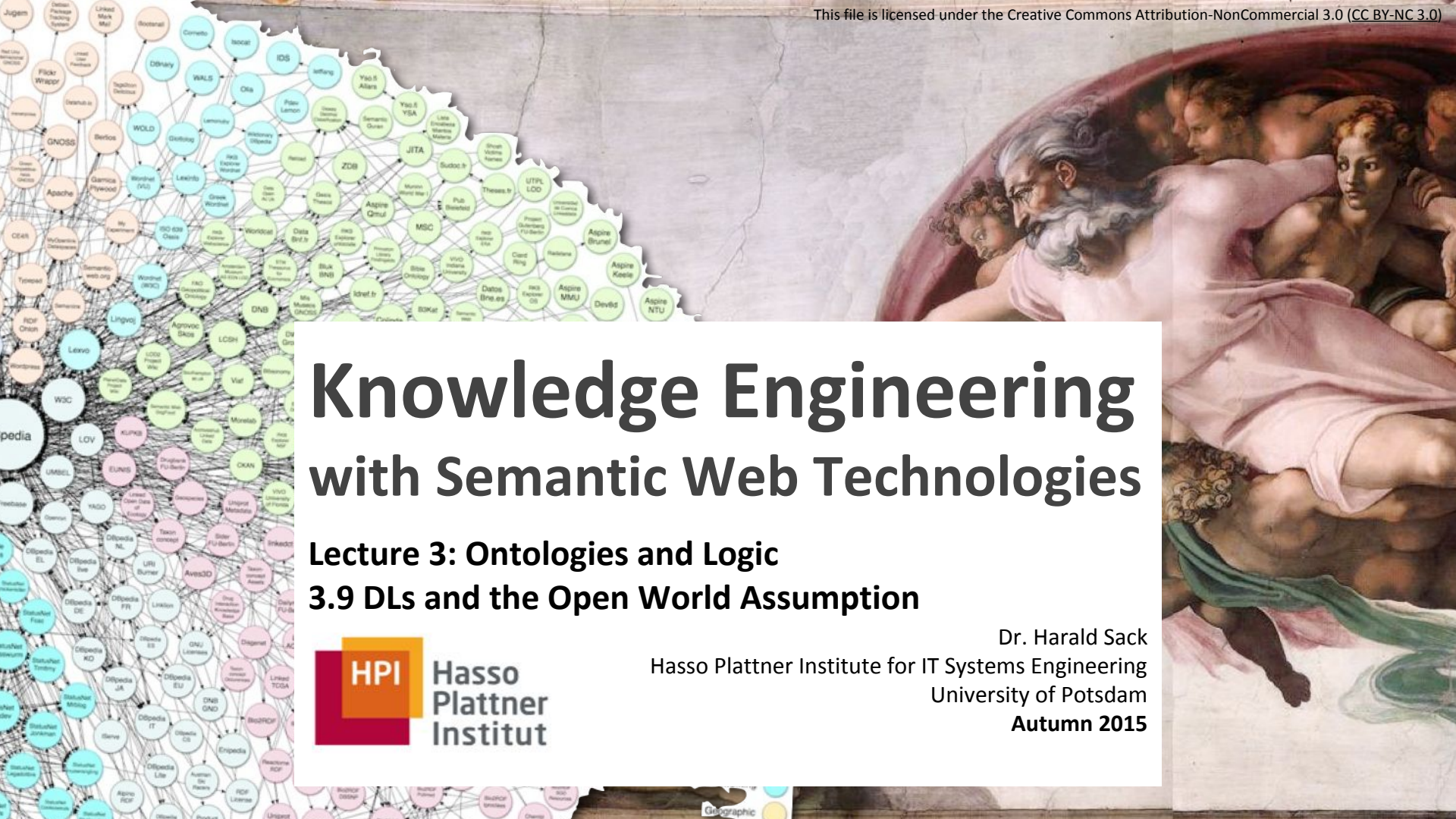

Knowledge Engineering
with Semantic Web Technologies

Lecture 3: Ontologies and Logic
3.9 DLs and the Open World Assumption

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No Unique Name Assumption (UNA)

- In **Databases**, each individual has a single, unique name
- In **DLs**, individuals may have more than one name
  - Thus, in DLs it is not necessarily true that **two individuals with different names** are really two different individuals
  - Example:

```
Wizard(HarryPotter)
Wizard(RonWeasley)
Wizard(HermioneGranger)

hasFriend(HarryPotter, RonWeasley)
hasFriend(HarryPotter, HermioneGranger)
```

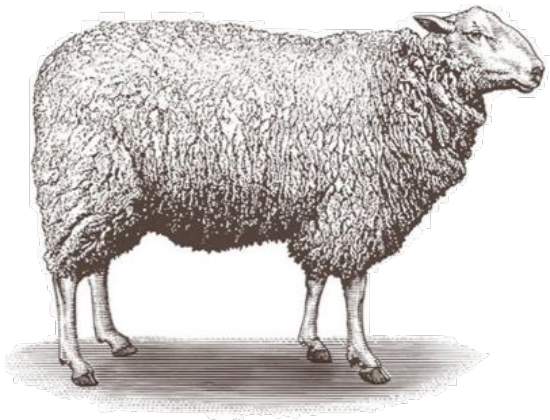
How many friends does Harry Potter have?

- DBs, with UNA: 2
- DLs, no UNA: at least 1

(since we did not explicitly say that RonWeasley and HermioneGranger are different individuals)

The Open World Assumption - OWA

- If we have an **empty** DL ontology, **everything is possible**
- We then **constrain an ontology iteratively**,
  making it more restrictive as we go
- We state what is **not possible**, what is **forbidden** or **excluded**



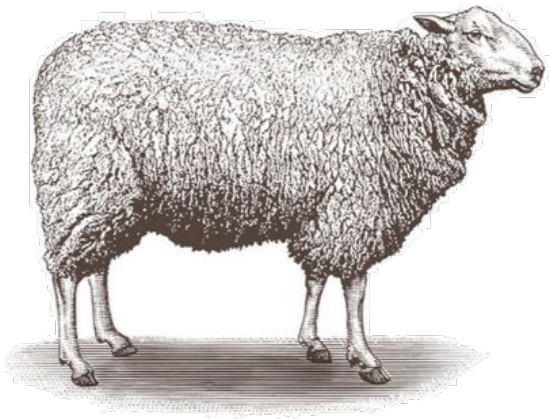
$$Sheep \sqsubseteq Animal \sqcap \forall hasLimbs.Leg$$

The Open World Assumption - OWA

- Question: Can Sheep fly?
- Answer under OWA assumption:

$\texttt{Sheep} \sqsubseteq \texttt{Animal} \sqcap \forall \texttt{hasLimbs.Leg}$

No idea, but probably yes
(according to our ontology/knowledge base)



- In the OWA, unless we have a statement (or we can infer) "*sheep can/cannot fly*" we return "***don't know***"
- In the real world, we are used to deal with incomplete information

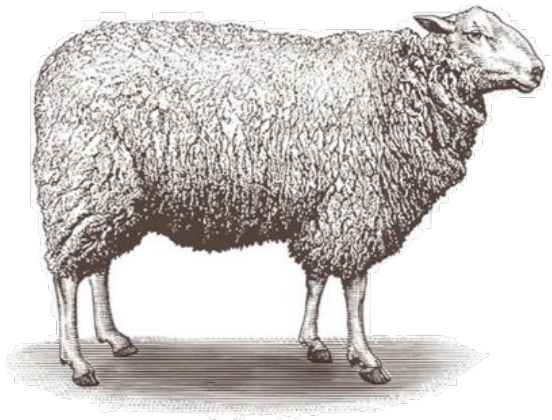
The Open World Assumption - OWA

- In the Semantic Web we expect people to extend our own models
  (*but we don‘t worry in advance how*)
- The OWA assumes incomplete information by default
- Therefore, we can intentionally underspecify our models and allow others to reuse and extend

$$Sheep \sqsubseteq Animal \sqcap \forall hasLimbs.Leg \sqcap canFly$$

The Closed World Assumption - CWA

- Closed World Systems require a place to put everything
- You can’t say anything until there’s somewhere to say it, as e.g. a slot on a frame, field on an OO class, column in a DB
- In Close World Systems, we state **what is possible** and **have to specify all knowledge**
- the CWA holds that **anything that cannot be shown to be true is false**; no explicit declaration of falsehood is needed.



$\mathtt{Sheep} \sqsubseteq \mathtt{Animal} \sqcap \forall \mathtt{hasLimbs.Leg}$

Sheep can‘t fly!

Open World vs. Closed World Assumption

- **OWA: Open World Assumption**
  The existence of further individuals is possible, if they are not explicitly excluded.
- **CWA: Closed World Assumption**
  It is assumed that the knowledge base contains all individuals.

	are all pets of HarryPotter owls?	*no idea since we do not know all pets of HarryPotter*	*if we assume that we know everything about HarryPotter then all of his pets are owls*
`hasPet(HarryPotter,Hedwig)` `Owl(Hedwig)`	`?⊨ ∀hasPet.Owl(HarryPotter)`	***DL** answers don't know*	***PROLOG** answers yes*
`≤1 hasPet.⊤(HarryPotter)`	`?⊨ ∀hasPet.Owl(HarryPotter)`	***yes***	*Now we know everything about HarryPotter's pets*

10: Tableaux for ALC

OpenHPI - Course Knowledge Engineering with Semantic Web Technologies

Lecture 3: Ontologies and Logic