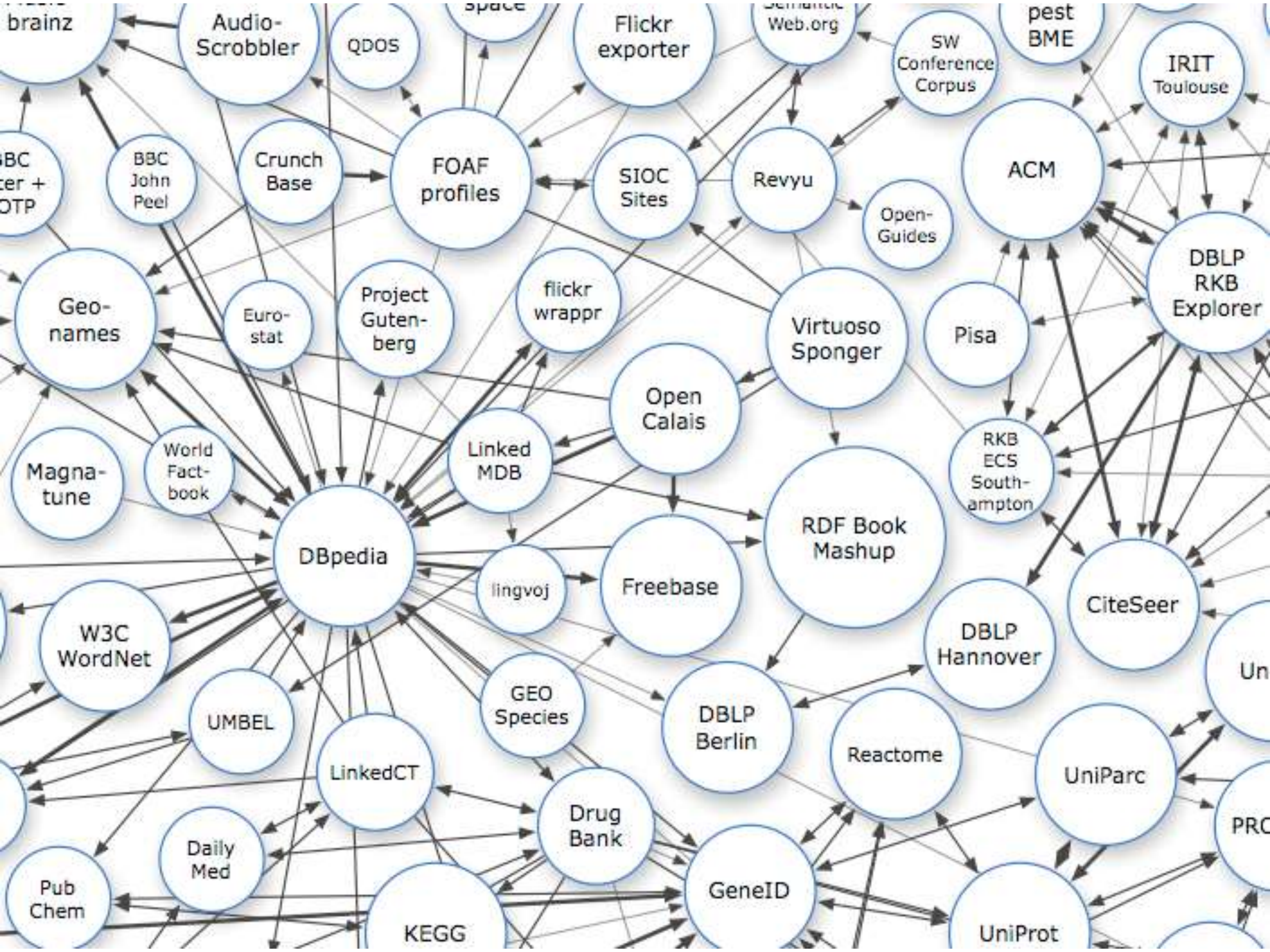
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Crunch Base
FOAF profiles
SIOC Sites
Revyu
ACM
Open-Guides
DBLP RKB Explorer
Geo-names
Euro-stat
Project Guten-berg
flickr wrappr
Virtuoso Sponger
Pisa
Open Calais
Magna-tune
World Fact-book
Linked MDB
RKB ECS South-ampton
DBpedia
lingvoj
Freebase
RDF Book Mashup
CiteSeer
W3C WordNet
DBLP Hannover
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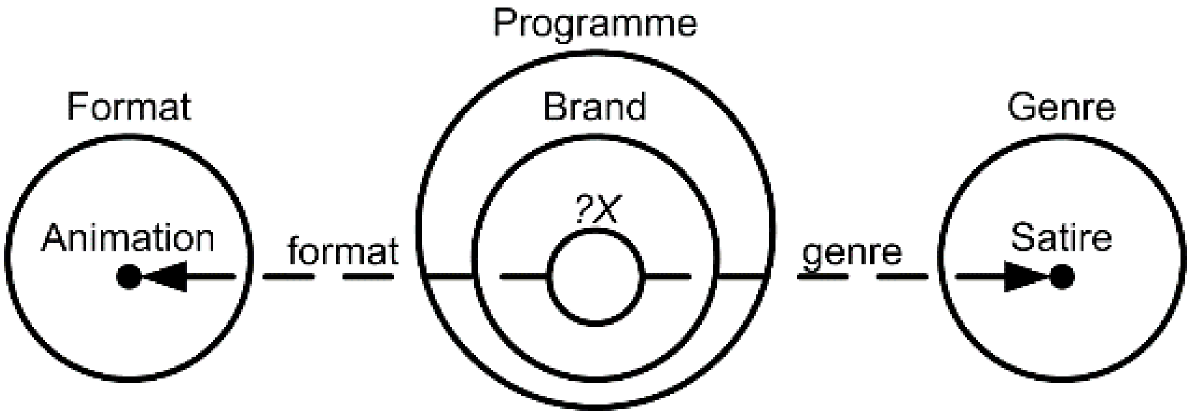


Querying Ontologies with Diagrams

A overview of a submitted EPSRC First Grant proposal

Dr Jon Nicholson

School of Computing, Engineering and Mathematics

Summary

- Background (linked data, ontologies, SPARQL, etc.)

Why?

- The project summary

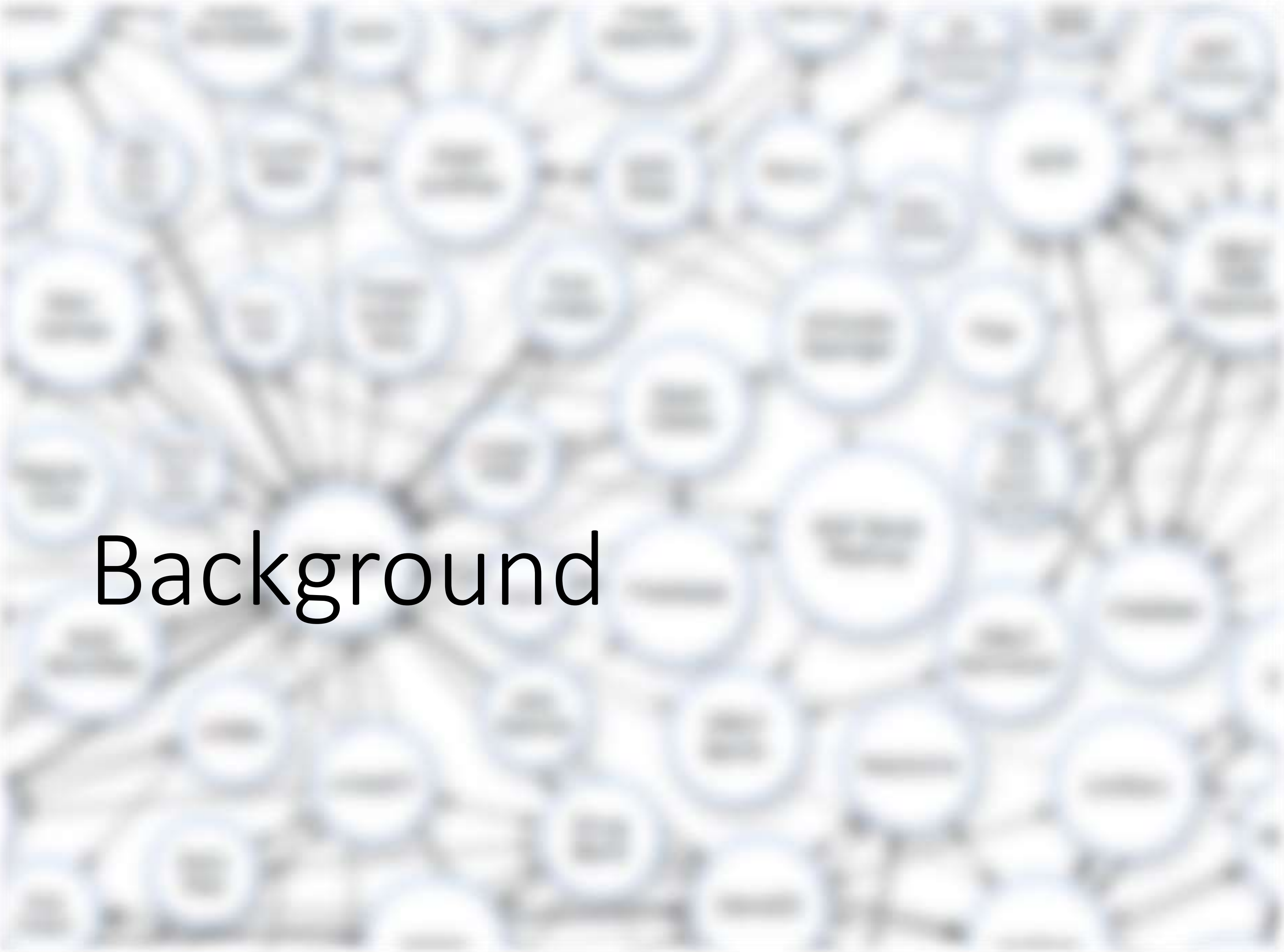
What?

- The notation

How?

- Work so far

When?

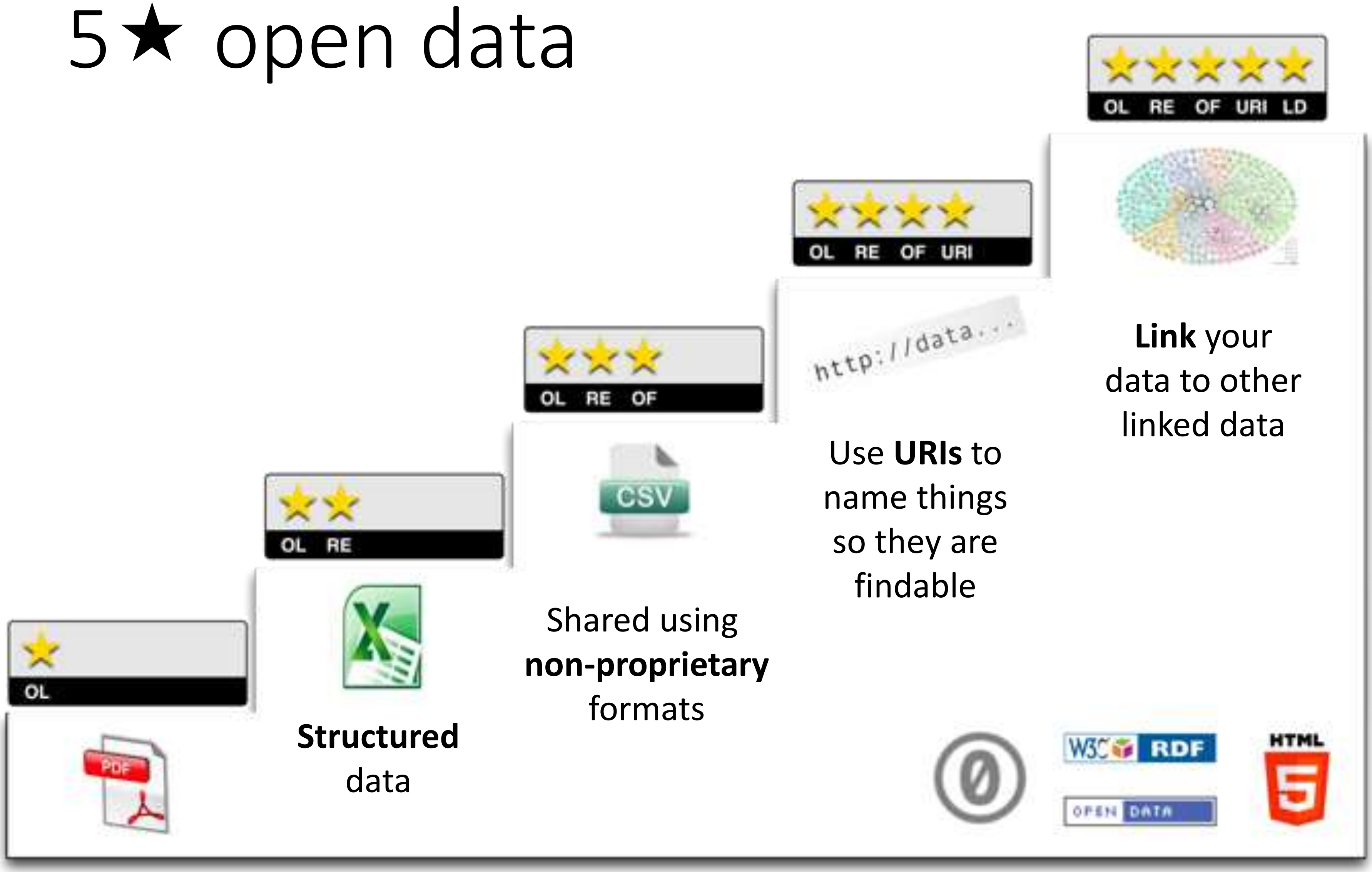


Background

Document- or Data-oriented

- We are all now familiar with the World Wide Web...?
- The WWW is a shared set of interconnected **documents** accessible over a global network (the internet)
    - A **document-oriented** approach, i.e. a "Web of Documents"
    - Designed for human consumption
    - Data not directly exposed
    - Problematic for machine processing
- Wouldn't it be great to reason over data from multiple sources?
    - To join data that is otherwise isolated
    - E.g. identify environmental and health factors that impact on education
- Tim Berners-Lee proposes the **Semantic Web**
    - See his 2009 TED talk: On the next web
    - A **data-oriented** approach, i.e. a "Web of Data"
    - Data linked to other data, i.e. "Linked Data"
    - Enables computers to do more useful work

5★ open data



Online data

Structured data

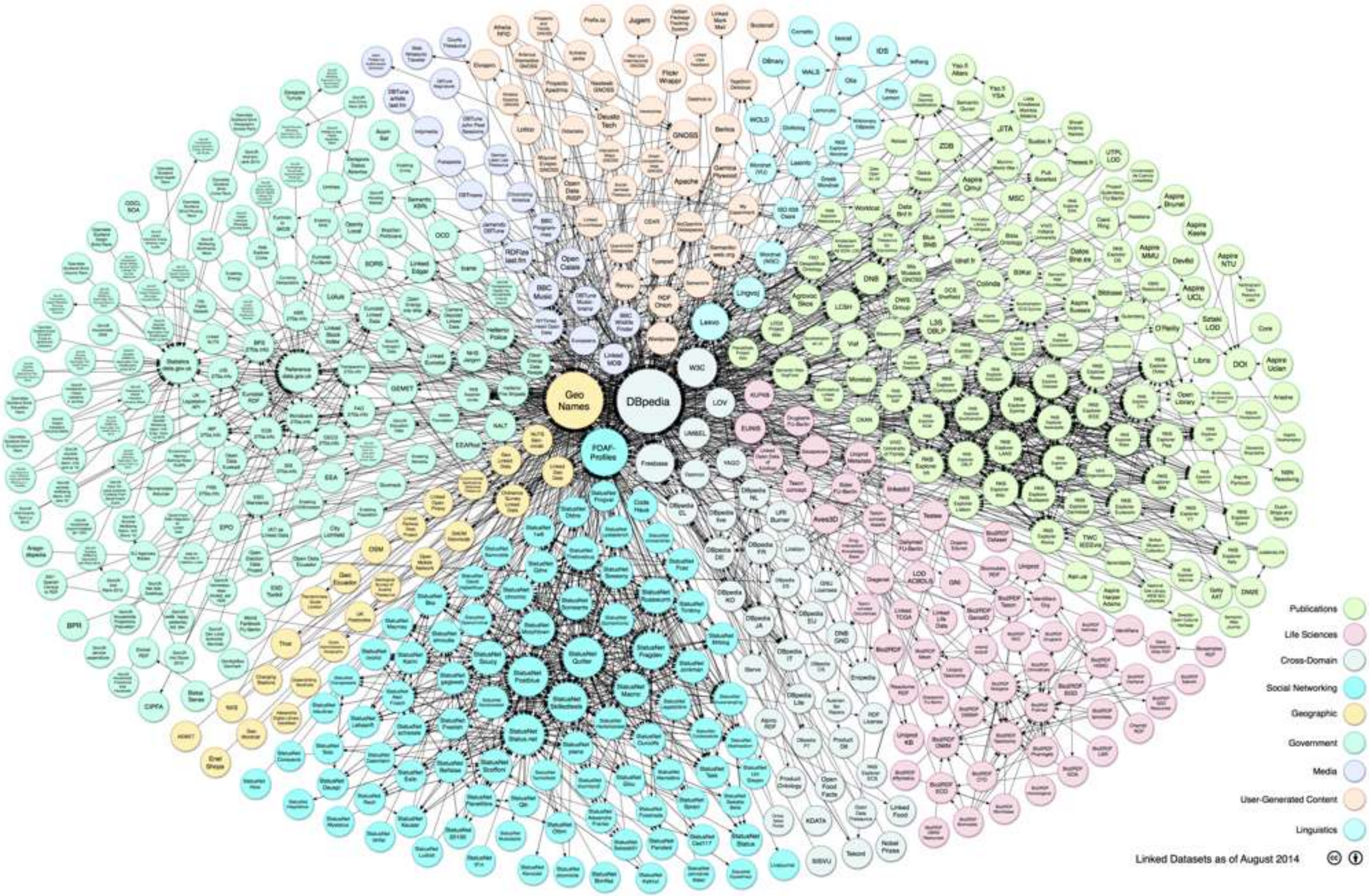
Shared using **non-proprietary** formats

Use **URIs** to name things so they are findable

Link your data to other linked data

Linked/open data examples

- **Data.gov.uk: Opening up government**
  - http://data.gov.uk/
  - Over 19,000 datasets (not all linked) published by the UK government
  - The EU, USA, etc., all committed to opening up their data (within reasonable limits)
- **Ordnance Survey**
  - http://data.ordnancesurvey.co.uk/
  - Great Britain's national mapping agency, providing the most accurate and up-to-date geographic data
- **BBC Programmes Ontology**
  - http://www.bbc.co.uk/ontologies/po
  - A vocabulary for programme (episodes, series, brands, etc.) data
- **DBPedia**
  - http://dbpedia.org/
  - Scrapes all the info boxes on Wikipedia pages into RDF format
- …And many more…



Source: http://lod-cloud.net/

Example uses

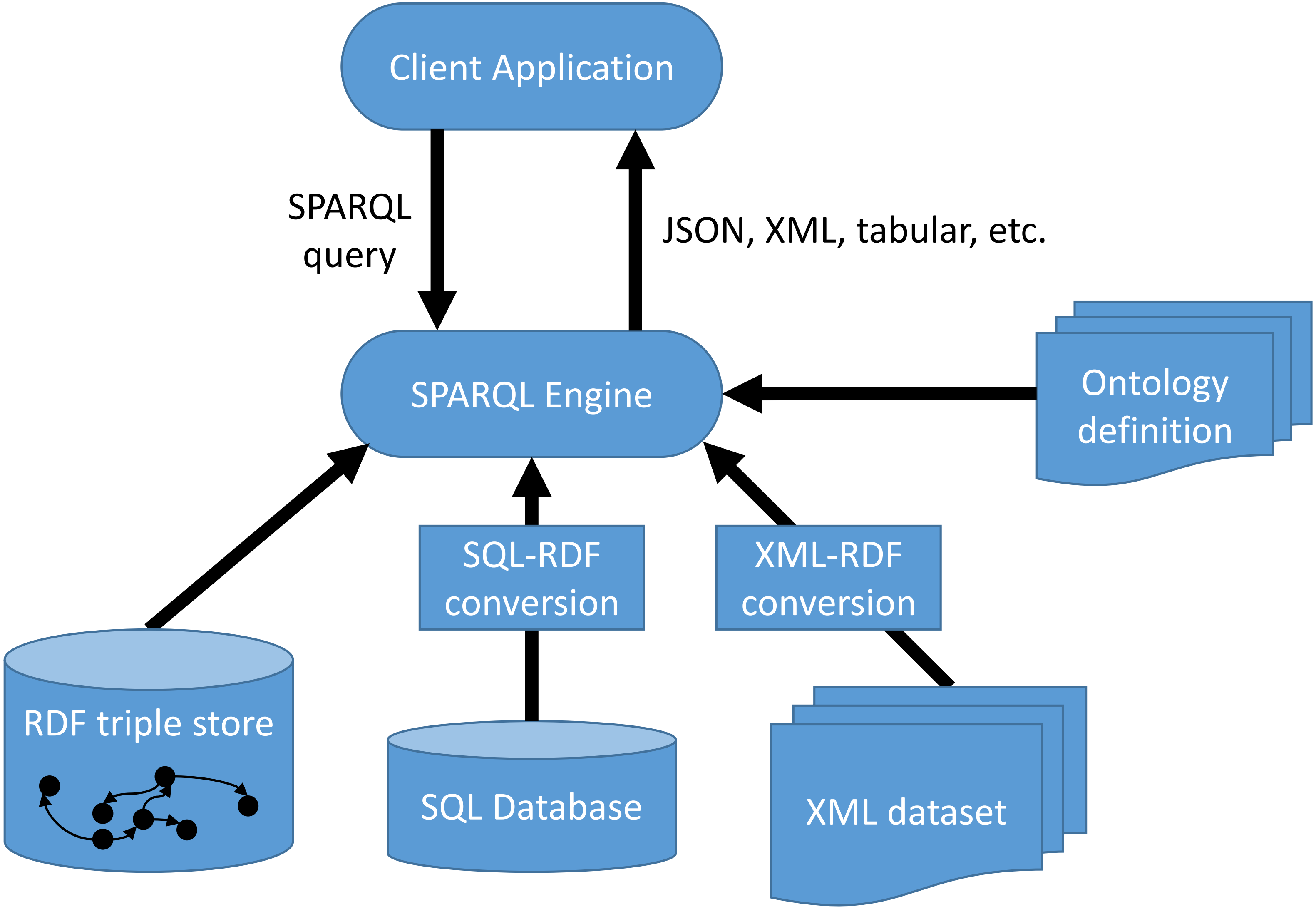
- Tim Berners-Lee's 2010 TED talk: The year open data went worldwide

- Lots available from data.gov.uk and others
- Police.uk
  - Lets you see crime statistics, street-by-street
- Local Authority Profiles
  - Provides a dashboard of local authority statistics, including deprivation, wellbeing, etc.
- Unistats
  - Statistics (including NSS and KIS data) of courses at university

How it works…

- **URI**: Uniform Resource Identifier
  - Web addresses (URLs) are common examples of URIs
  - A unique name that tells us where to find something
- **RDF**: Resource Description Framework
  - A very flexible notation for serializing data
  - Encodes data as triples forming a directed labelled graph
  - E.g. `Jon isa Lecturer`
- **Ontologies**
  - A way of describing data, often defined in formal mathematical notations such as description logics
  - Provides a vocabulary, constraints and rules
- **SPARQL**: **S**PARQL **P**rotocol **A**nd **R**DF **Q**uery **L**anguage
  - A query language for retrieving and manipulating RDF
  - Some implementations can infer information from the ontology def.

How it works…


Client Application
SPARQL query
JSON, XML, tabular, etc.
SPARQL Engine
Ontology definition
SQL-RDF conversion
XML-RDF conversion
RDF triple store
SQL Database
XML dataset

SPARQL example

- Get BBC satirical quiz/panel shows:

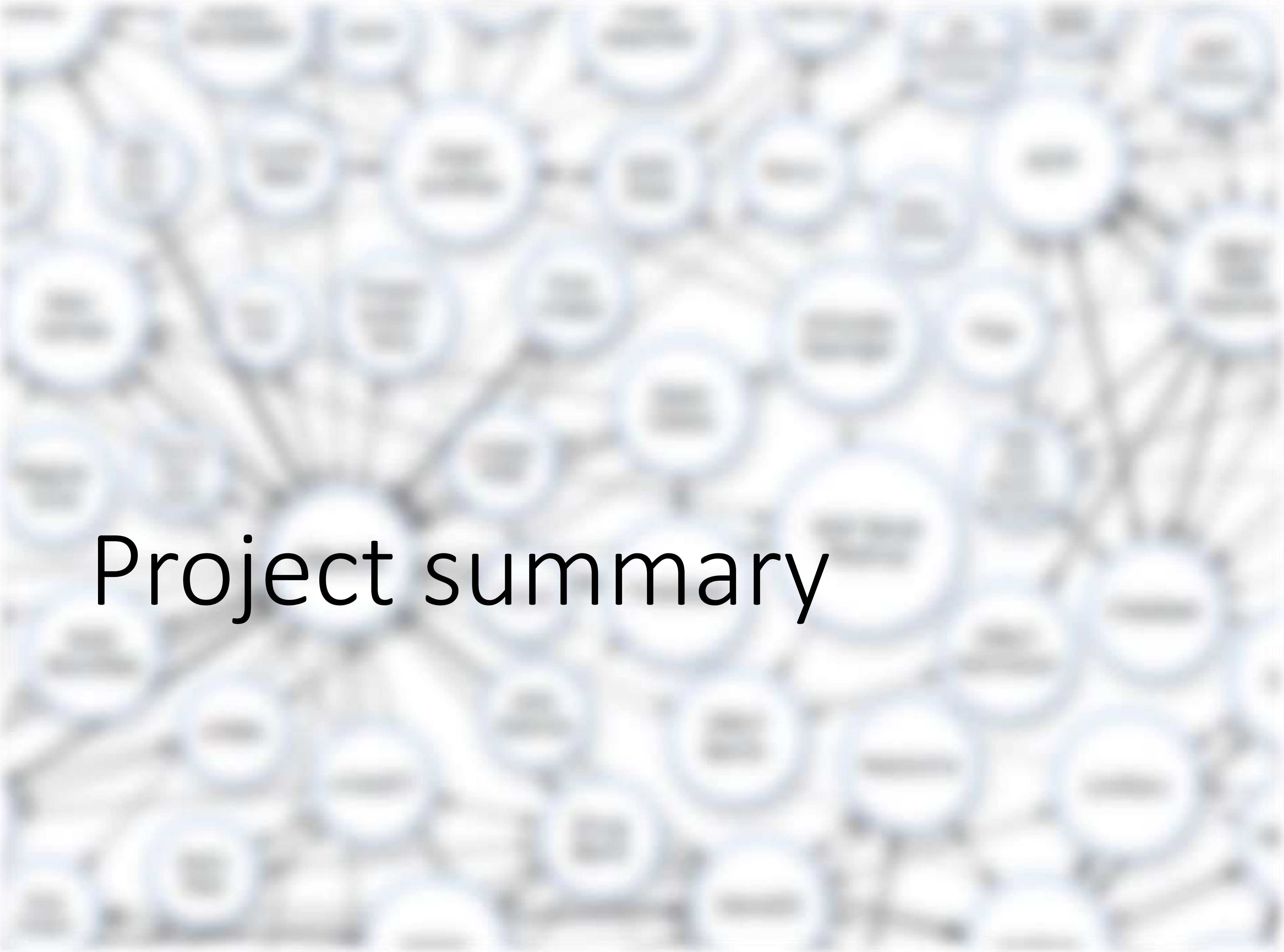
```
PREFIX po: <http://purl.org/ontology/po/>
PREFIX dc: <http://purl.org/dc/elements/1.1/>
SELECT ?uri ?title
WHERE {
  ?uri po:genre <bbc/genres/comedy/satire#genre>.
  ?uri po:format <bbc/formats/gamesandquizzes#format>.
  dc:title ?title
}
```

- Result (e.g.):

```
bbc/b006mkw3 "Have I Got News for You"
```

bbc/… URLs, replace with `http://www.bbc.co.uk/programmes`

Project summary



Proposal details

- 125k project (100k to be funded by the EPSRC)

- Submitted September 2014
  - Have just received reviews and am preparing a response

- This funds:
  - My time as principle investigator, 1 year, 1 day a week
  - 1x post-doctoral research fellow, 1 year, full time
  - 2x visits to project partner (Nokia, in Helsinki)
  - 3x conferences

- Nokia is a project partner
  - Providing staff time supporting the project
  - Helps to ensure relevance with industry

NOKIA

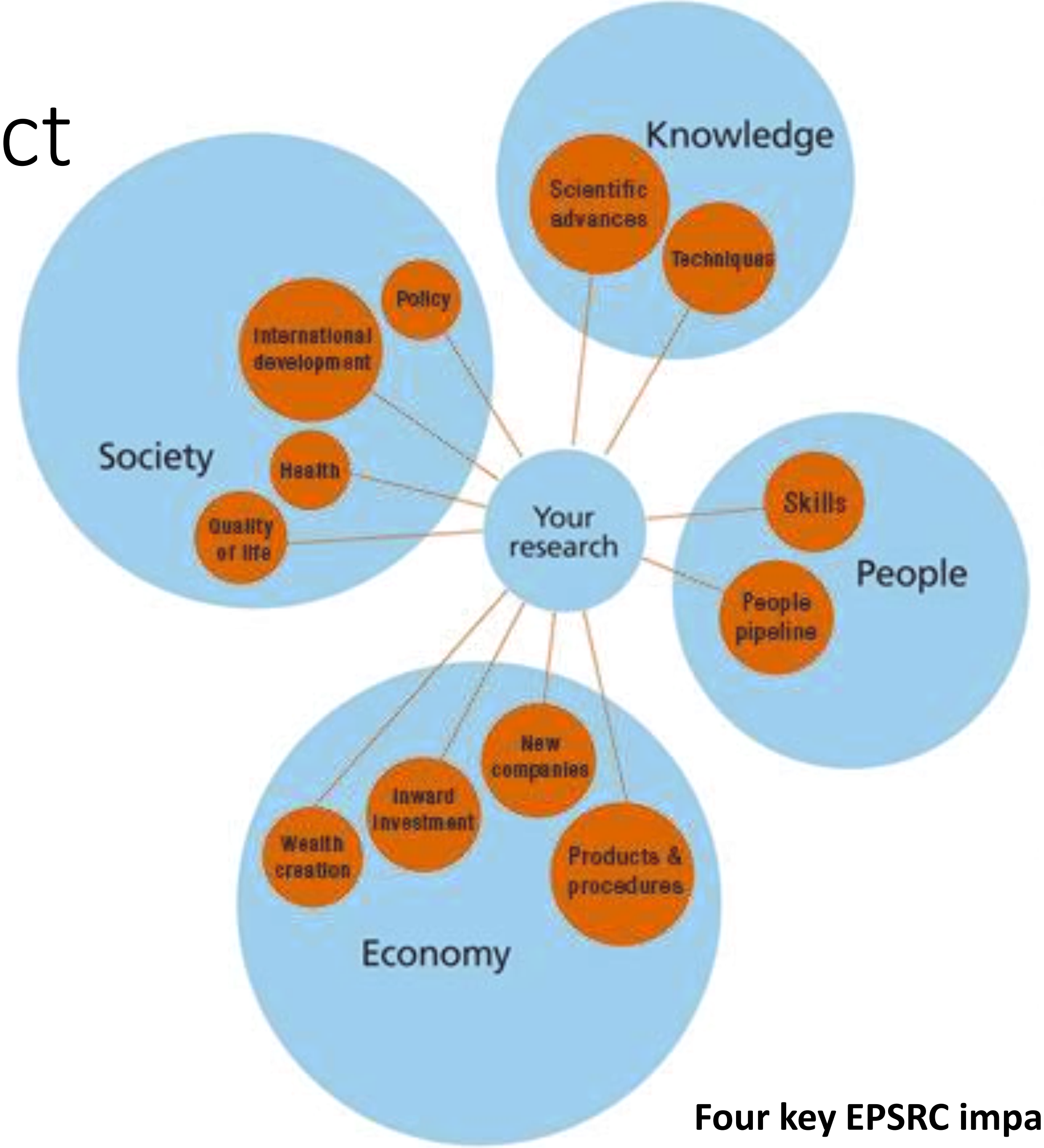
What is the project going to do?

- Manipulating populated ontologies/linked data is not easy, lot of technical symbolic notations and jargon…
- **Aim**
  To make querying populated ontologies (i.e linked data) more accessible to diverse stakeholders such as software engineers, lawyers, data analysts, marketing personnel, and managers
- **Hypothesis**
  We can devise an accessible formal diagrammatic notation for querying ontologies

Stakeholders

- **Ontology engineers**
  - Construct and query ontologies
  - Most likely to be trained in notations (e.g. symbolic/textual) used to define (e.g. OWL2) and query (e.g. SPARQL) ontologies
- **Domain experts**
  - Work with ontologies *in their field*
  - May not be trained in languages like SPARQL
  - Rely on ontology/software engineers for query construction
- **Other end users of ontologies**
  - Those with a need to extract information from populated ontologies for analysis
  - Perhaps the furthest removed from the definition of the underlying ontology and the logics used to define them
  - E.g. data analysts, marketing professionals and managers
- **The project team and other academic researchers**
  - The Visual Modelling Group (VMG)
  - Wider academic community in ontology engineering and diagrammatic logics

Impact



Four key EPSRC impact indicators

Impact: examples

- Proposal shows each key area of impact associated with each identified stakeholder group
- Too big to fit on a slide…

- Examples:
  - People/Ontology engineers
    - Enables increased communication between technical and non-technical staff, promoting efficient use of the skills of both (medium term)
  - Economy/Other users
    - Simplifies training required to interrogate large datasets, reducing costs to business, particularly useful to new and small businesses (long term)

Impact strategy

- Short-term (0-2 years)
  - Focuses on **project team**
  - Primarily through collaboration with project partner
  - Project web site to provide materials
- Medium-term (2-5 years)
  - Focuses on **software and ontology engineers**
  - Develop tools, such as a plugin for Protégé
  - Further publications in journals etc.
- Long-term (5+ years)
  - Focuses on **domain experts** and **general public**
  - Look to develop more tools targeting more general use
    - E.g. a web based tool made available through data.gov.uk
  - But ultimately dependant on interest

So what are the objectives?

1. Design a diagrammatic query notation informed by SPARQL
    - Based on *Concept Diagrams*
    - Informed by queries used in industry, i.e. with project partner Nokia
2. Formalise the diagrammatic query notation
    - Including formal mappings between SPARQL and the new query notation
    - Establish that all of SPARQL can be expressed
3. Evaluate the accessibility of the new query notation
    - Empirical study of the relative accessibility of the new diagrammatic query notation for **formulating queries** as compared to SPARQL
    - Empirical study of the relative accessibility of **representing results** diagrammatically as compared to the textual output from SPARQL
    - Accessibility measured in terms of performance, e.g. time taken and error rate

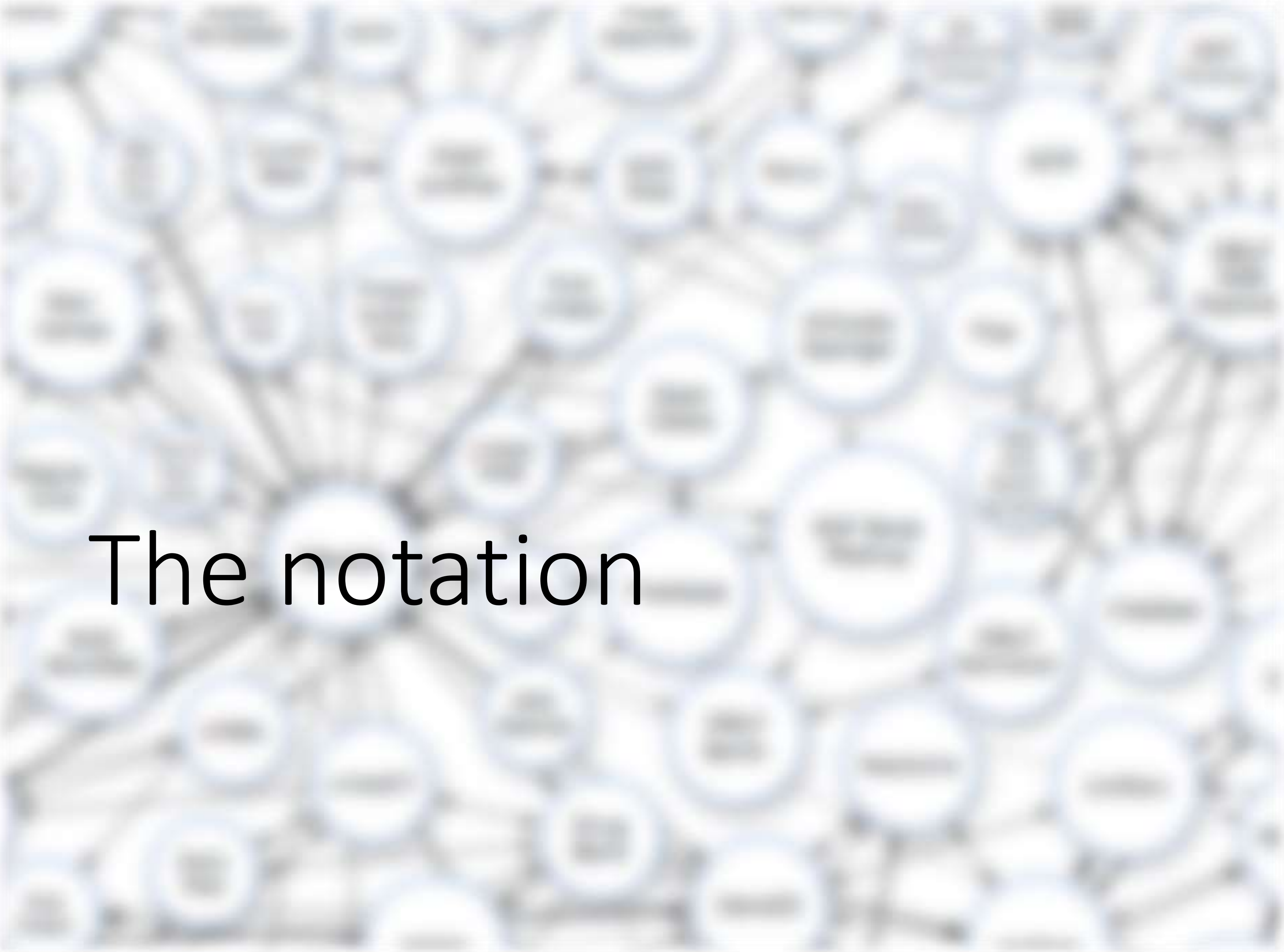
Challenges

- Covering all of SPARQL is very ambitious
  - Several types of queries
    - SELECT queries (tell me specific things about x)
    - DESCRIBE queries (what can I find out about x?)
    - ASK queries (does some property hold for x?)
  - Optionality (give me information if it exists)
  - Several types of conditions
    - FILTERs, regular expressions
  - Combination of data sources (linked data)

- Deciding how to represent these in a formal **and accessible** way is not easy
  - Likely to be trade-offs between expressiveness and clarity
  - But I believe that the basic building blocks are there…

Related work

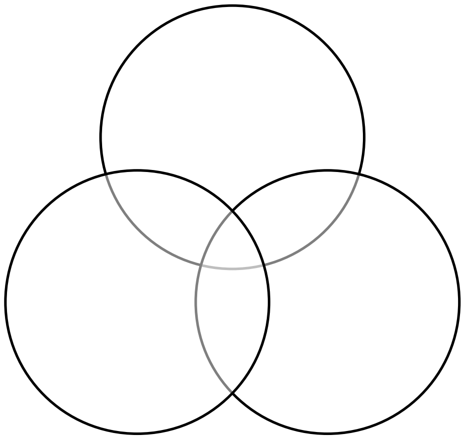
- Diagrammatic query notations / languages / visualizations are not new
  - Kaleidoquery for object databases (OCL)
  - Visionary for relational databases (SQL)
  - XQBE for XML documents (XQuery)
  - Konduit VQB, OptiqueVQS, and MashQL for linked data (SPARQL)
- Important because "domain experts mostly do not possess necessary competences to formulate queries by using structured query languages”
  - A. Soylu, M. Giese, E. Jimenez-Ruiz, E. Kharlamov, D. Zheleznyakov, and I. Horrocks. OptiqueVQS: Towards an ontology-based visual query system for big data. In 5th Int. Conf. on Management of Emergent Digital EcoSystems, pages 119–126. ACM, 2013.
- But they typically focus on building the query only
- This project's novelty is for the query **and** its results to be presented using the same diagrammatic notation
  - I theorise that presenting the query and its results in the same format will help users understand the context of the results making it easier to interpret



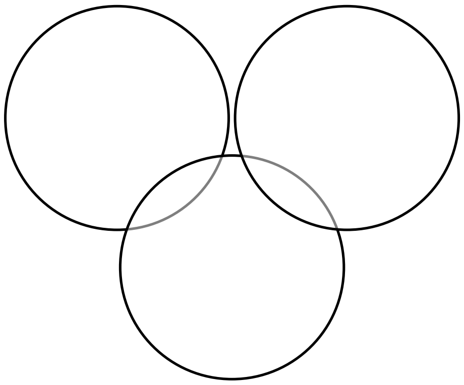
The notation

The notation

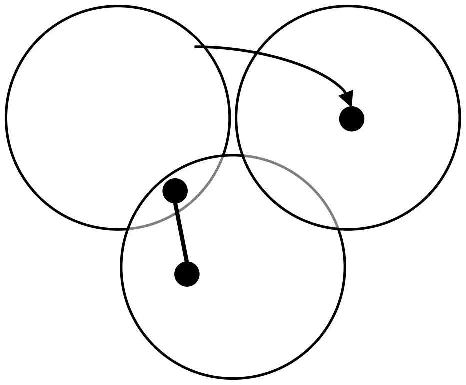
- Will be based on **Concept Diagrams**
  - Developed by J.Howse, G.Stapleton, et al. in the Visual Modelling Group (CEM, UoB)
  - Roughly speaking, Concept diagrams are based on Euler diagrams with the addition of individuals and edges



Venn diagram



Euler diagram



Concept diagram

Concept Diagrams

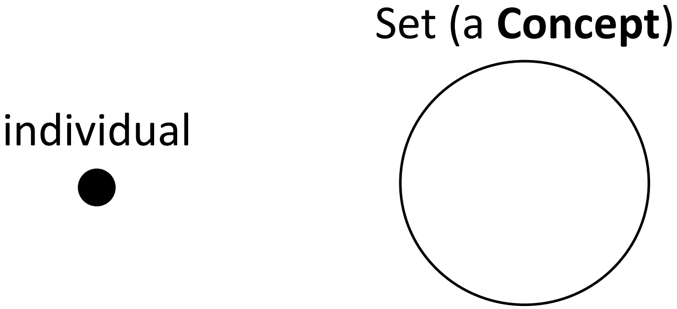
- Concept Diagrams have a formal syntax and semantics

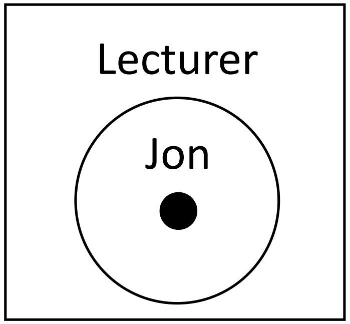
- Have been shown to be useful for describing/defining ontologies
    - Nokia use them for privacy engineering

- Concept diagrams have been said to be the exception, where most languages are either not accessible or are not formal artefacts
    - P. Warren, P. Mulholland, T. Collins, and E. Motta. The usability of description logics: Understanding the cognitive difficulties presented by description logics. In The Semantic Web: Trends and Challenges, LNCS 8465:550–564, Springer, 2014.

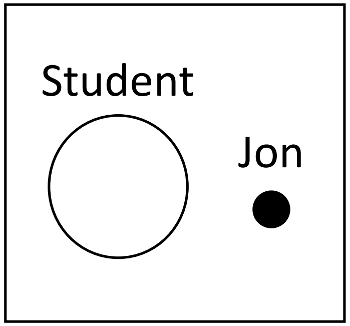
- I believe they have the potential to make an intuitive and accessible diagrammatic query notation

Concept Diagrams: a crash course

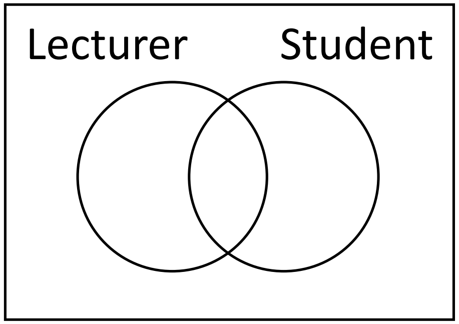




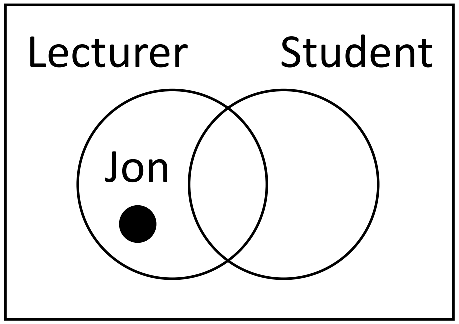
Jon is a Lecturer



Jon is not a Student

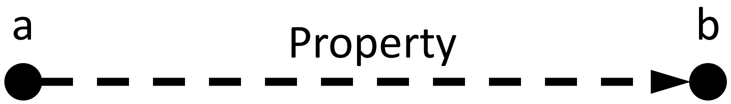


Some Lecturers are Students

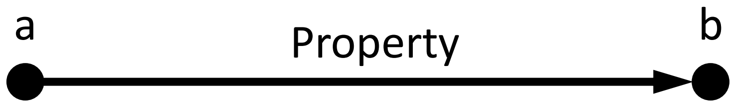


Jon is a Lecturer, but not a Student

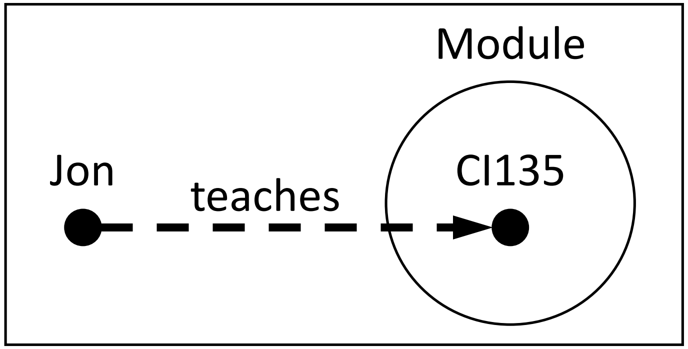
Concept Diagrams: a crash course



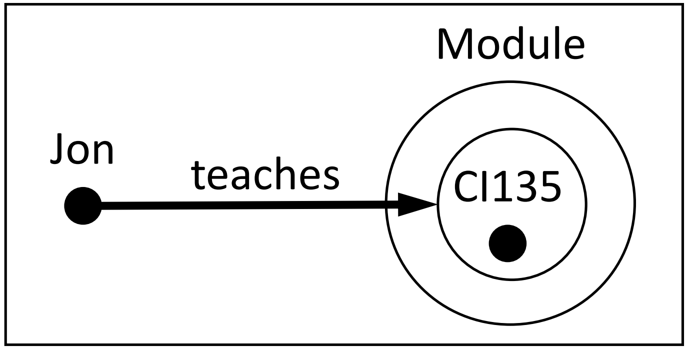
a relates to at least b under property



a relates to exactly b under property



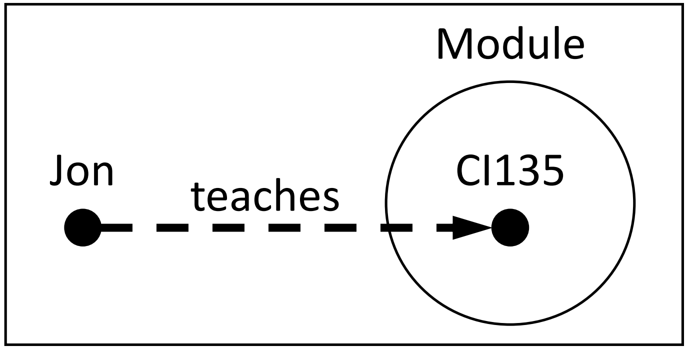
Jon teaches the module CI135, and possibly others things that may not be modules



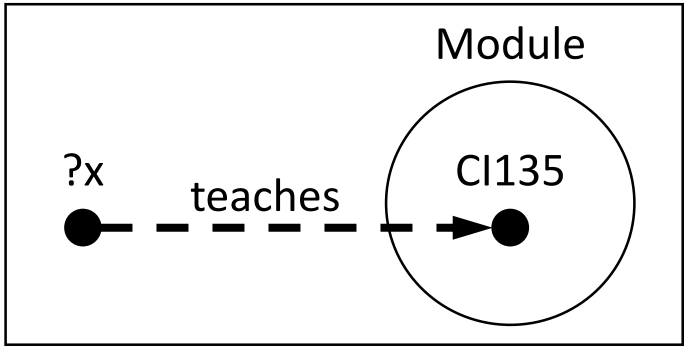
Jon teaches only modules, which includes CI135

A simple example

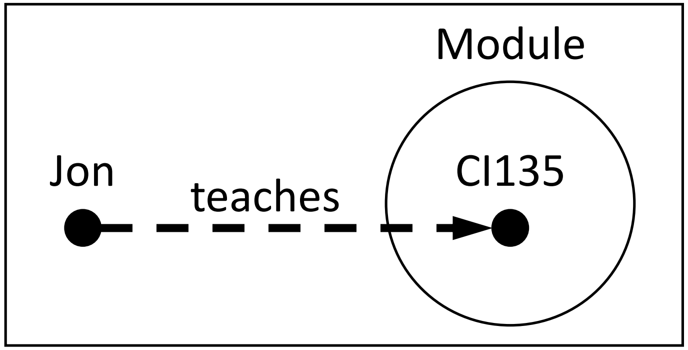
Specification



Query



Results



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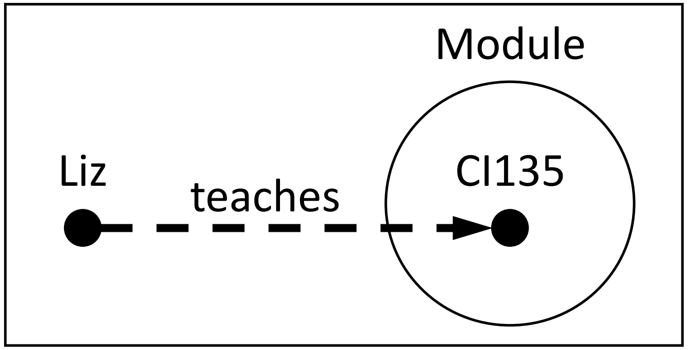
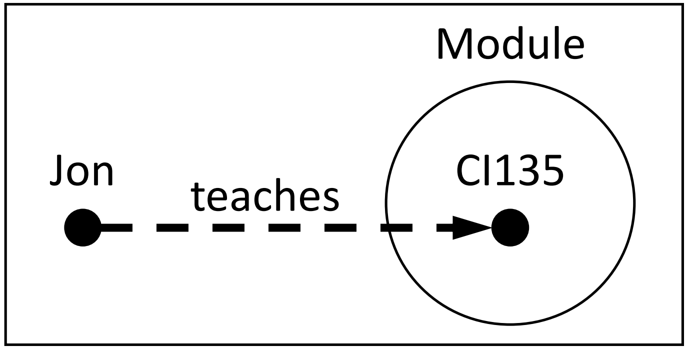
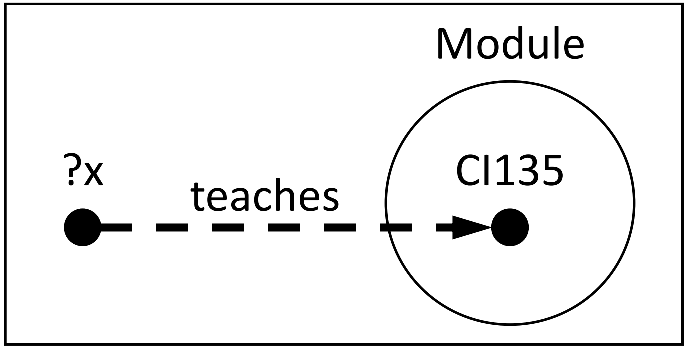


A simple example

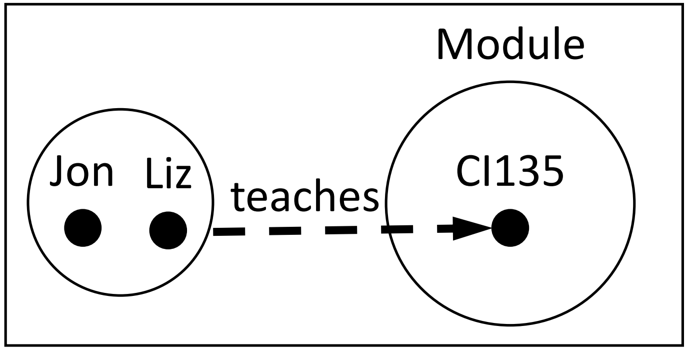
Specification



Query



Results



This is a very simple example

It's not clear yet how other parts of SPARQL will be captured in the notation

Work so far

Progress…

- Submitted the proposal (Sept 2014)
- Received 3 peer reviews (end of Jan 2015)
- Responded to reviews (start of Feb 2015)
- Now awaiting a panel date…

Work on the notation

- The project is only a year long
  - Will have a standing start to some extent

- Trying to get started now..
  - Identifying a small selection of SPARQL examples
  - Drawing diagrams for these
  - Highlights some of the difficulties that need to be addressed

- Have so far identified a need for a class, often only represented only as a concept (i.e. a set of its members), to be treated as an individual in some cases

Thank you

Questions welcome.