

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

$A \Rightarrow B$

$B :- A$

Inference Rule

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

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

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

Modus Ponens

$B \text{ :- } A \ \& \ A$

$\Rightarrow B$

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

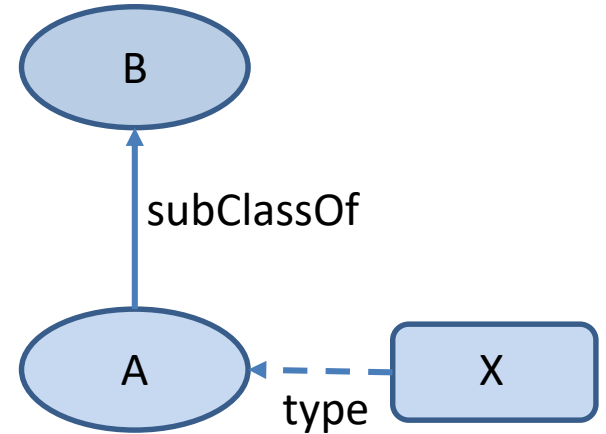
Type

`?x rdf:type ?b`

`:-`

`?x rdf:type ?a &`

`?a rdfs:subClassOf ?b`



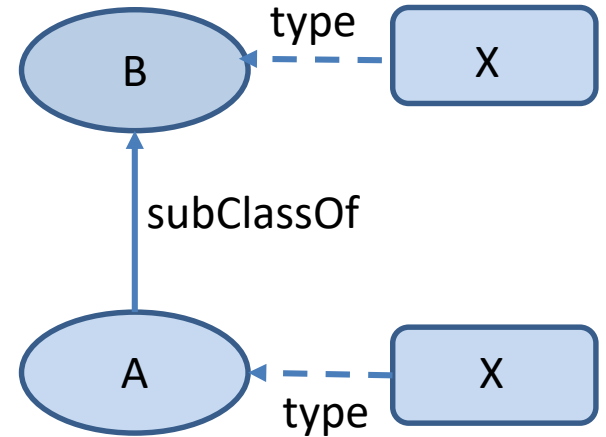
Type

`?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`

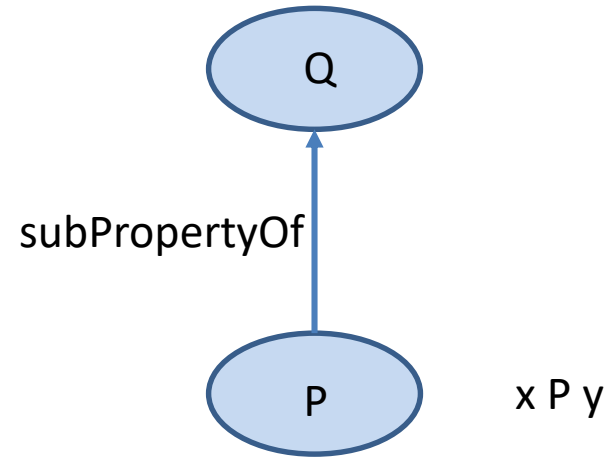
Property subsumption

$?x \ ?q \ ?y$

:-

$?x \ ?p \ ?y \ \&$

$?p \ \text{rdfs:subPropertyOf} \ ?q$



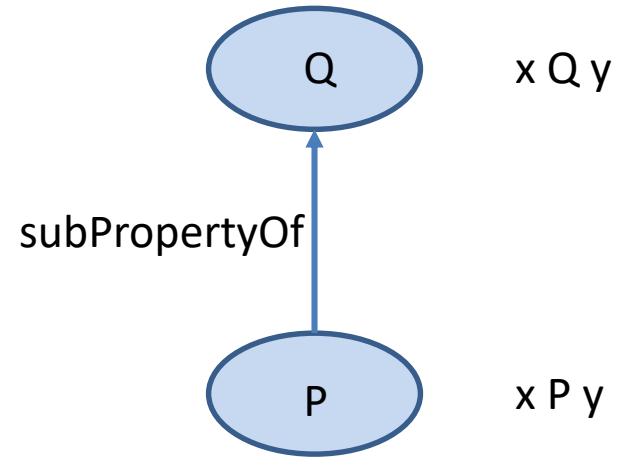
Property subsumption

$?x \ ?q \ ?y$

\vdash

$?x \ ?p \ ?y \ \&$

$?p \ \text{rdfs:subPropertyOf} \ ?q$



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