

# Probabilistic Semantic Web Ontologies



Ngoc-Tung Nguyen

# Uncertainty Exists

- Uncertainty
  - “90% of birds fly. A bird is *likely* to fly”
- Vagueness
  - “Retrieve all *inexpensive* hotels *nearby* ”
- Subjectivity
  - “I *believe* that Tweety does not fly”
- Ambiguity
  - “Washington”. State? City? Team? President?

# Pronto

- Idea :Integrated certain and uncertainty into ontologies
- Formalisms: Probabilistic Logic
  - Better integration with OWL (DL)
  - Better expressivity
  - Higher level of formality (e.g., soundness of reasoning)
- Complements the OWL syntax with conditional constraints - constructs that express probabilistic relationships between OWL classes or an OWL class and an individual

# Pronto extends Pellet

- Pellet
  - Open Source OWL Reasoner for OWL 2 DL in Java
  - Optimization techniques
    - Optimizations for nominals
    - Conjunctive query answering
    - Incremental reasoning
  - Fully supports the original OWL DL specification, which is a forthcoming revision of the international web standard produced by the W3C for web-friendly ontologies

# Pronto's Features and Capabilities

- Offers OWL reasoning services for knowledge base about uncertain/imprecision knowledge
  - “Tweety is-a Flying Object with probability less than 5%”
- Use Case
  - ontology and data alignment
  - reasoning about uncertain domain knowledge generally
    - “risk factors associated with medical conditions like breast cancer”

# Syntax

- Conditional constraints
  - Expression form (P-SHIQ(D)) :  $(D | C)[l,u]$ 
    - C,D – OWL classes,  $[l,u]$  – interval
    - C- Evidence, D- hypothesis
    - Probabilistic interpretation  $\Pr=(l,u)$
  - Example:
    - $(\text{Fly} | \text{Bird})[0.9,0.95]$  -*generally* birds fly with probability between 90% and 95%
    - $(\text{Flies})[0,0.05]$  – Tweety flies with probability less than 5%

# Demonstration