Creating the Ontologists of the Future

Panel Session 4

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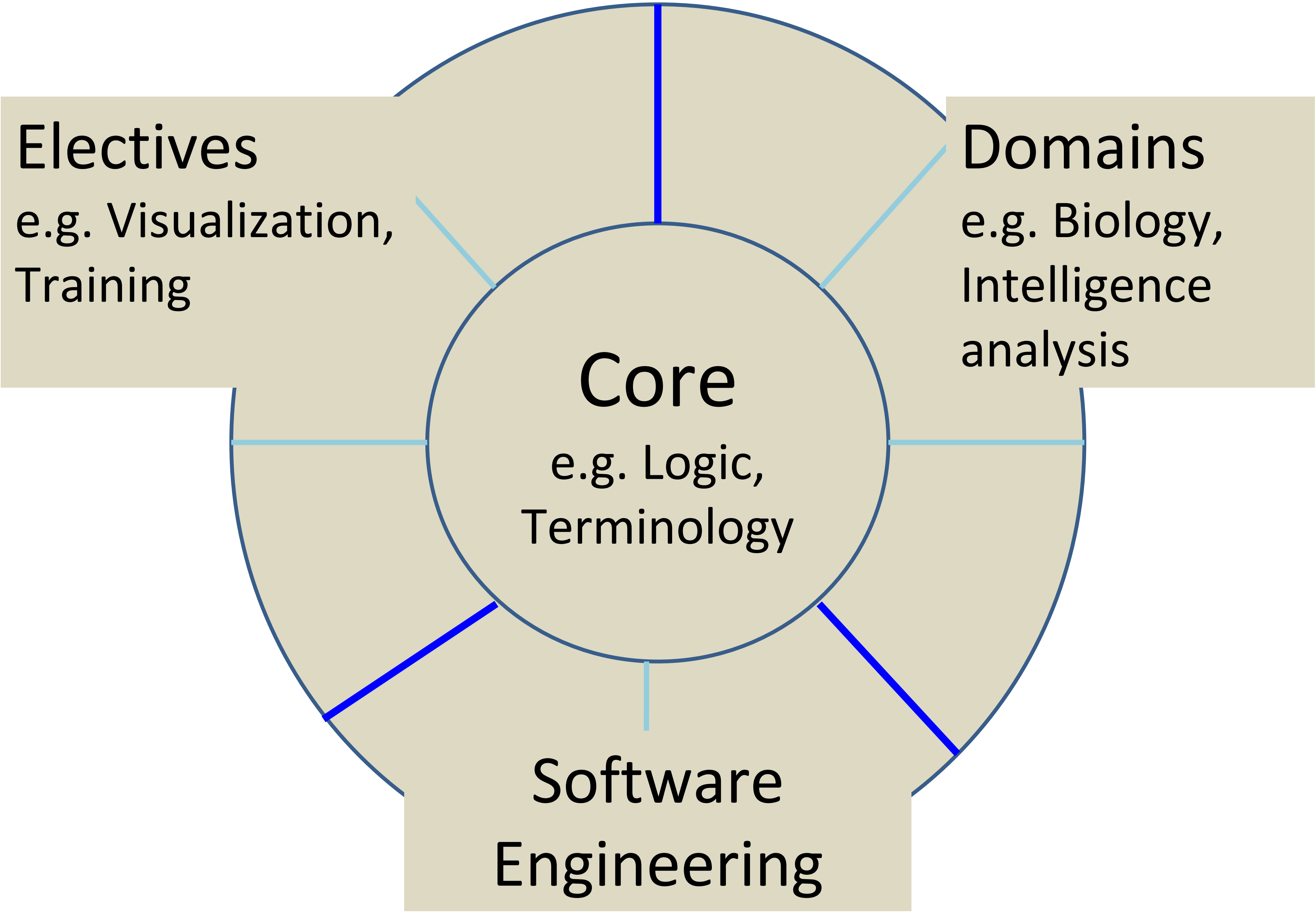
Goal of panel session

- Identify knowledge and skills that a student should be taught
- Not everything that has been identified as relevant during the other panels can be taught, we need to prioritize

Non-goals of panel session

- Specifying how skills and knowledge should be taught (design of program depends on the institution)
- Certification: too early to discuss a certification program (similar to Project Management Institute certification of PMP)



Electives

e.g. Visualization, Training

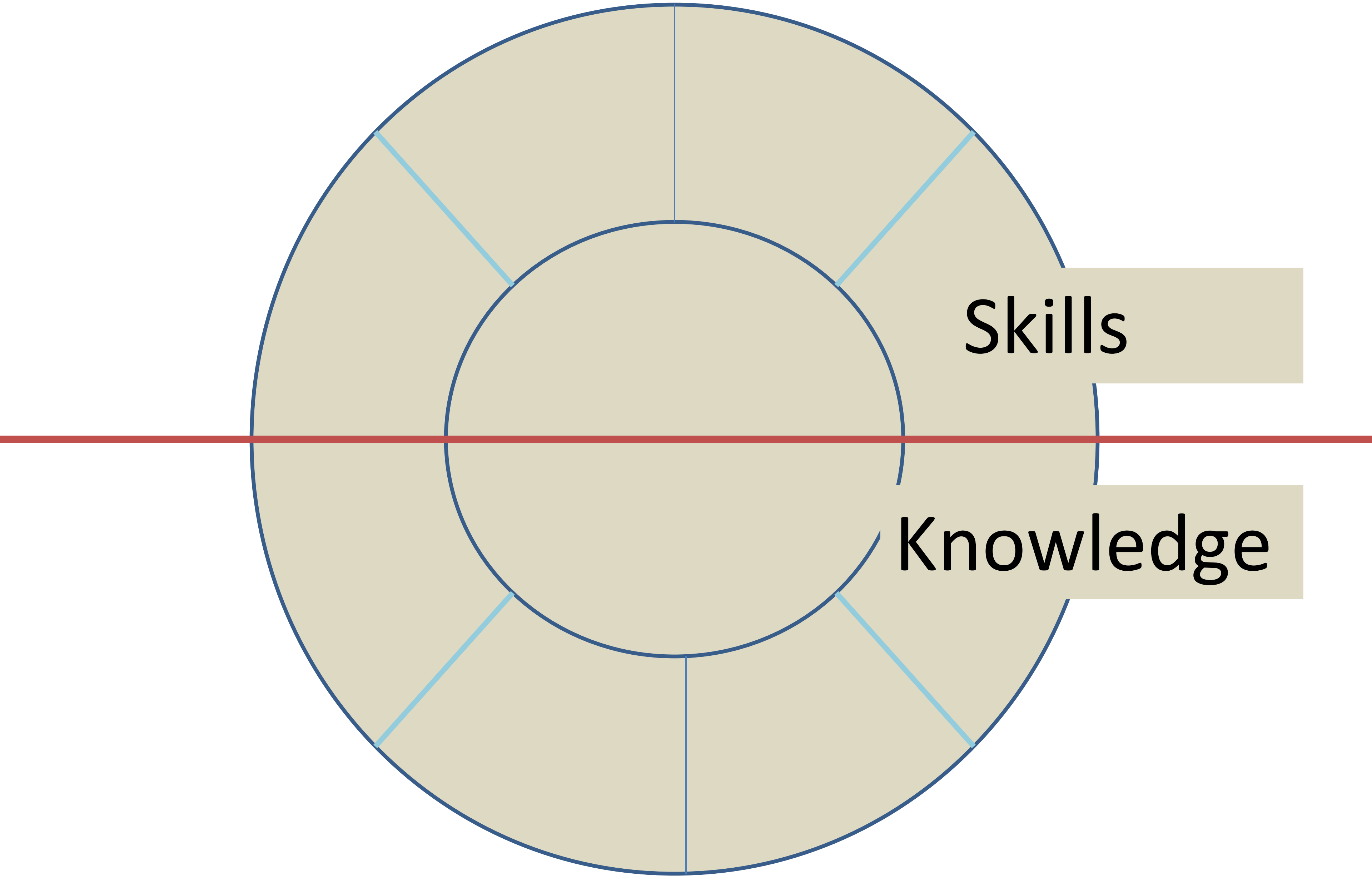
Domains

e.g. Biology, Intelligence analysis

Core

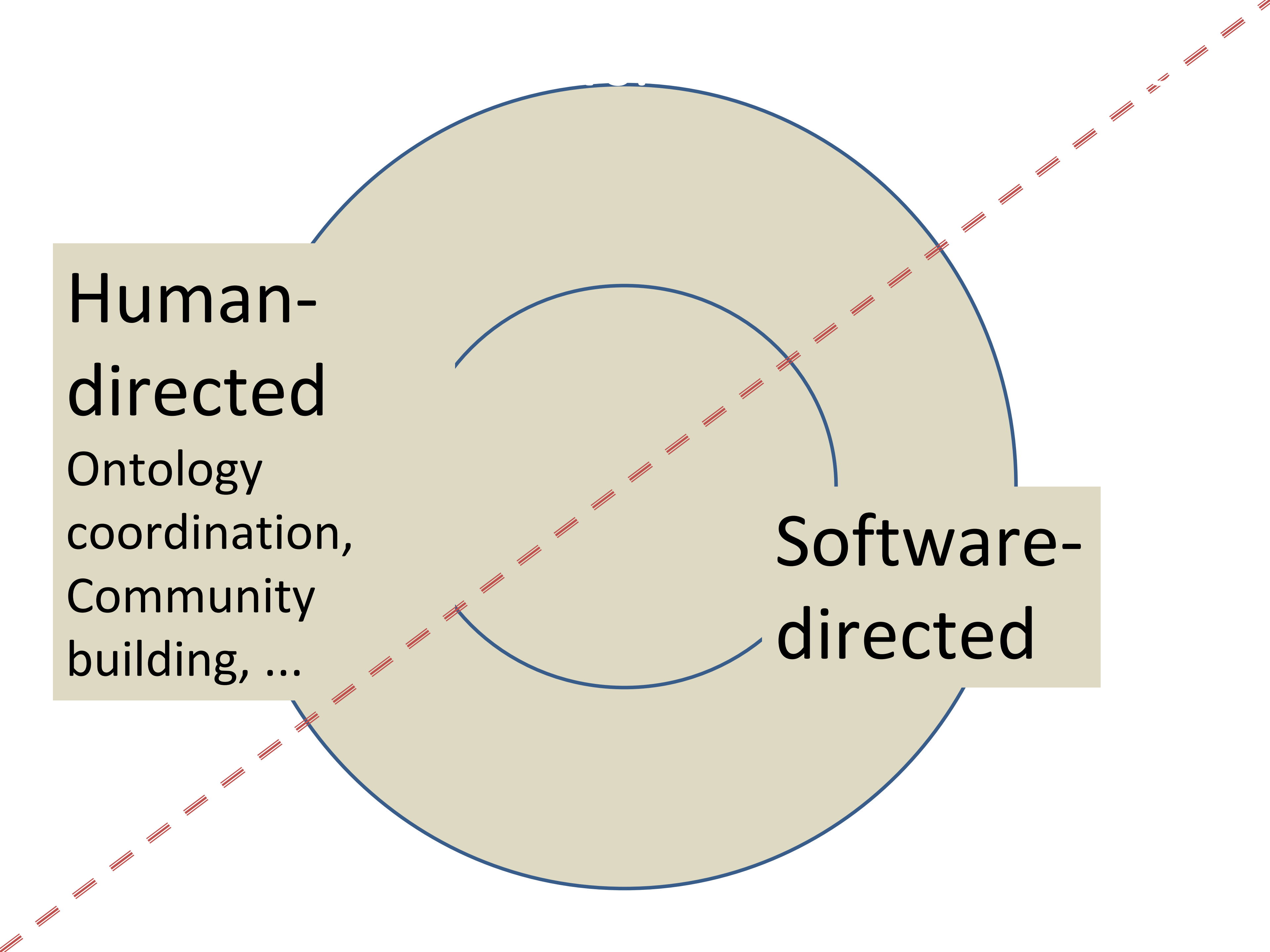
e.g. Logic, Terminology

Software Engineering



Skills

Knowledge



Human-directed

Ontology coordination, Community building, ...

Software-directed

A Template for the Ontology Training Programs

What follows are sample specifications of the skills and content which should be taught in programs designed to train the ontologists of the future.

Core Skills 1

Abilities required for developing and improving ontologies

1. Clarifying the purpose of the ontology, understand potential deployment, perform requirements analysis,
2. Managing the ontology across the life cycle (funding, versioning, ensuring, permanence, help desk ...)
3. Knowing what sort of ontology is useful for what sort of problem (including: know where ontologies are not useful)
4. Identifying, evaluating and using software for ontology development
5. Choosing the appropriate representation language
6. Choosing the appropriate level of detail
7. Identifying existing content resources (existing ontologies, terminologies and related resources; relevant data; domain expertise, ontology expertise)

Core Skills 2

8. Designing an ontology as an assembly of reusable modules
9. Using (reading, writing) different representation languages
10. Identifying terms and relationships; formulating definitions
11. Improving ontologies (finding errors via manual term-by-term inspection, solving interoperability problems)
12. Documenting ontologies, including: providing natural language definitions
13. Working in a team, including teams for distributed development

Core Skills 3

Abilities required for applying ontologies

See use cases below

The strategy is that these skills will be gained via internships and project-focused courses

Elective Skills

- Training people in the use of ontologies
- Coordinating ontology development efforts
- Creating meaningful visualizations of ontology structures for human beings

Core Knowledge 1

1. The basic terminology of ontology (relation of ontology to knowledge representation, conceptual modeling, data modeling)
2. Theoretical foundations
   a. Logic (first order, second order, Description Logic, ...; logic of definitions)
   b. Set theory
   c. Philosophical ontology (universals and particulars, time, mereology ...)
   d. Philosophy of language (the use-mention confusion, sense and reference, speech act theory, ...)
3. Representation languages Part 1: RDF, OWL; Common Logic
4. Building and Editing ontologies
   a. human aspects (application of classification principles, manual auditing, ...)
   b. software tools (Protégé, ...)
   c. resolving interoperability problems among ontologies

Core Knowledge 2

5. Ontology evaluation strategies and theories (Ontoclean, ...)
6. Examples of ontologies, illustrating different methodologies
   a. upper-level ontologies (BFO, DOLCE, SUMO, ...)
   b. domain ontologies (GO, PSL, Enterprise Ontology, ...)
7. Examples of ontology applications (successes and failures)
   a. as controlled vocabularies / standards, to achieve coordination between humans
   b. to solve interoperability problems among external data resources
   c. reasoning with ontology content
   d. improve search and retrieval
   e. NLP
8. Ontology and the Web
   a. General foundations (URIs, XML, etc.)
   b. Semantic Web initiative
   c. Semantically enhanced publishing, literature annotation, data curation

Elective Knowledge

Underlying and related disciplines

1. Advanced logic (modal logic, temporal logic, default logic, ...)
2. Advanced philosophical ontology (mereotopology, tropes, ...)
3. Computer science
   a. formal languages, formal machines, computability
   b. automated reasoning
   c. database theory
   d. knowledge representation, conceptual modeling, data modeling; metadata
4. Linguistics / cognitive sciences
   a. distinction between syntax, semantics, pragmatics
   b. natural language processing, natural language generation
   c. cognitive theories of categorization

Elective Knowledge

Supporting tools, technologies and methodologies

1. Representation languages Part 2 (SWRL, RIF, SKOS; OBO; UML; E-R, ...)
2. Ontology content acquisition (role of text mining, ...)
3. Achieving ontology interoperability
4. Principles for building ontology repositories
5. User interface issues (visualization / usability, principles of meaningful arrangement, ...)

Application domains

(Any domain could be an application domain.)

1. Natural sciences

    Biology and and biomedical informatics (Gene Ontology, OBO Foundry, HL7 and its problems)

    Physics, astronomy, geology

2. Business (Enterprise modeling, Enterprise memory, Manufacturing Systems , Supply Chain Integration) and E-Commerce (GoodRelations)

3. Government, military, intelligence community, security (Universal Core)

4. Education

Example

Outline of a 36 credit master program:

Core:

- 3 credits: General introduction to Ontology (know: 1, 6, 7, 8)
- 4 credits: Formal Foundations (know: 2.1, 2.2, 3)
- 3 credits: Philosophical ontology (know: 2.3)
- 2 credits: Philosophy of language (know: 2.4)
- 3 credits: Use cases and examples (know: 5, 6, 7, 8)
- 3 credits: Management and team work (know: 4.1, skills: 2, 13)
- 3 credits: Introduction to building ontologies (know: 4; all skills)
- 3 credits: Project course building ontologies (know: 4; all skills)
- 3 credits: Practicum building ontologies (know: 4; all skills)

9 credits for electives/ domain specific / software engineering courses

10 day course

- Course should aim to teach some of the core knowledge and skills
- Course needs to be tailored to the participants to be useful