ON DESCRIPTION LOGICS

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First-order logic (FOL) is very expressive, but is only semi-decidable.

DL’s are a subset of FOL with limited expressiveness as a trade-off for decidability or more efficient decision problems.

Not all DL’s are the same – there are many varieties depending on which operators are allowed.
Expressiveness
DL Operators

- DL’s are typically named by the operators they allow, showing their expressivity:
  - AL: Attributive Language
  - C: Complex Concept Negation
  - S: ALC with Transitive Roles
  - H: Role Hierarchy
  - O: Nominals
  - I: Inverse Properties
  - N: Cardinality Restrictions
  - (D): Use of Datatype Properties

- SHOIN(D) (OWL-DL is based on this) is a DL that allows all of these operators
Some more operators:

- **F**: Functional Properties
- **U**: Concept Union
- **E**: Full Existential Qualification
- **Q**: Qualified Cardinality Restrictions

**SHOIN**(D), for example, is a DL without existential qualification (E), and therefore cannot express many things that can be expressed in FOL

\[ \exists x (\text{Person}(x) \land \forall y (\text{Time}(y) \rightarrow \text{Hungry}(x))) \]
Trade-Offs

- Why use DL’s?
  - Can be fully decidable, unlike FOL
  - Even when semi-decidable, can still have much more efficient decision problems

- What is lost from FOL?
  - Expressivity – Every operator lost is expressivity lost
  - Completeness – Can no longer derive every truth
Questions