Fourth Mandatory Assignment

IN4060

March 13, 2025

2 Entailment

2.1 `sim:Marge rdf:type foaf:Person`

The statement `sim:Marge rdf:type foaf:Person` entails the following:

1. $\overset{aaa}{\texttt{fam:hasSpouse}}$ `rdfs:range` $\overset{xxx}{\texttt{foaf:Person}}$. - *P*
2. $\overset{yyy}{\texttt{sim:Homer}}$ $\overset{aaa}{\texttt{fam:hasSpouse}}$ $\overset{zzz}{\texttt{sim:Marge}}$. - *P*
3. $\overset{zzz}{\texttt{sim:Marge}}$ `rdf:type` $\overset{xxx}{\texttt{foaf:Person}}$. *rdfs3, 1, 2*

Pattern[1]	If S contains	then S RDFS entails recognizing D
rdfs3	*aaa* `rdfs:range` *xxx* . *yyy aaa zzz* .	*zzz* `rdf:type` *xxx* .

2.2 `fam:hasSister rdfs:subPropertyOf fam:isRelativeOf`

The statement `fam:hasSister rdfs:subPropertyOf fam:isRelativeOf` entails because, `fam:hasSister` ⊆ `fam:hasSibling` ⊆ `fam:isRelativeOf` as proven below:

1. $\overset{xxx}{\texttt{fam:hasSister}}$ `rdfs:subPropertyOf` $\overset{yyy}{\texttt{fam:hasSibling}}$. - *P*
2. $\overset{yyy}{\texttt{fam:hasSibling}}$ `rdfs:subPropertyOf` $\overset{zzz}{\texttt{fam:isRelativeOf}}$. - *P*
3. $\overset{xxx}{\texttt{fam:hasSister}}$ `rdfs:subPropertyOf` $\overset{zzz}{\texttt{fam:isRelativeOf}}$. *rdfs5, 1, 2*

Pattern[1]	If S contains	then S RDFS entails recognizing D
rdfs5	*xxx* `rdfs:subPropertyOf` *yyy* . *yyy* `rdfs:subProperyOf` *zzz* .	*xxx* `rdfs:subPropertyOf` *zzz* .

2.3 `sim:Marge rdf:type fam:Woman`

Based on the provided RDF graph, we cannot prove the statement `sim:Marge rdf:type fam:Woman` because even though we know that Lisa has two parents and her father is Homer, who is married to Marge; that does not prove that Lisa has a female parent or that Homer's spouse is a wife.

2.4 sim:Herb rdf:type fam:Man

The statement sim:Herb rdf:type fam:Man entails because:

1. fam:hasBrother^{aaa} rdfs:range fam:Man^{xxx} . - *P*
2. _:2^{yyy} fam:hasBrother^{aaa} sim:Herb^{zzz} . - *P*
3. sim:Herb^{zzz} rdf:type fam:Man^{xxx} . - *rdfs3, 1, 2*

Pattern[1]	If *S* contains	then *S* RDFS entails recognizing *D*
rdfs3	*aaa* rdfs:range *xxx* . *yyy aaa zzz* .	*zzz* rdf:type *xxx* .

2.5 sim:Lisa fam:isRelativeOf sim:Homer

The statement sim:Lisa fam:isRelativeOf sim:Homer entails because,
fam:hasFather ⊆ fam:hasParent ⊆ fam:isRelativeOf as proven below:

1. fam:hasFather^{aaa} rdfs:subPropertyOf fam:isRelativeOf^{bbb} . - *P*
2. sim:Lisa^{xxx} fam:hasFather^{aaa} sim:Homer^{yyy} . - *P*
3. sim:Lisa^{xxx} fam:isRelativeOf^{bbb} sim:Homer^{yyy} . - *rdfs7, 1, 2*

This works because fam:hasFather is a sub-property to fam:isRelativeOf:

1. fam:hasFather^{xxx} rdfs:subPropertyOf fam:hasParent^{yyy} . - *P*
2. fam:hasParent^{yyy} rdfs:subPropertyOf fam:isRelativeOf^{zzz} . - *P*
3. fam:hasFather^{xxx} rdfs:subPropertyOf fam:isRelativeOf^{zzz} . - *rdfs5, 1, 2*

Pattern[1]	If *S* contains	then *S* RDFS entails recognizing *D*
rdfs5	*xxx* rdfs:subPropertyOf *yyy* . *yyy* rdfs:subProperyOf *zzz* .	*xxx* rdfs:subPropertyOf *zzz* .
rdfs7	*aaa* rdfs:subPropertyOf *bbb* . *xxx aaa yyy* .	*xxx bbb yyy* .

2.6 sim:Lisa fam:hasMother sim:Marge

The statement sim:Lisa fam:hasMother sim:Marge does not entail because according to the provided RDF graph, Lisa has two parents, but does not specify that one of them is a woman or a mother.

2.7 sim:Patty rdf:type foaf:Person

We already know that:

1. _:1 fam:hasSister sim:Patty .
2. fam:hasSister rdfs:subPropertyOf fam:hasSibling .
3. fam:isRelativeOf rdfs:range foaf:Person .

Therefore, the statement `sim:Patty rdf:type foaf:Person` entails because:

Starting with the *rdfs5* pattern:

1. `fam:hasSister` ^{xxx} `rdfs:subPropertyOf fam:hasSibling` ^{yyy} `.` - *P*
2. `fam:hasSibling` ^{yyy} `rdfs:subPropertyOf fam:isRelativeOf` ^{zzz} `.` - *P*
3. `fam:hasSister` ^{xxx} `rdfs:subPropertyOf fam:isRelativeOf` ^{zzz} `.` - *rdfs5, 1, 2*

This proves that we can replace `_:1 fam:hasSister sim:Patty .` with `_:1 fam:isRelativeOf sim:Patty .`, which we use with the *rdfs3* pattern:

1. `fam:isRelativeOf` ^{aaa} `rdfs:range foaf:Person` ^{xxx} `.` - *P*
2. ^{yyy}`_:1` ^{aaa}`fam:isRelativeOf sim:Patty` ^{zzz} `.` - *P*
3. `sim:Patty` ^{zzz} `rdf:type foaf:Person` ^{xxx} `.` - *rdfs3, 1, 2*

Pattern[1]	If S contains	then S RDFS entails recognizing D
rdfs3	*aaa* `rdfs:range` *xxx* . *yyy aaa zzz* .	*zzz* `rdf:type` *xxx* .
rdfs5	*xxx* `rdfs:subPropertyOf` *yyy* . *yyy* `rdfs:subProperyOf` *zzz* .	*xxx* `rdfs:subPropertyOf` *zzz* .

2.8 `_:a fam:hasParent _:b .  _:b fam:hasSister sim:Patty .`

The statement is satisfactory due to blank node equivalence as illustrated in the RDF graph:

1. `sim:Lisa  fam:hasParent` $^{\_:b}$`_:1 .`
2. $^{\_:b}$`_:1  fam:hasSister sim:Patty .`

In other words, it entails without the use of RDFS patterns.

2.9 `_:d fam:hasBrother _:e .  _:d fam:hasBrother _:f .`

If the statement `_:d fam:hasBrother _:e .  _:d fam:hasBrother _:f .` is entailed or not cannot be proved by RDFS rules, because the RDF graph illustrates:

1. $^{\_:d}$`_:2  fam:hasBrother  sim:Herb .`
2. $^{\_:d}$`_:2  fam:hasBrother  sim:Herb .`

There is no rule that says if a person has a brother they must have multiple brothers. We know from the RDF graph that a blank node resource has a brother `sim:Herb`, but no sub-property or domain/range rule can generate a second brother triple out of nowhere.

References

[1] Patrick Hayes, Florida IHMC, and Peter Patel-Schneider (eds.) *RDF 1.1 Semantics*. World Wide Web Consortium. [Online; accessed 13-March-2025]. Feb. 2014. URL: https://www.w3.org/TR/rdf11-mt/#patterns-of-rdfs-entailment-informative.