How to query a database
you've never seen before

http://identifiers.org/ncbigene/672

ID

http://identifiers.org/ncbigene/672

Namespace

http://identifiers.org/ncbigene/

672

PREFIX ns: <http://identifiers.org/ncbigene/>

672

The prefix can be any series of characters; you can choose whatever you wish

PREFIX ncbi: <http://identifiers.org/ncbigene/>

672

PREFIX   ncbi: <http://identifiers.org/ncbigene/>

ncbi:672

PREFIX   ncbi: <http://identifiers.org/ncbigene/>

ncbi:672

And for the rest of the document (RDF or SPARQL)
you refer to BRCA1 as ncbi:672

easy!

Common Namespaces in SPARQL

PREFIX **rdf:** <http://www.w3.org/1999/02/22-rdf-syntax-ns#>

For example **rdf:type**

PREFIX **rdfs:** <http://www.w3.org/2000/01/rdf-schema#>

For example **rdfs:label**

PREFIX **dc:** <http://purl.org/dc/terms/>

Common Namespaces in Biomedicine

PREFIX   **obo**:   <http://purl.obolibrary.org/obo/>

For example: **obo:NCBITaxon_9606**   ("Human")

PREFIX   **sio**:   <http://semanticscience.org/resource/>

For example: **sio:SIO_000300**   ("has value")

PREFIX   **up**:   <http://purl.uniprot.org/core/>

http://prefix.cc

For example: http://prefix.cc/edam

Often this is done for you....

Expression Atlas SPARQL Endpoint

Enter SPARQL Query

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX dcterms: <http://purl.org/dc/terms/>
PREFIX obo: <http://purl.obolibr
PREFIX sio: <http://semanticscie
PREFIX efo: <http://www.ebi.ac.u
PREFIX atlas: <http://rdf.ebi.ac
PREFIX atlasterms: <http://rdf.e
```

UniProt

SPARQL   Downloads

Your SPARQL query

Add common prefixes

```
1  PREFIX up:<http://purl.uniprot.org/core/>
2  PREFIX keywords:<http://purl.uniprot.org/keywords/>
3  PREFIX uniprotkb:<http://purl.uniprot.org/uniprot/>
4  PREFIX taxon:<http://purl.uniprot.org/taxonomy/>
5  PREFIX ec:<http://purl.uniprot.org/enzyme/>
6  PREFIX rdf:<http://www.w3.org/1999/02/22-rdf-syntax-ns#>
7  PREFIX rdfs:<http://www.w3.org/2000/01/rdf-schema#>
8  PREFIX skos:<http://www.w3.org/2004/02/skos/core#>
9  PREFIX owl:<http://www.w3.org/2002/07/owl#>
10 PREFIX bibo:<http://purl.org/ontology/bibo/>
11 PREFIX dc:<http://purl.org/dc/terms/>
12 PREFIX xsd:<http://www.w3.org/2001/XMLSchema#>
13 PREFIX faldo:<http://biohackathon.org/resource/faldo#>
14
```
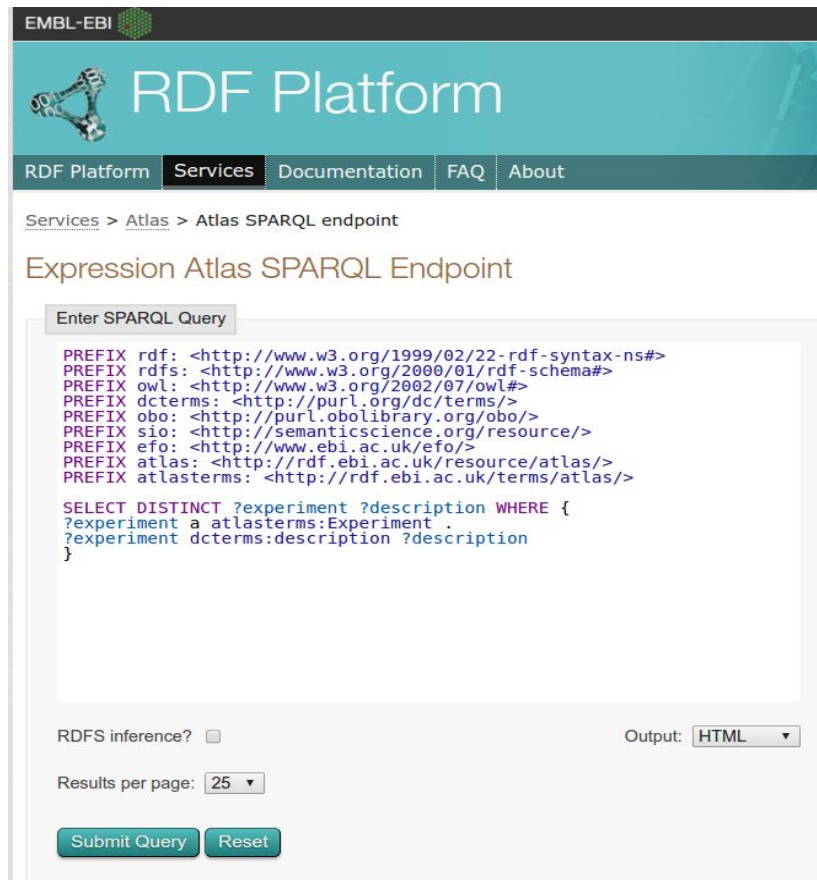
Let's start SPARQLing!

Go to: https://www.ebi.ac.uk/rdf/services/atlas/sparql

Or   http://wwwdev.ebi.ac.uk/rdf/services/sparql

RDF Platform

RDF Platform | **Services** | Documentation | FAQ | About

Services > Atlas > Atlas SPARQL endpoint

Expression Atlas SPARQL Endpoint

Enter SPARQL Query

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX dcterms: <http://purl.org/dc/terms/>
PREFIX obo: <http://purl.obolibrary.org/obo/>
PREFIX sio: <http://semanticscience.org/resource/>
PREFIX efo: <http://www.ebi.ac.uk/efo/>
PREFIX atlas: <http://rdf.ebi.ac.uk/resource/atlas/>
PREFIX atlasterms: <http://rdf.ebi.ac.uk/terms/atlas/>

SELECT DISTINCT ?experiment ?description WHERE {
?experiment a atlasterms:Experiment .
?experiment dcterms:description ?description
}
```

They give you an example query to help you get started

RDFS inference? ☐   Output: HTML ▾

Results per page: 25 ▾

Submit Query   Reset

We want to explore the array expression data for **BRCA1**

We know the URI is:
<http://rdf.ebi.ac.uk/resource/ensembl/ENSG00000012048>

We know that Array Express has expression data

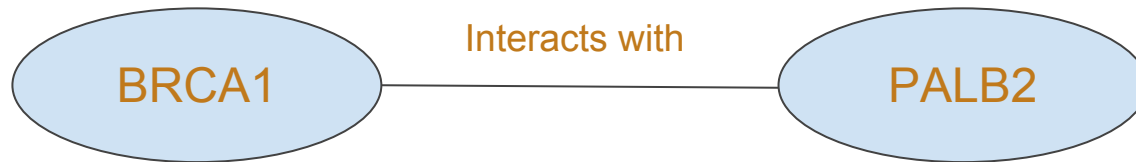How do we begin, when we don't know anything about the content/structure of that database?

Exploratory SPARQL

Patterns you can use to explore any
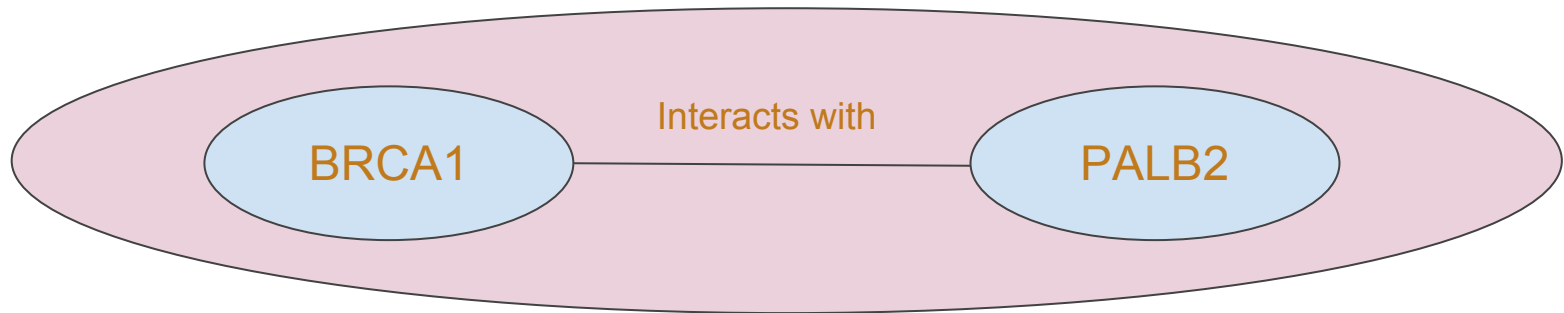SPARQL endpoint

Named Graphs
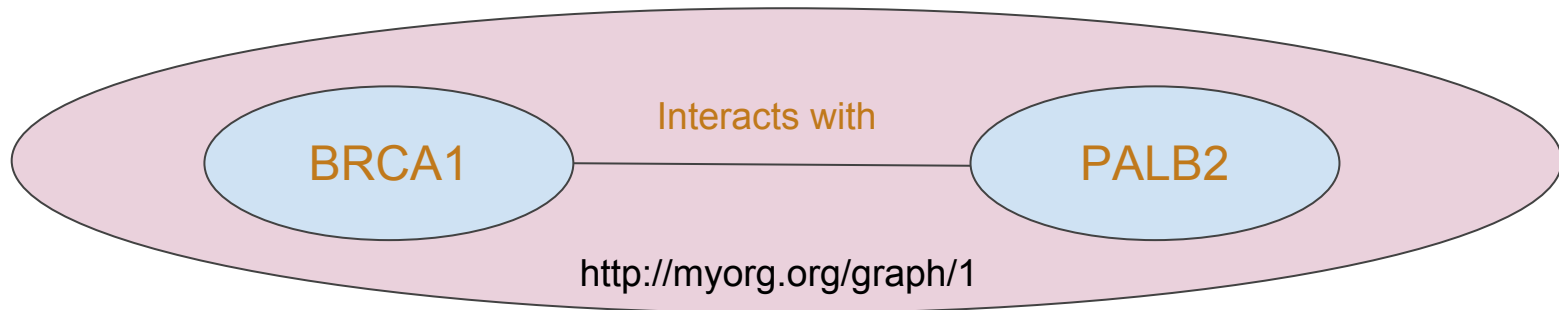
Named Graphs are a way to group-together sets of triples

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Named Graphs are a way to group-together sets of triples

The "name" of a graph is another URI

The EBI RDF Platform Named Graphs

title	namedGraph	description
ChEMBL RDF	<http://rdf.ebi.ac.uk/dataset/chembl>	ChEMBL is a database of bioactive drug-like small molecules, it contains 2-D structures, calculated properties (e.g. logP, Molecular Weight, Lipinski Parameters, etc.) and abstracted bioactivities (e.g. binding constants, pharmacology and ADMET data). The data is abstracted and curated from the primary scientific literature, and cover a significant fraction of the SAR and discovery of modern drugs.
Atlas	<http://rdf.ebi.ac.uk/dataset/expressionatlas>	Expression Atlas is an open science resource that gives users a powerful way to find information about gene and protein expression.
Biomodels	<http://rdf.ebi.ac.uk/dataset/biomodels>	BioModels Database is a repository of computational models of biological processes. Models described from literature are manually curated and enriched with cross-references
Biosamples RDF	<http://rdf.ebi.ac.uk/dataset/biosamples>	BioSamples stores and supplies descriptions and metadata about biological samples used in research and development by academia and industry
Ailuropoda melanoleuca	<http://rdf.ebi.ac.uk/dataset/ailuropoda_melanoleuca>	Ailuropoda melanoleuca Ensembl RDF
Anas platyrhynchos	<http://rdf.ebi.ac.uk/dataset/anas_platyrhynchos>	Anas platyrhynchos Ensembl RDF
Anolis carolinensis	<http://rdf.ebi.ac.uk/dataset/anolis_carolinensis>	Anolis carolinensis Ensembl RDF
Astyanax mexicanus	<http://rdf.ebi.ac.uk/dataset/astyanax_mexicanus>	Astyanax mexicanus Ensembl RDF
Bos taurus	<http://rdf.ebi.ac.uk/dataset/bos_taurus>	Bos taurus Ensembl RDF

The EBI RDF Platform Named Graphs

title	namedGraph	description
ChEMBL RDF	<http://rdf.ebi.ac.uk/dataset/chembl>	ChEMBL is a database of bioactive drug-like small molecules, it contains 2-D structures, calculated properties (e.g. logP, Molecular Weight, Lipinski Parameters, etc.) and abstracted bioactivities (e.g. binding constants, pharmacology and ADMET data). The data is abstracted and curated from the primary scientific literature, and cover a significant fraction of the SAR and discovery of modern drugs.
Atlas	<http://rdf.ebi.ac.uk/dataset/expressionatlas>	Expression Atlas is an open science resource that gives users a powerful way to find information about gene and protein expression.
Biomodels	<http://rdf.ebi.ac.uk/dataset/biomodels>	BioModels Database is a repository of computational models of biological processes. Models described from literature are manually curated and enriched with cross-references.

For the remainder of this lecture, all of our queries will have the clause:

FROM <http://rdf.ebi.ac.uk/dataset/expressionatlas>

This will allow us to limit our queries to ONLY data in expression atlas

DESCRIBE

So far you have focused on "SELECT" queries.

Another kind of query is a "DESCRIBE" query.

It (usually) tells you the triples that have a certain URI as the subject. It sometimes tells you other useful things. Sometimes it tells you nothing useful at all! But it is a good place to start!

DESCRIBE queries are as simple as:

DESCRIBE <http://rdf.ebi.ac.uk/resource/ensembl/ENSG00000012048>

So far you have focused on "SELECT" queries.

Another kind of query is a "DESCRIBE" query.

It (usually) tells you the triples that have a certain URI as the subject. It sometimes tells you other useful things. Sometimes it tells you nothing useful at all! But it is a good place to start!

DESCRIBE queries are as simple as:

```
PREFIX gene: <http://rdf.ebi.ac.uk/resource/ensembl/>
DESCRIBE   gene:ENSG00000012048
FROM <http://rdf.ebi.ac.uk/dataset/expressionatlas>
```

Enter SPARQL Query

```
PREFIX gene: <http://rdf.ebi.ac.uk/resource/ensembl/>
DESCRIBE   gene:ENSG00000012048
FROM <http://rdf.ebi.ac.uk/dataset/expressionatlas>
```

Subject	Predicate	Object
http://rdf.ebi.ac.uk/resource/ensembl/ENSG00000012048	dcterms:identifier	ENSG00000012048
http://rdf.ebi.ac.uk/resource/ensembl/ENSG00000012048	rdfs:label	BRCA1
http://rdf.ebi.ac.uk/resource/ensembl/ENSG00000012048	rdf:type	http://rdf.ebi.ac.uk/terms/expressionatlas/EnsemblDatabaseReference

Enter SPARQL Query

```
PREFIX gene: <http://rdf.ebi.ac.uk/resource/ensembl/>
DESCRIBE  gene:ENSG00000012048
FROM <http://rdf.ebi.ac.uk/dataset/expressionatlas>
```

Subject	Predicate	Object
http://rdf.ebi.ac.uk/resource/ensembl/ENSG00000012048	dcterms:identifier	ENSG00000012048
http://rdf.ebi.ac.uk/resource/ensembl/ENSG00000012048	rdfs:label	BRCA1
http://rdf.ebi.ac.uk/resource/ensembl/ENSG00000012048	rdf:type	http://rdf.ebi.ac.uk/terms/expressionatlas/EnsemblDatabaseReference

This result tells us that our BRCA1 gene is:
a) In the database (good!), but
b) NOT the subject of any "useful" triples

i.e. the query doesn't tell us anything we don't already know.
So, we will check if it is the object of some useful triples

In the next few slides
We will "step backwards" through the data.

We assume that our BRCA1 gene
Is the O of a [S, P, O] triple

We want to know the S's and the P's

```
PREFIX gene: <http://rdf.ebi.ac.uk/resource/ensembl/>

SELECT *
FROM <http://rdf.ebi.ac.uk/dataset/expressionatlas>
WHERE {
    ?s    ?p    gene:ENSG00000012048
}
```

Show 100 results per page (offset 0)   Next

s	p
<http://rdf.ebi.ac.uk/resource/expressionatlas/E-GEOD-11324#expression-45FA028D52ACCECDF6C5074B2A9A0518>	<http://rdf.ebi.ac.uk/terms/expressionatlas/refersTo>
<http://rdf.ebi.ac.uk/resource/expressionatlas/E-GEOD-22600#expression-E25243E10977579FF6A2D3F1CC72BBBD>	<http://rdf.ebi.ac.uk/terms/expressionatlas/refersTo>
<http://rdf.ebi.ac.uk/resource/expressionatlas/E-GEOD-10879#expression-2F9F047B7B98A6DE0339A1408B2BC8AD>	<http://rdf.ebi.ac.uk/terms/expressionatlas/refersTo>
<http://rdf.ebi.ac.uk/resource/expressionatlas/E-GEOD-10879#expression-E204861794442E76E3CA877AD62A1AC4>	<http://rdf.ebi.ac.uk/terms/expressionatlas/refersTo>
<http://rdf.ebi.ac.uk/resource/expressionatlas/E-GEOD-16179#expression-49FDC3B2C70EF4F16BBA32AE1F37AD7C>	<http://rdf.ebi.ac.uk/terms/expressionatlas/refersTo>

```
PREFIX gene: <http://rdf.ebi.ac.uk/resource/ensembl/>

SELECT *
FROM <http://rdf.ebi.ac.uk/dataset/expressionatlas>
WHERE {
    ?s    ?p    gene:ENSG00000012048
}
```

Show 100 results per page (offset 0)   Next

s	p
<http://rdf.ebi.ac.uk/resource/expressionatlas/E-GEOD-11324#expression-45FA028D52ACCECDF6C5074B2A9A0518>	<http://rdf.ebi.ac.uk/terms/expressionatlas/refersTo>
<http://rdf.ebi.ac.uk/resource/expressionatlas/E-GEOD-22600#expression-E25243E10977579FF6A2D3F1CC72BBBD>	<http://rdf.ebi.ac.uk/terms/expressionatlas/refersTo>
<http://rdf.ebi.ac.uk/resource/expressionatlas/E-GEOD-10879#expression-2F9F047B7B98A6DE0339A1408B2BC8AD>	<http://rdf.ebi.ac.uk/terms/expressionatlas/refersTo>
<http://rdf.ebi.ac.uk/resource/expressionatlas/E-GEOD-10879#expression-E204861794442E76E3CA877AD62A1AC4>	<http://rdf.ebi.ac.uk/terms/expressionatlas/refersTo>
<http://rdf.ebi.ac.uk/resource/expressionatlas/E-GEOD-16179#expression-49FDC3B2C70EF4F16BBA32AE1F37AD7C>	<http://rdf.ebi.ac.uk/terms/expressionatlas/refersTo>

The gene is connected to "things" in the database using the predicate "refersTo"

Is this the only way it is used in the Array Atlas dataset?

```
PREFIX gene: <http://rdf.ebi.ac.uk/resource/ensembl/>

SELECT distinct ?p
FROM <http://rdf.ebi.ac.uk/dataset/expressionatlas>
WHERE {
    ?s    ?p    gene:ENSG00000012048
}
```

Results	Query history	Named Graphs

<http://rdf.ebi.ac.uk/terms/expressionatlas/refersTo>

Ensembl genes are always "referredTo"

i.e., There are no other predicates with
gene:ENSG00000012048 as the object
of the triple.

```
PREFIX  atlasterms: <http://rdf.ebi.ac.uk/terms/expressionatlas/>
PREFIX  gene: <http://rdf.ebi.ac.uk/resource/ensembl/>

SELECT *
FROM <http://rdf.ebi.ac.uk/dataset/expressionatlas>
WHERE {
    ?s  atlasterms:refersTo    gene:ENSG00000012048
}
```

Show 100 results per pag

s

<http://rdf.ebi.ac.uk/resource/expressionatlas/E-GEOD-11324#expression-45FA028D52ACCECDF6C5074B2A9A0518>

<http://rdf.ebi.ac.uk/resource/expressionatlas/E-GEOD-22600#expression-E25243E10977579FF6A2D3F1CC72BBBD>

<http://rdf.ebi.ac.uk/resource/expressionatlas/E-GEOD-10879#expression-2F9F047B7B98A6DE0339A1408B2BC8AD>

<http://rdf.ebi.ac.uk/resource/expressionatlas/E-GEOD-10879#expression-E204861794442E76E3CA877AD62A1AC4>

<http://rdf.ebi.ac.uk/resource/expressionatlas/E-GEOD-16179#expression-49FDC3B2C70EF4F16BBA32AE1F37AD7C>

What are these subjects?

You can click on them (to go to a web page about them),
or… use SPARQL

```
PREFIX atlasterms: <http://rdf.ebi.ac.uk/terms/expressionatlas/>
PREFIX gene: <http://rdf.ebi.ac.uk/resource/ensembl/>

SELECT DISTINCT ?type
FROM <http://rdf.ebi.ac.uk/dataset/expressionatlas>
WHERE {
    ?s  atlasterms:refersTo   gene:ENSG00000012048 .
    ?s    a    ?type
}
```

Show 100 results per page (offset 0)

type

<http://rdf.ebi.ac.uk/terms/expressionatlas/IncreasedDifferentialExpressionRatio>

<http://rdf.ebi.ac.uk/terms/expressionatlas/DecreasedDifferentialExpressionRatio>

<http://rdf.ebi.ac.uk/terms/expressionatlas/BaselineExpressionValue>

The Subjects are of type Increased/Decreased Diff Expression
Ratio, and baseline expression value

What can we learn about these kinds of things?

```
PREFIX atlasterms: <http://rdf.ebi.ac.uk/terms/expressionatlas/>
PREFIX gene: <http://rdf.ebi.ac.uk/resource/ensembl/>

SELECT DISTINCT ?predicates
FROM <http://rdf.ebi.ac.uk/dataset/expressionatlas>
WHERE {
    ?s     atlasterms:refersTo    gene:ENSG00000012048 .
    ?s     ?predicates      ?o
}
```

rdf:type

rdfs:label

<http://rdf.ebi.ac.uk/terms/expressionatlas/fpkm>

<http://rdf.ebi.ac.uk/terms/expressionatlas/foldChange>

<http://rdf.ebi.ac.uk/terms/expressionatlas/isOutputOf>

<http://rdf.ebi.ac.uk/terms/expressionatlas/pValue>

<http://rdf.ebi.ac.uk/terms/expressionatlas/refersTo>

<http://rdf.ebi.ac.uk/terms/expressionatlas/tStatistic>

The label might be useful (to make things readable). "isOutputOf" also looks useful (i.e. an experimental observation is the output of an experiment, so… that probably points to the assay or or something like that…?)

```
PREFIX atlasterms: <http://rdf.ebi.ac.uk/terms/expressionatlas/>
PREFIX gene: <http://rdf.ebi.ac.uk/resource/ensembl/>

SELECT distinct ?type
FROM <http://rdf.ebi.ac.uk/dataset/expressionatlas>
WHERE {
?s   atlasterms:refersTo    gene:ENSG00000012048 .
?s   atlasterms:isOutputOf    ?a .
?a    a    ?type
}
```


?isOutputOf

(some kind of ratio)
?s

refersTo

12048

?a
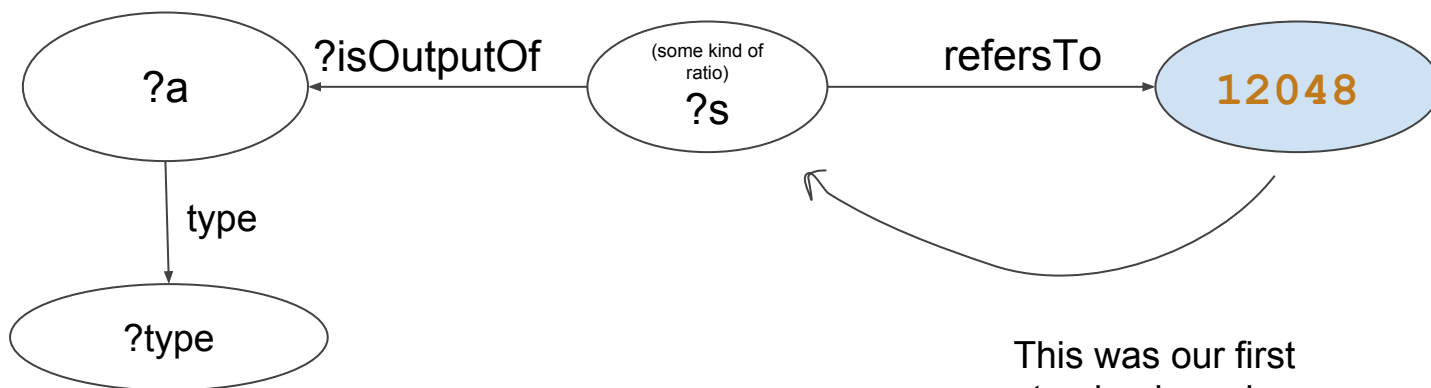
type

?type

This was our first step backwards

```
PREFIX atlasterms: <http://rdf.ebi.ac.uk/terms/expressionatlas/>
PREFIX gene: <http://rdf.ebi.ac.uk/resource/ensembl/>

SELECT distinct ?type
FROM <http://rdf.ebi.ac.uk/dataset/expressionatlas>
WHERE {
?s   atlasterms:refersTo    gene:ENSG00000012048 .
?s   atlasterms:isOutputOf     ?a .
?a     a      ?type
}
```
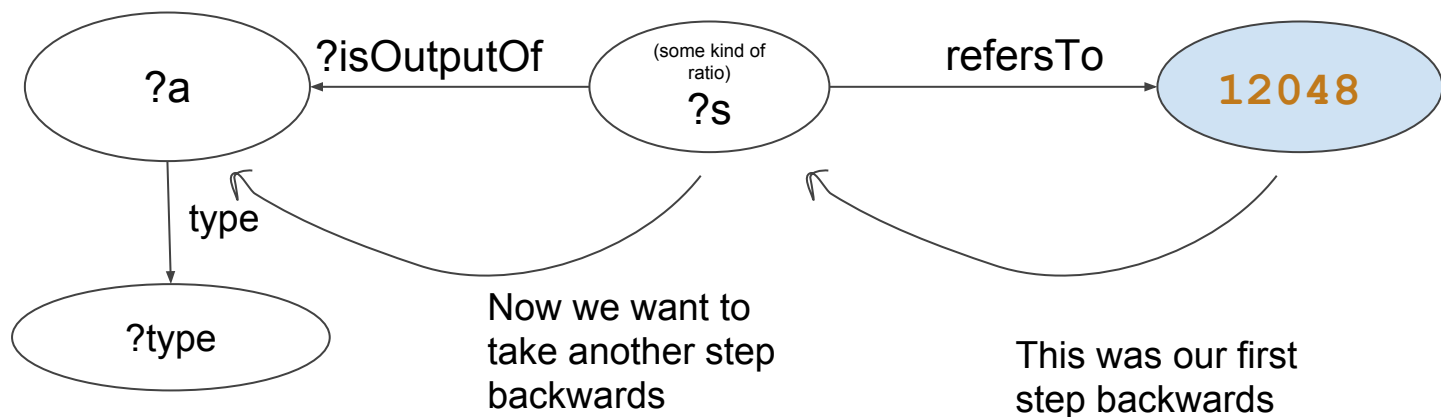
```
PREFIX atlasterms: <http://rdf.ebi.ac.uk/terms/expressionatlas/>
PREFIX gene: <http://rdf.ebi.ac.uk/resource/ensembl/>

SELECT distinct ?type
FROM <http://rdf.ebi.ac.uk/dataset/expressionatlas>
WHERE {
?s   atlasterms:refersTo    gene:ENSG00000012048 .
?s   atlasterms:isOutputOf     ?a .
?a     a      ?type
}
```
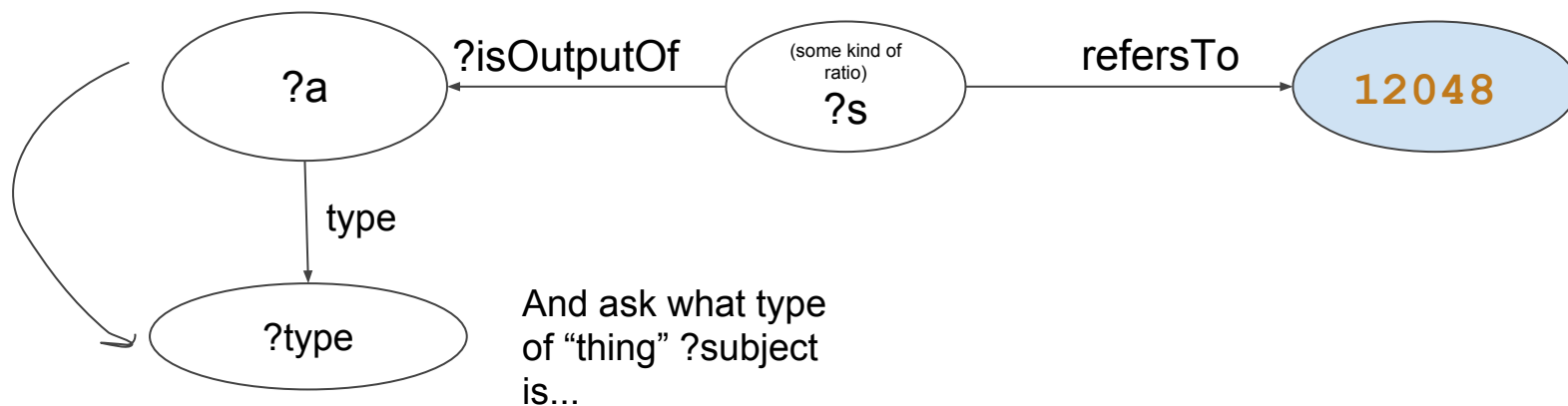
?a

?isOutputOf

(some kind of ratio)
?s

refersTo

12048

type

?type

And ask what type of "thing" ?subject is...

```
PREFIX atlasterms: <http://rdf.ebi.ac.uk/terms/expressionatlas/>
PREFIX gene: <http://rdf.ebi.ac.uk/resource/ensembl/>

SELECT distinct ?type
FROM <http://rdf.ebi.ac.uk/dataset/expressionatlas>
WHERE {
?s   atlasterms:refersTo    gene:ENSG00000012048 .
?s   atlasterms:isOutputOf    ?a .
?a     a      ?type
}
```

Show 100 results per page (offset 0)

type

<http://rdf.ebi.ac.uk/terms/expressionatlas/MicroarrayDifferentialExpressionAnalysis>

<http://rdf.ebi.ac.uk/terms/expressionatlas/RNASeqDifferentialAnalysis>

As we guessed, these "things" are all Analyses :-)

```
PREFIX atlasterms: <http://rdf.ebi.ac.uk/terms/expressionatlas/>
PREFIX gene: <http://rdf.ebi.ac.uk/resource/ensembl/>

SELECT distinct ?type
FROM <http://rdf.ebi.ac.uk/dataset/expressionatlas>
WHERE {
?s  atlasterms:refersTo   gene:ENSG00000012048 .
?s  atlasterms:isOutputOf    ?a .
?a    a     ?type
}
```
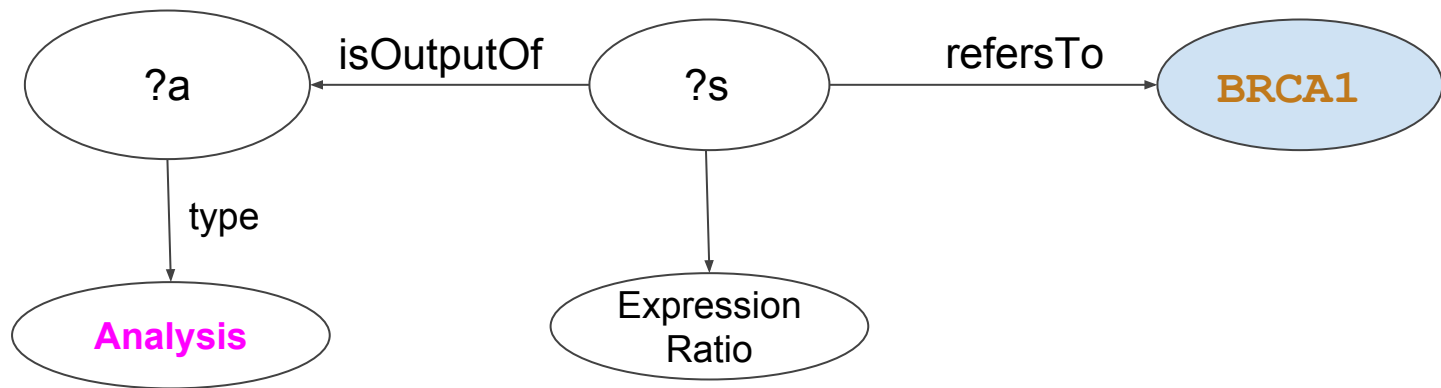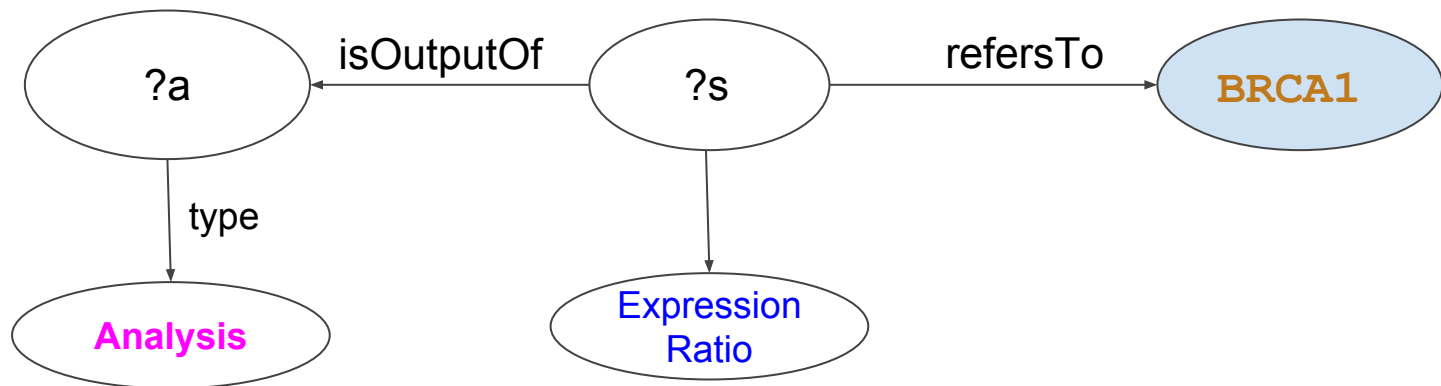
```
PREFIX atlasterms: <http://rdf.ebi.ac.uk/terms/expressionatlas/>
PREFIX gene: <http://rdf.ebi.ac.uk/resource/ensembl/>

SELECT ?a    ?etype   ?s     ?stype
FROM <http://rdf.ebi.ac.uk/dataset/expressionatlas>
WHERE {
?s   atlasterms:refersTo    gene:ENSG00000012048 .
?s   a    ?stype .
?s   atlasterms:isOutputOf     ?a .
?a   a    ?etype
}
```

e	etype	s	stype
<http://rdf.ebi.ac.uk/resource/expressionatlas /E-GEOD-11324#analysis- B3B5A8B82A01B06EC4052C755AC4214C>	<http://rdf.ebi.ac.uk/terms/expressionatlas /MicroarrayDifferentialExpressionAnalysis>	<http://rdf.ebi.ac.uk/resource/expressionatlas /E-GEOD-11324#expression- 45FA028D52ACCECDF6C5074B2A9A0518>	<http://rdf.ebi.ac.uk/terms /expressionatlas /IncreasedDifferentialExpre
<http://rdf.ebi.ac.uk/resource/expressionatlas /E-GEOD-22600#analysis- 7671EE46336BF05105C3EE36C48CA0BE>	<http://rdf.ebi.ac.uk/terms/expressionatlas /MicroarrayDifferentialExpressionAnalysis>	<http://rdf.ebi.ac.uk/resource/expressionatlas /E-GEOD-22600#expression- E25243E10977579FF6A2D3F1CC72BBBD>	<http://rdf.ebi.ac.uk/terms /expressionatlas /IncreasedDifferentialExpre
<http://rdf.ebi.ac.uk/resource/expressionatlas /E-GEOD-10879#analysis- 5D58AB04B7623724CCB7BB10ADA26FAF>	<http://rdf.ebi.ac.uk/terms/expressionatlas /MicroarrayDifferentialExpressionAnalysis>	<http://rdf.ebi.ac.uk/resource/expressionatlas /E-GEOD-10879#expression- E204861794442E76E3CA877AD62A1AC4>	<http://rdf.ebi.ac.uk/terms /expressionatlas /IncreasedDifferentialExpre
<http://rdf.ebi.ac.uk/resource/expressionatlas /E-GEOD-10879#analysis- B3B5A8B82A01B06EC4052C755AC4214C>	<http://rdf.ebi.ac.uk/terms/expressionatlas /MicroarrayDifferentialExpressionAnalysis>	<http://rdf.ebi.ac.uk/resource/expressionatlas /E-GEOD-10879#expression- 2F9F047B7B98A6DE0339A1408B2BC8AD>	<http://rdf.ebi.ac.uk/terms /expressionatlas /IncreasedDifferentialExpre
<http://rdf.ebi.ac.uk/resource/expressionatlas /E-GEOD-16179#analysis- A18BCEF1855D288C204F1AA62EBF0FDF>	<http://rdf.ebi.ac.uk/terms/expressionatlas /MicroarrayDifferentialExpressionAnalysis>	<http://rdf.ebi.ac.uk/resource/expressionatlas /E-GEOD-16179#expression- DB93A38814B88D6ED298A454833B3D16>	<http://rdf.ebi.ac.uk/terms /expressionatlas /DecreasedDifferentialExpr

```
PREFIX atlasterms: <http://rdf.ebi.ac.uk/terms/expressionatlas/>
PREFIX gene: <http://rdf.ebi.ac.uk/resource/ensembl/>

SELECT ?a    ?etype   ?s     ?stype
FROM <http://rdf.ebi.ac.uk/dataset/expressionatlas>
WHERE {
?s   atlasterms:refersTo    gene:ENSG00000012048 .
?s   a    ?stype .
?s   atlasterms:isOutputOf    ?a .
?a   a    ?etype
}
```

e	etype	s	stype
<http://rdf.ebi.ac.uk/resource/expressionatlas/E-GEOD-11324#analysis-B3B5A8B82A01B06EC4052C755AC4214C>	<http://rdf.ebi.ac.uk/terms/expressionatlas/MicroarrayDifferentialExpressionAnalysis>	<http://rdf.ebi.ac.uk/resource/expressionatlas/E-GEOD-11324#expression-45FA028D52ACCECDF6C5074B2A9A0518>	<http://rdf.ebi.ac.uk/terms/expressionatlas/IncreasedDifferentialExpre
<http://rdf.ebi.ac./E-GEOD-22600 7671EE46336B	ms/expressionatlas ExpressionAnalysis>	<http://rdf.ebi.ac.uk/resource/expressionatlas/E-GEOD-22600#expression-E25243E10977579FF6A2D3F1CC72BBBD>	<http://rdf.ebi.ac.uk/terms/expressionatlas/IncreasedDifferentialExpre
<http://rdf.ebi.ac./E-GEOD-10879 5D58AB04B762	ms/expressionatlas ExpressionAnalysis>	<http://rdf.ebi.ac.uk/resource/expressionatlas/E-GEOD-10879#expression-E204861794442E76E3CA877AD62A1AC4>	<http://rdf.ebi.ac.uk/terms/expressionatlas/IncreasedDifferentialExpre
<http://rdf.ebi.ac.uk/resource/expressionatlas/E-GEOD-10879#analysis-B3B5A8B82A01B06EC4052C755AC4214C>	<http://rdf.ebi.ac.uk/terms/expressionatlas/MicroarrayDifferentialExpressionAnalysis>	<http://rdf.ebi.ac.uk/resource/expressionatlas/E-GEOD-10879#expression-2F9F047B7B98A6DE0339A1408B2BC8AD>	<http://rdf.ebi.ac.uk/terms/expressionatlas/IncreasedDifferentialExpre
<http://rdf.ebi.ac.uk/resource/expressionatlas/E-GEOD-16179#analysis-A18BCEF1855D288C204F1AA62EBF0FDF>	<http://rdf.ebi.ac.uk/terms/expressionatlas/MicroarrayDifferentialExpressionAnalysis>	<http://rdf.ebi.ac.uk/resource/expressionatlas/E-GEOD-16179#expression-DB93A38814B88D6ED298A454833B3D16>	<http://rdf.ebi.ac.uk/terms/expressionatlas/DecreasedDifferentialExpr

Click on one of these and you will be able to see the entire record for that "subject"

We won't go beyond this

The pattern is always the same

Importantly, machines can follow the same pattern!

So machines can easily explore a SPARQL endpoint automatically

If you take my full course, you learn how to create this complex query in about 2 hours

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX atlasterms: <http://rdf.ebi.ac.uk/terms/expressionatlas/>
PREFIX gene: <http://rdf.ebi.ac.uk/resource/ensembl/>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>

SELECT   DISTINCT ?slab ?description ?fpt ?fpv ?cpt ?cpv ?pvalue  ?tstat
FROM <http://rdf.ebi.ac.uk/dataset/expressionatlas>

WHERE {
?s      atlasterms:refersTo     gene:ENSG00000012048 .
?s      rdfs:label              ?slab .
?s      atlasterms:isOutputOf   ?anal .
?s      atlasterms:pValue       ?pvalue .
?s      atlasterms:tStatistic   ?tstat .
?anal   rdfs:label                      ?description .

?anal     atlasterms:hasReferenceAssay    ?refass .
?anal     atlasterms:hasTestAssay         ?testass .

?refass   atlasterms:hasInputSampleCharacteristic  ?c .
?c        a       <http://purl.obolibrary.org/obo/UBERON_0002048> .

?testass atlasterms:hasFactorValue   ?fv .
?fv       atlasterms:propertyType     ?fpt .
?fv       atlasterms:propertyValue    ?fpv .

?refass   atlasterms:hasInputSampleCharacteristic  ?char .
?char     atlasterms:propertyType       ?cpt .
?char     atlasterms:propertyValue      ?cpv .

FILTER(?tstat < -3)
}
```

Leveraging GUIDs on a global scale

Points of intersection

My Graph

Stormy

http://xmlns.com/foaf/0.1/name

http://pet.registry.com/MDW_112/pets/MDW_112_Cat

http://some.predicates.org/relations/has_breed

British Long

Pet Shop's Graph

http://pet.registry.com/MDW_112/pets/MDW_112_Cat

http://some.predicates.org/relations/has_parent

http://pet.registry.com/LA_0/pets/LA099

http://xmlns.com/foaf/0.1/name
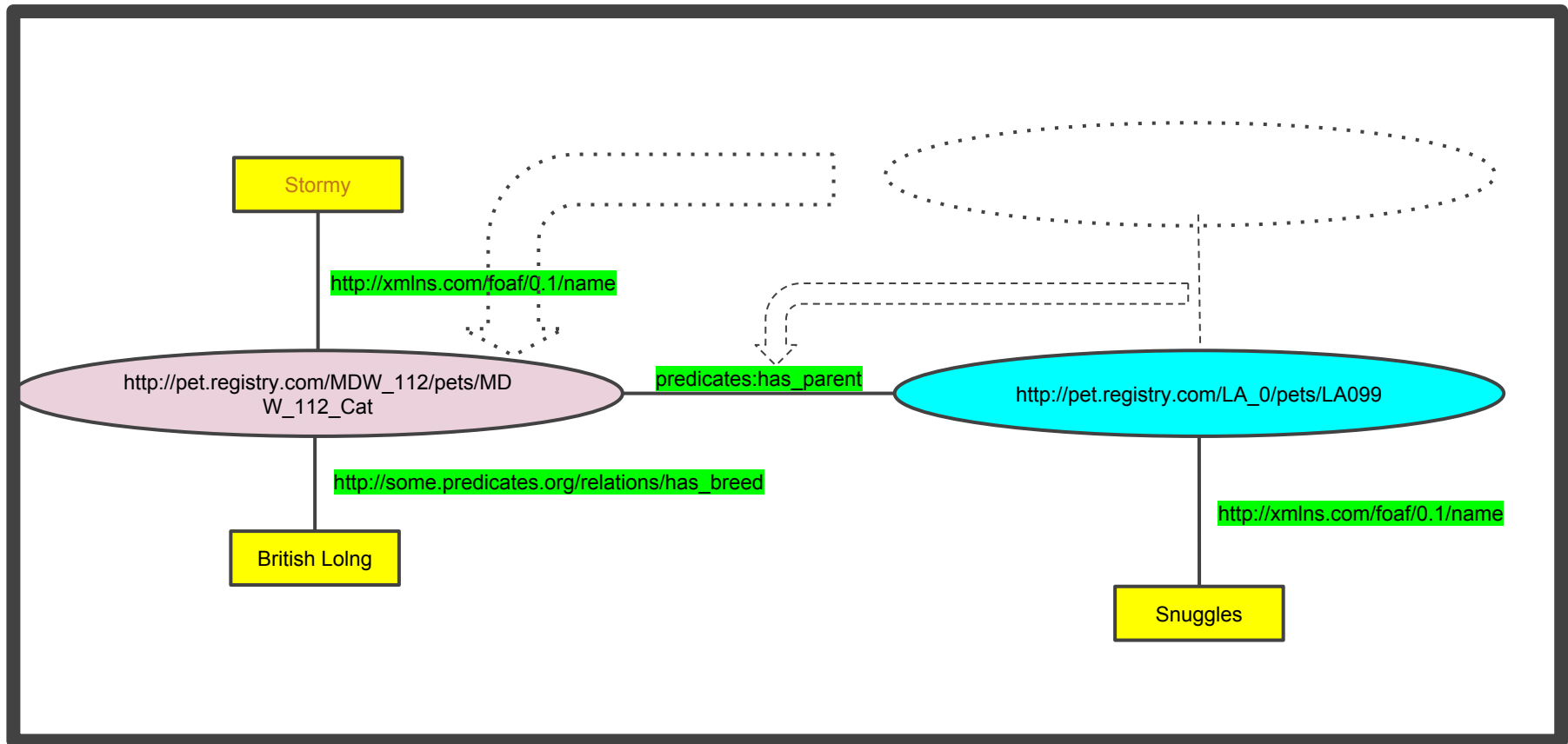
Snuggles

Benefits of RDF

Unified Graph

A machine can do this data integration automatically
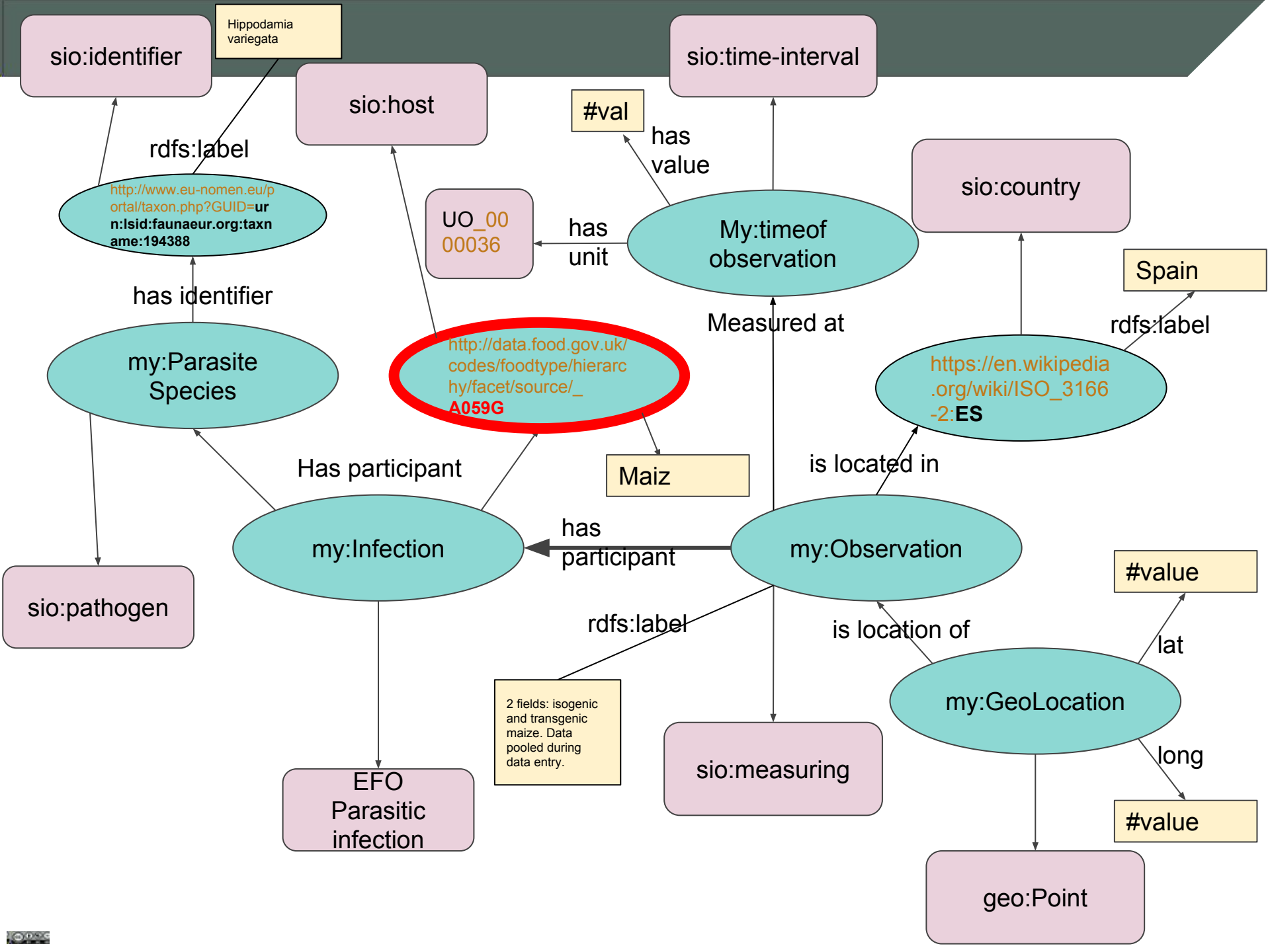
Dynamic Merging of Datasets

SPARQL allows "Federated Query"

We can query more than one dataset at a time, and "join" them over the Web based on their shared URLs

(if the source provider also has a SPARQL endpoint)

During the planning phase, I added some of these shared URLs

What food codes do we have in our database?

We modelled these as "hosts", so we will search for things that are SIO:host

```
select distinct ?host where {
    ?host a <http://semanticscience.org/resource/host> .
}
```

host
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A059G
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A05AE
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A05KG
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A05AN
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A05SF
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A05HX
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A059D
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A059V
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A05AF
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A05AD
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A05JF
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A05SA

What is my next step?

Explore food.gov SPARQL endpoint using the techniques we just learned.

```
PREFIX food: <http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/>
SELECT DISTINCT ?p
WHERE {
    food:_A059D ?p ?o
}
```

7 results in 0 min 0.183 s

Show [10 ⌄] entries

?p
dct:dateSubmitted
rdf:type
reg:itemClass
reg:notation
reg:register
reg:submitter
version:currentVersion

Showing 1 to 7 of 7 entries

```
PREFIX food: <http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/>
SELECT DISTINCT ?p
WHERE {
    food:_A059D ?p ?o
}
```

7 results in 0 min 0.183 s
Show [10 ⌄] entries

?p
dct:dateSubmitted
rdf:type
reg:itemClass
reg:notation
reg:register
reg:submitter
version:currentVersion

Showing 1 to 7 of 7 entries

```
PREFIX food:
<http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/>
PREFIX reg: <http://purl.org/linked-data/registry#>
SELECT ?o
WHERE {    food:_A059D    reg:submitter    ?o    }
```

1 result in 0 min 0.085 s

Show 10 ˅ entries

?o
_:Bfc181ead866f2392d9cc69d48ee0c859

Showing 1 to 1 of 1 entries

```
PREFIX food:
<http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/>
PREFIX reg: <http://purl.org/linked-data/registry#>
SELECT ?o
WHERE {   food:_A059D    reg:submitter   ?o    }
```

1 result in 0 min 0.085 s

Show 10 ⌄ entries

?o

_:Bfc181ead866f2392d9cc69d48ee0c859

Showing 1 to 1 of 1 entries
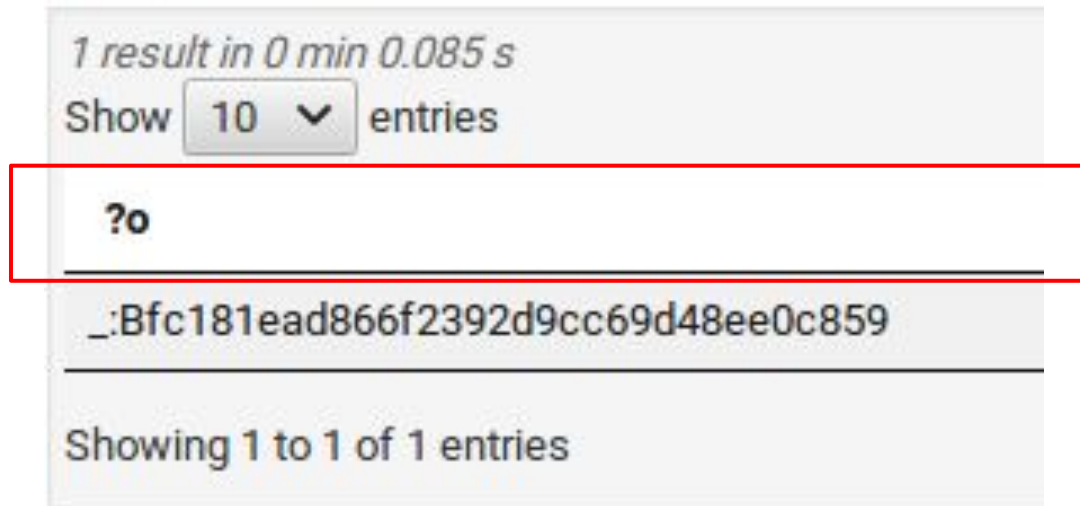
This is called a "bnode" - an RDF node that has an identifier that is only meaningful
inside of the RDF database

For this reason, we cannot query it directly, we can only use it in the context of a
variable within another query

It is used as an anonymous "placeholder" for an entity
that has several properties of its own

```
PPREFIX food:
<http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/>
PREFIX reg: <http://purl.org/linked-data/registry#>
SELECT ?p ?o
WHERE {
   food:_A059D reg:submitter ?bn .
   ?bn   ?p    ?o }
```

?p	▲	?o
foaf:name		"bootstrap"

```
PPREFIX food:
<http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/>
PREFIX reg: <http://purl.org/linked-data/registry#>
SELECT ?p ?o
WHERE {
  food:_A059D reg:submitter ?bn .
  ?bn   ?p   ?o }
```

?p	▲ ?o
foaf:name	"bootstrap"

A bit disappointing - not as informative as we might have hoped!

But, we now have a query that retrieves this information from
food.gov, so we can now ask the question:

*"Are there ANY entries in good.gov that have additional information
related to my Host species?"*

Federated Queries

Point at an external SPARQL endpoint using a "SERVICE" command

Looks like this:

```
SELECT xxx WHERE {

    SERVICE  <SPARQL-address-1> {

        SELECT yyy WHERE {...}

    }

    SERVICE  <SPARQL-address-2> {

        SELECT zzz WHERE {...}

    }

}
```

Federated Queries

Point at an external SPARQL endpoint using a "SERVICE" command

Looks like this:

```
SELECT xxx WHERE {

    SERVICE  <SPARQL-address-1> {

        SELECT yyy WHERE {...}

    }

    SERVICE  <SPARQL-address-2> {

        SELECT zzz WHERE {...}

    }

}
```

Importantly, you can use the same variable names in the WHERE clauses, and their values will be passed from one SPARQL endpoint to the other.

```
PREFIX dct: <http://purl.org/dc/terms/>
PREFIX food:
<http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/>
PREFIX reg: <http://purl.org/linked-data/registry#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>

SELECT ?h ?label ?date ?p ?o WHERE {

    { select distinct ?h ?label where {
        ?h rdfs:label ?label .
        {    select distinct ?h where {
              ?h a <http://semanticscience.org/resource/host> .
          }
        }
      }
    }

    SERVICE <https://data.food.gov.uk/codes/system/query> {
      ?h dct:dateSubmitted ?date .
      ?h reg:submitter ?bn .
      ?bn  ?p ?o
    }
}
```

Green is executed on our local database, **blue is executed at food.gov**, **?h** is passed between them

Results

h	label	date	p	o
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A059G	"Maize"@en	2017-08-18T10:21:14.934Z	http://xmlns.com/foaf/0.1/name	"bootstrap"
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A059G	"Maize (live plants)"@en	2017-08-18T10:21:14.934Z	http://xmlns.com/foaf/0.1/name	"bootstrap"
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A05AE	"Sorghum"@en	2017-08-18T10:21:09.768Z	http://xmlns.com/foaf/0.1/name	"bootstrap"
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A05AE	"Sorghum (live plants)"@en	2017-08-18T10:21:09.768Z	http://xmlns.com/foaf/0.1/name	"bootstrap"
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A05KG	"Potatoes"@en	2017-08-18T10:21:29.472Z	http://xmlns.com/foaf/0.1/name	"bootstrap"
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A05KG	"Potatoes (live plants)"@en	2017-08-18T10:21:29.472Z	http://xmlns.com/foaf/0.1/name	"bootstrap"
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A05AN	"Triticale"@en	2017-08-18T10:21:09.578Z	http://xmlns.com/foaf/0.1/name	"bootstrap"
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A05AN	"Triticale (live plants)"@en	2017-08-18T10:21:09.578Z	http://xmlns.com/foaf/0.1/name	"bootstrap"
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A05SF	"Cotton"@en	2017-08-18T10:21:22.889Z	http://xmlns.com/foaf/0.1/name	"bootstrap"
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A05SF	"Cotton (live plants)"@en	2017-08-18T10:21:22.889Z	http://xmlns.com/foaf/0.1/name	"bootstrap"
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A05HX	"Soy"@en	2017-08-18T10:21:27.996Z	http://xmlns.com/foaf/0.1/name	"bootstrap"
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A05HX	"Soy (live plants)"@en	2017-08-18T10:21:27.996Z	http://xmlns.com/foaf/0.1/name	"bootstrap"
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A059D	"Barley"@en	2017-08-18T10:21:15.054Z	http://xmlns.com/foaf/0.1/name	"bootstrap"
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A059D	"Barley (live plants)"@en	2017-08-18T10:21:15.054Z	http://xmlns.com/foaf/0.1/name	"bootstrap"
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A059V	"Oat"@en	2017-08-18T10:21:17.123Z	http://xmlns.com/foaf/0.1/name	"bootstrap"
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A059V	"Oat (live plants)"@en	2017-08-18T10:21:17.123Z	http://xmlns.com/foaf/0.1/name	"bootstrap"
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A05AF	"Wheat"@en	2017-08-18T10:21:09.688Z	http://xmlns.com/foaf/0.1/name	"bootstrap"
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A05AF	"Wheat (live plants)"@en	2017-08-18T10:21:09.688Z	http://xmlns.com/foaf/0.1/name	"bootstrap"
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A05AD	"Rye"@en	2017-08-18T10:21:09.738Z	http://xmlns.com/foaf/0.1/name	"bootstrap"
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A05AD	"Rye (live plants)"@en	2017-08-18T10:21:09.738Z	http://xmlns.com/foaf/0.1/name	"bootstrap"
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A05JF	"Beet"@en	2017-08-18T10:21:28.498Z	http://xmlns.com/foaf/0.1/name	"bootstrap"
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A05JF	"Beet (live plants)"@en	2017-08-18T10:21:28.498Z	http://xmlns.com/foaf/0.1/name	"bootstrap"
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A05SA	"Rape for seeds"@en	2017-08-18T10:21:21.558Z	http://xmlns.com/foaf/0.1/name	"bootstrap"
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A05SA	"Rape for seeds (live plants)"@en	2017-08-18T10:21:21.558Z	http://xmlns.com/foaf/0.1/name	"bootstrap"

Results

h	label	date	p	o
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A059G	"Maize"@en	2017-08-18T10:21:14.934Z	http://xmlns.com/foaf/0.1/name	"bootstrap"
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A059G	"Maize (live plants)"@en	2017-08-18T10:21:14.934Z	http://xmlns.com/foaf/0.1/name	"bootstrap"
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A05AE	"Sorghum"@en	2017-08-18T10:21:09.768Z	http://xmlns.com/foaf/0.1/name	"bootstrap"
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A05AE	"Sorghum (live plants)"@en	2017-08-18T10:21:09.768Z	http://xmlns.com/foaf/0.1/name	"bootstrap"
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A05KG	"Potatoes"@en	2017-08-18T10:21:29.472Z	http://xmlns.com/foaf/0.1/name	"bootstrap"
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A05KG	"Potatoes (live plants)"@en	2017-08-18T10:21:29.472Z	http://xmlns.com/foaf/0.1/name	"bootstrap"
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A05AN	"Triticale"@en	2017-08-18T10:21:09.578Z	http://xmlns.com/foaf/0.1/name	"bootstrap"
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A05AN	"Triticale (live plants)"@en	2017-08-18T10:21:09.578Z	http://xmlns.com/foaf/0.1/name	"bootstrap"
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A05SF	"Cotton"@en	2017-08-18T10:21:22.889Z	http://xmlns.com/foaf/0.1/name	"bootstrap"
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A05SF	"Cotton (live plants)"@en	2017-08-18T10:21:22.889Z	http://xmlns.com/foaf/0.1/name	"bootstrap"
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A05HX	"Soy"@en	2017-08-18T10:21:27.996Z	http://xmlns.com/foaf/0.1/name	"bootstrap"
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A05HX	"Soy (live plants)"@en	2017-08-18T10:21:27.996Z	http://xmlns.com/foaf/0.1/name	"bootstrap"
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A059D	"Barley"@en	2017-08-18T10:21:15.054Z	http://xmlns.com/foaf/0.1/name	"bootstrap"
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A059D	"Barley (live plants)"@en	2017-08-18T10:21:15.054Z	http://xmlns.com/foaf/0.1/name	"bootstrap"
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A059V	"Oat"@en	2017-08-18T10:21:17.123Z	http://xmlns.com/foaf/0.1/name	"bootstrap"
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A059V	"Oat (live plants)"@en	2017-08-18T10:21:17.123Z	http://xmlns.com/foaf/0.1/name	"bootstrap"
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A05AF	"Wheat"@en	2017-08-18T10:21:09.688Z	http://xmlns.com/foaf/0.1/name	"bootstrap"
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A05AF	"Wheat (live plants)"@en	2017-08-18T10:21:09.688Z	http://xmlns.com/foaf/0.1/name	"bootstrap"
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A05AD	"Rye"@en	2017-08-18T10:21:09.738Z	http://xmlns.com/foaf/0.1/name	"bootstrap"
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A05AD	"Rye (live plants)"@en	2017-08-18T10:21:09.738Z	http://xmlns.com/foaf/0.1/name	"bootstrap"
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A05JF	"Beet"@en	2017-08-18T10:21:28.498Z	http://xmlns.com/foaf/0.1/name	"bootstrap"
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A05JF	"Beet (live plants)"@en	2017-08-18T10:21:28.498Z	http://xmlns.com/foaf/0.1/name	"bootstrap"
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A05SA	"Rape for seeds"@en	2017-08-18T10:21:21.558Z	http://xmlns.com/foaf/0.1/name	"bootstrap"
http://data.food.gov.uk/codes/foodtype/hierarchy/facet/source/_A05SA	"Rape for seeds (live plants)"@e	2017-08-18T10:21:21.558Z	http://xmlns.com/foaf/0.1/name	"bootstrap"

What have we achieved? Things to note:

- I didn't have to download their database to integrate it with my own

- For small intersections, this operation is surprisingly efficient (about 3 seconds)

- Because of this efficiency, I was able to ask the question 'do you have any information of interest to me' within a couple of minutes, simply using SPARQL to compare their database with mine.

- *I could ask that question daily if I were comparing myself to a resource that updated frequently without having to download new versions of their data! (less curatorial effort, just-in-time integration)*

LOD Cloud Today

Legend

Cross Domain	
Geography	
Government	
Life Sciences	
Linguistics	
Media	
Publications	
Social Networking	
User Generated	
Incoming Links	
Outgoing Links	
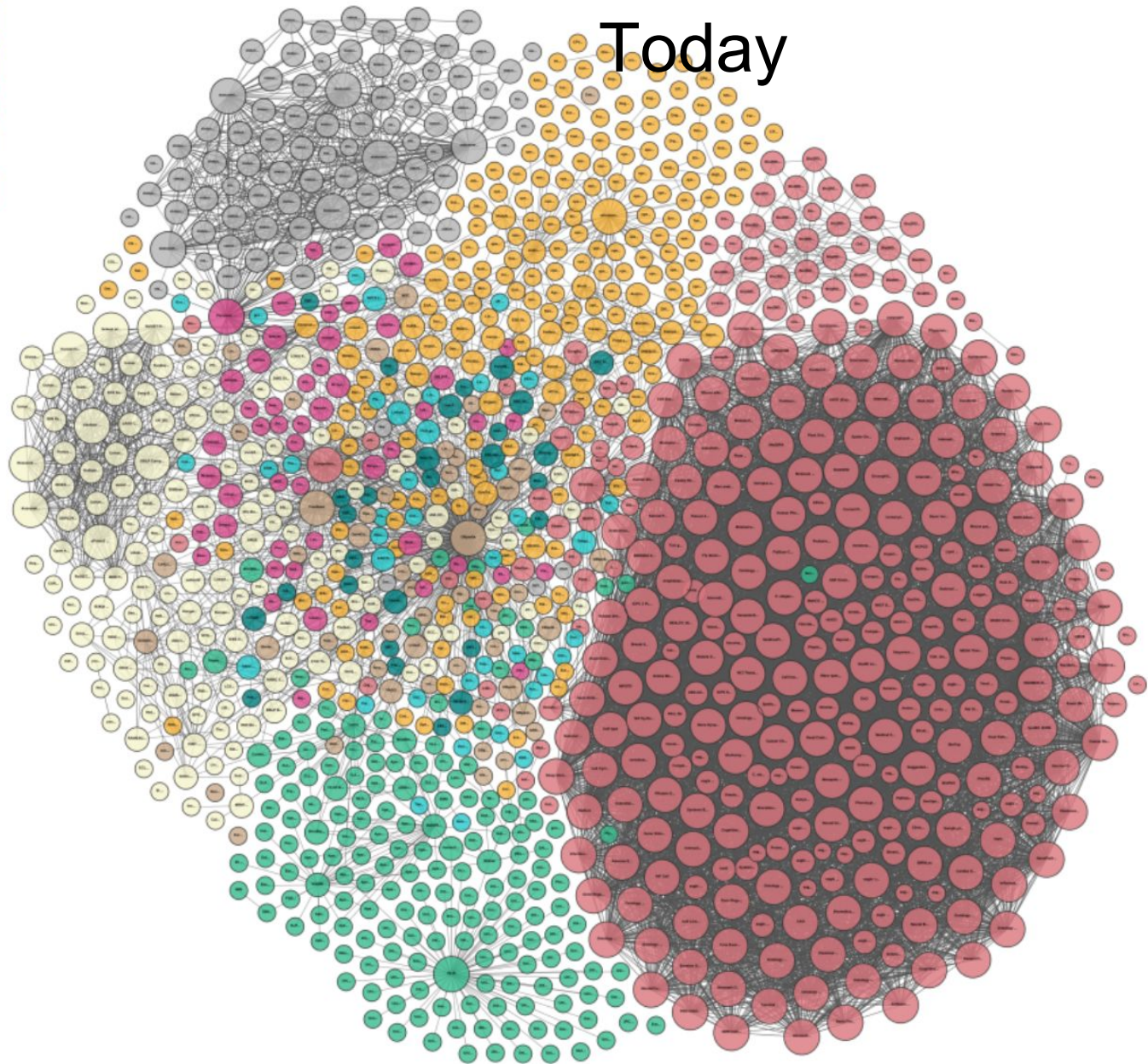
- RDF has existed (as a recommendation) since 2004

  - A lot of data is already available in RDF, but as RDF records (downloadable) rather than in SPARQL

```
PREFIX sio: <http://semanticscience.org/resource/>
select distinct ?pathogen ?lsid where {
    ?pathogen a <http://semanticscience.org/resource/pathogen> .
    ?pathogen sio:has-identifier ?lsid
 } LIMIT 1
```

pathogen	lsid
http://training.fairdata.solutions/DAV/home/LDP/gofair/species_290307346	http://www.eu-nomen.eu/portal/taxon.php?GUID=urn:lsid:faunaeur.org:taxname:194388

http://www.eu-nomen.eu/portal/taxon.php?GUID=urn:lsid:faunaeur.org:taxname:194388

EU-NOMEN
Pan-European Species directories Infrastructure

▸ Taxon search ▸ Taxon match ▸ Focal Point Data
▸ Nomenclators ▸ Statistics ▸ Webservices ▸ PES

Higher Classification: > Kingdom **Animalia** > Phylum **Arthropoda** > Subphylum **Hexapoda** > Class **Insecta** > Subclass **Pterygota** > Order Hemi
> Suborder **Cicadomorpha** > Superfamily **Membracoidea** > Family **Cicadellidae** > Subfamily **Deltocephalinae** > Tribe **Athysanini** > Genus Allyg
> Subgenus **Allygidius (Allygidius)**

Allygidius (Allygidius) commutatus (Fieber, 1872)

Rank: **Species**
Taxon Status: **accepted**

Original genus			Environment
Allygus Fieber, 1875			no data
Relationships towards this taxon			Importance
Genus group names			no data
Allygidius	Ribaut, 1952	accepted genus name	**Provided by**
Species group names			
Allygus commutatus	Fieber, 1872	objective synonym	

FAUNA EUROPAEA

http://www.eu-nomen.eu/portal/taxon.php?GUID=urn:lsid:faunaeur.org:taxname:194388

This is an LSID (Life Sciences Identifier)

urn:lsid:faunaeur.org:taxname:194388

LSID

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Life Science Identifiers[1][2] are a way to name and locate pieces of information on the web. Essentially, an LSID is a unique identifier for some data, and the LSID protocol specifies a standard way to locate the data (as well as a standard way of describing that data). They are a little like DOIs used by many publishers.

http://www.lsid.info/resolver/

Life Sciences Identifier (LSID) Resolver

	Go

Resolve a LSID and return metadata as RDF as JSON-LD, N-Triples, and RDF/XML.

To retrieve RDF directly, use either content negotiation or append the required file extension to the LSID (e.g., /urn:lsid:nmbe.ch:spidersp:021946.jsonld returns RDF for the LSID urn:lsid:nmbe.ch:spidersp:021946 in JSON-LD format).

Syntax	File extension	Accept header
JSON-LD	.jsonld	application/ld+json
N-triples	.nt	application/n-triples
RDF/XML	.rdf	application/rdf+xml

http://www.lsid.info/resolver/urn:lsid:marinespecies.org:taxname:127160.rdf

http://www.lsid.info/resolver/urn:lsid:marinespecies.org:taxname:127160.rdf

This gives me a LOT of extra information about that pest!

```
        },
        "ntriples": "<urn:lsid:marinespecies.org:taxname:127160> <http:\/\/purl.org\/dc\/elements\/1.1\/type>  \"ScientificName\" .
\n<urn:lsid:marinespecies.org:taxname:127160> <http:\/\/purl.org\/dc\/elements\/1.1\/date>  \"2019-03-13\" .
\n<urn:lsid:marinespecies.org:taxname:127160> <http:\/\/purl.org\/dc\/elements\/1.1\/subject>  \"Solea solea (Linnaeus, 1758)\" .
\n<urn:lsid:marinespecies.org:taxname:127160> <http:\/\/purl.org\/dc\/elements\/1.1\/title>  \"Solea solea\" .
\n<urn:lsid:marinespecies.org:taxname:127160> <http:\/\/purl.org\/dc\/elements\/1.1\/relation>  \"http:\/\/www.marinespecies.org
\/aphia.php?p=taxdetails&amp;id=127160\" . \n<urn:lsid:marinespecies.org:taxname:127160> <http:\/\/purl.org\/dc\/elements\/1.1\/creator>  \"van
der Land, Jacob\" . \n<urn:lsid:marinespecies.org:taxname:127160> <http:\/\/purl.org\/dc\/elements\/1.1\/creator>  \"Bailly, Nicolas\" .
\n<urn:lsid:marinespecies.org:taxname:127160> <http:\/\/purl.org\/dc\/elements\/1.1\/identifier>  <urn:lsid:marinespecies.org:taxname:127160> .
\n<urn:lsid:marinespecies.org:taxname:127160> <http:\/\/purl.org\/dc\/elements\/1.1\/publisher>  \"World Register of Marine Species (WoRMS)\" .
\n<urn:lsid:marinespecies.org:taxname:127160> <http:\/\/purl.org\/dc\/elements\/1.1\/license>  \"http:\/\/creativecommons.org\/licenses
\/by\/4.0\/\" . \n<urn:lsid:marinespecies.org:taxname:127160> <http:\/\/purl.org\/dc\/elements\/1.1\/language>  \"en\" .
\n<urn:lsid:marinespecies.org:taxname:127160> <http:\/\/purl.org\/dc\/terms\/bibliographicCitation>  \"Froese, R. and D. Pauly. Editors.
(2019). FishBase. Solea solea (Linnaeus, 1758). Accessed through: World Register of Marine Species at: http:\/\/www.marinespecies.org
\/aphia.php?p=taxdetails&id=127160 on 2019-03-13\" . \n<urn:lsid:marinespecies.org:taxname:127160> <http:\/\/purl.org\/dc\/terms\/created>
\"2004-12-21T16:54:05+01:00\" . \n<urn:lsid:marinespecies.org:taxname:127160> <http:\/\/purl.org\/dc\/terms\/modified>
\"2008-01-15T18:27:08+01:00\" . \n<urn:lsid:marinespecies.org:taxname:127160> <http:\/\/purl.org\/dc\/terms\/replaces>
<urn:lsid:marinespecies.org:taxname:163034> . \n<urn:lsid:marinespecies.org:taxname:127160> <http:\/\/purl.org\/dc\/terms\/replaces>
<urn:lsid:marinespecies.org:taxname:154712> . \n<urn:lsid:marinespecies.org:taxname:127160> <http:\/\/purl.org\/dc\/terms\/replaces>
<urn:lsid:marinespecies.org:taxname:323133> . \n<urn:lsid:marinespecies.org:taxname:127160> <http:\/\/purl.org\/dc\/terms\/rightsHolder>
\"WoRMS Editorial Board\" . \n<urn:lsid:marinespecies.org:taxname:127160> <http:\/\/rs.tdwg.org\/dwc\/terms\/kingdom>  \"Animalia\" .
\n<urn:lsid:marinespecies.org:taxname:127160> <http:\/\/rs.tdwg.org\/dwc\/terms\/phylum>  \"Chordata\" .
\n<urn:lsid:marinespecies.org:taxname:127160> <http:\/\/rs.tdwg.org\/dwc\/terms\/class>  \"Actinopterygii\" .
\n<urn:lsid:marinespecies.org:taxname:127160> <http:\/\/rs.tdwg.org\/dwc\/terms\/order>  \"Pleuronectiformes\" .
\n<urn:lsid:marinespecies.org:taxname:127160> <http:\/\/rs.tdwg.org\/dwc\/terms\/family>  \"Soleidae\" .
\n<urn:lsid:marinespecies.org:taxname:127160> <http:\/\/rs.tdwg.org\/dwc\/terms\/genus>  \"Solea\" .
\n<urn:lsid:marinespecies.org:taxname:127160> <http:\/\/rs.tdwg.org\/dwc\/terms\/specificEpithet>  \"solea\" .
\n<urn:lsid:marinespecies.org:taxname:127160> <http:\/\/rs.tdwg.org\/dwc\/terms\/taxonRank>  \"species\" .
\n<urn:lsid:marinespecies.org:taxname:127160> <http:\/\/rs.tdwg.org\/dwc\/terms\/ScientificName>  \"Solea solea (Linnaeus, 1758)\" .
\n<urn:lsid:marinespecies.org:taxname:127160> <http:\/\/rs.tdwg.org\/dwc\/terms\/scientificNameAuthorship>  \"(Linnaeus, 1758)\" .
\n<urn:lsid:marinespecies.org:taxname:127160> <http:\/\/rs.tdwg.org\/dwc\/terms\/taxonomicStatus>  \"accepted\" .
\n<urn:lsid:marinespecies.org:taxname:127160> <http:\/\/rs.tdwg.org\/dwc\/terms\/scientificNameID>  <urn:lsid:marinespecies.org:taxname:127160>
. \n<urn:lsid:marinespecies.org:taxname:127160> <http:\/\/rs.tdwg.org\/dwc\/terms\/parentNameUsageID>
<urn:lsid:marinespecies.org:taxname:126132> . \n",
    "jsonld": {
        "@context": {
            "type": "http:\/\/purl.org\/dc\/elements\/1.1\/type",
            "date": "http:\/\/purl.org\/dc\/elements\/1.1\/date",
            "subject": "http:\/\/purl.org\/dc\/elements\/1.1\/subject",
            "title": "http:\/\/purl.org\/dc\/elements\/1.1\/title",
            "relation": "http:\/\/purl.org\/dc\/elements\/1.1\/relation",
            "creator": "http:\/\/purl.org\/dc\/elements\/1.1\/creator",
            "identifier": {
```

http://www.lsid.info/resolver/urn:lsid:marinespecies.org:taxname:127160.rdf

This gives me a LOT of extra information about that pest!

The information in here would allow me to SPARQL-into additional global biodiversity or agricultural databases

HYBRID SOLUTION
(using code)

→ SPARQL Local Data

→ Federated SPARQL for remote SPARQL Endpoints

→ Download + in-memory SPARQL for published RDF files

Cool query

PREFIX geo: <http://www.w3.org/2003/01/geo/wgs84_pos#>
PREFIX sio: <http://semanticscience.org/resource/>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>


```
select  * where {
      ?p a geo:Point .
      ?p geo:lat ?lat .
      ?p geo:long ?long .
      FILTER(?latfloat > 50)
      BIND(xsd:float(?lat) as ?latfloat) .
      BIND(CONCAT("http://my.database.org/", str(?latfloat) ) as ?remoteurl)
      BIND(IRI(?remoteurl) as $remote)
 } LIMIT 5 OFFSET 100
```