View Inheritance as an Extension of the Normalization Ontology Design Pattern

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Motivation

- The ReSIST (Resilience for Survivability in Information Society Technologies) project features a semantic web portal in the field of resilient and dependable computing: The ReSIST Knowledge Base Explorer (RKB Explorer) <www.rkbexplorer.com/explorer/>
- The representation of the concept **`Fault`** (Figure 1) in the ontology built for the RKB Explorer is **difficult to model** due to:
  - The complexity of its **definition**.
  - The number of **roles** that it fulfils in the ontology.
  - The number and different types of **relationships** that it participates in.
- The representation of the **`Fault`** domain concept has also to support:
  - Classifying occurrences of actual faults in real world systems.
  - Providing a keyword index for: subjects of publications, research interest areas of projects, institutions or people, and support of resilient mechanisms.
- The representation of multiple alternative criteria (views) to classify the abstractions of a certain domain concept, such as **`Fault`**, motivated the development of the View Inheritance ODP.

Structure: Elements and Relationships

- **TargetDomainConcept** (Figure 2): This class represents the ontology domain concept being defined for which multiple alternative abstraction criteria exist.
  - Figure 3: Fault.
- **Criterion1, Criterion2, …, Criterion_i** (Figure 2): These classes represent each one of the alternative abstraction criteria of the TargetDomainConcept. The list of classes may not be exhaustive or pairwise disjoint.
  - Figure 3: BasicViewPointFault, MajorGroupFault, NamedClassFault, NamedCombinedFault.
- **C1_Class1, …, C2_Class1, …, Ci_Class_x** (Figure 2): These classes refine each abstraction criteria class. The list of classes may not be exhaustive or pairwise disjoint.
  - Figure 3: Subclasses of BasicViewPointFault, MajorGroupFault, NamedClassFault, NamedCombinedFault.
- **C1_Class1Class2** or any **Ci_Class_xClass_y** (Figure 2): These classes participate in multiple inheritance relationships combining different refinements from ***the same*** abstraction criteria class.
- **C1Class3_C2Class2,** or any **CiClass_x_CjClass_y** (Figure 2): These classes participate in multiple inheritance relationships combining different refinements from ***different*** alternative abstraction criteria classes.
  - Figure 3: FaultType1, FaultType2, …, FaultType32

Inter- and Intra-criterion Multiple Inheritance

- **Inter-criterion:** when the parent classes involved in the multiple inheritance relation are subclasses of different abstraction criteria. The class **C1Class3_C2Class2** in Figure 2 is an example of this type of inheritance because one of its parent classes, C1Class3, is a refining concept of Criterion1 and the other parent class, C2Class2, is a refining concept of Criterion2.
- **Intra-criterion:** when the parent classes involved in the multiple inheritance relation are subclasses of the same abstraction criterion. The class **C1_Class1Class2** is an example of this type of inheritance because all of its parents classes, C1Class1 and C1Class2, are refining concepts of the same criterion, Criterion1.
- **Intra- and inter-criterion:** when there are at least two parents involved in the relation that are subclasses of the same abstraction criterion and there is at least one more different parent that is a subclass of a different abstraction criterion. An example of this type of inheritance is trivial to extrapolate from the composition of the previous two.

Conclusions

- A survey of the current ontology building techniques was carried out. The **Normalization ODP** seemed a viable option, yet the pattern did not fully address the definition of **`Fault`** and the application requirements of the **ReSIST project**.
- To bridge this gap, the **View Inheritance ODP** is put forward as an extension to the Normalization ODP, combining the latter with the notion of View Inheritance originated in the O-O software design.
- View Inheritance revealed two basic types of likely relations that could take place in the structure of the pattern: **Inter- or Intra-criterion Multiple Inheritance**.
- These contributions, while not solving all the modelling challenges of the ontology module for ReSIST, do provide additional awareness to be considered in the development process.

Figure 1

Definition of Fault used in the ontology for ReSIST

Avizienis et al. (2005). Basic Concepts and Taxonomy of Dependable and Secure Computing.

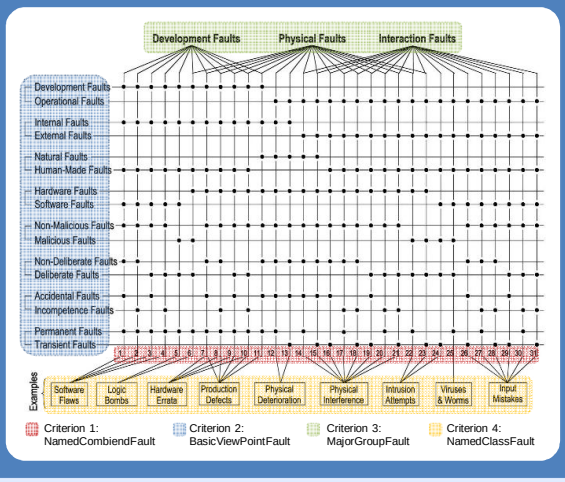


Figure 2

Structure of a generic use case of the View Inheritance ODP

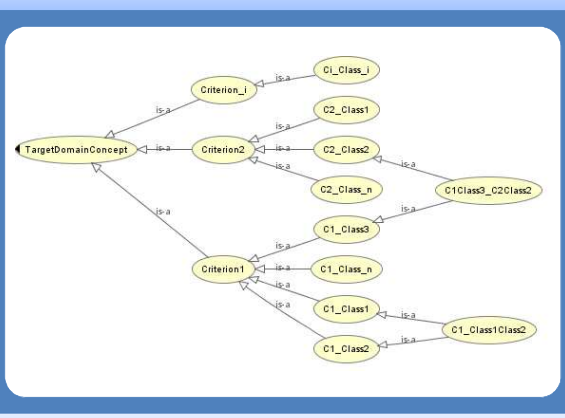
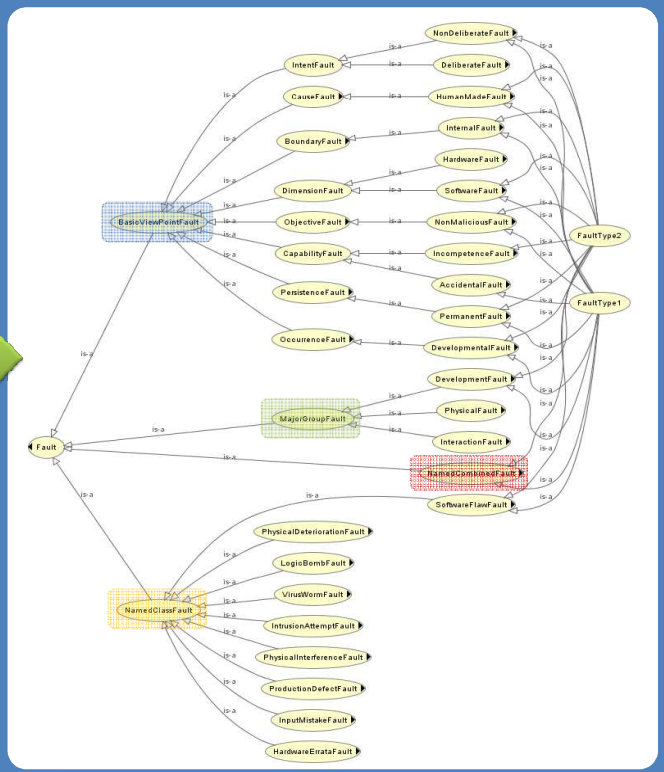


Figure 3

Structure of the View Inheritance ODP for the representation of Fault

For simplicity, only 2 types of faults are shown out of the 31 types defined



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