Collaborative Development of Dermatovenereology Ontology

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Intellectual systems in medicine

• **Aims**
  - Increase decision making quality
  - Education

• **Medical errors**
  - Number of actions in law ↑ in 13-14 times;
  - 30% - diagnosing errors;
  - 90% of them – human factor (training level, operational experience, character quality)

• **In Russia**
  - Territorial length;
  - Uneven population...
  - ... and skilled physician distribution
**Ontology** - explicit specification of conceptualization (Gruber 1993).

**Ontology** is a hierarchically structured set of terms for describing a domain that can be used as a skeletal foundation for a knowledge base (Gavrilova et al. 2005).
**Ontology types**

Dermatovenereology ontology

Aim: Education, Knowledge management (diagnosing);
Domain: dermatovenereology
Different relation types are used, main: structure of properties, taxonomy;
Has axioms;
Representation: graphic, OWL;
Owner: the group of researchers.

> 2500 symptoms and their properties

Ontology links

Dermatovenereology

227 diseases

Symptoms

Symptoms class 1

... Symptom * ...

Symptom ** ...

Symptoms class N

... Symptom ** ...

Symptom **** ...

Diseases

Diseases class 1

... Disease * ...

Disease ** ...

Diseases class N

... Disease *** ...

... Disease **** ...

Property "specificity" of the link "Is a symptom of":
Highly specific symptoms of a disease are a salient feature of this disease only,
Symptoms of middle specificity may occur in several diseases,
Low specific symptoms are uncharacteristic of this disease.

Ontology design algorithm

- Identification of strategy, goals and boundaries

- Development of glossary or identification of meta-concepts

- Specification and categorization

- Orchestration

Ontology representation

Visual Description language

Web Ontology Language (OWL)

1. The basic principle of “good gestalt”:
“The arrangement of each form in nature or in mind should be as good (regular, orderly, simple and symmetric) as possible.”

1. Law of closure

2. Law of similarity

4. Law of inclusion

5. Law of parsimony (Occam's razor)
Gestalt-psychology principles

“Harmony = conceptual balance + clarity”

Where conceptual balance implies:

– concepts of the same level are connected with the parent concept by the same type of relationship;
– paths depth of ontology tree are nearly the same (±2);
– general picture is rather symmetric;
– cross-references are excluded as far as possible;

Clarity means:

– minimization - maximal number of concepts of the same level or the path length of the tree doesn’t go beyond famous Yngve-Miller’s number (7±2);
– transparency for reading – types of relationships should be obvious not to overload ontology scheme and to omit the names of relationships.

COAT (Cognitive Ontology Assessment)

- Automatic calculation of metrics and integral criterion
- Metrics description
- Bottle-necks revealing
- Ontologies comparison
- Selection of the best one

Pic. 1 – Evaluation mode
Pic. 2 – Comparison mode

Ontology evolution ("aggravating factors")

First version

Current version

Expert system: diagnosing

System application

- Structured description and visual representation of the domain
- Education
- Examination
- Diagnosing
- Expert consultation
- Telemedicine consultation in a «store and forward» mode
Thank you for your attention!

Questions?
Ontology evolution (Beginning)

Ontology evolution (current)