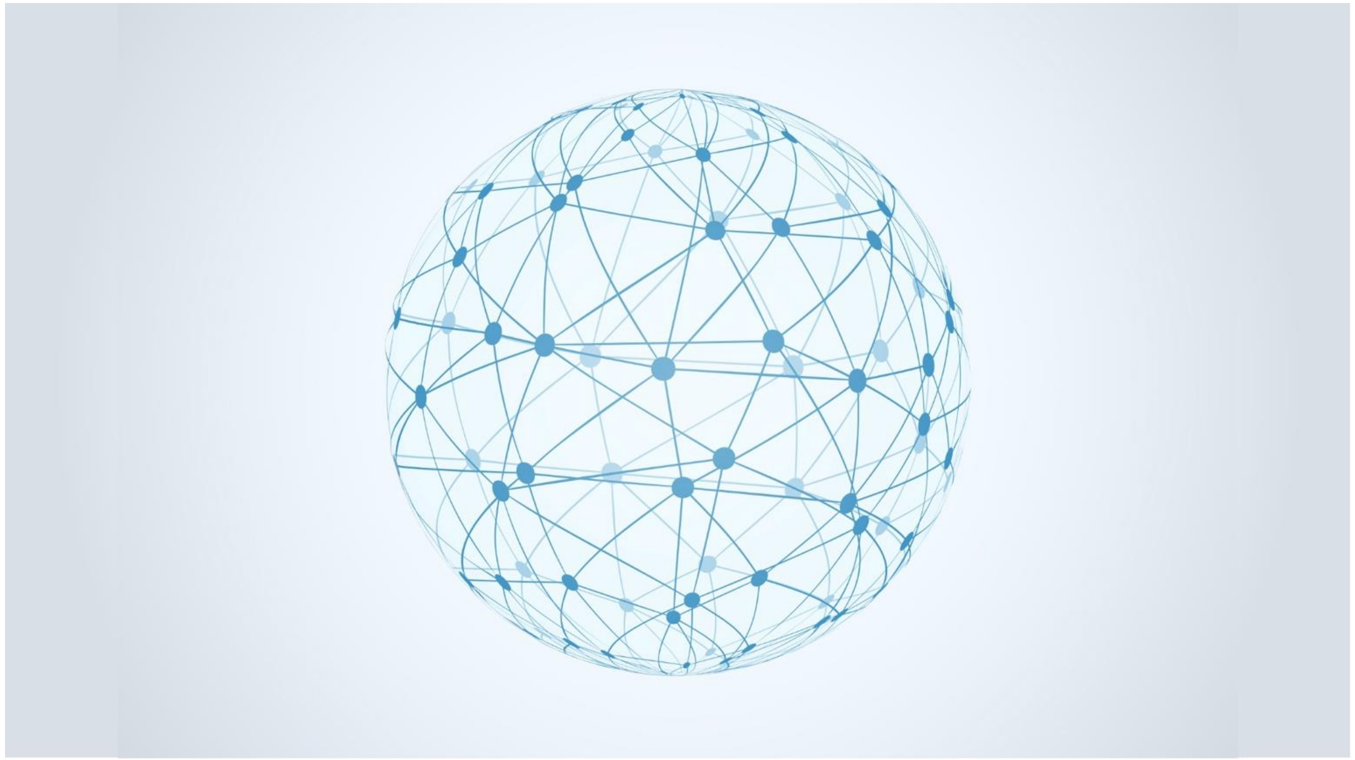
RDF and SPARQL Essentials

Summary



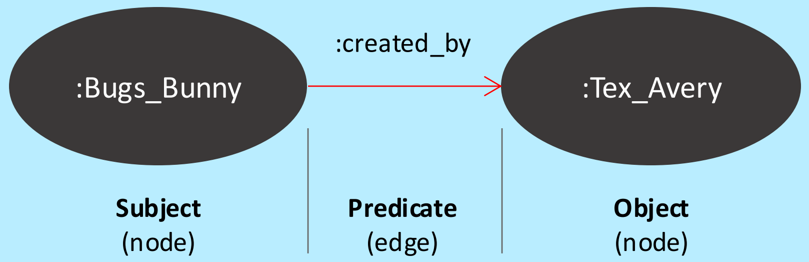
This document is intended to be used in conjunction with the course materials and is not a complete summary of SPARQL 1.1 specification.
The complete SPARQL 1.1 document can be accessed on the W3C website

graftilo

Building Blocks and Syntax

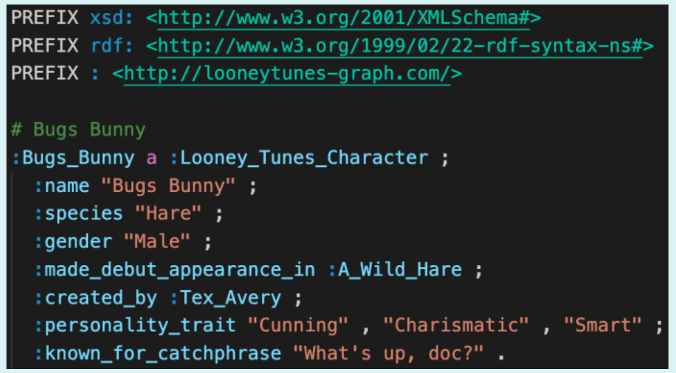
Triple

Basic building block of an RDF graph. A triple consists of three components: a subject, a predicate and an object



Turtle

A human-friendly and compact RDF serialization format (.ttl file extension)



```
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX : <http://looneytunes-graph.com/>

# Bugs Bunny
:Bugs_Bunny a :Looney_Tunes_Character ;
  :name "Bugs Bunny" ;
  :species "Hare" ;
  :gender "Male" ;
  :made_debut_appearance_in :A_Wild_Hare ;
  :created_by :Tex_Avery ;
  :personality_trait "Cunning" , "Charismatic" , "Smart" ;
  :known_for_catchphrase "What's up, doc?" .
```

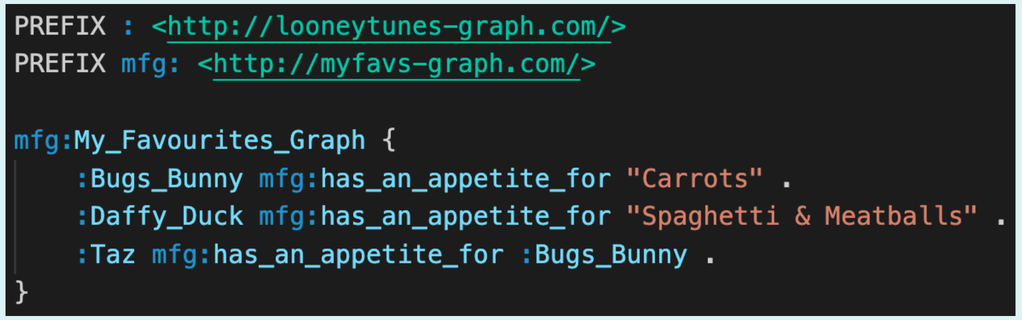
Common RDF Serialization Formats

There are are several commonly-used serialization formats for RDF graphs

- N-Quads
- N-Triples
- Notation3
- JSON
- RDF/XML
- TriG
- Turtle

TriG

A human-friendly and compact RDF serialization format for named graphs (.trig file extension)



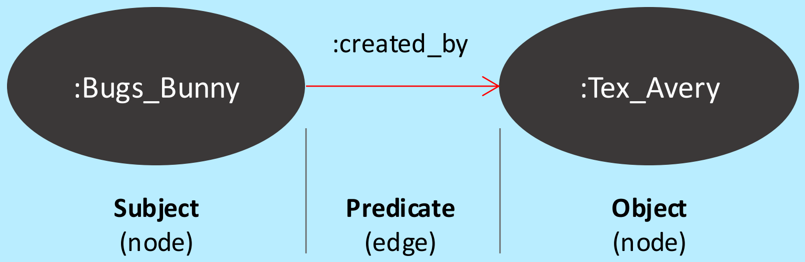
```
PREFIX : <http://looneytunes-graph.com/>
PREFIX mfg: <http://myfavs-graph.com/>

mfg:My_Favourites_Graph {
    :Bugs_Bunny mfg:has_an_appetite_for "Carrots" .
    :Daffy_Duck mfg:has_an_appetite_for "Spaghetti & Meatballs" .
    :Taz mfg:has_an_appetite_for :Bugs_Bunny .
}
```

Building Blocks and Syntax

Triple

Basic building block of an RDF graph. A triple consists of three components: a subject, a predicate and an object



IRI

Unique identifier for nodes and edges

```
<http://looneytunes-graph.com/:Bugs_Bunny>
```

Fully-written IRI

```
PREFIX : <http://looneytunes-graph.com/>
PREFIX mfg: <http://myfavs-graph.com/>

:Bugs_Bunny mfg:has_an_appetite_for "Carrots" .
```

Use prefix declarations to abbreviate IRIs
: is the default prefix

```
:Bugs_Bunny a :Looney_Tunes_Character .
```

Shortcut for rdf:type

RDF Nodes

There are three kinds of nodes in RDF: IRI, Literal and Blank Node

Internationalized Resource Identifier (IRI)

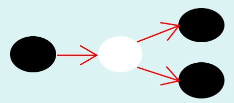
Literal

"Bugs Bunny"

"1940-07-27"^^xsd:date

.
.
.

Blank Node



Optional. Avoid as much as possible

Literal

Datatype values

Serialization	Datatype
"Bugs Bunny"	xsd:string
"Bugs Bunny"^^xsd:string	xsd:string
"Bugs Bunny"@en	rdf:langstring
"1940-07-27"^^xsd:date	xsd:date
101	xsd:integer
2.0	xsd:decimal
True	xsd:boolean

Comments

Comments are treated as whitespace

```
# Bugs Bunny
```

Single line comment

```
# Bugs Bunny
# A Wild Hare
# Tex Avery
# Daffy Duck
# Porky's Duck Hunt
```

Comments on multiple lines

SPARQL Query Forms

These query forms return RDF graphs

SELECT

Returns all, or a subset of, the variables bound in a query pattern match – results are tabulated

```
SELECT *
```

Returns all bound variables

```
SELECT ?c (COUNT(?pt) AS ?ptCount)
```

Returns a subset of variables and any variables declared in aggregation functions

```
SELECT DISTINCT ?t ?p
```

Returns distinct combinations only

CONSTRUCT

Returns an RDF graph constructed by substituting variables in a set of triple templates

```
CONSTRUCT {
    ?p :has_age ?age ;
       :birth_date ?b .
}
WHERE {
    ?p a :Person ;
        :born_on ?b ;
        :died_on ?d .

    BIND(year(?b) AS ?bYear)
    BIND(year(?d) AS ?dYear)
    BIND((?dYear - ?bYear) AS ?age)
}
```

ASK

Returns a Boolean indicating whether a query pattern matches or not

```
ASK {
    :Bugs_Bunny :created_by :Tex_Avery
}
```

Returns **true** if pattern matches or **false** if not

DESCRIBE

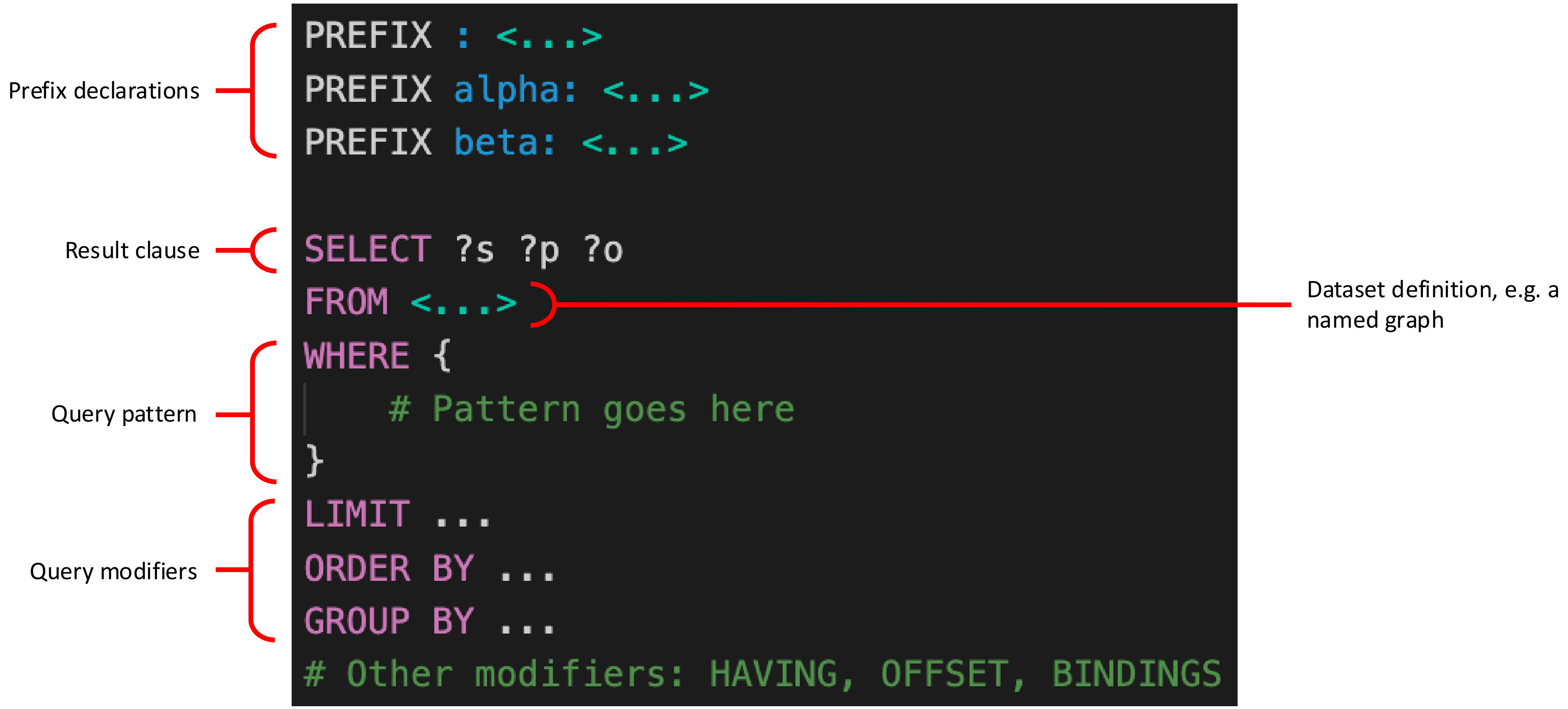
Returns an RDF graph that describes the resources found

```
DESCRIBE :Bugs_Bunny
```

Returns all 'one-hop-away' incoming and outgoing triples for the resource

SPARQL Query Structure

Returns all, or a subset of, the variables bound in a query pattern match – results are tabulated



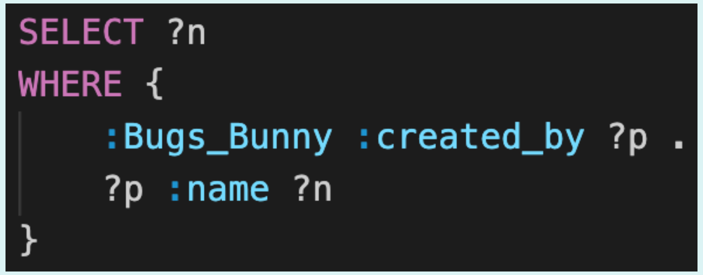
```
PREFIX : <...>
PREFIX alpha: <...>
PREFIX beta: <...>

SELECT ?s ?p ?o
FROM <...>
WHERE {
    # Pattern goes here
}
LIMIT ...
ORDER BY ...
GROUP BY ...
# Other modifiers: HAVING, OFFSET, BINDINGS
```

SPARQL Graph Pattern Combinations

X . Y

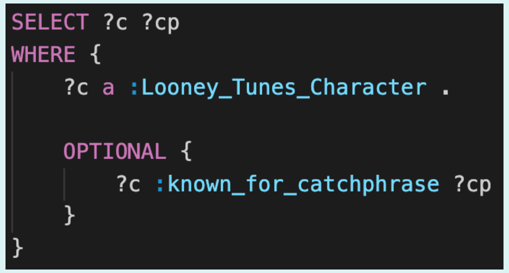
Basic graph pattern. The values of any common variables from solving X and Y are matched. Results are joined together



```
SELECT ?n
WHERE {
    :Bugs_Bunny :created_by ?p .
    ?p :name ?n
}
```

X OPTIONAL { Y }

Optional pattern matching. Solve X and solve Y. Join the results together. Keep all solutions from X regardless of whether or not there is a matching solution from Y

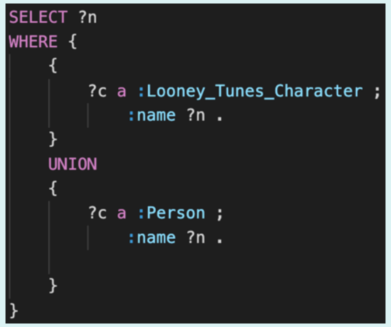


```
SELECT ?c ?cp
WHERE {
    ?c a :Looney_Tunes_Character .

    OPTIONAL {
        ?c :known_for_catchphrase ?cp
    }
}
```

{ X } UNION { Y }

Alternative graph patterns. Include both the results of solving X and the results of solving Y

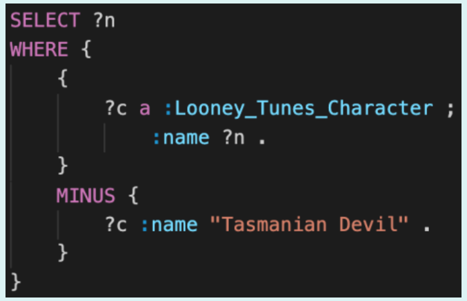


```
SELECT ?n
WHERE {
    {
        ?c a :Looney_Tunes_Character ;
            :name ?n .
    }
    UNION
    {
        ?c a :Person ;
            :name ?n .

    }
}
```

X MINUS { Y }

Remove possible solutions. Solve X and solve Y. Find solutions for X that are not compatible with the solutions for Y



```
SELECT ?n
WHERE {
    {
        ?c a :Looney_Tunes_Character ;
            :name ?n .
    }
    MINUS {
        ?c :name "Tasmanian Devil" .
    }
}
```

SPARQL Filters, Functions and Operators

Aggregate Functions

Can only be used in ***SELECT*** *queries for applying a function over a list of values*

```
AVG
COUNT
GROUP_CONCAT
MAX
MIN
SAMPLE
SUM
```

Operators

List of common operators which are typically used in ***FILTER*** *expressions*

Comparison operators (=, !=, <, <=, >, >=)

Logical operators (&&, ||, !)

Mathematical operators (+, -, /, *)

Existence

Use ***EXISTS*** *or* ***NOT EXISTS*** *filter operators to check for the existence or inexistence of a graph pattern, respectively*

```
SELECT ?c
WHERE {
    ?c a :Looney_Tunes_Character .

    FILTER NOT EXISTS {
        ?c :known_for_catchphrase ?p
    }
}
```

Functions on RDF Terms

Examples of useful functions that can be applied to test values

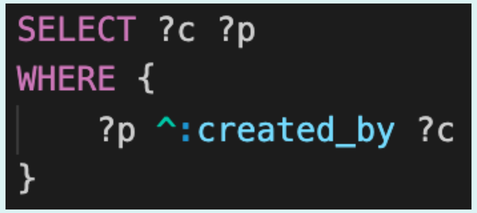
```
isIRI
isLiteral
isNumeric
isBlank
```

SPARQL Property Paths

Property paths are possible routes that can be traversed between nodes in a graph

Inverse path

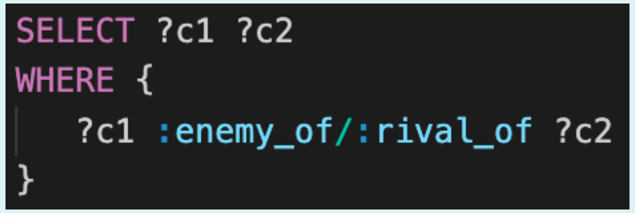
Reverse the direction of the path



```
SELECT ?c ?p
WHERE {
    ?p ^:created_by ?c
}
```

Sequence path

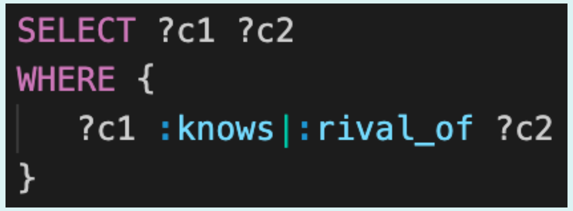
Follow a route in a specified direction of travel along predicates



```
SELECT ?c1 ?c2
WHERE {
    ?c1 :enemy_of/:rival_of ?c2
}
```

Alternative path

Try different path possibilities

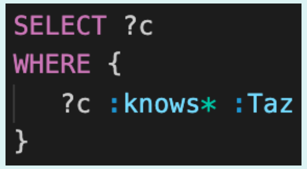


```
SELECT ?c1 ?c2
WHERE {
    ?c1 :knows|:rival_of ?c2
}
```

Recursive Path

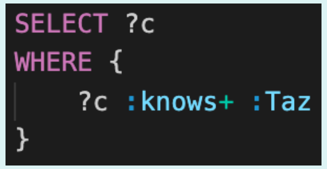
Property path of arbitrary length

Zero or more path



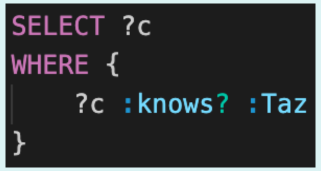
```
SELECT ?c
WHERE {
    ?c :knows* :Taz
}
```

One or more path



```
SELECT ?c
WHERE {
    ?c :knows+ :Taz
}
```

Zero or one path

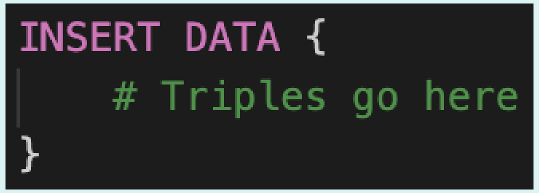


```
SELECT ?c
WHERE {
    ?c :knows? :Taz
}
```

SPARQL Update

INSERT DATA

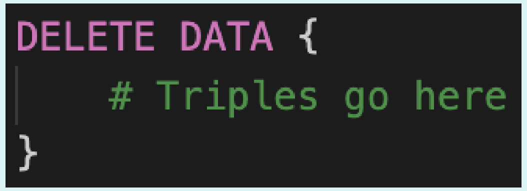
Operation that adds specific triples into the Graph Store



```
INSERT DATA {
    # Triples go here
}
```

DELETE DATA

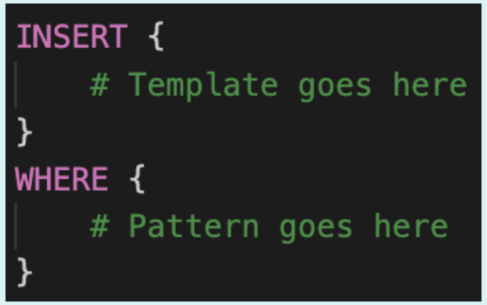
Operation that removes specific triples from the Graph Store



```
DELETE DATA {
    # Triples go here
}
```

INSERT

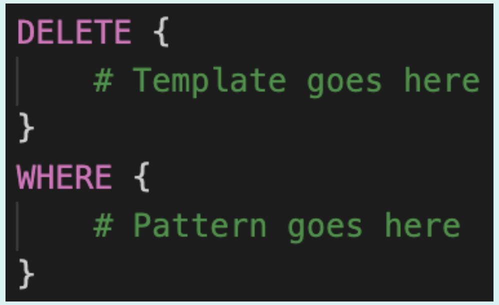
Operation that adds triples into the Graph Store, based on some graph pattern and a specified template



```
INSERT {
    # Template goes here
}
WHERE {
    # Pattern goes here
}
```

DELETE

Operation that removes triples from the Graph Store, based on some graph pattern and a specified template



```
DELETE {
    # Template goes here
}
WHERE {
    # Pattern goes here
}
```

W3C Prefixes

Prefix	Namespace
rdf:	http://www.w3.org/1999/02/22-rdf-syntax-ns#
xsd:	http://www.w3.org/2001/XMLSchema#
rdfs:	http://www.w3.org/2000/01/rdf-schema#
owl:	http://www.w3.org/2002/07/owl#
skos:	http://www.w3.org/2004/02/skos/core#

Namespace lookup for RDF Developers: http://prefix.cc/