RDFS Entailments

Data, Information & Knowledge

Continuum

- Data: raw facts
- Information, knowledge: facts with semantics
- Knowledge: deduce new data, information and knowledge

Inference / Entailment

Knowledge + Inference Rules

=>

new Knowledge

INFERENCE / ENTAILMENT

Inference Rule

if A then B

A => B

B :- A

Inference Rule

Hominidae(?x) :- Human(?x)

Mammal(?x) :- Hominidae(?x)

Vertebrate(?x) :- Mammal(?x)

Modus Ponens

B :- A & A

=> B

Modus Ponens

```
grandParent(?x, ?z) :-
        parent(?x, ?y) & parent(?y, ?z)


parent(John, Mary)
parent(Mary, James)
=>
grandParent(John, James)
```

RDFS ENTAILMENT

RDF

RDF: triples

subject predicate object

```
ex:John  foaf:knows  ex:James ;
         rdfs:label  "John" .
```

RDFS

RDFS: Class Hierarchy & Property definition

foaf:Person rdfs:subClassOf ex:Living

foaf:knows rdfs:domain foaf:Person

RDF(S) Semantics

- RDF 1.1 Semantics
- W3C Recommendation 25 February 2014
- https://www.w3.org/TR/rdf11-mt/

RDFS Entailment

- Type inference
- Class subsumption
- Property subsumption
- Domain & range inference

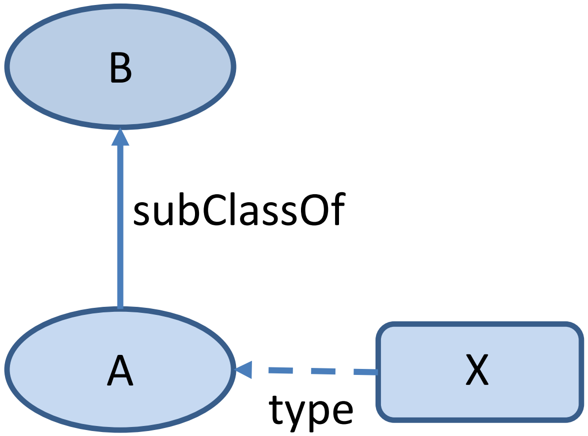
Type

?x rdf:type ?b

:-

?x rdf:type ?a &

?a rdfs:subClassOf ?b



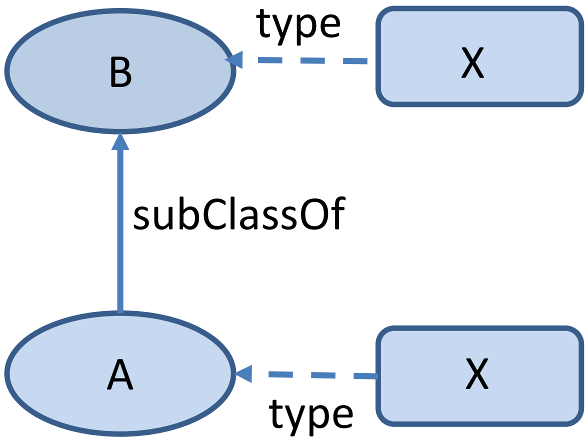
Type

?x rdf:type ?b

:-

?x rdf:type ?a &

?a rdfs:subClassOf ?b



Type

```
?x  rdf:type  rdfs:Resource
:-
?x  rdf:type  ?y
```

Type

?y rdf:type rdfs:Resource

:-

?x rdf:type ?y

Class subsumption

rdfs:subClassOf is transitive

```
?x  rdfs:subClassOf  ?z
:-
?x  rdfs:subClassOf  ?y  &
?y  rdfs:subClassOf  ?z
```

Class subsumption

```
?c  rdfs:subClassOf  ?c
:-
?c  rdf:type  rdfs:Class
```

Class subsumption

```
?c  rdfs:subClassOf  rdfs:Resource
:-
?c  rdf:type  rdfs:Class
```

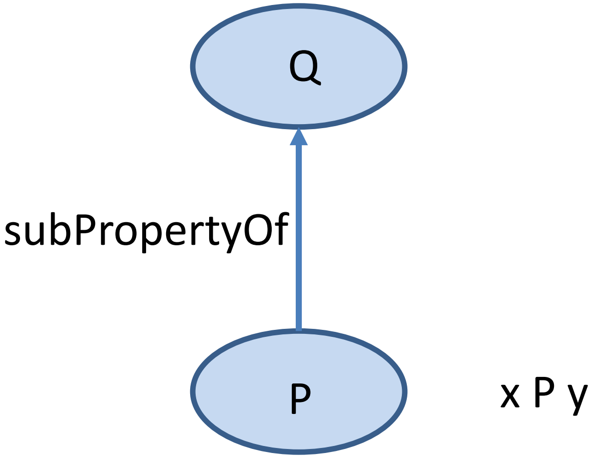
Property subsumption

?x ?q ?y

:-

?x ?p ?y &

?p rdfs:subPropertyOf ?q



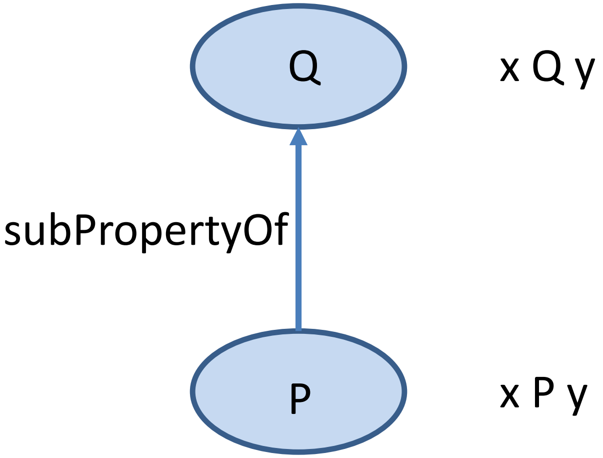
Property subsumption

?x ?q ?y

:-

?x ?p ?y &

?p rdfs:subPropertyOf ?q



Property subsumption

ex:author *rdfs:subPropertyOf* ex:creator

foaf:name *rdfs:subPropertyOf* rdfs:label

foaf:knows *rdfs:subPropertyOf* rdfs:seeAlso

Property subsumption

```
?p  rdfs:subPropertyOf  ?p
:-
?p  rdf:type  rdf:Property
```

Property subsumption

rdfs:subPropertyOf is transitive

```
?p  rdfs:subPropertyOf  ?r
:-
?p  rdfs:subPropertyOf  ?q   &
?q  rdfs:subPropertyOf  ?r  &
```

Domain

```
?s rdf:type ?d
:-
?p rdfs:domain ?d  &
?s ?p ?o
```

```
foaf:name  rdfs:domain  foaf:Person .
ex:John  foaf:name  'John' .
=>
ex:John  rdf:type  foaf:Person .
```

Domain

A property may have several domains

```
ex:speed  rdfs:domain  ex:Object, ex:Mobile .

ex:soyuz  a  ex:SpaceCraft ; ex:speed  28000 .

ex:soyuz  a  ex:Object, ex:Mobile .
```

Range

```
?o  rdf:type  ?r
:-
?p  rdfs:range  ?r  &
?s  ?p  ?o
```

```
foaf:knows  rdfs:range  foaf:Person .
ex:John  foaf:knows  ex:Jack .
=>
ex:Jack  rdf:type  foaf:Person .
```

Range

A property may have several ranges

ex:hasVehicule rdfs:range ex:Object, ex:Mobile .

ex:witch ex:hasVehicule ex:broom .

ex:broom a ex:Object, ex:Mobile .

Container (rdf:Bag …)

```
ex:riviera
        rdf:_1  ex:Nice ;
        rdf:_2  ex:Antibes ;
        rdf:_3  ex:Cannes .
```

Container (rdf:Bag …)

rdf:_1 a rdfs:ContainerMembershipProperty

rdf:_2 a rdfs:ContainerMembershipProperty

…

?p rdfs:subPropertyOf rdfs:member

:-

?p a rdfs:ContainerMembershipProperty

Use Case

RDFS Entailments:

- « *complement* » RDF graphs
- used to answer SPARQL queries