CC7220-1
La Web de Datos
Primavera 2022

Lecture 7: SPARQL [1.0]

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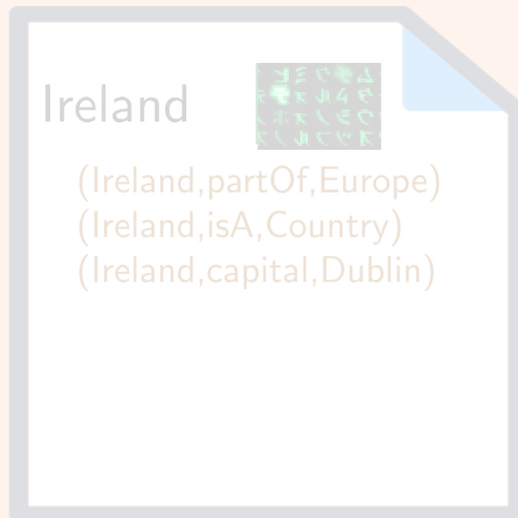
Last time ...

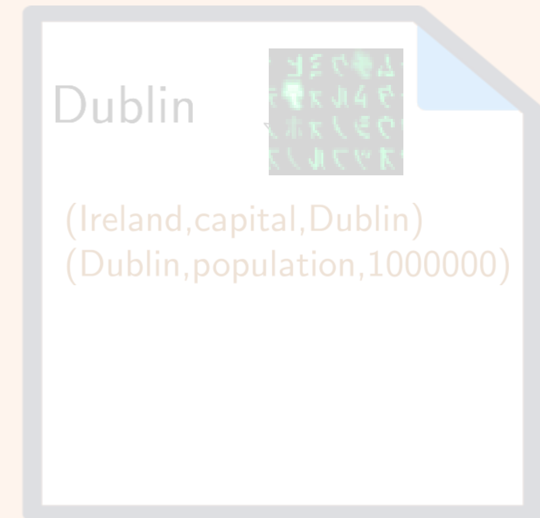
← OWL

* More or less

Semantic Web: Logic

Data:





Logic: "(b,capital,a) $\rightarrow$ (a,partOf,b)"
"(a,partOf,b), (b,partOf,c) $\rightarrow$ (a,partOf,c)"

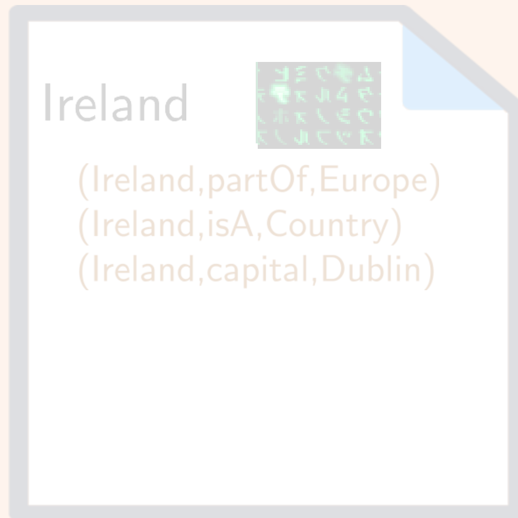
Query: "(x,partOf,y)?"

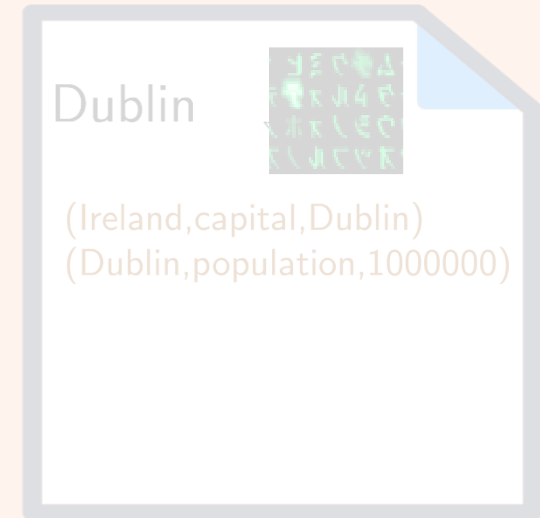
Output: {($x \mapsto$ Ireland, $y \mapsto$ Europe),
($x \mapsto$ Dublin, $y \mapsto$ Ireland),
($x \mapsto$ Dublin, $y \mapsto$ Europe)}

Today's Topic

Semantic Web: Query

Data:





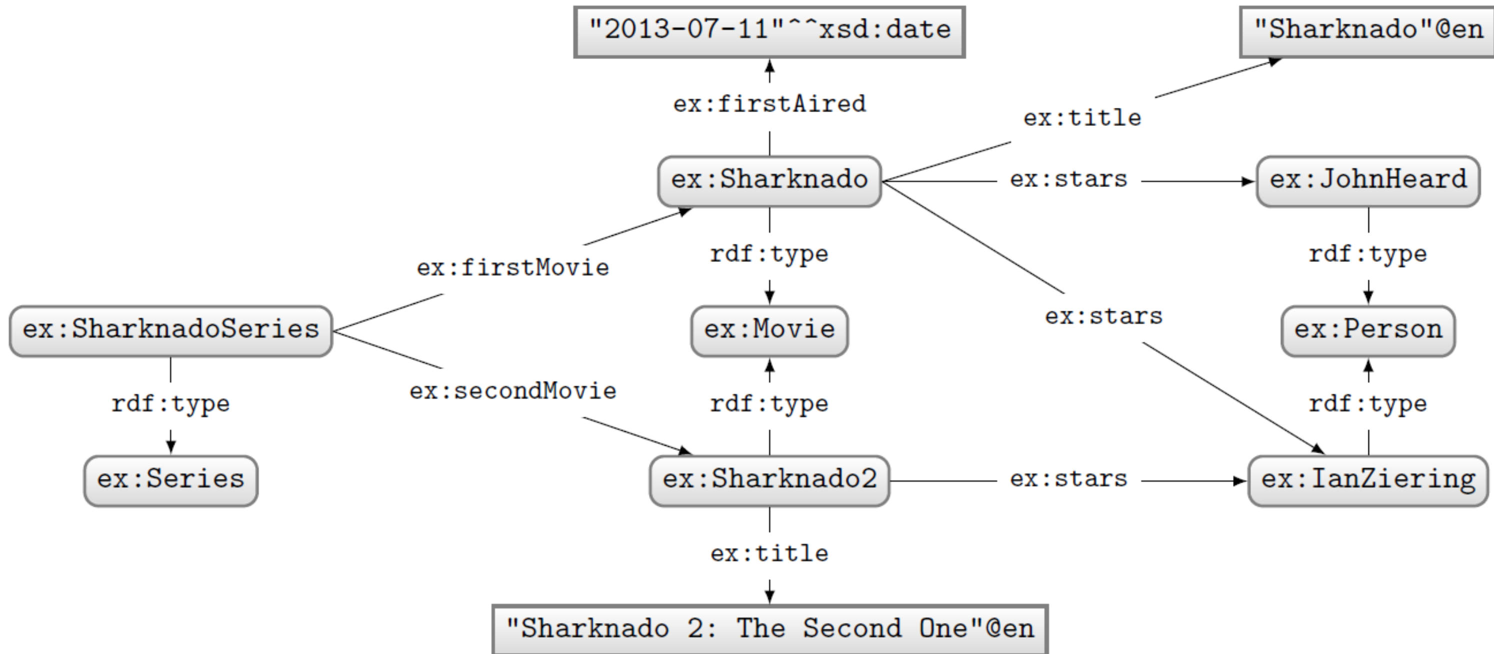
Logic: "(b,capital,a) $\rightarrow$ (a,partOf,b)"
"(a,partOf,b), (b,partOf,c) $\rightarrow$ (a,partOf,c)"

Query: "(x,partOf,y)?"

Output: {($x \mapsto$ Ireland, $y \mapsto$ Europe),
($x \mapsto$ Dublin, $y \mapsto$ Ireland),
($x \mapsto$ Dublin, $y \mapsto$ Europe)}

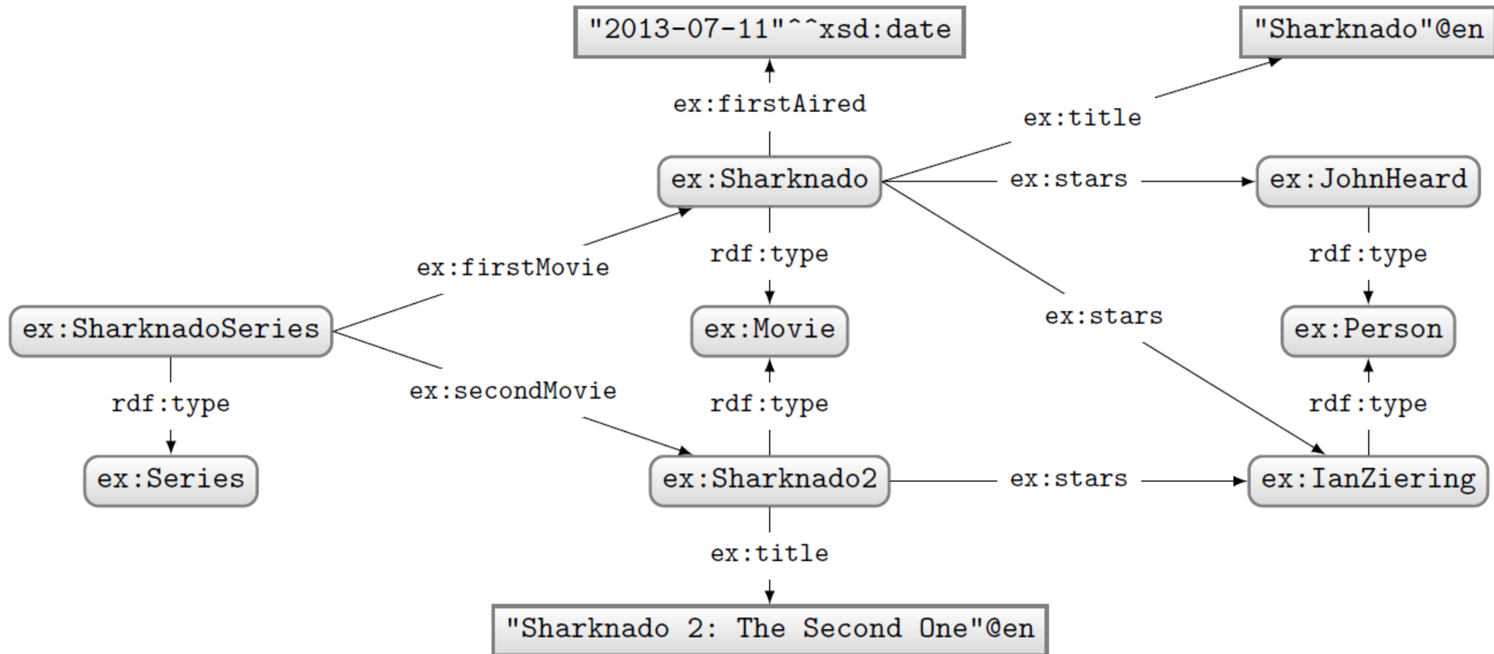
(1.1)
QL
First SPARQL (1.0)
Then SPARQL 1.1

SPARQL: Query Language for RDF



How to ask: “Who stars in ‘Sharknado’?”

SPARQL: Query Language for RDF



Query:

```
PREFIX ex: <http://ex.org/voc#>
SELECT *
WHERE {
  ex:Sharknado ex:stars ?star .
}
```

Solutions:

?star
ex:JohnHeard
ex:IanZiering

SPARQL: Prefix declarations

SPARQL: PREFIX DECLARATIONS

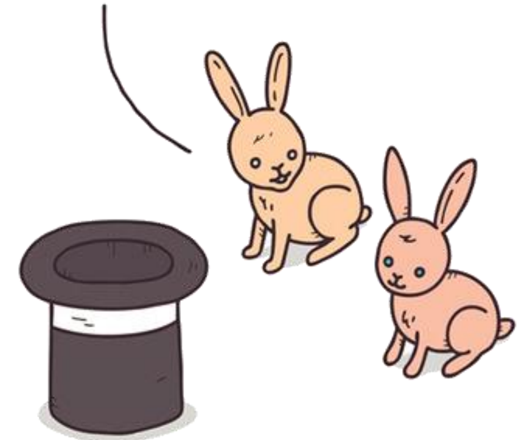
- Shortcuts for IRIs (exactly like in Turtle)

```
PREFIX ex: <http://ex.org/voc#>
SELECT *
WHERE {
  ex:Sharknado ex:stars ?star .
}
```

SPARQL: WHERE CLAUSE

SPARQL: WHERE CLAUSE

- Specifies what to match in the data

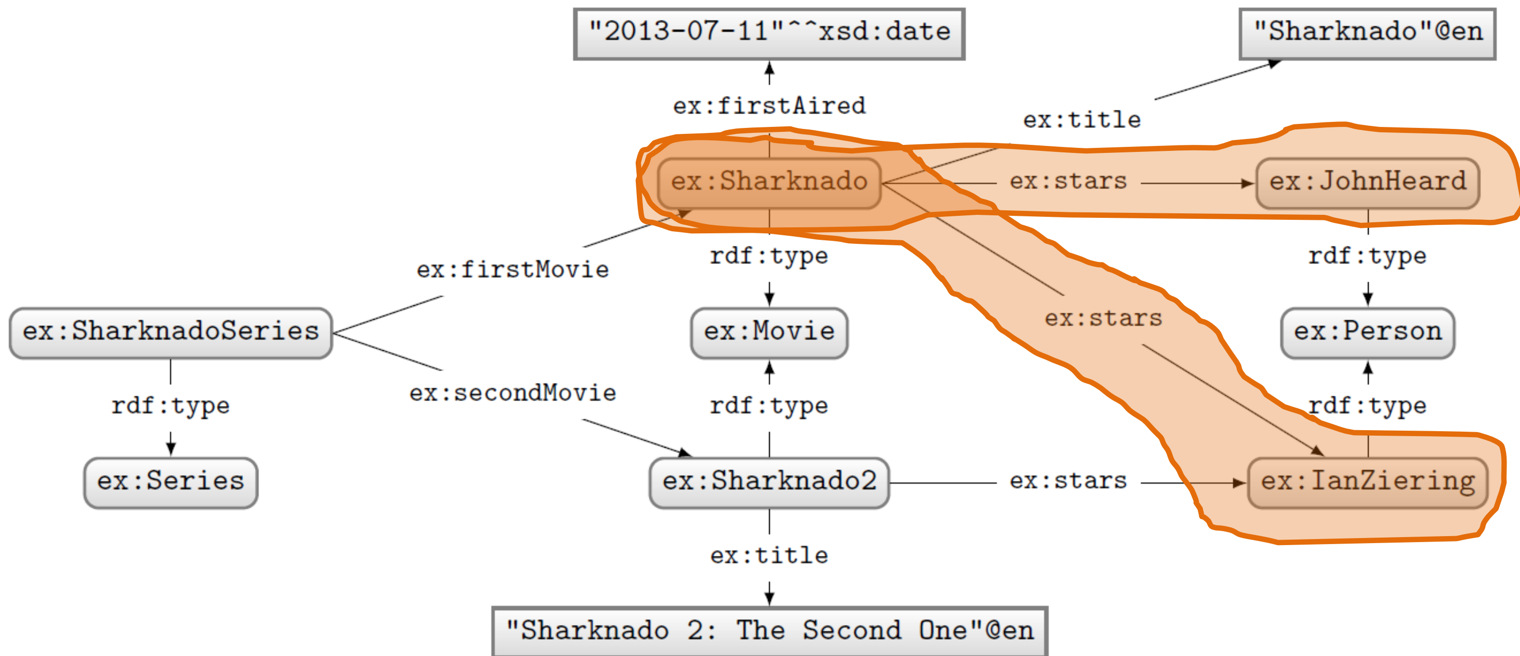



```
PREFIX ex: <http://ex.org/voc#>
SELECT *
WHERE {
  ex:Sharknado ex:stars ?star .
}
```

"Triple pattern"

(a triple with variables)

SPARQL: WHERE CLAUSE



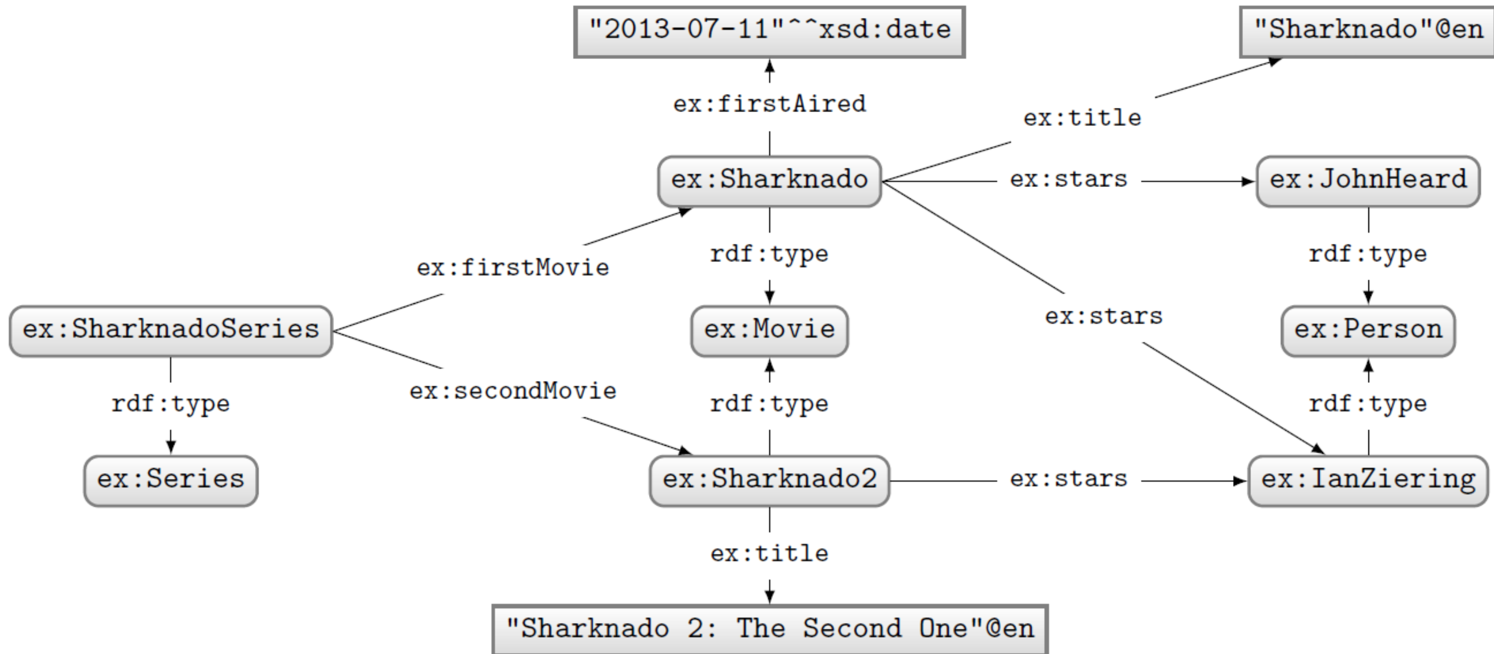
Query:

```
PREFIX ex: <http://ex.org/voc#>
SELECT *
WHERE {
  ex:Sharknado ex:stars ?star .
}
```

Solutions:

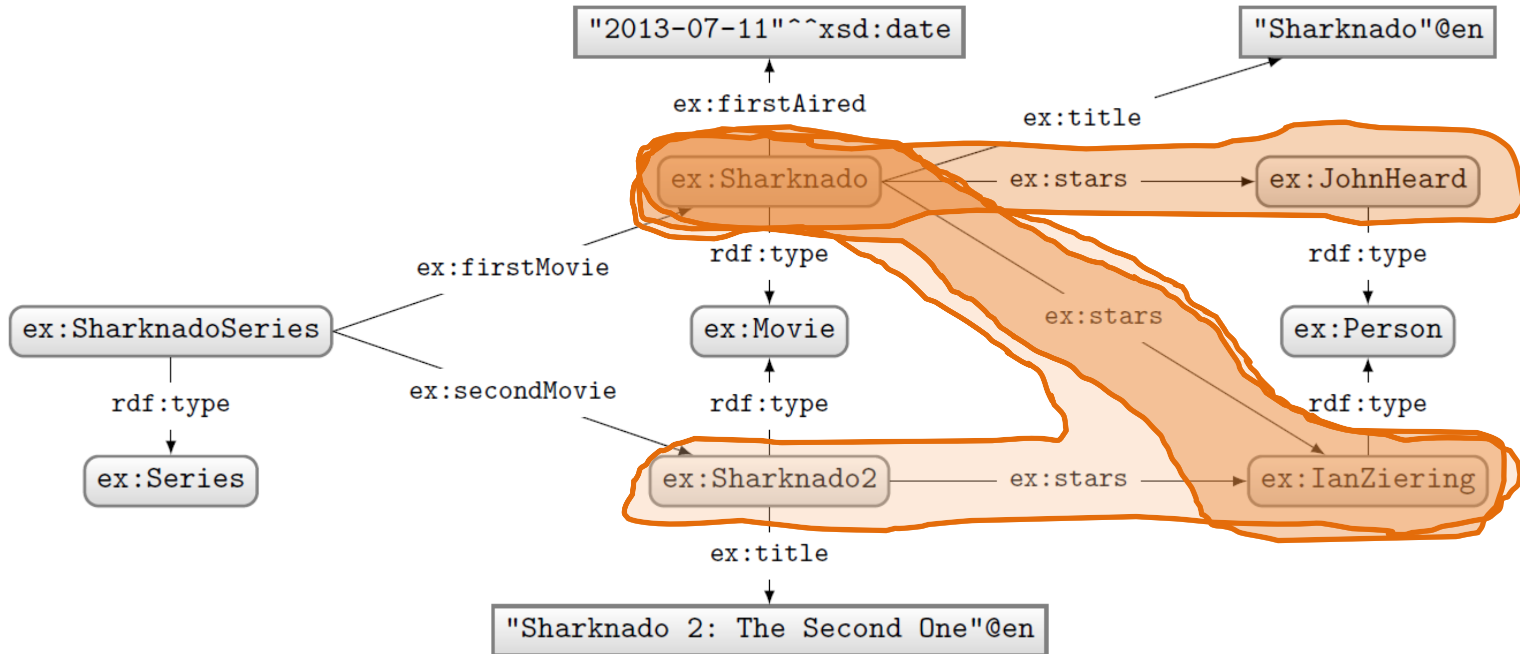
?star
ex:JohnHeard
ex:IanZiering

SPARQL: WHERE CLAUSE



How to ask: "What movies did the stars of 'Sharknado' also star in?"

SPARQL: Basic Graph Patterns



Query:

```
PREFIX ex: <http://ex.org/voc#>
SELECT *
WHERE {
  ex:Sharknado ex:stars ?star .
  ?movie ex:stars ?star .
}
```

Solutions:

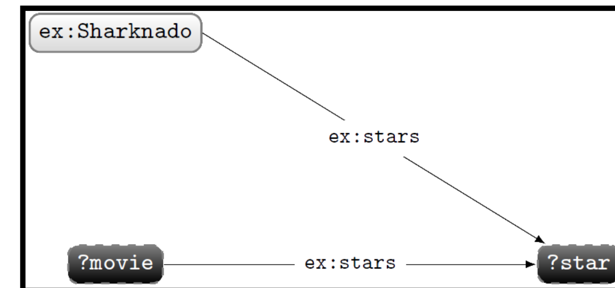
?star	?movie
ex:IanZiering	ex:Sharknado2
ex:IanZiering	ex:Sharknado
ex:JohnHeard	ex:Sharknado

SPARQL: Basic Graph Patterns

"2013-07-11"^^xsd:date
ex:firstAired
"Sharknado"@en
ex:title
ex:Sharknado
ex:stars
ex:JohnHeard
ex:firstMovie
rdf:type
rdf:type
ex:SharknadoSeries
ex:Movie
ex:stars
ex:Person
rdf:type
ex:secondMovie
rdf:type
rdf:type
ex:Series
ex:Sharknado2
ex:stars
ex:IanZiering
ex:title
"Sharknado 2: The Second One"@en

Query:

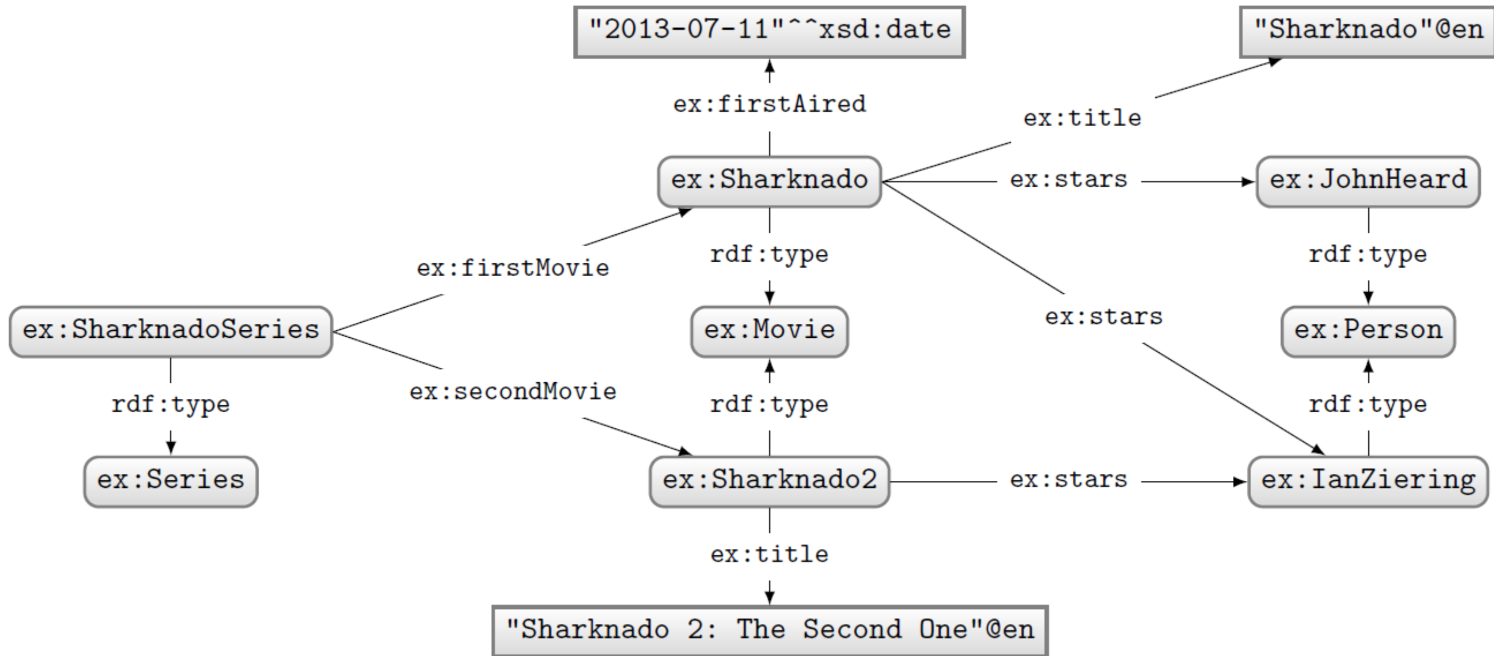
```
PREFIX ex: <http://ex.org/voc#>
SELECT *
WHERE {
  ex:Sharknado ex:stars ?star .
  ?movie ex:stars ?star .
}
```



"Basic Graph Pattern"

(a set of triple patterns)

SPARQL: Join Variables



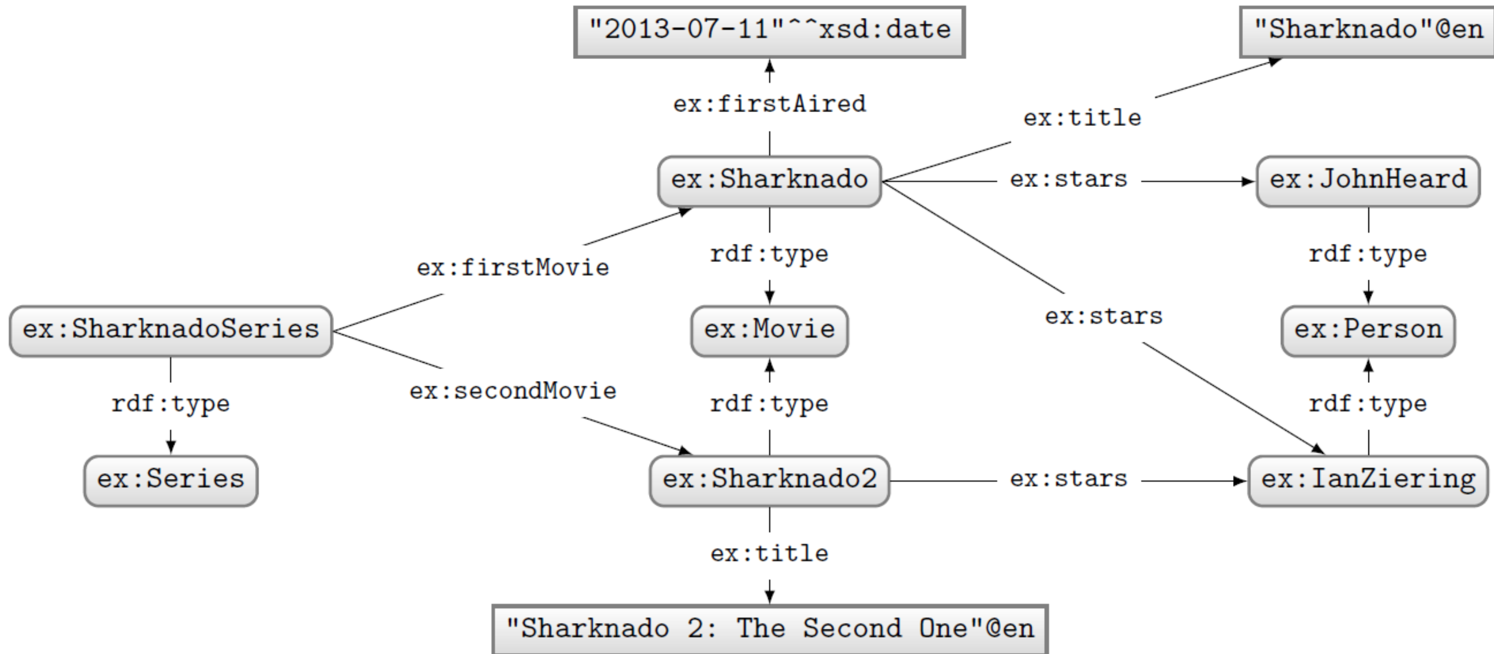
Query:

```
PREFIX ex: <http://ex.org/voc#>
SELECT *
WHERE {
  ex:Sharknado ex:stars ?star .
  ?movie ex:stars ?star .
}
```

"Join Variable"

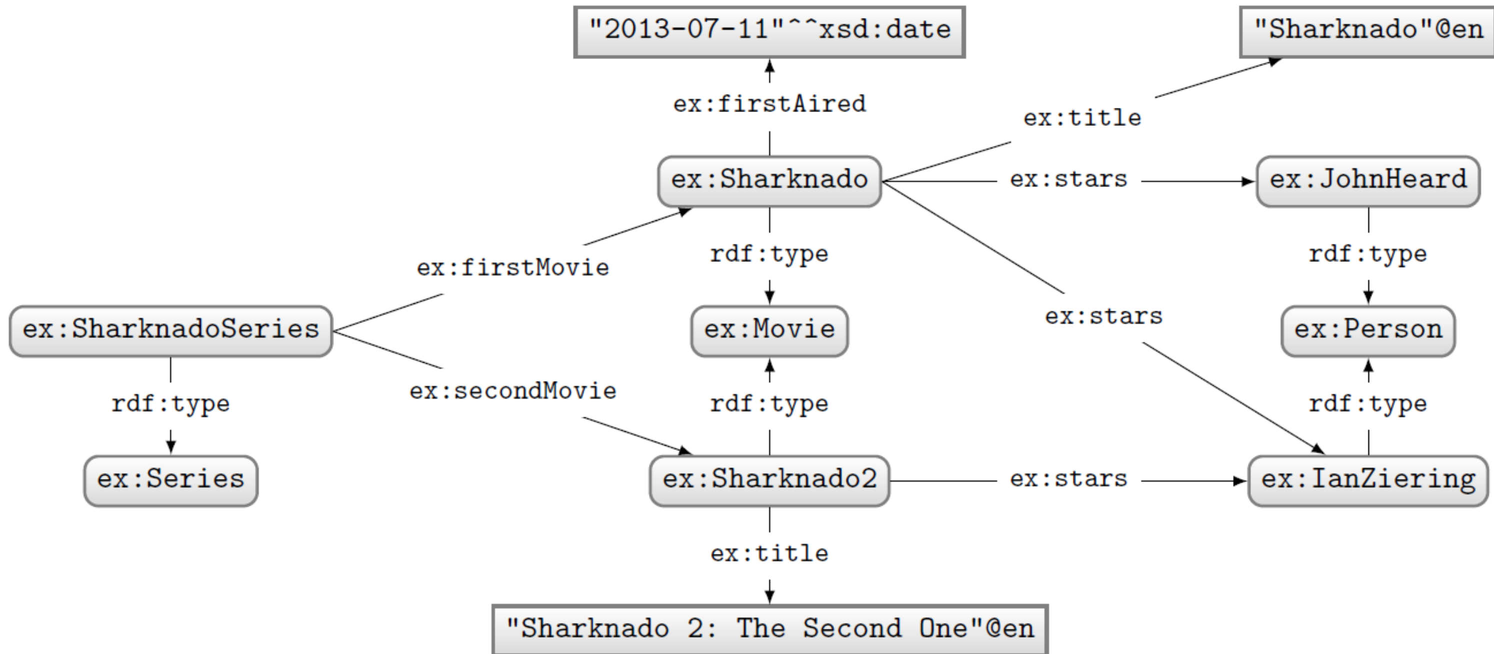
(a variable appearing in more than one triple pattern)

SPARQL: Disjunction



How to ask: “What are the titles of the (first two) movies in the Sharknado series?”

SPARQL: Disjunction (UNION)



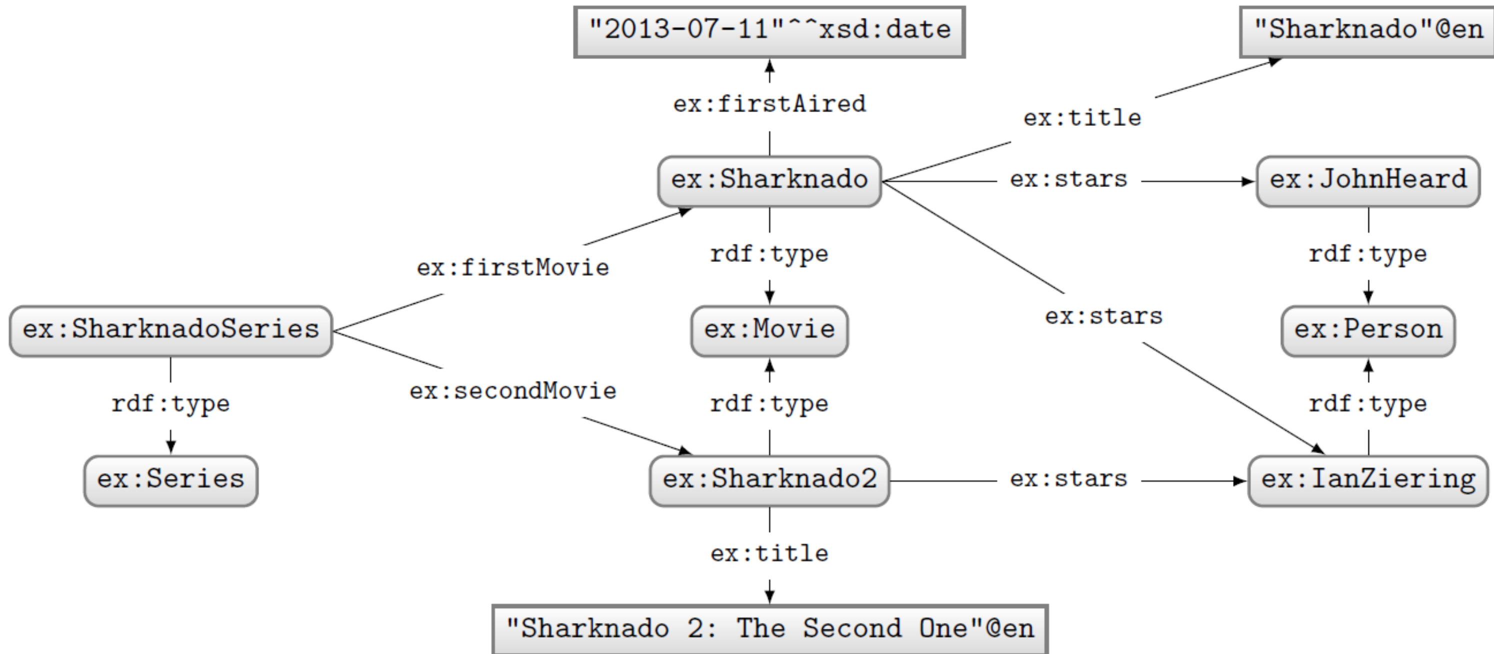
Query:

```
PREFIX ex: <http://ex.org/voc#>
SELECT *
WHERE {
  { ex:SharknadoSeries ex:firstMovie ?movie . }
  UNION
  { ex:SharknadoSeries ex:secondMovie ?movie . }
  ?movie ex:title ?title .
}
```

Solutions:

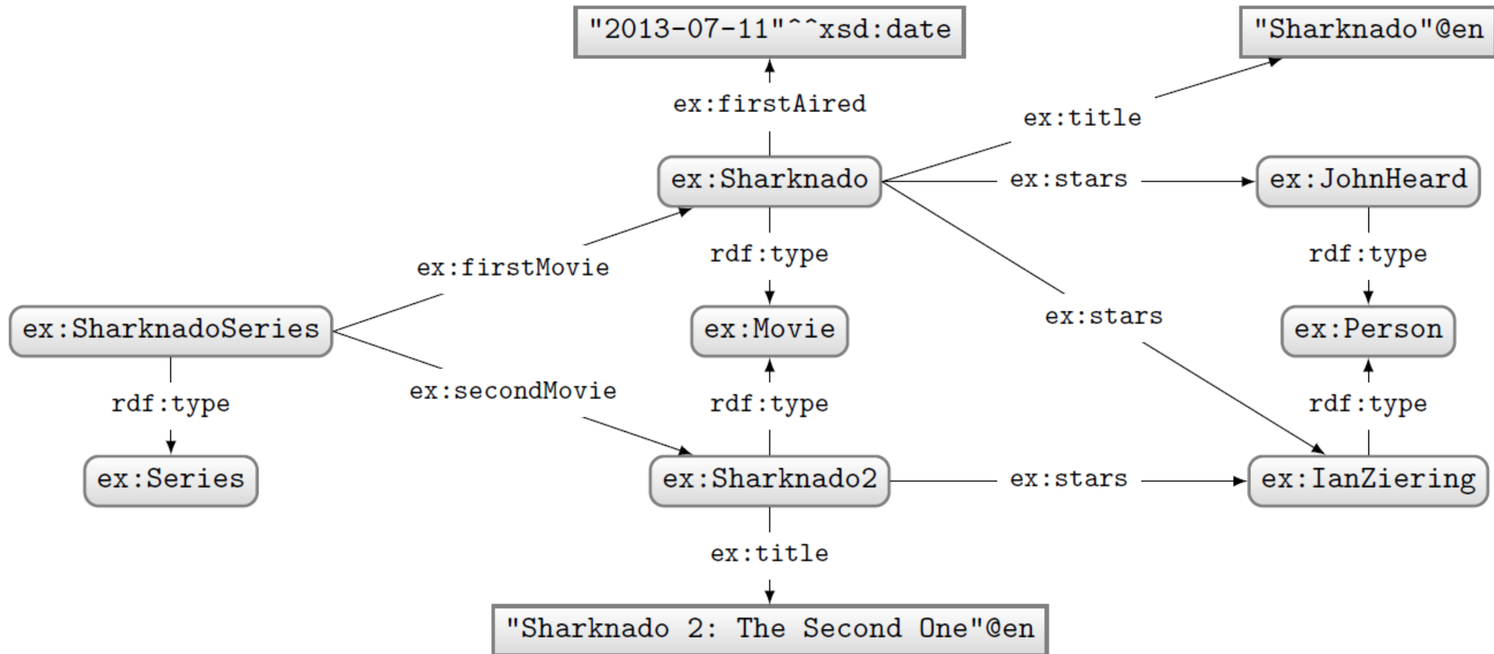
?movie	?title
ex:Sharknado	"Sharknado"@en
ex:Sharknado2	"Sharknado 2: The Second One"@en

SPARQL: Left-join



How to ask: "Give me the titles of all movies and, if available, their first-aired date?"

SPARQL: LEFT-JOIN (OPTIONAL)



Query:

```
PREFIX ex: <http://ex.org/voc#>
SELECT *
WHERE {
  ?movie a ex:Movie ; ex:title ?title .
  OPTIONAL { ?movie ex:firstAired ?date }
}
```

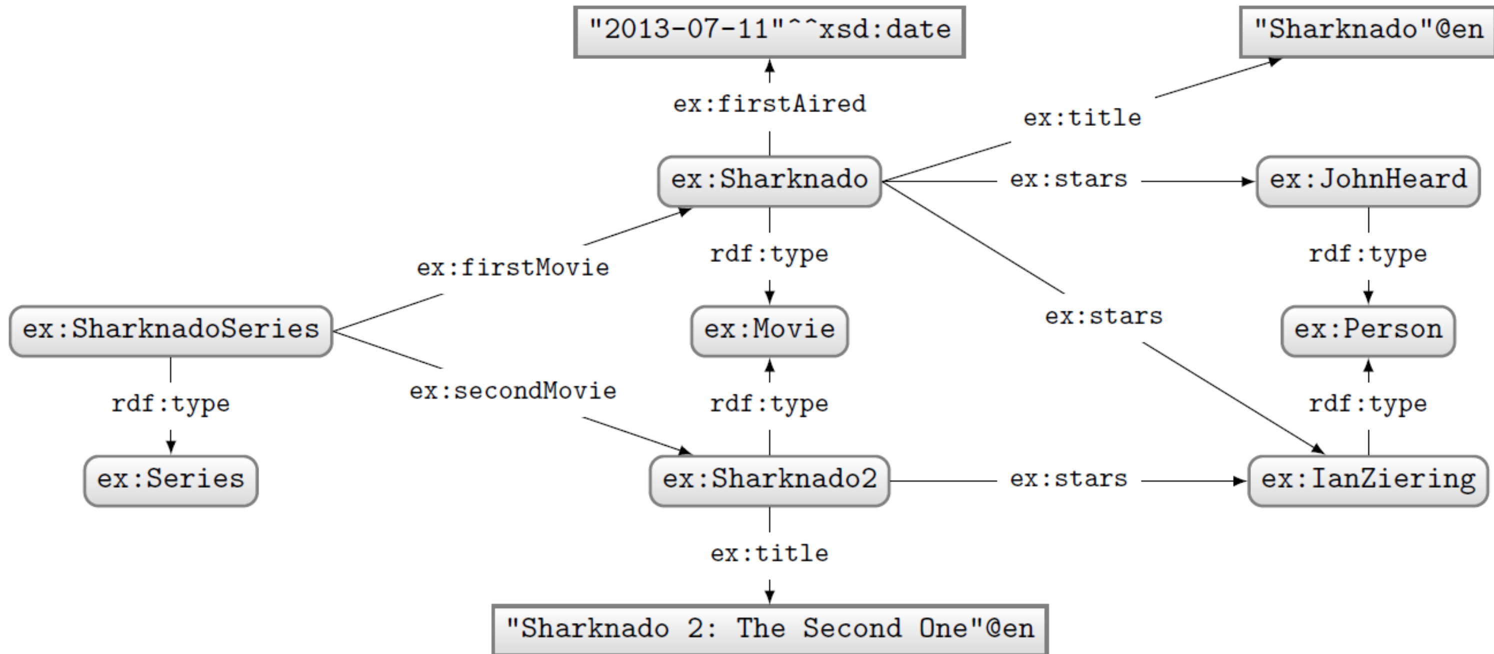
Solutions:

?movie	?title	?date
ex:Sharknado	"Sharknado"@en	"2013-07-11"^^xsd:date
ex:Sharknado2	"Sharknado 2: The Second One"@en	

"UNBOUND Variable"

(a variable without a binding in a solution)

SPARQL: Filtering results



How to ask: "What movies were first aired in 2014?"

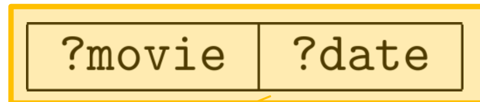
SPARQL: FILTER

"2013-07-11"
"Sharknado"@en
ex:firstAired
ex:title
ex:Sharknado
ex:stars
ex:JohnHeard
ex:firstMovie
rdf:type
rdf:type
ex:SharknadoSeries
ex:Movie
ex:stars
ex:Person
rdf:type
ex:secondMovie
rdf:type
rdf:type
ex:Series
ex:Sharknado2
ex:stars
ex:IanZiering
ex:title
"Sharknado 2: The Second One"@en

Query:

```
PREFIX ex: <http://ex.org/voc#>
SELECT *
WHERE {
  ?movie a ex:Movie ; ex:firstAired ?date .
  FILTER(?date > "2013-12-31"^^xsd:date
       && ?date <= "2014-12-31"^^xsd:date)
}
```

Solutions:



"Empty Results"

SPARQL: FILTER

Query:

```
PREFIX ex: <http://ex.org/voc#>
SELECT *
WHERE {
  ?movie a ex:Movie ; ex:firstAired ?date .
  FILTER(?date > "2013-12-31"^^xsd:date
        && ?date <= "2014-12-31"^^xsd:date)
}
```

What happens in this case where ?date bound in data to a string?

FILTERs (and other functions we see later) expect certain types. If not given, a type error is given.

SPARQL: Boolean FILTER operators

- FILTERs evaluate as `true`, `false` or `error`
- Only results evaluating as `true` are returned
- Can apply AND (&&) or OR (||)
- Can also apply NOT (!)
  - !E → E

A	B	A || B	A && B
T	T	T	T
T	F	T	F
F	T	T	F
F	F	F	F
T	E	T	E
E	T	T	E
F	E	E	F
E	F	E	F
E	E	E	E

SPARQL OPERATORS

<table>
<tr><th>A</th><th>Op</th><th>B</th><th colspan="2">Return type and value</th></tr>
<tr><td></td><td>!</td><td>BOOL b</td><td>BOOL</td><td><code>true</code> if $I_L(b)$ is false; <code>false</code> otherwise</td></tr>
<tr><td>BOOL b_1</td><td>||</td><td>BOOL b_2</td><td>BOOL</td><td><code>true</code> if $I_L(b_1)$ or $I_L(b_2)$; <code>false</code> otherwise</td></tr>
<tr><td>BOOL b_1</td><td>&&</td><td>BOOL b_2</td><td>BOOL</td><td><code>true</code> if $I_L(b_1)$ and $I_L(b_2)$; <code>false</code> otherwise</td></tr>
<tr><td>TERM* t_1</td><td>=</td><td>TERM* t_2</td><td>BOOL</td><td><code>true</code> if t_1 same term as t_2; <code>false</code> otherwise</td></tr>
<tr><td>TERM* t_1</td><td>!=</td><td>TERM* t_2</td><td>BOOL</td><td><code>true</code> if t_1 not same term as t_2; <code>false</code> otherwise</td></tr>
<tr><td>COM v_1</td><td>=</td><td>COM v_2</td><td>BOOL</td><td><code>true</code> if $I_L(v_1) = I_L(v_2)$; <code>false</code> otherwise</td></tr>
<tr><td>COM v_1</td><td>!=</td><td>COM v_2</td><td>BOOL</td><td><code>true</code> if $I_L(v_1) \neq I_L(v_2)$; <code>false</code> otherwise</td></tr>
<tr><td>COM v_1</td><td><</td><td>COM v_2</td><td>BOOL</td><td><code>true</code> if $I_L(v_1) < I_L(v_2)$; <code>false</code> otherwise</td></tr>
<tr><td>COM v_1</td><td>></td><td>COM v_2</td><td>BOOL</td><td><code>true</code> if $I_L(v_1) > I_L(v_2)$; <code>false</code> otherwise</td></tr>
<tr><td>COM v_1</td><td><=</td><td>COM v_2</td><td>BOOL</td><td><code>true</code> if $I_L(v_1) \leq I_L(v_2)$; <code>false</code> otherwise</td></tr>
<tr><td>COM v_1</td><td>>=</td><td>COM v_2</td><td>BOOL</td><td><code>true</code> if $I_L(v_1) \geq I_L(v_2)$; <code>false</code> otherwise</td></tr>
<tr><td></td><td>+</td><td>NUM n</td><td>NUM</td><td>n</td></tr>
<tr><td></td><td>-</td><td>NUM n</td><td>NUM</td><td>$-n$</td></tr>
<tr><td>NUM n_1</td><td>+</td><td>NUM n_2</td><td>NUM</td><td>$I_L(v_1) + I_L(v_2)$</td></tr>
<tr><td>NUM n_1</td><td>-</td><td>NUM n_2</td><td>NUM</td><td>$I_L(v_1) + I_L(v_2)$</td></tr>
<tr><td>NUM n_1</td><td>*</td><td>NUM n_2</td><td>NUM</td><td>$I_L(v_1) \times I_L(v_2)$</td></tr>
<tr><td>NUM n_1</td><td>/</td><td>NUM n_2</td><td>NUM</td><td>$\frac{I_L(v_1)}{I_L(v_2)}$</td></tr>
</table>

- COM: a comparable literal value
- TERM*: a non-comparable RDF term
- $I_L(\cdot)$: the value (e.g., 2 not `"2"`)

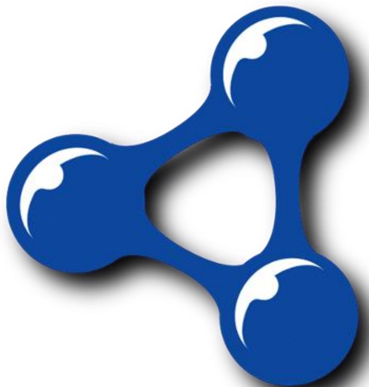
SPARQL Functions: Existence, equality, if ...

Function	Return type and value	
bound(TERM t)	BOOL	true if t is bound; false if unbound
if(BOOL b,TERM t_1,TERM t_2)	TERM	t_1 if b is true; t_2 otherwise
coalesce(TERM t_1,...,t_n)	TERM	first t_i $(1 \leq i \leq n)$ that is not an error or unbound
not exists(SUB Q)	BOOL	true if Q has any solution; false otherwise
exists(SUB Q)	BOOL	true if Q has no solution; false otherwise
sameTerm(TERM t_1, TERM t_2)	BOOL	true if t_1 same term as t_2; false otherwise
TERM t in(TERM t_1,...,t_n)	BOOL	true if $t = t_i$ for any $t_i \in \{t_1, ..., t_n\}$; false otherwise
TERM t not in(TERM t_1,...,t_n)	BOOL	true if $t \neq t_i$ for all $t_i \in \{t_1, ..., t_n\}$; false otherwise

- SUB: a sub-query

SPARQL Functions: Terms

Function	Return type and value	
isIRI(TERM t)	BOOL	true if t is an IRI; false otherwise
isBlank(TERM t)	BOOL	true if t is a blank node; false otherwise
isLiteral(TERM t)	BOOL	true if t is a literal; false otherwise
isNumeric(TERM t)	BOOL	true if t is a numeric value; false otherwise
str(LIT l|IRI i)	STR	lexical value of l | string of i
lang(LIT l)	STR	language tag string of l
datatype(LIT l)	IRI	datatype IRI of l
iri(STR s|IRI i)	IRI	s resolved against the in-scope base IRI | i
bnode([STR s])	BNODE	fresh blank node [unique to s]
strdt(STR s,IRI i)	LIT	"s"^^<i>
strlang(STR s,STR l)	LIT	"s"@l
uuid()	IRI	fresh IRI (from UUID URN scheme)
struuid()	STR	fresh string (from UUID URN scheme)



- $a|b$ indicates a or b
- $[a]$ indicates a optional

SPARQL Functions: Strings

Function	Return type and value	
`strlen`(STR s)	INT	length of string s
`substr`(STR s,INT b,[INT l])	STR	substring of s from index b [of length l]
`ucase`(STR s)	STR	uppercase s
`lcase`(STR s)	STR	lowercase s
`strstarts`(STR s,STR p)	BOOL	`true` if s starts with p; `false` otherwise
`strends`(STR s,STR p)	BOOL	`true` if s ends with p; `false` otherwise
`strbefore`(STR s,STR p)	STR	string before first match for p in s
`strafter`(STR s,STR p)	STR	string after first match for p in s
`encode_for_iri`(STR s)	STR	s percent-encoded
`concat`(STR s_1,...,s_n)	STR	s_1, ..., s_n concatenated
`langMatches`(STR s,STR l)	BOOL	`true` if s a language tag matching l; `false` otherwise
`regex`(STR s,STR p[,STR f])	BOOL	`true` if s matches regex p [with flags f]; `false` otherwise
`replace`(STR s,STR p,STR r[,STR f])	STR	s with matches for regex p [with flags f] replaced by r

SPARQL Functions: Numerics

Function	Return type and value	
`abs`(num n)	num	absolute value of n
`round`(num n)	num	round to nearest whole number (towards $+\infty$ for *.5)
`ceil`(num n)	num	round up (towards $+\infty$) to nearest whole number
`floor`(num n)	num	round down (towards $-\infty$) to nearest whole number
`rand`(num n)	num	random double between 0 (inclusive) and 1 (exclusive)

SPARQL Functions: Temporal

Function	Return type and value	
`now`()	DT	current date-time
`year`(DT d)	INT	year of d (as an integer)
`month`(DT d)	INT	month of d (as an integer)
`day`(DT d)	INT	day of d (as an integer)
`hours`(DT d)	INT	hours of d (as an integer)
`minutes`(DT d)	INT	minutes of d (as an integer)
`seconds`(DT d)	INT	seconds of d (as an integer)
`timezone`(DT d)	DTD	timezone of d (as day-time-duration)
`tz`(DT d)	STR	timezone of d (as a string)

- DT: date–time
- DTD: day–time–duration

SPARQL Functions: Hashing

Function	Return type and value	
md5(str s)	str	MD5 hash of s
sha1(str s)	str	SHA1 hash of s
sha256(str s)	str	SHA256 hash of s
sha384(str s)	str	SHA384 hash of s
sha512(str s)	str	SHA512 hash of s

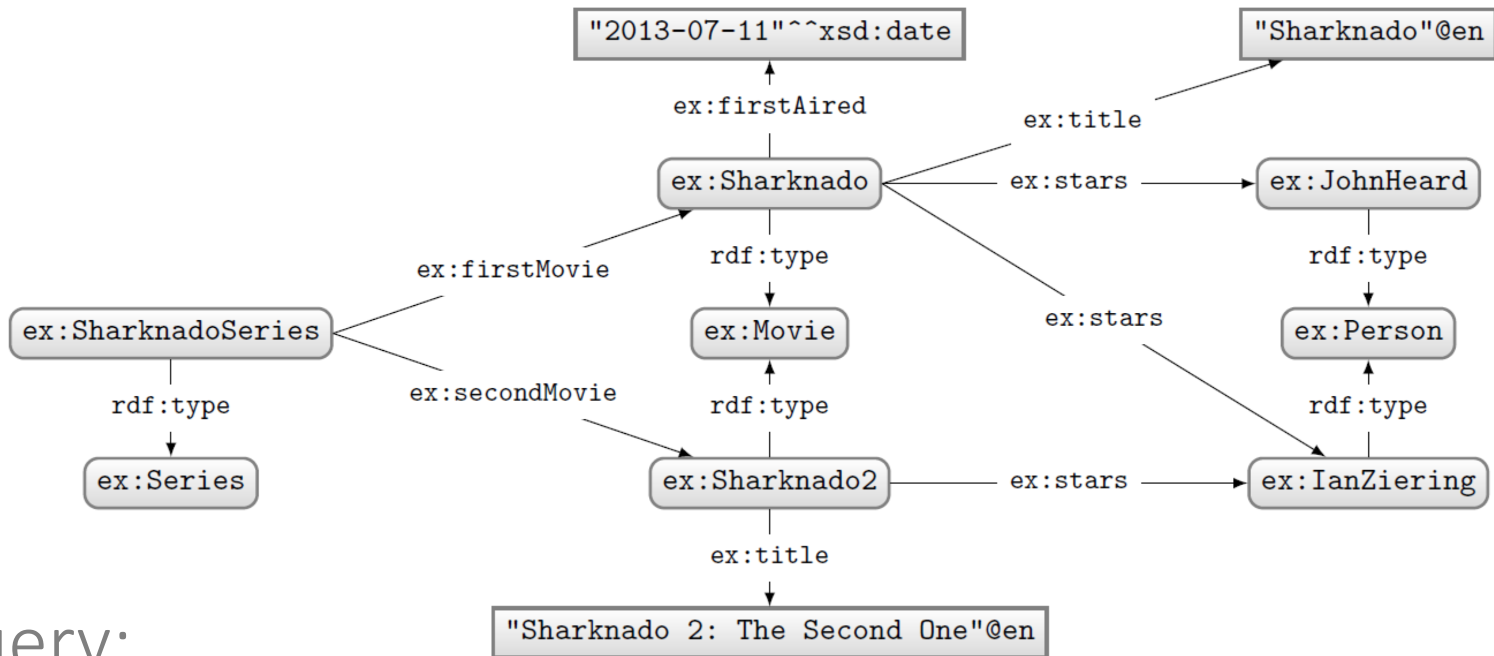
SPARQL: Casting between types

- Y: always allowed
- N: never allowed
- M: depends on value
  - e.g., `"2"^^xsd:string` can be mapped to `xsd:int` but `"P"^^xsd:string` cannot

From \ To	str	flt	dbl	dec	int	dT	bool
str	Y	M	M	M	M	M	M
flt	Y	Y	Y	M	M	N	Y
dbl	Y	Y	Y	M	M	N	Y
dec	Y	Y	Y	Y	Y	N	Y
int	Y	Y	Y	Y	Y	N	Y
dT	Y	N	N	N	N	Y	N
bool	Y	Y	Y	Y	Y	N	Y
IRI	Y	N	N	N	N	N	N
ltrl	Y	M	M	M	M	M	M

bool = xsd:boolean
dbl = xsd:double
flt = xsd:float
dec = xsd:decimal
int = xsd:integer
dT = xsd:dateTime
str = xsd:string
IRI = IRI
ltrl = `simple literal`

SPARQL: WHERE CLAUSE EXAMPLE (I)



Query:

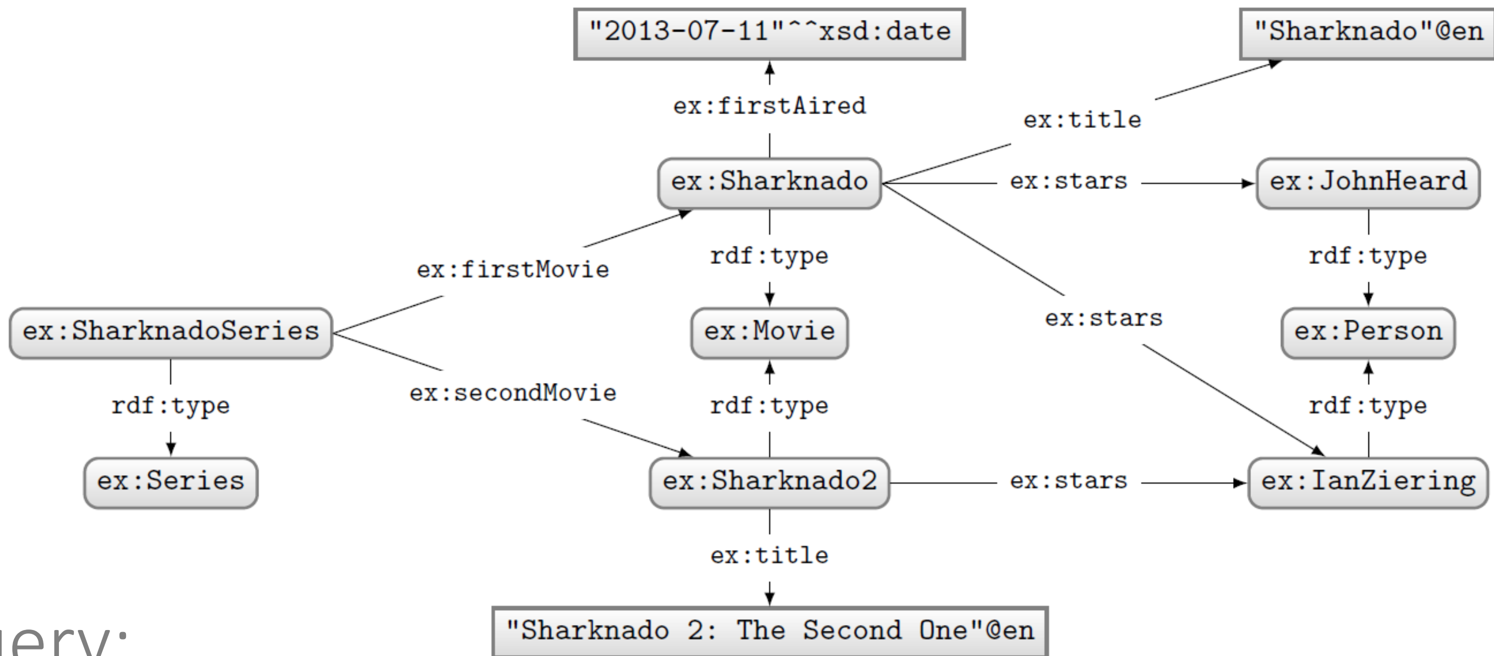
```
PREFIX ex: <http://ex.org/voc#>
SELECT *
WHERE {
  { ex:SharknadoSeries ex:firstMovie ?movie . }
  UNION
  { ex:SharknadoSeries ex:secondMovie ?movie . }
  OPTIONAL
  { ?movie ex:firstAired ?date . }
  ?movie ex:title ?title .
  FILTER(REGEX(STR(?title),"*[0-9]*"))
}
```

What solutions would this query return?

Solutions:

?movie	?title	?date
ex:Sharknado2	"Sharknado 2: The Second One"@en	

SPARQL: WHERE CLAUSE EXAMPLE (II)



Query:

```
PREFIX ex: <http://ex.org/voc#>
SELECT *
WHERE {
  ?movie a ex:Movie .
  OPTIONAL
  { ?movie ex:firstAired ?date . }
  FILTER(!BOUND(?date))
}
```

What solutions would this query return?

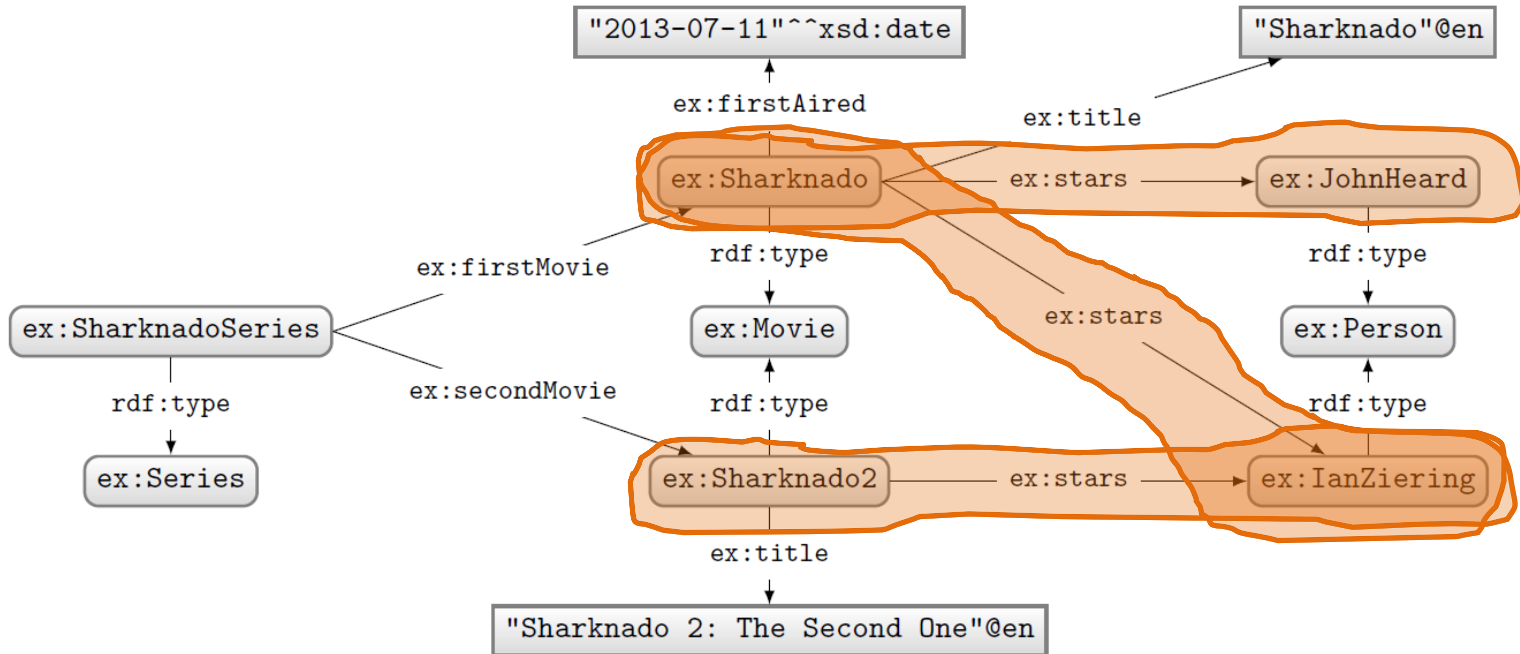
Solutions:

?movie	?date
ex:Sharknado2	

Can do negation!

SPARQL: Query Types

SPARQL: SELECT WITH *



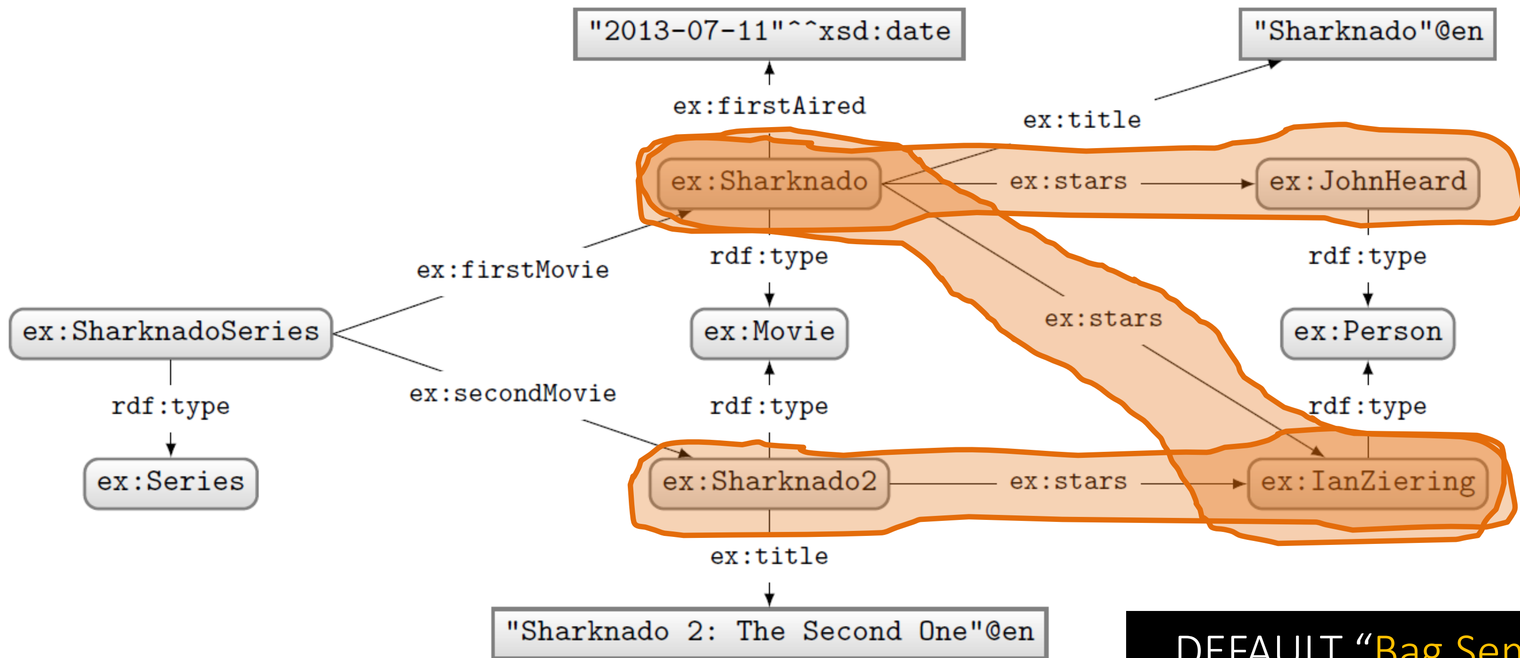
Query:

```
PREFIX ex: <http://ex.org/voc#>
SELECT *
WHERE {
  ?movie a ex:Movie.
  ?movie ex:stars ?star .
}
```

Solutions:

?movie	?star
ex:Sharknado	ex:JohnHeard
ex:Sharknado	ex:IanZiering
ex:Sharknado2	ex:IanZiering

SPARQL: SELECT WITH PROJECTION



DEFAULT "Bag Semantics"

(number of results returned must correspond to number of matches in data)

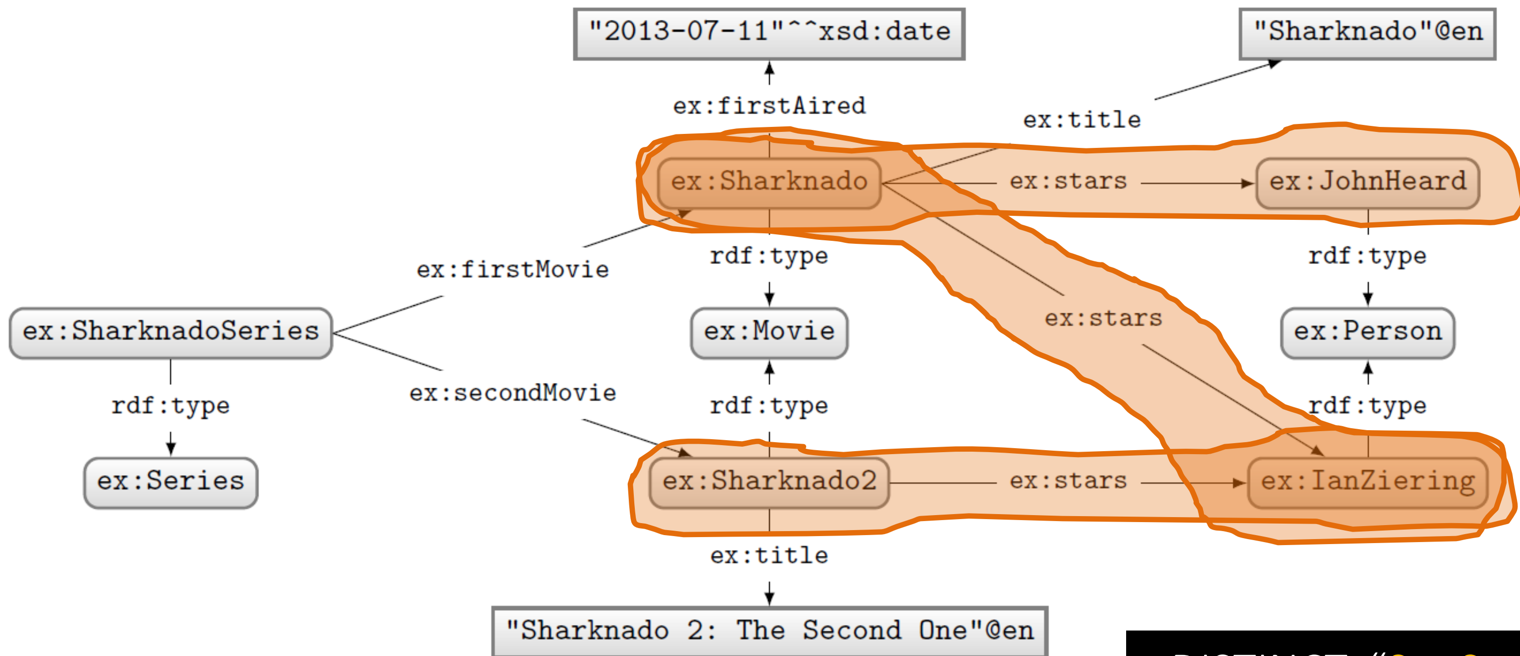
Query:

```
PREFIX ex: <http://ex.org/voc#>
SELECT ?star
WHERE {
  ?movie a ex:Movie.
  ?movie ex:stars ?star .
}
```

Solutions:

?star
ex:JohnHeard
ex:IanZiering
ex:IanZiering

SPARQL: SELECT WITH DISTINCT



DISTINCT: “Set Semantics”

(each result row must be unique)

Query:

```
PREFIX ex: <http://ex.org/voc#>
SELECT DISTINCT ?star
WHERE {
  ?movie a ex:Movie.
  ?movie ex:stars ?star .
}
```

Solutions:

?star
ex:JohnHeard
ex:IanZiering

SPARQL: SELECT WITH REDUCED

"2013-07-11"^^xsd:date
"Sharknado"@en
ex:firstAired
ex:title
ex:Sharknado
ex:stars
ex:JohnHeard
ex:firstMovie
rdf:type
rdf:type
ex:SharknadoSeries
ex:Movie
ex:stars
ex:Person
rdf:type
ex:secondMovie
rdf:type
rdf:type
ex:Series
ex:Sharknado2
ex:stars
ex:IanZiering
ex:title
"Sharknado 2: The Second One"@en

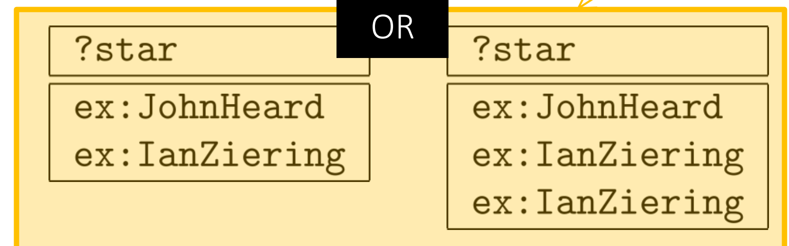
May (but do not <u>need</u> to) return duplicates.

(This allows the engine do whatever is most efficient.)

Query:

```
PREFIX ex: <http://ex.org/voc#>
SELECT REDUCED ?star
WHERE {
  ?movie a ex:Movie.
  ?movie ex:stars ?star .
}
```

Solutions:

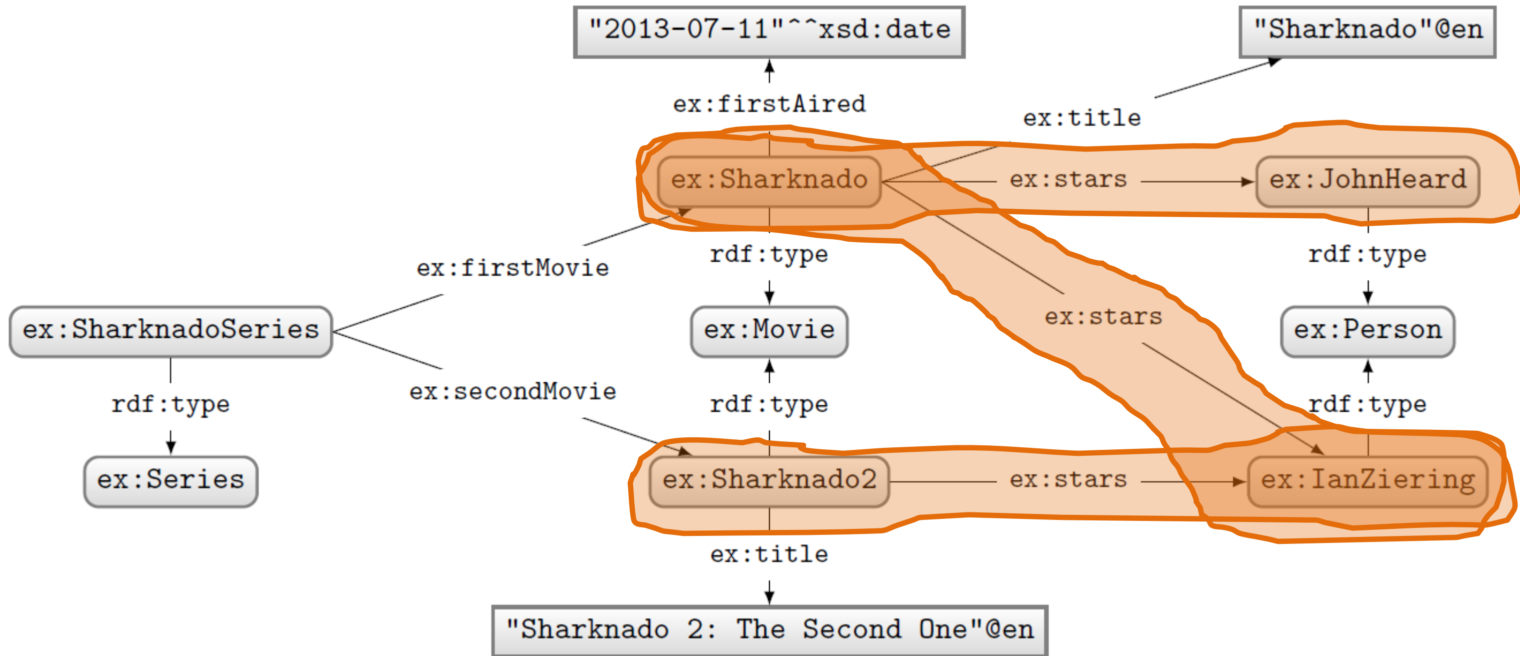


?star
ex:JohnHeard
ex:IanZiering

OR

?star
ex:JohnHeard
ex:IanZiering
ex:IanZiering

SPARQL: ASK



Query:

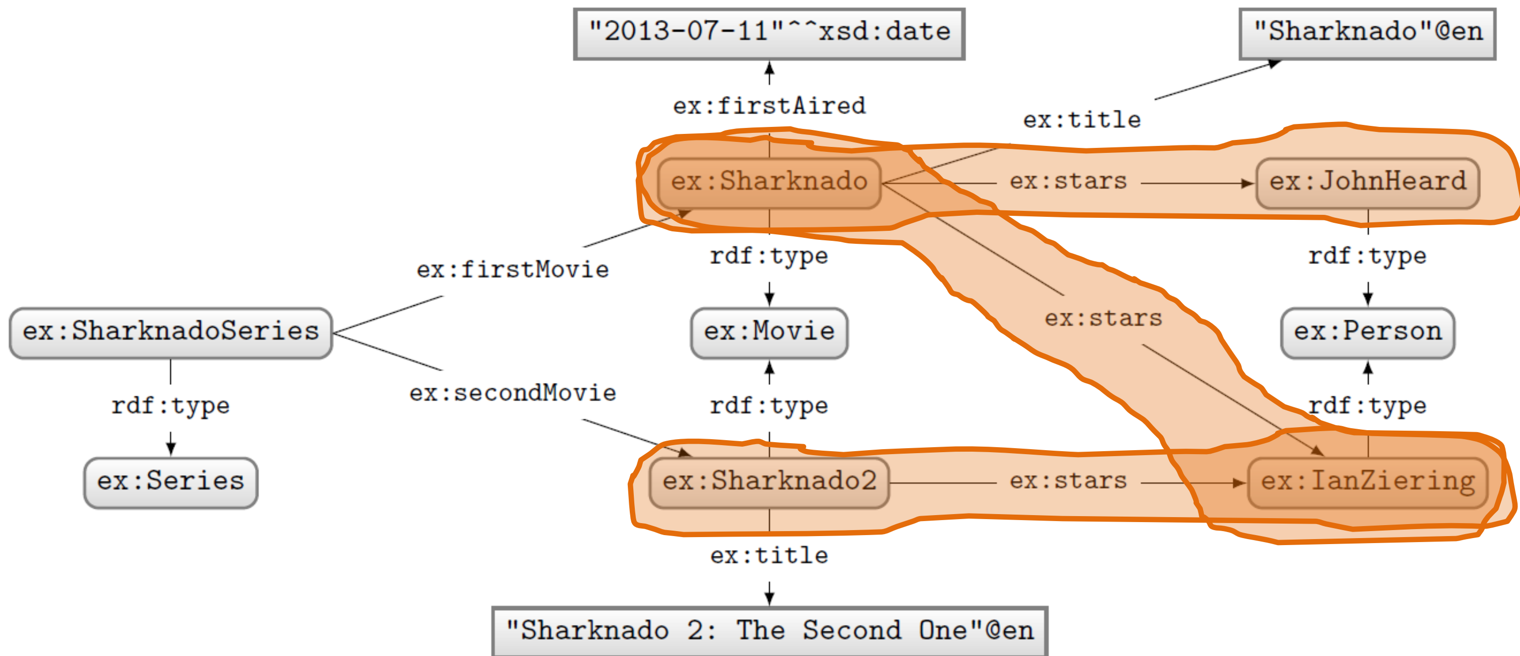
```
PREFIX ex: <http://ex.org/voc#>
ASK
WHERE {
  ?movie a ex:Movie.
  ?movie ex:stars ?star .
}
```

Solutions:

`true`

Returns `true` if there is a match, `false` otherwise.

SPARQL: CONSTRUCT



Query:

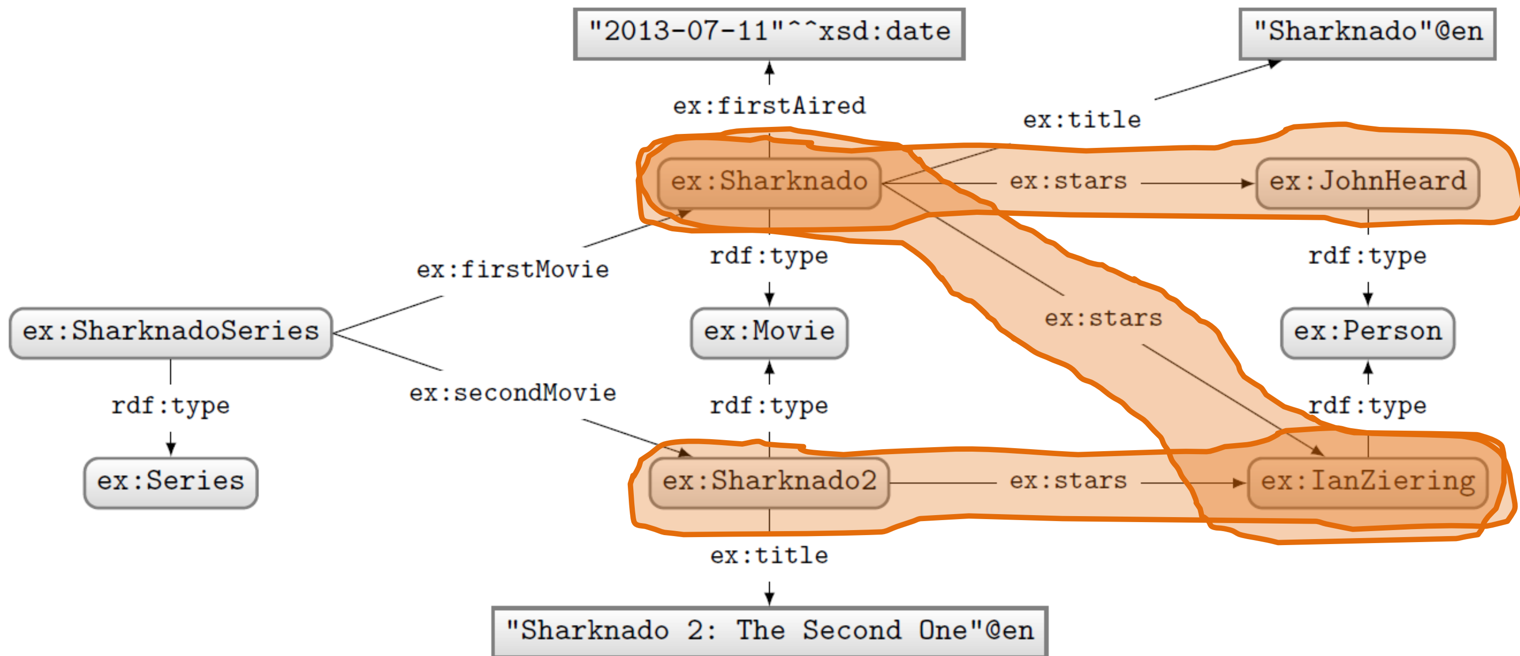
```
PREFIX ex: <http://ex.org/voc#>
CONSTRUCT { ?star ex:job ex:Actor }
WHERE {
  ?movie a ex:Movie.
  ?movie ex:stars ?star .
}
```

Solutions:

```
@prefix ex: <http://ex.org/voc#> .
ex:JohnHeard ex:job ex:Actor .
ex:IanZiering ex:job ex:Actor .
```

Returns an RDF graph based on the matching CONSTRUCT clause.

SPARQL: DESCRIBE (NON-NORMATIVE FEATURE)



Query:

```
PREFIX ex: <http://ex.org/voc#>
DESCRIBE ?star
WHERE {
  ?movie a ex:Movie.
  ?movie ex:stars ?star .
}
```

Solutions:

```
@prefix ex: <http://ex.org/voc#> .
ex:JohnHeard a ex:Person .
ex:IanZiering a ex:Person .
```

Returns an RDF graph "describing" the returned results. This is an non-normative feature. What should be returned is left open.

SPARQL: Solution Modifiers

SOLUTION MODIFIERS

- ORDER BY (DESC)
  - Can be used to order results
  - By default ascending (ASC), can specify descending (DESC)
  - Can order lexicographically on multiple items
- LIMIT *n*
  - Return only *n* results
- OFFSET *n*
  - Skip the first *n* results

Without ORDER BY results for queries with LIMIT or OFFSET might be non-deterministic!

How might we ask for the second and third most recently released movies?

```
PREFIX ex: <http://ex.org/voc#>
SELECT ?movie
WHERE { ?movie ex:firstAired ?date . }
ORDER BY DESC(?date)
LIMIT 2
OFFSET 1
```

Solution modifiers

The order of execution is always:
ORDER → OFFSET → LIMIT
Changing the order of LIMIT/OFFSET makes no difference to the query solutions.

ORDER BY must come before LIMIT/OFFSET according to the query syntax

How might we ask for the second and third most recently released movies?

```
PREFIX ex: <http://ex.org/voc#>
SELECT ?movie
WHERE { ?movie ex:firstAired ?date . }
ORDER BY DESC(?date)
LIMIT 2
OFFSET 1
```

≡

```
PREFIX ex: <http://ex.org/voc#>
SELECT ?movie
WHERE { ?movie ex:firstAired ?date . }
ORDER BY DESC(?date)
OFFSET 1
LIMIT 2
```

SPARQL: Named Graphs

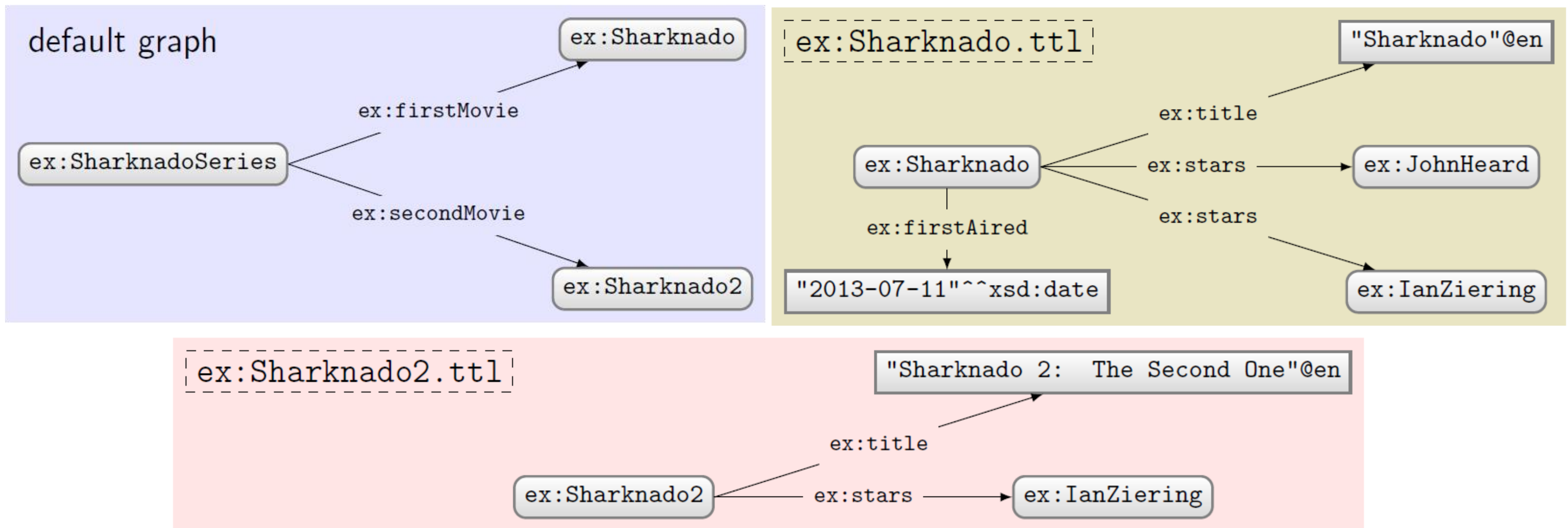
SPARQL: Named Graphs

SPARQL defined over a Dataset

- A dataset $D = \{G, (G_1, n_1), \ldots, (G_k, n_k)\}$
- $G, G_1, \ldots, G_k$ are RDF graphs
- $n_1, \ldots, n_k$ are pairwise distinct IRIs
- G is called the **default graph**
- each (G_i, n_i) is a **named graph** $(1 \leq i \leq n)$

Core idea: SPARQL can support multiple RDF graphs, not just one.
When using SPARQL, you can partition your data into multiple graphs.
The default graph is chosen if you don't specify a graph.
Otherwise you can explicitly select a named graph using it's IRI name.

An example dataset

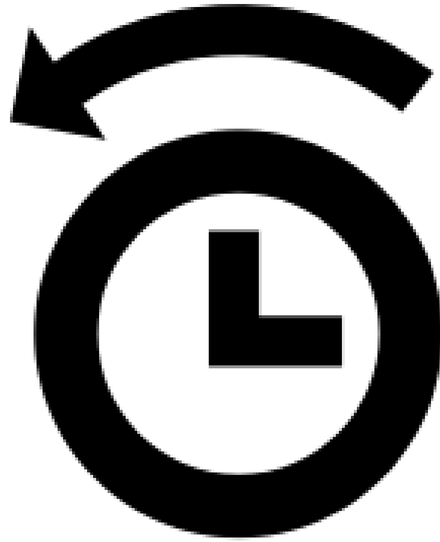


CREATING A DATASET FOR A QUERY

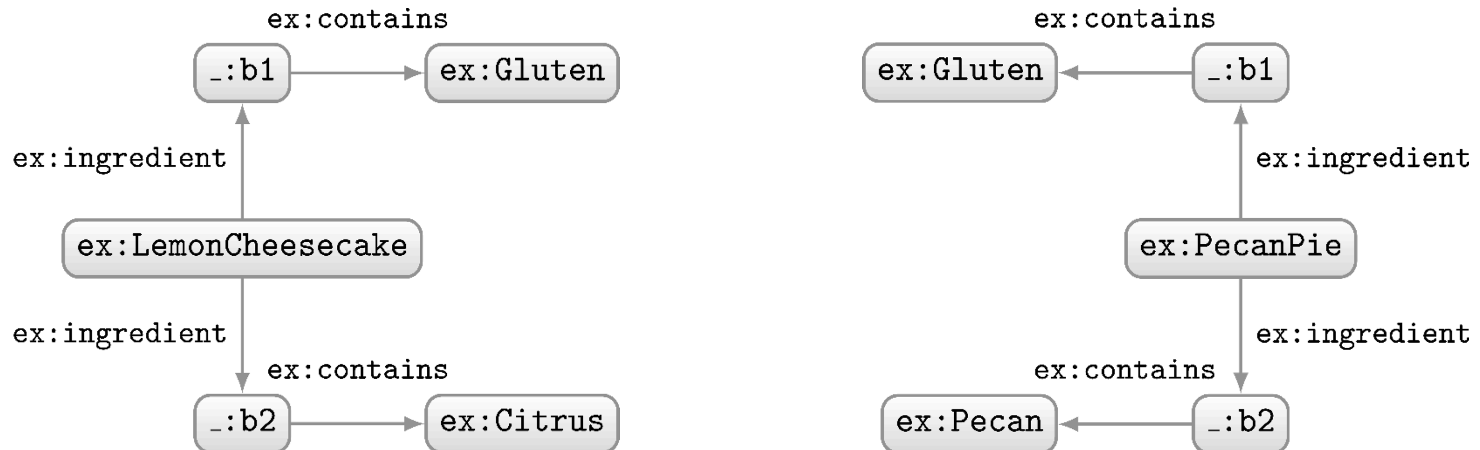
- Say an index has dataset $D = \{G, (G_1, n_1), \ldots, (G_k, n_k)\}$
- A query can pick an active dataset from the named graphs

- FROM
  - Used to define a default graph for the query using graph names
  - If multiple graphs are specified, they are RDF-merged
- FROM NAMED
  - Used to select the active named graphs to be used for the query

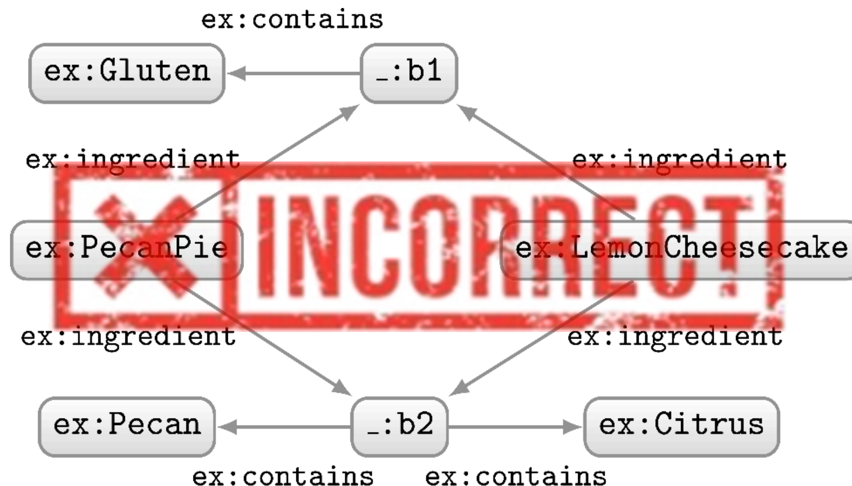
Using either feature clears the index dataset



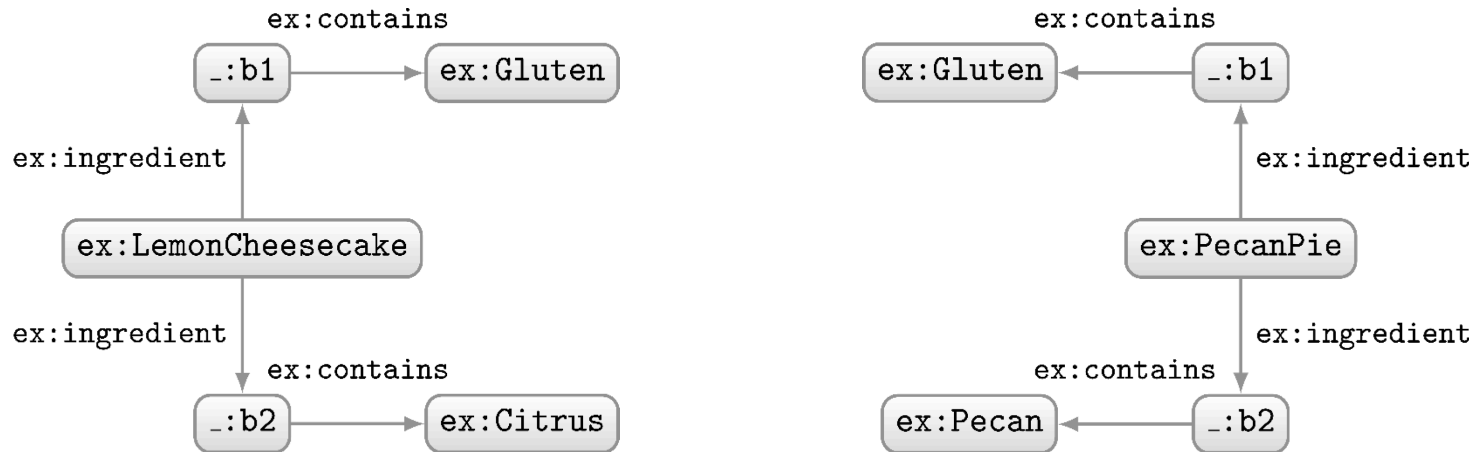
RDF MERGE: A QUICK REMINDER



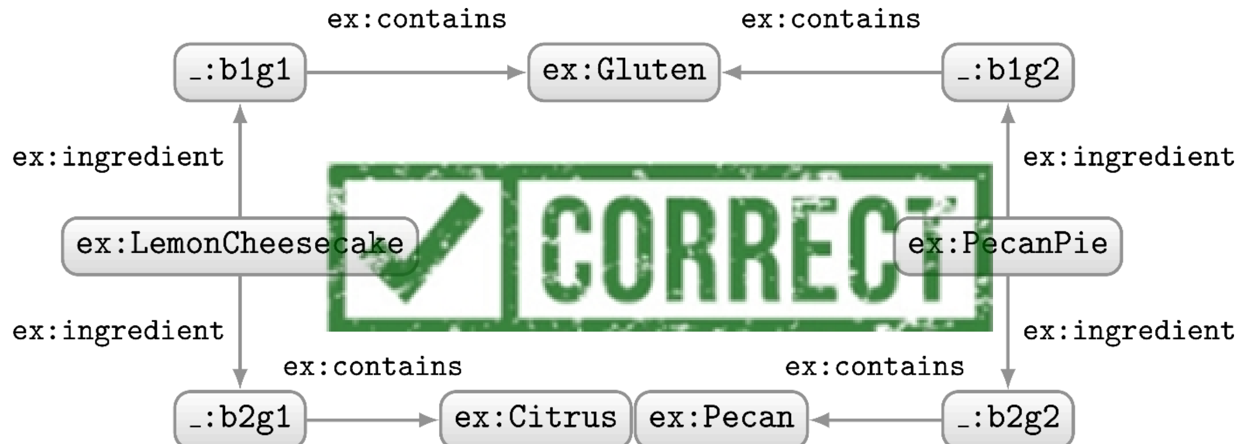
How should we combine these two RDF graphs?



RDF merge: A quick reminder



How should we combine these two RDF graphs?



Creating a dataset for a query

- Indexed dataset: $D = \{G, (G_1, n_1), \ldots, (G_k, n_k)\}$
- Query dataset (no `FROM`/`FROM NAMED`): D
- Query dataset D' (example 1):

  `FROM` n_1
  `FROM` n_2
  `FROM NAMED` n_3
  `FROM NAMED` n_4

  $\rightarrow D' = \{G_1 \uplus G_2, (G_3, n_3), (G_4, n_4)\}$

- Query dataset D' (example 2):

  `FROM` n_1
  `FROM` n_2

  $\rightarrow D' = \{G_1 \uplus G_2\}$

($\uplus$ indicates RDF merge)

Creating a dataset for a query

- Indexed dataset: $D = \{G, (G_1, n_1), \ldots, (G_k, n_k)\}$
- Query dataset (no `FROM`/`FROM NAMED`): D
- Query dataset D' (example 1):

```
FROM n1
FROM n2
FROM NAMED n3
FROM NAMED n4
```

$\rightarrow D' = \{G_1 \uplus G_2, (G_3, n_3), (G_4, n_4)\}$

- Query dataset D' (example 2):

```
FROM n1
FROM n2
```

$\rightarrow D' = \{G_1 \uplus G_2\}$

($\uplus$ indicates RDF merge)

Creating a dataset for a query

- Indexed dataset: $D = \{G, (G_1, n_1), \ldots, (G_k, n_k)\}$
- Query dataset (no `FROM`/`FROM NAMED`): D
- Query dataset D' (example 1):

```
FROM n1
FROM n2
FROM NAMED n3
FROM NAMED n4
```

$\rightarrow D' = \{G_1 \uplus G_2, (G_3, n_3), (G_4, n_4)\}$

- Query dataset D' (example 2):

```
FROM n1
FROM n2
```

$\rightarrow D' = \{G_1 \uplus G_2\}$

($\uplus$ indicates RDF merge)

Creating a dataset for a query

- Indexed dataset: $D = \{G, (G_1, n_1), \ldots, (G_k, n_k)\}$
- Query dataset (no FROM/FROM NAMED): D
- Query dataset D' (example 1):

```
FROM n1
FROM n2
FROM NAMED n3
FROM NAMED n4
```

$\rightarrow D' = \{G_1 \uplus G_2, (G_3, n_3), (G_4, n_4)\}$

- Query dataset D' (example 2):

```
FROM n1
FROM n2
```

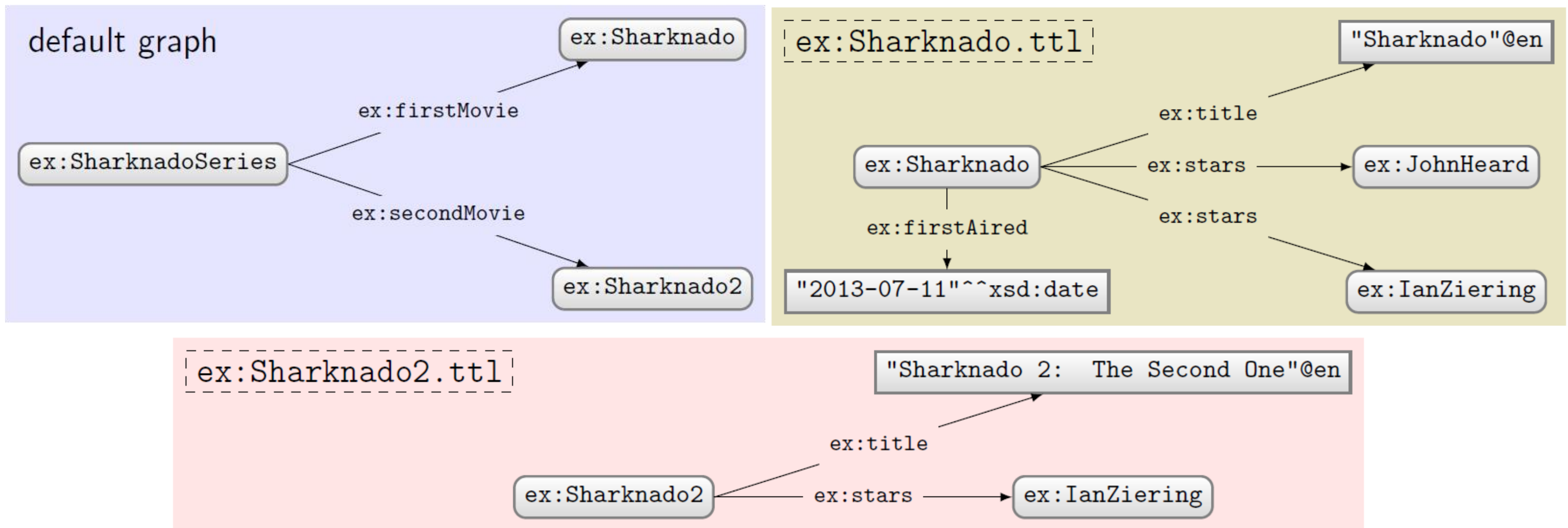
$\rightarrow D' = \{G_1 \uplus G_2\}$

($\uplus$ indicates RDF merge)

Querying the named graphs in a dataset

- We can query parts of the dataset using GRAPH
  - Specifies the IRI of a named graph over which the pattern is evaluated
  - Can also be a variable that ranges over all named graphs
  - Does not access the default graph!
  - If not specified, default graph is accessed

An example query



Query:

```
PREFIX ex: <http://ex.org/voc#>
SELECT DISTINCT ?s
WHERE { ?s ?p ?o }
```

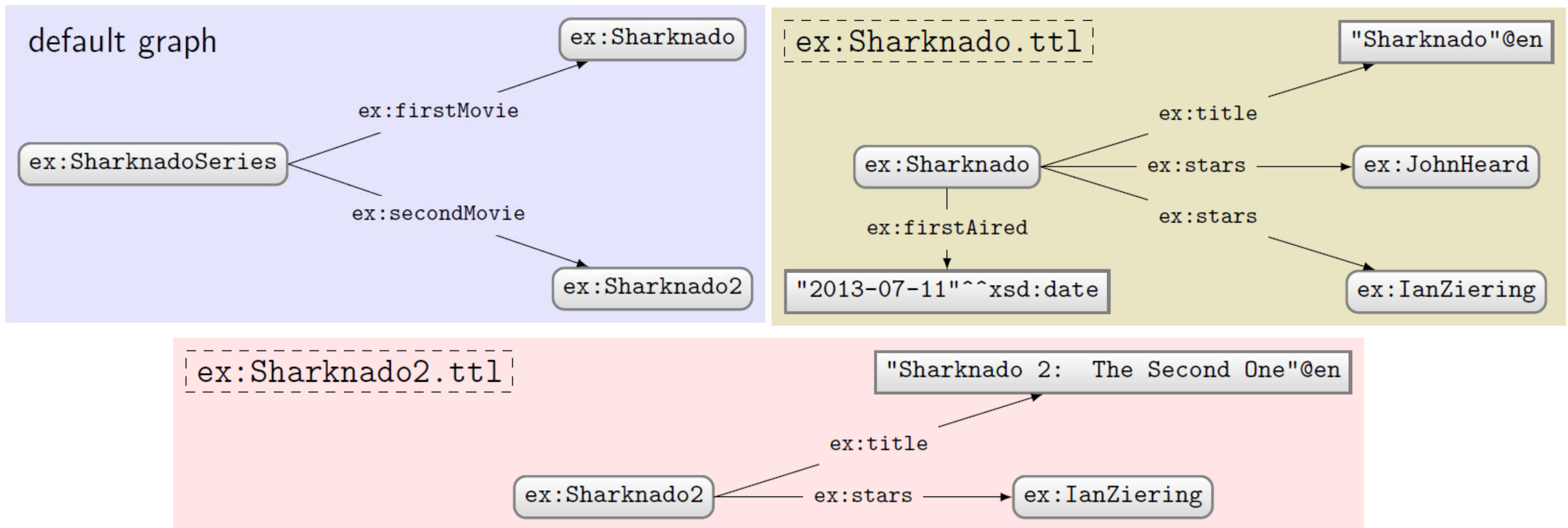
What solutions would this query return?

Solutions:

?s
ex:SharknadoSeries

No GRAPH clause so answers come from default graph only

USING FROM



Query:

```
PREFIX ex: <http://ex.org/voc#>
FROM ex:Sharknado.ttl
FROM ex:Sharknado2.ttl
SELECT DISTINCT ?s
WHERE { ?s ?p ?o }
```

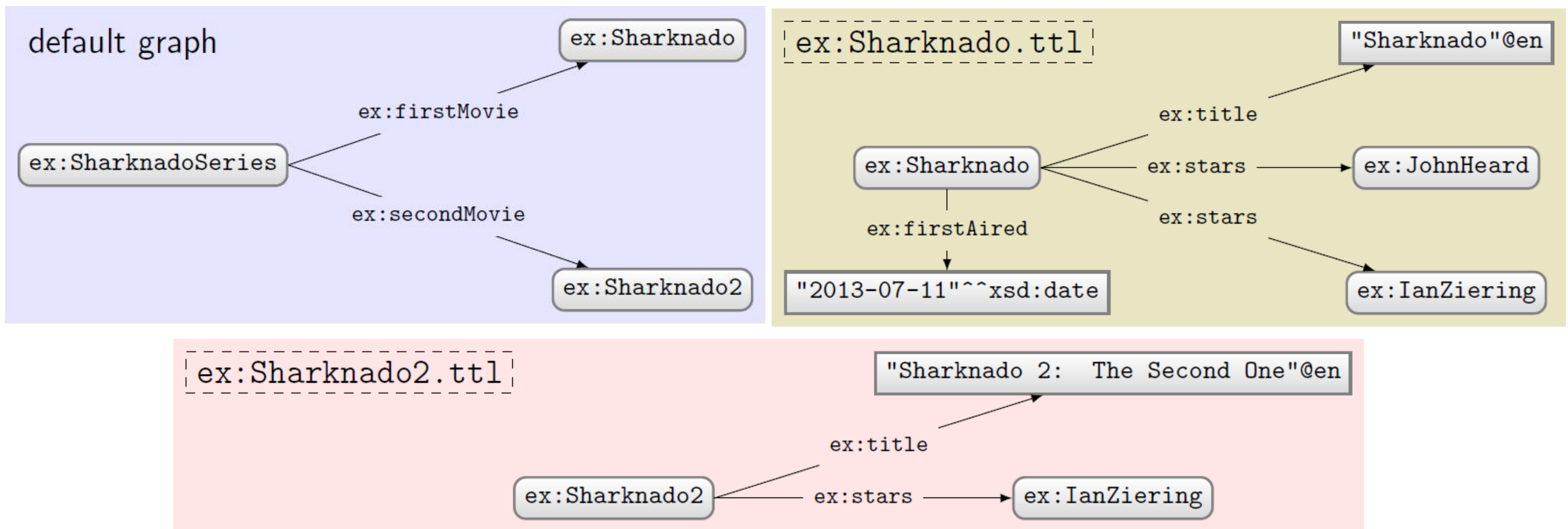
What solutions would this query return?

Solutions:

?s
ex:Sharknado
ex:Sharknado2

No GRAPH clause so answers come from default graph defined by FROM (old default graph cleared)

USING FROM NAMED



Query:

```
PREFIX ex: <http://ex.org/voc#>
FROM NAMED ex:Sharknado.ttl
SELECT DISTINCT ?s
WHERE { ?s ?p ?o }
```

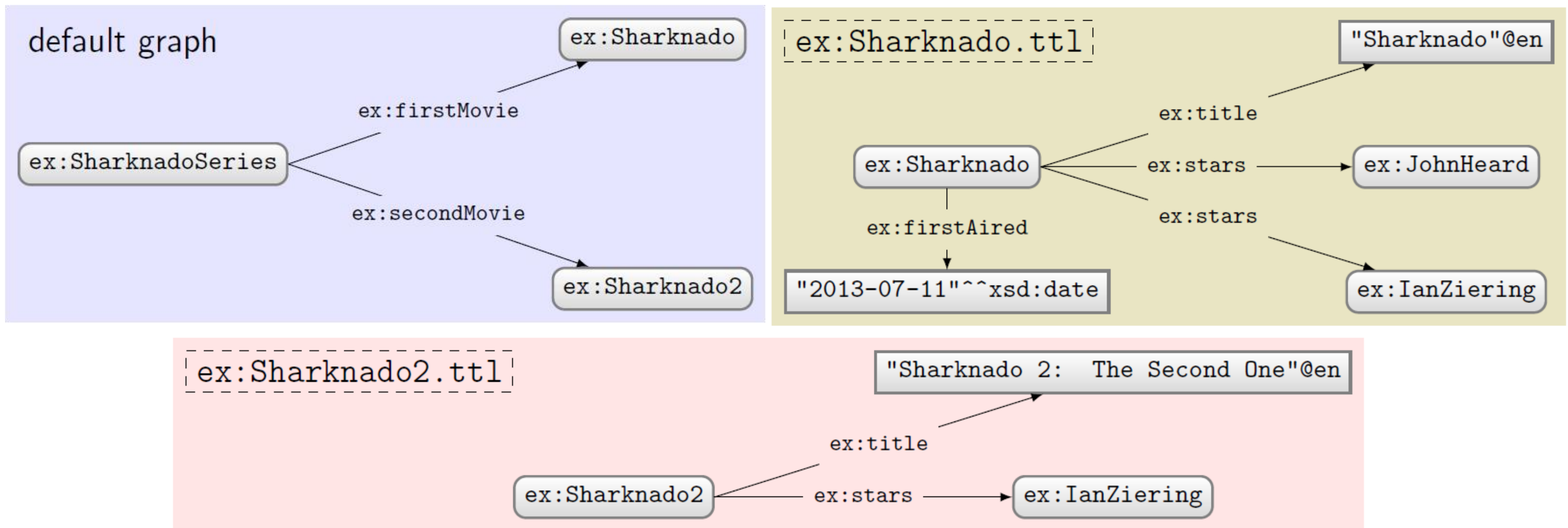
What solutions would this query return?

Solutions:

?s

No GRAPH clause so answers come from default graph, which is empty (since old default graph cleared)!

USING GRAPH WITH A VARIABLE



Query:

```
PREFIX ex: <http://ex.org/voc#>
SELECT DISTINCT ?s ?g
WHERE { GRAPH ?g { ?s ?p ?o } }
```

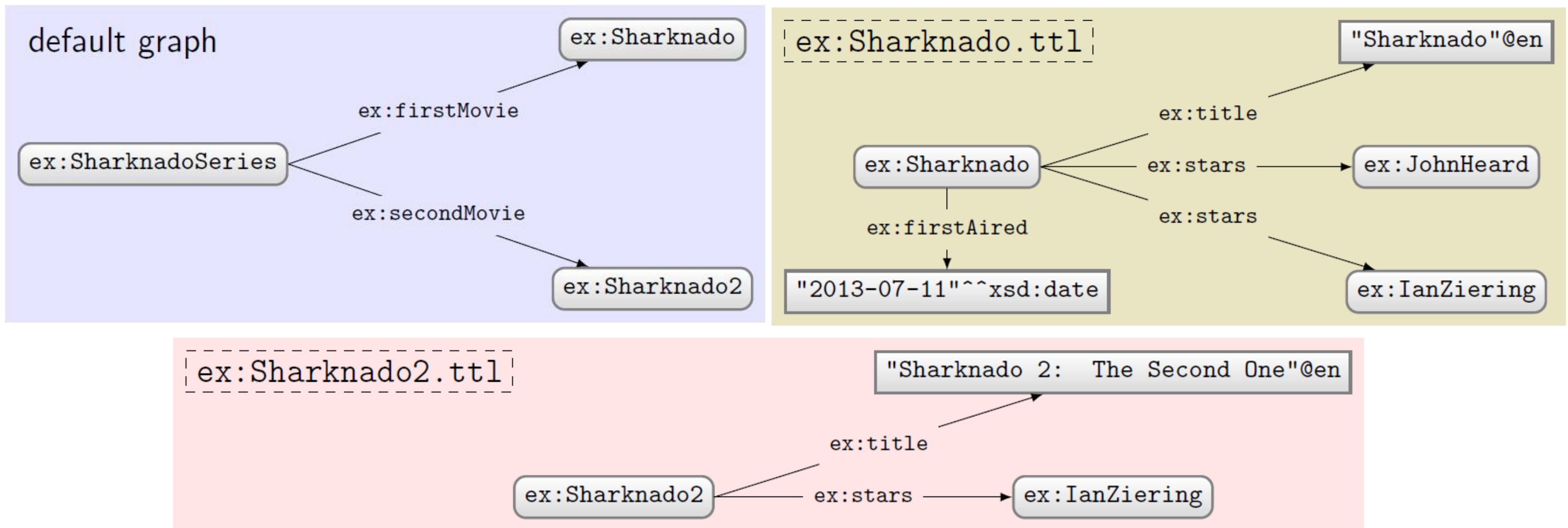
What solutions would this query return?

Solutions:

?s	?g
ex:Sharknado	ex:Sharnado.ttl
ex:Sharknado2	ex:Sharnado2.ttl

GRAPH clause only ranges over the named graphs.

USING GRAPH WITH A NAME



Query:

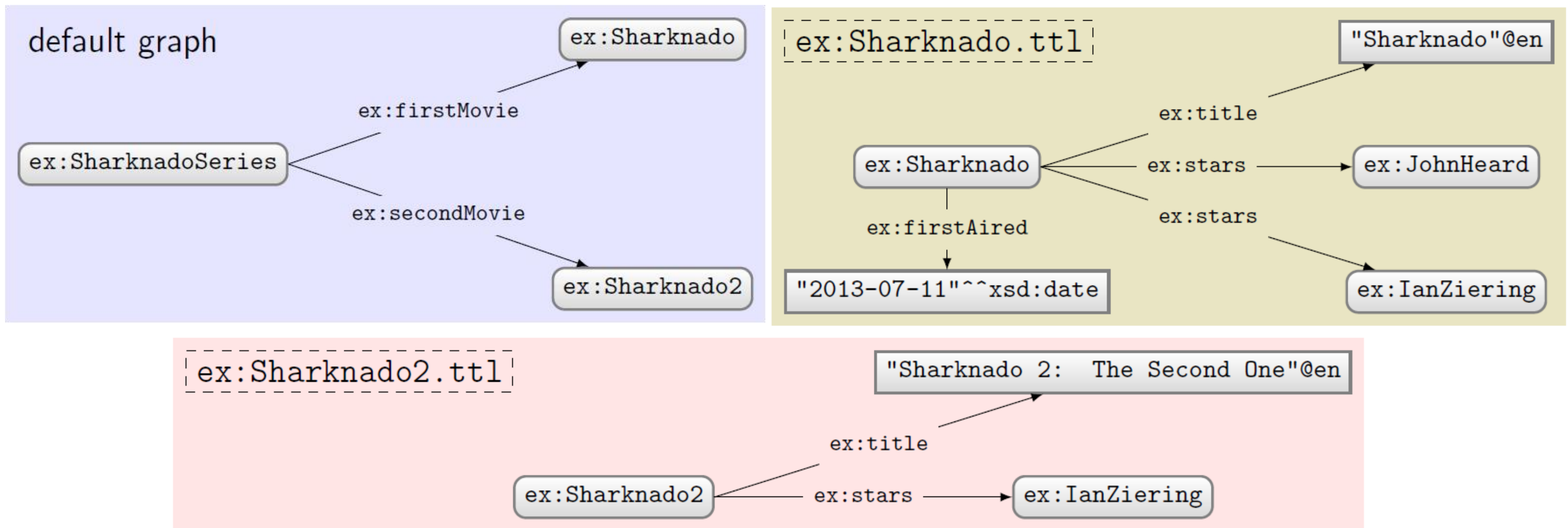
```
PREFIX ex: <http://ex.org/voc#>
SELECT DISTINCT ?s
WHERE {
  GRAPH ex:Sharknado.ttl { ?s ?p ?o }
}
```

What solutions would this query return?

Solutions:

?s
ex:Sharknado

Using GRAPH with FROM



Query:

```
PREFIX ex: <http://ex.org/voc#>
FROM ex:Sharknado.ttl
SELECT DISTINCT ?s ?g
WHERE {
  GRAPH ?g { ?s ?p ?o }
}
```

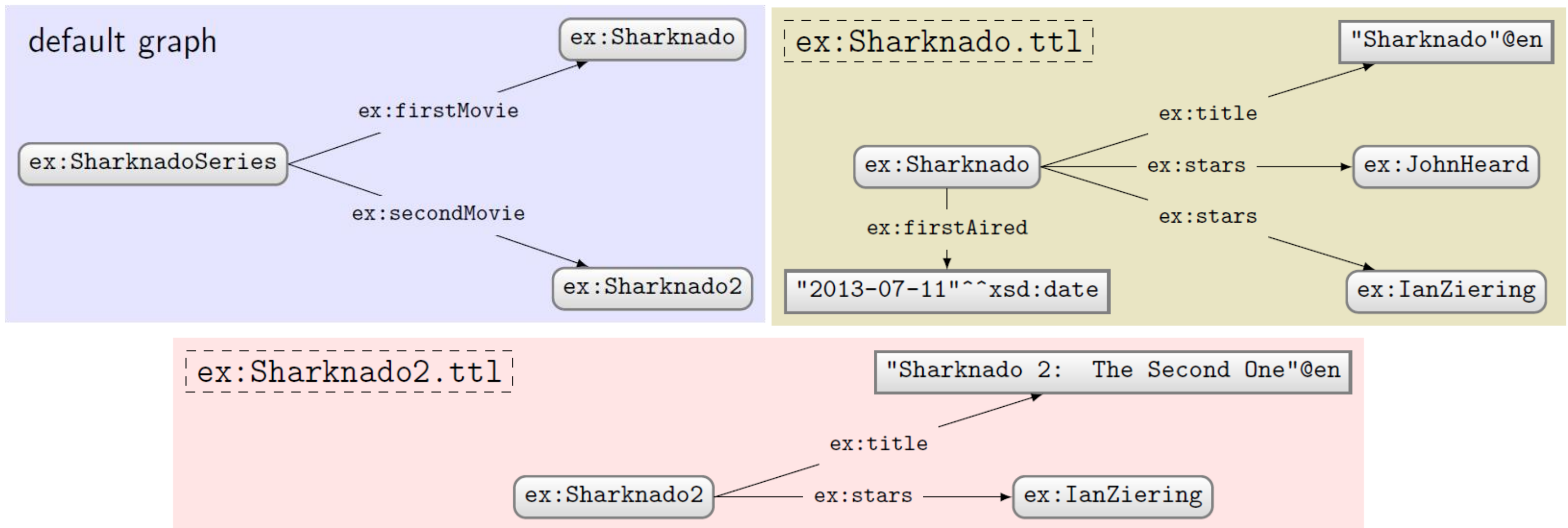
No named graphs specified!

What solutions would this query return?

Solutions:

?s	?g

USING GRAPH WITH FROM NAMED



Query:

```
PREFIX ex: <http://ex.org/voc#>
FROM NAMED ex:Sharknado.ttl
SELECT DISTINCT ?s ?g
WHERE {
  GRAPH ?g { ?s ?p ?o }
}
```

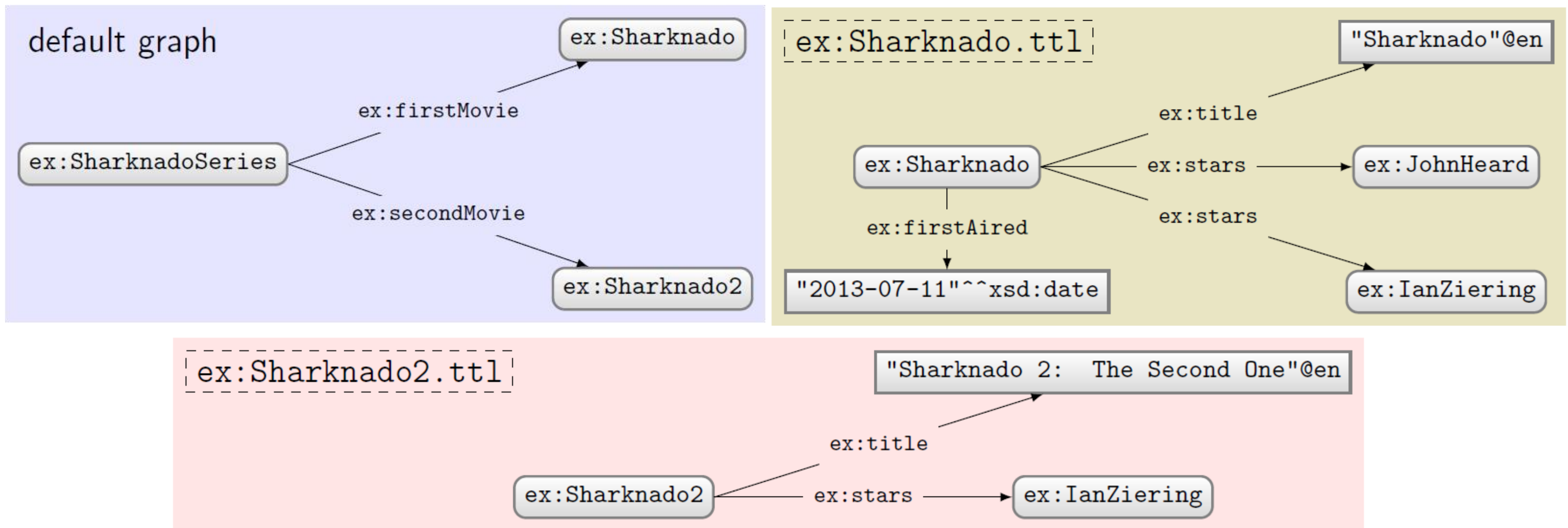
What solutions would this query return?

Solutions:

?s	?g
ex:Sharknado	ex:Sharnado.ttl

GRAPH accesses the one and only named graph

USING GRAPH WITH FROM AND FROM NAMED



Query:

```
PREFIX ex: <http://ex.org/voc#>
FROM ex:Sharknado2.ttl
FROM NAMED ex:Sharknado.ttl
SELECT DISTINCT ?x ?q
WHERE {
  GRAPH ?g { ?s ?p ?o }
  ?x ?q ?o .
}
```

What solutions would this query return?

Solutions:

?x	?q
ex:Sharknado2	ex:stars

Questions?