Validation of the openEHR Archetype Library by using OWL reasoning

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Oslo, August 30, 2011
Background

- **Dual-model architecture** (openEHR, ISO 13606)
  - Reference Model + Archetypes (ADL)

- **Archetypes** - shareable clinical knowledge in EHR
  - **Quality criteria** (Q-REC Project)
  - **Formal methods** for validating archetypes (e.g. LinkEHR Editor)
Objectives

• Using formal semantic methods for checking archetype technical correctness:
  – Representing archetypes and reference model in the same formalism
  – Improving clinical knowledge modeling based on semantic models
  – Taking advantage of reasoning techniques to implement quality assurance methods for archetypes.
Methods

• **Semantic representation**
  
  – Archetypes constraint concepts of the reference model (UML, XML Schema)
  
  – **OWL** can be used to represent both archetypes and reference model
  
  – OMG proposes a bridge between UML and OWL (**ODM** specification)
    
    → Semantic representation of the reference model
Methods

• Semantic representation (cont’d)

```
CLASS[at0000] matches { -- openEHR Inspection Archetype
  items cardinality matches {0..*; unordered} matches {
    -- Normal statements
    CLASS[at0001] occurrences matches {0..1} matches { ... }
  }
}
```

```
CLASS: CLUSTER_at0000
  EquivalentTo: CLUSTER and ARCHETYPED_CLASS
                and (id value "at0000")
                and (op_items only COLLECTION_CLUSTER_at0000_items)
```

```
CLASS: COLLECTION_CLUSTER_at0000_items
  EquivalentTo: COLLECTION and (ordered value false)
                and (id value "COLLECTION_CLUSTER_at0000_items")
                and (elements max 1 CLUSTER_at0001)
```
Methods

• **OWL reasoning**
  
  – Wrong archetype definitions imply **unsatisfiable OWL classes**

  – An **specialized archetype** is correct if it is subsumed by its parent archetype

  → **Subsume relationship** is inferred by OWL reasoners

  – **Precise error identification**: extended representation
Results

• **Archeck**
  - Implementation of the approach for openEHR

• **Validation of the openEHR archetype library**
  - 12 inconsistent archetypes *(wrong specializations)*
  - **Common errors**: occurrence constraint (11/12) and type conformance.
Conclusions

• Archetypes and the reference model can be expressed in OWL

• OWL-DL reasoning is useful for validating archetype technical correctness

• The approach can be applied to any dual model standard (e.g. ISO 13606)

• Further work: integration of terminologies in the modeling approach
Questions?

Thank you for your attention

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