



# Protégé and the Kasimir decision-support system

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- Knowledge-based systems
- Knowledge representation
- Classification systems
- Description logics
- Reasoning, CBR
- Data mining, Text Mining
- ...

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## 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



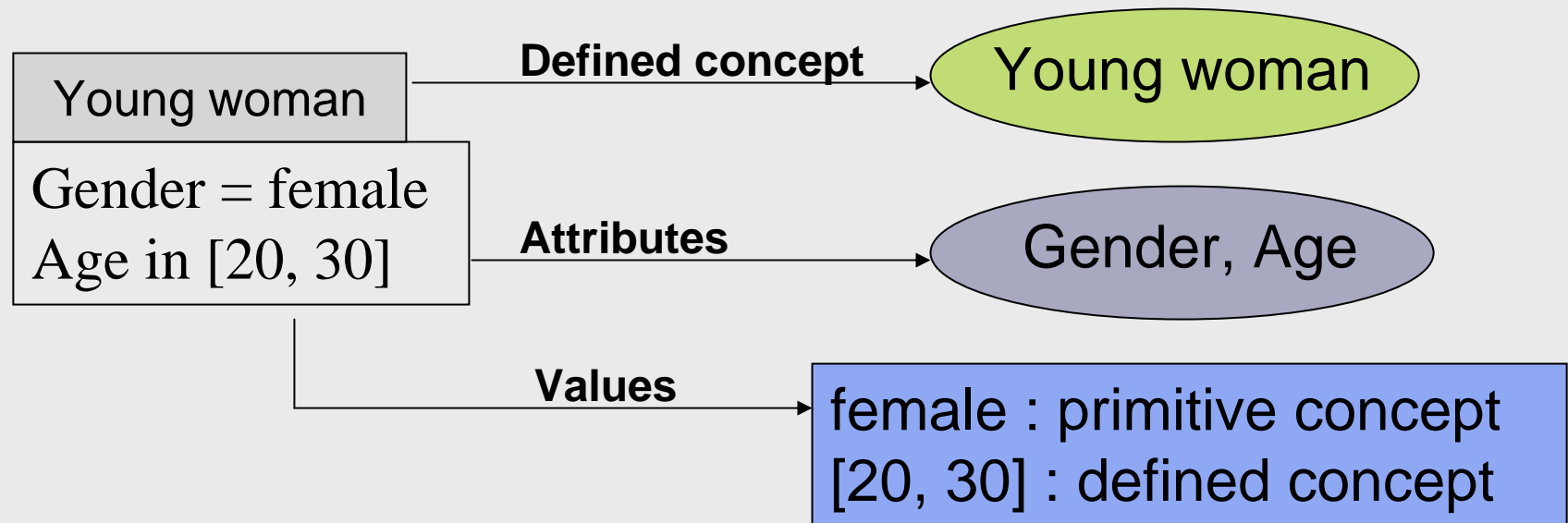
- ✓ **Decision-support system**
  - knowledge bases (clinical guidelines)
  - inference engine => reasoning capabilities
    - hierarchical classification (subsumption)
    - fuzzy logic (uncertainty on decision thresholds)
- ✓ **Applied to cancerology**
  - breast cancer treatment
  - to other cancerous localization (prostate, settler)
  - to other cancerology problems (diagnosis, surveillance)
- ✓ **A pluridisciplinary project**
  - computer scientists (researchers and developers)
  - medicine doctors (cancer specialists)
  - ergonomists



### ✓ Based on the principles of Description Logics

- primitive concepts
- defined concepts
- relational attributes whose ranges are concepts

### Example : patient description





### 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

Problem : Young woman

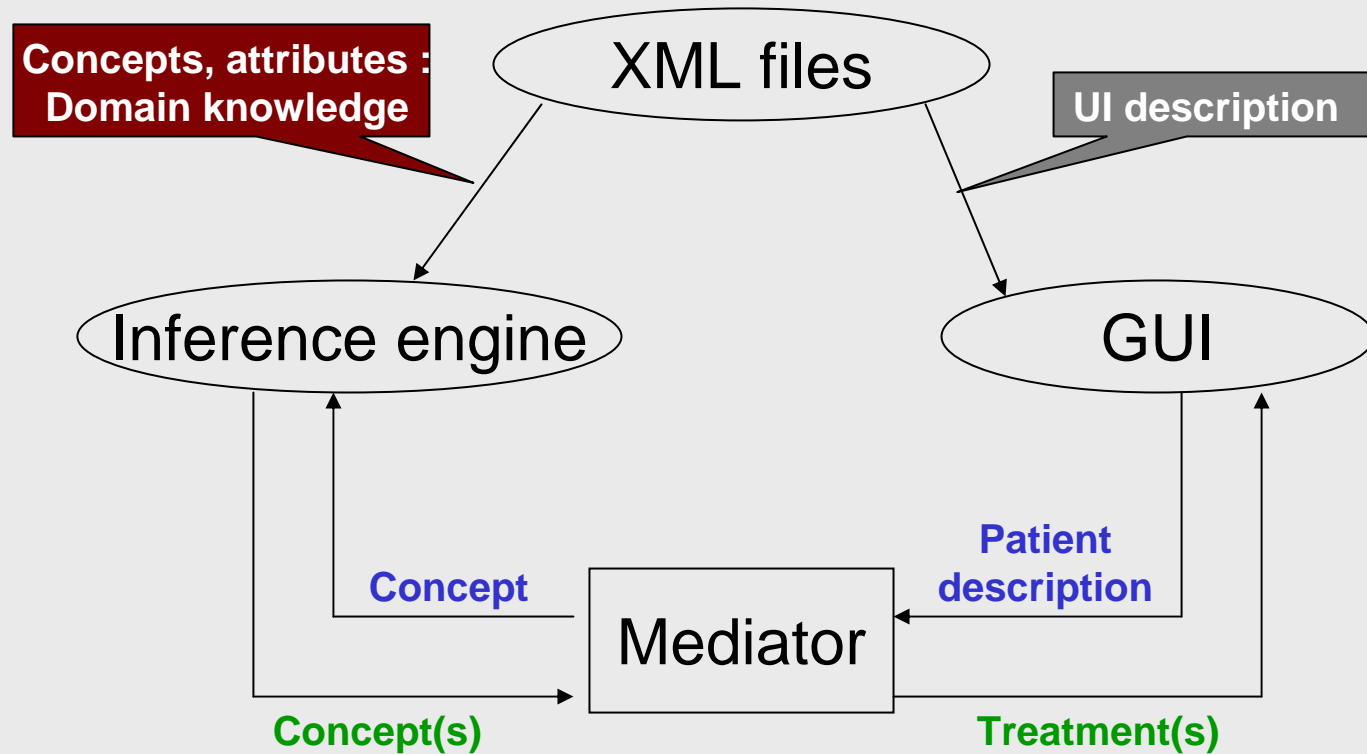
Gender = female

Age in [20, 30]

Treatment for a young woman



## - General working :





# Kasimir / Demonstration (1/1)



Kasimir 3.0

Sein

Nouveau cas Sein

Référentiel Sein

Liste des requêtes

Diagnostic

Traitement d'un carcinome mammaire infiltrant

Surveillance post-thérapeutique

Au stade locoregional

Au stade métastatique

Tumeur opérable d'emblée (T1 T2 T3 et/ou N0 N1)

Tumeur localement avancée (T4a,b,c et/ou N2)

Tumeur inflammatoire (T4d)

Traitement initial

Traitements complémentaires post-opératoires

Liste des résultats

**Quel est le traitement ?**

Référentiel du traitement d'un carcinome mammaire infiltrant, Patiente, âgée de 16 à 75 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 multi focale, 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 tumorectomie et curage.

il n'y a pas de ganglions axillaires palpables envahis :

■ Indication de curage axillaire inférieur.

la localisation est non centrale :

Liste des caractéristiques

Sexe : ☒ féminin ☐ masculin

Age : 26

Localisation :

Localisation Inf Int,

Taille clinique de la tumeur : 1.3

Tumeur multifocale : ☐ Oui ☒ Non

Adenopathie clinique : ☒ N0 ☐ N1

Souhait de conservation : ☒ Oui ☐ Non

Accord du chirurgien pour conservation : ☒ Oui ☐ Non





- ✓ 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

| Kasimir          | Protégé-2000 |
|------------------|--------------|
| Concepts         | Classes      |
| Attributes       | Slots        |
| Attribute values | Facets       |

**=> 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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✓ **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...