Protégé and the Kasimir decision-support system

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Plan

1) **Kasimir: a decision-support system**
   - Context and Principles
   - Demonstration
   - The need for a knowledge base editor

2) **Kasimir and Protégé-2000**
   - Describing the knowledge model of Kasimir
   - Introducing the inference engine
   - Visualization tools
   - Knowledge base comparison

3) **Prospects**
   - Knowledge representation languages
   - Component-based architecture
   - Reasoner plugged into patient databases
   - Case-Based Reasoning
Decision-support system
- knowledge bases (clinical guidelines)
- inference engine => reasoning capabilities
  - hierarchical classification (subsumption)
  - fuzzy logic (uncertainty on decision thresholds)

Applied to cancerology
- breast cancer treatment
- to other cancerous localization (prostate, settler)
- to other cancerology problems (diagnosis, surveillance)

A pluridisciplinary project
- computer scientists (researchers and developers)
- medicine doctors (cancer specialists)
- ergonomicists
Based on the principles of Description Logics:
- primitive concepts
- defined concepts
- relational attributes whose ranges are concepts

**Example:** patient description

- Young woman
- Gender = female
- Age in [20, 30]
About concepts in Kasimir:

✓ Primitive concepts: the subsumption is declared
✓ Defined concepts: the subsumption is calculated

Objective: Give a treatment to a patient

✓ Patient Description: defined concept ("Young woman")
✓ Problem: defined concept
  = Patient Description associated to a treatment

<table>
<thead>
<tr>
<th>Problem: Young woman</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender = female</td>
</tr>
<tr>
<td>Age in [20, 30]</td>
</tr>
<tr>
<td>Treatment for a young woman</td>
</tr>
</tbody>
</table>
- General working:

XML files

Inference engine

GUI

Mediator

Concept(s)

Concept

Patient description

Treatment(s)

Concepts, attributes: Domain knowledge

UI description

Domain knowledge

Concept(s)

Patient description

Treatment(s)
Quel est le traitement?
Référence du traitement d'un cancer mammaire infiltrant. Patiente, âgée de 65 à 70 ans, tumeur au stade locorégional, opérable d'emblée.

Quel traitement initial?
Traitement initial, taille clinique de la tumeur est inférieure à 4 cm, la tumeur n'est pas multiloculaire, la patiente souhaite une conservation du sein :

- Le référentiel propose une chirurgie conservatrice première, accord du chirurgien?

- le chirurgien est d'accord pour la conservation :
  - Indication de la tumorectomie et curage.
  - Il n'y a pas de ganglions axillaires palpables envahis :
  - Indication de curage axillaire inférieur.

- le localisation est non centrale:
Knowledge bases encoded within XML files

+ 1000 concepts for breast cancer treatment

Knowledge bases increase in size

Knowledge bases were hand-written encoded

⇒ Difficulty to maintain, to modify

⇒ Various visualization needs

⇒ Need for a knowledge editor with advanced functionalities
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Knowledge model of Protégé-2000
« A Protégé ontology consists of classes, slots, facets and axioms »

Knowledge model of Kasimir
Concepts, attributes

<table>
<thead>
<tr>
<th>Kasimir</th>
<th>Protégé-2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concepts</td>
<td>Classes</td>
</tr>
<tr>
<td>Attributes</td>
<td>Slots</td>
</tr>
<tr>
<td>Attribute values</td>
<td>Facets</td>
</tr>
</tbody>
</table>

=> Set of Kasimir metaclasses in Protégé
=> Adapted forms for the editing process
Thanks to the set of Kasimir metaclasses in Protégé, the user can perform the editing process.

All the edited knowledge has to be checked by the inference engine.

Inference engine introduced through tab plugins:

- discovers unexpected subsumptions
- detects errors
Huge hierarchies require other means of visualization:
- quick access to any knowledge element
- overview of the full knowledge structure

=> 2 plugins
- Palétuvier (Mathieu d’Aquin): graphical hierarchies viewer
  • zoom abilities
  • choice of the root
- HyperTree (Christophe Bouthier): hyperbolic tree view of hierarchies
Need to identify all changes carried out during the editing process

=> Use of Palétuvier with colors:
   - **red**: removed concepts
   - **green**: new/modified concepts
   - **yellow**: unchanged concepts
   - **blue**: modified treatments

Old knowledge-base = all concepts initially present in the Protégé project.

New knowledge-base = all concepts present in the same project at the time of comparison.
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Prospects (1/2)

- Implement fuzzy logic in the editing process
- Interoperability, Semantic Web
  => OWL ?  
  **Objective**: Kasimir as a resource of SW

- Component-based architecture
  => Independent inference engine communicating with XML
  **Objective**: knowledge server
✓ Patient databases

**Objective:** Plugged with the reasoner => intelligent queries

✓ Case-Based Reasoning

**Objective:** Try to respond and suggest treatments to patients not represented in the clinical guidelines
Thank you...