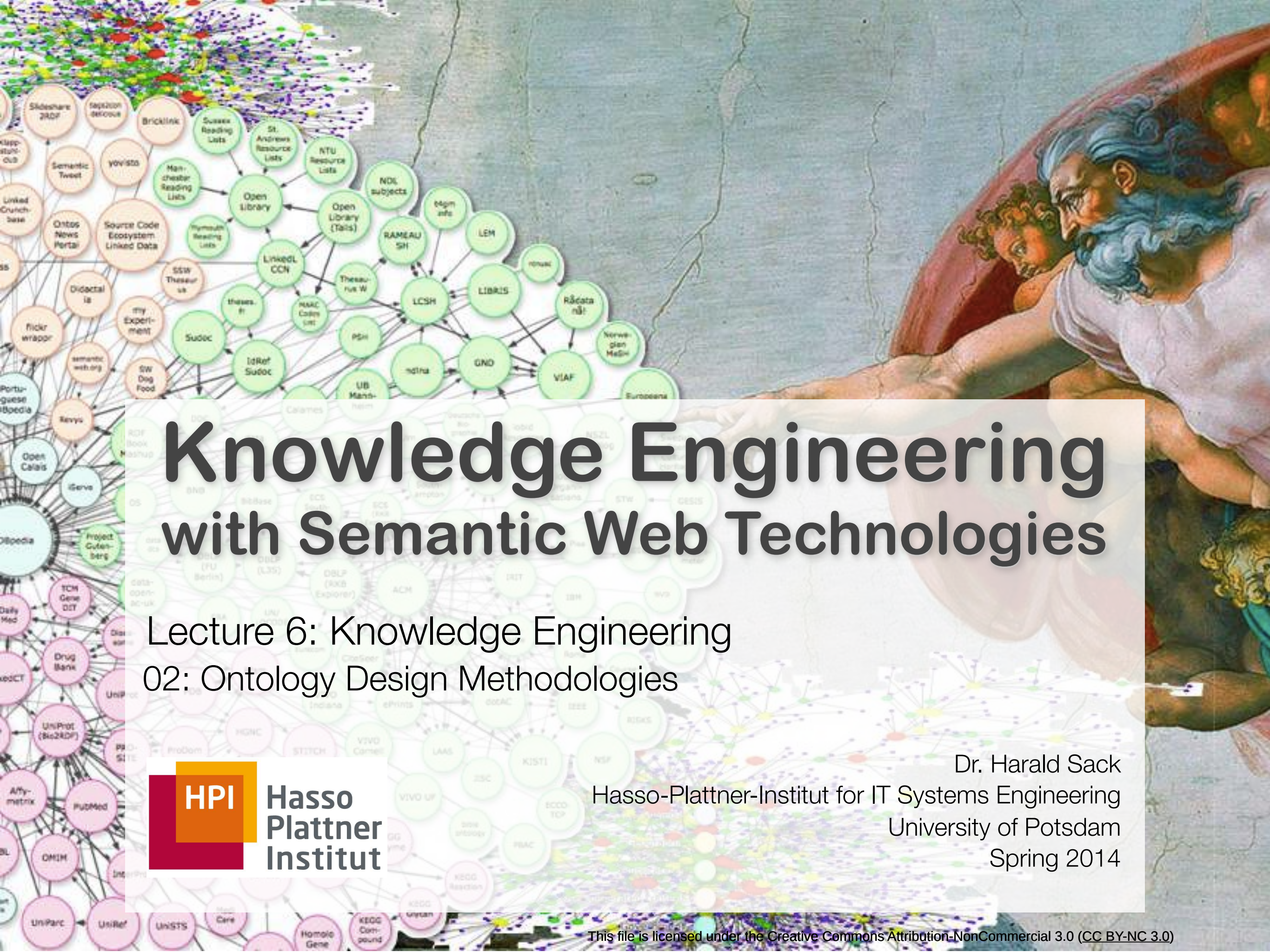




Knowledge Engineering with Semantic Web Technologies

Lecture 6: Knowledge Engineering 02: Ontology Design Methodologies

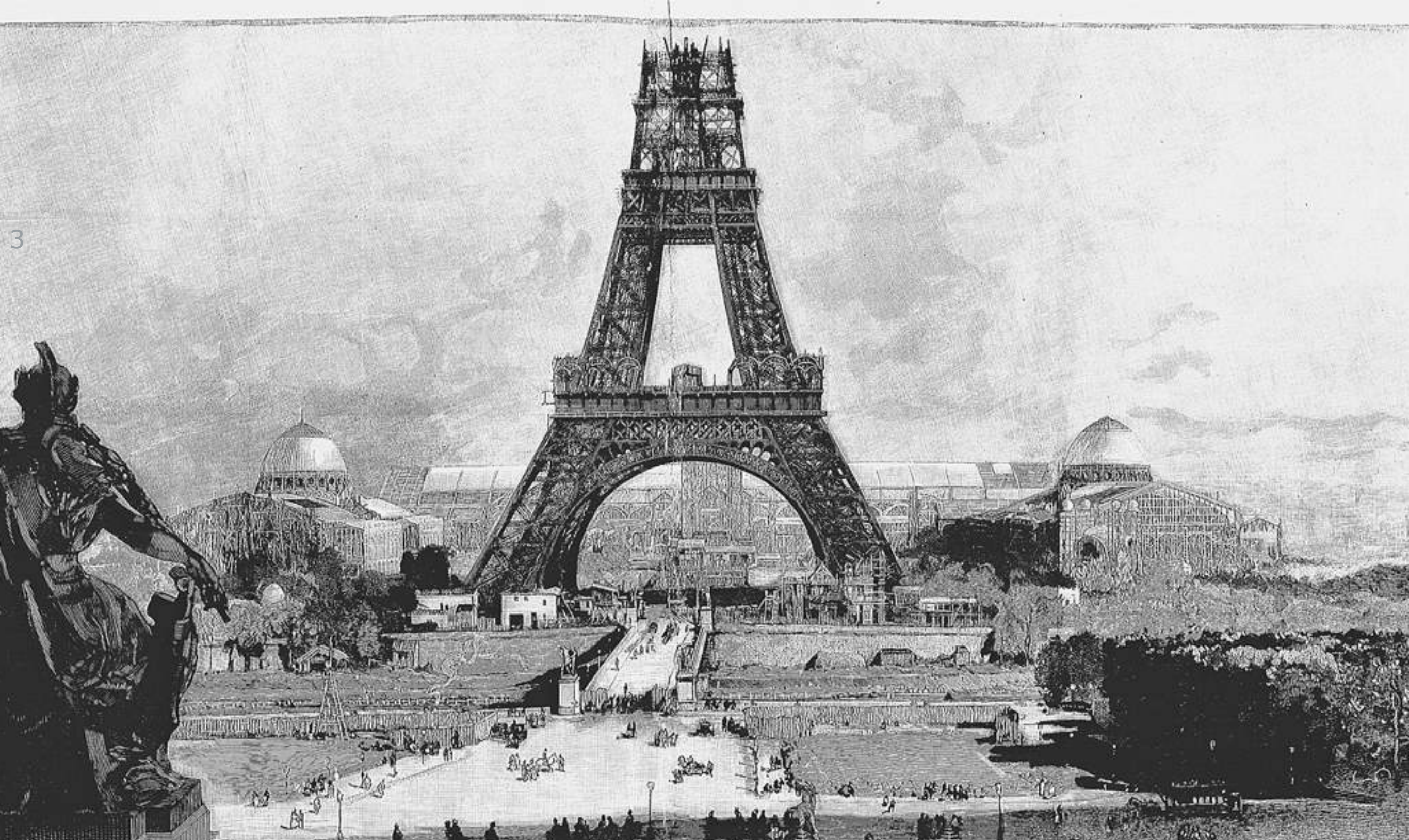


Dr. Harald Sack
Hasso-Plattner-Institut for IT Systems Engineering
University of Potsdam
Spring 2014



Lecture 6: Knowledge Engineering

Open HPI Course: Knowledge Engineering with Semantic Web Technologies

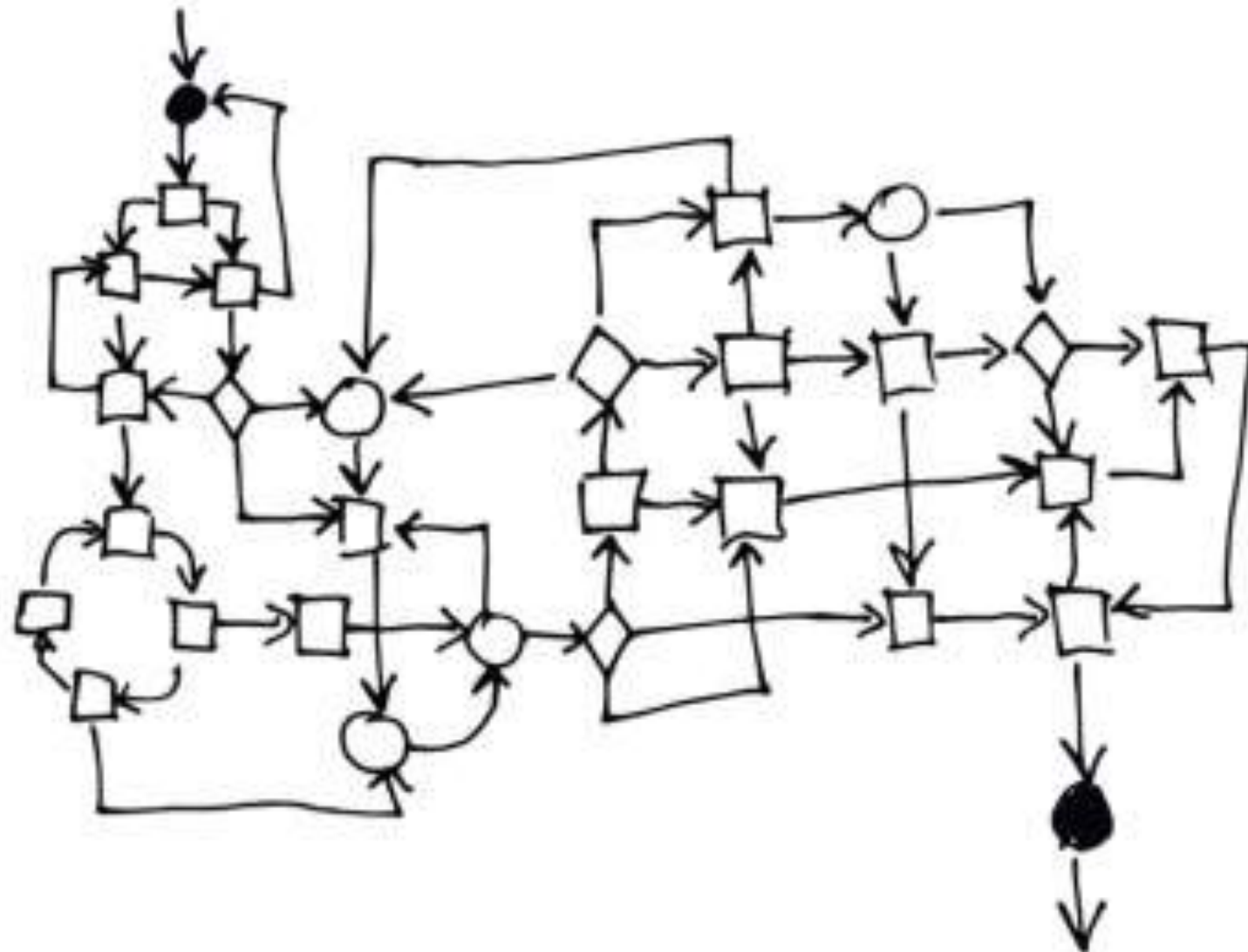


02 - Ontology Design Methodologies

Open HPI - Course: Knowledge Engineering with Semantic Web Technologies
Lecture 6: Knowledge Engineering

ONTOLOGY DEVELOPMENT PROCESS

SOMETHING



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Unified Process for Ontology Building

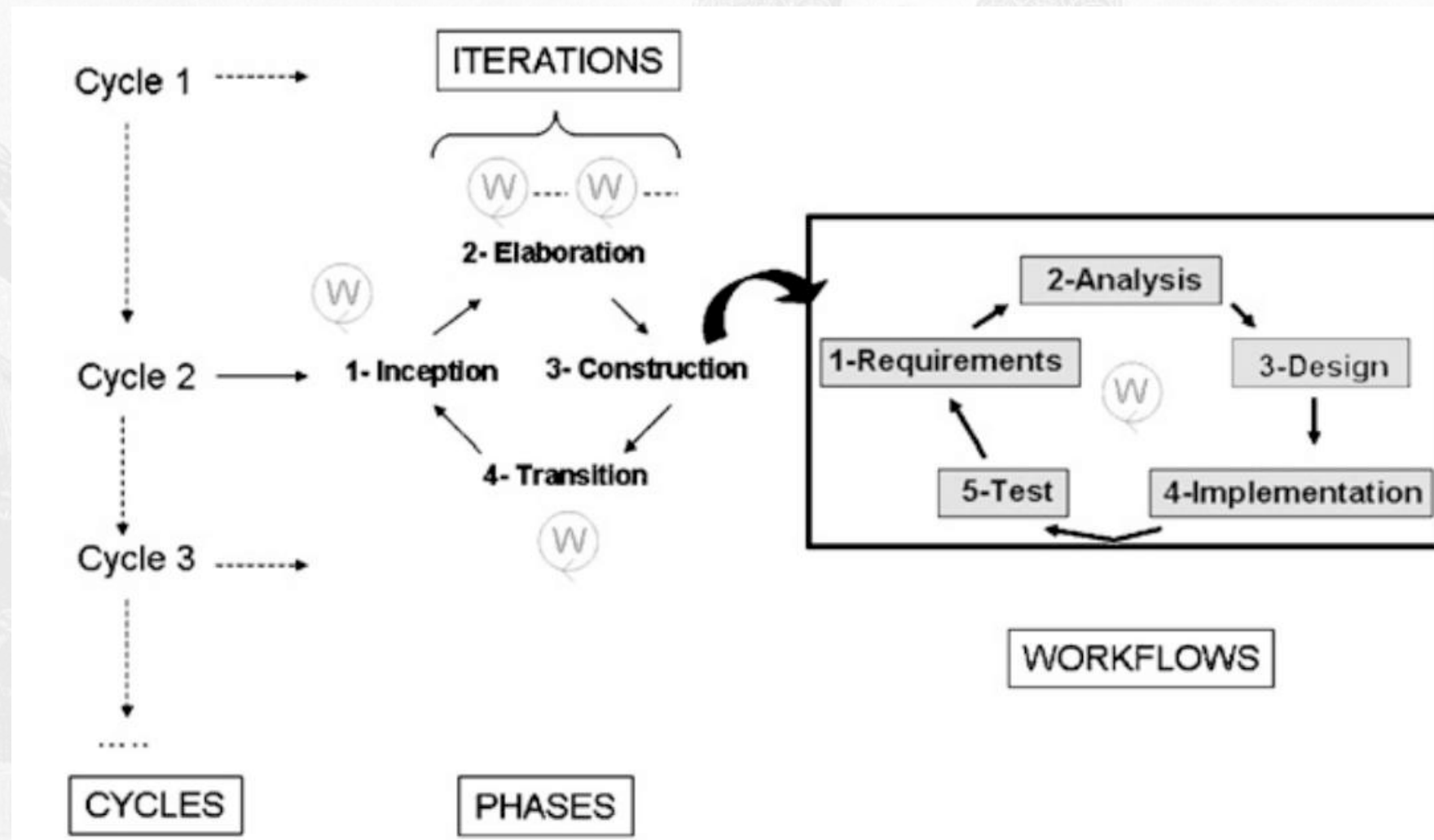
De Nicola, Missikoff, Navigli (2005)

- Based on **Unified Process** (UP) methodology in software development and **Unified Modelling Language** (UML)
- Use-Case driven, i.e. more suitable for **application ontologies** than for domain ontologies
- **Goals:**
 - **Reduction of time and cost** in the development of large scale ontologies
 - **Quality improvement** of the developed ontology via progressive validation of intermediate results
 - Methodology for **efficient collaboration** of Knowledge Engineers and Domain Experts with clear separation of roles
 - Intermediate results can already be evaluated by the user

Unified Process for Ontology Building

De Nicola, Missikoff, Navigli (2005)

- Development is divided into **Cycles**, which are subdivided into 4 **Phases** of **Iterations** (*Inception, Elaboration, Construction, Transition*). Each iteration results in a new prototype

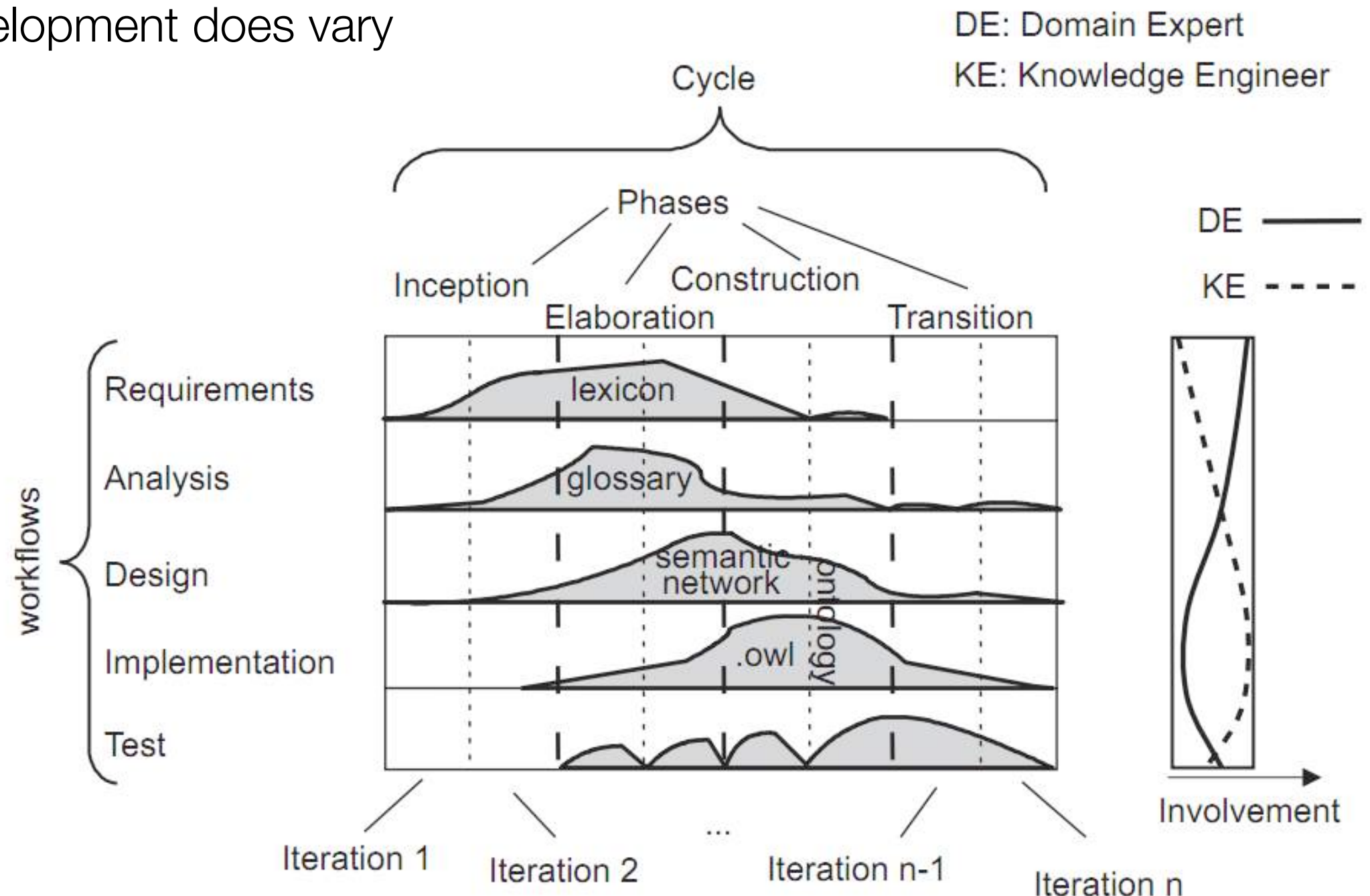


- Each iteration consists of 5 workflows (*Requirements, Analysis, Design, Implementation, Test*)

Unified Process for Ontology Building

De Nicola, Missikoff, Navigli (2005)

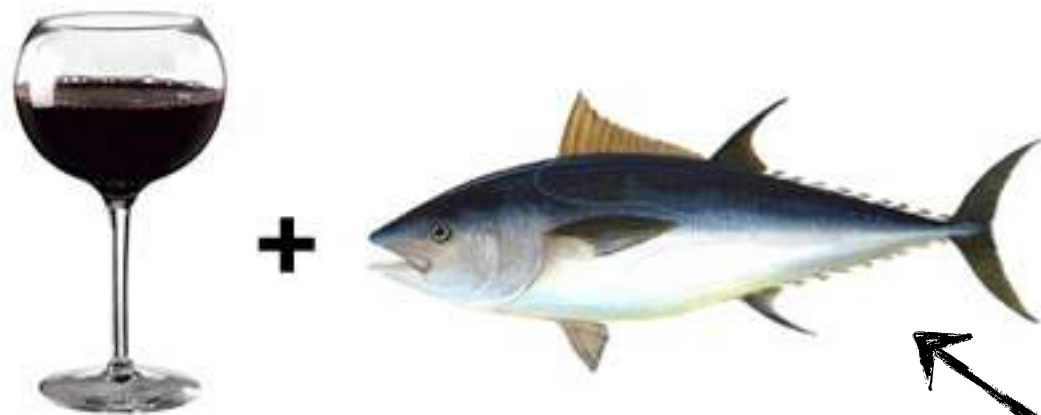
- Workflows and Phases are almost orthogonal, i.e. involvement of single workflows in different phases of ontology development does vary



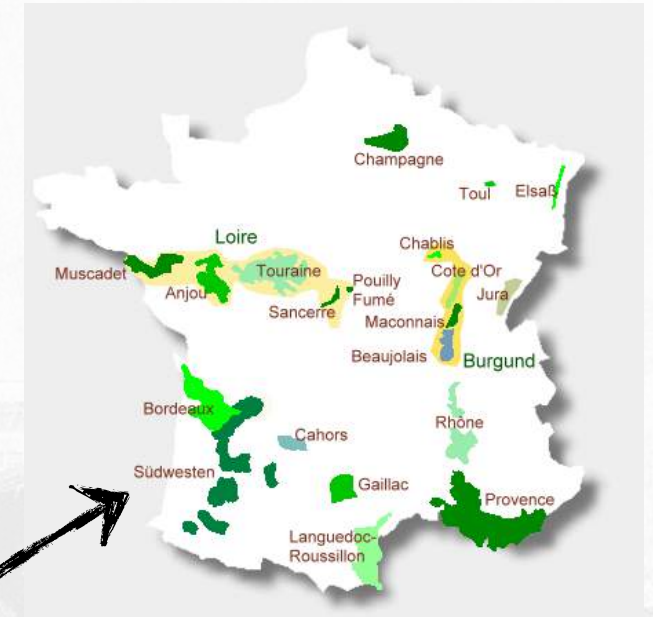
Ontology Development 101

(Noy, McGuinness, 2000)

- Example of a wine and food ontology

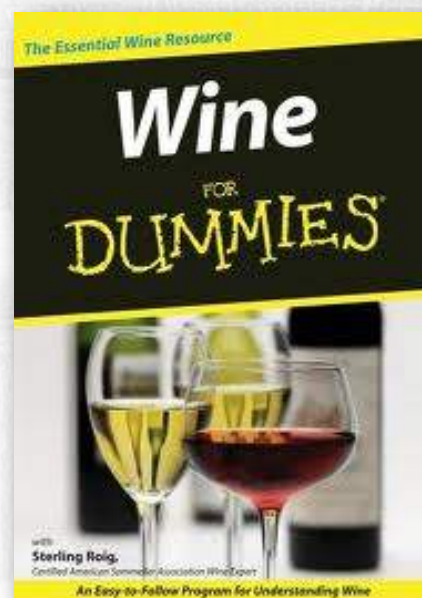


Which wine is the right one for fish?



French wine-growing regions and wines

A shared ontology on wine and food

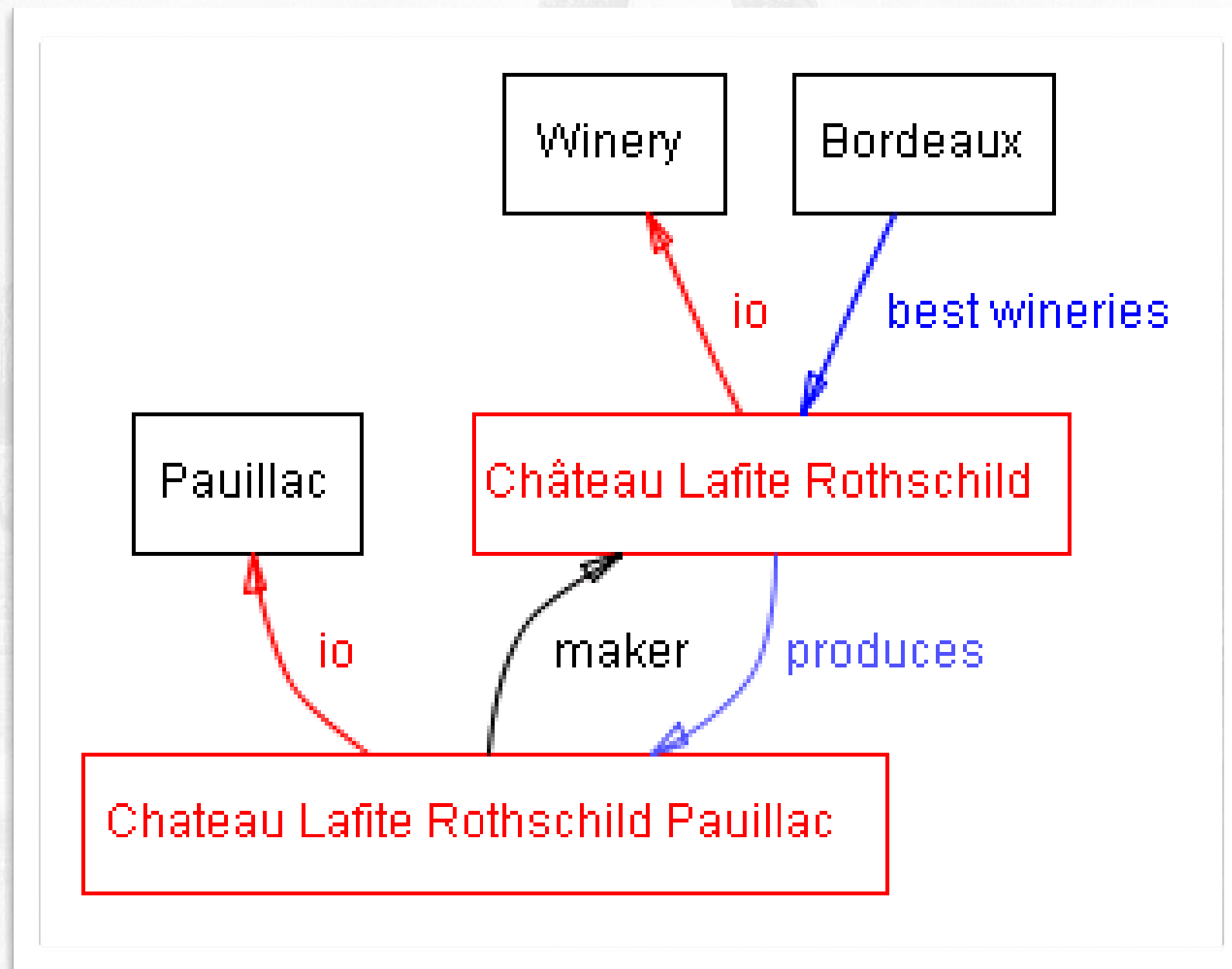


Californian wine-growing regions and wines

Ontology Development 101

(Noy, McGuinness, 2000)

- Example of a wine and food ontology



Ontology Development 101

(Noy, McGuinness, 2000)



- in practice an **iterative Process** that **repeats continuously** and improves the ontology
- there are always **different approaches** for modelling an ontology
- in practice the designated application decides about the modelling approach

**„There is no one correct way to
model a domain.
There are always viable alternatives.“**

Determine Domain and Focus



- Which **domain** should be covered by the ontology?
- **What** should the ontology be used **for**?
- What types of **Questions** should be answered by the knowledge represented in the ontology?
- **Who** will use and maintain the ontology?
- Formulation of **Competence Questions**

**These Questions might change
within the ontology life cycle**

Determine Domain and Focus



Competence Questions (Wine Ontology)

- *Which properties of the wine should be considered for modelling?*
- *Is Bordeaux a white wine or a red wine?*
- *Does a Sauvignon Blanc match with fish?*
- *Which wine matches best for grilled vegetables?*
- *Which properties of a wine do influence whether it matches with a specific dish?*
- *Does the bouquet of a wine change with different vintages?*
- *Does the color of the wine depend on the color of the grape?*
- ...

Consider Reuse



- Why should we consider reuse?
 - in order to save **cost**
 - in order to apply **tools** that are applied for other existing ontologies also for our own ontology
 - in order to reuse ontologies that have been validated by their application

If you don't find a suitable ontology or if the adaption is too complex then create a new ontology!

Develop a Terminology

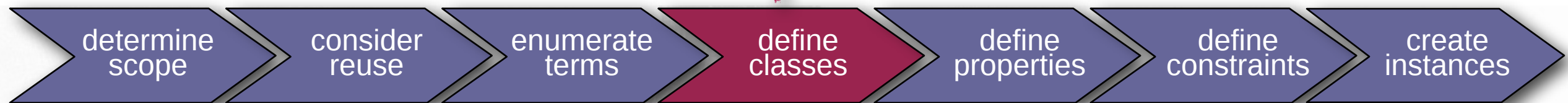


- About which **concepts** are we talking?
- Which **properties** have these concepts?
- **What** do we want **to say** about these concepts?

Example: **Wine Ontology**

- *wine, grape, winery, location,...*
- *a wine's color, body, flavor, sugar content,...*
- *subtypes of wine: white wine, red wine, Bordeaux wine,...*
- *types of food: seafood, fish, meat, vegetables, cheese,...*
- *...*

Develop Classes and Class Hierarchies



- **Classes** are concepts in the designated domain
 - *class of wines*
 - *class of wineries*
 - *class of red wines*
 - ...
- Classes are collections of objects with **similar properties**
- Choose a **top-down** / **bottom-up** / **middle-out** approach to model class hierarchies

Define Properties



- **Properties** in a class definition describe attributes of instances
 - *every wine has a color, residual sugar, producer, etc...*



Define Property Constraints



- **Property constraints** (restrictions) describe or restrict the set of possible property values
 - *The name of a wine is a String*
 - *The producer is an instance of Winemaker...*

P Properties and Restrictions

- ▶ ☐ hasColor (single WineColor) (cardinality 1)
- ▶ ☐ hasWineDescriptor (multiple WineDescriptor)
- ▶ ☐ madeFromGrape (multiple WineGrape) (minCardinality 1)
- ▶ ☐ hasBody (single WineBody) (cardinality 1)
- ▶ ☐ hasFlavor (single WineFlavor) (cardinality 1)
- ▶ ☐ hasMaker (allValuesFrom Winery, cardinality 1)
- ▶ ☐ hasSugar (single WineSugar) (cardinality 1)
- ▶ ☐ locatedIn (multiple Region) (someValuesFrom Region)
- ▶ ☐ food:madeFromFruit (multiple food:SweetFruit, food:NonSweetFruit)

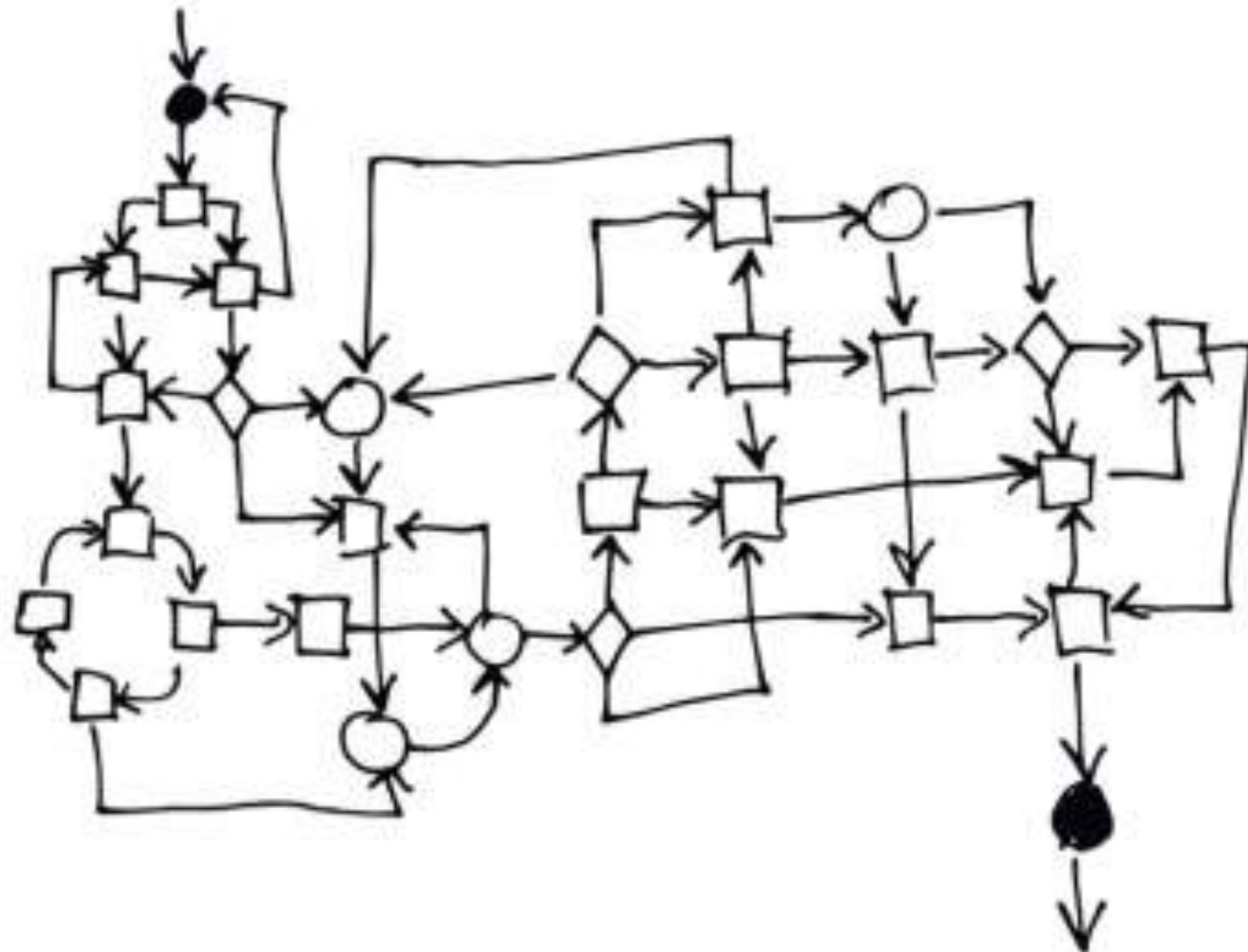
Definition of Instances



- Create **instances for the classes**
 - Every **class** directly becomes the **type** of its instances
 - Every **superclass** of a direct type is also type of its instances
- Create **instances for properties**, i.e. assignment of property values for the instances according to the given constraints
- *„the glass of red wine that I drank last supper...”*

ONTOLOGY DEVELOPMENT PROCESS

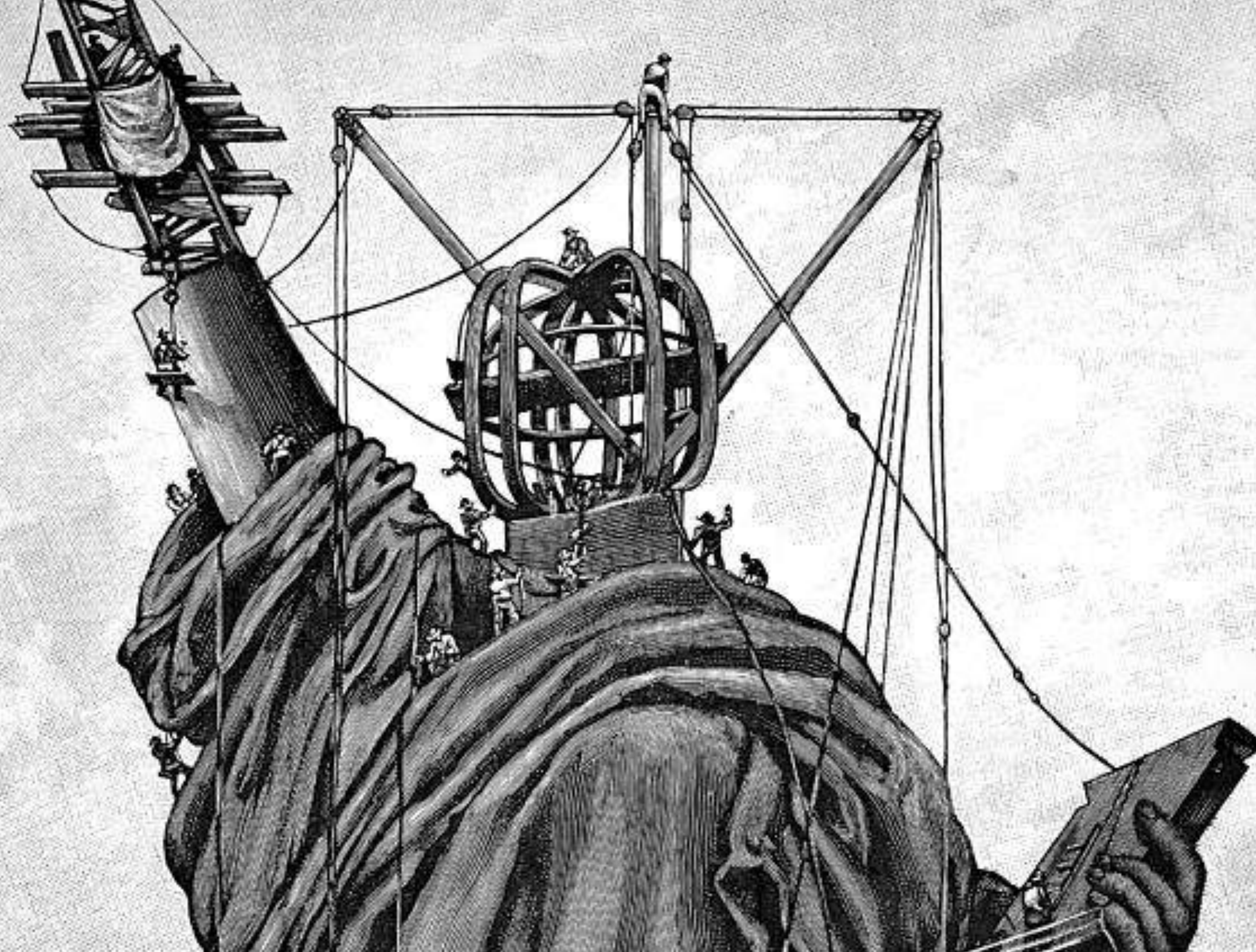
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03 - Ontology Learning

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Lecture 6: Knowledge Engineering