OWL abstract syntax and reasoning examples

Adapted from slides by Raphael Volz, AIFB

OWL Abstract Syntax

- Introduced in OWL Web Ontology Language Semantics and Abstract Syntax
- Useful notation, extended to make practical by
- Uses a kind of functional notation, e.g.
  - Class(pp:duck partial pp:animal)
  - ObjectProperty(pp:has_pet
domain(pp:person)
range(pp:animal))
  - Individual(pp:Walt
value(pp:has_pet pp:Huey)
value(pp:has_pet pp:Louie)
value(pp:has_pet pp:Dewey))

Namespaces

- Namespace(pp = <http://cohse.semanticweb.org/ontologies/people #>)

Declaring classes in OWL

- **Naming a new class “plant”:**
  Class(pp:plant partial)

- **Naming some “special plants”:**
  Class(pp:grass partial pp:plant)
  Class(pp:tree partial pp:plant)

- **Alternative Declaration:**
  Class(pp:grass partial)
  Class(pp:tree partial)
  SubClassOf(pp:grass pp:plant)
  SubClassOf(pp:tree pp:plant)
Declaring Properties in OWL: I

- A simple property:
  ObjectProperty(pp:eaten_by)

- Properties may be inverse to each other:
  ObjectProperty(pp:eats inverseOf(pp:eaten_by))

- Domain and Ranges:
  ObjectProperty(pp:has_pet
  domain(pp:person)
  range(pp:animal))

Declaring Properties in OWL: II

- Datatype Properties:
  DataProperty(pp:service_number
  range(xsd:integer))

- Property Hierarchy:
  SubPropertyOf(pp:has_pet pp:likes)

- Algebraic properties:
  ObjectProperty(pp:married_to Symmetric)
  ObjectProperty(pp:ancestor_of Transitive)
  ObjectProperty(pp:passport_nr Functional)

Individuals in OWL

Individual(pp:Tom type(owl:Person))
Individual(pp:Dewey type(pp:duck))
Individual(pp:Rex type(pp:dog)
  value(pp:is_pet_of pp:Mick))
Individual(pp:Mick type(pp:males)
  value(pp:reads pp:Daily Mirror)
  value(pp:drives pp:Golf GTI)
  value(pp:name "Mick"*xsd:string))

Entailment Quiz

What follows from these descriptions?
Quiz #1

Class(pp:old+lady complete intersectionOf(pp:elderly pp:female pp:person))

Class(pp:old+lady partial intersectionOf(restriction(pp:has_pet allValuesFrom(pp:cat)) restriction(pp:has_pet someValuesFrom(pp:animal))))

Quiz #1 - Solution

Every old lady must have a pet cat.
(Because she must have some pet and all her pets must be cats.)

Quiz #2

Class(pp:cow partial pp:vegetarian)
Class(pp:mad+cow complete intersectionOf(pp:cow restriction(pp:eats someValuesFrom(intersectionOf(pp:brain restriction(pp:part_of someValuesFrom pp:sheep)))))

What can be said about mad cows?

Quiz #2 - Solution

There can be no mad cows.
(Because cows, as vegetarians, don’t eat anything that is a part of an animal.)
Quiz #3

ObjectProperty(pp:has_pet domain(pp:person)
  range(pp:animal))
Class(pp:old+lady complete
  intersectionOf(pp:elderly pp:female pp:person))
Class(pp:old+lady partial
  intersectionOf(restriction(pp:has_pet
    allValuesFrom(pp:cat)) restriction(pp:has_pet
    someValuesFrom(pp:animal))))
Individual(pp:Minnie type(pp:elderly)
  type(pp:female) value(pp:has_pet pp:Tom))

Quiz #3 - Solution

Minnie must be a person (because pet owners are human) and thus is an old lady. Thus Tom must be a cat (because all pets of old ladies are cats).

Quiz #4

Class(pp:animal+lover complete
  intersectionOf(pp:person
    restriction(pp:has_pet minCardinality(3))))
Individual(pp:Walt type(pp:person)
  value(pp:has_pet pp:Huey)
  value(pp:has_pet pp:Louie)
  value(pp:has_pet pp:Dewey))
DifferentIndividuals(pp:Huey pp:Louie
  pp:Dewey)

Quiz #4 - Solution

Walt must be an animal lover. Note that stating that Walt is a person is redundant.
Quiz #5

What are Mick and the Daily Mirror?

Quiz #5 - Solution

Mick drives a white van, so he must be an adult (because all drivers are adults). As Mick is male, thus he is a white van man, so any paper he reads must be a tabloid, thus the Daily Mirror is a tabloid.