MODEL BASED TESTING AND COVERAGE OF XML REQUIREMENTS

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Outline

• Problematic: Why and where was the need?
  • Conformance validation steps
  • State of the Art
• Presentation and Architecture of model-based Validation
  • Objectives
  • Principles
• Results
• Conclusion
Conformance validation steps of XML documents

1. XML Document
   - XML WellFormed Validation
     - Is Valid?
       - yes
         - XSD Schema Validation
           - Is Valid?
             - yes
               - Business Rules Validation
             - no
               - Rules Validation Report
             - no
               - XSD Validation Report
             - no
               - XML Validation Report
     - no
       - Conformance validation failed

-Schematron Validation
- Proprietary tools
- Model-based Validation
SCHEMATRON: What looks like?

Schematron

XML Document

schematron-processor

schematron processed

Validation Report

<assert test="cda:recordTarget[cda:patientRole[cda:id[@root]]]"> ERR: ClinicalDocument/recordTarget/patientRole/id@root is missing </assert>

<report test="cda:recordTarget[cda:patientRole[cda:id[@root]]]"> CTX: ClinicalDocument/recordTarget/patientRole/id@root exists (PASS) </report>

<assert test="cda:recordTarget[cda:patientRole[cda:id[@extension]]]"> ERR: ClinicalDocument/recordTarget/patientRole/id@extension is missing </assert>

<report test="cda:recordTarget[cda:patientRole[cda:id[@extension]]]"> CTX: ClinicalDocument/recordTarget/patientRole/id@extension exists (PASS) </report>

<!- ClinicalDocument/recordTarget/patientRole/addr is present with at least coun

<assert test="cda:recordTarget[cda:patientRole[cda:addr[cda:country]]]"> ERR: ClinicalDocument/recordTarget/patientRole/addr/country is missing </assert>

<report test="cda:recordTarget[cda:patientRole[cda:addr[cda:country]]]"> CTX: ClinicalDocument/recordTarget/patientRole/addr/country exists (PASS) </report>
SCHEMATRON : Weakness

- Not easy to understand, once it is developed → *maintainability problems*
- The processing of schematron is too long. For complex XML documents, the processing and generation of validation report is too long (1000 checks => 1.5 seconds) → *performance problems*
- Coding is difficult, the assertions are based on xpath query
- The structure of schematrons over the world is not the same
- No concrete coupling between requirements and rules of schematrons
- IHE experience with schematron : very hard problems of maintainability

→ need to have new tool that tries to give a solution to all theses problems
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Presentation

- A scalable methodology to validate any kind of healthcare specifications based on the XML standard
- This method allows also to:
  - Simplify the use and the manipulation of XML documents
  - Generate documentation of constraints
  - Improve the coupling between rules and requirements
  - Support the validation of inheritance between healthcare standards

Source: eHealth Suisse, Format d’échange, Rapports de laboratoire soumis à déclaration en Suisse (Projet)
Principle (1)

Requirements from the healthcare standards

- Standards (HL7, etc)
- IHE TF
- eHealth Spec

UML models
OCL constraints
use

OCL Processor
(Dresden OCL)

M2T Processor
(Acircel)

XML

Description of the structure of the XML doc. Injection of rules and requirements into the model → OCL constraints

Scripts that extract information from UML models and generate structured texts related to these models

Java XML Binding

JAVA Validator

Java Unit Testing

Validator Documentation
A sample of a model of classes of constraints (1)
A sample of a model of classes of constraints (2)
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Results

• More than 70 validators based on this methodology
• More than 50 000 XML documents validated
• Applied on dozens of structures of XML standards, with a success to adapt their models => generic model
• Fast validation tools
• Easy to maintain and to modify
Integration of the validation tool in Gazelle Platform

ISTQB Foundation Level Syllabus – Model-Based Tester
EVSClient: front-end validation service
Comparison to schematrons

- 1300 HL7 CDA documents from the epSOS project
Conclusion

• A methodology of validation of XML documents on healthcare standards based on model based architecture
• Allows the management and the coupling between requirements and constraints
• Open source implementation with open source tools (Topcased, Acceleo, DresdenOCL)
• Other related topics :
  • Coupling with requirements meta-models editor tools (like ART-DECOR)
  • Application of the validation process on other fields than healthcare
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