigned to a historical person; in a gazetteer, to a geographical place.

This use of unique identifiers is what enables the enrichment of data by external streams, as it allows for the identification of the same entity in different datasets. Reasoning (inference of connections between such URIs, for example) does not necessitate the use of http://URIs specifically (inference could be carried out in a closed-off, offline system), but in doing so, online publication is made possible and that, it turn, opens up possibilities of

[18] Although differences can be as small as a single character, as any who have accidentally stumbled upon the wrong website would know.

(potentially, eventually) benefitting from the knowledge available across the entirety of the Web. In order to do so, the content of disparate information silos must be published in mutually comprehensible terms – what is needed is a *lingua franca* of online data exchange. It is here that technologies such as XML, RDF and ontologies come into play.

XML, RDF and SPARQL

The question of choice between XML and RDF is inherently relevant to this thesis. Surrounded by many examples of projects, which incorporate XML (including the ETCSL, the primary dataset), the research agenda of this doctoral study has nevertheless been on the use of ontologies and RDF. A brief discussion as to the main characteristics of these technologies is essential to illustrate the design choices made from the onset.

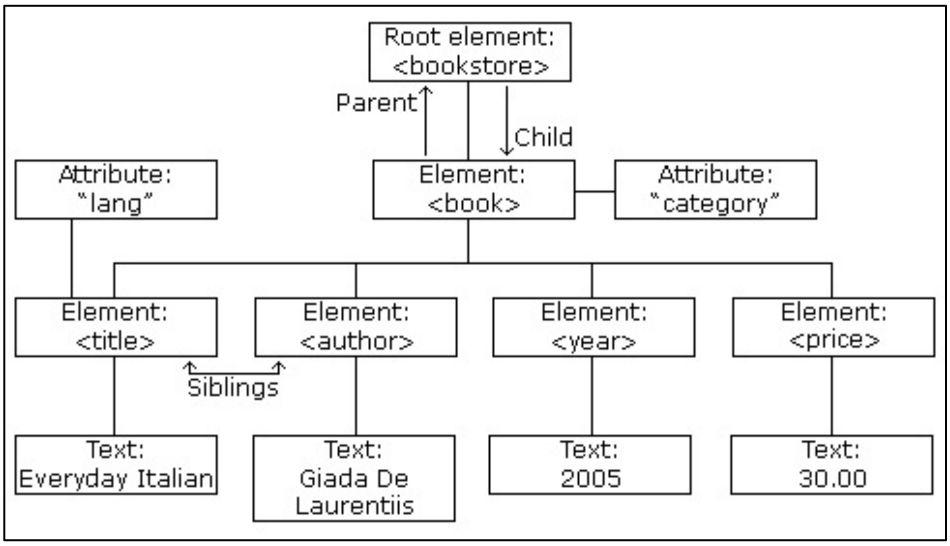

Figure 13 XML tree, illustrating the hierarchical nature of XML, and why it lends itself well to representing structured data. As at http://www.w3schools.com/xml/xmltree.asp

XML is a mark-up language that enables the coding of sites and resources in a format that is both human and *machine-readable* (cf. RDF, see below). The defining rules of XML aimed for universality and the interoperability with and between SGML (Standard Generalised Mark-up Language) and HTML (W3C, 2008) – projects from the sphere of the Digital Humanities that utilise XML schemas to define structure and to express content include EpiDoc (see below) and the ETCSL.

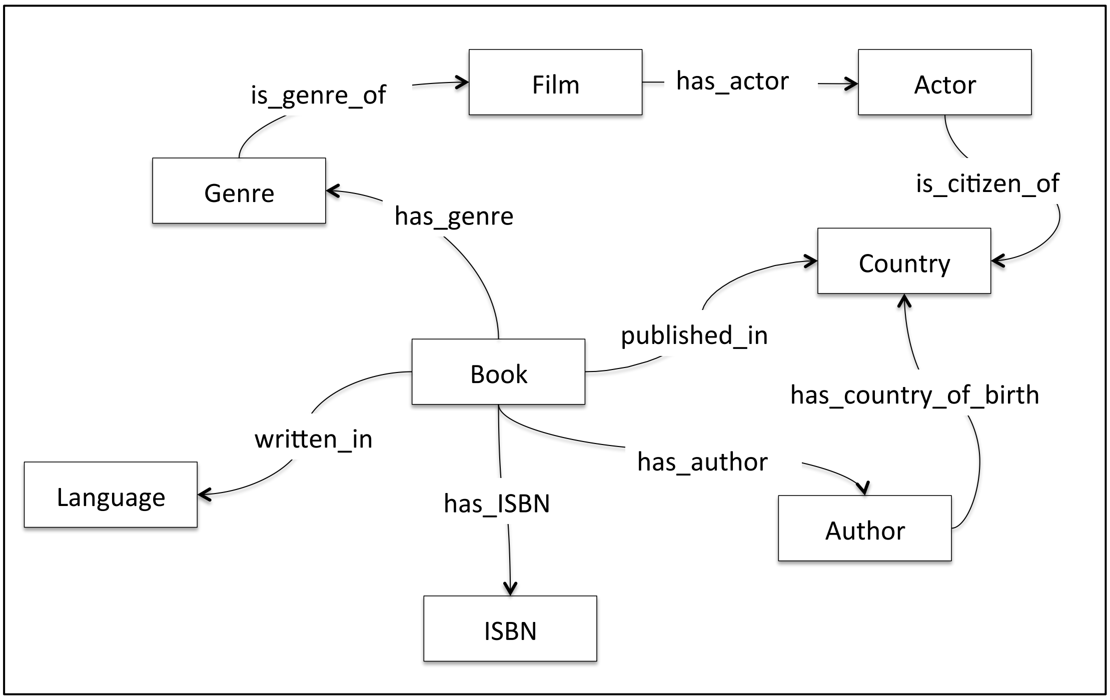

Figure 14 Simplified graph, illustrating the inherent flexibility of RDF, and how it lends itself well to representing messy, complicated and heterogeneous data.

RDF (Resource Description Framework) is a W3C (2014) specification and a tool for publishing data in a *machine-understandable* format. Like XML, RDF addresses the problem of enabling different systems to communicate with each other, but it is inherently more flexible.

Gonzales' (2014) analogy captures the difference between XML and RDF by way of a literary example:

> "Let us say that we have two copies [of the same book]…one in braille and one in regular print….From the point of view of RDF they are absolutely the same book. The book's meaning is what matters in RDF. The information represented…retains its self-same meaning regardless of its underlying format. If you save RDF file in Turtle or RDF/XML it's still the same information. Braille or print: it's the same book. From the point of view of XML they are not the same book. A person who cannot read braille cannot consume one of the two. The representation is what matters in the XML world."

The analogy is (as is in the nature of analogies to be) a simplification. It is not to say that RDF is inherently better suited or designed for the representation of the content of literature (such as representing the narrative structure) or that XML must be exclusively concerned with the representation of form or format: the Text Encoding Initiative (TEI) is an example of the versatility of XML to represent ancient texts in terms of both format (paragraphs, lines and so forth) and at least to some extent, the content (in particular for the mark up of errors, breaks, damage, and other features of the manuscript itself).

Sequeda (2012) notes that any attempt to directly compare XML and RDF to one another is complicated at best, for whilst XML is a syntax, RDF is a model, which has several syntaxes (Turtle, N3) of which RDF/XML is one. The comparison is also based on data models: for XML is a tree, for RDF a graph. Further, it could be specified that where XML uses elements and attributes, RDF has nodes and relations (Prud'hommeaux, 2003).

XML has inherent flexibility, which allows for a certain degree of freedom in representation. In order to “understand” the XML document, an application also needs the schema or DTD (document type definition) – for RDF, an ontology (see below) serves this purpose. XML schemas are inflexible, inextensible – any addition or change to the schema requires agreement on behalf of all using parties, and this may not always be pragmatically achievable: Changes to schemas that reflect project or dataset idiosyncrasies can result in the loss of universality of expression (much as is the case with the extensively customised TEI P4 used for the ETCSL, which is, as a result, largely unable to communicate with other projects using TEI schema). RDF and ontologies are more extensible – it is possible to merge ontologies and to add RDF triples. There are two fundamentally (at least for the purposes of this doctoral research) important differences between XML and RDF, which have led to the identification and use of the latter as the main technology for this project:

- The addition of semantics (via the ontology), facilitates a degree of “understanding” of the content of an text by the expert system and enables automated inference of new, implicit knowledge from explicitly declared facts, and
- The assignment of URIs as universally unique identifiers to data, which in connection to the graph model of RDF (interconnected triples) is the practical application of the LD paradigm.

Data stored as RDF can be queried using another W3C standard, SPARQL (the SPARQL Protocol and RDF Query Language). Searches that extended beyond a basic matching of keywords and Boolean operators (AND, OR, NOT or AND NOT) are possible: queries are across RDF graphs, with the additional ability to filter results and to generate new graphs based on found solutions. SPARQL facilitates four types of query: SELECT, CONSTRUCT, ASK and DESCRIBE – whilst all of these are not supported by all semantic platforms, most support SELECT (Segaran, et al 2009: 86).

The prerequisites for the user are an understanding of SPARQL and a degree of familiarity with the underlying ontology (see below), which ought to be extensively documented by the creator-developers. Even in the absence of descriptions of the classes and properties of an ontology, it is possible to elicit the structure and to successfully query the RDF data – this however is a time-consuming process and can, potentially, deter users from querying the data.

Ontologies

Ontologies have been described as being “crucial” to the SW (Wilks and Brewster, 2010:2). They are formalised structures, which form part of expert systems. They are used in the KR subset of Computer Science to represent and query information in machine-readable formats, and have been incorporated into the SW and business-to-business applications amongst others (Brewster, et al: 2003:2). Described as a “specification of a conceptualisation” (Gruber, 1993), ontologies are the rules, which determine which RDF triples are possible, (and to some extent, those that are not). They are used for automated inference, a process of bringing forth implicit connections within datasets, by deducing links, which indirectly exist between explicitly declared facts. Generally speaking, the aim of an ontological structure is to provide a formalisation able to represent (as much as is pragmatically possible) the knowledge (interpreted data) of a given domain.

Ontologies consist, in the simplest of terms, of classes and properties. Classes are categories of items, which share some common feature or trait, which allows them to be identified as belonging to the same category. Classes can have subclasses (a specialization) and superclasses (generalisation). To draw inspiration from the Sumerian proverb:

> **dub-sar eme-gir$_{15}$ nu-mu-un-zu-a a-na-am$_3$ nam-dub-sar-ra-ni** What kind of a scribe is a scribe who does not know Sumerian?

It could be said then, that there are scribes, who know Akkadian (class). Some of them know Sumerian too (subclass). But all of them, regardless of which language they know, are scribes (superclass). This would only hold true if all those scribes who know Sumerian, also knew Akkadian: whilst this is true for the later periods of Mesopotamian history, it could be argued that there is no evidence to support such a conclusion for the authors of the earliest of writers. Perhaps then scribes should remain a superclass, with two equal subclasses (for Akkadian and Sumerian)? The most pragmatic solution might in fact exclude the use of subclasses altogether, and specify a class of scribes, the instances of which can have knowledge of a language, and for some, that may be only Akkadian, or only Sumerian, or possibly, both. In this case, the information is mapped not by the classes, but by the classes and the properties together.

Properties define a relationship between classes, and like the latter, they too can have specialisation (subproperty) and generalisations (superproperty). A domain is a class for which a given property is specifically defined; the range the class that comprises all possible values for that property. Subclasses inherit properties from their respective superclasses. To refer back to the scribal example, the class of Akkadian scribes has the skill to write Akkadian (where scribe is the domain, ability to write is the property and Akkadian is the range); if those who know Sumerian are a subclass of the Akkadian scribes, they too know Akkadian, without the explicit need to declare that relationship in the ontological structure.

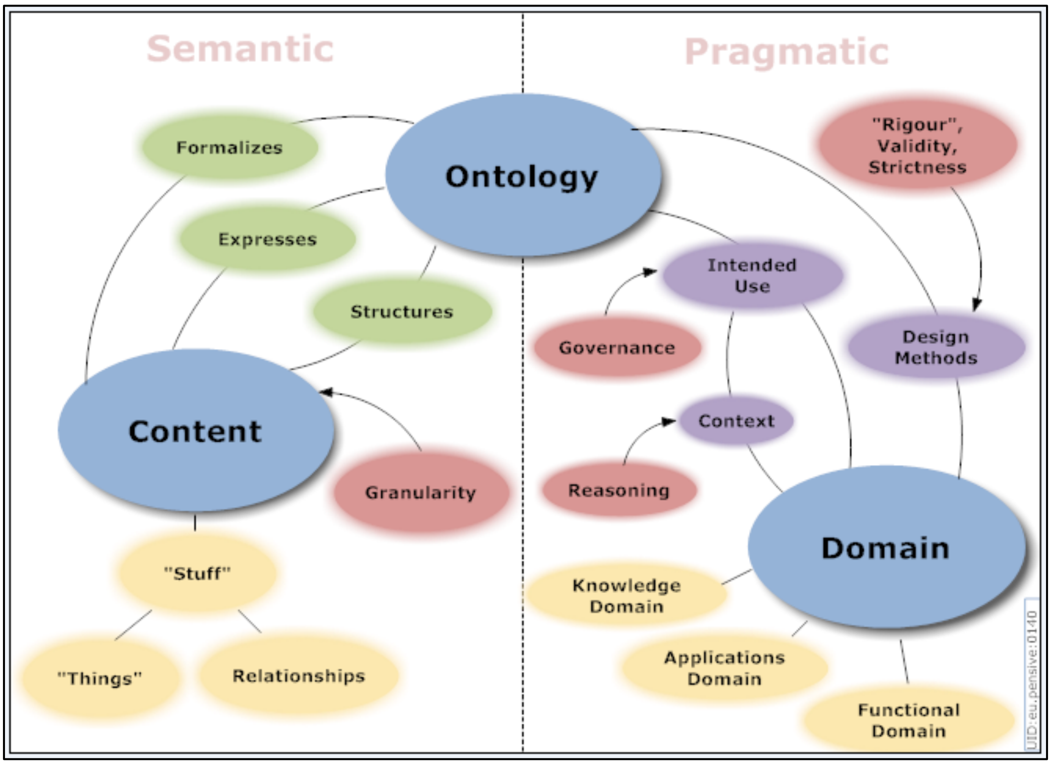

Figure 15 Ontologies incorporate semantic and pragmatic considerations. As at http://www/wbrlsite.com/2013/Library/SemanticsVsPragmatic.jpg.

For the purposes of this thesis, the Open World Assumption applies: the assumption is that the information is incomplete, and therefore, the absence of a feature in the ontology does not imply the absence of the feature in truth. This is particularly true in the case of properties.

Ontologies can be created in different ways, but those incorporated into mORSuL have been written in OWL (Web Ontology Language), a W3C standard (W3C, 2012). Ontologies are divided into four major categories; domain-specific (or domain ontologies), general (or upper), representation, and application ontologies. Of these, the first is (rather eponymously) concerned with the representation of the concepts that constitute a specific subset of the world (or specific domain). Examples include CIDOC CRM and Jaworski's (2008) ontology for the representation of Sumerian economic tablets from the Ur III period (see below). Upper ontologies on the other hand are designed to model those entities and aspects which are a common occurrence, universally. These include Cyc (common-sense ontology) and WordNet: English lexicon (where concepts number in their hundreds of thousands). Semantic web languages, OWL, RDF and RDFS are representation ontologies, used for low level representations, whilst those designed with the needs of a specific applications are examples of the final category. FOAF (Friend of a Friend) is one of these.

Ontologies can also vary in design philosophy. Brewster, et al (2004:2) quote Steve Fuller, who divides ontologies into two main categories: the Newtonian (a reductionist model) and the Leibnizian (concerned with the capture of the nuanced complexities of experience). The beauty of the former lies in the ease of control and administration, of the latter in the fuzziness, which makes it easier to apply. A Newtonian philosophy regarding ontology-design implies a degree of omniscience and detachment from the subject domain, whilst those of the Leibnizian school-of-thought may argue that true absolute objectivity is unachievable.

Ontologies are, by their very nature, a reflection of (a/ the) reality (or realities) as perceived by their developers. Idiosyncratic and culturally conditioned perspectives can (and inevitably will) affect the structure and design of an ontology. Consider for example the complex issues of gender and sex (both of which OM maps with multiple sub-classes) or the assumption that time is a linear construct. Since ontologies reflect the world and reality as interpreted by those who design them, a hermeneutic consideration ought to take place at the very onset of the process, so as to keep unavoidable biases and socio-cultural conditionings to a pragmatically achievable minimum. It is also worth noting that since no absolute taxonomy of ontologies exists, any descriptions seeking to pigeonhole them may be based on arbitrary, vague or misleading criteria.

There is a known and identified dichotomy of skill sets between those who are familiar with ontological representation (and able to formulate SPARQL queries) and those possessive of a high level of understanding of cuneiform texts. Projects are known that are working toward a natural language based querying tool which would convert questions asked by the user in natural languages into SPARQL (for an example of such a project, see Ngonga Ngomo, et al, 2013) but no fully available tool can be suggested for this purpose at this time (summer 2014). Advanced algorithms employed by search engines such as Google are becoming ever more complex and even at the time of the writing of this thesis are ever more efficiently bridging this gap between different query types. A practical example of the increasing incorporation of semantic technologies to mainstream, popular projects is Google's Knowledge Graph (http://www.google.co.uk/insidesearch/features/search/knowledge.html).

Although the research agenda has been one of semantic technologies such as RDF and ontologies, the ETCSL forms part of a cluster of Digital Heritage projects that have (for myriad reasons) opted to use XML. To understand these projects is to understand the wider context of the ETCSL.

4.3 Ancient World Data and XML/TEI

The Text Encoding Initiative (TEI, http://www.tei-c.org/index.xml) and EpiDoc (http://sourceforge.net/p/epidoc/wiki/Home/) are both examples of existing tools that utilise established and actively updated guidelines and standards for the electronic publication of ancient documents and text in machine-readable format (XML). By the time the project ceased to be actively developed in 2006, the entire ETCSL corpus (400 texts, both transliterations and translations) had been marked up in extensively customised TEI (P4). The idiosyncratic data, needs and aims of the scholars working on the project resulted in this departure from the TEI guidelines, and in an effort to capture features such as textual variation and linguistic annotations, much of the universality of TEI was lost. Since then, a conscious decision has been made not to address this problem – yet these TEI/XML files remain the only output of the entire corpus.

A similar issue arises with the possible adoption of the EpiDoc guidelines and the implementation of the ETCSL data to match the EpiDoc Schema. Being a subset of the TEI, EpiDoc criteria are largely the same, in terms of the transcription and editorial treatment of texts themselves, but with the additional elements of also addressing the history and materiality of the objects on which they appear. Whilst there are no strong arguments beyond the idiosyncrasies of Assyriological philology as to why the EpiDoc Schema should not be implemented with the ETCSL data, the same reasons of sensible allocation of time in respect to potential outcome are the ones that would deter one from adopting the generic TEI standard. Since no clear benefit has been identified from the use of the EpiDoc standards at this time, the design decision not to implement these changes to the existing XML/TEI files has been made. The output of any system incorporating mORSuL will instead be as RDF triples (determined by the structure of the ontology, as explained further below). This is not to say that future research is unlikely to make use of EpiDoc (or similar XML-based tooling) – indeed, the opposite is true.

Sharing Ancient Wisdoms (http://www.ancientwisdoms.ac.uk/) combines both TEI/XML and RDF. This project is particularly interesting, as it too refers to a genre described as “wisdom literature”, although additional work is required in order to establish whether the two genres (those of the project and that of the ETCSL) are sufficiently similar, or merely coincidentally named so. Sharing Ancient Wisdoms remains of specific interest as one where data is in TEI/XML, but RDF is used for expressing relationships. In terms of Assyriology-specific projects that incorporate TEI, the recently launched Berkeley Prosopography Service (BPS) combines the TEI files of nine separate corpora. Some projects within the wider context of Digital Heritage have however gone a step further, and incorporated semantic technologies.

4.4 Ancient World Data and Semantic Technologies

There are a number of existing DH projects which incorporate semantic technologies such as ontologies. A review of these projects has led to the identification of three specific structures: the CIDOC CRM, Ontomedia (OM) and FRBRoo. These ontologies have been purpose-built to represent cultural heritage data, the narrative content and bibliographic details respectively, and together they form a complex (and somewhat cumbersome) core for mORSuL. These three ontologies are discussed in great detail below; for now, other projects to incorporate semantic technologies are discussed. These projects provide a context for mORSuL and can be considered a benchmark against which it is to be validated.

The Linked Ancient World Data Institute provides a comprehensive list of projects (http://wiki.digitalclassicist.org/LAWDI_2013_Websites). Some of these are worth specific mention here:

- The Europeana Data Model (http://pro.europeana.eu/edm-documentation) includes a separate OWL ontology, but one which is compliant with the CIDOC CRM. The class hierarchy of EDM ontology incorporates other already mentioned ontologies (SKOS and dc), as well as a number of other potential linking classes of entities (Europeana, 2012), such as `Event` (which equates to `E4 Period` in CIDOC CRM), `Place` (equates to `E53 Place`) and `Agent` (equated with `E39 Actor`), meaning that Europeana's data model could be used to enrich mORSuL-coded data with relative ease.
- Syriaca is a multi-institutional project hosted at Beth Mardutho, and collaborated upon by staff from Vanderbilt University, Princeton University, St. Michael's College Vermont and Texas A&M University. It is a project for the development of an online reference tool for Syriac studies: the system will incorporate a domain-specific ontology, multi-lingual authority files for standardizing references to authors, texts, and place names. This project's gazetteer will be based on Pleiades (see below). It is particularly interesting in the context of potential linking of Near Eastern data across chronologically continuous but academically disparate datasets.
- Pleiades (http://pleiades.stoa.org/) is a community-built gazetteer of almost 35,000 geographical locations from the ancient world. It is published under the Creative Commons Attribution 3.0 License (cc-by) and CSV, KML and RDF datasets can be downloaded directly. There is no

underlying ontological structure. As noted on the project website (http://pleiades.stoa.org/help/technical-intro-places): "Pleiades concepts are somewhat different from those of other conceptual systems in the cultural heritage and geographic information domains. The entity of the CIDOC Conceptual Reference Model (CRM) labelled E53 Place…[…]…is almost exactly equivalent to the Pleiades concept of Location. The Pleiades Place has no single equivalent entity in the CRM. Many places are localized (settlements, stations, temples and monuments) and have much in common with the CRM's `E27 Site`. Others like ethnic territories, areas of centuriation, or mining districts are rather different." In 2012, 54 geographical locations from Oracc data were added to the Pleiades gazetteer. [19]

- For prosopographical studies, Trismegistos (http://www.trismegistos.org/nam/list_all.php) was initially identified as a suitable project for future cross-referencing and interlinking during the 2013 meeting of the Linked Ancient World Data Initiative. In the twelve months that transpired between the meeting and the completion of this thesis, another, collaborative prosopographical project, SNAP:DRGN (Standards for Networking Ancient Prosopographies) has emerged (http://snapdrgn.net/about) .

The aim of these projects is to utilise the potential of semantic technologies to enable and facilitate scholarship regarding the ancient world, be that through mapping of places or people. Assyriological data could be added to enrich these projects (in deed it has, in the case of the aforementioned additions to Pleiades), but has not been the primary focus of any such project thus far.

[19] For the use of other gazetteers please see Chapter 7.

There are however a small number of ontologies which have been designed for and with Assyriological data in mind.

4.5 Assyriology and Ontologies

There are but two ontologies, which are based on and designed to represent content written in Sumerian: one for economic tablets, the other for grammar.

Ontology for Sumerian Economic Tablets

In his paper, Jaworski (2008) describes an application-oriented system, designed with a focus on Sumerian economic documents. The system includes an ontology for a selected branch of economic activities, with translations of the documents into a meaning representation language (mrl) by means of a semantic grammar. This mrl is constructed in a way that allows for the representation of the ambiguity caused by the writing system, our incomplete knowledge of the Sumerian language and any omissions in the text caused by damage to the original primary sources.

The content of the economic records is formalised and limited, and as such, does little to enable the querying of narrative structures. This ontology does not currently form part of mORSuL, but may be added as a part of future research (see Chapter 7).

Ontology for Sumerian Grammar

A study from 2006 by Epistematica used Sumerian as an example for representing natural language grammars using an ontology. Described by the authors as an “experiment”, (Alivernini, 2006:3), this OWL ontology nevertheless at first appears an ideal addition to mORSuL (implemented using Protégé: The .owl file is readily accessible and the dataset complements that of the ETCSL).

Alivernini (2006: 2) describes the ontology as consisting of two parts: the T-Box (Terminological Box) and the A-Box (Assertions Box), where the former is the Sumerian grammar, the latter contains the content of the texts. Although described as the authors as little more than an investigation into the possibility of mapping ancient grammars, some elements of the T-Box have meant that, as it currently stands, there are some reservations as to the suitability of this ontology to represent complicated grammatical structures of the Sumerian language.

In their documentation of the ontology, the authors have not declared the source material in which the ontology is based. This omission complicates the evaluation: some description beyond identifying one Ur-Nammu foundation brick text (consisting of eight lines) may help in the assessment of the reasons behind the relative simplicity of the relationships between classes, and the example plural used in the foreword (Alivernini, 2006: 2). Alivernini cites duplication of a word for the expression of a plural, giving the example: "**lugal** = king → **lugal-lugal** = kings" although this repetition of a word or part there of (the nominal base) is usually applicable to nouns which are not classifiable as people. One might have expected the plural for "king" to be expressed via the addition of the suffix **-e-ne** whereby **lugal-e-ne** translates as "kings", or alternatively a translation, which more accurately captured the meaning encoded in the repetition, i.e. **lugal-lugal** to mean "all the kings".

As a reflection of the uncertainty as to the suitability of this ontology to adequately capture the complexities of Sumerian grammar (as discussed in Chapter 2), this ontology by Alivernini, et al. does not currently form part of mORSuL. Any future development of mORSuL is likely to include the addition of a Sumerian grammar ontology, at which point this one will be revisited (see Chapter 7).

4.6 Existing ontologies for mORSuL

Three existing ontologies with a structure matching the data types of ETCSL have been identified:

- the CIDOC CRM, which acts as a bridge between the other two, and opens up ETCSL for potential linking with other cultural heritage data,
- FRBRoo (for bibliographic data), and
- OM (for the representation of the text content).

CIDOC CRM

The CIDOC CRM (www.cidoc-crm.org) is a domain-specific, event-based ontology designed for the representation of cultural heritage data. It has been an official ISO standard from 2006, and lists some thirty examples of extensions and compatible models, which have been launched since. The purpose of the CIDOC CRM is to establish a common framework for the sharing of data between GLAM institutions (galleries, libraries, archives and museums), and to function as an example of best practice in the cultural heritage domain.

A number of other tools have already been incorporated into the CIDOC CRM. These include the vocabularies and ontologies of Dublin Core (dc), SKOS (Simple Knowledge Organisation System) and FOAF (Friend of a Friend), with available extensions (CIDOC-EH, CIDOCdig and the British Museum Ontology (BMO) further enabling the representation of archaeological data and processes, the provenance of digital artefacts, bibliographies and the British Museum’s collections (respectively). All of the above provide opportunities for linking to other data streams.

The CIDOC CRM is a large and complex ontology consisting of 90 distinct entities and 149 property declarations (Crofts, et al 2011). It is extensively documented, which makes the identification of suitable classes and properties easier – however, the focus of the structure is to map cultural heritage information or details regarding the biography of a given object, but neither is available directly through ETCSL. The CIDOC CRM alone is thus insufficient for the representation of the project data, but it is crucial in its role as linking FRBRoo and OM, as well as enabling possible future data exchange with other digital heritage projects, such as ResearchSpace (http://www.researchspace.org). Furthermore, one immediate future potential is clear: the CIDOC CRM allows for the differentiation between the text content, and the object that carries it. This aspect may become very useful for mapping the content of composite texts to their original witnesses (which could then be identified in another data set, such the CDLI).

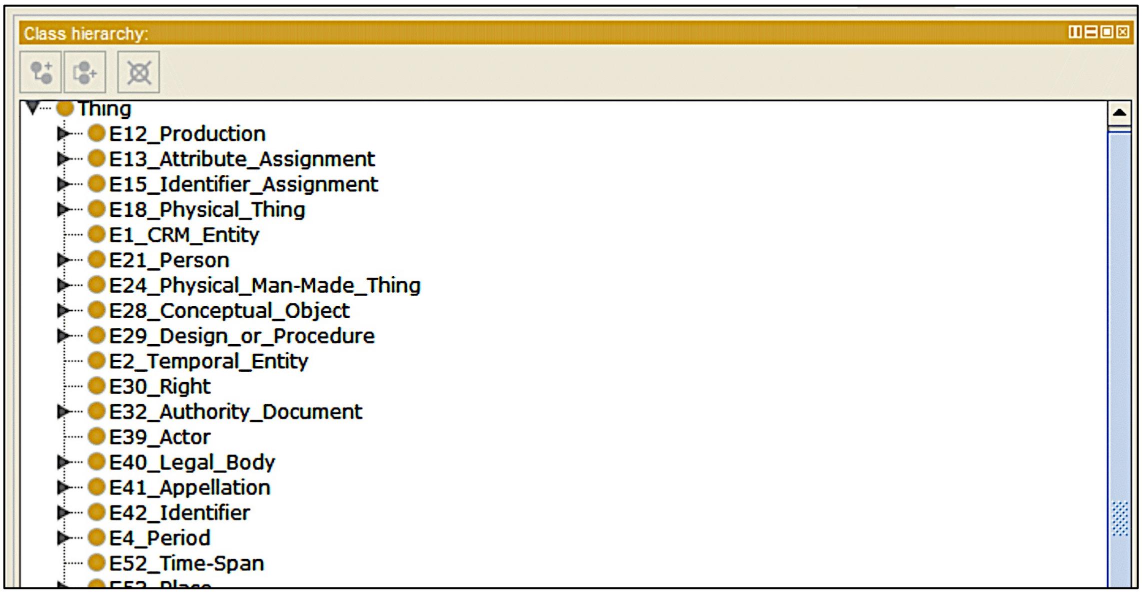

Figure 16 Some of the many classes of the CIDOC Conceptual Reference Model, here displayed in Protégé.

Chapter 4

FRBRoo

FRBRoo (http://www.cidoc-crm.org/frbr_inro.html) is a formal ontology for the representation of bibliographic information, specifically designed to merge with the CIDOC CRM and to thus facilitate the integration of museum and library data. It is based on the FRBR (Functional Requirements for Bibliographic Records). Originally designed as an entity-relationship model, FRBR was developed independently of CIDOC CRM, but coincidentally at approximately the same time (1991 – 1997). It was designed by a group appointed by the IFLA (International Federation of Library Associations and Institutions), and approved by IFLA Cataloguing Section in 1997.

In 2003, an international working group began to examine the potential of merging FRBR with the CIDOC CRM; the first draft of FRBRoo was completed in 2006, with the official publication of the version 1.0 at the end of 2009 (Le Bœuf, et al, 2010), which was approved and issued by January 2010 (Bekiari, et al 2013).

Unlike the CIDOC CRM, FRBR models products, not processes. It is smaller and less complex, with 52 entities and 64 properties (cf. 90 entities and 149 property declarations). The process of merging the two existing structures necessitated changes in both, resulting in changes to the CIDOC CRM ISO standard (Bekiari, 2013: 11). The combination of FRBR and the CIDOC CRM brought about FRBRoo – a new, object-orientated mapping. The process was one of extensive merging: FRBRoo is referred to in 60 CIDOC CRM classes and in 55 properties.

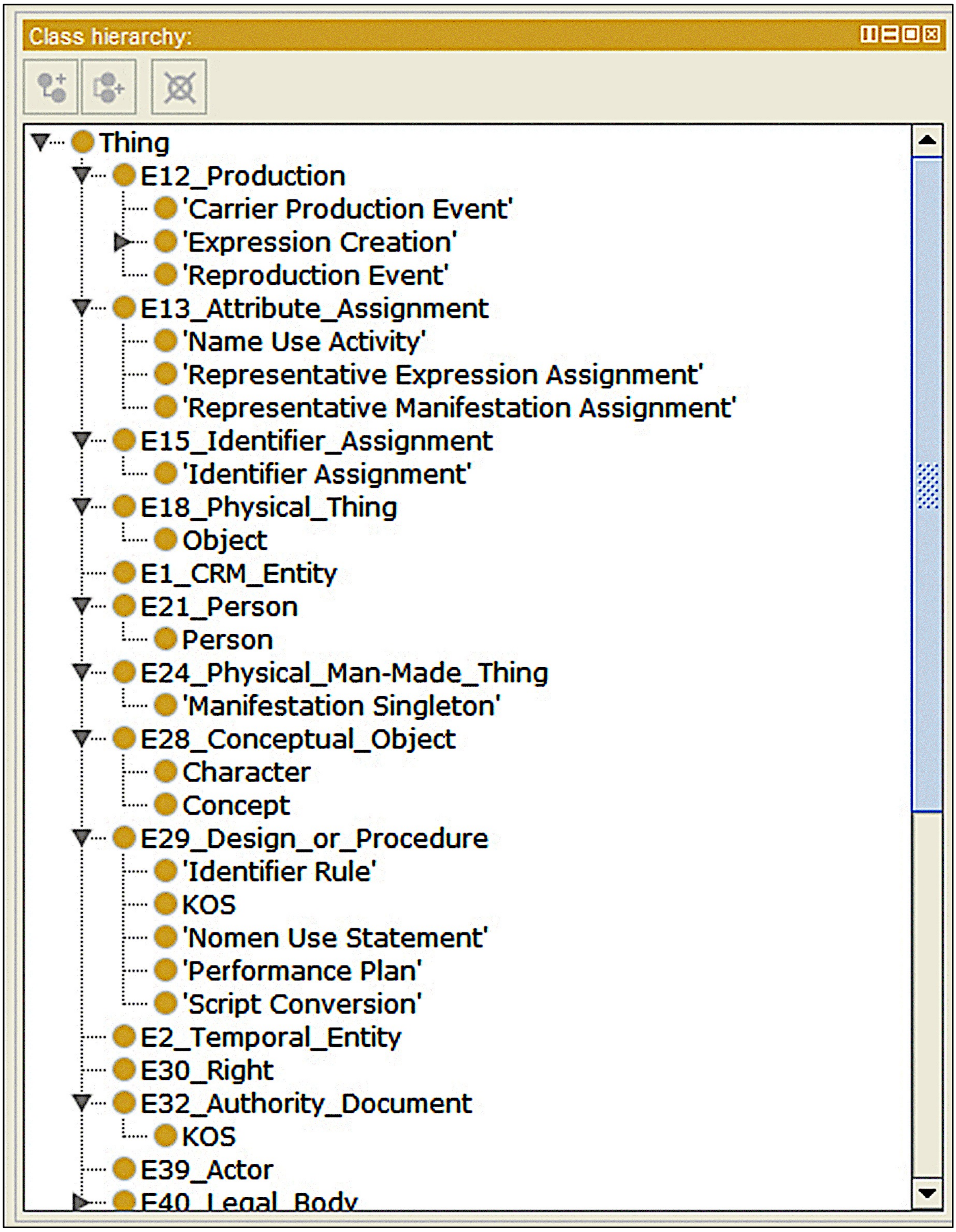

Figure 17 Some of the FRBRoo classes and properties, as displayed in Protégé. Illustrating how both CIDOC CRM and FRBR have contributed to FRBRoo.

The international working group for FRBRoo cite the complementary and interlinked nature of bibliographic and cultural heritage data as the incentive for the project:

> "Libraries and museums are memory institutions – both strive to preserve cultural heritage objects, and information about such objects, and they often share the same users…the boundary between them is often blurred…the cultural heritage objects preserved in both types of institutions were created in the same cultural context or period, sometimes by the same agents…it seems therefore appropriate to build a common conceptualisation of the information gathered by the two types of organisations…" (Bekiari, et al, 2013:11).

An example of the use of CIDOC CRM and FRBRoo for the representation of data related to ancient material is the British Museum's project for the digitization of Mosher's work on the ancient Egyptian *Book of the Dead* (Oldman and Norton, 2014). This project does not however appear to represent the content of the ancient composition, and thus differs in this crucial aspect from the research agenda discussed herein.

Ontomedia

Ontomedia (OM), like the CIDOC CRM, is event-based. It focuses on the representation of the narrative in multi-media and has been designed as linkable to the CIDOC CRM (Jewell, et al, 2005). The aim of this ontology has been described as the enabling of the human-like, vague questions, enabling searches to identify a given story, as well as facilitating comparative studies between compositions (Lawrence, 2008).

Ontomedia (OM), unlike CIDOC CRM or FRBRoo, is not a widely utilised ontology, nor has it been awarded ISO (or equivalent) status – the first version was the product of a collaboration of postgraduate students at the University of Southampton as part of their doctoral theses, and since then, the .owl files which constitute OM have been accessible online (e.g. https://code.google.com/p/contextus/source/browse/trunk/ontomedia/ext/common/bestiary.owl) . It has recently been using in conjunction with the Brat annotation tool (http://brat.nlplab.org/index.html) , and used as an educational tool at a Digital Research in the Humanities and Arts 2014 conference workshop (Lawrence and Nurmikko-Fuller, 2014).

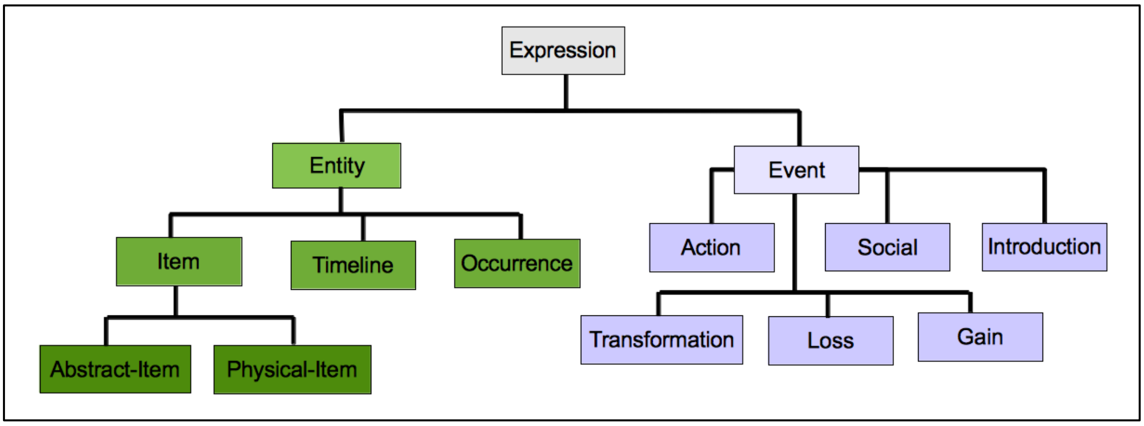

Figure 18 Ontomedia Expression sub-ontology, which consists of different types of entities, and events. For full-size image, please see Appendix G.

The aim of OM is to represent the narrative content of heterogeneous media (Lawrence, 2008). Although described as an upper level ontology, a more oxymoronic definition may be more accurate: OM may be an upper ontology, but it is an upper level ontology of a niche domain (narrative in fiction). It was based largely on two interlinking topics:

- The literary genres of fantasy and science fiction, and
- The fan-fiction, which was associated with them.

Whilst many of the generic entities of fictional narratives are included, OM also incorporates a number of additional classes, which are a specific reflection of the data it was originally designed to capture. The fandom audience is seen in the inclusion of the nested subclass `Online Account` for `Being`, the origins in science fiction genre from the class `Void-Travel` (for "travel between dimensions or through mystic/sub-reality realms, wormholes or other similar constructions"), and the inclusion of `Space-Travel` in `ome:Action` (Fig. 19). The contribution of the fantasy genre is particularly clear from the `Bestiary` (subclass of `Common`), which includes classes such as `Pegasii`, `Unicorn` and `Faerie` - some classes are specific not only to genre but also to the works of a specific author (`Hobbit`).

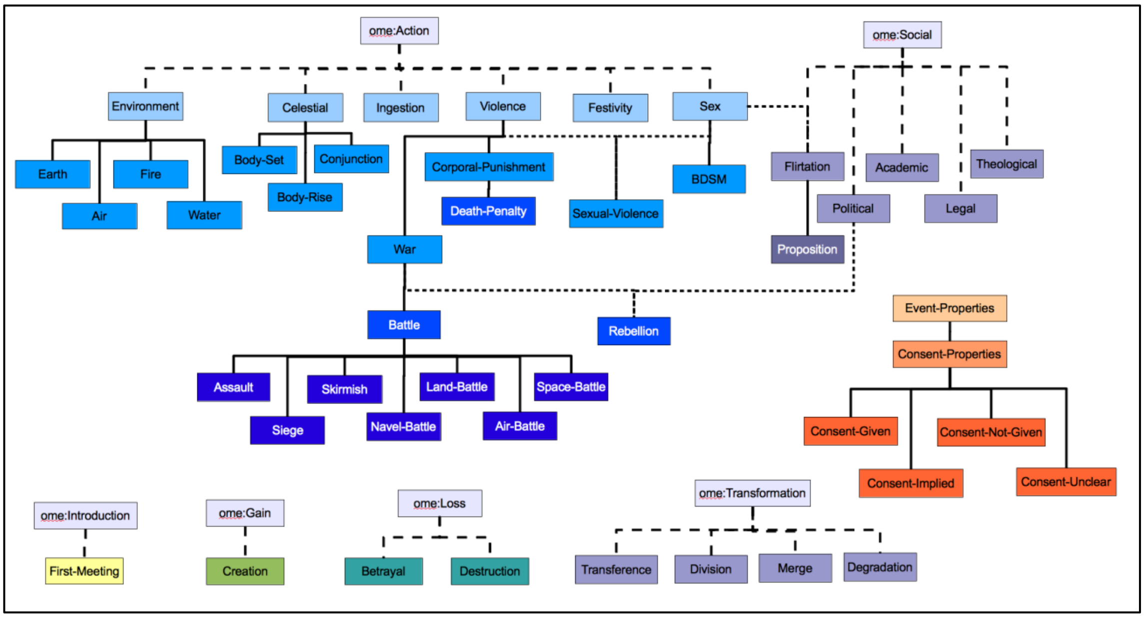

Figure 19 Ontomedia Event sub-ontology, which consists of actions, social things, events, and additional class clusters. For the full-size image, please see Appendix G.

The use of OM is affected by the seeming lack of extensive, clear and systematic documentation of the classes and properties. Information available through http://www.contextus.net/ontomedia is limited to descriptions of some (perhaps arbitrarily selected) classes, and none of the properties are discussed or indeed listed. Other sources, which discuss the structure of OM (Lawrence, 2008) are now noticeably out of sync as development and editing has continued without appropriate documentation being maintained.

The design decision to construct OM from multiple sub-ontologies further complicates the structure: classes of OM can (and often do) repeat across different sections and sub-ontologies. Furthermore, the design of OM is essentially based around nested subclasses, with numerous instances of a subclass where perhaps an alternative would have been to make use of a property of an instance (the various subclasses for `Faerie` in the aforementioned `Bestiary`, for example). The combination of the reliance of nested subclasses in the structural design of OM and the repetitive nature of classes even within a subontology are illustrated by `Trait`, which both simultaneously contains and is the superclass of 51 classes (and additionally a superclass of a further seven), as illustrated by Fig. 20. Another example is `Person≡Person≡Person` in `Being`, where one is `foaf:Person`, and the other two are nested classes of OM repeated within separate subontologies.

For all this complexity and lack of documentation, OM facilitates the representation of the content of texts in ways that CIDOC CRM and FRBRoo cannot. It enables queries such as:

- “Which years of Ur-Nammu’s reign were peaceful?”, or
- “Who was that king who claimed Gilgameš as his brother?”, or
- “What is that story where a man builds an ark to survive a colossal flood?”.

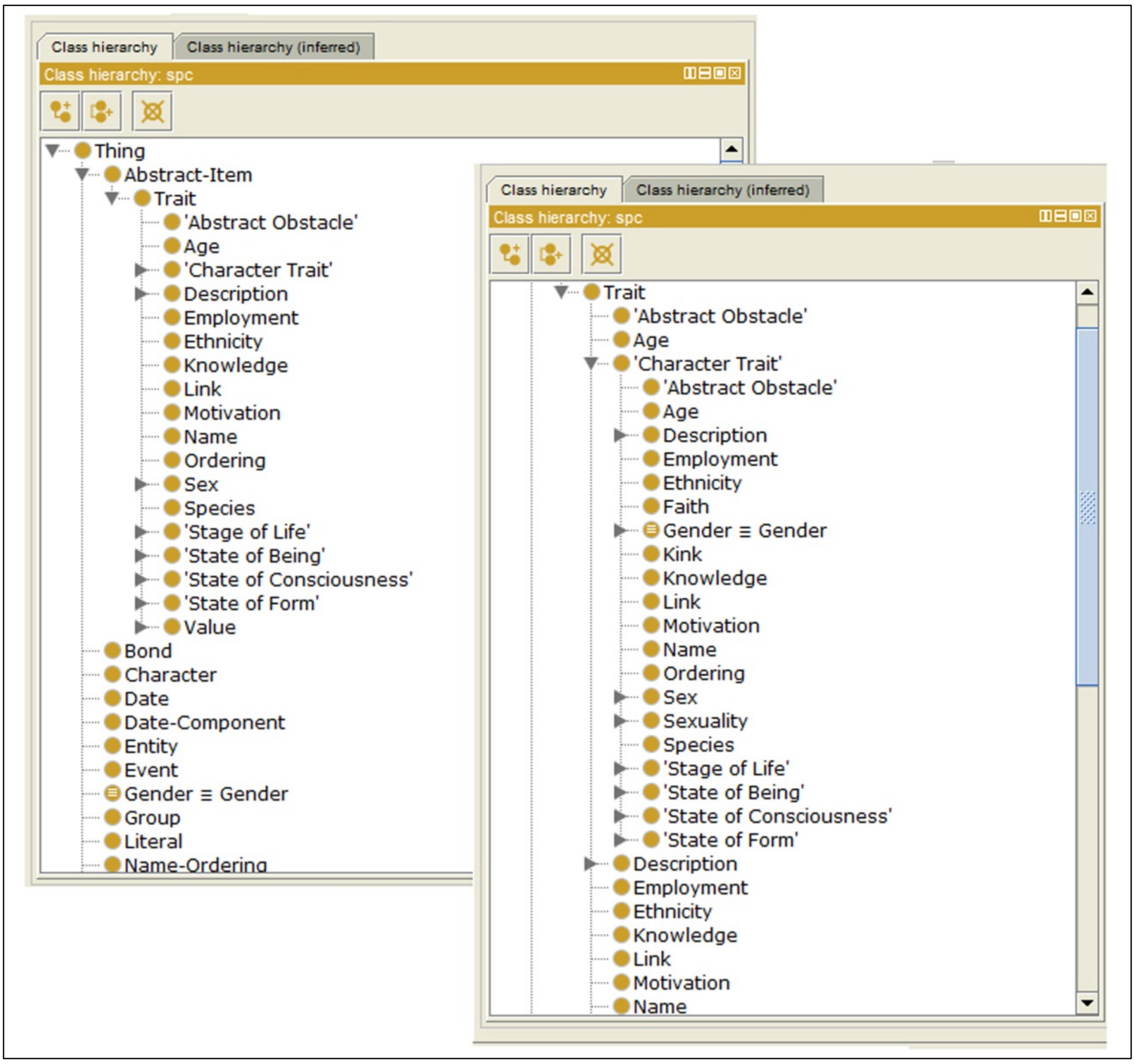

Figure 20 Ontomedia Trait and Character-Trait sub-ontologies as displayed in Protégé.

These are questions that are not impossible for a human scholar to answer, but which may require an extensive knowledge of the subject matter and the ability to infer the correct answer from data amalgamated from a number of different sources. Unless in a purposely-built relational database designed to specifically provide solutions to this type of query, the system cannot answer such a question directly. Even in the case of online publication, if data is not semantically tagged or expressed in a machine-readable format, the only way to provide the user with the correct answer would require that it already exists, collated and published on a website. Similar wording and the ranking of the site high in search results are also necessary in order for the information to be conveniently and efficiently found by the user.

The point can be further illustrated by a closer examination of the final example. A well-known and recognisable motif in world literature (appearing in the mythologies of at least three major religions), the benefit of an automated system capable of inferring such parallels might be difficult to show. Consider however the benefit derived by the user first encountering these parallels, and the possibility of bringing to light similar (but currently unknown) stories from other cultural contexts beyond those of the Middle East.

The benefit of semantic technologies in this instance is two-fold: known connections (known knowns) can be found and presented with shorter demands on time, and new connections (unknown unknowns) can be brought to light. Connections can also be drawn within multi-disciplinary datasets – for example the soil sample data collected by Pournelle, which helped provide context for Finkel's (2014) examination of the most recently discovered copy of the *Atrahasis Myth*.

The benefit of combining OM, CIDOC CRM and FRBRoo has already been noted by Lawrence (2008), who cited the top-level similarities between CIDOC CRM and OM as a deliberate design choice to enable the bridging of the two. mORSuL can be considered to occupy the space where all three existing ontologies overlap.

4.7 Conclusion

The SW and LD have been heralded as the next step in the evolution of data publication and data exchange on the Web, a move away from a Web of Documents. The benefits of doing so are myriad: information can be collated from diverse sources and knowledge is enriched; automated inference of implicit facts is made possible, as are bidirectional links between resources. For a discipline such as Assyriology, and the subset of literary Sumerology in particular, adopting these methodologies and publication paradigms could bring about a new form of scholarship – albeit one which has been discussed, longingly, since at least the onset of the ETCSL project.

There are a number of existing tools within Digital Heritage (DH) and the wider scope of both Web Science and Computer Science, which could be used for the publication of ETCSL data. A comprehensive review of online and digital resources has illustrated the potential that already exists in terms of interlinking and cross-domain enrichment of data, and projects from other corners of the DH world can be cited as examples to support claims as to the suitability and usefulness of semantic technologies to represent ancient data. At the same time, a review process of these technologies has highlighted the absence of existing projects that fully (or even partially) engage in publishing content as LD, although there is undeniable potential in the data and a precedent from similar projects within DH.

Whilst some existing tools might require customisation in order to fully capture the types of information literary Sumerologists might wish to uncover, the lesson-learnt from the existing (but currently disregarded) TEI files for ETCSL is that extensive customisation can affect the longevity and suitability of the end product; highly domain-specific ontologies even when designed for

Sumerological data are of little use in mORSuL as they represent the content of a different genre. At the same time, sufficient complexity and niche-specificity are required of any new development, to justify the creation of new systems and ontologies rather than adopting (and adapting) existing models.

Many of the known projects in DH have begun in or rest within the sphere of the Classics. Although much of the data from the ancient world is similar, the idiosyncrasies of separate subdomains of the scholarly pursuit of Ancient History mean that often a point of incompatibility is reached. Such issues rise partly due to the heterogeneity of various datasets, partly due to the differences in research methodologies, aims and paradigms. The differences between the philological conventions for Classics and ancient Near East (as illustrated in Appendices B and C) are a case in point from the sphere of literary analysis, and they find their parallel in the incompatibility of EpiDoc and TEI with cuneiform materials. With projects such as SNAP:DRGN and Pleiades, however, it seems that this interdisciplinary chasm may eventually be bridged with the help of semantic technologies and collaborative scholarship.

An extensive review of available technologies and projects has provided a context for understanding the ETCSL as an innovative, TEI/XML utilising and customising project. It has helped highlight the possibilities of RDF and semantic technologies, as well as bringing to the foreground those ontologies that are believed to be best suited for the representation of ETCSL data.

Chapter 5: Ontologies for ETCSL data

5.1 Background

The use of semantic technologies to represent the content of ancient texts can help shed light on the accuracy of composite texts and their relationships to witness tablets. Narrative representation enables queries which stretch beyond a character-matching search or the Vocabulary-Management Profile (VMP) experiment (Ebeling, 2007), which can be cited as one of the first, if not the first, examples of the use of computer-assisted research agendas to the study of ancient Sumerian literature. Furthermore, the VMP was an example of the use of computer technologies to analyse the narrative structure, focusing on mapping of the appearance of new lexical items in the text as a sign for a change on scene, setting, register or the introduction of new characters. In many ways a success, the VMP was however unable to provide results of much granularity, finding five distinct sections in a composition of 726 lines (Ebeling, 2007:45). This early system could do little in terms of the capture of semantics, and the resulting graph is a representation of the frequency of words with no meaning attached to these strings of characters.

As has already been noted, the ETCSL was pioneering within Assyriology for many reasons, including the decision to export and store data as XML. The extensive customisation of the TEI P4 has, however, effectively created a gilded cage, the data siloed and separated into the storage of the Oxford Text Archive (http://www.ota.ox.ac.uk). Whilst it is possible to download and search the data, and to access the composition though the ETCSL web-interface, research questions are by necessity limited to keyword searches with Boolean operators.

With the introduction of sematic technologies, however, a new type of question, one of greater complexity, becomes possible. Answering these types of searches will necessitate accessing data from several separate sources. Assyriological examples might include:

- How did the depiction of Inanna/Ištar change over millennia across Mesopotamia?
- Are there characteristics that are shared by the main protagonist across all or most literary compositions?
- Do certain narrative structures repeatedly occur in the history of the literary canon?
- Which Mesopotamian narratives are repeated in the traditions of other cultures (the Hittite, or Biblical texts)?

Finding the answers to these queries is not beyond the scope of human scholarship, as any researcher, given sufficient time and access to the necessary resources could provide the answer. An automated system with an ontology such as mORSuL could however help reduce the time taken to achieve the answer, increase the scope of research agendas, and potentially bring to light other, supporting and complementary information, which might be overlooked by a human scholar. The potential of such expert systems and online publication is essentially two-fold: known knowns (connections, parallels) can be collected for analysis at a greater speed and efficiency, and new, previously unknown examples can be brought to light.

The process of mapping ETCSL content using ontologies was one of identifying commonality between the available data and the needs of the professional community of Sumerologists. The process consisted of three steps:

Firstly, the data types were assessed, and were concluded to consist of philology (annotations, for example), the literary narrative content of the composites texts and the bibliographic data of those academic publications that discuss a given text.

Secondly, the query types and general research paradigms of the Sumerological community were assessed, based on conference topics and paper titles (ASOR, RAI) as well as journal articles (JCS, JNES, CDLJ). The majority of recent topics in the philological field were found to have fallen into at least one of three main categories:[20]

- Semantics of individual lexical items (examples such as Civil, 2013; Firth, 2013; Steinkeller, 2013),
- Analysis of features or lexical items occurring in specific genres and text types (cf. von Dassow, 2012; Samet and Adali, 2012; Firth and Nosch, 2012),
- Prosopographical examinations of social and economic groups via the analysis of the cuneiform material that refers to them (e.g. de Boer, 2013; Stępień, 2012).

Thirdly, hypothetical user-scenarios were created for the different types of queries users (be they scholars, enthusiasts or novices) might generate. These examples range from simple key-word searches to ones based on specific character and event types.

[20] Much of the background to this philological analysis necessitates an understanding of the socio-cultural and historical context in which these texts were created, which is also reflected in the content of these papers and articles.

5.2 User scenarios

Following the example set by Clark and Chalmers (1998) with Inga and Otto, three hypothetical examples of different queries have been created to reflect the needs and abilities of users. These range from a clearly defined search of a lexical item (in this case, a fictional or semi-historical character) to one based on a combination of character type and associated event, to an identification of a specific text based on the vague description of part of the content of the story. The discussion is limited to the type of query and the required complexity of the system, with an assumption that the skills and prior knowledge of literary Sumerology of the user are not in a position to directly influence the research topic.

The relationship between the increasing complexity of the system and that of the query has been mapped out as seen in Fig 21. Here, the x-axis maps the type of query needed, for example, a basic one might only contain DESCRIBE whereas a more complicated one might also include FILTER. The palest box (one closest to the origin) would require a basic keyword and could be accomplished by a simple matching of characters. The next of level of difficulty would necessitate the querying of the system in more complex ways. The increasing complexity of the system is similarly mapped on the y-axis.

As the distance from the origin increases, so does the complexity of a given task: in order to successfully complete the query and provide the right (or suitable) answer, both query and system must have a sufficient level of complexity. This is represented with the increasingly dark colour of the boxes. Whilst those three closest to the origin (the palest) fall within the remit of current search engines and the level of inference possible within, for example, Protégé, the darker squares represent an idealised case scenario (a case of "if only" or "what if.."), and are beyond the scope of the ontological structures and software used in this thesis.

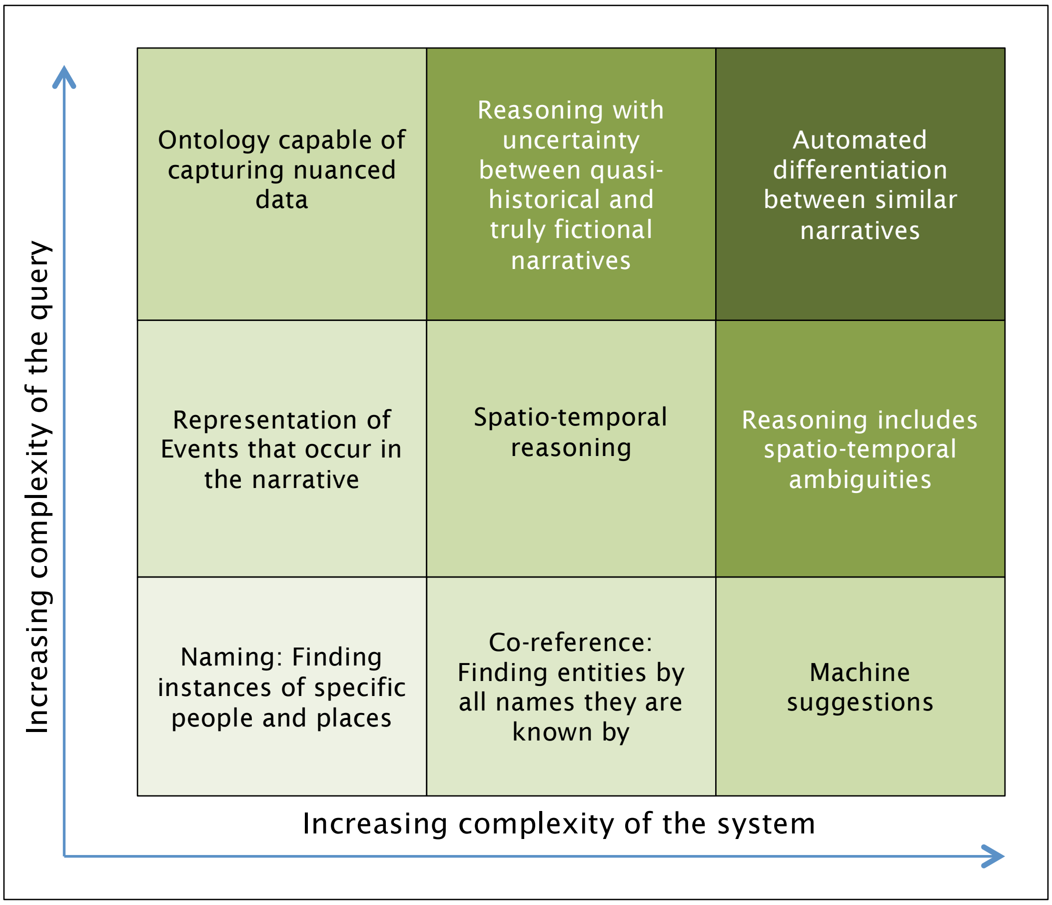

Figure 21 Generic mapping of the increasing complexities of both the hypothetical system, and use case queries.

Three different user cases have been designed with the aim of reflecting different types of genuine, existing research topics within literary Sumerology. These queries mirror those that were outlined earlier; the only deviation from this is with regard to the final category (prosopographical analysis). The uncertainty as to the relationship between scribe and a literary composition renders this type of query less suitable, and more unlikely, for literary pieces (cf. economic texts, sales receipts, contracts). Another type of query, more in line with the aim of focusing on narrative literature, has been generated in its place (user case 3). These queries were used to inform and evaluate mORSuL – they are further discussed in the latter capacity in Chapter 8.

User case 1

Anna is querying "Gilgameš".

Query

The query is essentially a keyword search. At its most basic, it is little more than matching strings of characters. It is here that the /š/ presents some issue, as there are at least three ways to transliterate the name of this epic hero: Gilgameš (Unicode transliteration and translation in ETCSL), Gilgamec (ASCII transliteration and translation in ETCSL) and Gilgamesh (alternative spelling utilised in many translations (see for example George, 1999). For the ETCSL search function, the appropriate query term is "gilgame&c", for another, it could potentially be "Gilgamesh". The simplicity of the query means that the quality of the results is directly related to the complexity of the system: ideally capable of co-referencing, equating any search of "Gilgameš" with the five earlier Sumerian poems, which mention "Bilgameš" (an earlier version of the eponymous hero's name, which also appears in Sumerological research). Translations aside, another useful feature might be the capture of the various possible cuneiform combinations for the spelling e.g. **GIŠ.NE.PAP.GA.MES/ ^{d}GIŠ.BIL$_{2}$.GA.MES/ GIŠ.šeššig.GA.MES/^{d}GIŠ.NE.PAP.GA.MES/ ^{d}GIŠ.BIL$_{2}$.aga$_{3}$.mes/ ^{d}GIŠ.NE.GA.MES/ ^{d}GIŠ.BIL-seššig.GA.MES/ ^{d}GIŠ.BIL.GA.MES/ ^{d}GIŠ.NE-šeššig.GA.MES** (Rubio, 2012). It is worth noting that lemmatization can help some of this issue of co-reference (that is to say, more than one string of letters and characters denoting one specific entity), and other projects such as Oracc have dealt with the issue by aligning citation forms, and the user sees only the canonised version. However, the true potential of using semantic technologies comes in their ability to diversify the range of sources, which could be considered. The user would, for example, benefit from recommendations to view other relevant sources, such as the Akkadian (***Šūtur eli šarrī*** (*Surpassing all other kings*) and ***Ša naqba īmuru*** (*He who saw the Deep*)) and Hittite versions of Gilgameš, which are beyond the remit of the ETCSL and would require information from data streams which are external to it.

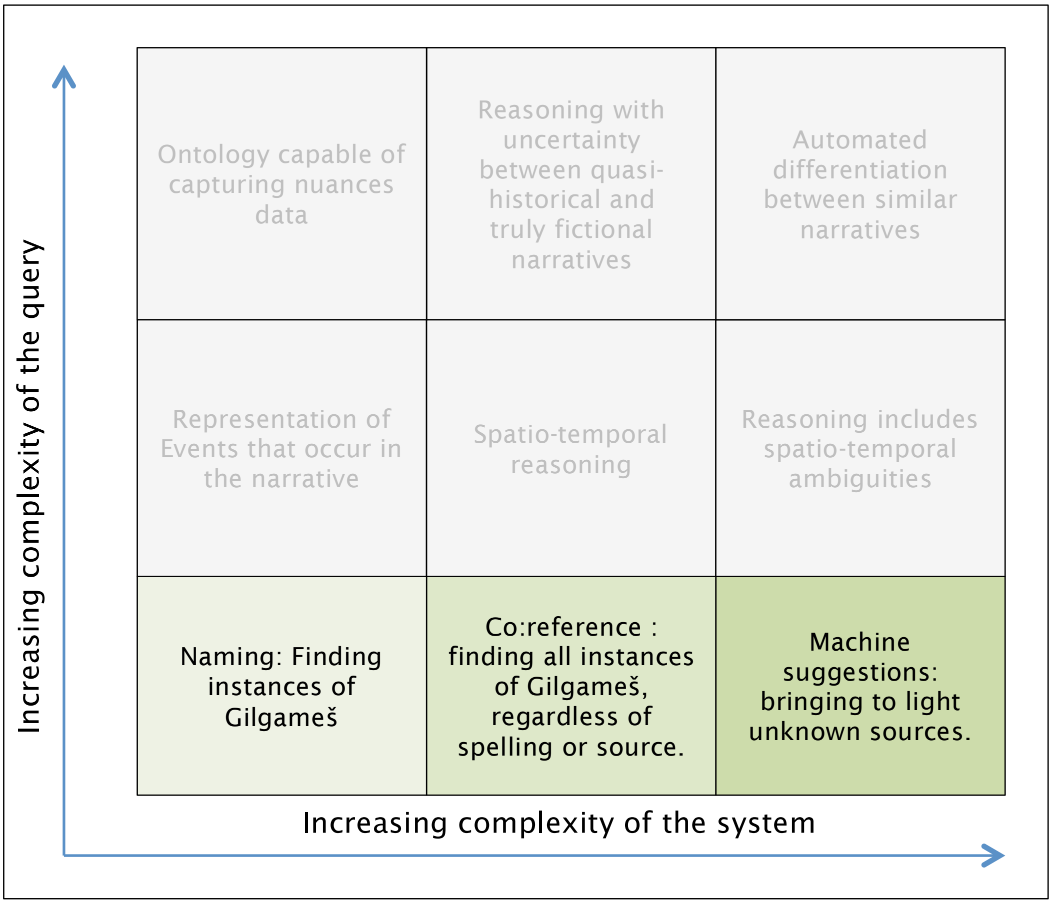

Figure 22 Use case 1: Querying Gilgameš – mapping the parameters of system and query complexity with specific examples.

The quasi-historical nature of Gilgameš would also be reflected in the search results. A supposedly genuine king of Uruk in the 3rd millennium BC, he appears, deified, in the *Sumerian King List* from c. 2600 BC (George, 2010) as well as in compositions classified as historical pieces (*the history of Tummal*; *the victory of Utu-hegal*), and is claimed as brother (in praise poems) by both Šulgi and Ur-namma.[21] A simple search term can thus return related content and information about the queried individual in many different contexts. If the aim were to return only those texts where the named character is the protagonist, a more complex query is required (see user case 2).

User case 2

Bob is interested in narrative features, which involve a specific type of protagonist. His query focuses on instances of battles involving demons and other non-human characters.

Query

This query is more complex than a keyword search for a specific character name, because Bob wants to find all instances of a particular type of event (all battles) involving all possible types of divine or super-natural being; deities, demigods, demons. A keyword search would be limited to just instances where the text includes the word (e.g.) "demon", or he would have to limit his searches to those entities he already knows (perhaps An, Enkidu, asag). In order to return comprehensive results, the ontological system would benefit from having a class, which included each instance of non-human, but sentient characters (including entities such as the Anuna, the seven judges, from *Inana's Descent to the Netherworld*). It would also include the ability to find

[21] Both rulers of the Ur III period (also known as the Third Dynasty of Ur). For a timeline of ancient Mesopotamia please see Appendix A.

named entities to return those texts where unnamed demons play a role (*Dumuzid's Dream*).

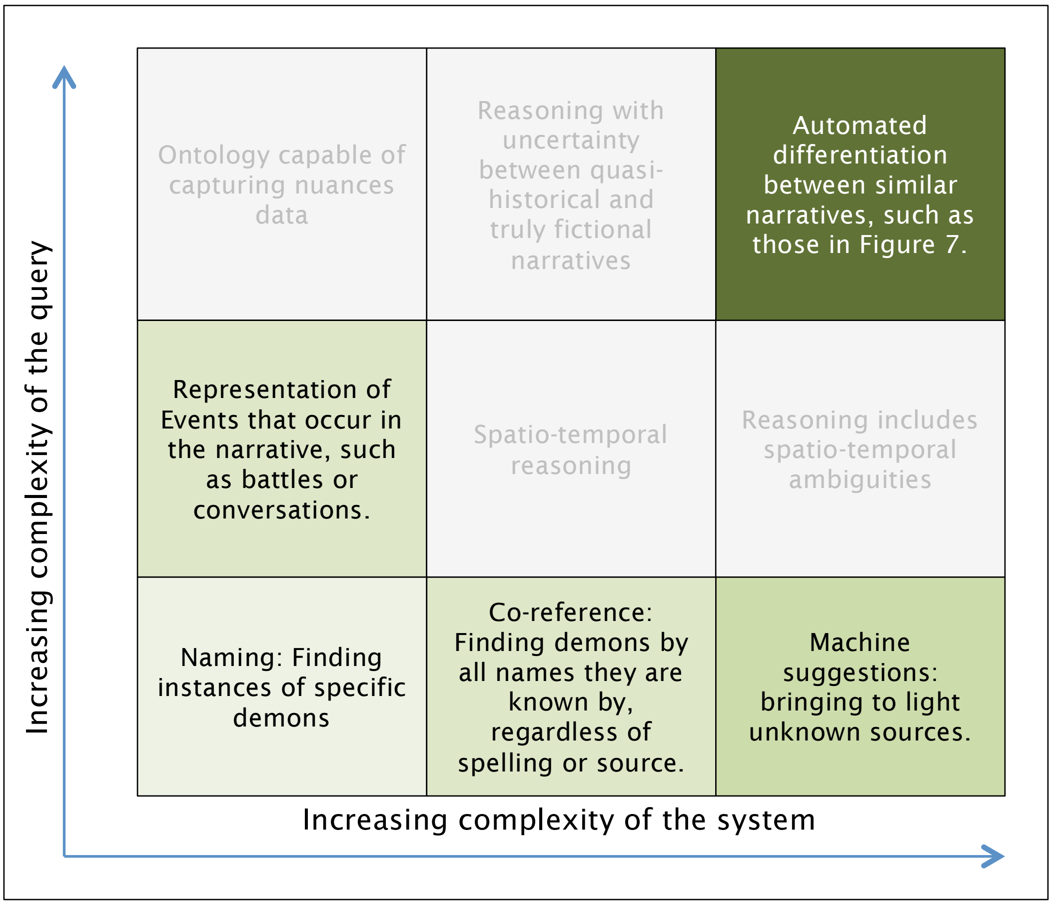

Figure 23 Querying for battles, which feature demons and other non-human protagonists – mapping the parameters of system and query complexity with specific examples.

As the query was not limited to finding every instance of a specific type of character, a filter is needed to exclude those search results, which would include a demon, deity or demigod not engaging in battle. A system capable of identifying specific events within the narrative is required, as is sufficient knowledge of the ontology by the user (in order for them to formulate an appropriate query). A user unfamiliar with SPARQL would undoubtedly benefit from an interface with additional support (such as dropdown lists) – even those familiar with it will need access to extensive documentation regarding classes, properties and the ontological structure as a whole.

Since the aim of the query was to cast a wide net, any differentiation between the compositions or the identification of a specific narrative remains a (manual) task for the user.

The results returned from this type of query will contain instances of demons, and a specific type of event. Although more complex than a keyword search, it does not capture the full potential of an expert system and an ontological structure within that system to capture and reason with vague data. Such in-built ambiguity of the research question is reflected in the third and final user case, which aims to find examples that share a similar narrative, although from different contexts as well as cultures, temporal periods and genres.

User case 3

Casey is interested in the comparative analysis of those compositions in which a man asks a woman for advice.

Query

This query is more in line with the types of questions that humans might ask one another. It is not entirely dissimilar from the example provided by Hendler in 2005, which is cited in www.contextus.net/ontomedia as a "type of query commonly used between people and which the semantic web might also be able to understand". His example is from the domain of popular culture:

> "What was that movie with the short henchman who decapitates a statue with his bowler hat?"[22]

An equivalent lengthy question or query is not currently possible on the ETCSL; using the phrase "Compositions where a man is advised by a woman", no results can be found by the ETCSL's current (character-matching) search. When simplified to the single term "advice", the search returns a list of no fewer than 51 paragraphs, spanning 39 different compositions, which the user must then sort manually to identify relevant compositions. Of these, the majority are hymns, letters, proverbs and prayers, and thus fall outside the remit of "Wisdom literature". For this reason, they have not been considered as relevant results for the query in the context of this thesis.

Within the ETCSL there are two compositions, *Marriage of Martu* and *Enki and Ninhursaga*, which include such an advice-giving event (albeit in the case of the latter, between a female and male deity, not a person). These texts are not, however, strictly a suitable answer for Casey's query, because although they are instances of a female giving advice to a male, it is unsolicited. Similarly, proverbs which include instances of women (often the slave-girl) giving advice, may be a piece of social satire, or a critique issued by a man, forced to listen to (and perhaps even heed!) unwanted and unsolicited counsel.

There are two Sumerian compositions that are known to share this element exactly: *The Three Ox-Drivers of Adab*, and the *Old Man and the Young Girl* (Gadotti, 2014: 66).[23] In order to represent the ontological structure must represent the content of the text, and the query needs to capture the direction

[22] *Goldfinger*.

[23] The latter is not part of ETCSL, and any queries, which would enable a comparison between them, would have to have to include results from beyond this dataset.

of advice given (female to male) as well as that it was requested, and not unwanted, advice.

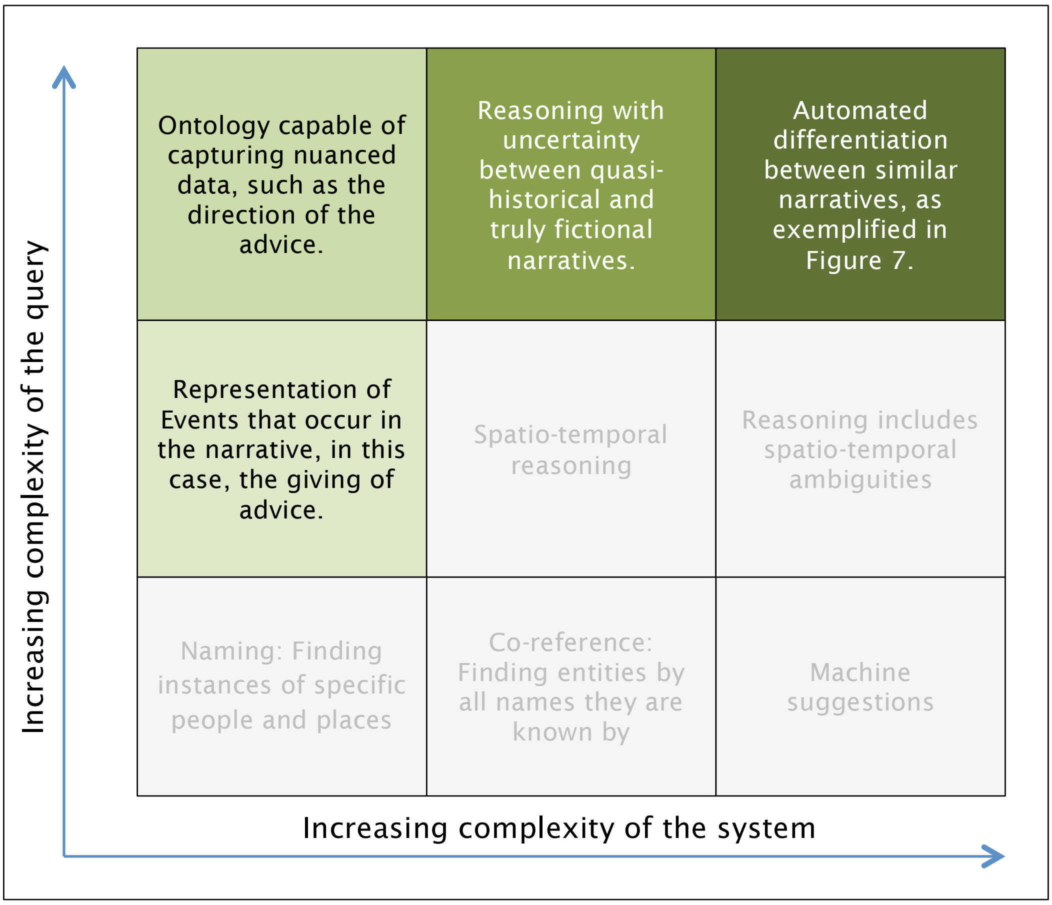

Figure 24 Requirements for an automated comparative analysis of compositions – mapping the parameters of system and query complexity with specific examples.

5.3 Representing ETCSL data in an ontology

The non-textual data published by the ETCSL consists of:

- Full catalogues, for translations and transliterations of the composite texts;
- Glossary of terms;

- Glossary of **eme.sal**;
- List of proper nouns (royal, divine, personal, temple, geographical and watercourse names);
- Sign list[24] (based on, but deviating from, Borger, 1988);
- Print sources (abbreviated bibliographic citation, linked to a text-only list of full references);
- Electronic sources (an abbreviated citation, with no link to the resource mentioned, nor to a full reference);
- Object number(s) for the cuneiform sources and a list of lines which relate to the transliteration, but no link to the record online), and a
- Revision history.

A hypothetical ontology representing these elements, SuLO (Sumerian Literary Ontology) was designed but not implemented. The aim was to identify those classes and properties, which were essential, *as a minimum*, in order for a structure to be considered suitable for the representation of Sumerian literary narratives (as published on the ETCSL, exclusively).

The lifecycle of ontology-development consists of six steps, regardless of the chosen methodology. These are:

1. Specification, when the reasons and aims of the ontology are assessed and determined,

[24] The Unicode characters of the Sign list were omitted from the elements represented in SuLO because they are disjoint from the transliterated text.

2. Conceptualisation, where the structure, classes and properties are planned out (for SuLO, this part was completed without specialist software),

3. Formalisation, whereby those ideas listed in the previous steps are realised in a model, and the hierarchy of concepts is defined,

4. Implementation, which requires the selecting of the language (e.g. RDFS, OWL), the editor software (e.g. Protégé), and the reasoner (FaCT++),

5. Evaluation, whereby the ontology is tested against SPARQL queries or through an online validator (e.g. WC3 RDF validator), and

6. Documentation, where information regarding the design decisions and the rationale are outlined for the benefit of other users.

Many of the potential pitfalls of ontological engineering can be avoided or compensated for by sufficient documentation. The extensive scope notes provided by the CIDOC CRM and FRBRoo help minimise the difficulty of implementation and confusion resulting from ambiguous terminology. Both these ontologies (as well as OM) were discussed in greater detail in Chapter 4. Only the first two steps of this six-step cycle were completed for SuLO, as these were sufficient in order to realise, record and compare the new structure to the existing ontologies, leading to the conclusion that many of the necessary classes were already present. The process for specification and conceptualisation of SuLO has been divided into three stages.

Stage 1

The first stage was the representation of the annotations and the transliteration (lines of translated and lemmatised words), the latter of which was seen as a manifestation of the composite text (see Chapter 3). In addition to word-by-word translation, the translation of groups of lines as they appear in the English translations (paragraphs consisting of prose) on the ETCSL was also mapped (see Fig. 25).

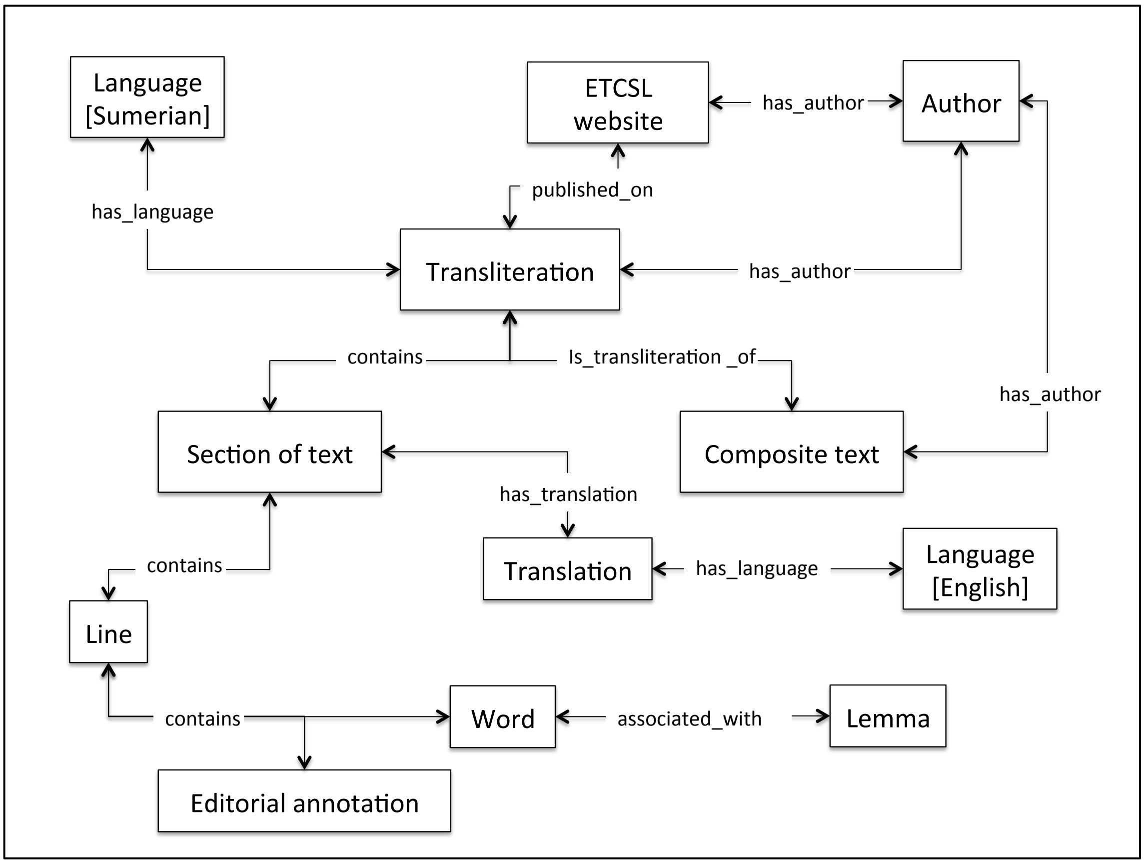

Figure 25 Stage 1 of SuLO, illustrating the capture of philological data only.

In this structure, the intangible idea of the composite text is represented as a separate entity, which has an author (the modern scholar) and separate manifestations (the TEI/XML code and the HTML), similar to the class E73 Information Object in CIDOC CRM (see below). Instances of the Philological annotations include determinatives, **eme.sal**, scribal errors, quotations and missing parts (signs, clusters of signs, sections of the text). Instances of scribal mistakes which result in the absence of a sign or lexical item (haplography, where a duplicated sign appears only once, or parablepsis, where mistakes involve entire lines of text) can be marked as instances of both the Scribal error and Missing Elements subclasses.

Quotation will enable the mapping of instances of proverbs or sections from other compositions – this detail is often indirectly available in the context of the text, as seen in the Sumerian suffix **e-še**, translated variably as "alludes to proverb" (e.g. *Dumuzid's Dream*; *Lugalbanda in the Mountain Cave*), "as the proverb goes" (*Enmerkar and the Lord of Aratta*) or "as the saying goes" (*Gilgameš and Aga*).

Stage 2

The second stage involved the incorporation of bibliographic information and the only piece of museological data available: the object number. The former is limited to the categories of the ETCSL reference list: author name, article title, year, name and type of the publication (e.g. journal), and the publisher, resulting in the addition of six categories.

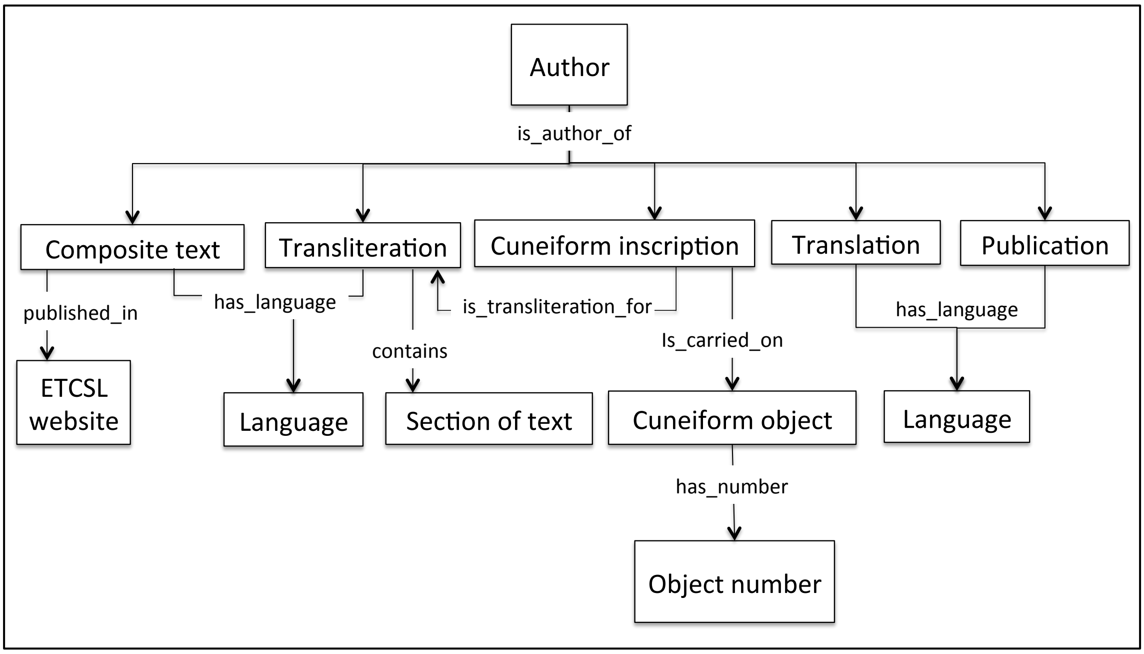

Figure 26 Stage 2 of SuLO, reflecting the increasing complexity of the data.

Stage 3

The third stage included the representation of the narrative content of the text. The intuitive place to start would be the inclusion of the protagonists and locations, which reflect the mark-up already existing in ETCSL, proper nouns having been colour coded (for details see Appendix B). This categorisation of protagonists was based on the list of 917 unique names (http://etcsl.orinst.ox.ac.uk/cgi-bin/etcslpropnoun. cgi), which includes people (personal and royal names) and deities (divine names). Those with even a cursory knowledge of Mesopotamian literature and mythology can enrich the list to contain supernatural beings (demons, ghosts, spirits), symbolic or metaphoric creatures, anthropomorphised animals and objects, and natural animals. This list has been divided into four subclasses of Protagonist:

- Realistic or real persons and people (occasionally but not exclusively associated with 𒁹 or ^{m} for male and 𒊩 or ^{f} for female names);
- Deities (gods and goddesses, all marked with the ^{d} determinative)
- Supernatural entities (such as ghosts, demons, spirits);
- Animals (symbolic animals, e.g. the Bull of Heaven, and natural animals)

In addition to these protagonist types, the proper noun list includes four types of location for which the ancient peoples allocated individual names: settlements, geographical sites, watercourses (rivers and canals) and temples. These categorisations form the basis of granularity for the representation of Place in SuLO (Fig. 27, next page). Representation of location and spatial reasoning are further elaborated upon in Chapter 7.

As well as protagonists and location SuLO should capture events. In order to do so, the main types of actions within Sumerian narratives were identified.

The scope of the analysis omitted ancient literary catalogues, poems (including debate poems and diatribes), hymns, songs (including cult songs, elegies and other songs) and literary letters, letter-prayers and proverbs as non-representative of “true literature” (as discussed in Chapter 3). Only longer compositions (mythical and historical) can adequately be represented in an ontology such as SuLO. For this reason, the analysis focused solely on the categories of the narrative, mythological, those with a historical background, and the category of Other Literature (see Appendix D).

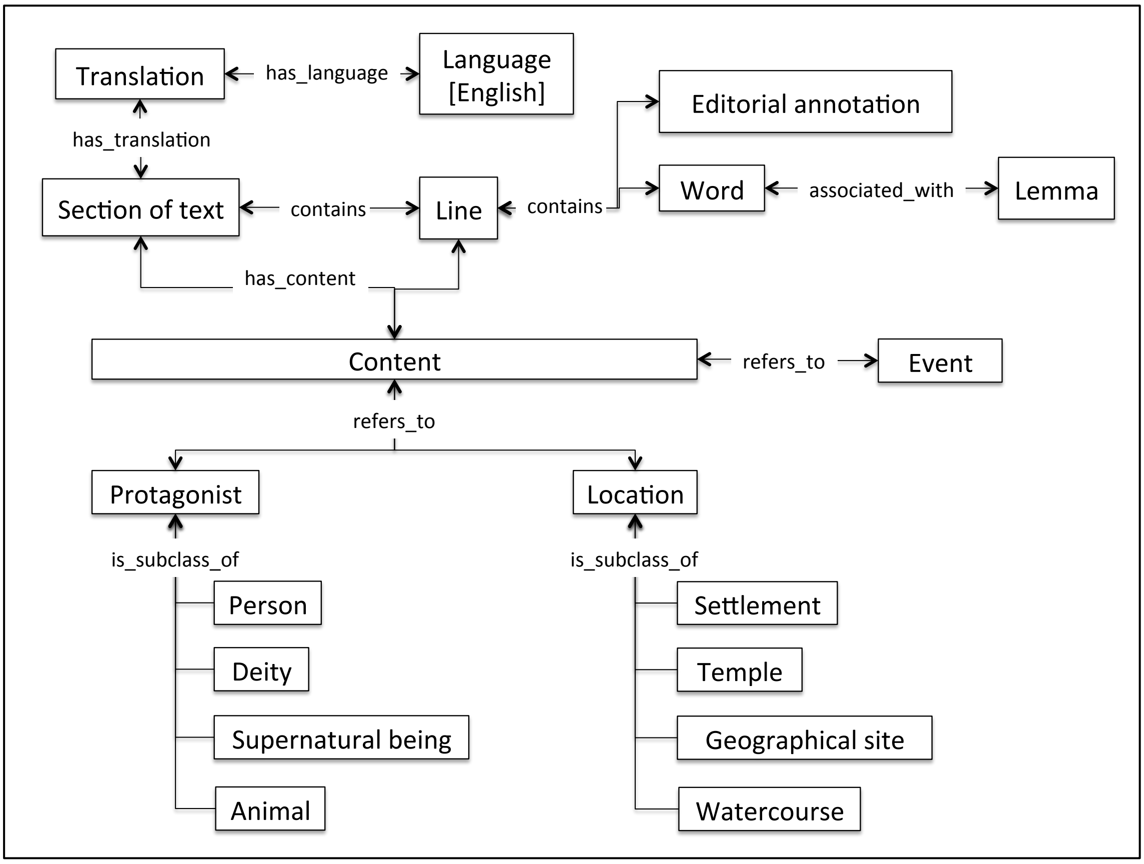

Figure 27 Stage 3 of SuLO, where additional details from the content of the text are incorporated. Details from the other stages of SuLO have been removed to ensure clarity of expression.

Even with these selection criteria in place, there are 69 compositions to consider. An example of each category was selected to represent that subgenre, selecting primarily against composition length, but deviating to make selection based on ensuring sufficient narrative complexity was present. The selected examples were:

- *Enki and Ninhursaga*, for narrative and mythological compositions featuring deities;
- *Gilgameš and Aga*, for narrative and mythological compositions featuring heroes;
- *The victory of Utu-hegal*, for historical background;
- *The Lament for Sumer and Urim*, for city laments;
- *The advice of a supervisor to a younger scribe*, for commentaries on scribal life, and
- *The Three Ox-drivers of Adab* as an example of 'Wisdom Literature'.

It is important to acknowledge that in addition to an arbitrary selection bias, these categories are a modern division, and groupings may contain extensive internal variation (the subcategory of "Wisdom Literature" is an ideal example of this). The wide breadth of different types of compositions however ensures that even when utilising such a sampling technique, a good overview of the different types of narrative elements is captured.

Only those events that occur in the main frame were considered. This formalization reduced the narrative to key actions: *The advice of a supervisor to a younger scribe* is simply a dialogue. Much of the content is expressed through literary forms of quoted speech (dialogues, for example, or a speech delivered by the eponymous hero to the citizens of Uruk in *Gilgameš and Aga)*. Repetitions are common (*Enki and Ninhursaga; The Lament for Sumer and Urim*; *The Three Ox-drivers of Adab)* and an entire composition can be reduced down to a small number of distinct (albeit reoccurring) occasions.

Five main types of event (with subclasses in parentheses) were identified:

- Social action (assignment of duty or spouse, observation, sexual encounter);
- Oration (dialogue; monologue; polylogue and directed speech; advice; warning; lament; curse; prayer; rejoicing),
- Natural phenomena (rain; storm; waters raising; fields growing crops),
- Journey (short; long; by foot; by boat),
- Military (attack; siege; escape; defeat; victory).

The fine grained and detailed aspects of many of the stories, namely the content of speeches (which often include extensive descriptions of places, events, people and other types of protagonist), are not represented at this level of granularity. To capture these elements, a more complex ontological structure is required (see mORSuL, below).

By opting to use pre-existing ontologies such as CIDOC CRM, and FRBRoo, ETCSL can be enriched with information from those external data-streams, which have also used any of these ontologies to mark up their data. Each of the three identified ontologies is a possible route for addition knowledge: the translation and transliteration are the remit of OM; both print and electronic sources, and the revision history of the ETCSL site content is that of FRBRoo; and the cuneiform sources (object numbers) of the CIDOC CRM. The name mORSuL (multi-Ontology for the Representation of Sumerian Literature) was developed as shorthand to describe the structure resulting from the combination of these existing ontologies and any description of mORSuL is largely based on them (see Chapter 4). In order to adhere to its intended aim of representing Sumerian literary compositions, mORSuL has been extended beyond just an amalgamation of OM, FRBRoo and CIDOC CRM to also include those classes (and associated subclasses) which formed part of SuLO, but for which no equivalents can be found in the other three.

5.4 Mapping Sumerian Literary Compositions with CIDOC CRM and FRBRoo classes in mORSuL

CIDOC CRM in mORSuL

The CIDOC CRM structure allows for the mapping of cultural heritage data and museological processes, and is particularly well suited for the encoding of an item's biography. In terms of ETCSL data, there is little overlap, as only object numbers for the witnesses have been provided – and these reflect those cited in the secondary sources. These numbers do not necessary match with current identifying numbers, and can complicate the identification of the original tablet (see Chapter 6).

It is however possible to map the relationship between the composite, its translation, and the texts that contributed to it as well as the witness tablets which carry those texts. All of these entities are to be considered as separate from one another: the content of the tablet is not the same thing as the physical item itself.

CIDOC CRM allows for the differentiation between the content (`E33 Linguistic Object`) and the object, which carries a composition (`E84`

Information Carrier). They are linked through E73 Information Object (superclass of E33) (Crofts, et al, 2011:29). This is particularly useful in the case of the composite text, which can be represented as being an intangible construct (an instance of a E33), which manifests as a transliteration on the ETCSL site (the site is an instance of E73). The transliteration and translation can each be mapped to have a language (Sumerian and English, respectively). Similarly, each witness tablet is an instance of E73, and each text carried on each object, a separate instance of E33.

The use of E90 Symbolic Object (the superclass of E73) makes it possible to represent the notion of the composite as a separate entity. Instances of E90 are clusters of characters (including writing) that have a recognisable structure. The P106 is composed of-property maps the composite (an instance in a subclass of E90) as an amalgamation of several other texts (which are also all instances within a subclass of E90). This nesting of super- and subclasses is significant because subclasses inherent the properties of the superclasses. The connection between these classes and the texts is illustrated in Fig. 28.

It is also possible to map the correlation between the text and the carrier, such as a cuneiform tablet, which has been purposely made for the task of storing data in the form of written text (E84 Information Carrier is a nested subclass of E24 Physical Man-Made Thing, whose relationship to E90 is mapped via the P128 carried by (is carried by)-property).

CIDOC enables the mapping of the physical features of the objects that carry the texts (E57 Material, E58 Measurement Unit). Although presently that data is not directly available through the ETCSL, by identifying the corresponding record from the housing institution's online collections (Musée du Louvre, the British Museum), it could be found (assuming the required object catalogue and collections management data by these heritage institutions had been published in adherence to the Five Star LD criteria as outlined in Chapter 4).

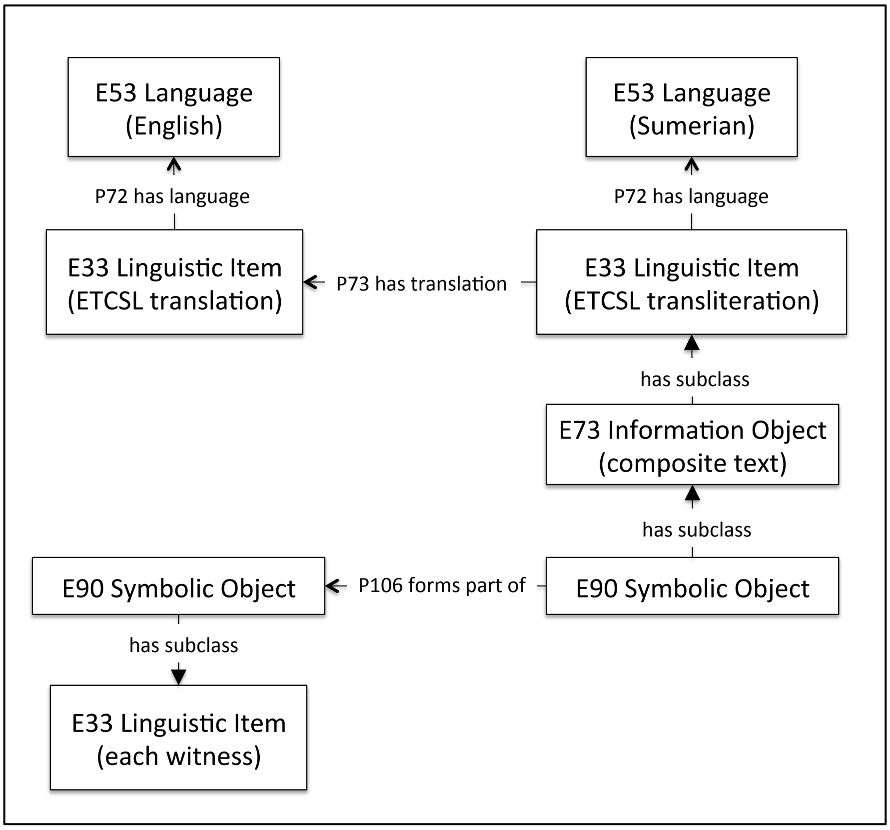

Figure 28 Mapping the composite text to CIDOC CRM.

This is an ideal example of the type of information-symbiosis that could be used to enrich the ETCSL (with relative ease) but also of how it could enrich museum records, providing access to the transliteration and translation of the text content, and by helping to place objects in a wider literary context. With the addition of high-resolution photography from projects such as the CDLI, the collections and the knowledge within the discipline could be efficiently brought together and accessed from a single entry point by anyone with access to the Web, facilitating and supporting research for academics across the globe.

FRBRoo in mORSuL

There are two bibliographies embedded into the ETCSL. The first is the metadata of the transliteration, including title[25] and the revision history. The second is the text-only page listing the items cited in the transliterations, including the author name, article title, the year and name of the publication type and the name of the publisher. These six categories of information can be mapped into mORSuL using the classes of FRBRoo, and connected to the aforementioned classes of `E73 Information Object`: FRBRoo class `F2 Expression` is a subclass of `E73`.

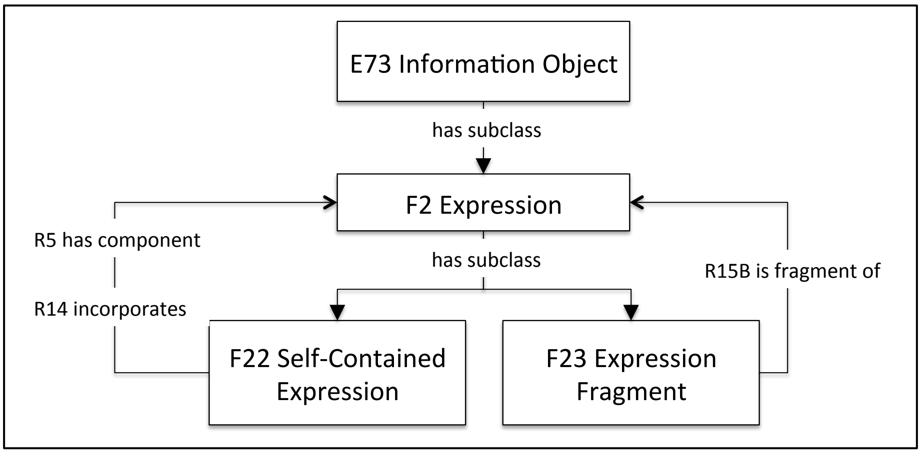

Figure 29 Two FRBRoo classes used to map Sumerian literary compositions.

`F2` has two subclasses which allow for the mapping of the composite text: `F22 Self-Contained Expression` is a class for the composites as they appear on ETCSL (as a cohesive text), whilst each separate segment is an instance of `F23`

[25] Composition titles are a modern addition, as Mesopotamian scribes recognised compositions by their first line e.g. *Ša naqba īmuru* for the Assyrian version of the *Epic of Gilgameš* (which, incidentally, has been transliterated in George, 2010: xxiv as ***Ša naqba Kmuru***, no doubt due to editorial or printer error).

Expression Fragment, since they are sections of the composite, and sections of the original witnesses tablets. The two classes are connected as subclasses of E2, and their relationships to E2 additionally include R5 has component (is component of) and R14 incorporates (is incorporated in) for E22, and R15B is fragment of (has fragment) for E23 (Fig. 29). The relationship of text to the object is via P128 carries (is carried by). It connects F4 Manifestation Singleton to F2.

Modern scholars named in the bibliography can be mapped as instances of F10 Person, which is an equivalent of (≡) E21, these classes providing an example of one of the many points where the two ontologies merge – another example relevant here is F4, which in turn is a subclass of E24 (discussed earlier). Furthermore, FRBRoo conveniently allows for the representation of both physical and electronic publishing (see Fig. 30).

In terms of the content, FRBRoo includes F38 Character, ideally suited for the capture of characters in Sumerian literature. The scope notes (Bekiari, et al, 2013: 61) specify this class for "fictional and iconographic individuals… appearing in works in a way relevant as subjects. Characters may be purely fictitious or based on real persons". Applicable to a wide spectrum of protagonists, it is equally valid for the unnamed characters (the slave-girl, the young scribe, the ox-driver) as it is to the Gilgameš.

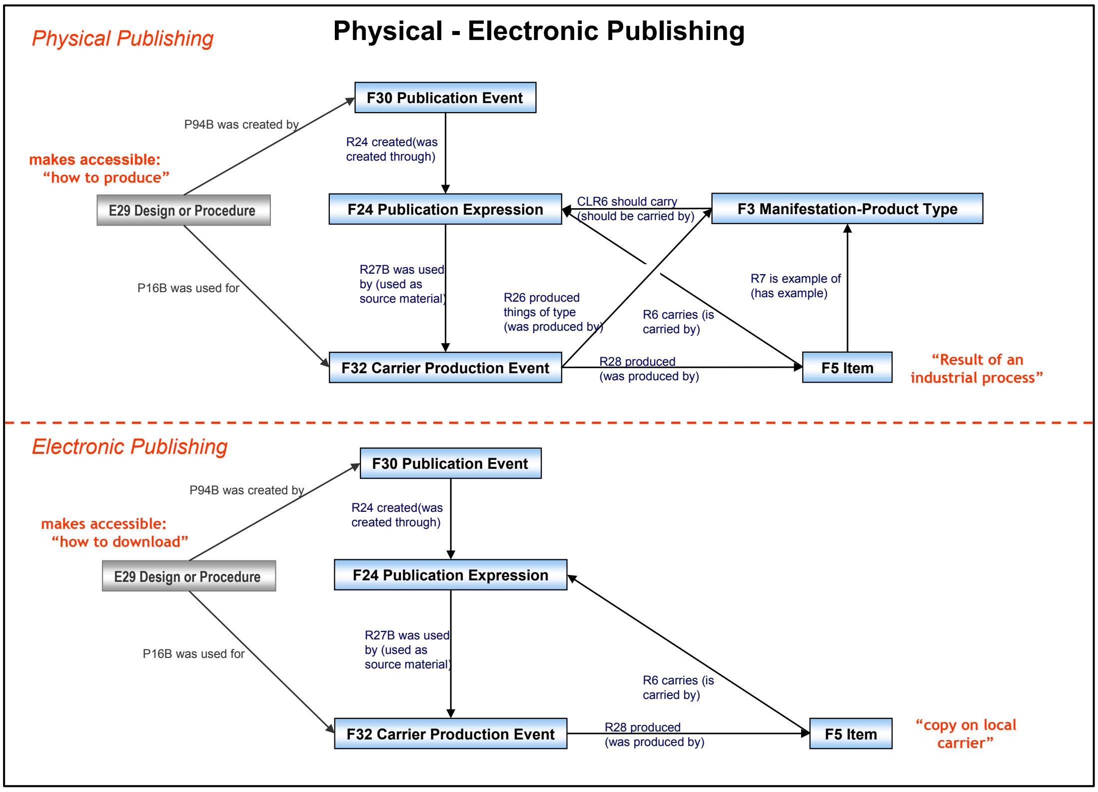

Figure 30 Physical and electronic publication of resources in the FRBRoo model. Bekiari, et al, 2013:18.

In the case of Gilgameš there are three disjoint categories:

- The man, who may have been a genuine, historical person, and is treated in the context of the literature as such, who thus ought to be mapped as an instance of F10≡E21;
- The later deified, [d]Gilgameš, a myth, a fabricated construct, which serves an educational, cultic or socio-political purpose;
- The character in a literary composition (F38). This character is separate from the divine manifestation, as he exists solely in the context (the fabula) of the text, and could, from the perspective of those who do not

believe in the existence of a divine entity, be considered wholly literary, or fictitious.

The deified dGilgameš is disjoint from the man, as the latter has to transform into the former (thus, they cannot coexist). Neither CIDOC CRM nor FRBRoo have a class that truly captures this notion, although FRBRoo does allow for the capture of the third manifestation of Gilgameš: the literary representation. It is possible to map the relationship between the protagonist and his historical counterpart, by `R57 is based on` (with `E39 Actor` as range).[26] To represent the divinity of Gilgameš, a new class is required. In mORSuL, this class has been added as an extension of OM's `Being`.

5.5 Mapping Sumerian Literary Compositions with Ontomedia classes in mORSuL

Those aspects and data that can be mapped using CIDOC CRM and FRBRoo are complemented by the representation of the content of the text. They can be seen to be in a supportive role for a resource which has focused predominantly on the online publication of Sumerian literature – the research agenda of this thesis mirrors that focus, and much of mORSuL is on the ontological representation of the narrative content. Most of the classes mapped in SuLO find their equivalent (often much more detailed and complex) in the classes of

[26] It is important to note the disjunction between characters and persons. In the context of a literary narrative, no matter how historically accurate (or otherwise), a person is always a character. FRBRoo `R57 is based on` allows for the representation of an instance where a character is based on a real person. This property enables a crucial separation between person, and the character: even in cases of a biography, where the aim is to represent a true event which occurred in the real world to a genuine person, for purposes of automated inference and machine reasoning, the character and the events that they are involved in, when occurring in the context of a composition are disjoint from the events and the persons in actuality. For example, the description, photograph and biography of a person online (say, Wikipedia), created on the day they were born, is not equivalent to that person. This separation between person and literary manifestation of their persona is equally true in the representation of literature, be it Sumerian or otherwise.

Ontomedia (OM). The five main types of content identified for SuLO were the protagonists, the locations, social actions, natural phenomena and military actions, all of which, to some extent, already exist in OM, with associated descriptions and characteristics enriching the formalised representation of a rich and diverse literary canon.

Protagonists

Protagonists can be mapped as instances of `Character`, although this class does not allow for any differentiation between people, deities, sentient supernatural beings, demigods or anthropomorphised creatures. Specific properties could be used to create such a distinction between entities, but have not been built into OM as it currently stands.

OM incorporates the FOAF ontology and enables the mapping of interpersonal relationships and physical characteristics through a series of additional classes. Of the former (relationships), it is possible to differentiate between four distinct `Family Bonds` (`Adopted`, `Blood`, `Foster` and `Step`), as well as to map alliances (including a separate subclass `Friendship`). There are classes for `Deal`, `Enmity`, `Pledge` and `Possession`, and `Agent` has subclasses for `Group`, `Organisation` and `Person`. Although there are many additional classes, which represent too modern a concept to be suitable for ancient text, with the use of existing OM classes a person can be shown to have a `Profession`, or belong to a `Community` (subclasses `Bonded Group` and `Partnership`).

Ontomedia's `Character Trait` contains many characteristics of individuals, enabling a more detailed description of the protagonist than the structures in SuLO. The complexity of this cluster of classes has already been noted, and as such will not be repeated here. Suffice to say that the classes of OM extend beyond that which was considered pragmatically feasible minimum as considered for the mapping of SuLO (as above), and for the more fine-detailed representation of the protagonists (cf. SuLO).

The most relevant of these are the subclasses of `Gender`, `Name`, `Stages of Life`, `Stages of Being`, and `State of Consciousness`, as well as `Knowledge` and `Motivation`. Various subclasses of `Detail` map human physical features (eye colour, body type, hair colour). Such classes could enable the mapping of some of the descriptions of protagonists such as lines 70-75 in *Gilgameš and Aga*, which describe "his angry brow…his bison eyes…his lapis lazuli beard…his elegant fingers…". `Attire` can also be used to represent different parts of the arc of the story, in this case, the undressing of the eponymous protagonist in a given `Timeline` in *Inanna's descent to the Netherworld.*

Seen as an extension of `Protagonist` in SuLO, OM has two classes which could be assumed to map the classes of supernatural being (be they deities or demons) and animals: `Bestiary` and `Zoology` respectively. Reflective of OM's origins in science fiction and fantasy, the latter allows for the specification of many animals, although the listings and subclasses lack an immediately obvious logic (categories are not based, for example on Linnaean taxonomy).[27] Furthermore, the myriad classes of animal as listed in OM do not match with those identified from the ETCSL, and this has been reflected in mORSuL, where unnecessary subclasses have been removed, and the structure changed to more accurately represent a Linnaean taxonomy of animals. The OM class of `Bestiary` is equally sporadic, and since it does not contain any directly

[27] Associated documentation from `www.contextus.net` sheds no light on the seemingly arbitrary list of animal types and subclasses: Bats and birds together form subclasses of `Avian`, although otherwise there are parallels to biological taxonomies.

declared subclasses, which would match the mythical beasts of Sumerian literary compositions, this sub-ontology (`Bestiary`) does not form part of mORSuL.[28]

Locations

`Space` (see Fig 31, next page) has three distinct subclasses. Two of these are structurally simple, consisting of a small number of nested subclasses; `AKT Abstract Space` (relevant nested subclasses include `Surface Space` and `Biological Surface Space`) and `AKT Enclosed Space` (including `Vessel`, `Portal` and `Container`), which allows for the representation of, for example, the coracle that held the infant Sargon as he was sent down the river in the *Sargon Birth Legend* (a story with striking narrative similarity to the infancy of Moses), or the much larger version built by Atrahasis, which held two of every animal, and protected them from a flood (Finkel, 2014).

There is also the extensive `AKT Open Space`, with almost 40 distinct classes and subclasses, most of which (with the exception perhaps of `World`, `Galaxy` and `Universe`) are directly useful for the representation of place in these ancient literary compositions.

Although extensive, `Space` does not include those architectural entities and features, which often occur in Sumerian narratives: the temple, the palace, the city wall, the canal, the dyke, and the reed bed. The closest is `Building`, a subclass of `Physical Item`. Since temples are individually named, it does not seem unfeasible to suggest that they were seen as a separate type of entity, disjoint from other, more mundane buildings. Perhaps then, they should not be represented as equal to the secular structures, but in a separate class?

[28] Not to be confused with the `Zoology` subclass `Bestial`, which has been incorporated into mORSuL.

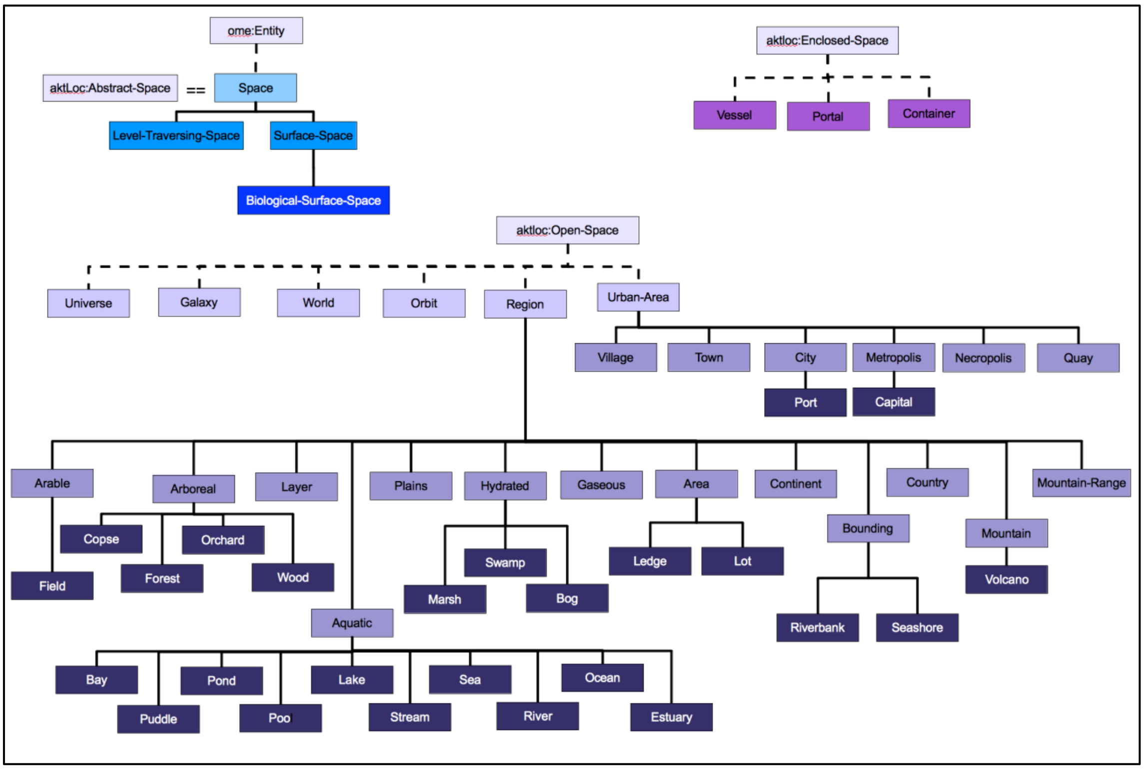

Figure 31 Ontomedia `Space` subontology, of which `Open-Space` is most relevant to mORSuL. For the full-size image, please see Appendix G.

The `Core Expression` class includes aspects, which can be described as features of an upper level ontology with universal applicability. These include `Abstract Item` and `Physical Item`, as well as the classes of `Timeline`, `Occurrence` (with the subclass `Event`), `Introduction, Gain, Loss, Transformation` (with subclass `Travel`), `Social` and `Action`. All encountered events in the Sumerian literary cannon can be mapped using these classes, although it is worth noting that at such a level of granularity (or more specifically, lack thereof), the results of queries are likely to return many instances of stories which share some parallelism, and that query-based, automated differentiation between different narrative structures would necessarily be quite limited.

A specific occurrence type, which occurred in several of the texts examined for SuLO was a military one (ranging from attacks to sieges, to inevitable retaliation, futile escape, unavoidable defeat and glorious victory). OM `Profession` includes `Military`, which may prove a suitable class for capturing such events, via the inclusion of characters who are representable as members of this profession. Without scope notes or discussion, challenges remain as to whether the differences between ancient (as described and recorded in the texts), modern (as per our own cultural perspectives), and indeed future (as expressed in the narratives of science fiction) warfare are sufficiently similar to justify this approach.

Actions

Those classes, which can be used to represent the actions of the protagonists fall within the `Events` subclass of OM's `Extensions`. There are thirteen classes, which allow for the mapping of human and animal actions, movements of celestial bodies and natural phenomena: `Action`, `Being`, `Celestial`, `Environment`, `EventProp`, `Gain`, `Group`, `Introduction`, `Loss`, `Social`, `Space`, `Transformation`, and `Travel`.[29]

`Action` contains the parallel subclass system discussed in context of the `Trait` class – here, `Celestial` and `Environmental` are subclasses of `Action`, as well as being parallel to it. When in parallel, they contain further subclasses.

`Environmental Event` subclasses enable the mapping of natural phenomena that appears in the context of the Sumerian narrative, consider, for example, the raising of waters (*Enki and Ninhursaga*) or growing of crops (*Enki and world Order*). `Celestial` is more complex, due to the Mesopotamian perspective on

[29] These thirteen classes form a collection when the eight subontologies of OM's `Events` are combined.

the cosmos, which at the most reductionist of levels could be described as viewing gods and goddesses as anthropomorphised celestial objects. Utu rises and sets; the sun is the god. The issues is, in actuality, a much more diverse and complex problem space, and for the purposes of this thesis, the deity and their celestial counterpart are treated as two disjoint entities – the movement of Inanna from heaven to the Underworld is not represented as a celestial movement of the planet Venus, although it would be possible with the classes and properties in mORSuL.

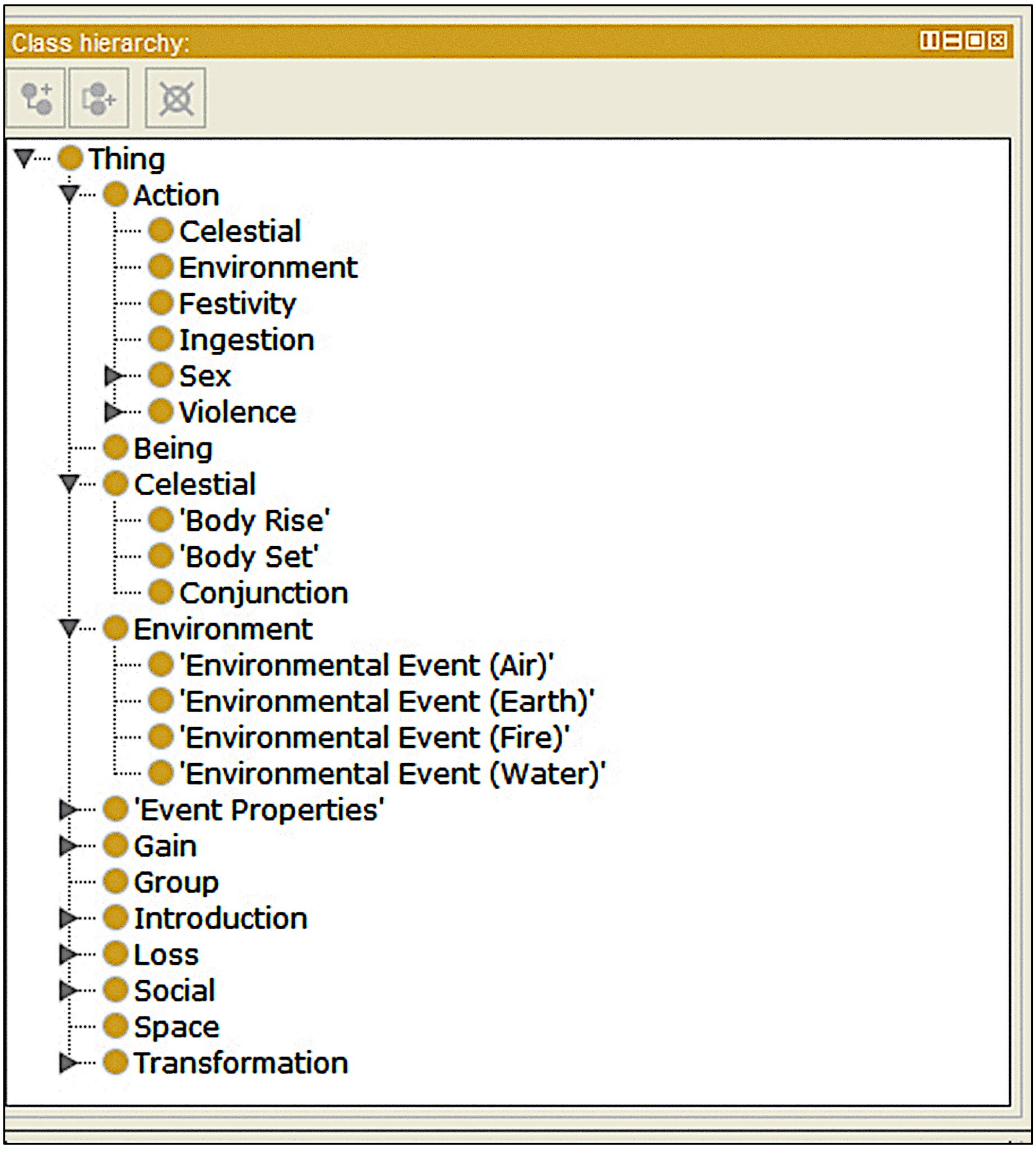

Figure 32 Ontomedia Action class and its subclasses, as displayed in Protégé.

Several of the `Action` class subclasses can be used directly to represent the elements of a Sumerian story. The *Victory of Utu-hegal* has instances of `Battle` and `War` – the beating received by Birḫar-tura in *Gilgameš and Aga* populates `Corporal Punishment`. Other classes of `Events` can be shown to be equally relevant, and others as unnecessary (cf. `Space Travel`). OM classes fall short of representing the potential richness of ETCSL data in the capture of verbal exchanges. Various sorts of oration (monologue, dialogue, polylogue) are a frequently utilised rhetoric device, and contain additional explanations and information. Consider, for example, *The Three Ox-drivers of Adab*, where the frame story contains a long description of events in a speech delivered to the king: it is this content which conveys the conundrum, the purpose of the composition. mORSuL therefore includes an extension to `Social`, which includes the subclasses of `monologue`, `dialogue`, `polylogue`, `advice`, `warning`, `lamentation`, `curse`, `prayer` and `rejoicing` (see Appendix H).

5.6 SuLO in mORSuL

The majority of classes from SuLO either have a counterpart in CIDOC CRM, FRBRoo and OM, or have been added to OM classes in mORSuL. The only elements to be entirely missing thus far are the philological annotations listed earlier in this chapter: determinatives, **eme.sal**, scribal errors, quotation and missing parts of the text as well as the lemma, which are addressed below.

In the case of the determinatives ^{d} and ^{ki}, these will be represented indirectly via existing classes, the former through `Deities` and the latter by `Place`. Many other determinatives will also have been mapped indirectly, such as ^{giš} for trees (and things made out of wood), ^{MUL} for stars and ^{É} for temples. Other determinates for which the words for instances of predetermined classes are ^{LÚ} for people and professions, as well as $^{LÚ.MEŠ}$ for groups of people (enemies of

Sumer, for example). Since watercourses are individually named, each instance of $^{\text{ÍD}}$ will have been marked. Thus far, no clear benefit has been identified for the separate representation of every instance of the determinative grammatical element, and as such, it has been excluded from the structure of mORSuL. Words in the **eme.sal** dialect could form part of various interesting, useful, and realistic search criteria, and a new, separate class, `Emesal` has been added to mORSuL (see Appendix H).

Scribal errors, variants and alternatives are clearly listed in the ETCSL and support the process of philological analysis. However, the individual representation of each type of scribal error was deemed unnecessary for mORSuL: it was thought unlikely (though not impossible) that a user would wish to query for “Each instance of haplography across the ETCSL corpus” – at any rate, such a research process has already been recently completed and published by Delnero (2012). A class of `Philological_annotation` has been incorporated into mORSuL, and contains instances of scribal errors, variants and alternatives.

Quotations and literary borrowings have not been added as a separate class to mORSuL, because the aim has been to design and implement a system capable of determining repeating patterns without them being explicitly (manually) declared. This point is discussed further in Chapter 6, citing examples as applicable to the case-study text.

The lemma is also included in mORSuL, as an important and useful tool for many aspects of literary Sumerology. The `Philological_annotation` class has two sub-classes, `emesal` and `lemma`.

5.7 Practical Implementation

mORSuL (see Appendix H) was implemented in the Stanford University ontological editor, Protégé. The benefits from doing so were the ease of use, the existence of a functioning user-interface, and the possibility to manipulate existing ontological structures such as those which make up the majority of mORSuL. Fine-tuning was carried out manually at the latest stages of the research project using a text editor.

The basic structure of mORSuL was created by the import of existing .owl files from the Web, raw files from https://contextus.googlecode.com for OM and from http://www.cidoc-crm.org/ for both CIDOC CRM and FRBRoo. For the latter, the import and merging was achieved easily, although the resulting structure is large and complex, with a large number of classes which cannot be populated with ETCSL data.

For OM, several problems were encountered. Firstly, the Contextus site, which acts as the point of access for the sub-ontologies, has a number of broken links, which return 404 errors. Both of the links for `Trait` (as at http://www.contextus.net/ontology/ontomedia/ex/ext/common/trait) are an example of this. As with the documentation concerning the ontology's structure, the site has seemed to have been affected by updates and changes to the code and its storage, and has not been recently updated.

The import of these sub-ontologies (once located) also highlighted a number of issues concerning indirect imports, particularly at the earliest stages of development (2013):

- `Being` indirectly imported not only the FOAF namespaces (`http://xmlns.com/foaf/0.1/`) but also `Expression`, which resulted in unnecessary reduplication,
- The addition of `Exprop` resulted in the indirect imports of both `Expression` (now theoretically a triple) and `Media` (a structure deemed unnecessary for the representation of ETCSL data as it does not incorporate video or audio files),
- The `Detail` subclass `Job` (now `Profession`) resulted in the indirect import of `Being` (potentially doubling the structure already imported), and,
- `Gain`, `Loss` and `Travel` each separately (and thus repeatedly) incorporated the indirect import of `Expression`. Since the specification in these sub-ontologies for the location of this additional element (`Expression`) had not been updated to reflect the move of that particular .owl file, the system would fail to complete the import and issue an error message.

By the summer of 2014, these errors had been solved, and the import of selected sub-ontologies from `https://contextus.googlecode.com` was completed.

In addition to the problems with the .owl files, challenges were also initially encountered with Protégé. The initial download of the software included an incompatible version of Java, an issue that caused the software to crash and to fail each time the reasoner was run. This problem, once identified, was solved by the install of an updated version.

Property Qualifiers

Following the recommendations of Bekiari, et al (2013: 28), property qualifiers have not, at this time, been discussed in the context of mORSuL. They are mentioned where relevant in Chapter 6 and in Chapter 7, as their categorical implementation across mORSuL as a whole falls under the remit of Future Work.

5.8 Conclusion

The creation of an ontological structure necessitates a solid understanding of both the subject domain and the needs of the users. For the purposes of this doctoral research, the former has been that of the content of the ETCSL, the latter the queries and processes of analysis of literary Sumerologists. The examination of the ETCSL highlighted four distinct categories of data:

- Bibliographic data, from the cited articles in the resource's bibliography;
- Museological data, in the form of object numbers identified for each witness tablet;
- Philological data, and
- The events in the story arc of each of the compositions.

Following the examples set by Clark and Chalmers in 1998, three distinct user cases were created and analysed. These helped identify those elements of the ontological structure, the expert system and the query type, which would be of sufficient complexity to adequately represent the needs of the Sumerological community and the opportunities created by the data. These elements have helped hone the final form of mORSuL to ensure those characteristics that are within the limits of pragmatic possibility have been achieved.

Three existing ontologies that correspond to the four data types have been identified: CIDOC CRM, FRBRoo and OM. Of these, the first two are well suited for the representation of the museological and bibliographic data, whilst OM can be used to map the narrative. A gap concerning the philological data was identified via the design of a domain-specific ontological structure, SuLO, and the process of designing it highlighted the inconsistencies between the ETCSL content and OM's myriad classes. The latter was edited by the omission of some sub-ontologies and the addition of a new class (`Oration`) to `Social`.[30]

These four ontologies were then brought together to form mORSuL (see Appendix H), a large and complex structure, which could be shown to successfully capture heterogeneous Sumerian literary compositions, each selected as a representative of its own niche-genre. Each composite ontology has been described and analysed in turn, with exemplar covering diverse sub-genres cited to support the relevance of the addition of each ontology – each of CIDOC CRM, FRBRoo and OM were found to adequately represent many diverse aspects of ETCSL data, but in each case, numerous unnecessary classes and properties were identified.

Having thus established the structure of mORSuL, and shown it to be both influenced by and suitable for the representation of various Sumerian compositions, attention now turns to the testing of the robustness of mORSuL by use of a specific case-study example. This will also be the opportunity to evaluate the suitability of mORSuL with regard to the user cases outlined at the beginning of this chapter.

[30] In the modified version of OM used at Digital Research in the Humanities and Arts 2014 workshop in August 2014, the `Conversational` class had been added.

Chapter 6: Case study

6.1 Background

Having examined the potential of mORSuL to represent generic motifs in Sumerian literature, attention now turns to testing the robustness of the structure with a case study example. The chosen composition is *The Three Ox-drivers of Adab*, thought to be a humorous piece (a view shared by Alster, 1991-1993; Foster, 1974 and Lambert, 1995).

The composite has a total length of 95 lines, but a large section following line 30 is missing. Following this gap is the final third of the tale but that too has many gaps – for this reason, the analysis and representation of the text have been limited to the first 30 lines only. Even within this limited section, there is a clear, repeating pattern and a frame narrative – the main action takes place in this story within a story, and it is here that the riddle is set.

The publication history has highlighted two points of discussion within the translations provided by earlier scholarship: Firstly, the fate of the wagon has been disputed, with original translations (such as Foster, 1974) describing the owner as being afraid that in his absence, the wagon breaks: See for example ""What if my wagon broke (?) under the load!" by Alster (1991-1993:32). A later analysis revising the phrase

> ^{giš}mar-mu gú-un ù-un-du/⌈dúr⌉/du/⌈dúr⌉/-ru

by Lambert (1995:1-2) comments on the unfeasibility of this translations based on common-sense logic – the owner is concerned that his wagon will break in his absence, but even if he remained, what could he do to prevent the problem? Lambert suggests that it not the fear of the wagon breaking, but that of the load being stolen, which deters the owner from leaving it: this interpretation is feasible as the witness tablets allow for the reading of the line as **ku-ku-ru**, referring to **ku_5-ru** ("to separate") – according to Lambert, this was misunderstood as **dúr-dúr-ru**, and thus written as **du-du-ru**, the error based largely on the gloss[31] which appears in the fragment from CBS1601 (see Fig. 33, for the gloss highlighted in red).

The text is known from two witnesses. The first is split into two fragments, AO 7739 and AO 9149, now at the Musée du Louvre, Paris; the second is the fragment CBS1601 from the collection at the University of Pennsylvania Museum of Archaeology and Anthropology. Foster (1974: 70) believed that another fragment, STVC 97, formed part of the same composition, but this has been shown to be inaccurate (Alster, 1991-1993:27). It is instead part of *The Old Man and the Young Girl,* which shares a number of narrative features and characteristics with *The Three Ox-drivers of Adab* (Alster, 1991-1993: 27; Gadotti, 2014: 66).

Translations of the latter have agreed on the translation of the term **sekrum**, (a loanword from Akkadian) translating it as either "the cloistered lady" (as in the ETCSL) or "a cloister woman" (Foster, 1974; Alster, 1991-1993), but Gadotti (2014:66) prefers the translation "court lady", as being in line with the later (Neo-Assyrian) meaning of the Akkadian word ***sekretum*** and for more accurately capturing the setting in the diegesis.

[31] The gloss is rendered by Alster (1991-1993) as ***ni_5?-i-za-ba-al***, but shown by Lambert (1995) to be to be read as ***ta-az-za-ba-al*** (present-future 3rd person singular feminine of ***zabālu*** "to carry") "will be carried off" (Lambert, 1995:1-2).

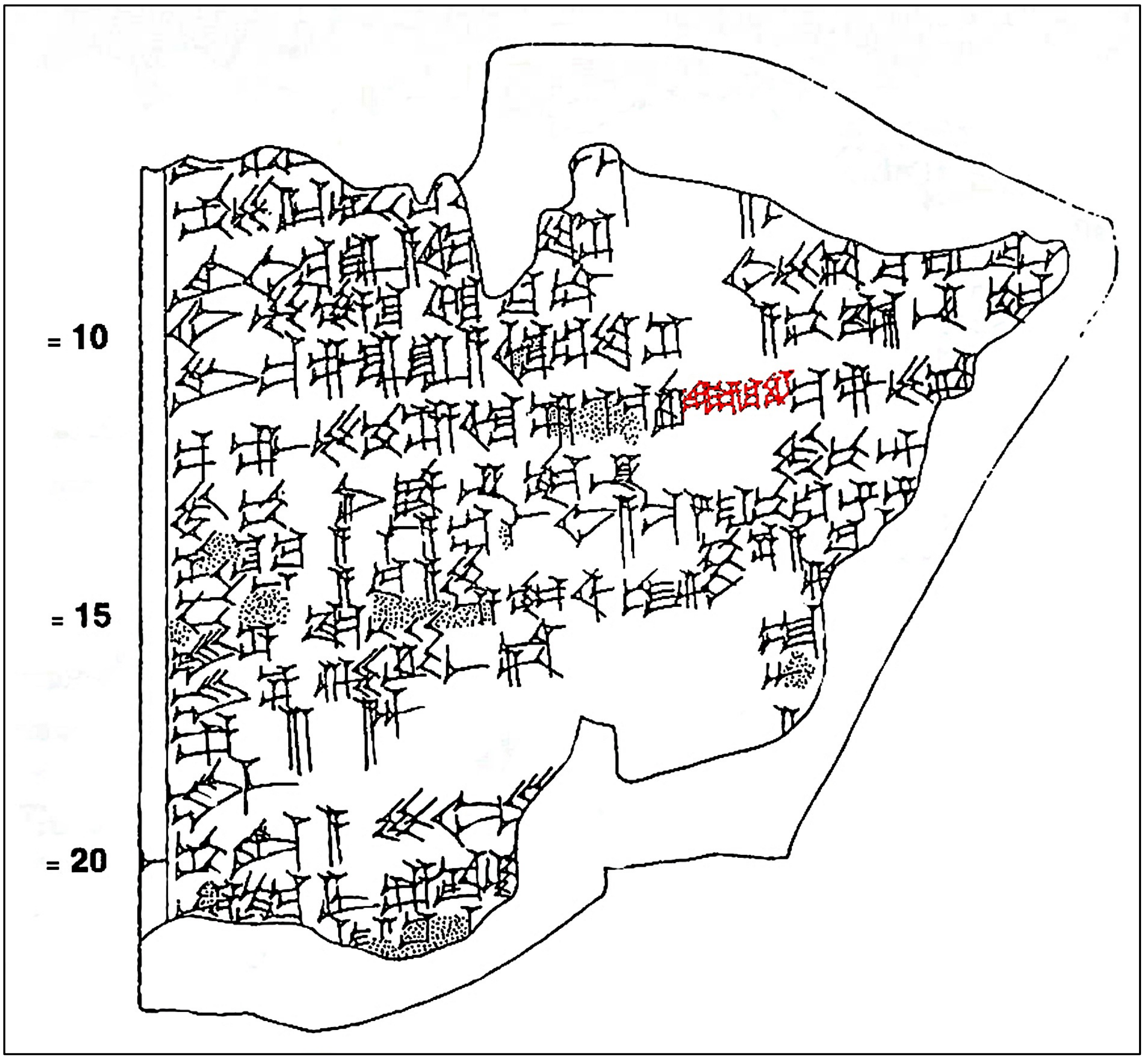

Figure 33 Gloss on the obverse of tablet CBS1601, here highlighted in red.
Based on Alster, 1991 - 1993: 28.

These differences in translation help highlight the need for the representation of not only the English translation, but also of the Sumerian in instances of specific keywords and proper nouns, which could be incorporated into a query. For example, if searching for either of the aforementioned compositions a question could combine narrative structure and a Sumerian keyword:

Instances of a dialogue between a king and a **sekrum**

For the purposes of this research project, only the translation and interpretation used by the ETCSL have been represented in mORSuL. The issues brought to light by the differences in these publications highlight the subjective nature of any interpretation, including the creation of the composite and the translations, as well as the level of granularity in the formalised representation. Any system implemented to capture this data (see Chapter 7), should incorporate a degree of in-built flexibility in order to cater for differences in interpretation as well as future scholarly developments, as well a method for recording the scholar, who has made each assertion.

6.2 The Tale

The eponymous ox-drivers, colleagues and friends, fall into a dispute. They are unable to solve their quarrel, and decide to seek the council of the king. What follows is a focalised analepsis (a flashback of the events, told from the perspective of the three men):

> ""Our king! We are ox-drivers. The ox belongs to one man, the cow belongs to one man, and the waggon [sic] belongs to one man. We became thirsty and had no water.
> We said to the owner of the ox, "If you were to fetch some water, then we could drink!". And he said, "What if my ox is devoured by a lion? I will not leave my ox!".
> We said to the owner of the cow, "If you were to fetch some water, then we could drink!". And he said, "What if my cow went off into the desert? I will not leave my cow!".
> We said to the owner of the waggon, "If you were to fetch some water, then we could drink!". And he said, "What if the load were removed from my waggon? I will not leave my waggon!".

> "Come on, let's all go! Come on, and let's return together!""
>
> "First the ox, although tied with a leash (?), mounted the cow, and then she dropped her young, and the calf started to chew up (?) the waggon's [sic] load. Who does this calf belong to? Who can take the calf?"" (Black,et al, 1995 – 2006)

The king is unable to provide a solution, and seeks in turn the council of the "cloistered lady" to whom he repeats the tale *verbatim*. She is able to provide a solution, but it is as this point that all witness tablets are damaged, and the modern audience is left without closure.

6.3 Selection Criteria

The Three Ox-drivers of Adab was chosen as the case study for several reasons. Firstly, it was identified as an example of a non-linear narrative structure. [32] Secondly, the instance and repetition of a frame story are characteristic of longer compositions from the ancient Near East, but (and this is also an additional reason for selection) this chosen example was shorter in length, without succumbing to a simplistic form. Thirdly, another text with similar elements, the *Old Man and the Young Girl,* has been identified (Alster, 1991-1993; Gadotti, 2014), providing an ideal opportunity for comparative analysis of similar details.

The Three Ox-drivers of Adab, has three key elements:

- The main story, consisting of a limited number of actions as narrated from an unidentified, omniscient perspective directly to the reader or the audience,

[32] One where the narrative is not identical to the chronological sequence of all described events.

- The frame, which recounts the events that led to the disagreement, narrated in the third person (for the introduction), the focalised[33] story by the three ox-drivers to the unnamed king, and its later repetition, by the king (including the dialogue between the three ox drivers which leads to their abandonment of their animals and property and ultimately results in the hypothetical or moral conundrum they face).

Repetition and duality occur in several contexts. There is the easily identifiable repetition of the ox-driver's story by the king to the cloistered lady; there is a frame narrative of the analepsis within the dialogue between the ox-drivers and the king; and there is a "frame dialogue" (the conversations which take place between the men as focalised by the ox-drivers to the king).[34]

The discussions and features of the composition, combined with the relatively short length (caused by the damage and resulting incompleteness of the tablets themselves, a feature not uncommon) make *The Three Ox-drivers of Adab* a suitable case study example, and one that can be analysed, represented and discussed within the limitations of time and scope of this thesis.

6.4 Witness Tablets and Prior Publications

Only two tablets carrying the text are known. There are a total of three fragments, but two of these (AO 7739 and AO 9149) are from the same object (now at the Musée du Louvre). The third fragment (CBS1601) was discovered as part of the collection at the University of Pennsylvania Museum of

[33] That is, expressed from the perspective and in the voice of the eponymous ox-drivers.
[34] The composite text is available in its entirety at http://etcsl.orinst.ox.ac.uk/cgi-bin/etcsl.cgi?text=c.5.6*#. . Both the transliteration and the translation of the first 30 lines are available in the Appendix.

Archaeology and Anthropology in 1991, and published by Alster soon after (1991–1993).

AO 7739 ((TCL 16 80), which contributes the lines 1–23 and 80–95 to the composite text) and AO 9149 ((TCL 16 83), which provides lines 19–28 and 69–71) have been dated to either the Kassite period (c. 1600 – 1500 BC) or to the reign of Ammīṣaduqa (c. 1650 BC). CBS 1601 (which provides the lines 69–88) has been dated to late OB period, between 1800 – 1600 BC (Alster, 1991–1993: 27ff.). Discrepancies and ambiguities of the chronologies of the second and third millennium BC notwithstanding, there is a possibility that the exemplars here are contemporary sources, and might even originate from the same place. It may however also be possible, that they are copies separated by several centuries (for a timeline of ancient Mesopotamia please see Appendix A). There appears to be no known provenance for either tablet – the secondary authors have made little comment on possible geographical origin or find spot for either witness, except to say none is known for the Louvre fragments (Alster, 1991 – 1993: 27). The city of Sippar may be a likely candidate.

These objects are referred to by at least three distinct object identifiers across the secondary publications: They are referred to as TRS 80 and TRS 83 by Foster (1974: 70), whilst Alster is reduced to the use of a shorthand (A_1, for example) to avoid repeating two known numbers (TCL 16,80 (AO 7739)) (Alster, 1991–1993:27ff.). Even when these are the same, their expression varies (cf. TCL 16, 80 in Alster to TCL 16 80 in the ETCSL), making finding them using character-matching searches difficult.

Museological research into the current state and preservation of these tablets is thwarted by the lack of information regarding the current object identifiers. In both cases, attempts to locate these fragments using the aforementioned identifying numbers failed to locate the correct item in either of the online collections as published by the housing institutions or the CDLI, which incorporates the collections of these museums. It is possible that the fragments have not yet been published or photographed, that they do not form part of the online collection. Alternatively, they might be one of the many records published thus far without a photograph, and since matches cannot be made based on physical characteristic or appearance, the museum number remains the only identifying feature.

The bibliographic data for *The Three Ox-drivers of Adab* lists a total of eight sources. Five of these are print sources, the remaining three electronic. Although a shorthand for the latter is provided (e.g. Alster 1998), there are no links, nor does the bibliography for the printed sources contain these references. For this reason they are omitted from further discussion. The five print sources (Alster, 1991 – 1993; Cavigneaux, 1987; Falkenstein, 1952; Foster, 1974 and Lambert, 1995) are cited in a text-only page of the ETCSL site – there are no links to the articles, the journals, or any other feature.

These aspects of the museological and bibliographic data are represented in mORSuL alongside the narrative. By mapping these aspects of supportive information, it may be possible to infer instances of other publications that are on similar topics, published in the same journal, written by the same author or are contemporary pieces. The use of the CIDOC CRM classes will also enable linking to other cultural heritage data, and help provide further interpretative context. It may even be possible to identify other complementary fragments or copies of the same (or similar) texts. These latter criteria are, however (in the absence of much archaeological and museological data) more likely to rise from the matching of manuscript content.

6.5 Using OM and the Brat Annotation Tool to Represent the *Three Ox-drivers of Adab*

The conclusions, evaluations and analyses of the suitability of mORSuL have been based on the mapping of *The Three Ox-drivers of Adab* into the structure (which was implemented in Protégé) manually. In the weeks prior to the completion of this doctoral research, another online resource the Brat annotation tool (http://brat.nlplab.org/index.html) was used to mark up the same case-study example. This work formed part of the workshop for the Digital Research in the Humanities and Arts (DRHA) conference, held at the University of Greenwich at the end of August 2014. The annotation tool allows for the generation of RDF through a simple graphical user-interface, which allows the user to mark up, for example, a piece of literature. The RDF for the first 30 lines of the piece can be found in Appendix F.

Since the DRHA workshop was exclusively focused on the representation of the narrative, the ontological structure used in conjunction with the Brat annotation tool was a simplified version of OM. Even with these relatively few classes, much of the case study compositions could be represented. Those elements, which were found to be pragmatically too complex or philosophically very nuanced (such as the concept of seeking justice, or the self-serving agenda of each man, although not explicitly stated) are equally beyond the remit of the original and the reduced forms of OM. As such, the resulting RDF (see Appendix F) can be considered an adequate representation of the type of information, which could be captured from pieces of Sumerian literature, if exclusively focusing on the scope of OM.

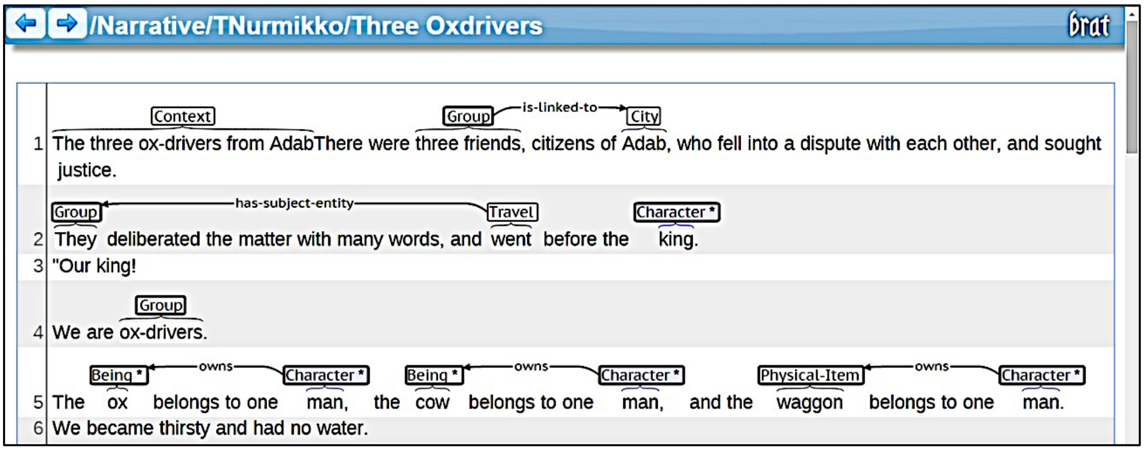

Figure 34 An example of how the Brat annotation tool could be used to mark up the case-study composition.

mORSuL, however, is a more complex structure, incorporating not only OM but also the CIDOC-CRM and FRBRoo. As such, the RDF generated at the DHRA workshop is not an accurate representation of the triples which would have been generated had mORSuL (rather than simplified OM) been used as the ontology for the annotation tool.

6.6 Ontological Representation in mORSuL

The limited museological and bibliographical details available via ETCSL can be represented by a small number of CIDOC CRM and FRBRoo classes and properties in mORSuL. Four data types are captured: the composite text, the website that carries it, the associated bibliography and the witness tablets.

Website and Pages

The ETCSL website which carries the transliteration and translation is an instance of `F24 Publication Expression`, as are both individual pages on which these texts appear (Page$_1$ http://etcsl.orinst.ox.ac.uk/cgi-bin/etcsl.cgi?text=c.5.6.5&display=Crit&charenc=gcirc#, Page$_2$ http://etcsl.orinst.ox.ac.uk/cgi-bin/etcsl.cgi?text=t.5.6.5#).

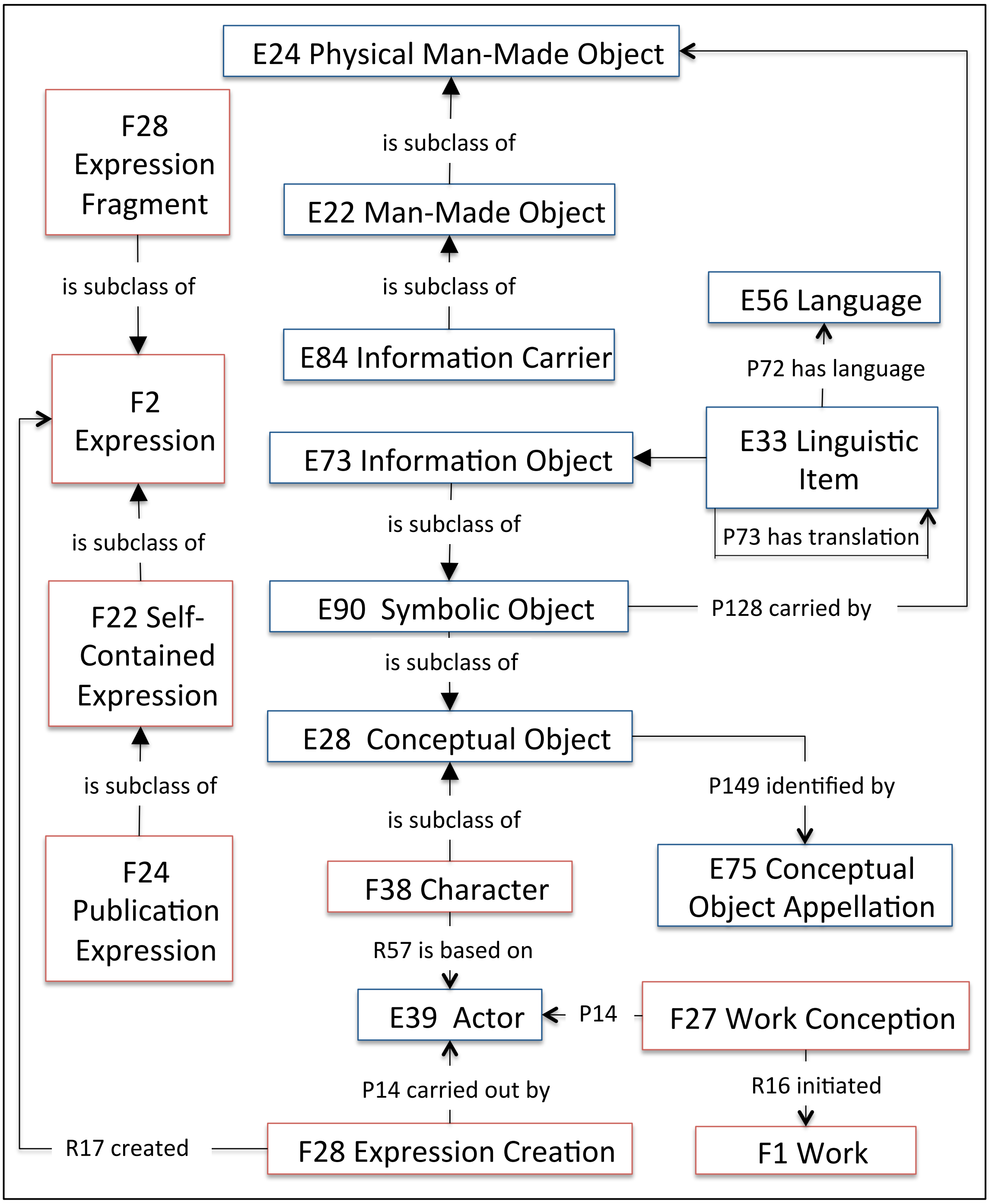

Figure 35 Necessary classes and properties from CIDOC CRM and FRBRoo.

As instances of `F24`, the Page$_1$ and Page$_2$ inherit the properties and characteristics of the nested supergroups `F22 Self-contained Expression` and F2 Expression, including the property R17 created (domain: F2, range F28 Expression creation), which allows for the capture of versioning between different versions of the page (capturing Revision history, as available with each translation). F28 is connected to E39 Actor by P14 carried out by: each version of the page can be assigned a specific author, again in line with the Revision history.

The website (and the corresponding TEI/XML file) are the carriers and the publication media for the composite text, which does not exist in a physical form elsewhere (for the exception of possible privately owned printed versions of the website). For the purposes of this thesis, the ETCSL website is the carrier of the text.

Composite Text

F23 Expression Fragment, a subclass of F2 allows for the representation of the composite (instance of F2) as a cohesive whole formed from other texts: those of CBS 1601 and the Louvre fragments each constitute an instance of F23. They are thus all instances of E73 Information Object, and can be shown to a language and a bidirectional relationship between translation and transliteration via E33 Linguistic Object, E56 Language and P72 has language. As an instance of E90 Symbolic Object (supergroup of E73) the composite text can also be shown to consist of a number of other E90 instances.

Physical Tablets

Each text as it appears on a witness tablet is a separate instance of E73. They are each (separately) carried on an entity of E84 Information carrier (e.g. CBS 1601). As a nested subgroup of E24 Physical Man-Made object, E84 inherits the connection between E24 and E90, offering an alternative way for representing the relationship between physical object and the text it carries.

Narrative structure

Since the narrative structure has occupied such a dominant position in this research agenda, it features most clearly in the representation of the case study example. It has already been discussed at length in a separate section below.

6.7 Narrative Content

For clarity of explanation, the representation of the narrative in *The Three Ox-drivers of Adab* has been divided into six sections. The translation and transliteration of the first 30 lines of the story are found in Appendix E.

People and Places

The main frame story of *The Three Ox-drivers of Adab* mentions five discreet entities which are represented in mORSuL as Characters: the eponymous group of men who are the citizens of Adab (**gu_5?-li-li 3-am_3 dumu adab[ki]-ke_4-ne**); the king (**lugal**) and the cloistered lady (**se_2-ek-rum** normalised as **sekrum**). There are no named protagonists or characters.

The three men (Man_1, Man_2 and Man_3) are all represented as Characters who are Gender:Male.[35] Each also has a Possession: for Man_1 it is an instance of Ox; for Man_2 an entity in the class Cow; for Man_3 it is a Physical:Item (string: "wagon"). To capture the [giš] determinative of the Sumerian ([giš]**mar**), this

[35] Although the OM structure would allow for a more detailed specification of the Sex of the characters (Behavioural, Genetic, Gonadal and Phenotypic), since these details are not clear, nor (perhaps more importantly) provable from the context of the story, the class of Sex and the aforementioned subclasses are not populated.

physical item is shown to have `Material` (string: “wood”). Each has a `Profession:Rural` (string:”oxdriver”). The men are connected to each other via an `Alliance:Friendship`. They also have an `Alliance` to the king, but are not explicitly declared to have a direct connection to the cloistered lady (although this could be inferred). The men are also shown to be citizens of Adab,[36] whereby the latter is an instance of a `City` and the men have a relationship to it. The men together are an instance of a `Group`. Man$_{1}$,$_{2}$, and $_{3}$ have not been marked up `SameAs` to their Sumerian equivalents (unlike the king and the cloistered lady, who have), because it was felt that the descriptive nature of the terminology of the men (e.g. Man$_{1}$ $\equiv$ **gud lu$_{2}$ diš-a-kam**) meant that it was unlikely to be used as a search term (cf. single lexical item terminology for the king and cloistered lady, as **lugal** and **sekrum** respectively).

The king, (Man$_{4}$) is also an instance of `Character` with `Gender:Male`. He has a `Profession:Ruler` and has an `Alliance` to Adab.[37] The relationship between the men and the king is not explicitly declared to be one of governance, because in the context of the story the role of the latter is advisory rather than

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[36] No http://URI has been found that has been assigned to the location by its ancient name, although the modern equivalent, Tell Bismaya, brings up two possible locations on Pleiades: http://pleiades.stoa.org/places/894129 (for BAtlas 91 G5 Tell Bismaya) and http://pleiades.stoa.org/places/894128 (for BAtlas 91 F4 Tell Bismaya).

[37] The settlement name appears 17 times list of proper nouns as published at http://etcsl.orinst.ox.ac.uk/cgi-bin/etcslpropnoun.cgi# and could be a suitable anchoring point facilitating cross-referencing between a number of compositions within the corpus and across other datasets online. A search of the ETCSL corpus by keyword returns references to **adab** (a type of drum), rather than the geographical site. Six texts mention the city of Adab (*Inana's descent to the Netherworld; Dumuzid's dream; the Sumerian king list; The victory of Utu-ḫeĝal; The lament for Sumer and Urim; The lament for Nibru;* the temple hymns and *The Three Ox-Drivers of Adab*). The content in which the city is mentioned is however rich with potential – In *Inanna’s descent to the Netherworld*, there are references to different regions of the city, even to specific buildings; in *Dumuzid’s dream*, not only is the city mentioned, but specifically in the context of two men who are citizens of Adab, and who are subsequently described with a phrase that alludes to a proverb. Thus, there are ample opportunities for the spread of a graph of nodes and arcs throughout the corpus, with parallel and complementary triples forming between a number of separate compositions.

governing. For expression of clarity, Man_4 has an entity property has_title (string:"king"), and he is SameAs to the $lugal_1$ entity in Character.

The cloistered lady is a Character with Gender:Female ($Woman_1$). Other than belonging to the same household as the king, little can be said of her characteristics. She is mapped as SameAs $sekrum_1$ in Character.

Throughout the story, these five protagonists interact with each other (albeit the cloistered lady and the three ox-drivers only indirectly via the king) and their possessions (in the case of the ox-drivers). These interactions are represented through a series of Events, which occur across a number of Timelines in two separate Contexts ($Context_1$ and $Context_2$).

Events on a Timeline

Events in *The Three Ox-drivers of Adab* take place across two distinct Contexts. Firstly, there is the frame story, $Context_1$, which consists of the Introduction and a small number of Events (see Fig. 36).

Context $_1$

All these Events occur on one timeline. Each subsequent Event begins where the previous has ended: the Introduction concludes when the story begins, the king leaves once the story finishes. The Introduction has been marked up to contain an instance of Event, (named $Event_1$) where the ox-drivers Gaining Bond:Enmity for each other (the quarrel). The decision to represent this part separately was based on the role of the dispute in the story: it is a vehicle for the setting of the scene in which the rest of the narrative unfolds – it is crucial to the story, and implied in their story to the king. Their decision to "seek justice"[38] has not been represented, as it is not unequivocal justice that the men wish, but rather each man hopes for the king to decide in his favour.

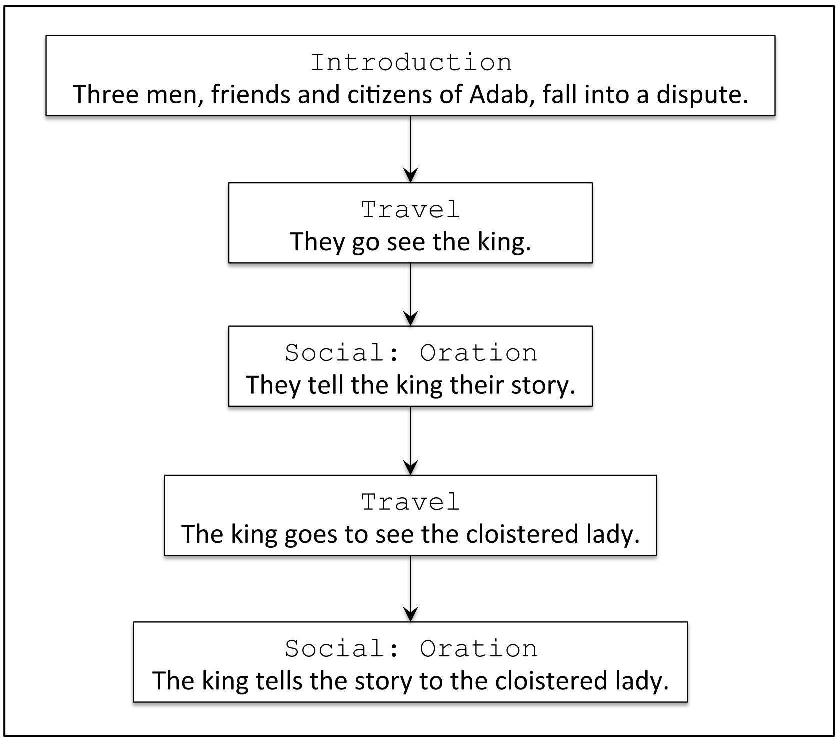


Figure 36 Context 1, the basic storyline for the *Three Ox-drivers of Adab*.

The men `Travel` between two unknown `Location`s ($Location_1$, the undescribed, unnamed place in the countryside and $Location_2$, the presence of the king, which is likely to be the palace, but this is not specified). At $Location_2$, the men tell their story to the king, an event represented as an instance of the mORSuL class `Oration`. The king then `Travels` between two unknown locations ($Location_2$, where he speaks to the ox-drivers and $Location_3$, where he speaks to the cloistered lady). Here, he repeats the story of the ox-men to her (`Oration`) and asks for her council. This latest turn in the story can only be represented in mORSuL via her reply (`Oration:Advice`).

[38] **di in-da-ab-tuku-uš-am3 di-da ab-kiĝ$_2$-kiĝ$_2$-e** refers to lawsuits.

In mORSuL, the direction of the given advice (i.e. who adviced who) isrepresented by mapping the two different Characters as being involved in two separate Oration events (specifically, Dialogue and Advice). The king telling the cloistered lady the story as told to him by the ox-drivers is a Dialogue event, for although it is only the king who is talking, he is doing so as a part of a conversation, which will also include the cloistered lady's reply. She can be represented as acquiring new information if mapped to show this as an event where she Gains Knowledge.

The second event is one of Advice, and here, only one of the Characters, in this case, the one who is Gender:Male, is involved in another event, in which only he Gains a type of Abstract-Item, which is Knowledge. All the classes necessary here already exist in OM, and it is also possible to specify the origins or type of Knowledge, be it an instance of Fact, Theory, Belief or Memory. Since the advice given by the cloistered lady in the *Three Ox-drivers of Adab is* not known, it is marked as an instance of the more generic Knowledge. Further practical implementations and trials will highlight whether this approach is sufficient in the capture of giving and receiving of Advice, or whether a more explicitly defined approach (such as a property of a Character) is necessary.

The level of granularity for Context_1 is inadequate for two reasons. Firstly, there is insufficient granularity to help identify this piece from amongst a number of other ones. Secondly, it fails to capture those aspects that show the original motivation for the creation of the text – the conundrum.

The riddle is posed as a question posed at the end of the story of the ox-drivers. It is the source of the humour, and the reason why the king must seek the advice of the cloistered lady (this latter being a characteristic it shares with another text, *the Old Man and the Young Girl*). A more detailed representation of $Context_2$ is thus necessary.

$Context_2$

$Context_2$ captures the essence of the composition, those attributes which are largely uniquely defining characteristics of the piece. It is the story within the story, and the events that unfold are concluded which a question posed as much to the audience as it is to the king.

$Context_2$ begins with an `Introduction`, as the men introduce themselves to the king .The actual tale is told in a sequence of three `Polylogues`: $Polylogue_1$ has the other men addressing Man_1, and his reply; $Polylogue_2$ has the other men addressing Man_2, and $Polylogue_3$ is for Man_3. After these verbal exchanges is $Polylogue_4$, and the men recite their story. $Polylogue_4$ contains $Event_2$, which contains other instances of `Event`: the men `Travel` between two unknown `Locations`, $Location_1$ and $Location_4$. Presumably, it is during their absence that the following `Events` occur:

- $Event_3$ the `Ox` `Action:Sex` the `Cow`,
- $Event_4$ the `Cow` `Gain:Creation` `Bovine` (`property:young`),
- $Event_5$ the `Bovine` (`young`) `Consume` `Physical:item`, and
- This `Physical:Item` `forms_part_of` `Physical:Item` (wagon).[39]

Once the tale is told, the king (Man_4) `Travels` from $Location_2$ to $Location_3$.There, he engages the cloistered lady ($Woman_1$) in a $Dialogue_1$ – the content of this instance of `Dialogue` are the same as $Polylogue_4$, thus

[39] Although the goods on the wagon are part of the physical entity (wagon) it is not a meronymic relationship, ie. The latter physical item is not partOf the latter class. The load is not a type of wagon.

representing the repetitive pattern of the composition. The final `Event` of Context$_2$ is the `Oration:Advice` between Man$_4$ and Woman$_1$, as discussed above.

This level of granularity captures the three of the main features (the frame story, the repetitive layout of the text and the conundrum), and enables identification based on those unique features. It is also sufficiently granular to capture those elements, which would support comparative textual analysis with other similar narratives. These elements include:

- men from Adab, a feature which it shares with (at least) *Dumuzid's dream* (although in the latter there are two men, not three) and
- a non-divine woman advising a non-divine man, which it shares with (at least) *The Old Man and the Young Girl*.

Representation of further detail within the content of the Dialogues is currently not within the scope of mORSuL, because it is expressing a conditional, theoretical situation. The Cow does not actually wonder into the desert; the `Ox` is not devoured by a lion. This expression of the hypothetical possibility of an action is beyond the finesse of mORSuL as it currently stands, but has been incorporated into the category of Future Work.

Property Qualifiers

The relationships between the classes were defined for the case-study example content. It is important to note that these qualities, designed to hold true for *the Three Ox-drivers of Adab* may not be universally applicable across all Mesopotamian literature. The descriptions of each property are in line with the suggestions provided by Bekiari, et al, (2013: xii – xiii).

- The relationship between the men as friends (Friendship) is a one to one (1,1:1,1:1) because each friendship exists between two individuals. The property is necessary and unrepeatable for both the domain and the range;
- The men's alliance to Adab and to the king are also (1,1:1,1:1).
- The relationship between the men and the animals has also been mapped as a (1,1:1,1:1) for each individual relationship, although this is realised to be unlikely to reflect the truth for other contexts. Owners may have several animals, although each animal would have only one owner;
- For `Physical-Item`, the ownership is classified as a one to many, necessary and dependent (1,n:1,1). An item must have a single owner, but a person can own several things;
- A person can be involved in several instances of `Oration`, `Event` and `Travel`, but each of these must have at least one protagonist. The property is defined as one to many, necessary and dependent (1,n:1,1), and
- All other properties are defined as many to many (0:n,0:n), where the property is unconstrained. Each individual domain and range can have either one, many or no instances, and thus the property is optional and repeatable for both the domain and range.

6.8 Evaluation Regarding the Use Cases

The previous sections in this chapter have illustrated the myriad ways in which the structure of mORSuL (in terms of classes and properties) can be used to represent the content of the case study composition. The final stage of the evaluation process returns to the user case examples, and discusses this case study example within the framework they create.

Firstly, use case 1, which consisted of finding a specific protagonist (Gilgameš). Since there are no named protagonists in *The Three Ox-drivers of Adab*, an identical query would not prove useful. It would however be simple to query the structure for a specific type of entity, in this case, a male protagonist (ox-driver, king):

```
SELECT  ?ome:Character
WHERE { ome:Character omt:hastrait omt:Male
}
```

A query could also be constructed to find characters who share the traits of Gilgameš, which may help bring to light similar protagonists known under a different name. This however, would require an extensive query listing each specific characteristic one by one, and since the protagonist in the case study example are not described in any other terms than their ownership of cattle and goods, the query would by necessity be have to limited to those characteristics.

Use case 2 combined a type of protagonist associated with a particular type of action. An equivalent of this from the case study text could be the instance of a group of friends falling into a dispute (in terms of mORSuL, a person in a group gains enmity). In terms of a SPARQL, to identify such an instance a query very similar to the one above would return the correct answer, where instead of a `Character` with the trait `Male`, the system was asked to SELECT instances of `Group` which were associated with the `Event Gain Enmity`.

The third use case is directly relevant to the case study example, at it is searching for instances where a male character asks a female character for advice. The query is more complex; it requires the filtering out of instances where the female consulted is a deity. It is possible to map such a narrative feature as an `Advice` event, where the `Character`s involved are specified as people (or, reversely, to FILTER NOT EXISTS those that are marked as `Divine`). The direction of the advice can be shown by having only one of the agents involved acquire information.

This case study has illustrated that, as a system, mORSuL is well suited for the representation of the case study example of Sumerian literary narrative. In order to illustrate that mORSuL would be well suited to mapping other literary compositions as a general tool (rather than one which is bespoke to the *Three Ox-drivers of Adab* alone), the other compositions as listed in section 5.3 are now revisited.

6.9 Evaluation Regarding other ETCSL compositions

The ETCSL is a vast resource containing more than 350 individual texts (Black, et al, 1998 – 2006). Even with the omission of texts that are classified as ancient literary catalogues, debate poems, diatribes, hymns, cult songs, elegies (and other songs), literary letters, letter-prayers or proverbs, there are still 69 texts to consider. These fall into six categories, and for each of those, one representative example has been chosen. The selected texts are:

- *Enki and Ninhursaga*, representative of texts which are classified as narrative and mythological compositions featuring deities;
- *Gilgameš and Aga*, an example of narrative and mythological compositions where the main protagonist is a hero;

- *The victory of Utu-hegal*, which is at least a quasi-historical, if not a true (or partly fictionalised) historical account of actual events;
- *The Lament for Sumer and Urim*, as an example of city laments; and,
- *The advice of a supervisor to a younger scribe*, representing texts, which are commentaries on scribal life.

The sixth and final example was the case-study example, the *Three Ox-drivers of Adab*, discussed above. Each of the remaining five compositions are briefly summarised below, and the suitability of mORSuL to adequately represent them, evaluated. Since the bibliographical and museological data for each composition is of the same type, the evaluation concentrates on the capture of the narrative content.

Content of *Enki and Ninhursaga*

A lengthy composition of 281 lines, the composite text of *Enki and Ninhursaga* has been complied from three known witness tablets. It is essentially a creation myth, and exhibits the same type of repetition of narrative elements as has been observed in other Sumerian literary compositions, such as the case study example.

The composition begins with an `Introduction` to the virgin `Land` and `City` of Dilmun (`Place`), including an extensive list of things and occurrences, which are not yet there. The first `Action` event, which occurs in the text, is an `Action:Sex`, as the god Enki (`Divine`) copulates with wife (both are members of a `Household`), the goddess (`Divine`) Ninsikila.[40] In

[40] Much could be said as to the symbolism and etymology of Ninsikila, whose name can be translated as "lady of pure place", which is how Dilmun is described in the text. She was also the goddess associated with the city of Dilmun (thought to be modern Bahrain), and thus the parallels between the description of the place and the goddess are almost certainly deliberate . And indepth analysis of the composition is however beyond the scope of this thesis.

the following lines, she is described as his daughter, and the two are engaged in a Dialogue about Dilmun, and the city's future. Enki makes a Pledge, and all that has been promised comes to fruition, in the form of various natural phenomena (Action:Water and Action:Environment).

The main body of the composition is a repeating sequence of events, where Enki is involved in a Action:Sex with a number of named female deities (Divine), and Marine-Travels across a body of water to reach his partner. Each in turn becomes pregnant, but each month of the gestation period is reduced to a day, resulting in the Birth of a new goddess, whom Enki then seduces and impregnates. The final daughter is Uttu, and she receives Advice from Nintur, as well as engaging in a Dialogue with Enki, who is turn goes through a temporary Transformation in order to appear to Uttu as the gardener.

They too proceed to take part in an Action:Sex, after which Uttu Laments that Enki has ejaculated onto her thighs. Ninhursaga cleans the semen from Uttu's thighs, and in a section that is fragmented, plans of various descriptions and names are grown. Enki and his minister Isimud engage in a Dialogue regarding the destiny of the plans, and Enki proceeds to eat (Action:Ingestion) each in turn, determining their fate (Social:AssignmentOfDuty). Ninhursaga Curses Enki, whilst a Fox and Enki engage in a Dialogue. The Fox then goes through a Transformation, and engages in a Dialogue with Ninhursaga.

After some fragmentary lines, Ninhursaga Travels to a Temple, where she engages in a Dialogue with Enki, regarding parts of his body that pain him. From each, a new god or goddess is born, and their duties and marriages are determined at the conclusion of the composition.

Evaluation of the suitability of mORSuL to capture *Enki and Ninhursaga*

The myriad classes and properties in mORSuL make it well suited to the representation of the inscription known as *Enki and Ninhursaga*. The consistency of the granularity of the captured data is not entirely consistent throughout, as the details provided in the story vary from place to place. Thus, for example, `Action:Sex` is ideally suited for the representation of the copulation between Enki and all the other goddesses, except for Uttu, because the story itself gives more detail of the event, including those, which are (at least seemingly) significant in the narrative context. Nevertheless, no clear examples could be identified of any evens which were essential to the arch of the story that mORSuL could not represent at any level – that is to say, even if not suitable for capturing every nuanced detail of a part of an event, those elements which are significant in the unfolding of the story can be successfully mapped onto mORSuL. It can thus be shown that the ontology is suited to the representation of literary compositions that are classified as narrative and mythological compositions featuring deities.

Attention now turns to assessing the suitability of mORSuL to capture and represent the narrative content of compositions where the main protagonist is a hero, rather than a divinity. The representative example chosen for this category of text is *Gilgameš and Aga*.

Content of *Gilgameš and Aga*

The composite text for this piece has been compiled from 16 witness tablets, and consists of 115 lines. It is a story of the build-up to a military conflict between two city-states, Kiš and Unug.

The text begins with envoys (Group) of Aga (Character) , who Travel from Kiš to Unug. Gilgameš engages in a Dialogue with the elders (Group with Males who are Trait:Old), regarding whether or not to engage in a battle with Aga. They Advice him against it, but Gilgameš is not convinced. Instead, he engages in a Dialogue with the young men (Group with Males who are Trait:Adult), who encourage him to smite Kiš.

Within a few days, Aga lays Siege on Unug. Birḫar-tura (Character, Male) Travels to Aga and imprisoned. When one of the men of Unug climbs the rampart, Aga and Birḫar-tura have a Dialogue about whether or not the man is Gilgameš, including listing Traits. Aga's men subject Birḫar-tura to Corporal Punishment, but eventually Gilgameš and his troops have a Victory over Aga, and he is captured. Recalling good deeds in Aga's past, Gilgameš sets him free.

Evaluation of the suitability of mORSuL to capture *Enki and Ninhursaga*

mORSuL is suitable for the capture of most of the features in this text. There are few details, which would require additional elaboration or extension of the ontology, and none that could not be represented by mORSuL to a significant level of accuracy. The only notable exception to this observation is the action of imprisonment, which does not itself appear in mORSuL, although it could be represented via more indirect routes, such as a type of Transformation (from a state of being free to a state of being captured).

Since it can be confidently concluded that mORSuL is very well suited for the representation of texts which have a hero as the main protagonist, attention now turns to the evaluation of the ontology in the case of compositions which have a historical background.

Content of *The victory of Utu-hegal*

This composition is an example of texts, which are classified as pieces of literature with a historical background. That is to say, that whilst the events which occur in the context of the story might not be entirely accurate, it is likely that the composition is at least partly based on actual events.

The victory of Utu-hegal as published on the ETCSL consists of segments combined from three cuneiform tablets, and spans 62 lines. It is a story of the war between Utu-hegal, and Tirigan, the king of Gutinum, and contains the recounting the route travelled by Utu-hegal and his army.

Enki (Divine) AssignmentOfDuty to Utu-hegal (Character, Male) to engage in Destruction of Gutinum (Place). Utu-hegal Prays to (Divine) Inanna, and Gutinum lays Siege on Unug (City). Utu-hegal brings about Transformations in the surrounding Environment. He then Travels to the Temple of (Divine) Iškur, and addresses (Oration) the people (Group) of Unug (City).

Utu-hegal then Travels for four days from the Temple of Iškur, reaching Nagsu (Place) on the Surungal Canal. The next day, he Travels to Ili-tappe (Place). He captures the two named generals (Character, Male) of Tirigan. He Prays to the raising (Celestial Body-Rise, Divine) Utu , lays a trap, and captures the army of Gutinum.

Tirigan flees (Travel) with his family (Household), but is captured – he is handcuffed, blindfolded, made to lie in the dirt at Utu-hegal's feet, and subject to the supremacy of Utu-hegal.

Evaluation of the suitability of mORSuL to capture *The victory of Utu-hegal*

This text differs from the others discussed thus far with a more obvious and clear used of euphemisms and culture-specific expressions of power and subordinance. Whilst mORSuL can be used to represent most of the content of the composition, the final stages, which account for Tirigan's escape, and subsequent humiliation, are less straightforward in their representation .

A case in point is the final section, where Utu-hegal's victory is complete when he places his foot on Tirigan's neck. The action could be captured as one involving these body parts, but would need to additionally be captured for the true meaning of subjugating a prisoner. Whilst `Action:Violence` might be used in this case, it is important to note that the act itself may not be physically violent, although is evidently meant to be psychologically, mentally and emotionally distressing to Tirigan. In the absence of a better-suited class or property, this moment is best captured as a `Punishment`. Whilst an accurate, it arguably fails to truly capture the nuance of the situation.

In terms of the narrative arc of this inscription, mORSuL is capable of representing each of the major narrative events in the storyline, including travel from various places, and the prayers said to different gods and goddesses. The next stage of the evaluation process is to asses whether it is equally suited to the representation of city laments.

Content of *The Lament for Sumer and Urim*

This composition is the longest of the ones considered as part of the development and evaluation of mORSuL, consisting of 519 lines. It is also the one for which there are the greatest number of witness tables (a total of 59 cited tablets). It is the telling of the destruction that has befallen Sumer and the city of Ur at the fall of the Ur III period. Although the locations (Sumer, the city of Uruk) , protagonists (Ibbi-Sin is a historical character) and events (the Ur III Dynasty did fall) are grounded in reality, the composition should not be classified as historical writing (Michalowski, 1989: 9). Due to the length and repetitive nature of the composition, the context is described below in generic terms, rather than from the perspective of each named protagonist. Furthermore, the description has been limited to the first 281 lines only.

The gods (`Divine`) An, Enlil, Enki and Ninhursaga have decided to `Destroy` the land of Sumer (`Place`) and the `City` of Ur. Listed for destruction are myriad `Places`, `Building`, animals (`Zoology`), `Area`s and `Character`s. The gods create `Transform:Environment` affecting `Water`, `Arable-Land` and there are several distinct `Destroy Events` in which different gods decimate buildings, areas and people.

`Environmental` chaos brought on my the gods causes society to deteriorate. There is much `Violence` and many named `Character`s `Travel` from their `Palace`s and `Temple`s and `Lament`. This pattern repeats in various configurations for the entirety of the lines until the break at like 281.

Evaluation of the suitability of mORSuL to capture *The victory of Utu-hegal*

Much of the described destruction is expressed through symbolic acts:

> "They destroyed Gaeš like milk poured out to dogs..."(line 188ff)

Although the language used in the description is rich, and could be extensively represented in a literal sense of the capturing the symbolism (that is to say, it is possible to map the second quote as having an instance of `Dog`), much of the true `Event`s that occur in the narrative are essentially a `Destruction Event`, with the richness of the text included as types of literary tools such as similes, metaphors and allegories. Whilst it is possible to use mORSuL to capture the terms used in these rhetoric devices, care must be taken to also adequately map their occurrence in the context of the description of the `Event`, and not as an `Event` in their own right.

The issue of granularity of representation thus becomes a major consideration in the evaluation of the suitability of mORSuL. The classes in this complex structure are unable to truly capture the above quote (the is no class for the act of pouring, nor a specific way to refer to milk when it is not a consumed commodity). However, the `Event`, which is being described (`Destruction`) is easy to map to mORSuL. The decision of the level at which the representation is to occur will ultimately fall to the user, but even if choosing to limit the mapping to major events in the plot, the resulting data would be rich and meaningful (several relationships of cause and effect can be seen).

This level of granularity may differ between composition types, however, as is illustrated by the case of the final example text, *The advice of a supervisor to* *a younger scribe*. It is a commentary on scribal life, and is considered at their most basic level, consist of nothing more than a `Dialogue`.

Content of *The advice of a supervisor to a younger scribe.*

This text is composted of 39 witness tablets, and spans 74 lines, of which only the final 15 include fragmentations and missing lines. The entirety of the inscription is a conversation between a learned scribe and his supervisor, and begins with the latter recounting the lessons he had learnt from his teacher, which he now wishes to pass onto his student as an act of graciousness. The younger scribe responds by recounting all the things he has already accomplished, and by defending his honour, is awarded the "honour of being a teacher" (line 68). The content of the text is thus not a dynamic tale of various events, but rather accounts for the social and moral codes to which a scribe ought to adhere to, and the daily tasks they should perform.

Evaluation of the suitability of mORSuL to capture *The advice of a supervisor to a younger scribe.*

The recalling of his youth by the supervisor needs to be viewed not as imply a `Dialogue`, but also as a instance of `Memory`. This is also true of the younger scribe accounting for his actions, and the scribes can also be shown to be engaging in the `Gain`ing of `Knowledge`. Individual features of the composition may also be picked out (mentions of `Rejoicing`, for example), although much of the richness of this text lies in the use of rhetoric devices, similarly to the ways as have already been discussed in the context of the other texts, and there remains little in terms of narrative structure, which could be mapped. The limitation is thus not one of mORSuL being insufficiently complex, or in other ways unsuited to the task, but rather that there is insufficient complexity inherent in this composition for it to lend itself well to the task. Since the content can still be represented using mORSuL classes, it would be possibly to query this text as an instance of a `Dialogue`, in which certain other entities occur.

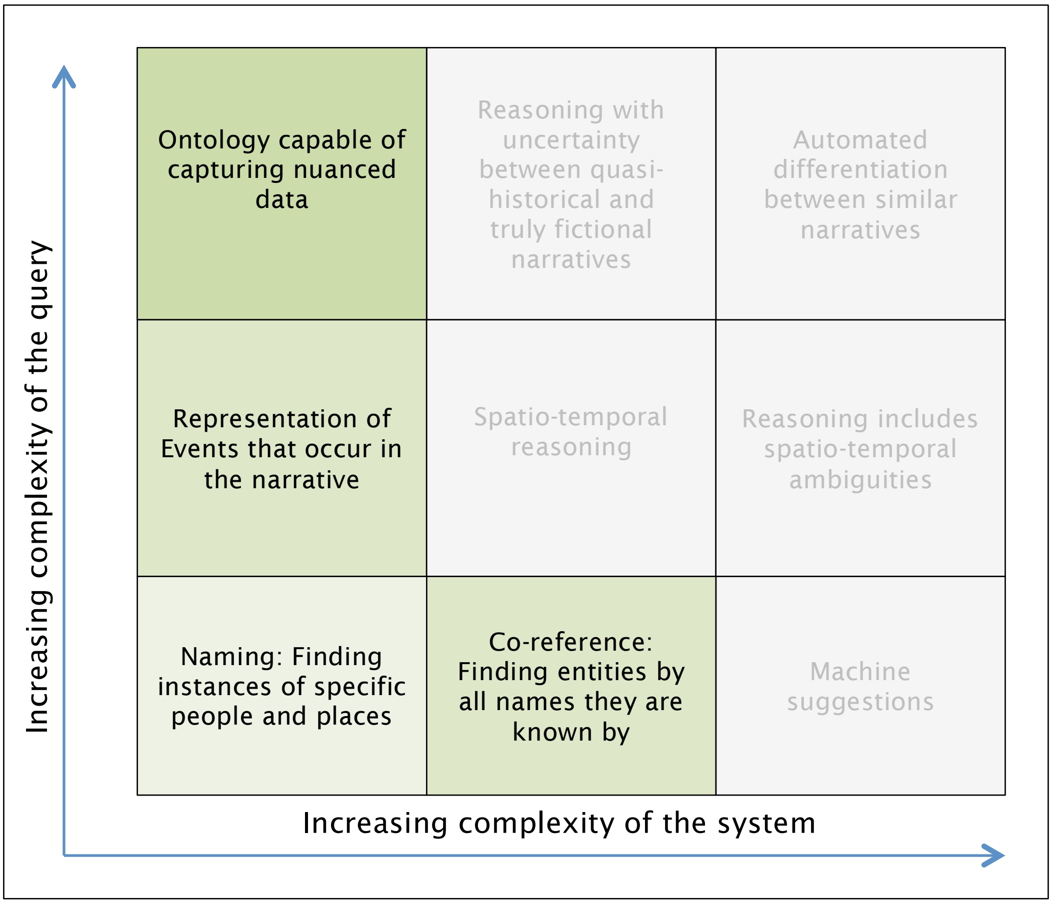


Figure 37 The scope of mORSuL, in terms of the levels of complexity of possible queries.

Evaluated against all six types of composition has led to the conclusion that mORSuL could be used to map data so that queries, which target specific types of individuals, or named characters, could be completed successfully. It is also possible to represent myriad different types of events, which occur in the narrative. It may not be sufficiently complex to support the most complex types of system, but it does enable complex queries (see Fig 37).

6.10 Conclusion

In this chapter, mORSuL was evaluated first again a specific case study example in a in-depth discussion of suitability and usefulness. In order to ensure that mORSuL has universality, and is not a bespoke structure simply to capture the *Three Ox-drivers of Adab*, it was also evaluated against five other compositions, each of a different type. mORSuL was found to be suitable for the representation of all six types of text.

The case-study example is a humorous conundrum, telling the story of three men who argue over the ownership of a calf, and seek advice from the king. The king in turn seeks the advice of a cloistered lady, whose reply (and thus the solution to this millennia old riddle) are lost due to the fragmented nature of the witness tablets. Neither of these original tablets has a robustly determined geographical context nor a reliably assigned date of origin. It is likely that both were written by bilingual scribes: such a conclusion is supported by the appearance of Akkadian glosses and the possible scribal mistake, which led to a mistake in the early translations of the piece.

The composition has a narrative structure that is represented as two separate contexts, the frame story structure of the narrative. The first is the underlying foundation, with minimal detail, which maps the movements of the protagonists in the wider milieu of the diegesis. The second consists of the dialogues and polylogues, used as a literary tool for conveying the riddle itself.

The granularity inherent in mORSuL was shown to map many of the key elements in the composition, which allow for the conclusion that a system utilising this ontological structure would be sufficient for the identification of this composition from amongst other, similar ones. The complexity of mORSuL allows for the representation of various different elements in the story, and often classes are superfluous, rather than wanting, although none where found which were not useful in any scenario (that is to say, not all classes are used to represent all texts, but all are used for at least one). The universal applicability of mORSuL was proved with an evaluation against six different types of composition.

When compared to the user case examples set out in Chapter 5, mORSuL can be shown to be suitable for the representation and querying these types of questions, which were selected as reflective of the types of questions that scholars traditionally ask. The nature of future scholarship, and the types of questions, which new generations of scholars may ask, have not been speculated upon explicitly.

Future circles of evaluation and adaption should seek to trial queries which extend beyond the complexities outline in this thesis, for example, to include filters to concentrate on a particular scholar's work, or to focus on a specific collection, perhaps using external elements such as author's VIAF identifiers as an anchoring point, bridging mORSuL-generated data into the realm of LOD.

Chapter 7: Future Work

7.1 Potential

There are numerous different avenues for potential expansion for mORSuL. These encompass further technical advances (which would both increase the suitability of the multi-ontological structure to represent the literary genre in particular, and enable a finer-grained mapping of the nuanced and multi-layered content) and the extension of the dataset. Myriad possibilities are seen with regard to incorporating material from traditions which fall beyond those of Sumer and Akkad, to include those of modern day Iraq, the oral traditions of the Kurdish and other ethnic minorities in the region, as well as Biblical narratives (including the much later and even modern reinterpretations of those themes).

mORSuL could be further developed in three distinct ways. Firstly, there is the realisation and practical implementation of a closed system, in which it would play a role in the mark up of the data and the generation of RDF triples, which would replace and expand upon the ones produced in the course of this study and presented in Appendix F. Such developments would involve many pragmatic considerations and decisions (such as those regarding the storage and maintenance of data, for example), but can be understood to not extend to the further development of the ontological structure. Whilst likely to necessitate the creation of a research team, this development would be realistically achievable with the use of existing tools and interdisciplinary skills (see section 7.2 for further details). In order to benefit from the wealth of information available on the Web, any system incorporating mORSuL would need to be, in the first instance, implemented in practice. The process would incorporate the publication of ETCSL data in adherence to the LD Five Star criteria (as outlined in Chapter 1).

Secondly, there is the possibility of extending the existing ontology resulting in a structure perhaps more in-line with the world view of the ancient people's whose literary traditions it was designed to capture. Ontologies reflect the perceived realities of their creators, and it is certain that the world-view held by ancient Mesopotamians differed from those of modern scholars. As such, other elements, which more accurately reflect the former, and are less in line with the perspectives of the latter, could be developed. This, however, would necessitate the involvement of additional specialist in many distinct subsets in the fields of Assyriology and Sumerology, and would be the result of a paradigm testing (if not altering), largely interdisciplinary research project.

Thirdly, there is the opportunity to diversify and extend the dataset to incorporate data from other datasets, disciplines, and authorities, creating a project, which would more accurately be in the realm of Linked Open Data. Additional material could be found from the content of the ETCSL, as well as other Sumerian texts that have thus far fallen beyond the scope of that resource. In the long term, this dataset could be extended to include Sumero-Akkadian bilingual compositions, as well as the literary traditions of later periods, and the sister cultures of Assyria and Babylonia. New research agendas could draw enriching information from the traditions of other peoples in the area, both in terms of historical and ethnographic examples. Complementary data could also be found from other, more distant disciplines, such as environmental data, ice-core samples, gazetteers and others. This project would be a long-term, multi- and interdisciplinary endeavour, and has the potential to bridge Sumerological data to other external bodies such as VIAF, DBpedia, Library of Congress and myriad others.

7.2 Practical implementation

The first intuitive step in the practical use of mORSuL in a project would be to use it to generate RDF triples, which would replace and expand on those available in Appendix F. The dichotomy of expertise in both Assyriology and semantic technologies has been noted in the course of this thesis, however, there are tools such as Open Refine (http://openrefine.org/), which have a graphical user-interface and thus lend themselves well as tools for those whose areas of expert knowledge are in domains other than Computer Science. Another, open source data annotation tool, Karma (http://www.isi.edu/integration/karma/) allows the mark up of data using any ontologies (including bespoke ones), and the publication of data as RDF (turtle). The final decision as to which tool to use to generate may require some further investigation and practical trials – however, since the ETCSL data is available as XML, and Karma supports hierarchical data structures (as well as tabular data), it seems a likely suitable candidate for any future project.

These tools could be used by scholars or students of Assyriology to capture museological and philological data from a ETCSL-based dataset. The resulting triples could then be combined with those produced using the Brat annotation tool (see section 6.5 and Appendix F) in a triplestore, such as Virtuoso (http://virtuoso.openlinksw.com/). Additionally, and depending on the chosen triplestore, elements such as reasoners and faceted browsers may be added. These include purpose-designed interfaces such as Pubby (http://wifo5-03.informatik.uni-mannheim.de/pubby/), which could be added to a SPARQL endpoint.

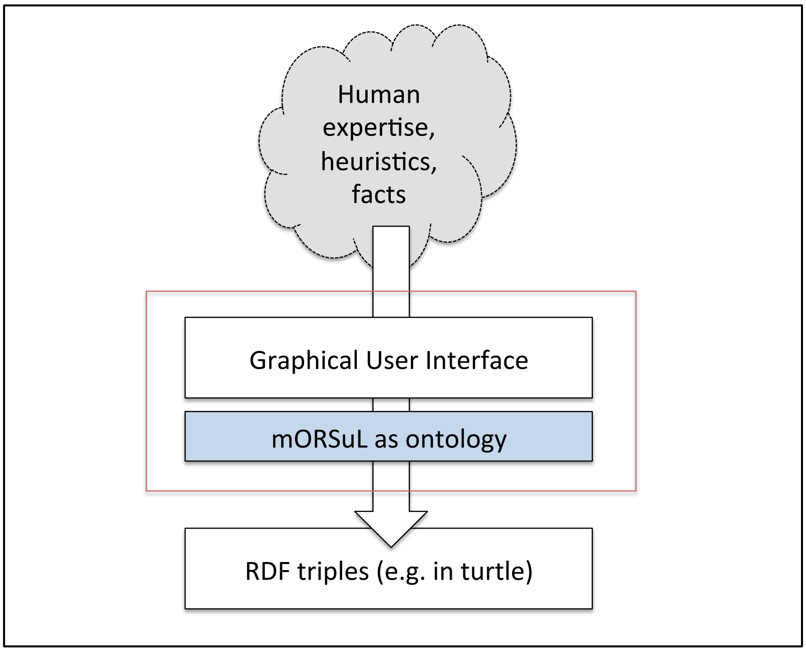


Figure 38 Karma, highlighted in red, is a data annotation tool, which allows the user to engage with a graphical interface and ontologies of their choice (e.g. mORSuL, highlighted in blue) to create RDF triples.

The process of creating RDF triples would necessitate the minting of URIs for each subject, property and object within that dataset. Of these, the ones that are most immediately of interest are those assigned to places, people and protagonists in the stories, as these can serve as anchor points to other, external data sources, and providing a tangible example of true Linked Data. Modern scholars and authors may have VIAF (http://viaf.org/) identifiers, to which they could be linked, and geographical locations to gazetteers such as Pelagios (http://pelagios-project.blogspot.co.uk/p/about-pelagios.html). In time, links could also be made to projects such as SNAP:DRGN (http://snapdrgn.net/about).

Beyond these steps, the future development of mORSuL could see the practical implementation of an expert system[41] incorporating the ontology as the representation of its knowledge base[42]. Reasoners such as the Cwm,[43] (http://www.w3.org/2000/10/swap/doc/cwn.html), a W3C recommended, general purpose data processor and forward-chaining reasoned could be used: alternatively, there is Prova, a SW rule engine which supports SPARQL queries, RDF and OWL ontologies (http://prova.ws). Reasoners will allow for the inference of implicit facts and connections between the triples, and will contribute towards a data analysis project, which is more likely to be a successful implementation of semantic technologies (cf. the use of Linked Data).

A new, custom-built and project specific user-interface, inclusive of features such as drop-down lists and machine recommendations (as described for ResearchSpace by Oldman and Norton, 2014) ought to be created to facilitate the bridging of the dichotomous groups of cuneiform experts and those who SPARQL. The system behind ResearchSpace, Information WorkBench, is a likely first step for any further analysis of an alternative practical implementation tool. The steps of future testing, evaluation and editing would necessarily follow.

An ontology representative of the ETCSL data (which in this thesis resulted in the conceptual model of SuLO) could also be revisited or created by the use of automated tools and natural language processing technologies. Such a project would result in an empirically deduced ontological structure, which could be

[41] Experts systems, in line with the highly eponymous and often absolutely descriptive nature of naming processes in Computer Science , is a computer system whiose function is to reproduce or at least emulate the decision-making procedures of human experts.

[42] A knowledge base is used to store complex structured and unstructured data and information for use by an computer system (see previous footnote) e.g. triplestore.

[43] Pronounced “coom”

compared and contrasted against mORSuL to engage the extent to which the latter is truly a representative of the dataset. The considerations for and against such an automated process can be found in Wilks and Brewster (2006). Such an empirically-derived ontology might also be used in conjunction with a parser such as the Penn Parsed Corpus of Sumerian (PPCS) as used by Oracc (http://oracc.museum.upenn.edu/doc/help/languages/sumerian/syntax/), although the latter is not currently active.

7.3 Extending the structure of mORSuL

In the short-term, few elements, such as the addition of Questions as a subclass of Oration or the declaration of property qualifiers systematically across each property throughout mORSuL would be carried out. Other developments would be those linked to the more efficient and accurate capture of philological annotation and the detailed representation of a greater number of case-study texts to test the robustness of the structure. The possibility of expressing a hypothetical action would also be research and if found feasible, incorporated.

The future of the system could also entail the more extensive expansion of the ontology, taking heed from the model used in OM. mORSuL could be extended with a collection of purpose-built sub-ontologies, each reflective of a specific category. Such an extension would also be an opportunity to revisit and possibly incorporate the ontologies designed by Alivernini (2006, for grammar), and Jaworski (2008, Ur III economic tablets).

The creation of numerous sub-ontologies would provide the user with the freedom of choice. These additional ontologies would facilitate (in particular) a comparative analysis between manifestations of the same groups of words, concepts and things across myriad genres of material. Information from other categories of data could be used to supplement and enrich the ETCSL data; sources such as lexical lists, dictionaries, administrative records, sales receipts could be used to compare and contrast between differences and similarities between ancient Mesopotamian truth and fiction.

Should the research undertaken for the purposes of this doctoral thesis be extended in the long term, it would provide an opportunity to extend and develop mORSuL. Such a move would allow for the incorporation of the work as carried out by Holmen, et al (2009), who assessed the suitability of the CIDOC CRM for inference of event chronologies from cultural heritage data. An interesting future research agenda would assess the possibility of determining, for example, whether compositions could be shown to have emerged soon after (or much later) a historically verified event took place. Furthermore, the research by Hyvönen, et al (2011) into inference based on spatio-temporal change and uncertainty with regard to historical locations and diachronic change could be benefitted from. Inference based on information from factual and historical texts, as well as archeolgical data, might even help shed some new light on some of the long-standing mysteries of Assyriology, such as the location of Agade.

Finally, in the long-term, if work with mORSuL is to span years and decades, regular revisits to the definitions (scope notes) are necessary. Applying lessons-learnt from the CYC project, the phenomenon of “predicate drift” (Wilks and Brewster, 2006: 49), continued work on mORSuL should include confirmation that structures, relationships and the dataset facts have not changed or become reinterpreted since this, the original implementation, of the ontology.

7.4 Extension of the dataset

Possible future developments are not limited to the change and extension of mORSuL, but also apply to the dataset. With the diversification of the ontology, further opportunities arise for the incorporation of other, non-literary genres. In addition to those examples already cited, analysed data could incorporate vaguely defined pieces: omens, hymns and songs. Historical texts, such as personal letters or royal correspondences could also enrich the Sumerian content, although these texts are complex and difficult, and would certainly require the contribution of Assruiological experts. Another specialist area that can be highlighted here as being of particular interest is the study of the corpora of medical records (tentatively described as a mix of both fact and interpretation of what were logically inexplicable phenomena). If wishing to stay within the remit of literature exclusively, additional compositions, known but not incorporated into ETCSL, could be added to the queried dataset (such as *the Old Man and the Young Girl*).

The most likely collaborators however would be those of the CDLI and possibly Oracc. Of these, as of summer 2014 the former is known to have applied for funding for the publication of the project data in adherence to the LD paradigm; the latter remains the only known project with Assyriological philological data to have published data as LD (see Chapter 3).

Akkadian content

Beyond this Sumerian content, the most likely source of enrichment for the ETCSL data can be readily identified in the corpus of bilingual texts, and furthermore, from the Assyrio-Babylonian compositions of later periods, such as *the Legend of the Tooth Worm*, or the aforementioned ***Šūtur eli šarrī*** and the later ***Ša naqba īmuru***, as well as the Babylonian Creation myth, ***Enûma***

eliš. Indeed, online resources such as Oracc provide a cornucopia of suitable material with which the existing dataset could be enriched, if limitations of language (no longer exclusively Sumerian) and genre (written material other than literature) are removed.

Material from other Near Eastern cultures, ancient and modern

Interdisciplinary research into the cultural adoption or polygenesis of narratives could be carried out if a wider net was cast to include the literary traditions of those cultures which neighboured the heartland of southern Mesopotamia (Hittites, Elamites, and others). Earlier scholarship into Sumerian proverb collections discussed existing parallels between modern Arabic and ancient Sumerian examples, and helps illustrate the potential connections, which can result from interdisciplinary, inter-textual analysis:

The proverb:

gub-gub-bu-de$_3$ tuš-tuš-de$_3$ zib$_2$ anše dab$_5$-dab$_5$-be$_2$-de$_3$ dumu lugal-la de$_2$-de$_2$-de$_3$ a-ba zi-bi mu-un-tuku

“To stand and to sit, to spur on the donkeys, to support (?) the prince: who has the breath for that?” (Black, et al, 1998-2006)

The proverb quoted in *Gilgameš and Aga* (ll. 25-28):

25 **gub-gub-bu-de$_3$ tuš-tuš-u$_3$-de$_3$**

26. **dumu lugal-la da ri-e-de$_3$**

27. **zib$_2$ anše dab$_5$-dab$_5$-be$_2$-e-de$_3$**

28. **a-ba zi-bi mu-un-tuku-e-še**

" "Standing on duty and sitting in attendance, escorting the king's son, and forever grasping the donkey's reins -- who has that much breath?", as the saying goes." (Black, et al, 1998-2006)

Modern Arabic proverb (transliterated):

"Ana amīr wa inta amīr wa mīn haysūg al hamīr"

"I am a prince and you are a prince, so who will drive the donkeys?" (Arnander and Skipwith, 2000:61).

In the light of such examples, it does not seem unreasonable to speculate as to the possibility of narratives similar to those listed in the ETCSL still (or again) existing in the oral traditions of the peoples of the Middle East.

In the aftermath of a paper given at the American Schools of Oriental Research (ASOR) in November 2013, a potential partner for future collaboration was found: Dr van der Steen, whose research on Bedouin heroic epics from the Levant provide rich and semi-ethnographic source material. Finding parallels between these oral traditions and the ETCSL is an interesting topic with great potential, but one that nonetheless falls beyond the scope of this thesis. Since van der Steen's data has not been previously published online, comparative analyses incorporating it can clearly be seen to have a number of unforeseeable research outcomes.

There is also the possibility of adding further datasets, and with online publication, the possibility of mapping the universality of certain narratives, feeding (and perhaps even answering) some of the existing conversations of Narrative theory – are there truly only a set number of different stories which map the entirety of the human experience; are reappearing stories always, no matter how indirectly, the result of cultural assimilation rather than polygenesis? Any future steps in the development of mORSuL should first and foremost test the suitability of the ontology (as is) to represent these different literary traditions, evaluate that success, and only if found lacking, to edit the ontology as necessary.

Other data

Since OM was purposely designed to capture the narratives of modern science fiction and fantasy, its inclusion into mORSuL also enables the comparative analysis of ancient and modern, even futuristic storylines. Many references to Sumerian and Mesopotamian culture are known in the genre of popular culture, including modern cinema such as *Ghostbusters*, *the Evil Dead, the Scorpion King* and *Queen of the Damned* ,[44] although the historical accuracy and reliance on Sumerological fact vary, and in general, the use of the term is to convey an ancient mysticism. At least one instance of a Sumerian incantation, read out in the original tongue, is known to have aired on television (*Buffy the Vampire Slayer*, season 4, episode 21).

Few examples citing Sumerian content seem to do so deliberately – one example is the truncated retelling of the *Epic of Gilgameš* by the character Captain Jean-Luc Picard as part of the StarTrek franchise,[45] and other similar instances could be identified based on similarities. The unavoidable reduction in the nuances of the story can also bring about less obvious parallels, such as the birth-story of the character Elora Danan in *Willow* and those of Sargon and Moses.[46] Identifying such instances may not directly influence the reinterpretation of the original composition, but adds to the overall biography

[44] The latter two are references to Akkadian, rather than Sumerian.
[45] StarTrek The Next Generation, season 5, episode 2, “Darmok”.
[4646] Each of them was, soon after birth, placed in a makeshift raft and sent a float on a river on their own, by their mother or another maternal character close to them, a sacrifice made in order to protect them from harm. Each was in turn adopted by those who found them, and rose to glory.

of the recognisable narrative. Such instances are also likely to help engage audiences for museum exhibitions such as *Babylon: Myth and Reality* (Finkel and Seymour, 2008).

Fiction aside, other types of new datasets could also be used to extend mORSuL data. In the concluding weeks prior to the submission of this thesis, the Getty vocabularies have been published as Linked Open Data (http://www.getty.edu/research/tools/vocabularies/). These vocabularies, which include a gazetteer (the Getty Thesaurus of Geographic Names, TGN), a Thesaurus for Art and Architecture (AAT) and the Cultural Objects Name Authority (CONA) were not considered in the earlier stages of this thesis, as they did not adhere to the LOD publication paradigm prior to August 2014. Other potential resources include VIAF (http://viaf.org/) and DBpedia (http://dbpedia.org/About). The potential for future collaboration is clear, and extensive.

7.5 Conclusion

There are myriad identified opportunities for the future development of mORSuL. These range from the practical implementation of an expert system, and the online publication of the ETCSL data, to the extension of mORSuL and the examined dataset, in various different ways.

Technologies and tools necessary for the pragmatic realisation of a system incorporating mORSuL have been suggested, the underlying common element being that of Open Access licensing and adherence to W3C standards and recommendations. Suggestions and calculations for the direct and indirect costs involved have not been attempted: much depends on the aims of any project that might incorporate it (as well as other considerations such as the size of the resulting triple-store).

Many different aspects have been considered for the extension of the structure of mORSuL. These extensions could further develop this ontology as a domain-specific structure, one more respectful and reflective of the perspectives and perceptions of the ancient peoples whose work it captures. Simultaneously, mORSuL could be extended to incorporate many different avenues of identified complementary data. Whether or not these would result in an overtly cumbersome and complex system remains a question which only future research, implementation and evaluation can solve.

The extension of the dataset would allow for more complex and interdisciplinary research agendas. Enriching the ETCSL data with literary traditions of the Akkadians, Assyrio-Babylonians, Hittites and other ancient cultures in the area could help answer questions regarding cultural adoption and might support prosopographical study (when people move, they take their stories with them, when people travel, they come back with stories they've heard). Further beyond the remits of temporal constrictions, ETCSL could be compared with modern Arabic sayings and literature, and contrasted further still against the oral traditions of the Bedouin peoples. Casting aside limitations of temporal and spatial boundaries, future research could examine the nature and causes of universally known narratives.

Chapter 8: Conclusion

The aim of this doctoral thesis has been to assess the suitability of existing OWL ontologies to represent the content of the ETCSL in general and of those compositions, which fall within the category or genre of “Wisdom literature” in particular. Three ontologies were identified which were felt, intuitively, to be most suitable: the CIDOC CRM, FRBRoo and OM. Of these, the first was for cultural heritage data, the second for bibliographic data and the third for the mapping of the narrative content. Each of the three was assessed in turn, and they were found to be in many ways adequate but to also contain numerous superfluous classes. These ontologies were all to a greater or lesser extent designed to capture data-types, which do not exist in the ETCSL. To better understand this conclusion, a chapter recap follows, as does a summary of finding. This chapter, and thus this thesis, culminate in a few final thoughts.

8.1 Chapter Recap

From the outset, the seeming dichotomy of the methodology (semantic technologies in general) and the dataset seemed, at best, curious. In many ways at the opposite ends of the spectrum of human expression through written material, the oldest of known writings and the most cutting-edge of online technologies might make strange bedfellows – instead, the marriage of these two disciplines has resulted in an interesting and worthwhile academic endeavour.

The aim of this doctoral research has incorporated the creation of new knowledge, and the achievement of better understanding of an inherently interdisciplinary topic. This has been achieved through a process of original research concerning Sumerian literary narratives and existing, purpose-built ontological structures.

From the perspective of Sumerology and Assyriology, the scholarship documented herein is currently unparalleled. Although ontologies for the representation of economic tablets of the UR III period and of the Sumerian grammar are known, this thesis is unique in its capacity of mapping the narrative structure of ancient Sumerian literature.

As for the Digital Heritage and Humanities perspectives, although the CIDOC CRM, FRBRoo and OM have been developed and tested on other cultural heritage data, the complexities of the data and its incomplete, heterogeneous nature were an ideal test scenario for the robustness and inclusiveness of these ontologies. The omniscient perspective from which each of them was designed resulted in a large number of unnecessary or redundant elements included in each structure.

Many interesting and engaging research topics were found to fall beyond the remit of the thesis, and allocated to future work. In many instances, the limitations of time and scope of the research agenda excluded the possibility of further interdisciplinary and in-depth analyses and parallel investigations.

Chapter 1

The first chapter of this thesis provided an introduction to the research agenda, and was an opportunity to define the oft-occurring terminologies of Assyriology, semantic technologies, suitability, philology and narrative. The main focus of this thesis has been on Sumerology, a subset of Assyriology, but in many ways the two are inseparably interlinked, and due to the small number of Assyriologists globally, essentially the same academics or at least colleagues working in close quarters. It seems no exaggeration or error to say that to understand the processes and paradigms of literary Sumerology (a niche within a niche) necessitates the knowledge of those of Assyriology.

Semantic technologies are in many ways at the foreground of development and scholarship in Computer Science. So much so, arguably, that many issues are still a matter of debate, and applications and methodologies are often without absolute criteria: there are many ways to build an ontology, for example, and whilst that gives the coder almost ultimate liberties, it also removes many of the support systems and guidelines as would be imposed by a more rigorous heuristic framework.

The notion of suitability centred on the extent to which the existing ontologies could be shown to match the data as provided by the ETCSL. In order to do accomplish this, the ETCSL was analysed (Chapters 3, 5 and 6), and the specific data types within it identified and listed. The structures of the ontologies were then tested against those findings, first in general terms in Chapter 5, and then against a specific case-study composition in Chapter 6.

“Narrative” has seemingly endless possible applications, ranging from the interpretation of a given archaeological site to the visitor experience at an cultural heritage facility. The term can encompass object biographies, museological processes and personal reflections relating to a specific object or location. In the context of this thesis, none of the scenarios listed above apply: the narrative was defined as specifically the way in which the chronological events which make up the story of a given composition are presented, including analepsis, story arcs and other literary devices.

Chapter 1 was also the opportunity to outline the rationale of the project as a new and innovative approach to representing Sumerian literature. The data was introduced and explained, and the separate methodologies as applying to different aspects of this interdisciplinary research topic were described. Whilst the study of the Assyriological content was largely those of philological analysis and corpus linguistics, the practical implementation of the semantic technologies was a more hermeneutic endeavour, benefitting from existing ontologies and lessons learnt in the process of observing other projects and indeed prior postgraduate scholarship of the current author.

Chapter 2

The second chapter detailed, at length, the heuristic framework necessary for the understanding of the dataset. The literary compositions as published by the ETCSL were written in Sumerian, and an understanding of that ancient language, in its nuances, manifestations and grammar is essential to the understanding of the literature it produced. Other elements, such as the role of scribal education systems and the extent to which Akkadian permeates almost every part of current knowledge and experience of Sumerian are crucial when attempting to sufficiently grasp the cultural and scholarly background of the chosen data.

Many issues complicate the process of comprehension of Sumerian features and nuances, subtleties of connotations, associations and rhetoric devises. Not the least of these is the linguistic isolation of Sumerian in the tree of world languages – although numerous and extensively disparate theories have been put forward throughout the history of modern Sumerology, no other language, neither living nor dead can be said with any certainty to be related to this ancient tongue. Indeed, as consensuses go, there seems to be one in Assyriology as to the absence of any such relative. Any analysis of Sumerian is thus largely introspective, enriched but simultaneously complicated by the almost ever-present echo of Akkadian, through which much of Sumerian in understood, either as examples of phonetics, meanings derived from bilingual texts or lists, or as the work of scribes whose native language was the first (or one of the first) of the Semitic family. In many other aspects of Sumerian philology, the question of **eme.sal** might be limited to a passing sentence, an observation as to the existence of a distinct dialect. Since it appears most obviously in literary genres, **eme.sal** is worthy of direct attention – but it too simply adds to the mysteries and complications of Sumerian, as the absolute agreement as to its nature (whether a genderlect, archaic conlang or professional jargon) across the whole of Sumerology remains elusive.

The role of scribal education in the survival, transmission and development of Sumerian literary narratives can scarcely be overestimated. The issue of original conception of an text is nuanced and complex (see Chapter 3 summary below) but what is known for certain from the archaeological evidence and material culture that survives today is that learner scribes diligently learnt their craft through copying existing texts. Much of the written content in Sumerian housed in museums and private collections is the result of ancient educational undertakings.

Cuneiform, it could be said, is morphologically hostile. The appearance of the wedged script may be the result of the methods and medium used to produce it (at least in the first, early days of tentative steps in creating writing to record units and quantities of sheep and grain), but it is also complex, with thousands of signs, and inhospitable with the absence of discernible punctuation (excluding determinatives and glosses) or even spaces between words (especially in the case of later texts). Morphologically (linguistically), the script was well suited to the capture the utterances of the agglutinative Sumerian, but the grammar of this language, especially in the case of compounds and the verb, differs from English to such an extent that (for example) line per line translations of the Sumerian would be near nonsensical if copied verbatim to

English. Instead, the content of these Sumerian compositions has been translated in continuous prose for the ETCSL. The nature of cuneiform and the language it captured are both reflected in the literature, which they produced.

Chapter 3

The definition of “Literature”, especially for ancient material, is neither straightforward nor without issue. Modern interpretations and categorisations are exactly that, modern, and there is little evidence to support any theory stipulating or proposing that the ancient peoples who wrote, commissioned or heard these texts would have categorised them as we do. In many cases, the identification of a suitable genre is an near-arbitrary process of selection – what plausible true difference, one might ask, could there be between, say, a mythical narrative, and a composition classified as historical, but which centres almost exclusively on the exploits of a fictional character?

Such problems of genre are by no means unique to the study of Sumerian literary genres but are prevalent in the study of literature the world over, across temporal, geographical and cultural borders alike. Whilst some disciplines have uniformly applied tools for the process of philological analysis of ancient texts (such as the Leiden Conventions, see Appendix C) the same cannot be said for Sumerian. Some agreement and understanding does exist, and in the context of this thesis, those set by the ETCSL have been adhered to (see Appendix B).

Similarly, a number of other disciplines focused on ancient data have taken advantage of the potential of online publication and even semantic technologies – although this particular interdisciplinary niche is small and nascent, it is ever growing. Within this context of online resources, the main, unique feature of the ETCSL is in many ways its pioneering work in the field of literary Sumerology, including the collaboration of modern scholars, free and unlimited access to data published online for the benefit of all researchers, and the conversion of the data to TEI-compliant XML by the end of active development in 2006. Other similar projects are known but few were implemented as early on as the ETCSL.

The dataset of the ETCSL is supported by bibliographic and museological data, but mainly centres on the publication of Sumerian literature as both transliteration and English translation. The transliterations are that of a composite text, a singular whole created from a number of different fragments. There is no evidence to support the idea that any of these texts existed in the exact form in antiquity as they do on the ETCSL – the composite itself is a process of interpretation and analysis, and for the purposes of automated inference ought to be represented as a modern entity, albeit based on ancient pieces.

The TEI/XML files of the ETCSL data prove the suitability of this material for machine-readable formats, and is also a valuable opportunity for heuristic learning: When applied, the existing TEI P4 was found to be an inadequate match for the ETCSL content and for the needs and desires of the Assyriological community: the code was customised to meet the idiosyncratic character of Sumerian. The addition of custom tags however limited and even removed much of the universality of the TEI, rendering the resulting data largely incompatible with other TEI data.

Chapter 4

The fourth chapter consisted of the description and comparison of sematic technologies such as URIs, XML and RDF, and the justification why the latter was chosen instead of the former for the research agenda of this thesis. The issue of ontologies, their characteristics and role within the wider SW setting were discussed, and the role of LOD in the publication of ancient world data illustrated by way of relevant examples known from the Linked Ancient World Data community.

Although few in number, ontologies specific to Sumerian content were listed and discussed. These include the representation of Ur III economic texts, as devised by Jaworski (2008), which, although contemporary to at least some of the data of ETCSL, was found to be unsuitable for the capture of the nuanced and fuzzy structures of literary narratives: It lacked sufficient granularity and complexity to tell these tales. The other, an ontology of Sumerian grammar designed by Alivernini (2006) as an experiment, was also found to be unsuitable to act as an extension to the other ontologies brought together to form mORSuL.

Those ontologies, the CIDOC CRM, FRBRoo and OM were each in turn described and analysed. For each, the same issue became apparent: in an attempt to represent a complex subject matter (be that cultural heritage data, bibliographies or narrative content), the structures have become vast and intricate, arguably at times even convoluted. The issue was aided by the extensive scope notes of both CIDOC CRM and FRBRoo, and exasperated by the absence of documentation for OM.

Issues and challenges aside, the need for universality and the benefits of reusing existing ontologies resulted in the use of these three ontologies represent ETCSL data. The resulting structure was more complex and convoluted still – rather than explain the structure at length, shorthand was devised: mORSuL (the multi-Ontology for the Representation of Sumerian

Literature). The next stage of the process was to assess the suitability of mORSuL to adequately capture Sumerian literary narratives.

Chapter 5

In this chapter, the robustness and usefulness of mORSuL for the ETCSL data was assessed. To do so, the ETCSL was examined and the different data types available listed. The following step saw the development and design of an ontological structure, SuLO (Sumerian Literature Ontology), whose sole purpose was to help identify those classes and properties which could be shown to be the minimum necessary for the representation of ETCSL data.

In addition to the categorisation of these data, and in line with the examples created by Clark and Chalmers (1998), user scenarios were created to show different types of possible queries that researchers of different levels of knowledge, experience and research interests would generate. These queries were mapped along the axis of increasing complexity of both the system and the query itself, and later used in the evaluation of mORSuL as a tool suitable and useful for the representation of Sumerian literature and the types of queries as outlined in the user case scenarios.

The process of creating SuLO helped highlight categories of information, which were not included in the expansive structure of mORSuL as it stood. These included some narrative elements (speech), reflective of the differences in modern science fiction and ancient Sumerian stories. In the representation of the former, actions speak louder than words: narratives are identified, compared and contrasted based on the actions of the characters. In the latter, however, dialogues, monologues, advice, warnings and questions can play a fundamentally important role – consider for example the debate poems, diatribes, or the frame story, where the moral of the story and every unique feature are embedded into a description given in the monologue of a character or in the course of a dialogue.

New classes were added to mORSuL to reflect those omissions, resulting in a new whole, which extended beyond the original constituent parts. mORSuL was discussed in the context of suitability against generic elements and actions as found in a sample of compositions from the ETCSL: mORSuL was found to adequately represent these general patterns. It was then tested against a genuine case-study example.

Chapter 6

A humorous composition, the *Three Ox-drivers of Adab* was chosen as the case study example for the testing of the robustness and suitability of mORSuL to represent a genuine Sumerian literary composition.

The composite text for this piece consists of only two known witnesses, thought to possible be roughly but not absolutely contemporary with one another, and both from unknown find spots. The objects in question are housed in different institutions separated by the Atlantic: the first forms part of the collection at the Musée du Louvre in Paris, whilst the other is housed at the University of Pennsylvania Museum of Archaeology and Anthropology.

The composition tells the story of three men, citizens of Adab, who fall into a dispute. They seek the judgement of the king: “Who does the calf belong to?” they ask. “Who can take the calf?” The king is unable to answer, and instead seeks the advice of a “cloistered lady”, to whom he repeats the story as told to him by the ox-drivers word perfectly. The “cloistered lady” responds, but the answer and the final verdict have been seemingly permanently lost by damage to both witness tablets.

The composition is short, with only 30 lines completed with minimal omission and fragmentation, but it is narratively complex with the inclusion of a frame story and has the repetition of a section so characteristic of Sumerian literature. These elements made it the ideal case study, and mORSuL was found to be able to the capture the story at various levels of increasing granularity. It has been possible to conclude that existing ontological structures, with the addition a few classes, were suitable for the representation of the composition known as *the Three Ox-drivers of Adab*.

The user case scenarios outlined in Chapter 5 were used to evaluate mORSuL. The structure and complexity of the ontology was found to be in many ways sufficient (and even inclusive of unnecessary classes), with practical limitations brought on by the in-built reasoners of Protégé. The questions themselves were realised to be very much in line with traditional scholarship, and further work is necessary in order to truly harness the potential of semantic technologies to bring about the next stage of scholarship within the Assyriological niche of the Digital Humanities.

mORSuL was also evaluated against five other types of Sumerian literary composition, and found to adequately or more than adequately represent the narrative structures (fabulas and functions, as defined by Popp, (1968)) of each of the example texts. As a tool for the capture of Sumerian literary narratives, mORSuL has thus been shown to be well suited for the task.

Chapter 7

The penultimate chapter of this thesis included a description of the potential of future work on and with mORSuL. These categories included the expansion and development of the ontological structure itself, and the practical implementation of an expert system incorporating it.

The dataset could also be enriched in a number of different ways, including the addition of other Sumerian content. Other genres such as medical texts, omens and songs, as well as pragmatic, non-literary texts such as administrative records and lexical lists could also enrich the ETCSL data.

Alternatively, or additionally, the dataset could be diversified with the addition of Akkadian material. This would likely consist first and foremost of other literary compositions for which only Assyrio-Babylonian versions are known (e.g. *Enûma eliš).* This data could be extended still with the inclusion of royal letters and personal correspondences as well as the types of practical documents as outlined for the Sumerian content above.

Moving beyond the temporal confines of Assyriology, the addition of modern Arabic and Bedouin oral traditions, mythologies and stories could enable inter- and cross-disciplinary comparative analyses. Such a mix of geographically close but non-contemporary stories could be used to illustrate the transfer and survival of particular narratives (if indeed examples of those exist), or the absorption and assimilation of older examples into newer stories. Questions as to the transfer of imagery and ideas, as well as major motifs through the ages and cultural boundaries could be examined, and the ideas of cultural adoption versus universal polygenesis addressed.

The functionality of mORSuL to represent both the generic patterns of Sumerian literature and the specific case study example, as well as the richness of potential future work help illustrate the ability of this research project to stand at the foreground of an inherently interdisciplinary field. Concentrating on the potential of mORSuL ontologies to map heterogeneous and diverse data, ETCSL could be enriched with cultural heritage data from other projects that incorporate the CIDOC CRM structure. Similarly, FRBRoo would allow for the addition of complementary bibliographical data, and facilitate the historiography of the discipline in recent history. Parallels between ancient and modern stories could be found via OM.

8.2 Summary of Findings

In the course of this doctoral research a number of discoveries with regard to the paradigms of Assyriology, the potential of semantic technologies, the nature of existing ontologies and the richness of future investigations were made.

Assyriology

Although not entirely unfamiliar with the Assyriological community prior to the commencement of this research project, attendance at workshops, conferences and events provided an insight into the current state of Sumerological research. Whilst many research agendas remain true to patterns set by the earlier pioneers of the field, the practices of collaboration and the incorporation of digitisation tools was found to be on the increase. The use of cuneiform objects as case study examples in projects otherwise entirely outside the remit of Assyriology (3D scans, RTI) evidence a truth that Assyriology is not, ultimately, as isolated as might initially seem.

Whilst some internal divisions remain (archaeologists and philologists, for example), recent conferences (BANEA), cross-disciplinary workshops (LAWDI) and projects (CDLI) show a blurring of these dividing lines. Literary Sumerology may be a niche community within one, but the sheer potential for future research with content from vastly disparate discipline (including modern cinematic fiction) shows that it does not share the idiosyncratic characteristic of isolation with the Sumerian language.

Chapter 8

ETCSL

The ETCSL has been intermittently incorporated into research by the current author since 2003. Prior to this current work, however, focus had always been exclusively on the analysis of the content from a Sumerological and philological perspective, with little thought spared to the resource itself, its history or the design features behind it. Although extensively criticised by Delnero (2012), the ETCSL should be considered a success story of Sumerological projects: the creators addressed issues and pragmatic implementations that are still discussed and debated almost a decade after the active development of this resource came to an end (2006). The ideas of Open Access and LOD are clearly echoed throughout the ETCSL, even if called by other names and implemented through different (perhaps somewhat less successful) ways. What the ETCSL lacks in methodological robustness and consistency, it makes up for as a pioneer in the world digital Assyriology in general, remaining in many ways unique as a resource for literary Sumerian.

Existing Ontologies

The original hypothesis for this thesis was:

> Existing, domain-specific ontologies, designed from omniscient perspectives are suitable for the representation of the heterogeneous, incomplete and un-known narratives, which play out in ancient Sumerian literary compositions.

The assumption since the onset of this research project has been that existing ontologies could be used to map ETCSL data, and be shown to be a useful endeavour. The complexities of the CIDOC CRM, FRBRoo and OM were found to in fact reach even beyond the finesse of the data available. Each ontology is vast, complex, and as a result incorporates a large number of redundant classes. Yet, they are a bridge enabling the linking between data regarding Sumerian literature and myriad other areas of historical and contemporary research.

The CIDOC CRM was, prior to the commencement of this thesis, intuitively thought to be of primary importance in the project. The analyses of the ETCSL data and the structure of the ontology proved the opposite: in the final version of mORSuL, the CIDOC CRM has the two clear functions: it is the bridge between FRBRoo and OM, and a gateway for linking to other cultural heritage projects. FRBRoo, designed to extend the CIDOC CRM, was found to be well equipped for the representation of the bibliographic data on ETCSL, including enabling the differentiation between physical and electronic publication.

OM was found to be capable of representing the narrative features of Sumerian literature almost entirely, with only a few additions needed to capture all encountered patterns. The design and documentation paradigms (which occasionally seemed rather arbitrary), however complicate the use of the ontology, as does its vast structure consisting of hundreds of nestled classes.

Where the true benefits of OM lies is in the types of inter- and cross-disciplinary research that it enables. Connections, which could only be possible by a human expert of eclectic interests (and an unlimited supply of energy and time) may now be brought to light – many of these could be described as unlikely to emerge in the course of traditional study of the Sumerian literary canon, and have not been discussed in the context of known projects which incorporated attempts to link Mesopotamian motifs to modern culture. mORSuL combines all these elements and possibilities into one complex but coherent structure.

8.3 Evaluation of mORSuL

The suitability of mORSuL was evaluated with regard to its ability, suitability and usefulness for the representation of six different types of Sumerian literary narrative, and the case study composition *The Three Ox-Drivers of Adab* specifically. The process consisted of two parts:

Firstly, the main features of the story were mapped onto the structure, and the ontological structure was found to be adequate in the capture of the piece. mORSuL wwas found to be more likely to contain superfluous classes than to be lacking necessary ones, although some specific classes had been added from SuLO (thus the three existing OWL ontologies of CIDOC CRM, FRBRoo and OM would not have sufficed alone). This was found to be true for both the compositions in general, and for the case study text in particular.

Secondly, mORSuL was evaluated against the user cases outlined in chapter 5.These were found to be relatively simple for the structure of mORSuL, and realised to be very reflective of the state of current and past scholarship (from which they were derived). As such, the simplicity of the resulting query did little to illustrate the power of semantic technologies, and highlighted the need for a new type of research question, both supported and inspired by the use of semantic technologies in the Digital Humanities.

As a proof of concept piece, mORSuL can be shown to be useful for the representation of Sumerian literary narratives in terms of complexity of its structure, and the types of suggested user cases. Extensive further development is both possible and necessary, and myriad diverse and multidisciplinary avenues have already been identified.

8.4 Final Thoughts

This thesis sits firmly within a cluster of interdisciplinary fields. It has drawn from the fields of Web Science, the Digital Humanities, Digital Heritage as well as Computer Science and Assyriology. Combining data and methodologies from seemingly disparate sources evidenced the complementary nature between semantic technologies, Linguistics and cultural heritage – all are concerned with the understanding of meanings which extend beyond a word standing solely for itself, or the possibility of boiling down an item (either concrete or abstract) to its mere constituent parts.

The one clear lesson learnt from the process has been the suitability of existing domain-specific ontological structures to represent data for which they were not originally designed. The omniscient perspectives they reflect are not a hindrance, although it results in large number of superfluous classes. At the same time, this richness of the ontological structure opens up possibilities for future research outcomes.

Although the Sumerian literary canon contains a number of heterogeneous compositions, the differences between even separate genres (let alone individual texts) are not insurmountable. General patterns are universal, across not only ETCSL but also stories of other cultures, time periods and languages. No narrative structure absolutely unique to the Sumerian literary canon was identified: it could however prove an interesting research agenda for future research, and certainly one which is unlikely to ever be accomplished without the help of Web-published data and automated systems.

The incompleteness and the inclusion of the unknown elements of the composition process and the final product were in many ways the greatest hurdle to the representation of ancient literature. Several questions remain:

Could the omitted conclusion alter the interpretation of the story? Would a glorious conclusion make the audience view the narrative differently to one mapping the ultimate failure of the protagonist? Is one miraculous birth story comparable to another, and if not, where is the line drawn? Had Gilgameš gained immortality, would his story have been repeated by a fictional starship captain to his dying companion?

Three conclusions are clear. Firstly, the ontological representation of Sumerian literary narratives remains an interesting, rich and engaging research topic, with great potential for future development and investigation. Secondly, this doctoral thesis has done little more than scratch the surface of an iceberg, and future scholarship is likely to bring to light further parallels and patterns which help us better understand the literature of ancient Sumer. Thirdly, semantic technologies are in a position to help support existing research paradigms across a vast array of topics, both within and beyond the entirety of the Humanities.

It is the prediction of this author that, whilst they cannot be described as a silver bullet, semantic technologies will, in time, enable new types of scholarship. They will facilitate an evolutionary step in domain-focused scholarship, and enable researchers to reap the benefits of bringing together complementary data from a number of disparate and diverse areas. The SW will be a tool for merging the collective knowledge of the whole of the connected Web, and all those who have access to it will in turn have the opportunity to access and benefit from the entirety of the human experience.

Appendices

Appendix A Timeline of Mesopotamia

Based on George, 2010. Dates prior to 1100 BC are approximate.

DATE (BC)	POLITICAL HISTORY	INTELLECTUAL LIFE
3000	**Early city-states of Sumer**	Invention of writing Earliest Sumerian tablets
2800		
2600		Early Sumerian literature
2400	**Old Akkadian Empire**	
2300		Akkadian as language of the empire
2200	**Third Dynasty of Ur (Ur III)**	Sumerian renaissance Royal Tablet Houses
2100		Sumerian court literature
2000	Fall of Ur	Spoken Sumerian dying out
1900	**Isin Dynasty** **Larsa Dynasty**	Scribal schools at Ur and Nippur
1800	**Old Babylonian Kingdom**	
1750	Decline of southern Babylonia	Literary creativity in Akkadian
1600	Sack of Babylon by the Hittites **Kassite Dynasty**	Very few *literary* tablets extant from this period (predominantly administrative records)
1400	Amarna Age	Akkadian as *lingua franca* Spread of Babylonian texts to the West
1200		Organisation and editing of Babylonian literature
1100	Tiglath-pileser I of Assyria	

Appendix A

1000		Very few tablets extant from this period
900	**Neo-Assyrian Empire**	
700		Royal libraries at Nineveh
600	**Neo-Babylonian Empire**	Spoken Akkadian dying out
500	**Persian Empire**	Babylonian literature copied out and preserved in libraries of temples and scholars
300	**Greek (Hellenistic) Period**	
200	**Parthian Period**	
100 BC	Decline of Babylon	
AD 100	Roman wars	Last cuneiform tablets

Appendix B ETCSL Philological Conventions

X	indicates a fragmentary unreadable sign
!	follows a corrected sign
?	follows a queried sign
[ ]	delimit missing, but supplied text
[X]	indicates one sign missing
[...]	indicate more than two signs missing
/ \	delimit partially damaged text
{ }	enclose textual variants
< >	delimit corrected scribal omissions
« »	delimit corrected scribal additions
(note)	English notes are in italics and delimited by brackets
(source: RU)	means the source has 'RU'; i.e., it is a note following a reading of a sign, as in 'im-ma-an-pad3(source: RU)'
$^{\mathrm{tum9}}\mathrm{u}_{18}$-lu	determinatives, e.g. tum$_{9}$ are in superscript
Sumerian glosses	superscript
Akkadian glosses	italics
Emesal	Emesal text is in purple
Proper	Proper nouns are in green

Appendix C Leiden Conventions

[...]	a lacuna or gap in the original text, not restored by the editor (extent known)
[— — —]	a lacuna or gap in the original text, not restored by the editor (extent unknown)
[abc]	letters missing from the original text due to lacuna, restored by the editor
a(bc)	abbreviation in the text, expanded by the editor
<ab>	characters erroneously omitted by the ancient scribe, restored or corrected by the editor
{ab}	letters in the text considered erroneous and superfluous by the editor
ạḅ	characters damaged or otherwise unclear in the text, ambiguous outside of their context
...	traces of letters on the surface, insufficient for restoration by the editor (Greek and Papyrological usage)
+++	traces of letters on the surface, insufficient for restoration by the editor (Roman epigraphic practice)
ABC	clear but incomprehensible letters
[[abc]]	deleted letters
vac.	space left empty (vacat) on the stone or page

Appendix D ETCSL Thematic Structure

The ETCSL divides literary compositions into the following seven categories:

1) Ancient Literary Catalogues
    - Ur III
    - Old Babylonian

2) Narrative and mythological compositions
    - Narratives featuring deities
    - Narrative featuring heroes

3) Compositions with a historical background
    - King lists and other compositions
    - City laments

4) Royal praise poetry
    - Lagaš
    - Third Dynasty of Ur
    - Isin Dynasty
    - Larsa Dynasty
    - Uruk
    - First Dynasty of Babylon
    - Praise poetry for unknown rulers

5) Literary letters and letter-prayers
    - Royal correspondence
    - Other letters and letter-prayers

6) Hymns and cult songs
    - Hymns addressed to deities
    - Hymns addressed to or concerning temples

7) Other literature

Of these broad categories, the focus for the purposes of this has been limited to three, namely Narrative and mythological compositions, Compositions with a historical background and Other literature. These categories have been divided in the ETCSL to further sub-categories as follows:

Appendix D

1) Narrative and mythological compositions

   a) Narratives featuring deities

   b) Narratives featuring heroes

2) Compositions with a historical background

   a) King lists and other compositions

   b) City laments

3) Other literature

   a) Scribal life

   b) Debate poems

   c) Dialogues and diatribes

   d) Songs, elegies and related compositions

   e) "Wisdom literature" and other compositions

   f) Various compositions

      - A man and his god
      - The poem of early rulers
      - Enlil and Nam-zid-tara
      - A dog for Nintinuga
      - An axe for Nergal
      - The home of the fish
      - The heron and the turtle

   g) Proverb collections

   h) Other proverbs

For this doctoral research project, particular attention was paid to the subcategories of Narrative and mythological compositions and "Wisdom literature", as these were the source categories for many of the example composition cited in this thesis.

Appendix E Case Study

As published by the ETCSL.

E.1 Translation of *the Three Ox-drivers of Adab*

First 30 lines only. Available from http://etcsl.orinst.ox.ac.uk/cgi-bin/etcsl.cgi?text=t.5.6.5#

1-3. There were three friends, citizens of Adab, who fell into a dispute with each other, and sought justice. They deliberated the matter with many words, and went before the king.

4-13. "Our king! We are ox-drivers. The ox belongs to one man, the cow belongs to one man, and the waggon belongs to one man. We became thirsty and had no water. We said to the owner of the ox, "If you were to fetch some water, then we could drink!". And he said, "What if my ox is devoured by a lion? I will not leave my ox!". We said to the owner of the cow, "If you were to fetch some water, then we could drink!". And he said, "What if my cow went off into the desert? I will not leave my cow!". We said to the owner of the waggon, "If you were to fetch some water, then we could drink!". And he said, "What if the load were removed from my waggon? I will not leave my waggon!". "Come on, let's all go! Come on, and let's return together!""

14-15. "First the ox, although tied with a leash (?), mounted the cow, and then she dropped her young, and the calf started to chew up (?) the waggon's load. Who does this calf belong to? Who can take the calf?"

16-17. The king did not give them an answer, but went to visit a cloistered lady. The king sought advice from the cloistered lady:

18-28. "Three young men came before me and said: "Our king, we are ox-drivers. The ox belongs to one man, the cow belongs to one man, and the waggon belongs to one man. We became thirsty and had no water. We said to the owner of the ox, "If you were to draw some water, then we could drink!". And he said, "What if my ox is devoured by a lion? I will not leave my ox!". We said to the owner of the cow, "If you were to draw some water, then we could drink!". And he said, "What if my cow went off into the desert? I will not leave my cow!". We said to the owner of the waggon, "If you were to draw some water, then we could drink!". And he said, "What if the load were removed from my waggon? I will not leave my waggon!" he said. "Come on, let's all go! Come on, and let's return together!""'

29-30. " "First the ox, although tied with a leash (?), mounted the cow, and then she dropped her young, and the calf started to chew up (?) the waggon's load. Who does this calf belong to? Who can take the calf?""

E.2 Transliteration of *the Three Ox-drivers of Adab*

First 30 lines only. Available at http://etcsl.orinst.ox.ac.uk/cgi-bin/etcsl.cgi?text=c.5.6.5&display=Crit&charenc=gcirc#

1. gu$_5^?$-li-li 3-am$_3$ dumu adab^{ki}-ke$_4$-ne
2. di in-da-ab-tuku-uš-am$_3$ di-da ab-kiĝ$_2$-kiĝ$_2$-e
3. inim ib$_2$-ta-an-šar$_2$-šar$_2$-eš-am$_3$ lugal-e an-ta ba-an-gi
4. lugal-me gud-da ri i$_3$-ak-e-de$_3$-nam
5. gud lu$_2$ 1(DIŠ)-a-kam ab$_2$ lu$_2$ 1(DIŠ)-a-kam ^{ĝiš}mar lu$_2$ 1(DIŠ)-a-kam
6. enmen$_2$ bi$_2$-tuku-un-da-nam a nu-mu-e-da-ĝal$_2$
7. lu$_2$ gud-da-ra a u$_3$-um-te-si a ga-naĝ-en-de$_3$-en-e-še

8. gud-ĝu$_{10}$ ur$^{!}$-maḫ-e u$_3$-bi$_2$-gu$_7$ gud-ĝu$_{10}$-ta ba-ra-ed$_2$-de$_3$-en-e-še
9. lu$_2$ ab$_2$-ba-ra a u$_3$-um-te-si a ga-naĝ-en-de$_3$-en-e-še
10. ab$_2$-ĝu$_{10}$ edin-še$_3$ u$_3$-ba-ĝen ab$_2$-ĝu$_{10}$-ta ba-ra-ed$_2$-de$_3$-en-e-še
11. lu$_2$ ^{ĝiš}mar-ra-ra a u$_3$-um-te-si a ga-naĝ-en-de$_3$-en-e-še
12. ^{ĝiš}mar-ĝu$_{10}$ gu$_2$$^{?}$-un$^{?}$ u$_3$-un-/ku-ku\\-ru (*ta-az-za-ba-al*) ^{ĝiš}mar-ĝu$_{10}$-ta ba-ra-ed$_2$-de$_3$-en-e-še
13. gana ga-ni-re$_7$-en-de$_3$-en gana ga-an-ga-am$_3$-gi-de$_3$-en
14. gud eš$_2$$^{?}$ ba-a-la$_2$-e um$^{?}$-la$_2$ ab$_2$ a-sila$_3$-ĝar-ra-bi um$^{?}$-sur-sur-ru amar ^{ĝiš}mar-ra zu$_2$ bi$_2$-in-gub
15. amar-e a-ba-kam amar-e a-ba-am$_3$ ba-an-de$_6$
16. lugal-e inim nu-mu-un-ne-ši-ib$_2$-gi se$_2$-ek-rum-še$_3$ ba-da-an-kur$_9$
17. lugal-e se$_2$-ek-rum-ta ad mu-un-di-ni-ib$_2$-gi-gi
18. [ĝuruš 3]-/am$_3$\\ an-ta ba-an-gi-eš-a
19. /lugal-me\\ gud-da ri i$_3$-ak-en-de$_3$-nam
20. gud lu$_2$ 1(DIŠ)-a-kam ab$_2$ lu$_2$ 1(DIŠ)-a-kam ^{ĝiš}mar lu$_2$ 1(DIŠ)-a-kam
21. enmen$_2$$^{!}$ bi$_2$-/tuku\\-un-da-nam a nu-mu-e-da-ĝal$_2$
22. lu$_2$ gud-da-ra a u-um-te-šub a ga-naĝ-en-de$_3$-en-e-[še]
23. gud-ĝu$_{10}$ ur-maḫ-e u$_3$-bi$_2$-gu$_7$ gud-ĝu$_{10}$-ta ba-ra-/ed$_2$\\-[de$_3$-en-e-še]
24. lu$_2$ ab$_2$-ba-ra a u$_3$-um-te-šub a ga-naĝ-en-de$_3$-[en-e-še]
25. ab$_2$-/ĝu$_{10}$\\ [edin]-/še$_3$\\ u$_3$-ba-ĝen ab$_2$-ĝu$_{10}$-ta ba-ra-ed$_2$-[de$_3$-en-e-še]
26. /lu$_2$\\ [^{ĝiš}mar-ra]-/ra\\ a u$_3$-um-te-šub a ga-naĝ-en-de$_3$-/en\\-[e-še]
27. [^{ĝiš}mar-ĝu$_{10}$ gu$_2$-un] /u$_3$\\-[un-ku-ku-ru] ^{ĝiš}mar-ĝu$_{10}$-ta ba-ra-/ed$_2$\\-[de$_3$-en-e-še]

28. [gana ga-ni-re$_7$-en-de$_3$-en] /gana$^?$ ga$^?$\-[an-ga-am$_3$-gi-de$_3$-en]

29. gud eš$_2$$^?$ ba-a-la$_2$-e ab$^?$-la$_2$ ab$_2$ a-sila$_3$-ĝar-ra-bi ab$^?$-sur-sur-ru amar ^{ĝiš}mar-ra zu$_2$ bi$_2$-in-gub

30. [amar-e a-ba-kam amar-e a-ba-am$_3$ ba-an-de$_6$]

Appendix F RDF Generated based on OM in the Brat Annotation Tool for the *Three Ox-Drivers of Adab*

```
@prefix aktloc: <http://contextus.net/ontology/ontomedia/misc/AKTlocation#>.
@prefix omb: <http://contextus.net/ontology/ontomedia/ext/common/being#>.
@prefix cnt: <http://www.w3.org/2011/content#>.
@prefix omf: <http://contextus.net/ontology/ontomedia/ext/fiction/fic#>.
@prefix ome: <http://contextus.net/ontology/ontomedia/core/expression#>.
@prefix omel: <http://contextus.net/ontology/ontomedia/ext/events/loss#>.
@prefix loc: <http://contextus.net/ontology/ontomedia/core/space#>.
@prefix omj: <http://contextus.net/ontology/ontomedia/ext/events/travel#>.
@prefix omea: <http://contextus.net/ontology/ontomedia/ext/events/action#>.
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#>.
@prefix omeg: <http://contextus.net/ontology/ontomedia/ext/events/gain#>.
@prefix omc: <http://contextus.net/ontology/ontomedia/ext/common/critters#>.
@prefix eprop: <http://contextus.net/ontology/ontomedia/ext/events/eventprop#>.
@prefix omfc: <http://contextus.net/ontology/ontomedia/ext/fiction/char#>.
@prefix omt: <http://contextus.net/ontology/ontomedia/ext/common/trait#>.
@prefix omes: <http://contextus.net/ontology/ontomedia/ext/events/social#>.
@prefix owl: <http://www.w3.org/2002/07/owl#>.
@prefix ompi: <http://contextus.net/ontology/ontomedia/ext/common/physitem#>.
@prefix omet: <http://contextus.net/ontology/ontomedia/ext/events/trans#>.

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T2>
        a omb:Group ;
        cnt:chars "ox-drivers" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T2> owl:sameAs
<http://contextus.net/resource/RRH/TNurmikko/Three>;

        rdfs:label "N1" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T3>
        a ome:Character ;
        cnt:chars "man" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T3>
         omt:has-trait [
                 a omt:Male;
                 rdfs:label "Male (Gender)"
                 ];
        rdfs:label "A1" .
```

Appendix F

```
<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T3>
            omt:has-trait [
                    a omt:Name ;
                    omt:has-name "Man1"
                    ];
           rdfs:label "A2" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T3> owl:sameAs
<http://contextus.net/resource/RRH/TNurmikko/Three>;

           rdfs:label "N2" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T4>
           a ome:Character ;
           cnt:chars "man" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T4>
            omt:has-trait [
                    a omt:Male;
                    rdfs:label "Male (Gender)"
                    ];
           rdfs:label "A3" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T4>
            omt:has-trait [
                    a omt:Name ;
                    omt:has-name "Man2"
                    ];
           rdfs:label "A4" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T4> owl:sameAs
<http://contextus.net/resource/RRH/TNurmikko/Three>;

           rdfs:label "N3" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T5>
           a ome:Character ;
           cnt:chars "man" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T5>
            omt:has-trait [
                    a omt:Male;
                    rdfs:label "Male (Gender)"
                    ];
           rdfs:label "A5" .
```

```
<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T5>
           omt:has-trait [
                     a omt:Name ;
                     omt:has-name "Man3"
                     ];
          rdfs:label "A6" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T5> owl:sameAs
<http://contextus.net/resource/RRH/TNurmikko/Three>;

          rdfs:label "N4" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T6>
          a ome:Being ;
          cnt:chars "ox" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T6>
           omt:has-trait [
                     a omt:Male;
                     rdfs:label "Male (Gender)"
                     ];
          rdfs:label "A7" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T6>
           omt:has-trait [
                     a omt:Name ;
                     omt:has-name "ox"
                     ];
          rdfs:label "A8" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T6>
           omt:has-trait [
                     a omc:Bovine;
                     rdfs:label "Bovine (Species)"
                     ];
          rdfs:label "A9" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T7>
          a ome:Being ;
          cnt:chars "cow" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T7>
           omt:has-trait [
                     a omt:Female;
```

```
                        rdfs:label "Female (Gender)"
                        ];
            rdfs:label "A10" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T7>
             omt:has-trait [
                        a omt:Name ;
                        omt:has-name "cow"
                        ];
            rdfs:label "A11" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T7>
             omt:has-trait [
                        a omc:Bovine;
                        rdfs:label "Bovine (Species)"
                        ];
            rdfs:label "A12" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T6> owl:sameAs
<http://contextus.net/resource/RRH/TNurmikko/Three>;

            rdfs:label "N5" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T7> owl:sameAs
<http://contextus.net/resource/RRH/TNurmikko/Three>;

            rdfs:label "N6" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T8>
            a ome:Physical-Item ;
            cnt:chars "waggon" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T8> owl:sameAs
<http://contextus.net/resource/RRH/TNurmikko/Three>;

            rdfs:label "N7" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T3> omb:owns
<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T6>;
            rdfs:label "R1" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T4> omb:owns
<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T7>;
            rdfs:label "R2" .
```

```
<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T5> omb:owns
<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T8>;
        rdfs:label "R3" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T9>
        a ome:Character ;
        cnt:chars "king" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T9>
         omt:has-trait [
                a omt:Male;
                rdfs:label "Male (Gender)"
                ];
        rdfs:label "A13" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T9>
         omt:has-trait [
                a omt:Name ;
                omt:has-name "King"
                ];
        rdfs:label "A14" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T9> owl:sameAs
<http://contextus.net/resource/RRH/TNurmikko/Three>;

        rdfs:label "N8" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T10>
        a ome:Character ;
        cnt:chars "the owner of the ox" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T10> owl:sameAs
<http://contextus.net/resource/RRH/TNurmikko/Three>;

        rdfs:label "N9" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T11>
        a ome:Character ;
        cnt:chars "he" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T11> owl:sameAs
<http://contextus.net/resource/RRH/TNurmikko/Three>;

        rdfs:label "N10" .
```

```
<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T12>
	a ome:Being ;
	cnt:chars "the owner of the cow" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T12> owl:sameAs
<http://contextus.net/resource/RRH/TNurmikko/Three>;

	rdfs:label "N11" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T13>
	a ome:Character ;
	cnt:chars "the owner of the waggon" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T13> owl:sameAs
<http://contextus.net/resource/RRH/TNurmikko/Three>;

	rdfs:label "N12" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T14>
	a ome:Being ;
	cnt:chars "ox" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T14> owl:sameAs
<http://contextus.net/resource/RRH/TNurmikko/Three>;

	rdfs:label "N13" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T15>
	a ome:Being ;
	cnt:chars "cow" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T15> owl:sameAs
<http://contextus.net/resource/RRH/TNurmikko/Three>;

	rdfs:label "N14" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T16>
	a ome:Being ;
	cnt:chars "she" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T16> owl:sameAs
<http://contextus.net/resource/RRH/TNurmikko/Three>;

	rdfs:label "N15" .
```

```
<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T17>
        a ome:Being ;
        cnt:chars "calf" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T17>
         omt:has-trait [
                a omt:Name ;
                omt:has-name "calf"
                ];
        rdfs:label "A15" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T17>
         omt:has-trait [
                a omc:Bovine;
                rdfs:label "Bovine (Species)"
                ];
        rdfs:label "A16" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T17> owl:sameAs
<http://contextus.net/resource/RRH/TNurmikko/Three>;

        rdfs:label "N16" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T18>
        a ome:Being ;
        cnt:chars "young" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T18> owl:sameAs
<http://contextus.net/resource/RRH/TNurmikko/Three>;

        rdfs:label "N17" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T19>
        a ome:Physical-Item ;
        cnt:chars "waggon" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T19> owl:sameAs
<http://contextus.net/resource/RRH/TNurmikko/Three>;

        rdfs:label "N18" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T20>
        a ompi:Consumables ;
        cnt:chars "load" .
```

```
<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T21>
        a ome:Being ;
        cnt:chars "calf" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T21> owl:sameAs
<http://contextus.net/resource/RRH/TNurmikko/Three>;

        rdfs:label "N19" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T22>
        a ome:Being ;
        cnt:chars "calf" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T22> owl:sameAs
<http://contextus.net/resource/RRH/TNurmikko/Three>;

        rdfs:label "N20" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T23>
        a ome:Character ;
        cnt:chars "king" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T23> owl:sameAs
<http://contextus.net/resource/RRH/TNurmikko/Three>;

        rdfs:label "N21" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T24>
        a ome:Character ;
        cnt:chars "a cloistered lady" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T24>
         omt:has-trait [
                a omt:Female;
                rdfs:label "Female (Gender)"
                ];
        rdfs:label "A17" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T24>
         omt:has-trait [
                a omt:Name ;
                omt:has-name "cloistered lady"
                ];
        rdfs:label "A18" .
```

```
<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T24> owl:sameAs
<http://contextus.net/resource/RRH/TNurmikko/Three>;

            rdfs:label "N22" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T25>
            a ome:Character ;
            cnt:chars "king" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T25> owl:sameAs
<http://contextus.net/resource/RRH/TNurmikko/Three>;

            rdfs:label "N23" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T26>
            a ome:Entity ;
            cnt:chars "the cloistered lady" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T26> owl:sameAs
<http://contextus.net/resource/RRH/TNurmikko/Three>;

            rdfs:label "N24" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T1>
            a ome:Context ;
            cnt:chars "The three ox-drivers from Adab" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T27>
            a loc:City ;
            cnt:chars "Adab" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T28>
            a omb:Group ;
            cnt:chars "three friends" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T28> owl:sameAs
<http://contextus.net/resource/RRH/TNurmikko/Three>;

            rdfs:label "N25" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T28> ome:is-
linked-to <http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T27>;
            rdfs:label "R4" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T29>
```

```
            a omb:Group ;
            cnt:chars "They" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T29> owl:sameAs
<http://contextus.net/resource/RRH/TNurmikko/Three>;

            rdfs:label "N26" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T30>
            a omj:Travel ;
            cnt:chars "went" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T30>
            a omj:Travel;
            ome:has-subject-entity
<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T29>;
            rdfs:label "E1" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T31>
            a omes:Conversational ;
            cnt:chars "\"What if my ox is devoured by a lion? I will not leave my ox!\"" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T31>
            a omes:Conversational;
            ome:has-subject-entity
<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T11>;
            rdfs:label "E2" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T32>
            a omes:Conversational ;
            cnt:chars "\"If you were to fetch some water, then we could drink!\"" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T32>
            a omes:Conversational;
            ome:has-subject-entity
<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T34>;
            ome:has-object-entity
<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T10>;
            rdfs:label "E3" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T33>
            a omes:Conversational ;
            cnt:chars "\"If you were to fetch some water, then we could drink!\"" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T33>
```

```
            a omes:Conversational;
            ome:has-subject-entity
<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T35>;
            ome:has-object-entity
<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T12>;
            rdfs:label "E4" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T34>
            a omb:Group ;
            cnt:chars "We" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T34> owl:sameAs
<http://contextus.net/resource/RRH/TNurmikko/Three>;

            rdfs:label "N27" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T35>
            a omb:Group ;
            cnt:chars "We" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T35> owl:sameAs
<http://contextus.net/resource/RRH/TNurmikko/Three>;

            rdfs:label "N28" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T36>
            a ome:Character ;
            cnt:chars "he" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T36> owl:sameAs
<http://contextus.net/resource/RRH/TNurmikko/Three>;

            rdfs:label "N29" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T37>
            a omes:Conversational ;
            cnt:chars "\"What if my cow went off into the desert? I will not leave my
cow!\"" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T37>
            a omes:Conversational;
            ome:has-subject-entity
<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T36>;
            rdfs:label "E5" .
```

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T38>
a omb:Group ;
cnt:chars "We" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T38> owl:sameAs <http://contextus.net/resource/RRH/TNurmikko/Three>;

rdfs:label "N30" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T39>
a omes:Conversational ;
cnt:chars "\"If you were to fetch some water, then we could drink!\"" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T39>
a omes:Conversational;
ome:has-subject-entity
<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T38>;
ome:has-object-entity
<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T13>;
rdfs:label "E6" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T40>
a ome:Character ;
cnt:chars "he" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T40> owl:sameAs <http://contextus.net/resource/RRH/TNurmikko/Three>;

rdfs:label "N31" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T41>
a omes:Conversational ;
cnt:chars "\"What if the load were removed from my waggon? I will not leave my waggon!\"" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T41>
a omes:Conversational;
ome:has-subject-entity
<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T40>;
rdfs:label "E7" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T42>
a omea:Sex ;
cnt:chars "mounted" .

```
<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T42>
          a omea:Sex;
          ome:has-subject-entity
<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T14>;
          ome:has-object-entity
<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T15>;
          rdfs:label "E8" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T43>
          a omeg:Creation ;
          cnt:chars "dropped" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T43>
          a omeg:Creation;
          ome:involves <http://contextus.net/resource/RRH/TNurmikko/Three
Oxdrivers/T16>;
          ome:has-subject-entity
<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T18>;
          rdfs:label "E9" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T10>
           omt:has-trait [
                    a omt:Male;
                    rdfs:label "Male (Gender)"
                    ];
          rdfs:label "A19" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T10>
           omt:has-trait [
                    a omt:Name ;
                    omt:has-name "Man1"
                    ];
          rdfs:label "A20" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T11>
           omt:has-trait [
                    a omt:Male;
                    rdfs:label "Male (Gender)"
                    ];
          rdfs:label "A21" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T11>
           omt:has-trait [
                    a omt:Name ;
                    omt:has-name "MAn1"
```

```
                ];
        rdfs:label "A22" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T12>
        omt:has-trait [
                a omt:Male;
                rdfs:label "Male (Gender)"
                ];
        rdfs:label "A23" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T12>
        omt:has-trait [
                a omt:Name ;
                omt:has-name "Man2"
                ];
        rdfs:label "A24" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T36>
        omt:has-trait [
                a omt:Male;
                rdfs:label "Male (Gender)"
                ];
        rdfs:label "A25" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T36>
        omt:has-trait [
                a omt:Name ;
                omt:has-name "Man2"
                ];
        rdfs:label "A26" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T13>
        omt:has-trait [
                a omt:Male;
                rdfs:label "Male (Gender)"
                ];
        rdfs:label "A27" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T13>
        omt:has-trait [
                a omt:Name ;
                omt:has-name "Man3"
                ];
        rdfs:label "A28" .
```

```
<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T40>
        omt:has-trait [
                a omt:Male;
                rdfs:label "Male (Gender)"
                ];
        rdfs:label "A29" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T40>
        omt:has-trait [
                a omt:Name ;
                omt:has-name "Man3"
                ];
        rdfs:label "A30" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T14>
        omt:has-trait [
                a omt:Male;
                rdfs:label "Male (Gender)"
                ];
        rdfs:label "A31" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T14>
        omt:has-trait [
                a omt:Name ;
                omt:has-name "ox"
                ];
        rdfs:label "A32" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T14>
        omt:has-trait [
                a omc:Bovine;
                rdfs:label "Bovine (Species)"
                ];
        rdfs:label "A33" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T15>
        omt:has-trait [
                a omt:Female;
                rdfs:label "Female (Gender)"
                ];
        rdfs:label "A34" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T15>
        omt:has-trait [
                a omt:Name ;
```

```
                        omt:has-name "cow"
                        ];
            rdfs:label "A35" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T15>
             omt:has-trait [
                        a omc:Bovine;
                        rdfs:label "Bovine (Species)"
                        ];
            rdfs:label "A36" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T16>
             omt:has-trait [
                        a omt:Female;
                        rdfs:label "Female (Gender)"
                        ];
            rdfs:label "A37" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T16>
             omt:has-trait [
                        a omt:Name ;
                        omt:has-name "cow"
                        ];
            rdfs:label "A38" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T16>
             omt:has-trait [
                        a omc:Bovine;
                        rdfs:label "Bovine (Species)"
                        ];
            rdfs:label "A39" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T18>
             omt:has-trait [
                        a omt:Name ;
                        omt:has-name "calf"
                        ];
            rdfs:label "A40" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T18>
             omt:has-trait [
                        a omc:Bovine;
                        rdfs:label "Bovine (Species)"
                        ];
            rdfs:label "A41" .
```

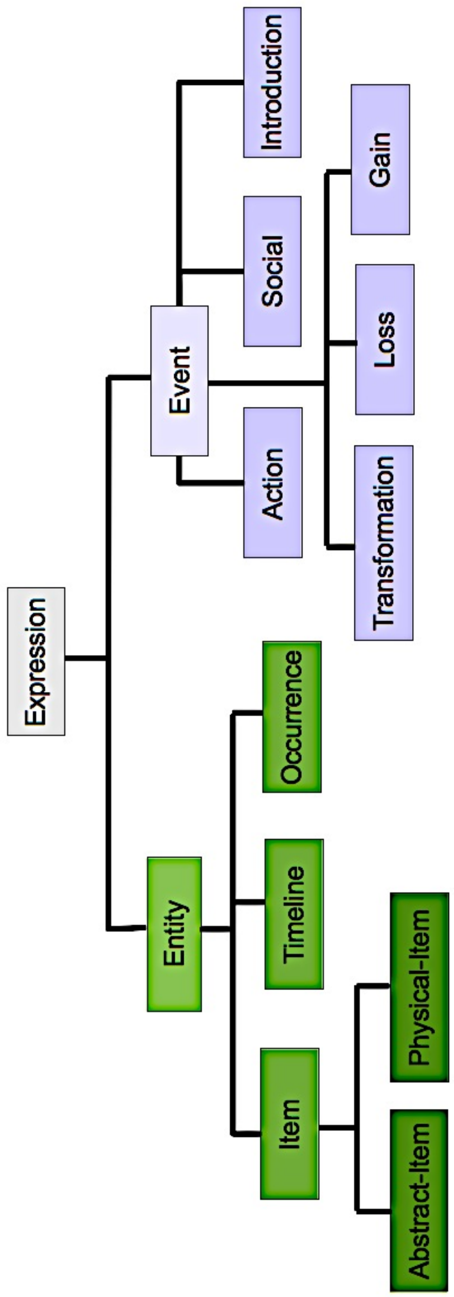
```
<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T20>
ome:contained-by <http://contextus.net/resource/RRH/TNurmikko/Three
Oxdrivers/T19>;
        rdfs:label "R5" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T21>
         omt:has-trait [
                 a omt:Name ;
                 omt:has-name "calf"
                 ];
        rdfs:label "A42" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T21>
         omt:has-trait [
                 a omc:Bovine;
                 rdfs:label "Bovine (Species)"
                 ];
        rdfs:label "A43" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T22>
         omt:has-trait [
                 a omt:Name ;
                 omt:has-name "calf"
                 ];
        rdfs:label "A44" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T22>
         omt:has-trait [
                 a omc:Bovine;
                 rdfs:label "Bovine (Species)"
                 ];
        rdfs:label "A45" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T23>
         omt:has-trait [
                 a omt:Male;
                 rdfs:label "Male (Gender)"
                 ];
        rdfs:label "A46" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T23>
         omt:has-trait [
                 a omt:Name ;
                 omt:has-name "king"
```

```
                ];
        rdfs:label "A47" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T25>
         omt:has-trait [
                a omt:Male;
                rdfs:label "Male (Gender)"
                ];
        rdfs:label "A48" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T25>
         omt:has-trait [
                a omt:Name ;
                omt:has-name "king"
                ];
        rdfs:label "A49" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T44>
        a omea:Ingestion ;
        cnt:chars "chew up" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T44>
        a omea:Ingestion;
        ome:has-subject-entity
<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T17>;
        ome:has-object-entity
<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T20>;
        rdfs:label "E10" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T45>
        a omes:Conversational ;
        cnt:chars "Who does this calf belong to" .

<http://contextus.net/resource/RRH/TNurmikko/Three Oxdrivers/T45>
        a omes:Conversational;
        rdfs:label "E11" .
```

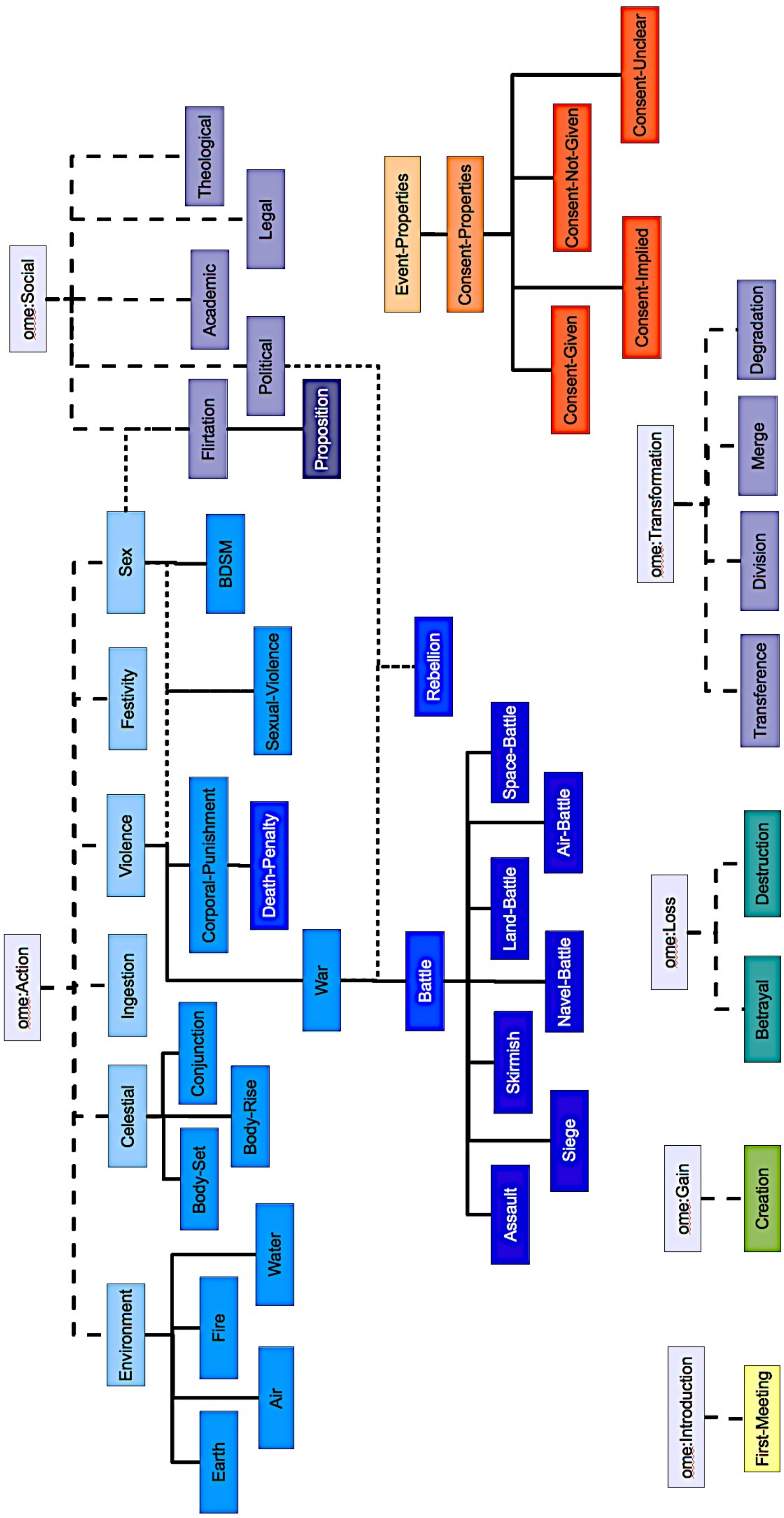
Appendix G Ontomedia images

All images have been accessed via http://www.contextus.net/ontomedia.

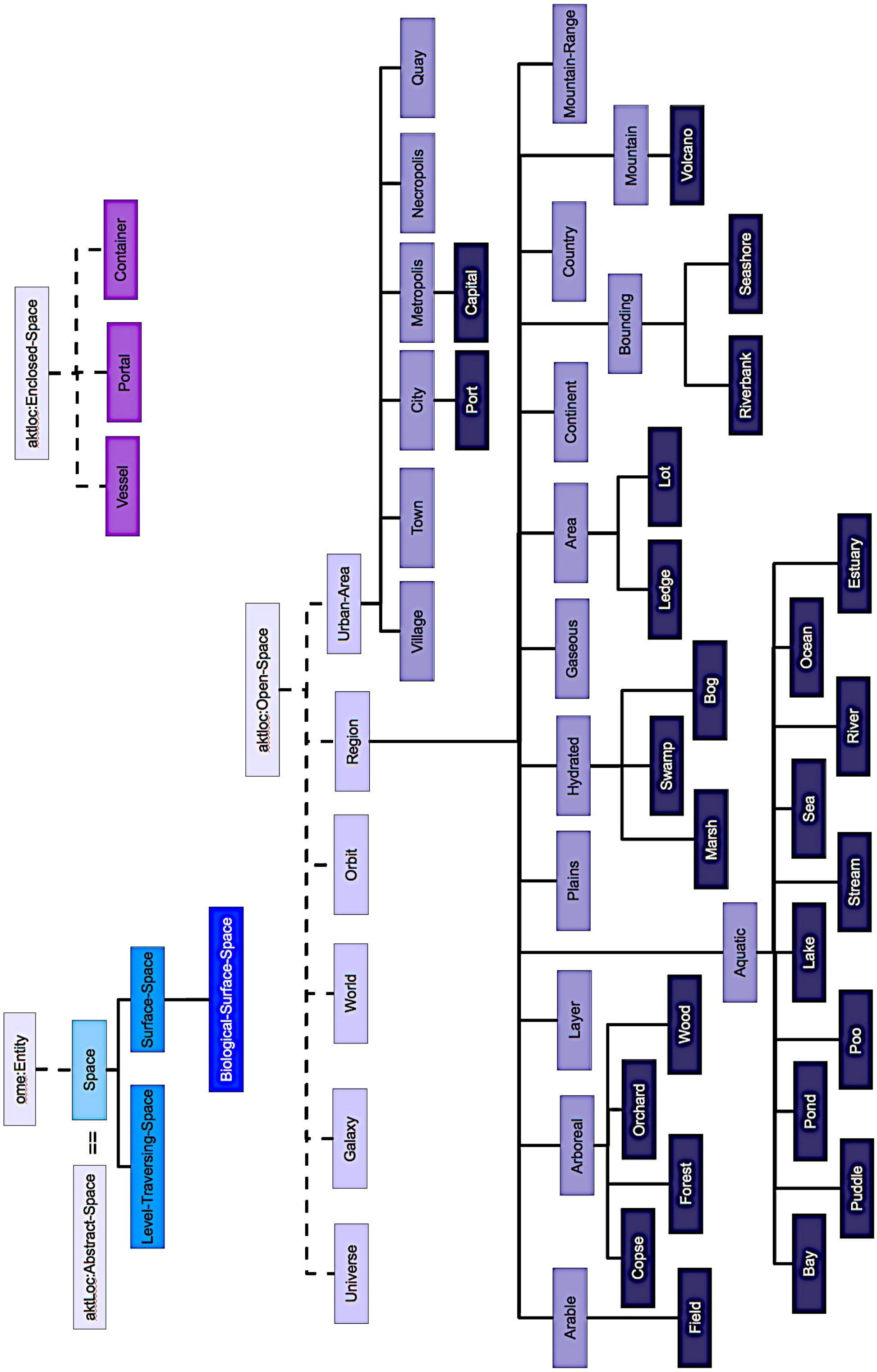
G.1 Ontomedia Expression



G.2 Ontomedia Event



G.3 Ontomedia Space



Appendix H mORSuL in Turtle Terse RDF Triple Language

```
@prefix owl: <http://www.w3.org/2002/07/owl#> .
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
@prefix xsd: <http://www.w3.org/2001/XMLSchema#> .
@prefix skos: <http://www.w3.org/2004/02/skos/core#> .
@prefix cidoc: <http://erlangen-crm.org/current/> .
@prefix frbroo: <http://erlangen-crm.org/efrbroo/> .
@prefix dc11: <http://purl.org/dc/elements/1.1/> .
@prefix dc: <http://purl.org/dc/terms/> .
@prefix foaf: <http://xmlns.com/foaf/0.1/> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .

<http://www.semanticweb.org/terhi/ontologies/mORSuL>
  a owl:Ontology .

########## CIDOC CRM as denined in http://www.cidoc-crm.org/docs/cidoc_crm_version_5.1.2.pdf  #####################
cidoc:E21_Person
  a owl:Class ;
  rdfs:comment """Scope note:
This class comprises real persons who live or are assumed to have lived.
Legendary figures that may have existed, such as Ulysses and King Arthur, fall
into this class if the documentation refers to them as historical figures. In
cases where doubt exists as to whether several persons are in fact identical,
multiple instances can be created and linked to indicate their relationship. The
CRM does not propose a specific form to support reasoning about possible
identity.

Examples:
- Tut-Ankh-Amun
- Nelson Mandela"""@en ;
  rdfs:label "E21 Person"@en ;
  skos:notation "E21"^^xsd:string ;
  rdfs:subClassOf <http://erlangen-crm.org/current/E20_Biological_Object>, [
    a owl:Restriction ;
    owl:cardinality "1"^^xsd:nonNegativeInteger ;
    owl:onProperty <http://erlangen-crm.org/current/P98i_was_born>
  ], <http://erlangen-crm.org/current/E39_Actor>, [
    a owl:Restriction ;
```

```
    owl:onProperty <http://erlangen-crm.org/current/P152_has_parent> ;
    owl:minCardinality "2"^^xsd:int
  ] .

cidoc:E24_Physical_Man-Made_Thing
    a owl:Class ;
    rdfs:label "E24 Physical Man-Made Thing"@en ;
    skos:notation "E24"^^xsd:string ;
    rdfs:comment """Scope note:
  This class comprises all persistent physical items that are purposely created
by human activity.
  This class comprises man-made objects, such as a swords, and man-made
features, such as rock art. No assumptions are made as to the extent of
modification required to justify regarding an object as man-made. For
example, a "cup and ring" carving on bedrock is regarded as instance of E24
Physical Man-Made Thing.

  Examples:
  - the Forth Railway Bridge (E22)
  - the Channel Tunnel (E25)
  - the Historical Collection of the Museum Benaki in Athens (E78)"""@en ;
    rdfs:subClassOf <http://erlangen-crm.org/current/E18_Physical_Thing>, [
      a owl:Restriction ;
      owl:onProperty <http://erlangen-
crm.org/current/P108i_was_produced_by> ;
      owl:someValuesFrom <http://erlangen-crm.org/current/E12_Production>
    ], <http://erlangen-crm.org/current/E71_Man-Made_Thing> .


cidoc:E33_Linguistic_Object
  a owl:Class ;
  rdfs:comment """Scope note:
This class comprises identifiable expressions in natural language or languages.
Instances of E33 Linguistic Object can be expressed in many ways: e.g. as
written texts, recorded speech or sign language. However, the CRM treats
instances of E33 Linguistic Object independently from the medium or method
by which they are expressed. Expressions in formal languages, such as
computer code or mathematical formulae, are not treated as instances of E33
Linguistic Object by the CRM. These should be modelled as instances of E73
Information Object.
```

```
The text of an instance of E33 Linguistic Object can be documented in a note
by P3 has note: E62 String

Examples:
- the text of the Ellesmere Chaucer manuscript
- the lyrics of the song "Blue Suede Shoes"
- the text of the Jabberwocky by Lewis Carroll
- the text of "Doktoro Jekyll kaj Sinjoro Hyde" (an Esperanto translation of Dr
Jekyll and Mr Hyde)"""@en ;
  skos:notation "E33"^^xsd:string ;
  rdfs:label "E33 Linguistic Object"@en ;
  rdfs:subClassOf [
    a owl:Restriction ;
    owl:maxCardinality "1"^^xsd:nonNegativeInteger ;
    owl:onProperty <http://erlangen-crm.org/current/P73i_is_translation_of>
  ], [
    a owl:Restriction ;
    owl:minCardinality "1"^^xsd:nonNegativeInteger ;
    owl:onProperty <http://erlangen-crm.org/current/P72_has_language>
  ], <http://erlangen-crm.org/current/E73_Information_Object> .

cidoc:E39_Actor
    a owl:Class ;
    rdfs:subClassOf <http://erlangen-crm.org/current/E77_Persistent_Item> ;
    rdfs:comment """Scope note:
  This class comprises people, either individually or in groups, who have the
potential to perform intentional actions for which they can be held responsible.
  The CRM does not attempt to model the inadvertent actions of such actors.
Individual people should be documented as instances of E21 Person, whereas
groups should be documented as instances of either E74 Group or its subclass
E40 Legal Body.

  Examples:
  - London and Continental Railways (E40)
  - the Governor of the Bank of England in 1975 (E21)
  - Sir Ian McKellan (E21)"""@en ;
    rdfs:label "E39 Actor"@en ;
    skos:notation "E39"^^xsd:string .

cidoc:E56_Language
    a owl:Class ;
```

```
   rdfs:comment """Scope note:
  This class is a specialization of E55 Type and comprises the natural
languages in the sense of concepts.
  This type is used categorically in the model without reference to instances of
it, i.e. the Model does not foresee the description of instances of instances of
E56 Language, e.g.: "instances of  Mandarin Chinese".
  It is recommended that internationally or nationally agreed codes and
terminology are used to denote instances of E56 Language, such as those
defined in ISO 639:1988.
  Example:
  el [Greek]
  - en [English]
  - eo [Esperanto]
  - es [Spanish]
  - fr [French]"""@en ;
   rdfs:subClassOf <http://erlangen-crm.org/current/E55_Type> ;
   skos:notation "E56"^^xsd:string ;
   rdfs:label "E56 Language"@en .

cidoc:E57_Material
      a owl:Class ;
      rdfs:subClassOf <http://erlangen-crm.org/current/E55_Type> ;
      rdfs:comment """Scope note:
      This class is a specialization of E55 Type and comprises the concepts of
materials.
      Instances of E57 Material may denote properties of matter before its use,
during its use, and as incorporated in an object, such as ultramarine powder,
tempera paste, reinforced concrete. Discrete pieces of raw-materials kept in
museums, such as bricks, sheets of fabric, pieces of metal, should be modelled
individually in the same way as other objects. Discrete used or processed
pieces, such as the stones from Nefer Titi's temple, should be modelled as
parts (cf. P46 is composed of).
      This type is used categorically in the model without reference to instances
of it, i.e. the Model does not foresee the description of instances of instances
of E57 Material, e.g.: "instances of  gold".
      It is recommended that internationally or nationally agreed codes and
terminology are used."""@en ;
       rdfs:label "E57 Material"@en ;
       skos:notation "E57"^^xsd:string .

cidoc:E58_Measurement_Unit
```

a owl:Class ;
rdfs:label "E58 Measurement Unit"@en ;
rdfs:subClassOf <http://erlangen-crm.org/current/E55_Type>, [
a owl:Restriction ;
owl:someValuesFrom <http://erlangen-crm.org/current/E54_Dimension> ;
owl:onProperty <http://erlangen-crm.org/current/P91i_is_unit_of>
] ;
skos:notation "E58"^^xsd:string ;
rdfs:comment """Scope note:

This class is a specialization of E55 Type and comprises the types of measurement units: feet, inches, centimetres, litres, lumens, etc.

This type is used categorically in the model without reference to instances of it, i.e. the Model does not foresee the description of instances of instances of E58 Measurement Unit, e.g.: "instances of cm".

SystÃ¨me International (SI) units or internationally recognized non-SI terms should be used whenever possible. (ISO 1000:1992). Archaic Measurement Units used in historical records should be preserved.

Examples:
- cm [centrimetre]
- km [kilometre]
- m [meter]
- m/s [meters per second]
- A [Ampere]
- GRD [Greek Drachme]
- CÂ° [degrees centigrade]"""@en .

cidoc:E73_Information_Object
a owl:Class ;
skos:notation "E73"^^xsd:string ;
rdfs:comment """Scope note:

This class comprises identifiable immaterial items, such as a poems, jokes, data sets, images, texts, multimedia objects, procedural prescriptions, computer program code, algorithm or mathematical formulae, that have an objectively recognizable structure and are documented as single units.

An E73 Information Object does not depend on a specific physical carrier, which can include human memory, and it can exist on one or more carriers simultaneously.

Instances of E73 Information Object of a linguistic nature should be declared as instances of the E33 Linguistic Object subclass. Instances of E73

Information Object of a documentary nature should be declared as instances of the E31 Document subclass. Conceptual items such as types and classes are not instances of E73 Information Object, nor are ideas without a reproducible expression.

Examples:
- image BM000038850.JPG from the Clayton Herbarium in London
- E. A. Poe's "The Raven"
- the movie "The Seven Samurai" by Akira Kurosawa
- the Maxwell Equations"""@en ;
    rdfs:subClassOf <http://erlangen-crm.org/current/E89_Propositional_Object>, <http://erlangen-crm.org/current/E90_Symbolic_Object> ;
    rdfs:label "E73 Information Object"@en .

cidoc:E84_Information_Carrier
    a owl:Class ;
    rdfs:label "E84 Information Carrier"@en ;
    rdfs:comment """Scope note:
This class comprises all instances of E22 Man-Made Object that are explicitly designed to act as persistent physical carriers for instances of E73 Information Object.

This allows a relationship to be asserted between an E19 Physical Object and its immaterial information contents. An E84 Information Carrier may or may not contain information, e.g., a diskette. Note that any E18 Physical Thing may carry information, such as an E34 Inscription. However, unless it was specifically designed for this purpose, it is not an Information Carrier. Therefore the property P128 carries (is carried by) applies to E18 Physical Thing in general.

Examples:
- the Rosetta Stone
- my paperpack copy of Crime & Punishment
- the computer disk at ICS-FORTH that stores the canonical Definition of the CIDOC CRM"""@en ;
    skos:notation "E84"^^xsd:string ;
    rdfs:subClassOf <http://erlangen-crm.org/current/E22_Man-Made_Object> .

cidoc:E90_Symbolic_Object
    a owl:Class ;

```
    rdfs:label "E90 Symbolic Object"@en ;
    rdfs:subClassOf <http://erlangen-
crm.org/current/E28_Conceptual_Object>, <http://erlangen-
crm.org/current/E72_Legal_Object>, [
    a owl:Restriction ;
    owl:someValuesFrom <http://erlangen-
crm.org/current/E90_Symbolic_Object> ;
    owl:onProperty <http://erlangen-
crm.org/current/P106_is_composed_of>
     ] ;
    skos:notation "E90"^^xsd:string ;
    rdfs:comment """Scope note: This class comprises identifiable symbols
and any aggregation of symbols, such as characters, identifiers, traffic signs,
emblems, texts, data sets, images, musical scores, multimedia objects,
computer program code or mathematical formulae that have an objectively
recognizable structure and that are documented as single units. It includes
sets of signs of any nature, which may serve to designate something, or to
communicate some propositional content.
    An instance of E90 Symbolic Object does not depend on a specific
physical carrier, which can include human memory, and it can exist on one or
more carriers simultaneously. An instance of E90 Symbolic Object may or may
not have a specific meaning, for example an arbitrary character string.
     In some cases, the content of an instance of E90 Symbolic Object may
completely be represented by a serialized digital content model, such as a
sequence of ASCII-encoded characters, an XML or HTML document, or a TIFF
image. The property P3 has note allows for the description of this content
model. In order to disambiguate which symbolic level is the carrier of the
meaning, the property P3.1 has type can be used to specify the encoding (e.g.
"bit", "Latin character", RGB pixel). """@en .

cidoc:P72_has_language
  a owl:ObjectProperty ;
  skos:notation "P72"^^xsd:string ;
  rdfs:domain <http://erlangen-crm.org/current/E33_Linguistic_Object> ;
  rdfs:comment """Scope note:
This property describes the E56 Language of an E33 Linguistic Object.
Linguistic Objects are composed in one or more human Languages. This
property allows these languages to be documented.

Examples:
```

```
- the American Declaration of Independence (E33) has language 18th Century
English (E56)"""@en ;
  rdfs:range <http://erlangen-crm.org/current/E56_Language> ;
  owl:inverseOf <http://erlangen-crm.org/current/P72i_is_language_of> ;
  rdfs:label "P72 has language"@en .

cidoc:P73_has_translation
    a owl:ObjectProperty ;
    rdfs:label "P73 has translation"@en ;
    rdfs:range <http://erlangen-crm.org/current/E33_Linguistic_Object> ;
    rdfs:comment """Scope note:
  This property describes the source and target of instances of E33 Linguistic
Object involved in a translation.
  When a Linguistic Object is translated into a new language it becomes a new
Linguistic Object, despite being conceptually similar to the source object.

  Examples:
  - "Les Baigneurs" (E33) has translation "The Bathers" (E33)"""@en ;
    rdfs:domain <http://erlangen-crm.org/current/E33_Linguistic_Object> ;
    rdfs:subPropertyOf <http://erlangen-
crm.org/current/P130_shows_features_of> ;
    owl:inverseOf <http://erlangen-crm.org/current/P73i_is_translation_of> ;
    skos:notation "P73"^^xsd:string .

cidoc:P106_is_composed_of
        a owl:ObjectProperty, owl:TransitiveProperty ;
        rdfs:range <http://erlangen-crm.org/current/E90_Symbolic_Object> ;
        rdfs:domain <http://erlangen-crm.org/current/E90_Symbolic_Object> ;
        owl:inverseOf <http://erlangen-crm.org/current/P106i_forms_part_of>
;
        rdfs:label "P106 is composed of"@en ;
        skos:notation "P106"^^xsd:string ;
        rdfs:comment """Scope note:
       This property associates an instance of E90 Symbolic Object with a part of
it that is by itself an instance of E90 Symbolic Object, such as fragments of
texts or clippings from an image.

       Examples:
       - this Scope note P106 (E33) is composed of fragments of texts (E33)
       - 'recognizable' P106 (E90) is composed of 'ecognizabl' (E90)"""@en .
```

```
cidoc:P106i_forms_part_of
        a owl:ObjectProperty, owl:TransitiveProperty ;
        owl:inverseOf <http://erlangen-
crm.org/current/P106_is_composed_of> ;
        rdfs:domain <http://erlangen-crm.org/current/E90_Symbolic_Object> ;
        rdfs:label "P106 forms part of"@en ;
        rdfs:range <http://erlangen-crm.org/current/E90_Symbolic_Object> ;
        skos:notation "P106i"^^xsd:string .

cidoc:P128_carries
          a owl:ObjectProperty ;
          rdfs:comment """Scope note:
        This property identifies an E90 Symbolic Object carried by an instance of
E24 Physical Man-Made Thing.
        In general this would be an E84 Information Carrier P65 shows visual
item (is shown by) is a specialisation of P128 carries (is carried by) which
should be used for carrying visual items.

        Examples:
        - Matthew's paperback copy of Reach for the Sky (E84) carries the text
of Reach for the Sky (E73)"""@en ;
          rdfs:domain <http://erlangen-crm.org/current/E24_Physical_Man-
Made_Thing> ;
          owl:inverseOf <http://erlangen-crm.org/current/P128i_is_carried_by>
;
          skos:notation "P128"^^xsd:string ;
          rdfs:range <http://erlangen-crm.org/current/E90_Symbolic_Object> ;
          rdfs:label "P128 carries"@en ;
          rdfs:subPropertyOf <http://erlangen-
crm.org/current/P130_shows_features_of> .

##### FRBRoo as denined at http://www.cidoc-
crm.org/docs/frbr_oo//frbr_docs/FRBRoo_V2.0_draft_2013May.pdf #######

frbroo:F2_Expression
  a owl:Class ;
  rdfs:label "expression"@en ;
  rdfs:comment """Scope note:
This class comprises the intellectual or artistic realisations of works in the form
of identifiable immaterial objects, such as texts, poems, jokes, musical or
choreographic notations, movement pattern, sound pattern, images,
```

multimedia objects, or any combination of such forms that have objectively recognisable structures. The substance of F2 Expression is signs.

Expressions cannot exist without a physical carrier, but do not depend on a specific physical carrier and can exist on one or more carriers simultaneously. Carriers may include human memory.

Inasmuch as the form of F2 Expression is an inherent characteristic of the F2 Expression, any change in form (e.g., from alpha-numeric notation to spoken word, a poem created in capitals and rendered in lower case) is a new F2 Expression. Similarly, changes in the intellectual conventions or instruments that are employed to express a work (e.g., translation from one language to another) result in the creation of a new F2 Expression. Thus, if a text is revised or modified, the resulting F2 Expression is considered to be a new F2 Expression. Minor changes, such as corrections of spelling and punctuation, etc., are normally considered variations within the same F2 Expression. On a practical level, the degree to which distinctions are made between variant expressions of a work will depend to some extent on the nature of the F1 Work itself, and on the anticipated needs of users.

The genre of the work may provide an indication of which features are essential to the expression. In some cases, aspects of physical form, such as typeface and page layout, are not integral to the intellectual or artistic realisation of the work as such, and therefore are not distinctive criteria for the respective expressions. For another work features such as layout may be essential. For instance, the author or a graphic designer may wrap a poem around an image.

An expression of a work may include expressions of other works within it. For instance, an anthology of poems is regarded as a work in its own right that makes use of expressions of the individual poems that have been selected and ordered as part of an intellectual process. This does not make the contents of the aggregated expressions part of this work, but only parts of the resulting expression.

If an instance of F2 Expression is of a specific form, such as text, image, etc., it may be simultaneously instantiated in the specific classes representing these forms in CIDOC CRM. Thereby one can make use of the more specific properties of these classes, such as language (which is applicable to linguistic objects only). """@en ;

```
  rdfs:subClassOf [
    a owl:Restriction ;
    owl:someValuesFrom <http://erlangen-
crm.org/efrbroo/F28_Expression_Creation> ;
    owl:onProperty <http://erlangen-crm.org/efrbroo/R17i_was_created_by>
  ], <http://erlangen-crm.org/current/E73_Information_Object> .
```

```
frbroo:F4_Manifestation_Singleton
        a owl:Class ;
        rdfs:comment """Scope note:
        This class comprises physical objects that each carry an instance of F2
Expression, and that were produced as unique objects, with no siblings
intended in the course of their production. It should be noted that if all but one
copy of a given publication are destroyed, then that copy does not become an
instance of F4 Manifestation Singleton, because it was produced together with
sibling copies, even though it now happens to be unique. Examples of
instances of F4 Manifestation Singleton include manuscripts, preparatory
sketches and the final clean draft sent by an author or a composer to a
publisher."""@en ;
        rdfs:label "manifestation singleton"@en ;
        rdfs:subClassOf [
        a owl:Restriction ;
        owl:onProperty <http://erlangen-
crm.org/efrbroo/R18i_was_created_by> ;
        owl:maxCardinality "1"^^xsd:nonNegativeInteger
        ], <http://erlangen-crm.org/current/E24_Physical_Man-Made_Thing> .

frbroo:F10_Person
          a owl:Class ;
          rdfs:comment """Scope note:
        This class comprises real persons who live or are assumed to have lived.
[Beginning of scope note for E21 Person in CIDOC CRM version 5.0.1] F10
Person covers the notion of persona. Examples: Margaret Atwood, Hans
Christian Andersen, Queen Victoria."""@en ;
          owl:equivalentClass <http://erlangen-crm.org/current/E21_Person> ;
          rdfs:label "person"@en .

frbroo:F22_Self-Contained_Expression
    a owl:Class ;
    rdfs:label "self-contained expression"@en ;
    rdfs:comment """Scope note:
  This class comprises the immaterial realisations of individual works at a
particular time that are regarded as a complete whole. The quality of
wholeness reflects the intention of its creator that this expression should
convey the concept of the work. Such a whole can in turn be part of a larger
whole.
```

Inherent to the notion of work is the completion of recognisable outcomes of the work. These outcomes, i.e. the Self-Contained Expressions, are regarded as the symbolic equivalents of Individual Works, which form the atoms of a complex work. A Self-Contained Expression may contain expressions or parts of expressions from other work, such as citations or items collected in anthologies. Even though they are incorporated in the Self-Contained Expression, they are not regarded as becoming members of the expressed container work by their inclusion in the expression, but are rather regarded as foreign or referred elements.

F22 Self-Contained Expression can be distinguished from F23 Expression Fragment in that an F23 Expression Fragment was not intended by its creator to make sense by itself. Normally creators would characterise an outcome of a work as finished. In other cases, one could recognise an outcome of a work as complete from the elaboration or logical coherence of its content, or if there is any historical knowledge about the creator deliberately or accidentally never finishing (completing) that particular expression. In all those cases, one would regard an expression as self-contained."""@en ;

```
  rdfs:subClassOf [
    a owl:Restriction ;
    owl:onProperty <http://erlangen-crm.org/efrbroo/R9i_realises> ;
    owl:cardinality "1"^^xsd:nonNegativeInteger
  ], [
    a owl:Restriction ;
    owl:cardinality "1"^^xsd:nonNegativeInteger ;
    owl:onProperty <http://erlangen-crm.org/efrbroo/R3i_realises>
  ], <http://erlangen-crm.org/efrbroo/F2_Expression> .

frbroo:F23_Expression_Fragment
        a owl:Class ;
        rdfs:label "expression fragment"@en ;
        rdfs:comment """Scope note:
```

This class comprises parts of Expressions and these parts are not Self-contained Expressions themselves.

The existence of an instance of F23 Expression Fragment can be due to accident, such as loss of material over time, e.g. the only remaining manuscript of an antique text being partially eaten by worms, or due to deliberate isolation, such as excerpts taken from a text by the compiler of a collection of excerpts.

An F23 Expression Fragment is only identified with respect to its occurrence in a known or assumed whole. The size of an instance of F23 Expression Fragment ranges from more than 99% of an instance of F22 Self-Contained Expression to tiny bits (a few words from a text, one bar from a musical composition, one detail from a still image, a two-second clip from a movie, etc.)."""@en ;
rdfs:subClassOf <http://erlangen-crm.org/efrbroo/F2_Expression> .

frbroo:F38_Character
a owl:Class ;
rdfs:subClassOf <http://erlangen-crm.org/current/E28_Conceptual_Object>
rdfs:comment """Scope note: This class comprises fictional or iconographic individuals or groups of individual appearing in
works in a way relevant as subjects. Characters may be purely fictitious or based on real persons
or groups, but as characters they may exhibit properties that would be inconsistent with a real
person or group. Rather than merging characters with real persons, they should be described as
disjoint, but related entities.
Examples: Harry Potter [in J.K. Rowling's series of novels and the films based on them]
Sinuhe the Egyptian [in Mika Waltari's novel]
The Knights of the Round Table [in fiction]"""
owl:onProperty <http://erlangen-crm.org/efrbroo/R57_is_based_on>, <http://erlangen-crm.org/efrbroo/R58_has_fictional_member> .

frbroo:R17_created
a owl:ObjectProperty ;
rdfs:subPropertyOf <http://erlangen-crm.org/current/P94_has_created> ;
rdfs:range <http://erlangen-crm.org/efrbroo/F2_Expression> ;
rdfs:comment """Scope note:
This property associates the expression that was first externalised during a particular creation event with that particular creation event."""@en ;
rdfs:label "created"@en ;
rdfs:domain <http://erlangen-crm.org/efrbroo/F28_Expression_Creation> .

frbroo:R17i_was_created_by
a owl:ObjectProperty ;
rdfs:label ""@en ;

```
    owl:inverseOf <http://erlangen-crm.org/efrbroo/R17_created> .

frbroo:R18i_was_created_by
  a owl:ObjectProperty ;
  rdfs:label "was created by"@en ;
  owl:inverseOf <http://erlangen-crm.org/efrbroo/R18_created> .

frbroo:R9i_realises
  a owl:ObjectProperty ;
  rdfs:label "realises"@en ;
  owl:inverseOf <http://erlangen-crm.org/efrbroo/R9_is_realised_in> .

frbroo:R3i_realises
  a owl:ObjectProperty ;
  owl:inverseOf <http://erlangen-crm.org/efrbroo/R3_is_realised_in> ;
  rdfs:label "realises"@en .

frbroo:R57_is_based_on
    a owl:ObjectProperty ;
    rdfs:domain frbroo:F38_Character ;
    rdfs:range <http://erlangen-crm.org/current/E39_Actor> ;
    rdfs:comment """Scope note: shortcut of creation P15 influenced (MD).
This property associates an instance of F38 Character with an instance of E39
Actor that the character is motivated by or is intended to represent. An
instance of F38 Character may be
based on a combination of features taken from several actors.
Examples: Sinuhe (MD)""" .

frbroo:R58_has_fictional_member
    rdfs:domain frbroo:F38_Character ;
    rdfs:range frbroo:F38_Character ;
    rdfs:comment """Scope note: out of CRM Scope. This property associates
an instance of F38 Character representing a group with another
instance of F38 Character that is presented in relevant fiction as a member of
the fictional
group. Examples: Argonauts (F38) R58 has fictional member Jason (F38)""" .

########## Ontomedia Subontologies as defined at
http://www.contextus.net/ontomedia ############
```

```
##### Classes from Ontomedia Expression, which contains the basic classes
and properties for describing narrative. #####

<http://contextus.net/ontology/ontomedia/core/expression#Physical-Item>
  a owl:Class ;
  rdfs:comment "This class represents a physical entity which may participate in
an event within the media" ;
  rdfs:label "Physical Item" ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Item>,
<http://contextus.net/ontology/ontomedia/core/expression#Collection> .

<http://contextus.net/ontology/ontomedia/core/expression#Timeline>
  a owl:Class ;
  rdfs:comment "This class contains a sequence of occurring events" ;
  rdfs:label "Timeline" ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Entity> .

<http://contextus.net/ontology/ontomedia/core/expression#Occurrence>
  a owl:Class ;
  rdfs:comment "This class represents a single occurrence of an event, placing
it at a position in a timeline" ;
  rdfs:label "Occurrence" ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Entity> .

<http://contextus.net/ontology/ontomedia/core/expression#Event>
  a owl:Class ;
  rdfs:label "Event" ;
  rdfs:comment "This property defines an event" ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Expression> .

<http://contextus.net/ontology/ontomedia/core/expression#Gain>
  a owl:Class ;
  rdfs:label "Gain" ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Event> ;
  rdfs:comment "This event class results in an overall increase of the entities
related to the primary subject or subjects of the event" .
```

```
<http://contextus.net/ontology/ontomedia/core/expression#Introduction>
  a owl:Class ;
  rdfs:label "Introduction" ;
  rdfs:comment "This event class denotes the introduction of an entity to the
media" ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Event> .

<http://contextus.net/ontology/ontomedia/core/expression#Loss>
  a owl:Class ;
  rdfs:label "Loss" ;
  rdfs:comment "This event class results in an overall reduction of the entities
related to the primary subject or subjects of the event" ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Event> .

<http://contextus.net/ontology/ontomedia/core/expression#Transformation
>
  a owl:Class ;
  rdfs:comment "This event class results in no gain or loss of attributes or
entities, merely alteration" ;
  rdfs:label "Transformation" ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Event> .

<http://contextus.net/ontology/ontomedia/core/expression#Action>
  a owl:Class ;
  rdfs:comment "This event class describes an action sequence (ie no plot)" ;
  rdfs:label "Action" ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Event> .

<http://contextus.net/ontology/ontomedia/core/expression#Social>
  a owl:Class ;
  rdfs:comment "This event class describes a sequence focusing on social,
interpersonal and personal emotional elements" ;
  rdfs:label "Social" ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Event> .
```

```
##### Classes from Ontomedia Space, which denotes areas of landscape.
Expands on the AKT location ontology. #####

<http://contextus.net/ontology/ontomedia/core/space#Vessel>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/misc/AKTlocation#Enclosed-
Space> ;
  rdfs:label "Vessel" ;
  rdfs:comment "This property is to be used to describe a vessel" .

<http://contextus.net/ontology/ontomedia/core/space#Container>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/misc/AKTlocation#Enclosed-
Space> ;
  rdfs:label "Container" ;
  rdfs:comment "This property is to be used to describe a container" .

<http://contextus.net/ontology/ontomedia/core/space#Region>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/misc/AKTlocation#Open-Space> ;
  rdfs:label "Region" ;
  rdfs:comment "This property is to be used to describe a region" .

<http://contextus.net/ontology/ontomedia/core/space#World>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/misc/AKTlocation#Open-Space> ;
  rdfs:label "World" ;
  rdfs:comment "This property is to be used to describe a world, planet, moon
or other similar body" .

<http://contextus.net/ontology/ontomedia/core/space#Urban-Area>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/misc/AKTlocation#Open-Space> ;
  rdfs:label "Urban Area" ;
  rdfs:comment "This property is to be used to describe an urban area" .
```

```
<http://contextus.net/ontology/ontomedia/core/space#Village>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/space#Urban-Area> ;
 rdfs:label "Village" ;
 rdfs:comment "This property is to be used to describe a village space" .

<http://contextus.net/ontology/ontomedia/core/space#City>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/space#Urban-Area> ;
 rdfs:label "City" ;
 rdfs:comment "This property is to be used to describe a city space" .

<http://contextus.net/ontology/ontomedia/core/space#Metropolis>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/space#Urban-Area> ;
 rdfs:label "Metropolis" ;
 rdfs:comment "This property is to be used to describe a metropolis" .

<http://contextus.net/ontology/ontomedia/core/space#Quay>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/space#Urban-Area> ;
 rdfs:label "Quay" ;
 rdfs:comment "This property is to be used to describe a quay" .

<http://contextus.net/ontology/ontomedia/core/space#Town>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/space#Urban-Area> ;
 rdfs:label "Town" ;
 rdfs:comment "This property is to be used to describe a town" .

<http://contextus.net/ontology/ontomedia/core/space#Port>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/space#City> ;
 rdfs:label "Port" ;
```

```
 rdfs:comment "This property is to be used to describe a port city" .

<http://contextus.net/ontology/ontomedia/core/space#Capital>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/space#Metropolis> ;
 rdfs:label "Capital" ;
 rdfs:comment "This property is to be used to describe a Capital city" .

<http://contextus.net/ontology/ontomedia/core/space#Aquatic>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/space#Region> ;
 rdfs:label "Aquatic Region" ;
 rdfs:comment "This property is to be used to describe an aquatic region" .

<http://contextus.net/ontology/ontomedia/core/space#Arable>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/space#Region> ;
 rdfs:label "Arable" ;
 rdfs:comment "This property is to be used to describe an arable region" .

<http://contextus.net/ontology/ontomedia/core/space#Arboreal>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/space#Region> ;
 rdfs:label "Arboreal" ;
 rdfs:comment "This property is to be used to describe an arboreal region" .

<http://contextus.net/ontology/ontomedia/core/space#Area>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/space#Region> ;
 rdfs:label "Area" ;
 rdfs:comment "This property is to be used to describe a specific area" .

<http://contextus.net/ontology/ontomedia/core/space#Mountain>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/space#Region> ;
```

```
  rdfs:label "Mountain" ;
  rdfs:comment "This property is to be used to describe a mountain" .

<http://contextus.net/ontology/ontomedia/core/space#Mountain-Range>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/space#Region> ;
  rdfs:label "Mountain Range" ;
  rdfs:comment "This property is to be used to describe a continious
mountainous region" .

<http://contextus.net/ontology/ontomedia/core/space#Plains>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/space#Region> ;
  rdfs:label "Plains" ;
  rdfs:comment "This property is to be used to describe plains" .

<http://contextus.net/ontology/ontomedia/core/space#Bay>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/space#Aquatic> ;
  rdfs:label "Bay" ;
  rdfs:comment "This property is to be used to describe a bay region" .

<http://contextus.net/ontology/ontomedia/core/space#Pool>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/space#Aquatic> ;
  rdfs:label "Pool" ;
  rdfs:comment "This property is to be used to describe a pool region" .

<http://contextus.net/ontology/ontomedia/core/space#Lake>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/space#Aquatic> ;
  rdfs:label "Lake" ;
  rdfs:comment "This property is to be used to describe a lake region" .

<http://contextus.net/ontology/ontomedia/core/space#Sea>
  a owl:Class ;
```

```
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/space#Aquatic> ;
 rdfs:label "Sea" ;
 rdfs:comment "This property is to be used to describe a sea region" .

<http://contextus.net/ontology/ontomedia/core/space#Ocean>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/space#Aquatic> ;
 rdfs:label "Ocean" ;
 rdfs:comment "This property is to be used to describe an ocean region" .

<http://contextus.net/ontology/ontomedia/core/space#Stream>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/space#Aquatic> ;
 rdfs:label "Stream" ;
 rdfs:comment "This property is to be used to describe a stream region" .

<http://contextus.net/ontology/ontomedia/core/space#River>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/space#Aquatic> ;
 rdfs:label "River" ;
 rdfs:comment "This property is to be used to describe a river region" .

<http://contextus.net/ontology/ontomedia/core/space#Estuary>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/space#Aquatic> ;
 rdfs:label "Estuary" ;
 rdfs:comment "This property is to be used to describe an estuary region" .

<http://contextus.net/ontology/ontomedia/core/space#Puddle>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/space#Aquatic> ;
 rdfs:label "Puddle" ;
 rdfs:comment "This property is to be used to describe a puddle region" .

<http://contextus.net/ontology/ontomedia/core/space#Pond>
```

```
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/space#Aquatic> ;
  rdfs:label "Pond" ;
  rdfs:comment "This property is to be used to describe a man-made pond
region" .

<http://contextus.net/ontology/ontomedia/core/space#Copse>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/space#Arboreal> ;
  rdfs:label "Copse" ;
  rdfs:comment "This property is to be used to describe a copse region" .

<http://contextus.net/ontology/ontomedia/core/space#Forest>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/space#Arboreal> ;
  rdfs:label "Forest" ;
  rdfs:comment "This property is to be used to describe a forested region" .

<http://contextus.net/ontology/ontomedia/core/space#Orchard>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/space#Arboreal> ;
  rdfs:label "Orchard" ;
  rdfs:comment "This property is to be used to describe a cultivated orchard
region" .

<http://contextus.net/ontology/ontomedia/core/space#Wood>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/space#Arboreal> ;
  rdfs:label "Wood" ;
  rdfs:comment "This property is to be used to describe a wooded region" .

<http://contextus.net/ontology/ontomedia/core/space#Marsh>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/space#Hydrated> ;
  rdfs:label "Marsh" ;
```

```
  rdfs:comment "This property is to be used to describe a marshy region" .

<http://contextus.net/ontology/ontomedia/core/space#Swamp>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/space#Hydrated> ;
  rdfs:label "Swamp" ;
  rdfs:comment "This property is to be used to describe a swampy region" .

<http://contextus.net/ontology/ontomedia/core/space#Bog>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/space#Hydrated> ;
  rdfs:label "Bog" ;
  rdfs:comment "This property is to be used to describe a boggy region" .

<http://contextus.net/ontology/ontomedia/core/space#Field>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/space#Arable> ;
  rdfs:label "Field" ;
  rdfs:comment "This property is to be used to describe a field" .

<http://contextus.net/ontology/ontomedia/core/space#Ledge>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/space#Area> ;
  rdfs:label "Ledge" ;
  rdfs:comment "This property is to be used to describe a ledge i.e on the
mountain wall" .

<http://contextus.net/ontology/ontomedia/core/space#Lot>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/space#Area> ;
  rdfs:label "Lot" ;
  rdfs:comment "This property is to be used to describe a lot of land" .

<http://contextus.net/ontology/ontomedia/core/space#Riverbank>
  a owl:Class ;
```

```
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/space#Bounding> ;
  rdfs:label "Riverbank" ;
  rdfs:comment "This property is to be used to describe a riverbank" .

<http://contextus.net/ontology/ontomedia/core/space#Seashore>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/space#Bounding> ;
  rdfs:label "Seashore" ;
  rdfs:comment "This property is to be used to describe a sea shore" .

<http://contextus.net/ontology/ontomedia/core/space#Volcano>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/space#Mountain> ;
  rdfs:label "Volcano" ;
  rdfs:comment "This property is to be used to describe a volcano" .

<http://contextus.net/ontology/ontomedia/core/space#Surface-Space>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/space#Space> ;
  rdfs:label "Surface Space" ;
  rdfs:comment "This property is to be used to describe the surface of a object"
.

<http://contextus.net/ontology/ontomedia/core/space#Biological-Surface-
Space>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/space#Surface-Space> ;
  rdfs:label "Biological Surface Space" ;
  rdfs:comment "This property is to be used to describe the surface of a
biological object" .


##### Classes from Ontomedia Being, classes and properties describing
beings, groups of beings and links between beings. #####
<http://contextus.net/ontology/ontomedia/ext/common/being#Being>
  a owl:Class ;
```

```
 owl:equivalentClass foaf:#Person ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Entity> ;
 rdfs:comment "This class represents an Entity with a personality" ;
 rdfs:label "Being" .

<http://contextus.net/ontology/ontomedia/ext/common/being#Character>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/being#Being> ;
 rdfs:comment "This class represents an fictionalised contruction of an entity
with a personality" ;
 rdfs:label "Character" .

<http://contextus.net/ontology/ontomedia/ext/common/being#Group>
 a owl:Class ;
 owl:equivalentClass foaf:#Group ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Collection>, [
  a owl:Restriction ;
  owl:onProperty
<http://contextus.net/ontology/ontomedia/core/expression#contains> ;
  owl:allValuesFrom [
   a owl:Class ;
   owl:unionOf (
    <http://contextus.net/ontology/ontomedia/ext/common/being#Being>
    <http://contextus.net/ontology/ontomedia/ext/common/being#Group>
   )
  ]
 ] ;
 rdfs:comment "This class represents a group of beings" ;
 rdfs:label "Group" .

<http://contextus.net/ontology/ontomedia/ext/common/being#Community>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/being#Group> ;
 rdfs:comment "This class represents a community" ;
 rdfs:label "Community" .
```

```
<http://contextus.net/ontology/ontomedia/ext/common/being#Organisation
>
  a owl:Class ;
  owl:equivalentClass foaf:#Organization ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/being#Group> ;
  rdfs:comment "This class represents an organisation" ;
  rdfs:label "Organisation" .

<http://contextus.net/ontology/ontomedia/ext/common/being#Household>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/being#Community>
;
  rdfs:comment "This class represents a household" ;
  rdfs:label "Household" .

<http://contextus.net/ontology/ontomedia/ext/common/being#Bonded-
Group>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/being#Community>
;
  rdfs:comment "This class represents a bonded group" ;
  rdfs:label "Bonded Group" .

<http://contextus.net/ontology/ontomedia/ext/common/being#Partnership>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/being#Bonded-
Group> ;
  rdfs:comment "This class represents a partnership" ;
  rdfs:label "Partnership" .

<http://contextus.net/ontology/ontomedia/ext/common/being#Bond>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Abstract-Item> ;
  rdfs:comment "This class represents a bond that exists between beings or
groups of beings" ;
  rdfs:label "Bond" .
```

```
<http://contextus.net/ontology/ontomedia/ext/common/being#Pledge>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/being#Bond> ;
  rdfs:comment "This class represents a promise that exists between beings or
groups of beings" ;
  rdfs:label "Pledge" .

<http://contextus.net/ontology/ontomedia/ext/common/being#Deal>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/being#Bond> ;
  rdfs:comment "This class represents a deal that exists between beings or
groups of beings" ;
  rdfs:label "Deal" .

<http://contextus.net/ontology/ontomedia/ext/common/being#Enmity>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/being#Bond> ;
  rdfs:comment "This class represents an emnity that exists between beings or
groups of beings" ;
  rdfs:label "Enmity" .

<http://contextus.net/ontology/ontomedia/ext/common/being#Alliance>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/being#Bond> ;
  rdfs:comment "This class represents an alliance that exists between beings or
groups of beings" ;
  rdfs:label "Alliance" .

<http://contextus.net/ontology/ontomedia/ext/common/being#Family>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/being#Bond> ;
  rdfs:comment "This class represents a family bond that exists between beings
or groups of beings" ;
  rdfs:label "Family Bond" .
```

```
<http://contextus.net/ontology/ontomedia/ext/common/being#Possession>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/being#Bond> ;
  rdfs:comment "This class represents a the bond between two entities where
one claims ownership of the other" ;
  rdfs:label "Possession" .

<http://contextus.net/ontology/ontomedia/ext/common/being#Friendship>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/being#Alliance> ;
  rdfs:comment "This class represents an friendship that exists between beings
or groups of beings" ;
  rdfs:label "Friendship" .

<http://contextus.net/ontology/ontomedia/ext/common/being#Blood>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/being#Family> ;
  rdfs:comment "This class represents a blood bond that exists between beings
or groups of beings" ;
  rdfs:label "Blood Family Bond" .

<http://contextus.net/ontology/ontomedia/ext/common/being#Adopted>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/being#Family> ;
  rdfs:comment "This class represents an adopted bond that exists between
beings or groups of beings" ;
  rdfs:label "Adopted Family Bond" .

<http://contextus.net/ontology/ontomedia/ext/common/being#Foster>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/being#Family> ;
  rdfs:comment "This class represents a foster bond that exists between beings
or groups of beings" ;
  rdfs:label "Foster Family Bond" .

<http://contextus.net/ontology/ontomedia/ext/common/being#Step>
```

```
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/being#Family> ;
  rdfs:comment "This class represents a step bond that exists between beings
or groups of beings" ;
  rdfs:label "Step Family Bond" .

<http://contextus.net/ontology/ontomedia/ext/common/being#Profession>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Abstract-Item> ;
  rdfs:comment "This class represents a profession" ;
  rdfs:label "Profession" .

<http://contextus.net/ontology/ontomedia/ext/common/being#Mental-
Illness>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Abstract-Item> ;
  rdfs:comment "This class represents a mental illness" ;
  rdfs:label "Mental Illness" .

<http://contextus.net/ontology/ontomedia/ext/common/being#Physical-
Illness>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Abstract-Item> ;
  rdfs:comment "This class represents a physical illness" ;
  rdfs:label "Physical Illness" .

<http://contextus.net/ontology/ontomedia/ext/common/being#Physical-
Injury>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Abstract-Item> ;
  rdfs:comment "This class represents a physical injury" ;
  rdfs:label "Physical Injury" .

<http://contextus.net/ontology/ontomedia/ext/common/being#Emotional-
Crisis>
  a owl:Class ;
```

```
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Abstract-Item> ;
  rdfs:comment "This class represents a emotional crisis" ;
  rdfs:label "Emotional Crisis" .

<http://contextus.net/ontology/ontomedia/ext/common/being#place_of_citiz
enship>
  a owl:ObjectProperty ;
  rdfs:label "Place of Citizenship" ;
  rdfs:comment "This property specifies the place that the being is a citizan of"
;
  rdfs:domain
<http://contextus.net/ontology/ontomedia/ext/common/being#Being> ;
  rdfs:range <http://contextus.net/ontology/ontomedia/core/space#Space> .

<http://contextus.net/ontology/ontomedia/ext/common/being#wears>
  a owl:ObjectProperty ;
  rdfs:label "Wears" ;
  rdfs:comment "This property specifies an item worn by the being" ;
  rdfs:domain
<http://contextus.net/ontology/ontomedia/core/expression#Physical-Item> ;
  rdfs:range
<http://contextus.net/ontology/ontomedia/ext/detail/know#Alphabet> .

<http://contextus.net/ontology/ontomedia/ext/common/being#wears-type>
  a owl:ObjectProperty ;
  rdfs:label "Wears Type" ;
  rdfs:comment "This property specifies a class of items worn by the being" ;
  rdfs:domain
<http://contextus.net/ontology/ontomedia/ext/common/being#Being> ;
  rdfs:range [
   a owl:Restriction ;
   owl:onProperty rdf:hasParent ;
   owl:allValuesFrom [
      a owl:Class ;
      owl:unionOf (
<http://contextus.net/ontology/ontomedia/core/expression#Physical-Item> )
    ]
  ] .
```

```
<http://contextus.net/ontology/ontomedia/core/expression#Physical-Item> a
owl:Class .
<http://contextus.net/ontology/ontomedia/ext/common/being#is-relation-
of>
  a owl:ObjectProperty ;
  rdfs:label "Is Relation Of" ;
  rdfs:comment "This property specifies that the Being is the child of the
specified Being" ;
  rdfs:domain
<http://contextus.net/ontology/ontomedia/ext/common/being#Family> ;
  rdfs:range
<http://contextus.net/ontology/ontomedia/ext/common/being#Being> ;
  owl:inverseOf
<http://contextus.net/ontology/ontomedia/ext/common/being#is-relation-
of> .

<http://contextus.net/ontology/ontomedia/ext/common/being#is-child-of>
  a owl:ObjectProperty ;
  rdfs:label "Is Child Of" ;
  rdfs:comment "This property specifies that the being is the child of the
specified being" ;
  rdfs:subPropertyOf
<http://contextus.net/ontology/ontomedia/ext/common/being#is-relation-
of> ;
  rdfs:domain
<http://contextus.net/ontology/ontomedia/ext/common/being#Family> ;
  rdfs:range
<http://contextus.net/ontology/ontomedia/ext/common/being#Being> ;
  owl:inverseOf
<http://contextus.net/ontology/ontomedia/ext/common/being#is-parent-
of> .

<http://contextus.net/ontology/ontomedia/ext/common/being#is-parent-
of>
  a owl:ObjectProperty ;
  rdfs:label "Is Parent Of" ;
  rdfs:comment "This property specifies that the being is the parent of the
specified being" ;
  rdfs:subPropertyOf
<http://contextus.net/ontology/ontomedia/ext/common/being#is-relation-
of> ;
```

```
  rdfs:domain
<http://contextus.net/ontology/ontomedia/ext/common/being#Family> ;
  rdfs:range
<http://contextus.net/ontology/ontomedia/ext/common/being#Being> ;
  owl:inverseOf
<http://contextus.net/ontology/ontomedia/ext/common/being#is-child-of>
.

<http://contextus.net/ontology/ontomedia/ext/common/being#sibling-of>
  a owl:ObjectProperty ;
  rdfs:label "Sibling Of" ;
  rdfs:comment "This property specifies that the being is a sibling of the
specified being" ;
  rdfs:subPropertyOf
<http://contextus.net/ontology/ontomedia/ext/common/being#is-relation-
of> ;
  rdfs:domain
<http://contextus.net/ontology/ontomedia/ext/common/being#Family> ;
  rdfs:range
<http://contextus.net/ontology/ontomedia/ext/common/being#Being> ;
  owl:inverseOf
<http://contextus.net/ontology/ontomedia/ext/common/being#sibling-of> .

<http://contextus.net/ontology/ontomedia/ext/common/being#cured>
  a owl:ObjectProperty ;
  rdfs:label "Cured" ;
  rdfs:comment "This property specifies a cure event" ;
  rdfs:domain [
    a owl:Class ;
    owl:unionOf (
      <http://contextus.net/ontology/ontomedia/ext/common/being#Physical-
Injury>
      <http://contextus.net/ontology/ontomedia/ext/common/being#Physical-
Illness>
      <http://contextus.net/ontology/ontomedia/ext/common/being#Mental-
Illness>
    )
  ] ;
  rdfs:range
<http://contextus.net/ontology/ontomedia/core/expression#Event> .
```

```
<http://contextus.net/ontology/ontomedia/ext/common/being#have-
bonded-to>
  a owl:ObjectProperty ;
  rdfs:label "Have Bonded To" ;
  rdfs:comment "This property represents a pledge that the entity has a bond
with the named entity" ;
  rdfs:domain
<http://contextus.net/ontology/ontomedia/ext/common/being#Pledge> ;
  rdfs:range [
    a owl:Class ;
    owl:unionOf (
      <http://contextus.net/ontology/ontomedia/ext/common/being#Group>
      <http://contextus.net/ontology/ontomedia/ext/detail/know#Culture>

<http://contextus.net/ontology/ontomedia/ext/common/being#Profession>
      <http://contextus.net/ontology/ontomedia/ext/common/being#Being>
    )
  ] .
##### Classes from Ontomedia Trait, Classes and properties describing traits
which entities may have such as descriptive properties, motivations, current
physical, mental or psychological state and other information related to an
entities profile.. #####

<http://contextus.net/ontology/ontomedia/ext/common/trait#Being-Trait>
  a owl:Class ;
  rdfs:label "Character Trait" ;
  rdfs:comment "This class represents the characteristics that describe a
Character Entity" ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/trait#Trait> .

<http://contextus.net/ontology/ontomedia/ext/common/trait#Age>
  a owl:Class ;
  rdfs:comment "This class represents the age of an Entity" ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/trait#Being-Trait>,
<http://contextus.net/ontology/ontomedia/ext/common/trait#Trait> ;
  rdfs:label "Age" .

<http://contextus.net/ontology/ontomedia/ext/common/trait#Description>
  a owl:Class ;
```

```
  rdfs:label "Description" ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/trait#Being-Trait>,
<http://contextus.net/ontology/ontomedia/ext/common/trait#Trait> ;
  rdfs:comment "This class represents the physical description of an Entity" .

<http://contextus.net/ontology/ontomedia/ext/common/trait#Employment>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/trait#Being-Trait>,
<http://contextus.net/ontology/ontomedia/ext/common/trait#Trait> ;
  rdfs:label "Employment" ;
  rdfs:comment "This class represents the employment or other type of job
undertaken by an Entity" .

<http://contextus.net/ontology/ontomedia/ext/common/trait#Gender>
  a owl:Class ;
  rdfs:comment "This class represents the gender of an Entity" ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/trait#Being-Trait> ;
  rdfs:label "Gender" ;
  owl:equivalentClass <http://www.aktors.org/ontology/portal#Gender> .

<http://contextus.net/ontology/ontomedia/ext/common/trait#Knowledge>
  a owl:Class ;
  rdfs:label "Knowledge" ;
  rdfs:comment "This class represents things known by an Entity" ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/trait#Being-Trait>,
<http://contextus.net/ontology/ontomedia/ext/common/trait#Trait> .

<http://contextus.net/ontology/ontomedia/ext/common/trait#Name>
  a owl:Class ;
  rdfs:label "Name" ;
  rdfs:comment "This class represents the name or equivilent designation of an
Entity" ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/trait#Being-Trait>,
<http://contextus.net/ontology/ontomedia/ext/common/trait#Trait> .
```

```
<http://contextus.net/ontology/ontomedia/ext/common/trait#State-Of-Being>
  a owl:Class ;
  rdfs:comment "This class represents the state of being of an Entity" ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/trait#Being-Trait>,
<http://contextus.net/ontology/ontomedia/ext/common/trait#Trait> ;
  rdfs:label "State of Being" .

<http://contextus.net/ontology/ontomedia/ext/common/trait#State-Of-Consciousness>
  a owl:Class ;
  rdfs:label "State of Consciousness" ;
  rdfs:comment "This class represents the state of consciousness of an Entity" ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/trait#Being-Trait>,
<http://contextus.net/ontology/ontomedia/ext/common/trait#Trait> .

<http://contextus.net/ontology/ontomedia/ext/common/trait#Build>
  a owl:Class ;
  rdfs:label "Build" ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/trait#Description> ;
  rdfs:comment "This class represents a physical build type" .

<http://contextus.net/ontology/ontomedia/ext/common/trait#Colour>
  a owl:Class ;
  rdfs:label "Colour" ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/trait#Description> ;
  rdfs:comment "This class represents colours" .

<http://contextus.net/ontology/ontomedia/ext/common/trait#Distinguishing-Mark>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/trait#Description> ;
  rdfs:comment "This class represents a distinguishing mark" ;
  rdfs:label "Distinguishing Mark" .

<http://contextus.net/ontology/ontomedia/ext/common/trait#Material>
```

```
  a owl:Class ;
  rdfs:comment "This class represents a type of material" ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/trait#Description> ;
  rdfs:label "Material" .

<http://contextus.net/ontology/ontomedia/ext/common/trait#Dimension>
  a owl:Class ;
  rdfs:comment "This class represents a dimension" ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/trait#Description> ;
  rdfs:label "Dimension" .

<http://contextus.net/ontology/ontomedia/ext/common/trait#Male>
  a owl:Class ;
  rdfs:label "Male" ;
  rdfs:comment "This class represents the male gender" ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/trait#Gender> .

<http://contextus.net/ontology/ontomedia/ext/common/trait#Neuter>
  a owl:Class ;
  rdfs:label "Neuter" ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/trait#Gender> ;
  rdfs:comment "This class represents the neuter gender" .

<http://contextus.net/ontology/ontomedia/ext/common/trait#Female>
  a owl:Class ;
  rdfs:comment "This class represents the female gender" ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/trait#Gender> ;
  rdfs:label "Female" .

<http://contextus.net/ontology/ontomedia/ext/common/trait#Adult>
  a owl:Class ;   rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/trait#Stage-Of-
Life> ;
  rdfs:comment "This class represents the adult stage of life of an entity" ;
  rdfs:label "Adult" .
```

```
<http://contextus.net/ontology/ontomedia/ext/common/trait#Old>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/trait#Stage-Of-
Life> ;
  rdfs:comment "This class represents the old stage of life of an entity" ;
  rdfs:label "Old" .

<http://contextus.net/ontology/ontomedia/ext/common/trait#Young>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/trait#Stage-Of-
Life> ;
  rdfs:comment "This class represents the young stage of life of an entity" ;
  rdfs:label "Young" .

<http://contextus.net/ontology/ontomedia/ext/common/trait#Virgin>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/trait#Stage-Of-
Life> ;
  rdfs:comment "This class represents the pre-sexually active stage of life of an
entity" ;
  rdfs:label "Virgin" .

<http://contextus.net/ontology/ontomedia/ext/common/trait#Child>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/trait#Young> ;
  rdfs:comment "This class represents the child stage of life of an entity" ;
  rdfs:label "Child" .

<http://contextus.net/ontology/ontomedia/ext/common/trait#Teenager>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/trait#Young> ;
  rdfs:comment "This class represents the teenage stage of life of an entity" ;
  rdfs:label "Teenage" .

<http://contextus.net/ontology/ontomedia/ext/common/trait#Young-Adult>
  a owl:Class ;
```

```
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/trait#Young> ;
  rdfs:comment "This class represents the young adult stage of life of an entity"
;
  rdfs:label "Young Adult" .

<http://contextus.net/ontology/ontomedia/ext/common/trait#Unconscious>
  a owl:Class ;
  rdfs:label "Unconscious" ;
  rdfs:comment "This class describes an Entity which is unconscious" ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/trait#State-Of-
Consciousness> ;
  owl:disjointWith [
    a owl:Class ;
    owl:unionOf (

<http://contextus.net/ontology/ontomedia/ext/common/trait#Conscious>
<http://contextus.net/ontology/ontomedia/ext/common/trait#Unresponsive>
     <http://contextus.net/ontology/ontomedia/ext/common/trait#Asleep>
     http://contextus.net/ontology/ontomedia/ext/common/trait#Instinctual>
   )
  ] .

<http://contextus.net/ontology/ontomedia/ext/common/trait#Conscious>
  a owl:Class ;
  owl:disjointWith [
    a owl:Class ;
    owl:unionOf (

<http://contextus.net/ontology/ontomedia/ext/common/trait#Unresponsive>
     <http://contextus.net/ontology/ontomedia/ext/common/trait#Asleep>

<http://contextus.net/ontology/ontomedia/ext/common/trait#Instinctual>
   )
  ] ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/trait#State-Of-
Consciousness> ;
  rdfs:comment "This class describes an Entity which is conscious" ;
  rdfs:label "Conscious" .
```

```
<http://contextus.net/ontology/ontomedia/ext/common/trait#Unresponsive>
  a owl:Class ;
  owl:disjointWith
<http://contextus.net/ontology/ontomedia/ext/common/trait#Instinctual>,
<http://contextus.net/ontology/ontomedia/ext/common/trait#Conscious> ;
  rdfs:label "Unresponsive" ;
  rdfs:comment "This class describes an Entity which is totally unresponsive to
external stimuli i.e. coma" ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/trait#State-Of-
Consciousness> .

<http://contextus.net/ontology/ontomedia/ext/common/trait#Asleep>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/trait#State-Of-
Consciousness> ;
  rdfs:label "Asleep" ;
  rdfs:comment "This class describes an Entity which is asleep" ;
  owl:disjointWith [
    a owl:Class ;
    owl:unionOf (

<http://contextus.net/ontology/ontomedia/ext/common/trait#Conscious>
<http://contextus.net/ontology/ontomedia/ext/common/trait#Unresponsive>
    <http://contextus.net/ontology/ontomedia/ext/common/trait#Instinctual>
   )
  ] .

<http://contextus.net/ontology/ontomedia/ext/common/trait#has-trait>
  a owl:ObjectProperty ;
  rdfs:range
<http://contextus.net/ontology/ontomedia/ext/common/trait#Trait> ;
  rdfs:comment "This property specifies a general trait which belongs to an
Entity" ;
  rdfs:label "Has Trait" ;
  rdfs:domain
<http://contextus.net/ontology/ontomedia/core/expression#Entity> .

##### Classes from Ontomedia  Physical Items  #####
```

```
<http://contextus.net/ontology/ontomedia/ext/common/physitem#Attire>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Physical-Item> ;
  rdfs:comment "This class represents an item of clothing" ;
  rdfs:label "Attire" .

<http://contextus.net/ontology/ontomedia/ext/common/physitem#BodyPart
>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Physical-Item> ;
  rdfs:comment "This class represents a part of a biological organism" ;
  rdfs:label "Body Part" .

<http://contextus.net/ontology/ontomedia/ext/common/physitem#Building>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Physical-Item> ;
  owl:equivalentClass
<http://contextus.net/ontology/ontomedia/location#Building> ;
  rdfs:comment "This class represents a building" ;
  rdfs:label "Building" .

<http://contextus.net/ontology/ontomedia/ext/common/physitem#Consuma
bles>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Physical-Item> ;
  rdfs:comment "This class represents physical objects which are intended to
be eaten or drunk" ;
  rdfs:label "Consumables" .

<http://contextus.net/ontology/ontomedia/ext/common/physitem#Craft>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Physical-Item> ;
  owl:equivalentClass
<http://contextus.net/ontology/ontomedia/core/space#Vessel> ;
  rdfs:comment "This class represents physical objects which can be used for
transportantion" ;
```

```
  rdfs:label "Craft" .

<http://contextus.net/ontology/ontomedia/ext/common/physitem#Furniture
>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Physical-Item> ;
  rdfs:comment "This class represents physical objects which is an item of
furniture" ;
  rdfs:label "Furniture" .

<http://contextus.net/ontology/ontomedia/ext/common/physitem#Geo>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Physical-Item> ;
  rdfs:comment "This class represents physical objects which is related to the
earth/ground/landscape" ;
  rdfs:label "Geo-" .

<http://contextus.net/ontology/ontomedia/ext/common/physitem#Monumen
t>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Physical-Item> ;
  rdfs:comment "This class represents physical objects which is a monument" ;
  rdfs:label "Monument-" .

<http://contextus.net/ontology/ontomedia/ext/common/physitem#Vegetatio
n>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Physical-Item> ;
  rdfs:comment "This class represents physical object of vegetation" ;
  rdfs:label "Vegetation" .

<http://contextus.net/ontology/ontomedia/ext/common/physitem#Weapon>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Physical-Item> ;
  rdfs:comment "This class represents a weapon" ;
  rdfs:label "Weapon" .
```

```
<http://contextus.net/ontology/ontomedia/ext/common/physitem#usually_w
orn_for>
  a owl:ObjectProperty ;
  rdfs:domain
<http://contextus.net/ontology/ontomedia/ext/common/physitem#Attire> ;
  rdfs:range
<http://contextus.net/ontology/ontomedia/core/expression#Event> .

<http://contextus.net/ontology/ontomedia/ext/common/physitem#usually_w
orn_by>
  a owl:ObjectProperty ;
  rdfs:domain
<http://contextus.net/ontology/ontomedia/ext/common/physitem#Attire> ;
  rdfs:range [
    a owl:Class ;
    owl:unionOf (
     <http://contextus.net/ontology/ontomedia/ext/common/being#Group>
     <http://contextus.net/ontology/ontomedia/ext/common/being#Being>
   )
  ] .

##### Classes from Ontomedia Zoology #####
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Amphibian>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/critters#Bestial> ;
  rdfs:comment "This class represents an amphibian species" ;
  rdfs:label "Amphibian" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Anthropod>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/critters#Bestial> ;
  rdfs:comment "This class represents species with an anthropod form" ;
  rdfs:label "Arthropod" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Avian>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/critters#Bestial> ;
```

```
 rdfs:comment "This class represents species with an avian form" ;
 rdfs:label "Avian" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Bovidine>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/critters#Bestial> ;
 rdfs:comment "This class represents species with a bovidine form" ;
 rdfs:label "Bovidine" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Canine>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/critters#Bestial> ;
 rdfs:comment "This class represents species with a canine form" ;
 rdfs:label "Canine" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Ceridine>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/critters#Bestial> ;
 rdfs:comment "This class represents species with a ceridine form" ;
 rdfs:label "Ceridine" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Equine>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/critters#Bestial> ;
 owl:equivalentClass
<http://contextus.net/ontology/ontomedia/ext/common/critters#Equine> ;
 rdfs:comment "This class represents species with an equine form" ;
 rdfs:label "Equine" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Feliformoid>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/critters#Bestial> ;
 rdfs:comment "This class represents species with a feliformoid form" ;
 rdfs:label "Feliformoid" .
```

```
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Hippopotamus
>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/critters#Bestial> ;
  rdfs:comment "This class represents species with a hippopotamus form" ;
  rdfs:label "Hippopotamus" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Leporoid>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/critters#Bestial> ;
  rdfs:comment "This class represents species with a leporoid form" ;
  rdfs:label "Leporoid" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Marine>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/critters#Bestial> ;
  rdfs:comment "This class represents species with a marine form" ;
  rdfs:label "Marine" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Mollusk>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/critters#Bestial> ;
  rdfs:comment "This class represents species with a mollusk form" ;
  rdfs:label "Mollusk" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Musteloid>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/critters#Bestial> ;
  rdfs:comment "This class represents species with a musteloid form" ;
  rdfs:label "Museloid" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Primate>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/critters#Bestial> ;
  rdfs:comment "This class represents species with an primate form" ;
```

```
 rdfs:label "Primate" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Reptilian>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/critters#Bestial> ;
 rdfs:comment "This class represents species with a reptilian form" ;
 rdfs:label "Reptilian" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Suinine>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/critters#Bestial> ;
 rdfs:comment "This class represents species with a suinine form" ;
 rdfs:label "Suinine" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Ursine>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/critters#Bestial> ;
 rdfs:comment "This class represents species with an ursine form" ;
 rdfs:label "Ursine" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Frog>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Amphibian> ;
 rdfs:comment "This class represents species with a frog form" ;
 rdfs:label "Frog" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Toad>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Amphibian> ;
 rdfs:comment "This class represents species with a toad form" ;
 rdfs:label "Toad" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Arachnoid>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Arthropod> ;
```

```
  rdfs:comment "This class represents species with an arachnoid form" ;
  rdfs:label "Arachnoid" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Insectoid>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Arthropod> ;
  rdfs:comment "This class represents species with a insectoid form" ;
  rdfs:label "Insectoid" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Spider>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Arachnoid> ;
  rdfs:comment "This class represents species with a spider form" ;
  rdfs:label "Spider" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Ant>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Insectoid> ;
  rdfs:comment "This class represents species with an ant form" ;
  rdfs:label "Ant" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Butterfly>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Insectoid> ;
  rdfs:comment "This class represents species with a butterfly form" ;
  rdfs:label "Butterfly" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Grasshopper>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Insectoid> ;
  rdfs:comment "This class represents species with a grasshopper form" ;
  rdfs:label "Grasshopper" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Mayfly>
  a owl:Class ;
```

```
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Insectoid> ;
 rdfs:comment "This class represents species with a mayfly form" ;
 rdfs:label "Mayfly" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Mosquito>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Insectoid> ;
 rdfs:comment "This class represents species with a mosquito form" ;
 rdfs:label "Mosquito" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Bat>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Avian> ;
 rdfs:comment "This class represents species with a bat form" ;
 rdfs:label "Bat" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Chicken>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Avian> ;
 rdfs:comment "This class represents species with a chicken form" ;
 rdfs:label "Chicken" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Parrot>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Avian> ;
 rdfs:comment "This class represents species with a parrot form" ;
 rdfs:label "Parrot" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Raptor>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Avian> ;
 rdfs:comment "This class represents species with a raptor form" ;
 rdfs:label "Raptor" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Owl>
```

```
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Raptor> ;
  rdfs:comment "This class represents species with a owl form" ;
  rdfs:label "Owl" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Vulture>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Raptor> ;
  rdfs:comment "This class represents species with a vulture form" ;
  rdfs:label "Vulture" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Bovine>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Bovidine> ;
  rdfs:comment "This class represents species with a bovine form" ;
  rdfs:label "Bovine" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Caprinine>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Bovidine> ;
  rdfs:comment "This class represents species with a caprinine form" ;
  rdfs:label "Caprinine" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Buffalo>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Bovine> ;
  rdfs:comment "This class represents species with a buffalo form" ;
  rdfs:label "Buffalo" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Cow>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Bovine> ;
  rdfs:comment "This class represents species with a cow form" ;
  rdfs:label "Cow" .
```

```
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Ox>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Bovine> ;
 rdfs:comment "This class represents species with a ox form" ;
 rdfs:label "Ox" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Goat>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Caprinine> ;
 rdfs:comment "This class represents species with a goat form" ;
 rdfs:label "Goat" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Sheep>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Caprinine> ;
 rdfs:comment "This class represents species with a sheep form" ;
 rdfs:label "Sheep" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Dog>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Canine> ;
 rdfs:comment "This class represents species with a dog form" ;
 rdfs:label "Dog" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Deer>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Ceridine> ;
 rdfs:comment "This class represents species with a deer form" ;
 rdfs:label "Deer" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Roebuck>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Deer> ;
 rdfs:comment "This class represents species with a roebuck form" ;
 rdfs:label "Roebuck" .
```

```
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Ass>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Equine> ;
  rdfs:comment "This class represents species with an ass form" ;
  rdfs:label "Ass" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Feline>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Feliformoid> ;
  rdfs:comment "This class represents species with a feline form" ;
  rdfs:label "Feline" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Hyena>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Feliformoid> ;
  rdfs:comment "This class represents species with a hyena form" ;
  rdfs:label "Hyena" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Lion>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Feline> ;
  rdfs:comment "This class represents species with a lion form" ;
  rdfs:label "Lion" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Tiger>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Feline> ;
  rdfs:comment "This class represents species with a tiger form" ;
  rdfs:label "Tiger" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Hare>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Leporoid> ;
  rdfs:comment "This class represents species with a hare form" ;
```

```
 rdfs:label "Hare" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Cephalopod>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Marine>,
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Mollusk> ;
 rdfs:comment "This class represents species with a cephalopod form" ;
 rdfs:label "Cephalopod" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Cetecea>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Marine> ;
 rdfs:comment "This class represents species with a cetecea form" ;
 rdfs:label "Cetecea" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Cnidaria>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Marine> ;
 rdfs:comment "This class represents species with a cnidaria form" ;
 rdfs:label "Cnidaria" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Echinoderms>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Marine> ;
 rdfs:comment "This class represents species with a echinoderms form" ;
 rdfs:label "Echinoderms" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Oyster>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Marine>,
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Mollusk> ;
 rdfs:comment "This class represents species with a oyster form" ;
 rdfs:label "Oyster" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Pinnipeds>
 a owl:Class ;
```

```
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Marine> ;
  rdfs:comment "This class represents species with a pinnipeds form" ;
  rdfs:label "Pinnipeds" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Piscine>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Marine> ;
  rdfs:comment "This class represents species with a piscine form" ;
  rdfs:label "Piscine" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Anthozoa>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Cnidaria> ;
  rdfs:comment "This class represents species with a anthozoa form" ;
  rdfs:label "Anthozoa" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Seal>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Pinnipeds> ;
  rdfs:comment "This class represents species with a seal form" ;
  rdfs:label "Seal" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Fish>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Piscine> ;
  rdfs:comment "This class represents species with a fish form" ;
  rdfs:label "Fish" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Sea-Horse>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Sea-Horse> ;
  rdfs:comment "This class represents species with a sea-horse form" ;
  rdfs:label "Sea-Horse" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Gastropod>
```

```
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Mollusk> ;
 rdfs:comment "This class represents species with a gastropod form" ;
 rdfs:label "Gastropod" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Slug>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Gastropod> ;
 rdfs:comment "This class represents species with a slug form" ;
 rdfs:label "Slug" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Weasel>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Musteloid> ;
 rdfs:comment "This class represents species with a weasel form" ;
 rdfs:label "Weasel" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Ape>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Primate> ;
 rdfs:comment "This class represents species with an ape form" ;
 rdfs:label "Ape" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Monkey>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Primate> ;
 rdfs:comment "This class represents species with a monkey form" ;
 rdfs:label "Monkey" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Crocodilian>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Reptilian> ;
 rdfs:comment "This class represents species with a crocodilian form" ;
 rdfs:label "Crocodilian" .
```

```
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Lizard>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Reptilian> ;
  rdfs:comment "This class represents species with a lizard form" ;
  rdfs:label "Lizard" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Serpentine>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Reptilian> ;
  owl:equivalentClass
<http://contextus.net/ontology/ontomedia/ext/common/critters#Serpentine
> ;
  rdfs:comment "This class represents species with a serpentine form" ;
  rdfs:label "Serpentine" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Alligator>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Crocodilian> ;
  rdfs:comment "This class represents species with an alligator form" ;
  rdfs:label "Alligator" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Crocodile>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Crocodilian> ;
  rdfs:comment "This class represents species with a crocodile form" ;
  rdfs:label "Crocodile" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Chameleon>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Lizard> ;
  rdfs:comment "This class represents species with a chameleon form" ;
  rdfs:label "Chameleon" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Snake>
  a owl:Class ;
```

```
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Serpentine> ;
 rdfs:comment "This class represents species with a snake form" ;
 rdfs:label "Snake" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Pig>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Suinine> ;
 rdfs:comment "This class represents species with a pig form" ;
 rdfs:label "Pig" .

<http://contextus.net/ontology/ontomedia/ext/common/zoo#Bear>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/zoo#Ursine> ;
 rdfs:comment "This class represents species with a bear form" ;
 rdfs:label "Bear" .

##### Classes from Ontomedia Action #####
<http://contextus.net/ontology/ontomedia/ext/events/action#Celestial>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Action> ;
 rdfs:comment "This class represents celestial actions" ;
 rdfs:label "Celestial" .

<http://contextus.net/ontology/ontomedia/ext/events/action#Environment>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Action> ;
 rdfs:comment "This class represents environmental actions" ;
 rdfs:label "Environment" .

<http://contextus.net/ontology/ontomedia/ext/events/action#Festivity>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Action>,
<http://contextus.net/ontology/ontomedia/core/expression#Social> ;
 rdfs:comment "This class represents festivity actions" ;
 rdfs:label "Festivity" .
```

```
<http://contextus.net/ontology/ontomedia/ext/events/action#Ingestion>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Action> ;
  rdfs:comment "This class represents ingestion actions i.e. eating, drinking,
photosynthesis etc. The subject of the action ingests the object." ;
  rdfs:label "Ingestion" .

<http://contextus.net/ontology/ontomedia/ext/events/action#Sex>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Action> ;
  rdfs:comment "This class represents sexual actions" ;
  rdfs:label "Sex" .

<http://contextus.net/ontology/ontomedia/ext/events/action#Violence>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Action> ;
  rdfs:comment "This class represents violent actions" ;
  rdfs:label "Violence" .

<http://contextus.net/ontology/ontomedia/ext/events/action#Body-Rise>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Celestial> ;
  rdfs:comment "This class represents a celestial body rising over the horizon
of another celestial body" ;
  rdfs:label "Body Rise" .

<http://contextus.net/ontology/ontomedia/ext/events/action#Body-Set>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Celestial> ;
  rdfs:comment "This class represents a celestial body lowering below the
horizon of another celestial body" ;
  rdfs:label "Body Set" .

<http://contextus.net/ontology/ontomedia/ext/events/action#Conjunction>
  a owl:Class ;
```

```
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Celestial> ;
  rdfs:comment "This class represents the conjunction of two or more celestial
bodies" ;
  rdfs:label "Conjunction" .

<http://contextus.net/ontology/ontomedia/ext/events/action#Air>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Environment> ;
  rdfs:comment "This class represents an air/gas based environmental event" ;
  rdfs:label "Environmental Event (Air)" .

<http://contextus.net/ontology/ontomedia/ext/events/action#Earth>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Environment> ;
  rdfs:comment "This class represents an earth/ground based environmental
event" ;
  rdfs:label "Environmental Event (Earth)" .

<http://contextus.net/ontology/ontomedia/ext/events/action#Fire>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Environment> ;
  rdfs:comment "This class represents an fire based environmental event" ;
  rdfs:label "Environmental Event (Fire)" .

<http://contextus.net/ontology/ontomedia/ext/events/action#Water>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Environment> ;
  rdfs:comment "This class represents an water based environmental event" ;
  rdfs:label "Environmental Event (Water)" .

<http://contextus.net/ontology/ontomedia/ext/events/action#Sexual-
Violence>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/events/action#Violence>,
<http://contextus.net/ontology/ontomedia/ext/events/action#Sex> ;
```

```
  rdfs:comment "This class represents actions that involve sexual violence" ;
  rdfs:label "Sexual Violence" .

<http://contextus.net/ontology/ontomedia/ext/events/action#Corporal-
Punishment>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/events/action#Violence> ;
  rdfs:comment "This class represents punishment inflicted on a being's body" ;
  rdfs:label "Corporal Punishment" .

<http://contextus.net/ontology/ontomedia/ext/events/action#War>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/events/action#Violence> ;
  rdfs:comment "This class represents actions involved in war" ;
  rdfs:label "War" .

<http://contextus.net/ontology/ontomedia/ext/events/action#Battle>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/events/action#Violence> ;
  rdfs:comment "This class represents a battle" ;
  rdfs:label "Battle" .

<http://contextus.net/ontology/ontomedia/ext/events/action#Rebellion>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/events/action#Violence>,
<http://contextus.net/ontology/ontomedia/ext/events/social#Political> ;
  rdfs:comment "This class represents a rebellion" ;
  rdfs:label "Rebellion" .

<http://contextus.net/ontology/ontomedia/ext/events/action#Assault>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/events/action#Battle> ;
  rdfs:comment "This class represents an assault" ;
  rdfs:label "Assault" .

<http://contextus.net/ontology/ontomedia/ext/events/action#Siege>
```

```
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/events/action#Battle> ;
  rdfs:comment "This class represents a siege" ;
  rdfs:label "Siege" .

<http://contextus.net/ontology/ontomedia/ext/events/action#Skirmish>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/events/action#Battle> ;
  rdfs:comment "This class represents a skirmish" ;
  rdfs:label "Skirmish" .

##### Ontomedia Gain #####
<http://contextus.net/ontology/ontomedia/ext/events/gain#Creation>
a owl:Class ;
rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Gain> ;
rdfs:comment "This class represents an act of creation" ;
rdfs:label "Creation" .

<http://contextus.net/ontology/ontomedia/ext/events/gain#GainAbstractIte
m>
a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Gain> ;
rdfs:comment "This class represents an abstract item being gained" ;
rdfs:label "Gain Abstract Item" .

<http://contextus.net/ontology/ontomedia/ext/events/gain#GainBond>
 a owl:Class ;
rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/events/gain#AbstractItem> ;
rdfs:comment "This class represents a bond being gained" ;
rdfs:label "Gain Bond" .

<http://contextus.net/ontology/ontomedia/ext/events/gain#GainTrait>
 a owl:Class ;
rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/events/gain#AbstractItem> ;
rdfs:comment "This class represents a trait being gained" ;
```

```
rdfs:label "Gain Trait" .

<http://contextus.net/ontology/ontomedia/ext/events/gain#GainPhysicalItem
>
a owl:Class ;
rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Gain> ;
rdfs:comment "This class represents a physical item being gained" ;
rdfs:label "Gain Physical Item" .

##### Ontomedia Loss #####
<http://contextus.net/ontology/ontomedia/ext/events/loss#Destruction>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Loss> ;
  rdfs:comment "This class represents an act of destruction" ;
  rdfs:label "Destruction" .

##### Ontomedia Transformation #####
<http://contextus.net/ontology/ontomedia/ext/events/trans#Transference>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Transformation
> ;
  rdfs:comment "This class represents an entity being transfered" ;
  rdfs:label "Transfer Entity" .

<http://contextus.net/ontology/ontomedia/ext/events/trans#Trait>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Transformation
> ;
  rdfs:comment "This class represents a trait being transformed" ;
  rdfs:label "Transform Trait Value" .

<http://contextus.net/ontology/ontomedia/ext/events/trans#StateOfBeing>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Transformation
> ;
  rdfs:comment "This class represents a change in a the state of being trait" ;
```

```
 rdfs:label "State of Being Change" .

<http://contextus.net/ontology/ontomedia/ext/events/trans#StateOfForm>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Transformation
> ;
 rdfs:comment "This class represents a change in a the state of form trait" ;
 rdfs:label "State of Form Change" .

<http://contextus.net/ontology/ontomedia/ext/events/trans#StateOfConscio
usness>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Transformation
> ;
 rdfs:comment "This class represents a change in a the state of consciousness
trait" ;
 rdfs:label "State of Consciousness Change" .

<http://contextus.net/ontology/ontomedia/ext/events/trans#Species>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Transformation
> ;
 rdfs:comment "This class represents a change in a the species trait" ;
 rdfs:label "Species Change" .

<http://contextus.net/ontology/ontomedia/ext/events/trans#Gender>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Transformation
> ;
 rdfs:comment "This class represents a change in a the gender trait" ;
 rdfs:label "Gender Change" .

<http://contextus.net/ontology/ontomedia/ext/events/trans#Division>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Transformation
> ;
```

```
  rdfs:comment "This class represents an entity dividing or otherwise
transforming into multiple entities" ;
  rdfs:label "Division/Seperation" .

<http://contextus.net/ontology/ontomedia/ext/events/trans#Merge>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Transformation
> ;
  rdfs:comment "This class represents multiple entities merging or otherwise
transforming into a single entity" ;
  rdfs:label "Merge" .

<http://contextus.net/ontology/ontomedia/ext/events/trans#Degradation>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/events/trans#Division> ;
  rdfs:comment "This class represents an entity degrading" ;
  rdfs:label "Degradation" .

##### Ontomedia Travel #####
<http://contextus.net/ontology/ontomedia/ext/events/travel#Travel>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/events/trans#Transference> ;
  rdfs:comment "This class represents travel" ;
  rdfs:label "Travel" .

<http://contextus.net/ontology/ontomedia/ext/events/travel#Terrain-
Travel>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/events/travel#Solid-Travel> ;
  rdfs:comment "This class represents travel on a solid object" ;
  rdfs:label "Terrain Travel" .

<http://contextus.net/ontology/ontomedia/ext/events/travel#Subterranean-
Travel>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/events/travel#Solid-Travel> ;
```

```
 rdfs:comment "This class represents travel underground" ;
 rdfs:label "Subterranean Travel" .

<http://contextus.net/ontology/ontomedia/ext/events/travel#Marine-Travel>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/events/travel#Liquid-Travel>
;
 rdfs:comment "This class represents travel on a liquid" ;
 rdfs:label "Marine Travel" .

<http://contextus.net/ontology/ontomedia/ext/events/travel#Air-Travel>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/events/travel#Gas-Travel> ;
 rdfs:comment "This class represents air travel" ;
 rdfs:label "Air Travel" .

########## Classes from SuLO ############
<http://www.semanticweb.org/terhi/ontologies/mORSuL/Temple>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/physitem#Building>
;
 rdfs:comment "This class represents a temple as a specific and significant
type of building" ;
 rdfs:label "Temple" .

<http://www.semanticweb.org/terhi/ontologies/mORSuL/Palace>
 a owl:Class ;
 rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/physitem#Building>
;
 rdfs:comment "This class represents a palace as a specific and significant
type of building" ;
 rdfs:label "Palace" .

<http://www.semanticweb.org/terhi/ontologies/mORSuL/Oration>
   a owl:Class ;
   rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Social> ;
```

```
   rdfs:comment "This class represents social interactions which have
something to do with verbal communication" ;
   rdfs:label "Oration" .

<http://www.semanticweb.org/terhi/ontologies/mORSuL/Monologue>
  a owl:Class ;
  rdfs:subClassOf
<http://www.semanticweb.org/terhi/ontologies/mORSuL/Oration> ;
  rdfs:comment "This class represents verbal communication where one
person speaks alone" ;
  rdfs:label "Monologue" .

<http://www.semanticweb.org/terhi/ontologies/mORSuL/Dialogue>
   a owl:Class ;
   rdfs:subClassOf
<http://www.semanticweb.org/terhi/ontologies/mORSuL/Oration> ;
   rdfs:comment "This class represents verbal communication where two
people speak together" ;
   rdfs:label "Dialogue" .

<http://www.semanticweb.org/terhi/ontologies/mORSuL/Polylogue>
   a owl:Class ;
   rdfs:subClassOf
<http://www.semanticweb.org/terhi/ontologies/mORSuL/Oration> ;
   rdfs:comment "This class represents verbal communication where many
people speak together" ;
   rdfs:label "Polylogue" .

<http://www.semanticweb.org/terhi/ontologies/mORSuL/Advice>
   a owl:Class ;
   rdfs:subClassOf
<http://www.semanticweb.org/terhi/ontologies/mORSuL/Oration> ;
   rdfs:comment "This class represents verbal communication where one
person gives advice to another" ;
   rdfs:label "Advice" .

<http://www.semanticweb.org/terhi/ontologies/mORSuL/Warning>
   a owl:Class ;
   rdfs:subClassOf
<http://www.semanticweb.org/terhi/ontologies/mORSuL/Oration> ;
```

```
   rdfs:comment "This class represents verbal communication where one
person warns another" ;
   rdfs:label "Warning" .

<http://www.semanticweb.org/terhi/ontologies/mORSuL/Lamentation>
   a owl:Class ;
   rdfs:subClassOf
<http://www.semanticweb.org/terhi/ontologies/mORSuL/Oration> ;
   rdfs:comment "This class represents verbal communication where the
person speaking is in mourning." ;
   rdfs:label "Lamentation" .

<http://www.semanticweb.org/terhi/ontologies/mORSuL/Curse>
   a owl:Class ;
   rdfs:subClassOf
<http://www.semanticweb.org/terhi/ontologies/mORSuL/Oration> ;
   rdfs:comment "This class represents verbal communication someone utters
a curse" ;
   rdfs:label "Curse" .

<http://www.semanticweb.org/terhi/ontologies/mORSuL/Prayer>
   a owl:Class ;
   rdfs:subClassOf
<http://www.semanticweb.org/terhi/ontologies/mORSuL/Oration> ;
   rdfs:comment "This class represents verbal communication where someone
is praying" ;
   rdfs:label "Prayer" .

<http://www.semanticweb.org/terhi/ontologies/mORSuL/Rejoicing>
   a owl:Class ;
   rdfs:subClassOf
<http://www.semanticweb.org/terhi/ontologies/mORSuL/Oration> ;
   rdfs:comment "This class represents verbal communication where people are
happy" ;
   rdfs:label "Rejoice" .

<http://www.semanticweb.org/terhi/ontologies/mORSuL/AssignmentOfDuty>
   a owl:Class ;
   rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Social> ;
```

```
   rdfs:comment "This class represents social interactions where someone
assigns a duty to someone else, such as a god to another god, or to a person" ;
   rdfs:label "AssignmentOfDuty" .

<http://www.semanticweb.org/terhi/ontologies/mORSuL/AssignmentOfSpous
e>
   a owl:Class ;
   rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/expression#Social> ;
   rdfs:comment "This class represents social interactions where someone
assigns a spouseto someone else, such as a god to another god, or to a
person" ;
   rdfs:label "AssignmentOfSpouse" .

< http://www.semanticweb.org/terhi/ontologies/mORSuL/Canal>
  a owl:Class ;
  rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/core/space#Aquatic> ;
  rdfs:label "Canal" ;
  rdfs:comment "This property is to be used to describe a man-made canal " .

<http://www.semanticweb.org/terhi/ontologies/mORSuL/Divinity>
   a owl:Class ;
   rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/being#Being>;
   rdfs:comment "This class represents gods and goddesses" ;
   rdfs:label "Divine" .

<http://www.semanticweb.org/terhi/ontologies/mORSuL/SupernaturalBeing>
   a owl:Class ;
   rdfs:subClassOf
<http://contextus.net/ontology/ontomedia/ext/common/being#Being>;
   rdfs:comment "This class represents supernatural beings such as demons" ;
   rdfs:label "SupernaturalBeing" .

<http://www.semanticweb.org/terhi/ontologies/mORSuL/Philological_annotati
on>
  a owl:Class ;
   rdfs:comment "This class is for capturing philological annotations such as
scribal mistakes, determinatives, etc." ;
   rdfs:label "Philological_annotation" .
```

```
<http://www.semanticweb.org/terhi/ontologies/mORSuL/emesal>
   a owl:Class ;
   rdfs:subClassOf
<http://www.semanticweb.org/terhi/ontologies/mORSuL/Philological_annotati
on> ;
   rdfs:comment "This class captures instances of eme.sal" ;
   rdfs:label "emesal" .

<http://www.semanticweb.org/terhi/ontologies/mORSuL/lemma>
   a owl:Class ;
   rdfs:subClassOf
<http://www.semanticweb.org/terhi/ontologies/mORSuL/Philological_annotati
on> ;
   rdfs:comment "This class captures lemma" ;
   rdfs:label "lemma" .
```

Glossary

agglutinative language: one in which words are formed by joining together smaller lexical items such as a root with an prefix or suffixes

Akkadian (language): A now extinct Semitic language which emerged during the third millennium BC

analepsis: a narrative technique whereby an event which has occurred earlier on in the story is revisited – a “flashback”

ancient Near East: A toponym. A synonym for “Mesopotamia”

Assyriology: the study of Mesopotamian archaeology, culture, history and language

colophon: an author’s distinctive mark or section identifying them and other metadata about the composition

conlang: A constructed language, such as Esperanto.

corpus: A large and structured set of texts

cuneiform: The script used throughout Mesopotamia and surrounding areas, the earliest evidence for which comes from the 4th millennium BC, disappearing from use by the end of the first century AD.

diachronic: occurring or changing over time

dialogue: a conversation or verbal exchange between two characters

diatribes: a forceful verbal attack against someone or something

dichotomy: a whole consisting of two non-overlapping parts

diegesis: the reality in which a narrative takes place discourse (in narrative analysis): often referred to as the "plot", discourse refers to the ways in which the narrative retells the story (i.e. the actual chronologically sequenced events that took place)

disjunction: The difference between things expected to be similar

eme.sal: a dialect of Sumerian

eponym: the name of something which is named after something else

fabula: the components of a story, the reality which a narrative captures.

first-person narration: the telling of a story from the perspective of the first person, focalising the narrative from a single perspective

focalisation: the story from the perspective of a specific narrator or person

frame narrative: a story within a story

fuzzy logic: Reasoning based on approximate, rather than exact values

fuzzy trace theory: a theoretical model used to explain instances of cognitive interference

gloss: A type of annotation, usually a brief notation made above or incorporated into the line of text to show the meaning of a word or sign.

glyph: An individual sign or collection of wedges which has a known and specific phonetic, semantic and lexical value

grapheme: a lexical unit consisting of more than one glyph

haplography: omitting one of a sign that should be in duplicate

hegemony: imperial dominance through the means of implied power (rather than applied force) hermeneutic consistency: analysis of texts searching for coherent explanations

hermeneutics: the study of the practice and theory of interpretation

heuristic: Experience-based approaches for problem solving

homonym: words in a language spelt and pronounced identically but with different meanings

homophonous signs: signs which have the same pronunciation but different meanings, origins, spellings, appearance

inference: providing conclusions which are beyond the scope of any individual source of data by fitting together knowledge from separate sources

inversions (metathesis): the swapping around of two sequential or near sequential signs

knowledge representation: area of Artificial Intelligence concerned with presenting in such a way as to allow inference

lingua franca: a languages used to facilitate communication between people who do not share a native language, often one which is distinct from the native languages of all of those involved in the exchange

lingua sacra: language used for religious or sacred texts; sacred language

logogram: aka logograph is a grapheme that represents a word or morpheme

meronymy: A term denoting that one thing is a part of another: part-Of relationship

Mesopotamia: Literally the “land between the rivers”, Mesopotamia is the toponym for the area which lies between the Euphrates and Tigris rivers, more or less overlapping the area of present day Iraq, but also encompasses western

Iran, as well as northeast Syria and southeast Turkey. Synonymous to the term “ancient Near East”.

monologue: a speech delivered by one person (see also soliloquy)

morphology (Biology): the study of the form and structure of organisms and their specific structural features. Sometimes used to describe the physical features of inanimate objects and has been known to be used to describe the appearance of a cuneiform sign, especially when describing diachronic change. Distinct from the use of the term in Linguistics (please see below).

morphology (Linguistics): the study of the structure of a given language's morphemes and other linguistic units

motif: smallest defined meaningful element in a story

narration: the way a story is told

Old Babylonian (culture): the socio-cultural period of the first dynasty of Babylon

Old Babylonian (language): a dialect of an ancient Semitic language (Akkadian), dominant in southern Mesopotamia during the Old Babylonian period.

ontology (Computer Science): a formalised structure for the representation of the knowledge of a given domain, mapping out the entities and relationships between those entities.

ontology (Philosophy): the metaphysical study of the nature of being

omniscient: all-knowing, capable of knowing all that there is to know

orthography: conventional spelling system of a language or the study thereof.

palaeography : the study of ancient writing, including the deciphering, reading, and dating of historical manuscripts and the study of the cultural context of the writings, including the methods of writing

parablepsis: a miscopy in texts caused by the scribe looking at the wrong line or at the wrong part of a line

patrilineage: Kin-group descended from a common ancestor through males.

philology: The study of the language of historical sources

phonology: the sound system of a given language, and the study thereof.

polylogue: A speech delivered by several people

polyvalence: characteristic of cuneiform glyphs which means that, dependent on context, a single sign can have several distinct values e.g. 𒁍 is known as BU, but has the possible readings bu, bur12, dur7, gid2, kim3, pu, sir2, su13, sud4, tur8. The numbers are a modern philological convention to identify the glyph from the transliteration.

prosopography: The study of the common characteristics of a historical group

reasoning: the process of inference

soliloquy: Especially in drama, a character speaking to himself (and thus providing the audience with more information)

story: the actual chronologically ordered events that took place (e.g. within a narrative)

Sumerian (culture): Dominant culture in the southern part of Mesopotamia in the early Bronze Age (Uruk period, fourth millennium BC). Supressed by the

Akkadian Empire, the Sumerian culture enjoyed a renaissance during the third millennium BC (Ur III).

Sumerian (language): an agglutinative language of southern Mesopotamia, first written down during the fourth millennium BC. A linguistic isolate.

sumerogram: Sumerian cuneiform glyph or grapheme used as an ideogram or logogram in another language

Sumerology: the study of the archaeology, culture, history and language of ancient Sumer.

syuzhet :the actual employment of the narrative, i.e. what the story is like, not just the sequence of events in a chronological order.

Third Dynasty of Ur: Also referred to as the Neo-Sumerian period, the Ur III was a relatively short-lived renaissance for the Sumerian culture and language in the third millennium.

third-person omniscient narration: any narrative told in the third person, with an all-knowing perspective on events, locations, secrets and features of the diegesis.

triple-store: a store for RDF triples

Ur: A city in the southern-most part of Mesopotamia.

Uruk: A city in the southern-most part of Mesopotamia.

verbatim: copied or repeated exactly, word by word with no mistakes or alterations

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