INF3580 – Semantic Technologies – Spring 2010

Lecture 10: OWL: Loose Ends

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13th April 2010

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Today's Plan

1. Reminder: OWL
2. Cardinality restrictions
3. More about Datatypes
4. owl:sameAs and owl:differentFrom
5. Disjointness and Covering Axioms

Outline

$\mathcal{ALC}$ Semantics

Interpretation

An interpretation $\mathcal{I}$ fixes a set $\Delta^{\mathcal{I}}$, the *domain*, $A^{\mathcal{I}} \subseteq \Delta$ for each atomic concept A, and $R^{\mathcal{I}} \subseteq \Delta \times \Delta$ for each role R

Interpretation of concept descriptions

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\begin{aligned}
\top^{\mathcal{I}} &= \Delta^{\mathcal{I}} \\
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(\neg C)^{\mathcal{I}} &= \Delta^{\mathcal{I}} \setminus C^{\mathcal{I}} \\
(C \sqcap D)^{\mathcal{I}} &= C^{\mathcal{I}} \cap D^{\mathcal{I}} \\
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(\forall R.C)^{\mathcal{I}} &= \{a \in \Delta^{\mathcal{I}} \mid \forall b.(a, b) \in R^{\mathcal{I}} \to b \in C^{\mathcal{I}}\} \\
(\exists R.C)^{\mathcal{I}} &= \{a \in \Delta^{\mathcal{I}} \mid \exists b.(a, b) \in R^{\mathcal{I}} \land b \in C^{\mathcal{I}}\}
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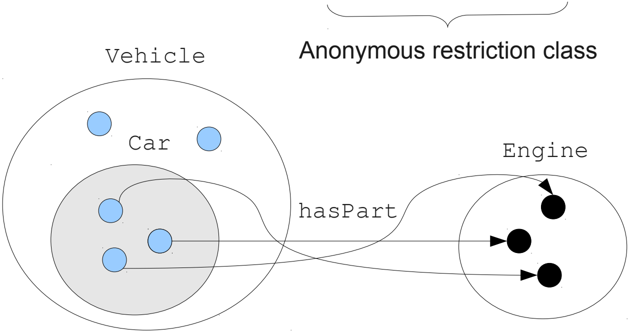
  - $Car \sqsubseteq Vehicle \sqcap \exists hasPart.Engine$

Existential restrictions illustrated

$$Car \sqsubseteq Vehicle \sqcap \exists hasPart.Engine$$



A different perspective

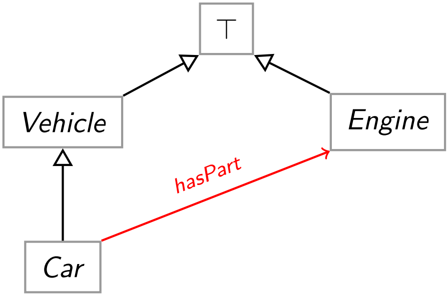


Figure: Connecting classes

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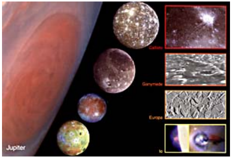

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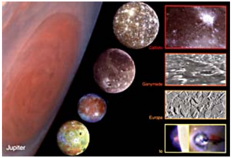

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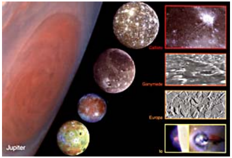

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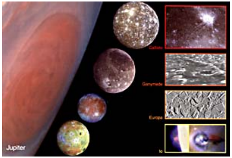

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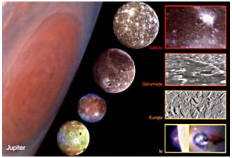

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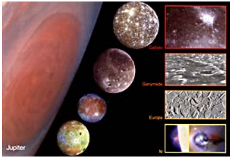

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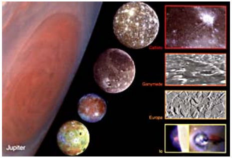

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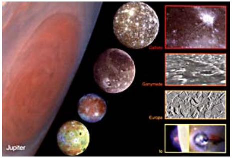

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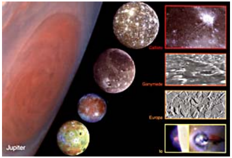

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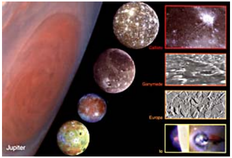

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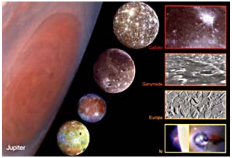

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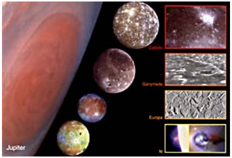

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$$SolarSystem \sqsubseteq \geq_1 hasPart.Star \sqcap \geq_1 hasPart.Planet$$

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- R is functional $\iff \leq_1 R.\top$

Manchester Syntax

- $\leq_1$ *orbits.Star*
  `orbits max 1 Star`
- $\geq_8$ *hasPart.Planet*
  `hasPart min 8 Planet`

The $\mathcal{ALCQ}$ Description Logic

$\mathcal{ALCQ}$ concept descriptions

$C, D \rightarrow$	A	$\mid$	(atomic concept)
	$\top$	$\mid$	(universal concept)
	$\bot$	$\mid$	(bottom concept)
	$\neg C$	$\mid$	(atomic negation)
	$C \sqcap D$	$\mid$	(intersection)
	$C \sqcup D$	$\mid$	(union)
	$\forall R.C$	$\mid$	(value restriction)
	$\exists R.C$	$\mid$	(existential restriction)
	$\leq_n R.C$	$\mid$	(max. cardinality restriction)
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Cardinalities, non-unique names and open worlds

Cardinalities + the OWA and the NUNA is tricky, consider:

TBox:

$$Ensemble \sqsubseteq ChamberEnsemble \sqcup Orchestra$$

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That is;

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ABox:

```
Ensemble(oslo)
firstViolin(oslo, båtnes)
firstViolin(oslo, tønnesen)
```

Musical taxons

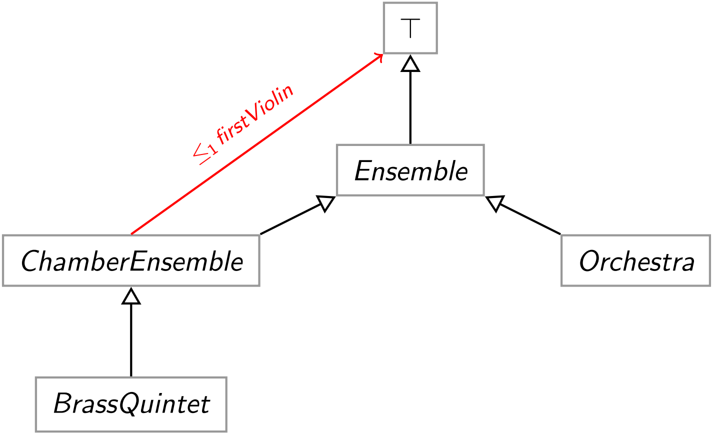

Figure: An ontology of ensembles

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- Possible to define more (dates, date ranges, etc.)

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- Note: often makes best sense with functional properties

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  - Reasoner can find out that $B \sqsubseteq A$.

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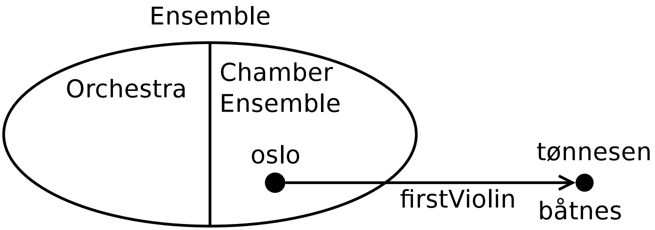

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- Note: only for individuals. For classes, use class equivalence axioms:
  `en:Town owl:equivalentClass no:By .`

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Outline

1. Reminder: OWL
2. Cardinality restrictions
3. More about Datatypes
4. owl:sameAs and owl:differentFrom
5. Disjointness and Covering Axioms

Guys and Gals

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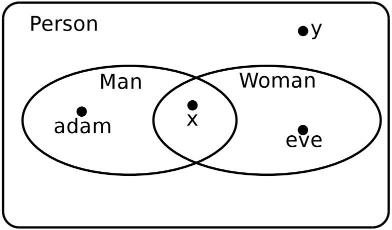

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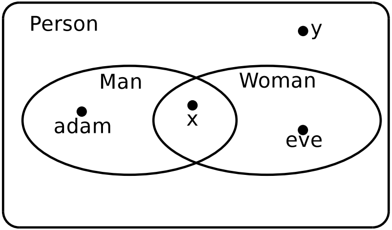

- x is both *Man* and *Woman*, y is neither but a *Person*.

Disjointness Axioms

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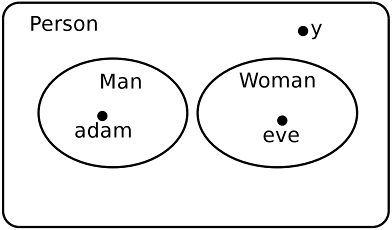

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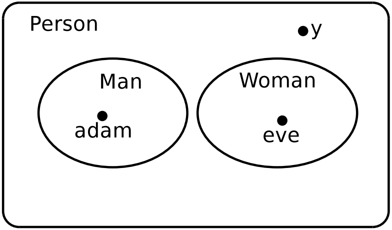

- Specific support in OWL (`owl:disjointWith`) and Protégé

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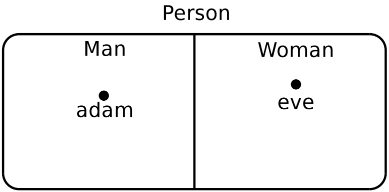

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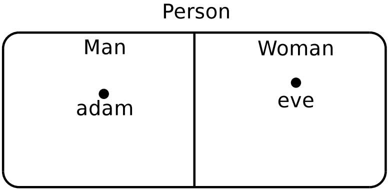

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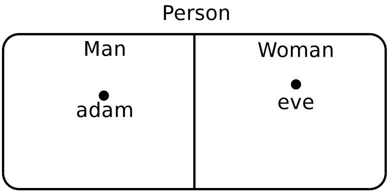

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- Compare to "abstract classes" in OO!

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- No disjointness axiom for *MeatEatingMammal* and *VeggieEatingMammal*!

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- No disjointness axiom for *Teacher* and *Student*!

Next Week

- Audun will take a recap:
- Some basic notions of sets and relations
- Repetition of logic, models, entailment, etc.