Pragmatics of Semantic Technologies in Education: Linked Data

SemHE ‘10: Semantic Web Applications in Higher Education

University of Southampton, UK

Hugh Glaser
Seme4 Ltd. and University of Southampton, UK

http://eprints.ecs.soton.ac.uk/id/eprint/21666
Linked Data – a little motivation
Linked Open Data

data.nytimes.com

For the last 150 years, The New York Times has maintained one of the most authoritative news vocabularies ever developed. In 2009, we began to publish this vocabulary as linked open data.

The Data

As of 13 January 2010, The New York Times has published approximately 10,000 subject headings as linked open data under a CC BY license. We provide both RDF documents and a human-friendly HTML versions. The table below gives a breakdown of the various tag types and mapping strategies on data.nytimes.com.

<table>
<thead>
<tr>
<th>Type</th>
<th>Manually Mapped Tags</th>
<th>Automatically Mapped Tags</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>People</td>
<td>4,978</td>
<td>0</td>
<td>4,978</td>
</tr>
<tr>
<td>Organizations</td>
<td>1,489</td>
<td>1,592</td>
<td>3,081</td>
</tr>
<tr>
<td>Locations</td>
<td>1,910</td>
<td>0</td>
<td>1,910</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>9,969</td>
</tr>
</tbody>
</table>

Browse individual data records:

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

SKOS Files

Download all of the data records as SKOS Files.

- People
- Organizations
- Locations

Using Our Linked Data

Want to learn more about the nuts and bolts of our RDF documents? This page provides technical documentation. This blog post provides step-by-step instructions for building your own NYT Linked Data Application.
Iron Maiden

Formed 1975.
English heavy metal band

Biography

Iron Maiden are an English heavy metal band from Leyton in East London, formed in 1975. The band is directed by founder, bassist and songwriter Steve Harris. Since their inception, the group has released a collective total of thirty albums: fourteen studio albums, seven live albums, four EPs and five compilations.

Pioneers of the New Wave of British Heavy Metal, with such an original sound they achieved success during the early 1980s and after several lineup changes, went on to release a series of platinum and gold albums. These include the US platinum-selling landmarks The Number of the Beast.
British Museum – Search object details

Limestone stele of intendent of Sant'Julien (all objects)

Date
1868 BC

Period/Culture
Ptolemaic

Description
Part of grey and pink granodiorite stele bearing priestly decree concerning Ptolemy V in three blocks of text Hieroglyphic (14 lines), Demotic (32 lines) and Greek (53 lines).

Inscriptions
Inscription Type: inscription
Inscription Language: Greek

Inscription Type: inscription
Inscription Script: hieroglyphic
Inscription Language:
Inscription Comment: The inscription is a decree passed by a council of priests, one of a series that affirm the royal cult of the 13 year-old Ptolemy V on the first anniversary of his coronation.

Inscription Type: inscription
Inscription Script: demotic
Inscription Language:

Dimensions
Length: 112.3 centimetres (max)
Width: 75.7 centimetres
Thickness: 28.4 centimetres

© The Trustees of the British Museum

Department: Ancient Egypt & Sudan
Registration number: 24
BM/Reg number: 24
Additional IDs
BS.24
Location:
G4/CSE

Commission photography
Back to search results

April 2010 – Temporary Exhibition

April 1992 – Examination

About these records

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Repositories

• Eg Dspace, ePrints
• Open sharing of material (usually)
• Benefit scientific research
  – Makes available results
    • Quickly
    • Accessible to almost all
• Benefit researchers
  – A vehicle for publication and easy access
  – Reputation is enhanced
  – Online access is many times more seen than paper
• Some argue
  – Researchers do the work, often funded by government
  – They give the outputs to publishers (or even pay)
  – Then they pay to get the outputs back from the publishers
• Which repositories?
  – Institutional
  – Professional organisation
  – Governments and other stakeholders
  – Publishers
  – Third parties

• What?
  – Open Archive people are concerned to make the content public
  – Here, we are concerned primarily with the metadata

• Metadata publishing should be non-controversial
  – But many organisations do not understand!
Information Management: A Proposal

Abstract

This proposal concerns the management of general information about accelerators and experiments at CERN. It discusses the problems of loss of information about complex evolving systems and derive a solution based on a distributed hypertext system.

Keywords: Hypertext, Computer conferencing, Document retrieval, Information management, Project control
Generic browser

Dummy hypertext server makes existing database look like hypertext to the browser.
Linked Data

• Tim Berners-Lee

  – “the Semantic Web done right, and the Web done right”
Linked Data Principles
1. Use URIs as names for things

• **Everything**
  – If you don’t name something you can’t talk about it
  – Things of course
  – Year of publication
  – Ideas
  – …

• **Cool URIs**
  – Think of the consumer/customer
    • [https://secure.ecs.soton.ac.uk/gizmos/person_by_username.php?username=hg](https://secure.ecs.soton.ac.uk/gizmos/person_by_username.php?username=hg)
    • [https://secure.ecs.soton.ac.uk/person/username/hg](https://secure.ecs.soton.ac.uk/person/username/hg)

• **RESTful Interfaces**

• **Ambiguity**
  – URIs help to avoid it, especially if you…
2. Use HTTP URIs so that people can look up those names

- HTTP URI names come with an excellent look up mechanism
- And ownership, etc.
3. When someone looks up a URI, provide useful information, using the standards (RDF, SPARQL)

- So they know what you mean
- Deliver some human readable data
  - html
- Deliver some machine processable data
  - RDF
  - JSON
  - CSV
  - text
RDF (Resource Description Framework)

“Hugh Glaser works for the University of Southampton”

person-00021
  name
    "Hugh Glaser"

person-00021
  works-for
    Southampton_University

Southampton_University
  label
    "The University of Southampton"

How to Publish Linked Data on the Web:- http://www4.wiwiss.fu-berlin.de/bizer/pub/LinkedDataTutorial/
RDF (Resource Description Framework)

“Hugh Glaser works for the University of Southampton”

<http://southampton.rkbexplorer.com/id/person-00021>
  <http://xmlns.com/foaf/0.1/name>
    "Hugh Glaser" .

<http://southampton.rkbexplorer.com/id/person-00021>
  <http://aktors.org/ontology/portal#works-for>
    <http://dbpedia.org/resource/Southampton_University> .

<http://dbpedia.org/resource/Southampton_University>
  <http://www.w3.org/2000/01/rdf-schema#label>
    "The University of Southampton" .

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Seme4.com
RDF (Resource Description Framework)

- RDF Triples constitute a graph
  - \(<\text{subject-uri}>\ <\text{predicate-uri}>\ <\text{object-uri}>\)
  - \(<\text{subject-uri}>\ <\text{predicate-uri}>\ \text{"String"}\)

- **ontologies** define vocabularies, types and relationships

- Agreed URIs facilitate linkage between datasets
4. Include links to other URIs. so that they can discover more things

- **“Foreign” URIs**
  - dbpedia:Southampton_University

- **Equivalence**
  - owl:sameAs
  - skos:exactMatch
  - ...

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Making Processing “safer”

Difficult problem

Natural Language

Semantic Web

URIs

rdfs:label
Example – This Presentation in HTML
This Presentation in RDF
Machine-Processable Metadata

- Accessible data
- Common vocabularies
- Relations
  - Eg dct:creator
- Instances
  - Eg epid:person/ext-21
• Current statistics for this RDF repository (http://oai.rkbexplorer.com/sparql/) —

• Last data assertion  2010-01-06 21:22:05
• Number of triples  24206591
• Number of symbols  8512102
• Size of RDF dataset  22G
In the OAI.rkbexplorer.com Repository
Somehow Open Data should offer Linkage

- At present very little linkage between repositories

- Our other data stores:
The following is a possibly incomplete list:

- http://opus.bath.ac.uk/ -- University of Bath Online Publications Store - OPuS
- http://eprints.bournemouth.ac.uk/ -- Bournemouth University EPrints
- http://authors.library.caltech.edu/ -- CaltechAUTHORS
- http://cogprints.org/ -- Cogprints
- http://publications.eng.cam.ac.uk/ -- Cambridge University Engineering Department Publications Database
- http://dro.dur.ac.uk/ -- Durham Research Online
- http://eprints.ecs.soton.ac.uk/ -- University of Southampton: Department of Electronics and Computer Science
- http://eprints.rclis.org/ -- E-LIS E-Prints
- http://eprints.gla.ac.uk/ -- Glasgow Enlighten
- http://eprints.hud.ac.uk/ -- University of Huddersfield
- http://eprints.lis.cemet.it/ -- Italian Institute of Science
- http://kar.kent.ac.uk/ -- KAR (Kent Academic Repository)
- https://eprints.kfupm.edu.sa/ -- King Fahd University of Petroleum and Minerals
- http://eprints.kname.kharkov.ua/ -- KNAMES Digital Repository
- http://eprints.lancs.ac.uk/ -- Lancaster E-Prints
- http://epub.unibw-muenchen.de/ -- Universität München: Elektronische Publikationen E-Prints
- http://eprints.lse.ac.uk/ -- LSE Research Online
- http://eprints.mdx.ac.uk/ -- Middlesex University Research Repository
- http://mpra.ub.uni-muenchen.de/ -- Munich RePEc Personal Archive
- http://nora.nerc.ac.uk/ -- NERC Open Research Archive
- http://eprints.lib.okayama-u.ac.jp/ -- Okayama University Digital Information Repository
- http://oro.open.ac.uk/ -- Open Research Online (ORO) E-Prints
- http://tesi.cab.unipd.it/ -- Padova Digital University Archive
- http://eprints.qut.edu.au/ -- Queensland University of Technology
- http://eprints.soas.ac.uk/ -- SOAS Research Online
- http://strathprints.strath.ac.uk/ -- Strathprints (University of Strathclyde Institutional Repository)
- http://eprints.eemcs.utwente.nl/perl/search/simple/export_eemcs_xml.xml -- University of Twente Repository
- http://eprints.ucl.ac.uk/ -- University College London Eprints
- http://eprints.utas.edu.au/ -- UTas ePrints (University of Tasmania Eprints Repository)
- http://journal.webscience.org/ -- Web Science Overlay Journal
- http://westminsterresearch.wmin.ac.uk/ -- WestminsterResearch
- http://eprints.wl.ac.uk/ -- White Rose - Leeds, Sheffield and York
LOD Datasets on the Web: March 2009

4.5 billion triples
180 million data links

As of March 2009
Context: RKB and RKBExplorer

- RKB (ReSIST Knowledge Base) and RKBExplorer
- Knowledge-enabled infrastructure for cooperation in research into resilient systems
- Came out of CS AKTiveSpace
  - (Semantic Web Challenge winner 2003)
- Reasonably mature system and ongoing development
RKBExplorer – the ReSIST Project

ReSIST is a NoE that addresses the strategic objective “Towards a global dependability and security framework” of the Work Programme, and responds to the stated “need for resilience, self-healing, dynamic content and volatile environments”. It will integrate leading researchers active in the multidisciplinary domains of Dependability, Security, and Human Factors, in order that Europe will have a well-focused coherent set of research activities aimed at ensuring that future “ubiquitous computing systems”, the immense systems of ever-evolving networks of computers and mobile devices which are needed to support and provide Ambient Intelligence (AmI), have the necessary resilience and survivability, despite any residual development and physical faults, interaction mistakes, or malicious attacks and disruptions. The objectives of the Network are: 1) integration of teams of researchers so that the fundamental topics...
Or a Paper
Or a Couple of People

And how they are linked
And Why they are Linked?

Hugh Davis is connected to David Millard

They are linked by 70 relations.

Publications

They have co-authored 64 papers:

- Solent --- a Platform for Distributed Open Hypermedia Applications
- Interoperability between Hypermedia Systems: The Standardisation Work of the OHSWG
- Naming in OHP

(61 more)

Affiliations

They are both affiliated to School of Electronics and Computer Science.

Projects

They are both contacts for 4 projects:

- Multimedia Annotation and Community Folksonomy Building
- Assessment Delivery Engine for QTV2 Questions
- Rendering and response processing services for QTV2 questions

(1 more)

Organisation

They are both affiliated to School of Electronics and Computer Science.
One of Many KBs, including other ePrints

<table>
<thead>
<tr>
<th>acm.rkbexplorer.com</th>
<th>italy.rkbexplorer.com</th>
</tr>
</thead>
<tbody>
<tr>
<td>budapest.rkbexplorer.com</td>
<td>kaunas.rkbexplorer.com</td>
</tr>
<tr>
<td>citeseer.rkbexplorer.com</td>
<td>kisti.rkbexplorer.com</td>
</tr>
<tr>
<td>cordis.rkbexplorer.com</td>
<td>laas.rkbexplorer.com</td>
</tr>
<tr>
<td>courseware.rkbexplorer.com</td>
<td>lisbon.rkbexplorer.com</td>
</tr>
<tr>
<td>darmstadt.rkbexplorer.com</td>
<td>newcastle.rkbexplorer.com</td>
</tr>
<tr>
<td>dblp.rkbexplorer.com</td>
<td>nsf.rkbexplorer.com</td>
</tr>
<tr>
<td>dbpedia.org</td>
<td>pisa.rkbexplorer.com</td>
</tr>
<tr>
<td>deepblue.rkbexplorer.com</td>
<td>rae2001.rkbexplorer.com</td>
</tr>
<tr>
<td>deploy.rkbexplorer.com</td>
<td>resex.rkbexplorer.com</td>
</tr>
<tr>
<td>epsrc.rkbexplorer.com</td>
<td>roma.rkbexplorer.com</td>
</tr>
<tr>
<td>eurecom.rkbexplorer.com</td>
<td>southampton.rkbexplorer.com</td>
</tr>
<tr>
<td>ft.rkbexplorer.com</td>
<td>ulm.rkbexplorer.com</td>
</tr>
<tr>
<td>ibm.rkbexplorer.com</td>
<td>unlocode.rkbexplorer.com</td>
</tr>
<tr>
<td>ieee.rkbexplorer.com</td>
<td>wiki.rkbexplorer.com</td>
</tr>
<tr>
<td>irit.rkbexplorer.com</td>
<td>xxx.yyy.zzz</td>
</tr>
</tbody>
</table>

Range from a few 100 to more than 10,000,000 “facts”
The Need to Expose More

• Drill down from the papers to the data
• And the experimental method

• Climategate
'Show Your Working': What 'ClimateGate' means

VIEWPOINT
Mike Hulme and Jerome Ravetz

The "ClimateGate" affair - the publication of e-mails and documents hacked or leaked from one of the world's leading climate research institutions - is being intensely debated on the web. But what does it imply for climate science? Here, Mike Hulme and Jerome Ravetz say it shows that we need a more concerted effort to explain and engage the public in understanding the processes and practices of science and scientists.

As the repercussions of ClimateGate reverberate around the virtual community of global citizens, we believe it is both important and urgent to reflect on what this moment is telling us about the practice of science in the 21st Century.

In particular, what is it telling us about the social status and perceived authority of scientific claims about climate change? We argue that the evolving...
RDF API
myExperiment's RDF API provides myExperiment data in RDF/XML format. Please see the guide explaining how to request RDF for myExperiment. There are also some examples of various myExperiment entities represented in RDF/XML. Alternatively, if you can download a dump of all myExperiment's public RDF data.

Some of myExperiment's data is private and is protected using HTTP authentication. If you request a URI that is private then you will need to provide your myExperiment username and password to prove you have permission to retrieve this RDF. To save time you can "log in" using the login form to the right. This will save you having to provide your credentials for each URI. It will also allow you to make requests for RDF for all entities of a certain type that you have permission to see.

Ontology
The structure of myExperiment RDF is defined by a ontology modules that can be assembled to build the complete myExperiment Ontology. This is a set of modules that borrows classes/properties from FOAF, SIOC, Dublin Core, Creative Commons and OAI-ORE, that can be assembled to build a comprehensive specification for the myExperiment data model. An autogenerated specification document for the ontology is also available. A ChangeLog is also maintained for the ontology.

SPARQL Endpoint
All myExperiment's public RDF data can queried using the query language SPARQL at myExperiment's SPARQL Endpoint. There is also a guide of how to use the endpoint and write SPARQL queries with real executable examples.

OAI-ORE Export
myExperiment Packs and Experiments can be exported as OAI-ORE Resource Maps. Like RDF export private entities can be accessed using HTTP authentication. A guide for how to export OAI-ORE Resource Maps can be found here.
Co-Reference

- Repositories have people, publications, etc. from other institutions who also have records there and elsewhere
- And vice versa
- Co-Reference is a Big Problem
  - Everything is a URI (not title, name, number…)
  - Identifying multiple URIs for one resource
  - Rejecting incorrectly conflated resources
  - Publishing
  - Using
- Coldstart
  - A serious problem
  - Nothing is linked to anything
  - Not even (reliably) within most repositories
Who is Nigel Shadbolt?

See this bundle as RDF/XML or N3

Client applications can retrieve different data formats by specifying an HTTP Accept header when requesting

http://www.rkbexplorer.com/sameAs/?uri=...

Use application/rdf+xml for a bundle representation, or text/n3 for owl:sameAs relationships.
Alternatively, you can append &format=rdf or &format=n3 to the request.

For example:

http://www.rkbexplorer.com/sameAs/?format=rdf&url=http://sws.geonames.org/2647554/
http://www.rkbexplorer.com/sameAs/?format=n3&url=http://sws.geonames.org/2647554/
Co-Reference Service (CRS)

• **CRS Subsystem**
  – Find co-references
  – Store them
  – Publish them
    • Essentially:
      • $URI_i \rightarrow \{ URI_1, ..., URI_i, ..., URI_n \}$
    – Recommend a “Canon”

• **Published by the Data Publisher**
  – And possibly others

• **Middleware aggregates co-references from recognised CRSes**
CRS continued

• **CRS Policies are defined by context**
  – Often one per Triplestore
  – Can be many per Triplestore for different purposes
  – May not be associated with a particular Triplestore

• **Maintenance**
  – Provenance
  – Rollback

• **Can be used to infer owl:sameAs**

• **Eg OAI CRS has**
  – 7531045 different URIs
  – in
  – 2544955 bundles
Co-Reference Closure

Complete Co-Reference Information

This service computes the equivalence class within the known URIs for a specified URI by consulting all relevant CRS knowledge bases.

<http://kisti.rkbexplorer.com/id/PER_000000000000000131417>

Equivalent URIs...
1. (Canon) http://acm.rkbexplorer.com/id/person-407157
4. http://dblp.rkbexplorer.com/id/people-1ec5a600299222dd6374685ef521405-90402e01491255e565c573c5a15e43c

The following diagram shows the interconnectivity between the CRS knowledge bases which maintain the context-dependent representation of coference for each of the RKBExplorer domains.

Seungwoo Lee

Showing information queried from all repositories ...

Subject | Property | Object/Value | Source
--- | --- | --- | ---
Seungwoo Lee | rdfs:resource |  | 

Showing information queried from all repositories ...

Subject | Property | Object/Value | Source
--- | --- | --- | ---
Seungwoo Lee | hasFullname | Seungwoo Lee [Explore] | acm-periodicals.rdf =>
Seungwoo Lee | hasFullname | Seungwoo Lee [Explore] | acm-proceedings.rdf =>
Seungwoo Lee | hasFullname | Seungwoo Lee [Explore] | dblp-publications-2001.rdf =>
Seungwoo Lee | hasAffiliation | Electrical and Computer Engineering Division, Pohang University of Science & Technology (POSTECH), Pohang, South Korea, ghlee@postech.ac.kr | acm-periodicals.rdf =>
Seungwoo Lee | hasAffiliation | POSTECH, Pohang, Korea | acm-proceedings.rdf =>
Seungwoo Lee | hasName | Seungwoo Lee [Explore] | datatypeproperties.ttl =>
Seungwoo Lee | type | ak:Affiliated-Person | acm-periodicals.rdf =>
Seungwoo Lee | type | ak:Affiliated-Person | acm-proceedings.rdf =>
Seungwoo Lee | type | Generic Agent | acm-periodicals.rdf =>
Seungwoo Lee | type | Generic Agent | acm-proceedings.rdf =>
Seungwoo Lee | type | Generic Agent | dblp-publications-2001.rdf =>
Seungwoo Lee | type | ak:Person | acm-periodicals.rdf =>
Seungwoo Lee | type | ak:Person | acm-proceedings.rdf =>
Seungwoo Lee | type | ak:Person | dblp-publications-2001.rdf =>
Seungwoo Lee | type | PER_char200/A | datatypeproperties.ttl =>
Seungwoo Lee | type | PER_char200/A | objectproperties.ttl =>
Seungwoo Lee | type | PER_char200/A | resources.ttl =>

Automatic acquisition of named entity tagged corpus from world wide web

A Corpus-Based Learning Method of Compound Noun Indexing Rules for Korean

A Corpus-Based Learning Method of Compound Noun

A Corpus-Based Learning Method of Compound Noun

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Distributed System – discoverable with attribution

<owl:Ontology rdf:about=""
  <dc:creator>ReSIST Project</dc:creator>
</owl:Ontology>

<rdf:Description rdf:about="http://southampton.rkbexplorer.com/id/person-00021">
  <rdf:type rdf:resource="#&kt:Person"/>
  <rdf:type rdf:resource="#&kt:Affiliated-Person"/>
  <rdf:type rdf:resource="#&kt:Academic"/>
  <owl:sameAs rdf:resource="http://id.ecs.soton.ac.uk/person/21"/>
  <akt:full-name>Hugh Glaser</akt:full-name>
  <akt:given-name>Hugh</akt:given-name>
  <akt:family-name>Glaser</akt:family-name>
</rdf:Description>
A General Facility - Finding Co-reference

The Web of Data has many equivalent URIs. This service helps you to find co-references between different data sets. Enter a known URI, or use Sindice to search first.

Search results from Sindice, with co-references applied...

2. http://southampton.rkbexplorer.com/id/person-98e0f2e8dd84b079a54318...f484814122
3. http://southampton.rkbexplorer.com/id/person-a83851b18c81bf1df7db...84425oe0250

Show 118 more

   rdf:xml - rdfs:json - text

“Les Carr”

1. http://dblp.l3s.de/2r/resource/authors/Les_Carr
   rdf:xml - rdfs:json - text

Currently serving 23268924 URIs in 8454882 bundles!
Other Subsystems

- All fit into a Linked data framework
This is a page that gives a simple demonstration showing papers which have been deemed related through textual analysis by IAI Saarbrucken. Up to the top 20 are listed for each paper, when they meet a simple thresholding:

1 – very strong – 0.9 – strongly – 0.7 – related – 0.6 – ignored – 0

The 1980 paper **Exception Handling and Software-Fault Tolerance** [browse]

is very strongly related to

- [browse] 2003 "Automatic detection and masking of non-atomic exception handling" [PDF]
- [browse] 1989 "Formal Verification of Programs with Exceptions"
- [browse] 1983 "Programming Reliable and Robust Software in ADA"

is strongly related to

- [browse] 1998 "Improving software robustness with dependability cases" [PDF]
- [browse] 1999 "Wrapping windows NT software for robustness" [PDF]
- [browse] 1981 "Exception Handling and Error Recovery Techniques in Modular Systems - An Application to the Isaure System"
- [browse] 2003 "Deadlock resolution via exceptions for dependable Java applications" [PDF]
- [browse] 2002 "Robust software - no more excuses" [PDF]

is related to

- [browse] 1995 "Fault tolerance in concurrent object-oriented software through coordinated error recovery" [PDF]
- [browse] 2004 "Implementing simple replication protocols using CORBA portable interceptors and Java serialization" [PDF]
- [browse] 1984 "Fault Tolerance Using Communicating Sequential Processes"
- [browse] 2001 "Middleware support for voting and data fusion" [PDF]
Dealing With Different Ontologies

• The RKBExplorer application uses particular ontologies
  – Mostly AKT Reference Ontology
  – Some KBs will use different ontologies
  – Eg kisti.rkbexplorer.com
  – Uses KISTI Research Ontology

• One solution
  – Represent the ontology mapping in RDF (as far as possible)
  – Resolve the URI through a mapping service to get RDF in the required ontology
On-The-Fly Translation

RDF Mapping Service

This is the home page for a service that allows instances in RDF in one ontology to be dynamically translated to a representation in another ontology.

It is highly experimental, limited in functionality and subject to change without notice.

The service uses an RDF description of the relationships between the two ontologies (provided by the Mapping URI) to process the required RDF which is obtained by resolving the Resource URI.

In some instances the RDF for the mapping service also specifies bespoke code on the server to perform more complex mappings.


(mapping-uri)

The URI of the mapping to apply to the resource.
For example: [http://id.eos.soton.ac.uk/person/21](http://id.eos.soton.ac.uk/person/21)
or [http://kisti.rkbexplorer.com/id/PERL_0000000000000054414](http://kisti.rkbexplorer.com/id/PERL_0000000000000054414)

(resource-uri)

The resource URI to apply the mapping to.
For example: [http://rdf.eos.soton.ac.uk/ontology/mapping/foaf](http://rdf.eos.soton.ac.uk/ontology/mapping/foaf)
or [http://www.rkbexplorer.com/maps/kisti/akt](http://www.rkbexplorer.com/maps/kisti/akt)

(output (default: RDF))

The default is to return the list in RDF format. An HTML output is also available.

Running from a URI

It is quite likely that you will want this service to be run from a script. This can be done by setting the path. It should look like this

User Interaction

• Semantic MediaWiki
• Custom form interfaces
• Google Maps
• Raw Knowledge Browser

• RKBExplorer
• Why do you think that? information
Welcome to the ReSIST Wiki, which is the internal communication mechanism for the EU funded ReSIST “Network of Excellence”.

Note that virtually all pages are private, and viewable only to ReSIST members who have logged in.

Most content can be found by firstly browsing the main ReSIST page, which details the different research areas in which activities are ongoing as part of the project.

If you have any questions or problems, please check that they have not previously been answered in the frequently asked questions, before contacting Ian Millard or Hugh Glaser at Southampton.

Quick Links
- Frequently asked questions
- ReSIST project page
- Recent changes to the wiki
- Upload new file / View uploaded files
- ReSIST members / photos / locations
- Calendar of Events
- Browse, query, or find out more about the Resilience Knowledge Base
Step 1 of 4: Information regarding the organisation of the course
(For questions, problems or feedback filling out this form, please email us.)

Name of the course
Advanced seminars on Distributed Systems

Taught at:
- Universita degli studi di Roma, La Sapienza
- Universitat ULM
- Universite de Toulouse 1
- Universite de Rennes 1
- University of Naples
- University of Toulouse III

Currently being taught
Select currently being taught

Description
The course focuses on recent advances on distributed systems. A set of topics is selected and studied through the help of original papers and, practically, most known distributed system platforms are selected and analyzed.

Language(s) of the course
- English
- Esperanto
- Estonian
- Finnish
- French
- Gaelic

Select Author(s)
Roberto Baldoni
Roberto Beraldi
Roberto Bonato
Robin Bloomfield
Ruta Marcinkeviciene
Sadie Creese
# ReSIST / Resilience-Explicit Computing Mechanisms

<table>
<thead>
<tr>
<th>Name of the resilience mechanism</th>
<th>N-Version Programming/1/1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Submitted by</td>
<td>Zoe Andrews</td>
</tr>
<tr>
<td>Author of mechanism</td>
<td>Algirdas Avizienis</td>
</tr>
<tr>
<td>Associated projects</td>
<td>&lt;None&gt;</td>
</tr>
<tr>
<td>Mechanism Objectives</td>
<td></td>
</tr>
<tr>
<td>Detailed Description</td>
<td></td>
</tr>
<tr>
<td>Detailed Description Publication</td>
<td></td>
</tr>
</tbody>
</table>

**Mechanism Objectives**

To utilise design diversity and voting in order to tolerate software faults.

**Detailed Description**

The information here applies to the specific variant of the mechanism NVP/1/1, described in "Definition and Analysis of Hardware- and Software-Fault Tolerant Architectures". The specific variant considered, NVP/1/1, has three diverse implementations of a software module. For a more general overview of the mechanism please see "The N-Version Approach to Fault-Tolerant Software".

**Definition and Analysis of Hardware- and Software-Fault-Tolerant Architectures**
Step 5 of 7: Resilience metadata - how the mechanism helps a system's resilience

(For questions, problems or feedback filling out this form, please email us.)

Failure Modes
(Select the ways in which your mechanism can fail to function as intended. To help you to decide what the appropriate failure modes are you could treat your mechanism as a black box and think about the kinds of failures you expect to observe from it. The terms in this list are taken from the ReSSIST ontology on security and dependability.)

(CTRL+Click to select multiple values)

Threats Addressed
(Select the threats to resilience that your mechanism aims to address. In the faults it aims to remove, the errors it aims to compensate for and the failures it aims to prevent. The terms in this list are taken from the ReSSIST ontology on security and dependability.)

(CTRL+Click to select multiple values)

Resilience Metadata
In this question you are asked to think about the effect your mechanism has on the resilience of a system. If you were to compare your mechanism to a different mechanism addressing a similar aim, what data would you use to choose which was fit for a specific purpose? This question allows you to define such metrics and associate a value with them for your mechanism. New resilience metadata metrics and values can be added to this list by clicking on the "add new item" link. Existing metadata instances can be deleted or edited by clicking the cross or the pencil next to them respectively. Note that when you edit some metadata a new version is saved as well as the old one, which can then be deleted.

Time-dependent probability (P(t)) of undetected failure
POFOD (Undetected) * application software's execution rate * t Probability

Time-dependent probability (P(t)) of failure
POFOD * application software's execution rate * t Probability

Time-dependent probability (P(t)) of detected failure
Knowledge-Enabled Research Support: RKBExplorer.com
Ian Millard & Hugh Glaser, {icm,hg}@ecs.soton.ac.uk

We are pleased to acknowledge the help and work provided by our ReSIST Partners and many others.

This work was supported by the ReSIST Network of Excellence, which is sponsored by the Information Society Technology (IST) priority under contract number IST 4026764 NOE.
Before and after inserting this paper in the Southampton ePrints repository and RKB has noticed.

Note the position of Les Carr in Hugh’s related People.
Our Application Domain: Supporting resilient computing

- People, Publication, Projects, Research Areas
- Resilience-related topics
- Resilience-Explicit Computing
- Educational Resources

- In the future
  - Automating discovery of issues and solutions
    - Design time
    - Run time
Finding mechanisms that are appropriate for Hardware and Aerospace

```sparql
SELECT DISTINCT ?mechanismURI ?mechanismName ?metadataName ?metadataValue WHERE {
  ?mechanismURI rdf:type resex:Resilience-Mechanism .
  ?mechanismURI resex:has-application-domain acm:J.2.0 .
  ?mechanismURI rdfs:label ?mechanismName .
}
```

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<th>Value</th>
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<td><a href="http://resex.rkbexplorer.com/id/resilience-mechanism-7425f52f">http://resex.rkbexplorer.com/id/resilience-mechanism-7425f52f</a></td>
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<tr>
<td></td>
<td>?mechanismName</td>
<td>Recovery Blocks/1/1</td>
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Inspecting metadata, number of variants

```
SELECT DISTINCT ?mechanismURI ?mechanismName ?metadataName ?metadataValue WHERE {

  ?mechanismURI rdf:type resex:Resilience-Mechanism .


  ?mechanismURI resex:has-application-domain acm:J.2.0 .

  ?mechanismURI rdfs:label ?mechanismName .


  ?metadata resex:metadata-type id:resilience-metadata-type-231c8583


  ?metadata resex:has-value ?metadataValue

}
```

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<td>Number of variants</td>
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<tr>
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Inspecting metadata, average cost of implementing fault tolerant system - vs- cost of implementing non fault tolerant system

SELECT DISTINCT ?mechanismURI ?mechanismName ?metadataName ?metadataValue WHERE {
?mechanismURI rdf:type resex:Resilience-Mechanism .
?mechanismURI resex:has-application-domain acm:J.2.0 .
?mechanismURI rdfs:label ?mechanismName .
?metadata resex:has-value ?metadataValue
}

<table>
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</thead>
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<td><a href="http://resex.rxbcompler.com/id/resilience-mechanism-e679bd05">http://resex.rxbcompler.com/id/resilience-mechanism-e679bd05</a></td>
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<td>?mechanismName</td>
<td>N-Version Programming/1/1</td>
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<tr>
<td></td>
<td>?metadataName</td>
<td>Av CFT/CNFT</td>
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<tr>
<td></td>
<td>?metadataValue</td>
<td>2.25</td>
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<tr>
<td>2</td>
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<tr>
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</tr>
<tr>
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<td>?metadataName</td>
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<tr>
<td></td>
<td>?metadataName</td>
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<tr>
<td></td>
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<td>1.75</td>
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Comparison of the operational overheads in determining a fault has occurred

```sparql
SELECT DISTINCT ?mechanismURI ?mechanismName ?metadataName ?metadataValue WHERE {
  ?mechanismURI rdf:type resex:Resilience-Mechanism .
  ?mechanismURI resex:has-application-domain acm:J.2.0 .
  ?mechanismURI rdfs:label ?mechanismName .
    ?metadata resex:metadata-type id:resilience-metadata-type-3443934c .
    ?metadata resex:has-value ?metadataValue
}
```

<table>
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<tr>
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</thead>
<tbody>
<tr>
<td>1</td>
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<td>?mechanismName</td>
<td>Recovery Blocks/1/1</td>
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<tr>
<td></td>
<td>?metadataName</td>
<td>Errors op time overheads</td>
</tr>
<tr>
<td></td>
<td>?metadataValue</td>
<td>One variant and acceptance test execution</td>
</tr>
<tr>
<td>2</td>
<td>?mechanismURI</td>
<td><a href="http://resex.rkbexplorer.com/d/resilience-mechanism-267972cd">http://resex.rkbexplorer.com/d/resilience-mechanism-267972cd</a></td>
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<tr>
<td></td>
<td>?metadataName</td>
<td>Errors op time overheads</td>
</tr>
<tr>
<td></td>
<td>?metadataValue</td>
<td>Possible result switching</td>
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<tr>
<td>3</td>
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<td>N-Version Programming/1/1</td>
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<tr>
<td></td>
<td>?metadataName</td>
<td>Errors op time overheads</td>
</tr>
<tr>
<td></td>
<td>?metadataValue</td>
<td>Usually negligible</td>
</tr>
</tbody>
</table>
Open System

- **RKBExplorer is only one interface**
  - And not a required part

- **Services:**
  - Details for a paper (the right hand pane in RKBExplorer):
  - Network of people for a publication (lower pane):
  - ...

- **Services**
  - [http://www.rkbexplorer.com/services/](http://www.rkbexplorer.com/services/)

- **Other Interfaces (using the services)**
  - Personal Web pages
  - iPhone
  - iGoogle Gadget
This page gives convenient access to various useful links and demonstrations associated with RKBExplorer. It is primarily for the use of project members and collaborators, and not intended as a general entry point for other people. It exposes many of the services of the RKB system in RESTful-style manners. One day I will find the time to make a better page, with documentation.

If you are interested in something here and want to explore using it, please contact Hugh Glaser or Ian Millard.

RKB Explorer application
ReSIST project, Jean-Claude Laprie, ALRL Paper

iGoogle Gadgets of the RKB Panels
[Main Page]

Complete Co-Reference Information
[Main Page],
or try: Nigel Shadbolt, Hugh Glaser, Brian Randell, Jean-Claude Laprie, Seungwoo Lee

Ontology Mapping
[Main Page],
or try: KISTI -> AKT (RDF, html);

Networks (Communities of Practice)
[Find the Network of a URI],
or try: Hugh Glaser, The Semantic Web Revisited, Tim Bemers-Lee

Detail Information
[Find Information about a URI],
or try: Hugh Glaser, The Semantic Web Revisited, Tim Bemers-Lee

Why? - Why are two Things Related?
[Main Page].
iPhone App

Hugh Glaser

Telephone +44-1703-593670

Works For School of Electronics and Computer Science, University of Southampton

Full Name Hugh Glaser

Fax +44-1703-593045

Web http://www.ecs.soton.ac.uk/
Address people/hg

Projects
- ReSIST Resilience for Survivability in IST
- HELIOS

Research Areas
- Static Analysis
Semantic Web is not “All or Nothing”
Concluding Remarks

• Linked Data works for integration
• Much added value
• Repositories are a rich source of metadata
• Need to support the entire research life-cycle
• Linked Data works pretty well
• RDF works pretty well
• A little Ontology goes a long way
• Please don’t stop at the repository
• Drill down to the science
• Go on and get the added value of Linked Data
• Worry about your co-reference
  – Do you have IDs in your repository?
  – Can you reliably identify all the papers of a single person?
You are never alone

• Ian Millard
• ReSIST Project
• AKT Project
• EnAKTing Project
• 10 years of collaborators