Generating a Document-Oriented View of a Protégé Knowledge Base

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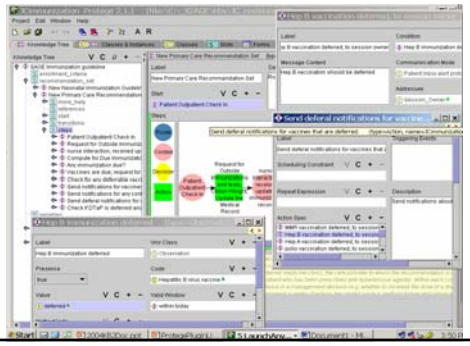
Seventh International Protégé Conference, Bethesda, MD July 8, 2004

Problem: What's in a Protégé knowledge base?

- Frame-based knowledge base can be a very large network
- A user may have difficulty comprehending the content of the knowledge base
  - Learning curve of Protégé
  - Organization of knowledge base



Current state: Protégé allows limited views of knowledge bases

- Default classes/instances tabs
  - Present tree-based views
  - Browse by classes and instances
- Specialized views
  - Examples
    - Diagram/graph widgets
    - Instance tree tab/widget
    - Ontoviz, Jambalaya tabs
    - Java-doc HTML generator
  - Most expose a small amount of information
  - Most organized around Protégé modeling constructs

Alternative: Domain-oriented document views

- Expose content of knowledge bases as a documents
- Organize documents around “rhetorical models” of the domain
  - Chapters and sections
  - Structured text
  - Graphics and tables
  - Index and glossaries
- Convey large amount of information
- Allow “reading” of knowledge base
  - Domain expert: can review KB content in a more familiar medium
  - Knowledge engineer: can review KB systematically
- Literate knowledge engineering

Outline of "KB2Doc" Work

- Problem domain
- Design decisions
- First experiment
  - Results
  - Methods
  - Assessment
- Extensions
  - Current work
  - Future possibilities

Work in progress!!

Problem domain: Guideline knowledge base

- Context: SAGE Project (www.sageproject.net)
- Encoding of clinical practice guidelines (example) for purpose of providing patient-specific decision support
- Structure of information
  - Guideline ontology and instances
  - Associated ontologies and KBs
    - Patient data model
    - Model of organization resources
    - Medical terminologies
- Scoping decisions
  - Produce a document-oriented view of the content of a guideline
  - In Protégé term: expose content of an instance tree (all frames referenced directly or indirectly from a root guideline instance)

Design criteria

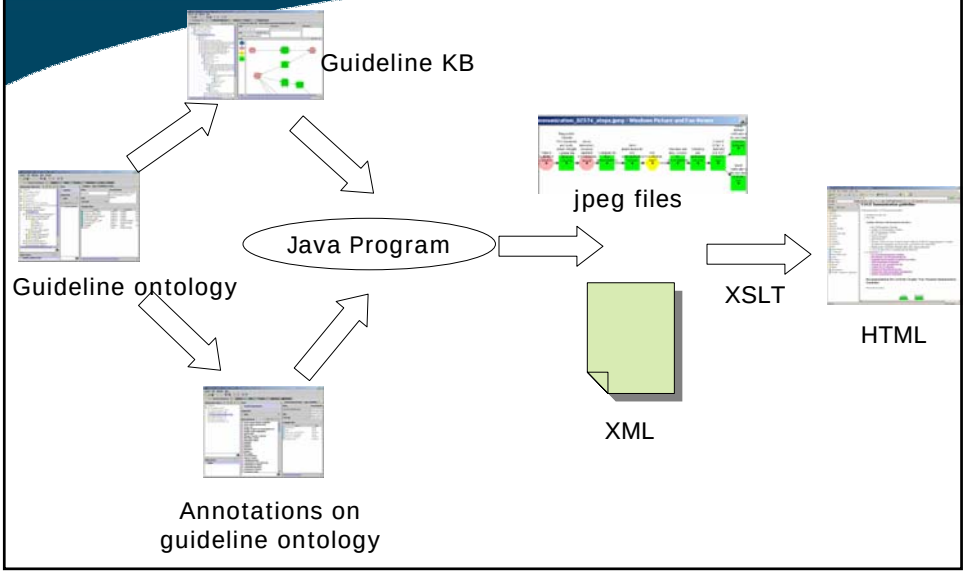
- The document-generation capability should be generic
- The document should expose the machine-readable parts of Protégé knowledge base
- Multiple views should be allowed
- There should be no modification to guideline knowledge base
- The document should be “readable” on the web or as printed document
  - Pseudo-natural language and domain graphics
  - Mostly linear organization
    - Trade-off between expansion of content at points of use and repetition

First experiment: Results

SAGE immunization guideline
JCimmunization.html

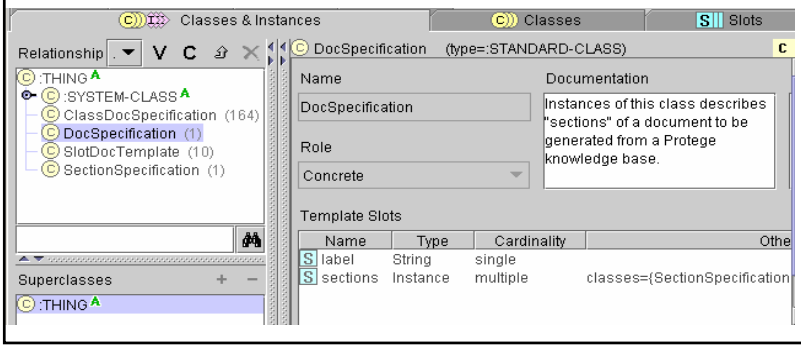
PRODIGY guideline for patients with previous myocardial infarction
Curtsey of Neill Jones (SCHIN, University of Newcastle)
PriorMI.html

Method of first experiment: How were the html pages generated



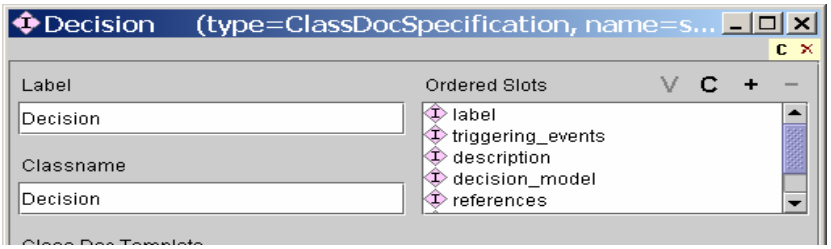
Guideline ontology annotations: Document

- A “document” consist of a number of “sections”
- A “section” specifies the “root” node
- Two types of sections
  - Expansion of instances tree from the root node (e.g. start from instances of Guideline class)
  - Expansion of class hierarchy from the root node



Generating ontology annotations: Classes

- Select “classes of interest” for annotation
- Automatic generation of annotations, followed by manual editing
  - Selection and ordering of slots (for default text generation)

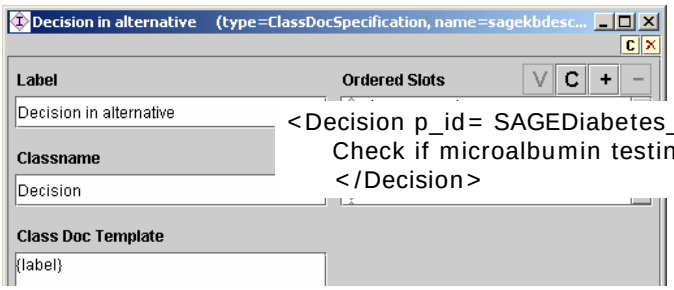


XML generation

- XML format: class and slot names as tags
  - <Decision p_id= "SAGEDiabetes_01535">
  - <label>
  - Check if microalbumin testing due
  - </label>
  - <description>
  - Checks to see if any urine protein test has been performed in the last yr, or if any urine protein test in ordered within the next month.
  - </description>
  - <decision_model>
  - ....
  - </decision_model>
  - </Decision>

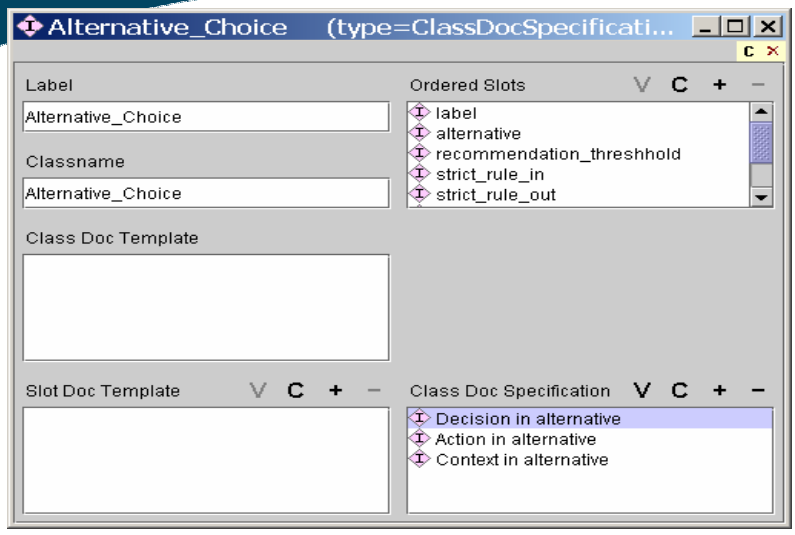
Alternative annotations

- For selected classes, define alternative annotations

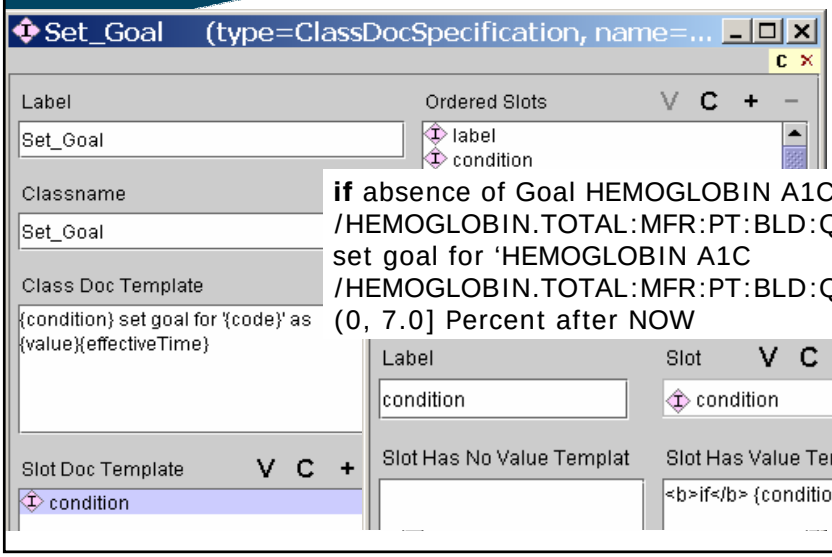


<Decision p_id= SAGEDiabetes_01535">
Check if microalbumin testing due
</Decision>

Context-sensitive XML generation



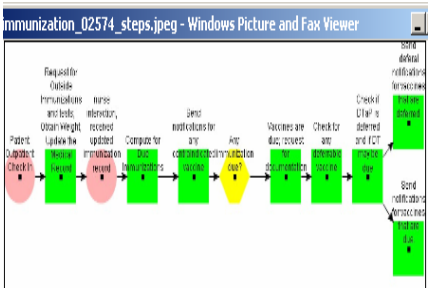
Use of templates to generate text



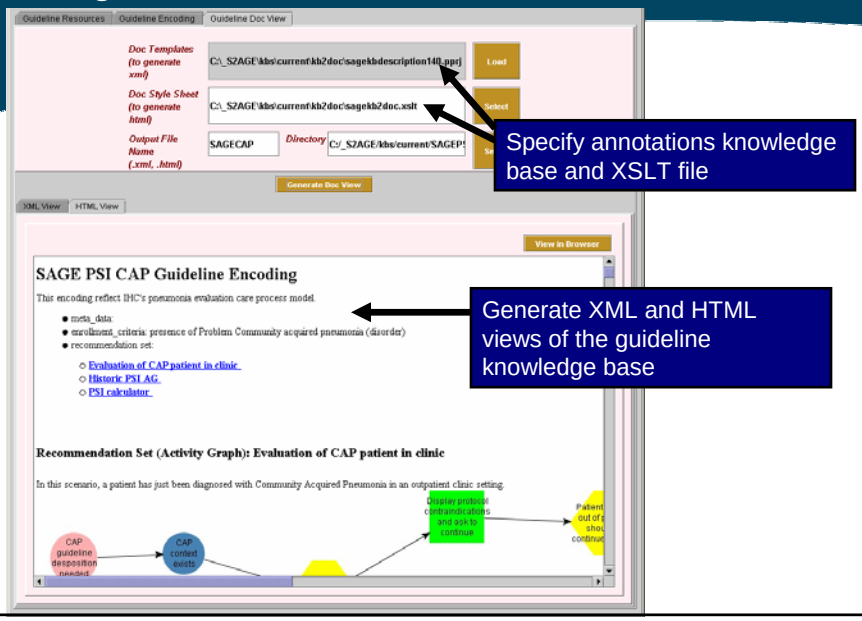
if absence of Goal HEMOGLOBIN A1C /HEMOGLOBIN.TOTAL:MFR:PT:BLD:QN: set goal for 'HEMOGLOBIN A1C /HEMOGLOBIN.TOTAL:MFR:PT:BLD:QN:' as (0, 7.0] Percent after NOW

Special treatment of graph widget

- Guideline recommendations depicted as graphical flowchart-like format
- Handling of graphs
  - Generate images as jpeg file
  - Save coordinates of nodes in special tags
  - Transform to clickable images in html



Document-generation integration into Protégé Guideline Workbench as a tab



Assessment: Satisfy design criteria?

- ✔ The document-generation capability should be generic
- ✔ The document should expose the machine-readable parts of Protégé knowledge base
- ✔ Multiple views should be allowed
- ✔ There should be no modification to guideline knowledge base
- ? The document should be “readable” on the web or as printed document

Assessment

- Clinician feedback: Not enough contextual information about encoded guideline recommendations
  - Purpose of guideline graphs different from paper flowcharts
  - Interpretations and encoding decisions not explicit (no commented code)
- Maintenance problem
  - Annotation knowledge base has to track changes in guideline ontology
- Simplistic document model
- Brittle XML generation

Extensions: revised XML generation

- XML instances based on XML schema generated from guideline ontology
  - Schema-based transformations
  - "Protégé-independent" export format for guideline instances
- Export, not backend
  - Conflation of class and metaclass
  - Single inheritance of subtypes
  - Relaxation of constraints
    - Multiple allowed classes=>most-specific superclass
    - No overridden facet constraints

Extension possibilities

- Better integration into Protégé
  - Use of Protégé's :ANNOTATION facility
  - A wizard to guide creation of annotation knowledge base?
  - Maintenance of annotation knowledge base
- Document-oriented views of other large-scale Protégé structures?
  - Glossary of terms?
  - Clinical trial protocol documents?
  - Document-oriented knowledge acquisition?

Document-oriented views of Protégé knowledge base

- Simple annotations on Protégé ontology for document generation
- Results of first experiment encouraging
  - Not completely satisfactory for clinicians
  - Useful tool for knowledge engineer
  - PRODIGY document much more polished
- Potentially rich avenue of research