

# On the Semantics of SPARQL Queries with Optional Matching under Entailment Regimes

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ISWC 2014  
Riva del Garda  
October 22, 2014

## Question of the talk

**Is the semantics of OPTIONAL always intuitive  
under entailment regimes?**

No complex OWL regimes with anonymous part, just with  
**inconsistencies**.

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**Is the semantics of OPTIONAL always intuitive  
under entailment regimes?**

*Our answer:* **no, not always!**

*Main aim of this talk:* justify the answer and attract attention.

*Supplementary:* suggest a solution.

## Example: OPTIONAL matching

### RDF graph:

*PropA(train London Holyhead)*

*PropA(train London Oxford)*

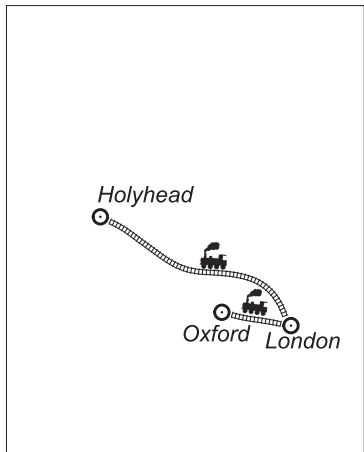
### SPARQL query:

*PropA(train ?X ?Y) OPTIONAL*

*PropA(ferry ?Y ?Z)*

### Answers:

<i>?X</i>	<i>?Y</i>	<i>?Z</i>
<i>London</i>	<i>Holyhead</i>	—
<i>London</i>	<i>Oxford</i>	—



## Example: possibility of extensions

### RDF graph:

PropA(*train London Holyhead*)

PropA(*train London Oxford*)

PropA(*ferry Holyhead Dublin*)

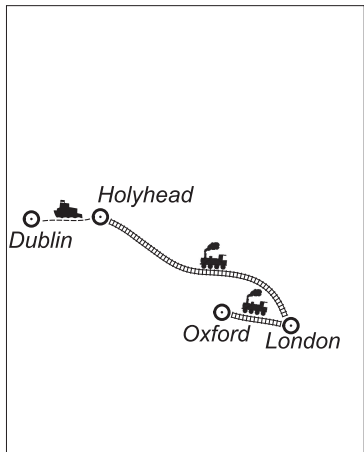
### SPARQL query:

PropA(*train ?X ?Y*) OPTIONAL

PropA(*ferry ?Y ?Z*)

### Answers:

?X	?Y	?Z
<i>London</i>	<i>Holyhead</i>	<i>Dublin</i>
<i>London</i>	<i>Oxford</i>	—



## Motivation for OPTIONAL

- (a) For *“not rejecting solutions because some part of the query pattern does not match”*

SPARQL 1.0 W3C Recommendation

- (b) To deal with the *“lack of regular, complete structures in RDF graph”*

SPARQL 1.1 W3C Recommendation

## Motivation for OPTIONAL

- (a) For *“not rejecting solutions because some part of the query pattern does not match”*

Our example: ✓

- (b) To deal with the *“lack of regular, complete structures in RDF graph”*

Our example: ✓



## Example: OPTIONAL matching

### RDF graph:

PropA(*train London Holyhead*)

PropA(*train London Oxford*)

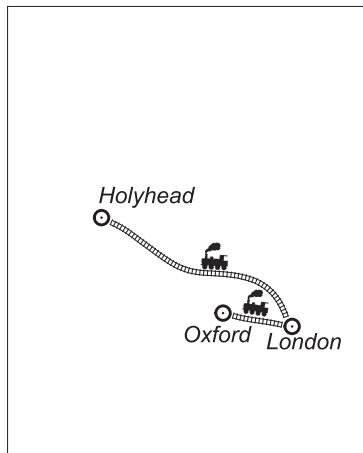
### SPARQL query:

PropA(*train ?X ?Y*) OPTIONAL

PropA(*ferry ?Y ?Z*)

### Answers:

?X	?Y	?Z
<i>London</i>	<i>Holyhead</i>	—
<i>London</i>	<i>Oxford</i>	—



## Example: entailment regimes

### RDF graph + **OWL 2 RL regime:**

PropA(*train* London Holyhead)

PropA(*train* London Oxford)

ClassA(*InlandCity* Oxford)

ClassA(*CoastalCity* Holyhead)

PropDom(*ferry* CoastalCity)

**Disjoint**(*CoastalCity* *InlandCity*)

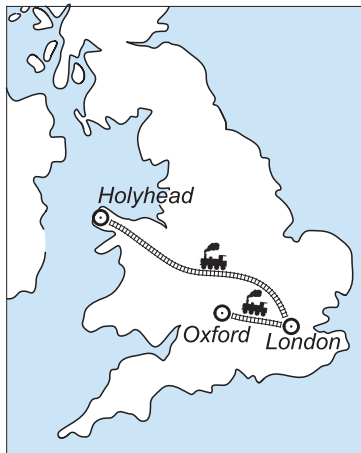
### SPARQL query:

PropA(*train* ?X ?Y) OPTIONAL

PropA(*ferry* ?Y ?Z)

### Normative answers:

?X	?Y	?Z
London	Holyhead	—
London	Oxford	—



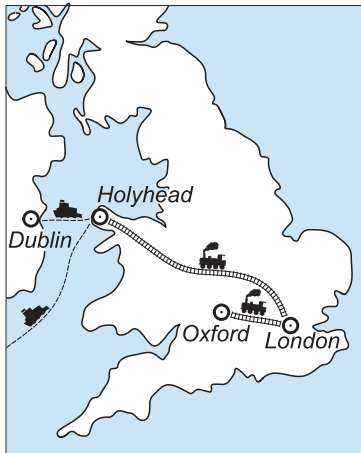
## Example: analysis of normative answers

**Normative answer:**

?X	?Y	?Z
<i>London</i>	<i>Holyhead</i>	—

has possible extension of data  
with the answer

?X	?Y	?Z
<i>London</i>	<i>Holyhead</i>	<i>Dublin</i>



## Example: analysis of normative answers

**Normative answer:**

<i>?X</i>	<i>?Y</i>	<i>?Z</i>
<i>London</i>	<i>Oxford</i>	—

does not have  
any consistent data extension



## Conclusions from the example

1. The situations are different — behaviour is the same.
2. SPARQL **ignores** knowledge on disjointness  
(**even under entailment regimes**)!

## Motivation for OPTIONAL

- (a) For *“not rejecting solutions because some part of the query pattern does not match”*

Our example: ✓

- (b) To deal with the *“lack of regular, complete structures in RDF graph”*

Our example: ✗

For the second answer we **do have complete structure** which does not allow for extensions.

## Example: we propose *strict* semantics

### RDF graph + OWL 2 RL regime:

PropA(*train* London Holyhead)

PropA(*train* London Oxford)

ClassA(*InlandCity* Oxford)

ClassA(*CoastalCity* Holyhead)

PropDom(*ferry* CoastalCity)

Disjoint(*CoastalCity* *InlandCity*)

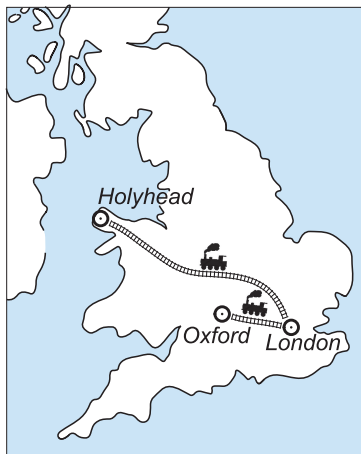
### SPARQL query:

PropA(*train* ?X ?Y) OPTIONAL

PropA(*ferry* ?Y ?Z)

### Strict answers:

?X	?Y	?Z
London	Holyhead	—



In the paper



# In the paper

1. Formalisation of the notion **entailment regime**.

In the specification just few examples are given (e.g. RDFS, OWL 2), but nothing is said in general.

## In the paper

2. Proposal of **strict semantics** of OPTIONAL matching, which give a partial mapping as answer only if there is a *consistent* extension of data which extends the answer to undefined variables.

Is conservative extension of normative semantics: for regimes without inconsistencies they coincide.

Is in line with intuition (b): deals with lack of complete structures is graphs.

## In the paper

3. Comparison of normative and strict semantics: for monotone queries (well-designed, no negation in FILTERs) every answer under strict semantics can be **extended** to answer under normative semantics.

Justifies the name “strict” — allows only liable normative answers (and nothing else).

## In the paper

4. The complexity of evaluation problem for strict semantics is established: it is **PSPACE-complete**.

The same complexity as for normative semantics.

## In the paper

5. Several rewriting (optimisation) rules are proved.

Again, the same as for normative semantics.

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