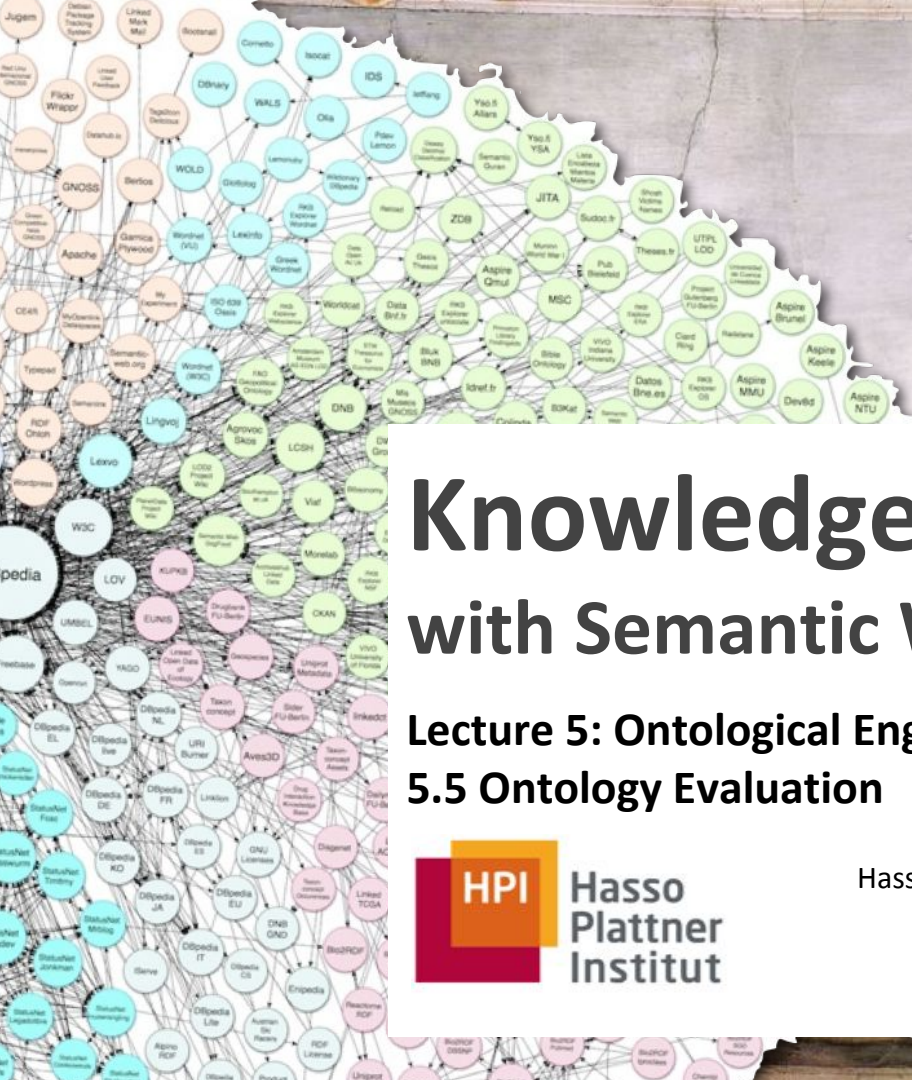


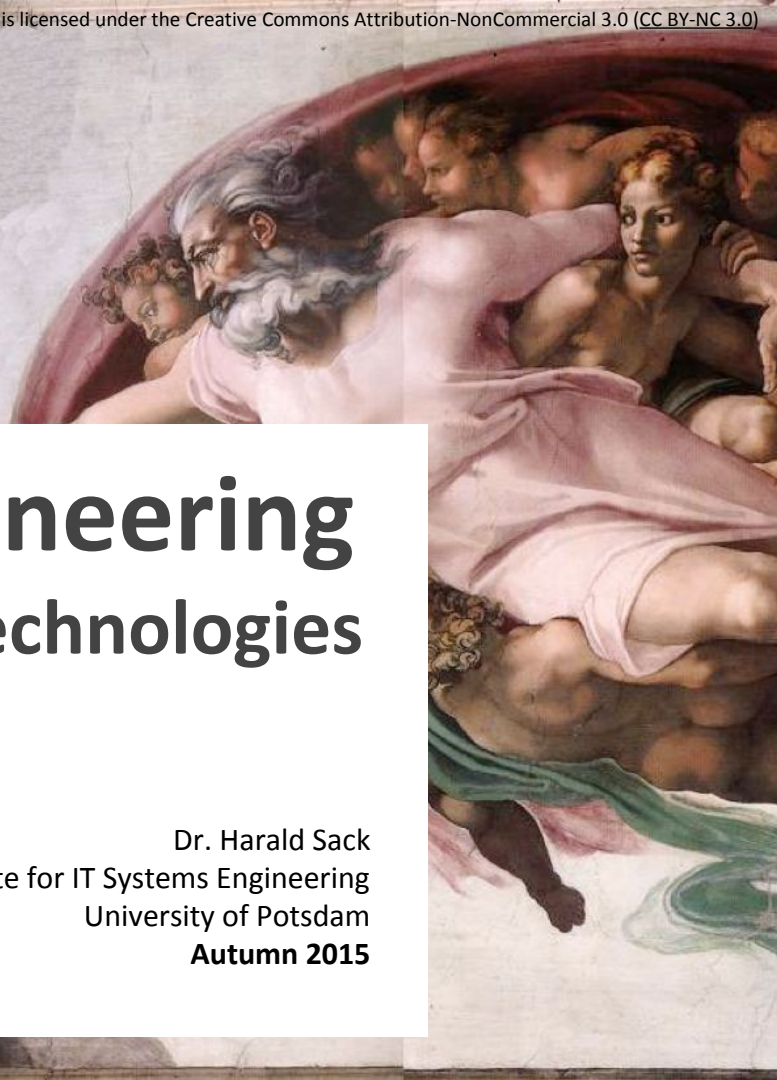


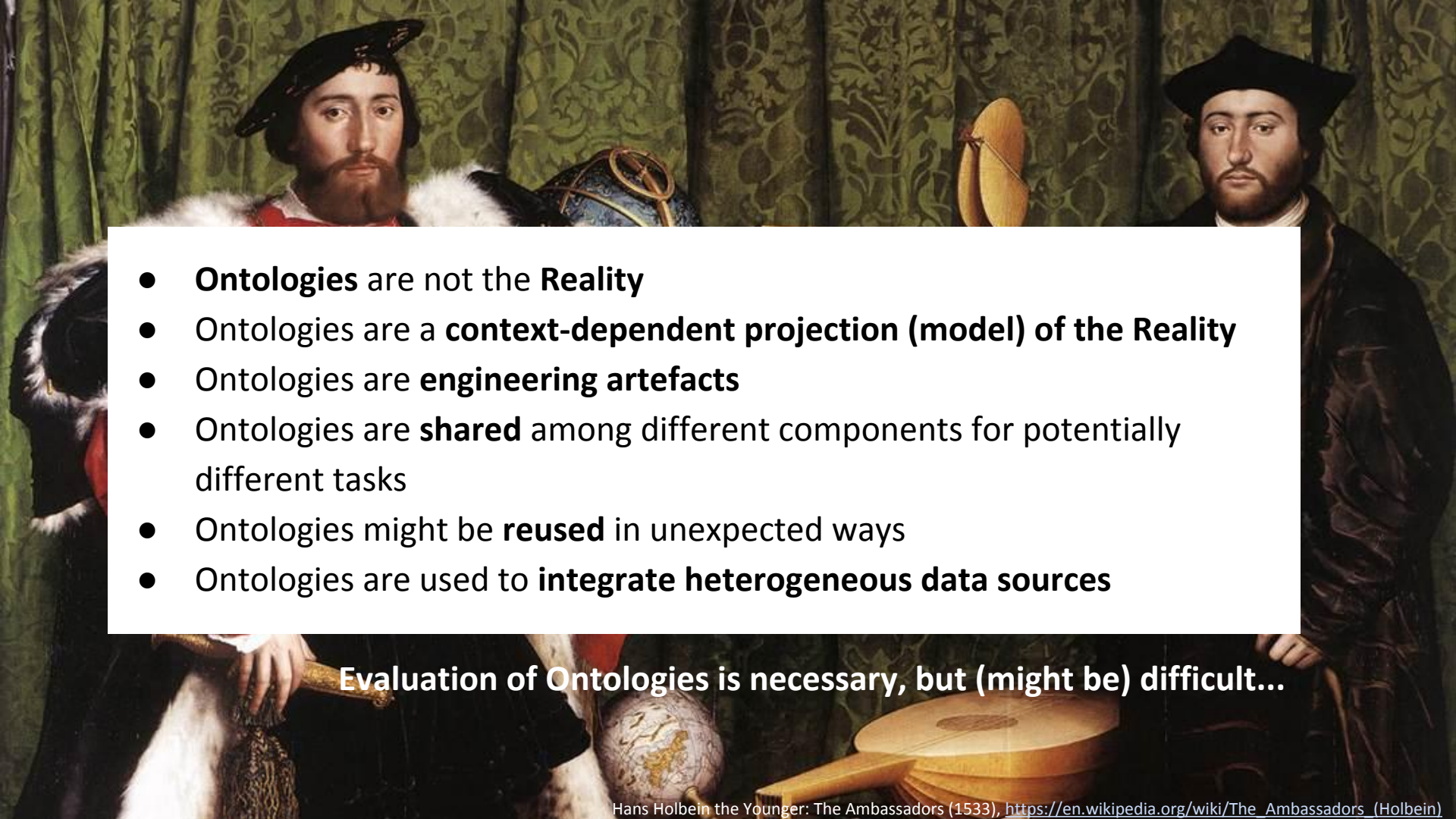
Knowledge Engineering with Semantic Web Technologies

Lecture 5: Ontological Engineering 5.5 Ontology Evaluation



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- The background of the slide is a detail from Hans Holbein the Younger's painting 'The Ambassadors' (1533). It shows two men in 16th-century attire standing in front of a green patterned curtain. The man on the left wears a black cap and a red garment with a white fur collar. The man on the right wears a black cap and a dark robe. Between them, a yellow hat hangs on the wall. In the foreground, a globe and a stack of books are visible.
- **Ontologies** are not the **Reality**
 - Ontologies are a **context-dependent projection (model)** of the **Reality**
 - Ontologies are **engineering artefacts**
 - Ontologies are **shared** among different components for potentially different tasks
 - Ontologies might be **reused** in unexpected ways
 - Ontologies are used to **integrate heterogeneous data sources**

Evaluation of Ontologies is necessary, but (might be) difficult...

- **Ontology Evaluation** in general can be defined as the process of **deciding the quality of an ontology** in respect to a particular criterion with the view of determining which in a collection of ontologies would best suit in a specific purpose.
- **Goal:**
 - compare the ontology with the **specification requirements** and (if available) gold standards
 - by taking into account **evaluation criteria** and applying various **evaluation approaches**,
 - yielding **evaluation results** and advices on how to improve the ontology.

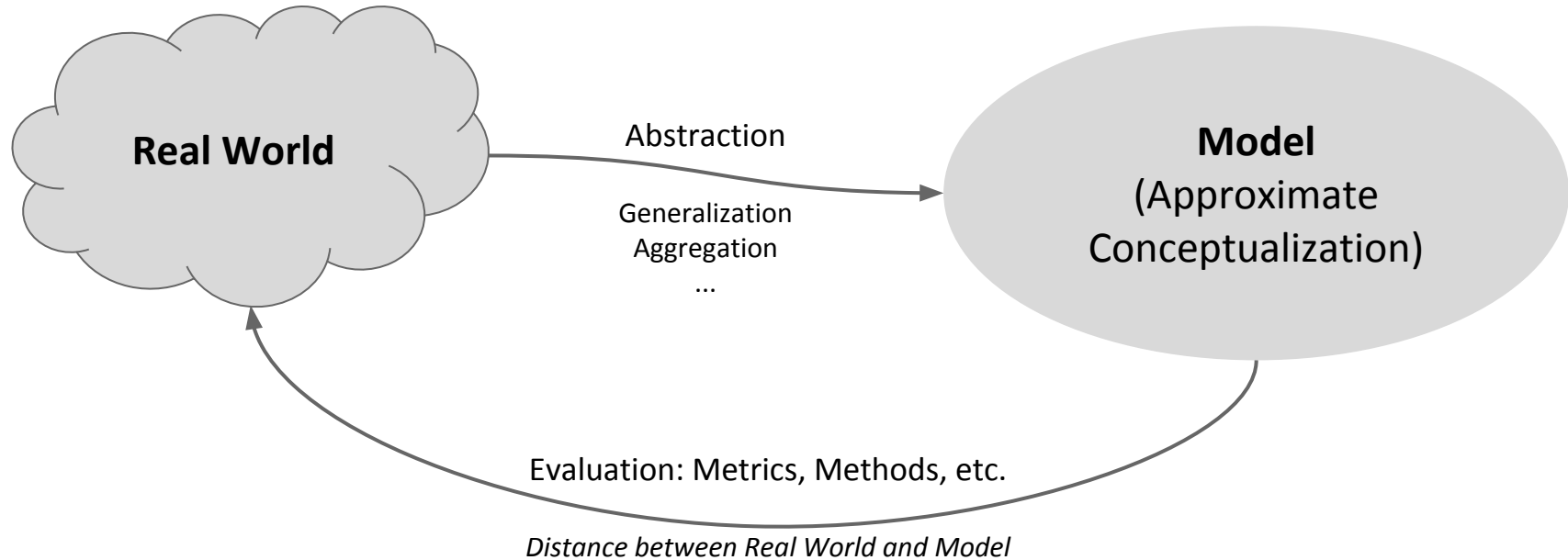
- **Ontology Verification:**

- checks the encoding of the specification
- detects errors, as e.g. circular, class hierarchies, redundant axioms, inconsistent naming schemes etc.
- confirms that the ontology has been built according to certain specified ontology quality criteria

- **Ontology Validation:**

- checks whether the meaning of the definitions matches with the conceptualization the ontology is meant to specify
- the goal is to show that the world model is compliant with the formal model

Ontology Evaluation



Criteria for Ontology Evaluation (1/4)

- **Accuracy:**

- Do axioms comply to the expertise of the users?
- Does the ontology capture and represent correctly aspects of the real world?

- **Adaptability:**

- Does the ontology offer the conceptual foundation for a range of anticipated tasks?
- Can the ontology be extended and specialized monotonically, i.e. without the need to remove axioms?
- Does the ontology comply to procedures for extension, integration, and adaption?

Criteria for Ontology Evaluation (2/4)

- **Clarity:**

- Does the ontology communicate effectively the intended meaning of the defined terms?
- Are the definitions objective and independent of context?
- Does the ontology use definitions or (partial) descriptions?
- Are the definitions documented?
- Is the ontology understandable?

- **Completeness:**

- Is the domain of interest appropriately covered?
- Are competency questions defined and can the ontology answer them?
- Does the ontology include all relevant concepts and their lexical representations?

Criteria for Ontology Evaluation (3/4)

- **Computational Efficiency:**

- How easy and successful can reasoners process the ontology?
- How fast can the standard reasoning processes (satisfiability, instance classification, etc.) be applied to the ontology?

- **Conciseness:**

- Does the ontology include irrelevant axioms?
- Does the ontology specify the weakest theory possible and define only essential terms?
- How weak are the assumptions regarding the ontology's underlying philosophical theory about reality?

Criteria for Ontology Evaluation (4/4)

- **Consistency:**

- Do the axioms lead to contradictions (logical consistency)?
- Are formal and informal description of the ontology consistent?
- Are any representation choices made purely for the convenience of notation or implementation?
- Does the translation from the knowledge level to the encoding show a minimal encoding bias?

- **Organisational Fitness:**

- Is the ontology easily deployed within the organization?
- Do tools within the organization put constraints on the ontology?
- Does the ontology meet legal requirements, etc.?

Measures for Ontology Evaluation

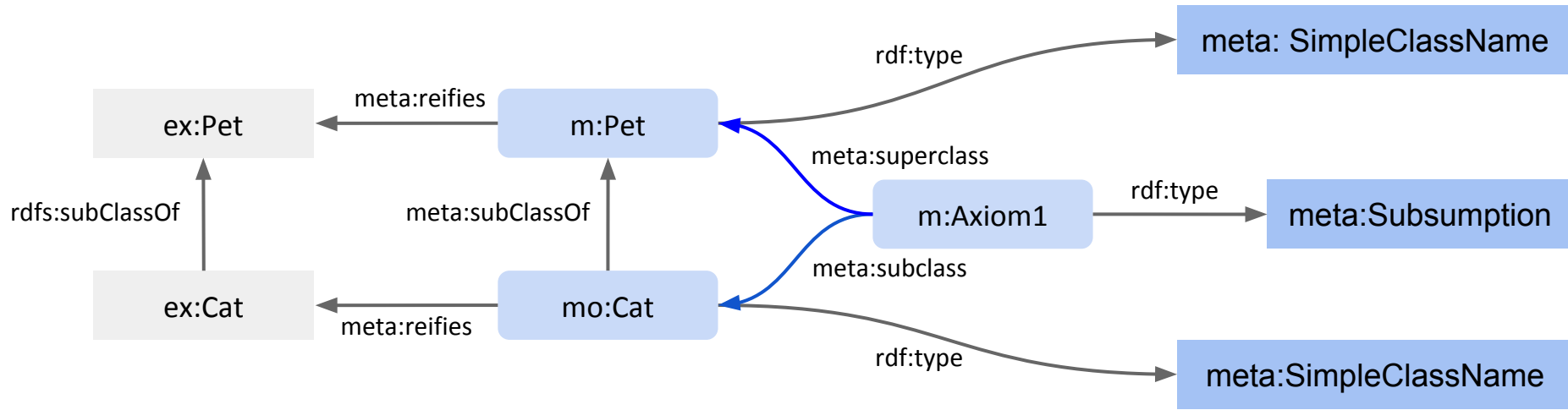
- Direct measurement of the mentioned criteria is difficult
- **Ontology Correctness**
 - **Accuracy**, e.g. via precision (*total number correctly found over whole knowledge defined in ontology*) and recall (*total number correctly found over all knowledge that should be found*)
 - **Completeness**, e.g. via coverage of encoded axioms and axioms in specification
 - **Consistency**, e.g. count terms with inconsistent meaning
- **Ontology Quality**
 - **Computational Efficiency**, e.g. via size
 - **Adaptability**, e.g. via coupling (*number of external classes referenced*) and cohesion (*number of root, leaf, avg. inheritance depth, etc.*)
 - **Clarity**, e.g. via number of word senses

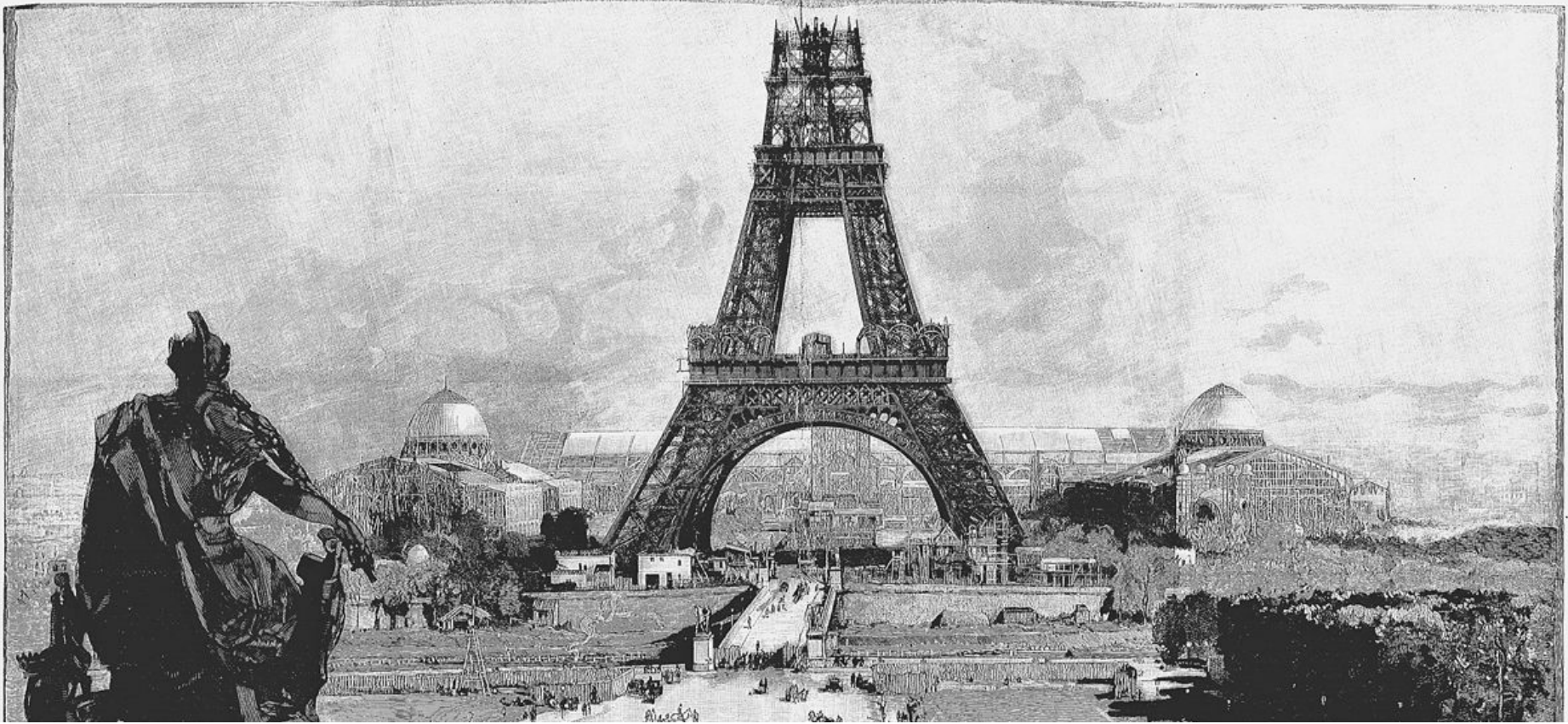
Aspects of Ontology Evaluation

- Aspects describe choices being made during ontology design
- **Vocabulary** - set of all names (URIs and literals)
- **Syntax** - serialization syntax (RDF/XML, Turtle, OWL Abstract Syntax, etc.)
- **Structure** - structure of underlying RDF graph, can largely vary although with same semantics
- **Semantics** - ontology describes a non-empty, infinite set of possible models, characterized by semantics
- **Representation** - relation between structure and semantics
- **Context** - ontology features when compared with other artifacts in its environment, as e.g. an application using the ontology, different representation of data within the ontology, formalized requirements towards the ontology, etc.

Meta Ontology

- Ontology evaluation may be expressed by an ontology
- Advantage: the evaluation result can be reused with the very same ontology evaluation tools
- Describe an ontology with the help of a **meta ontology** via reification





06: EXTRA - More Ontology Design Methodologies

OpenHPI - Course Knowledge Engineering with Semantic Web Technologies

Lecture 5: Ontological Engineering