O Say Can You See

Network Analysis and Relationship Exploration with Linked Data

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- BA Music and History, University of Nebraska
- MSc Digital Humanities, University College London

Introduction

Early Washington D.C.,
Family & Law

Part I: Overview and Current Site

Part II: Make Your Own Ontology

Part III: Querying Data

Introductions

The Tech Behind OSCYS

The Site, Documents, and Search

- XML Encoded Documents (TEI)
- Ruby on Rails
- Apache Solr

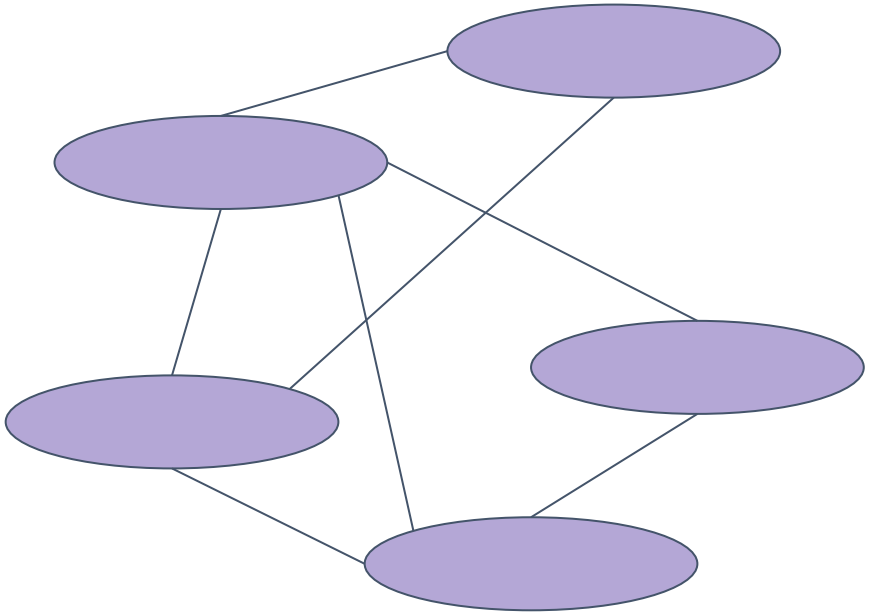
The Relationships

- Apache Fuseki
- Linked Data

“It is about making links...when you have some of it, you can find other, related, data.”

https://www.w3.org/DesignIssues/LinkedData.html

Linked Data
vs
Relational Databases



Triples

Benjamin Sisko has rank Captain

Sisko serves on DS9

Sisko knows Jadzia Dax

Dax has rank Lt. Commander

Dax serves on DS9

Dax has position Chief Science Officer

Worf is the son of Mogh

Mogh is a Klingon warrior

"Dax" refers to the same entity each time

- Dax has rank Lt. Commander
- Dax serves on DS9
- Dax has position Chief Science Officer

Resource Description Framework

Resource

an entity with a URI

Literal

a single use description

#1 refers to a **resource**

#1 is named "Jadzia Dax"

#1 serves on DS9

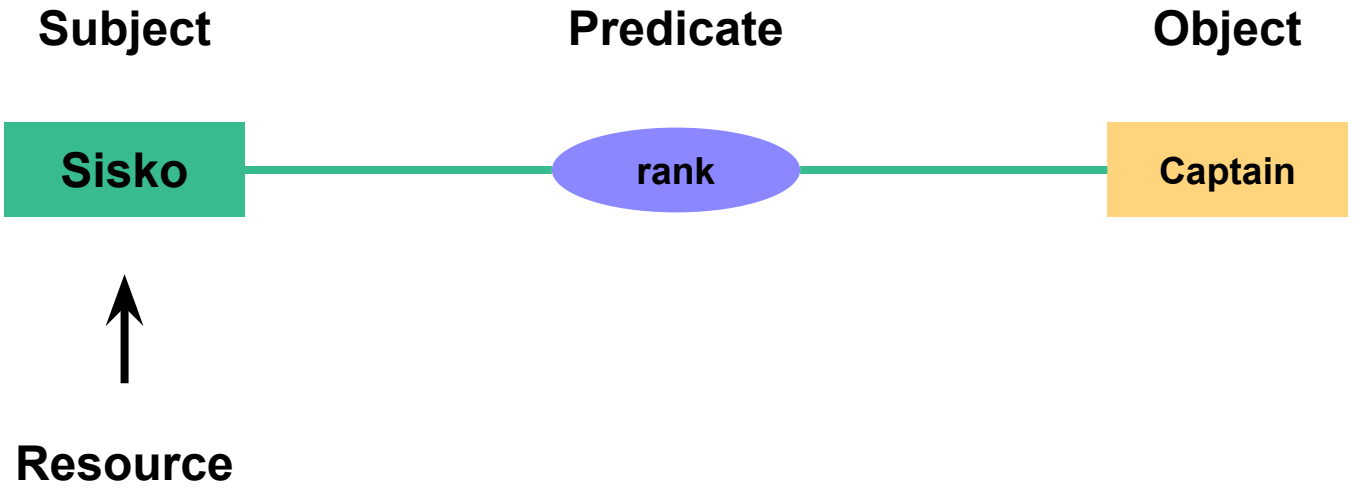
#1 has position Chief Science Officer

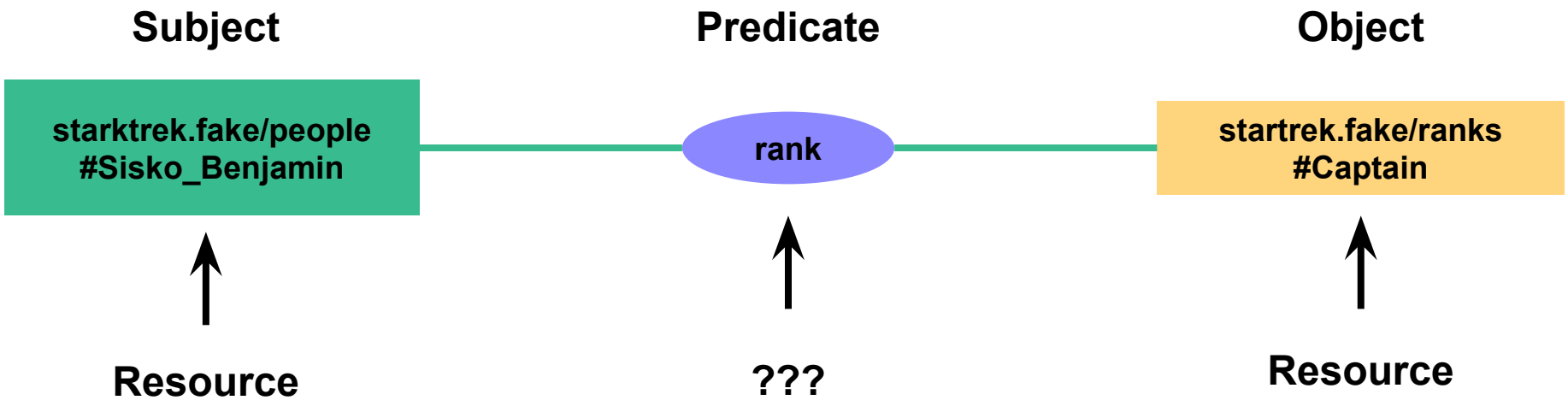
#1 has rank Lt. Commander

Her name is a **literal**

These could be resources

startrek.fake/people#1
startrek.fake/people#Dax_Jadzia


Subject
Predicate
Object
Sisko
rank
Captain
Resource


Subject
Predicate
Object
starktrek.fake/people
#Sisko_Benjamin
rank
startrek.fake/ranks
#Captain
Resource
???
Resource

Web Ontology Language

≈

OWL

Ontology is the philosophical study of the nature of being, becoming, existence, or reality -- wikipedia

Property: foaf:workInfoHomepage

work info homepage - A work info homepage of some person; a page about their work for some organization.

Status: testing

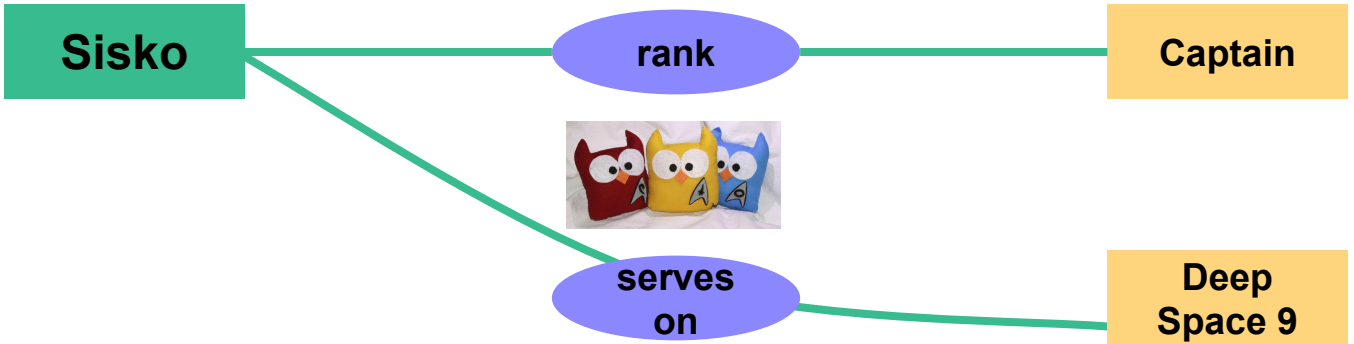
Domain: having this property implies being a Person

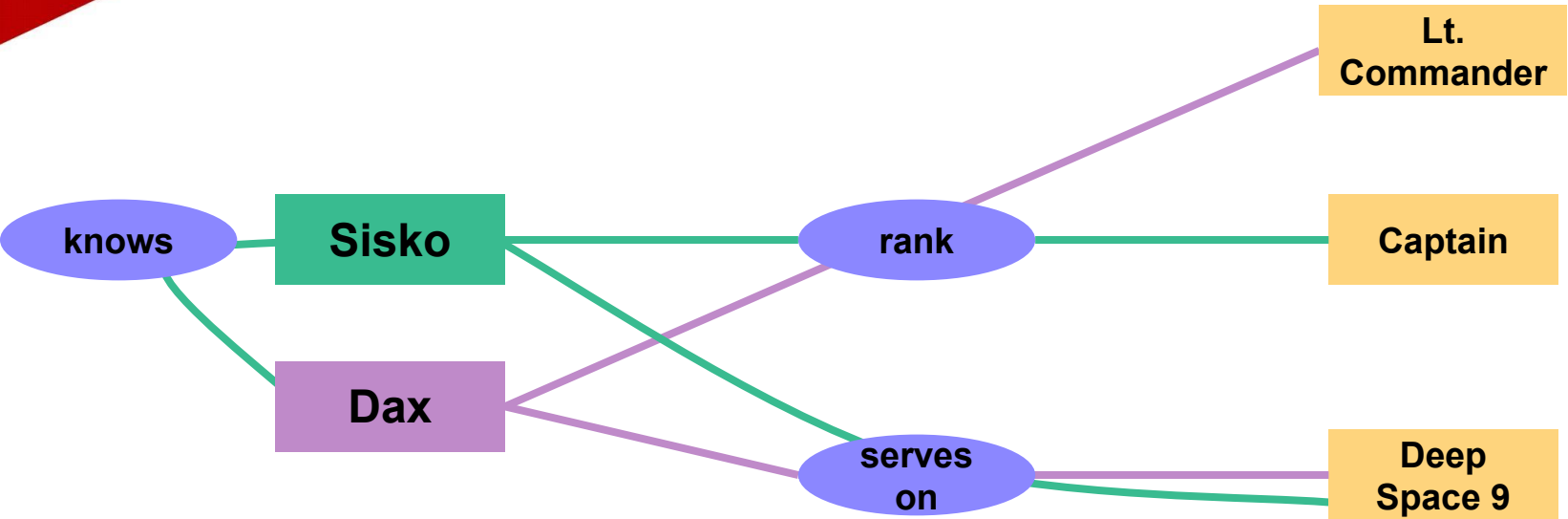
Range: every value of this property is a Document

The `workInfoHomepage` of a `Person` is a `Document` that describes their work. It is generally (but not necessarily) a different document from their `homepage`, and from any `workplaceHomepage`(s) they may have.

The purpose of this property is to distinguish those pages you often see, which describe someone's professional role within an organisation or project. These aren't really homepages, although they share some characterstics.

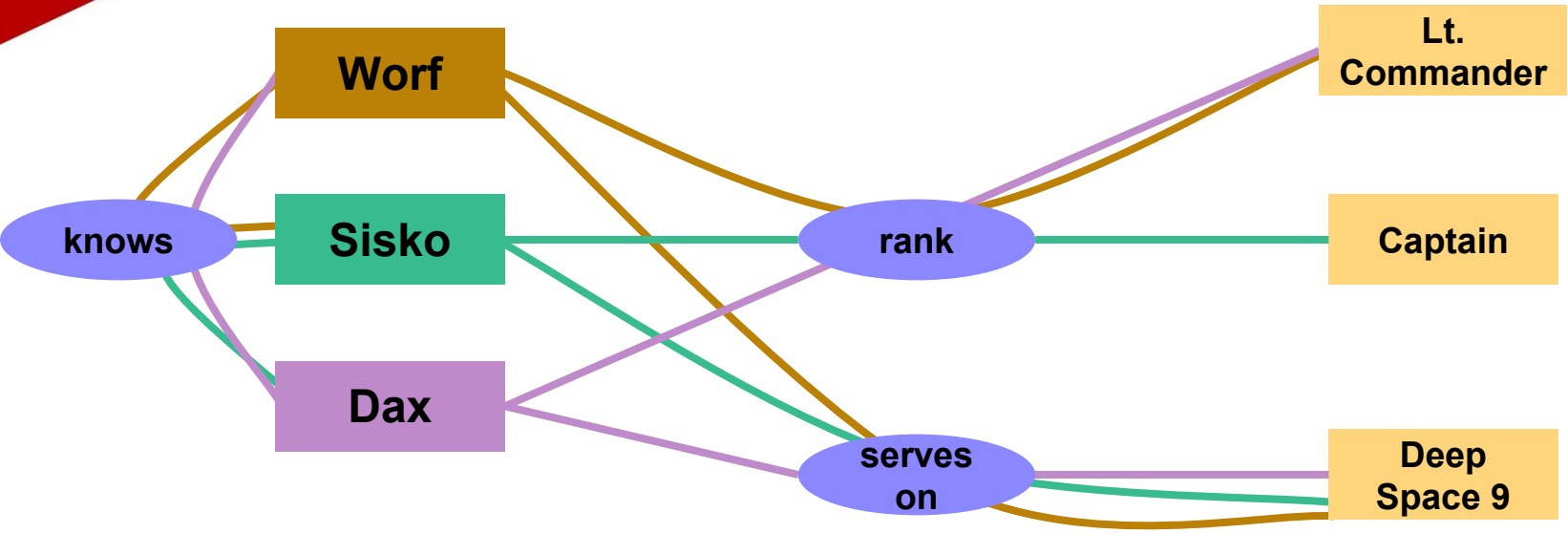

```
▼<owl:ObjectProperty rdf:about="#childOf">
   <rdfs:domain rdf:resource="#Person"/>
   <rdfs:range rdf:resource="#Person"/>
   <owl:Inverseof rdf:resource="#parentOf"/>
   <rdfs:subPropertyOf rdf:resource="#familyRelationship"/>
 </owl:ObjectProperty>
```

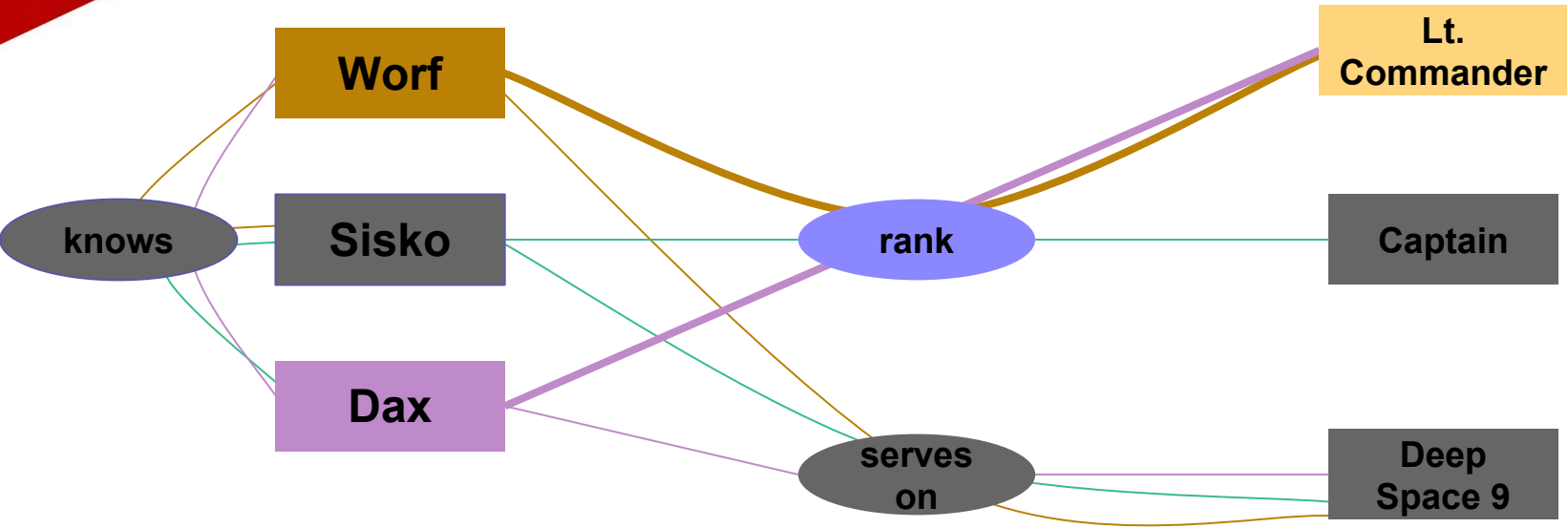

Sisko
rank
Captain
serves on
Deep Space 9


Lt.
Commander
knows
Sisko
rank
Captain
Dax
serves
on
Deep
Space 9

Give me anything ?subject **connected to** ?predicate **other things** ?object

?subject	?predicate	?object
Sisko	knows	Dax
Dax	knows	Sisko
Sisko	rank	Captain
Dax	rank	Lt. Commander
Sisko	serves on	Deep Space 9
Dax	serves on	Deep Space 9


Worf
Sisko
Dax
knows
rank
serves on
Lt. Commander
Captain
Deep Space 9



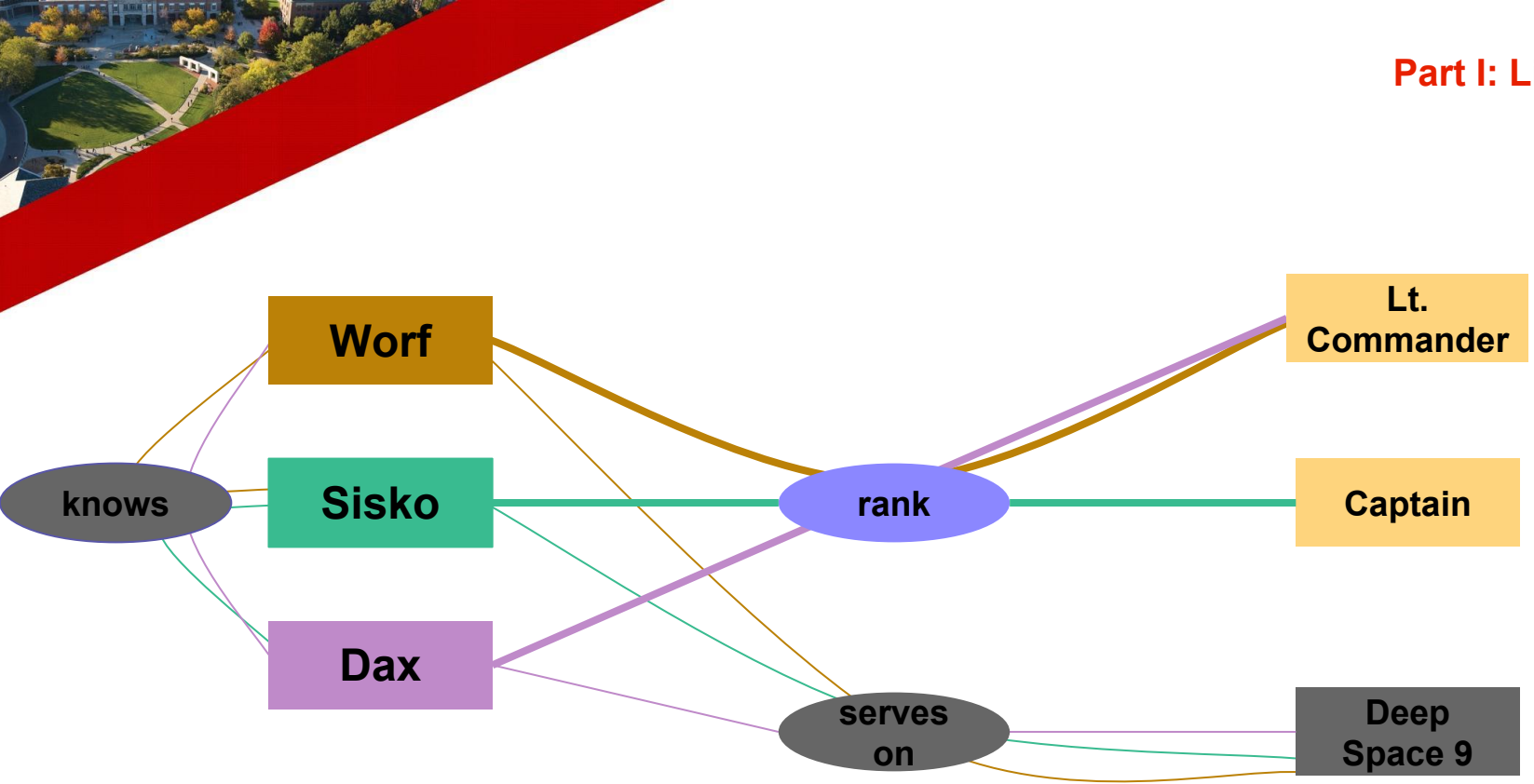
Who has rank Lt. Commander **?**

Who has rank Lt. Commander?

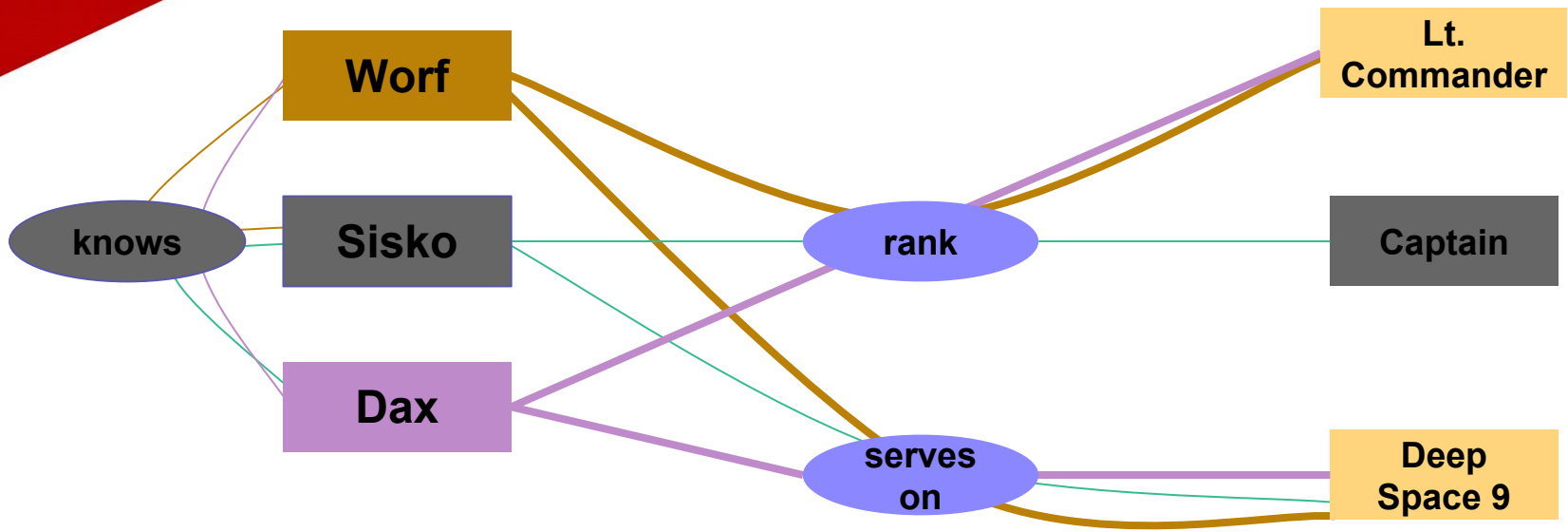
?person rank Lt. Commander

?person	rank	Lt. Commander
Worf	rank	Lt. Commander
Dax	rank	Lt. Commander

?person
Worf
Dax

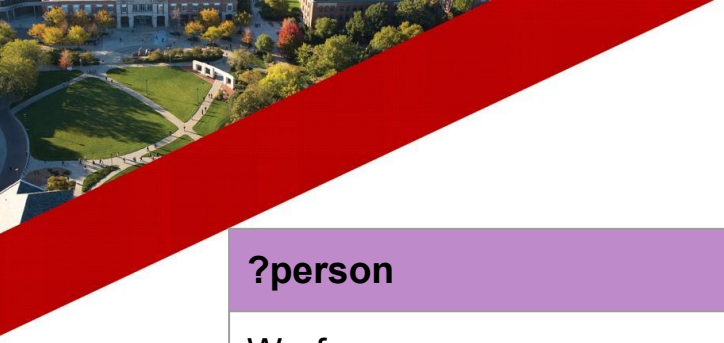


Who has rank anything?



Who has rank Lt. Commander ?

Those people serve on what vessel / station?



?person	rank	Lt. Commander
Worf	rank	Lt. Commander
Dax	rank	Lt. Commander

?person	serves on	?vessel
Worf	serves on	Deep Space 9
Dax	serves on	Deep Space 9

?person	?vessel
Worf	Deep Space 9
Dax	Deep Space 9

Linked Data in OSCYS

?person1	?relationship	?person2
Lee, Edmund J.	attorneyAgainst	Thornton, Joseph
Eliza	indenturedTo	Wetzel, John

```
<owl:ObjectProperty rdf:about="#indenturedTo">
  <rdfs:domain rdf:resource="#Person"/>
  <rdfs:range rdf:resource="#Person"/>
  <owl:Inverseof rdf:resource="#indenturerOf"/>
  <rdfs:subPropertyOf rdf:resource="#workRelationship"/>
</owl:ObjectProperty>
```

Search By Relationship Type

Find people related by a specific type of connection in the OSCYS data.

Attorney Against

Go!

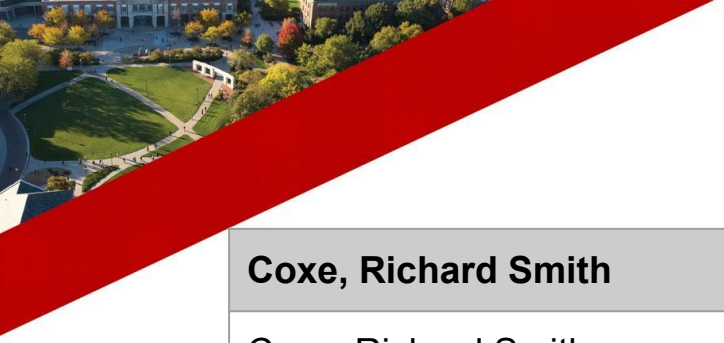
Individual	attorney against
Lee, Edmund J.	Thornton, Joseph
Key, Francis Scott	Edelin, Edward
Jones, Walter	Butler, Sally

Direct Relationships

Starting Person	Relationship	Final Person
Caldwell, Elias Boudinot	attorney with	Key, Francis Scott
Caldwell, Elias Boudinot	oppositions attorney	Key, Francis Scott

Relationships Two Apart

Starting Person	Relationship	Person	Relationship	Final Person
Coxe, Richard Smith	attorney for	Lemon, Betsey	client of	Smith, B. P.
Coxe, Richard Smith	attorney for	Lemon, Lavinia	client of	Smith, B. P.



Coxe, Richard Smith	?relationship1	?person1
Coxe, Richard Smith	attorneyFor	Lemon, Betsey
Coxe, Richard Smith	attorneyFor	Lemon, Lavinia

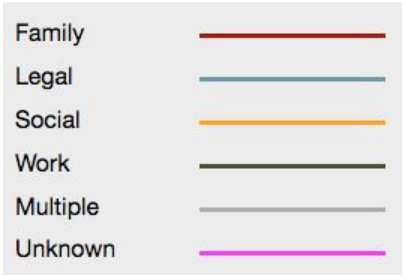
?person1	?relationship2	Smith, B. P.
Lemon, Betsey	clientOf	Smith, B. P.
Lemon, Lavinia	clientOf	Smith, B. P.

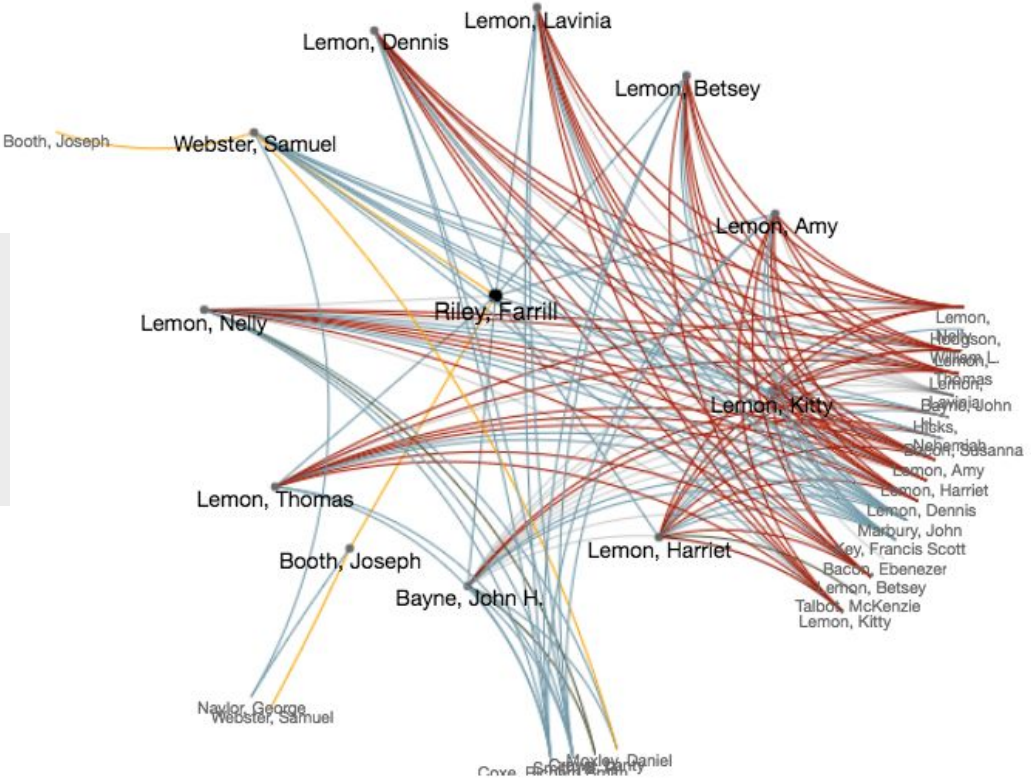
?relationship1	?person1	?relationship2
attorneyFor	Lemon, Betsey	clientOf
attorneyFor	Lemon, Lavinia	clientOf

Relationships:

- Child Of Lemon, Nelly
- Client Of Coxe, Richard Smith
- Client Of Key, Francis Scott
- Client Of Smith, B. P.
- Enslaved By Bayne, John H.
- Judged By Cranch, William
- Oppositions Attorney Marbury, John
- Petitioner Against Bayne, John H.
- Sibling Of Lemon, Amy
- Sibling Of Lemon, Betsey
- Sibling Of Lemon, Dennis
- Sibling Of Lemon, Harriet
- Sibling Of Lemon, Kitty
- Sibling Of Lemon, Thomas

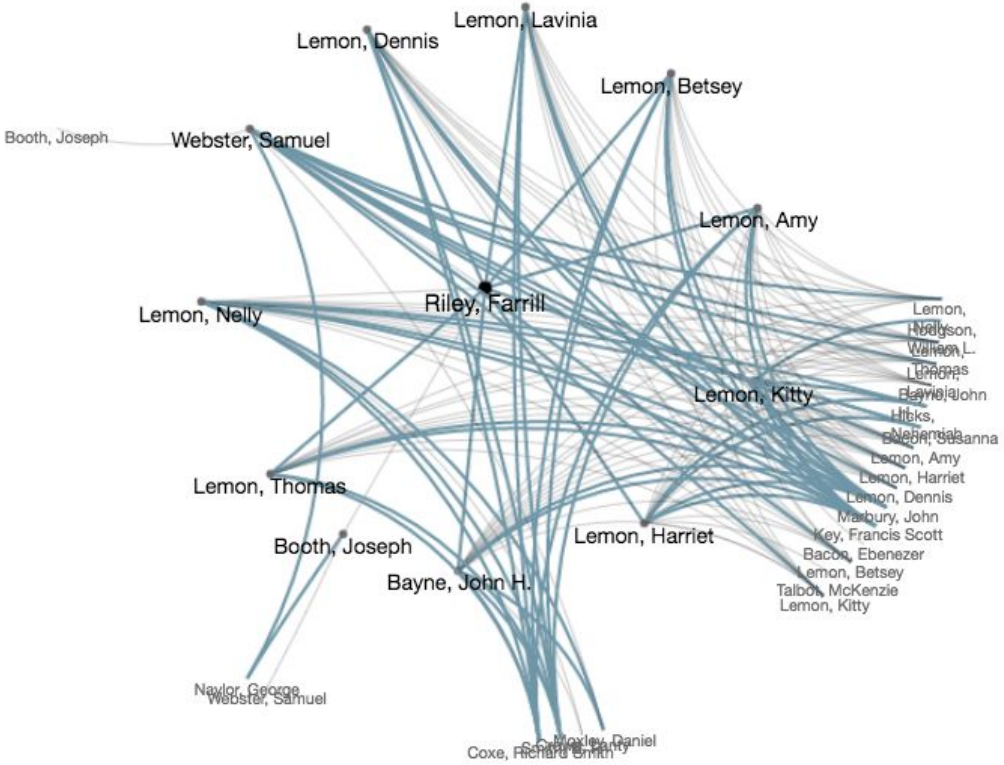
Part I: Linked Data





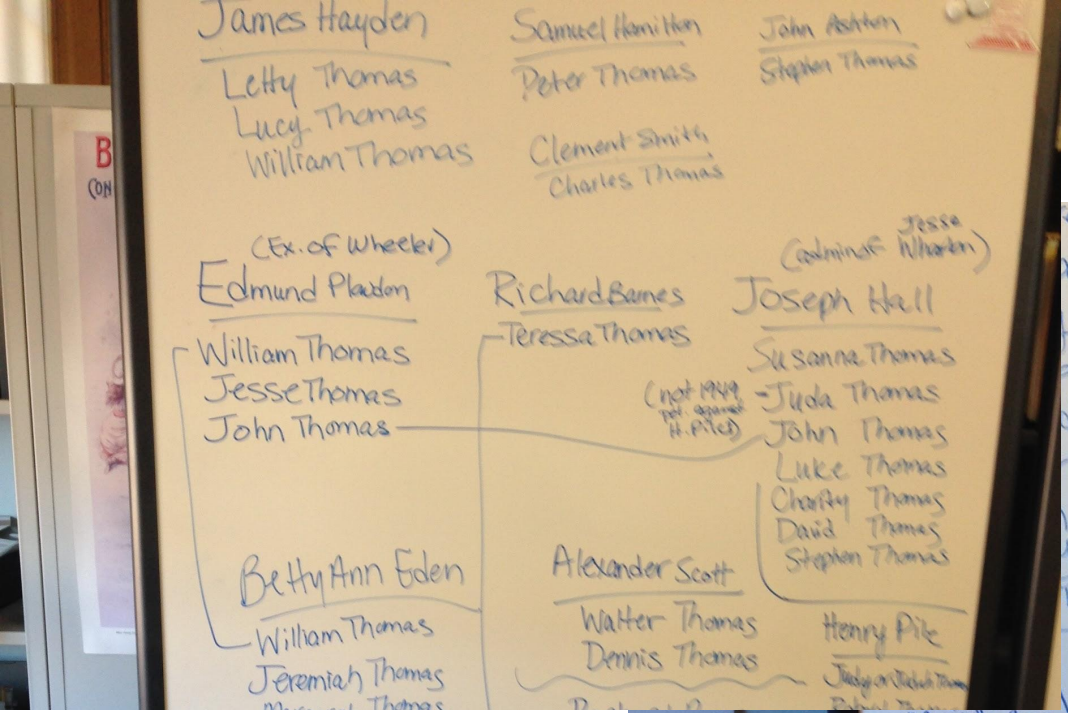
http://earlywashingtondc.org/people/network/per.001437

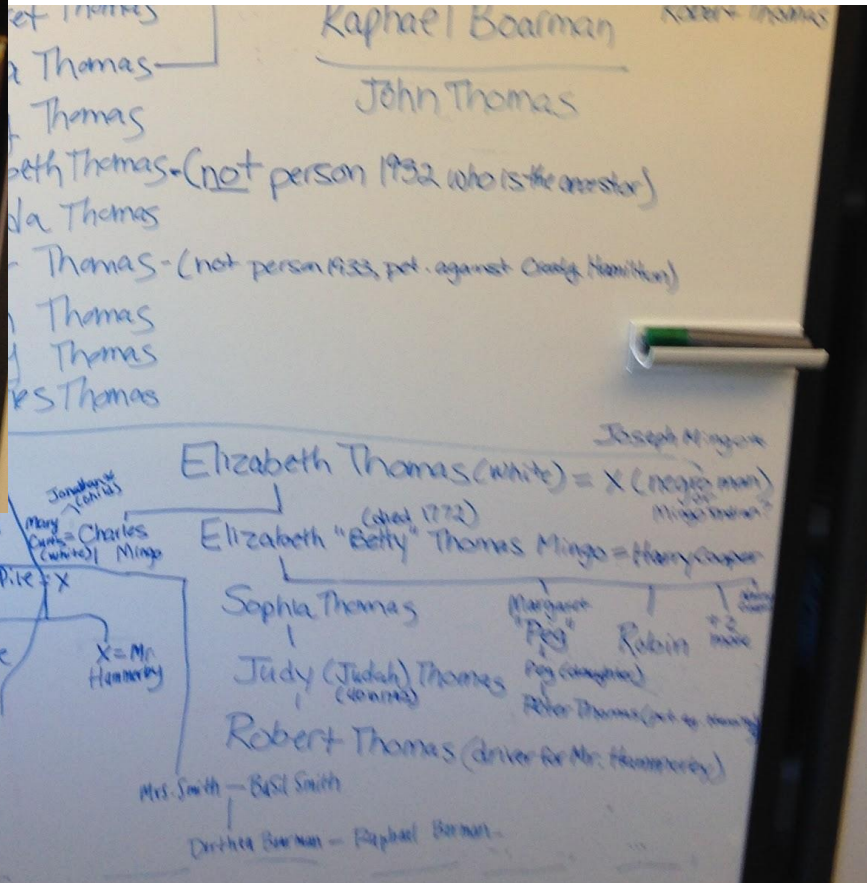
Part I: Linked Data



Decisions

- Custom ontology
- Focus on relationships, not cases
- Marking relationships by hand

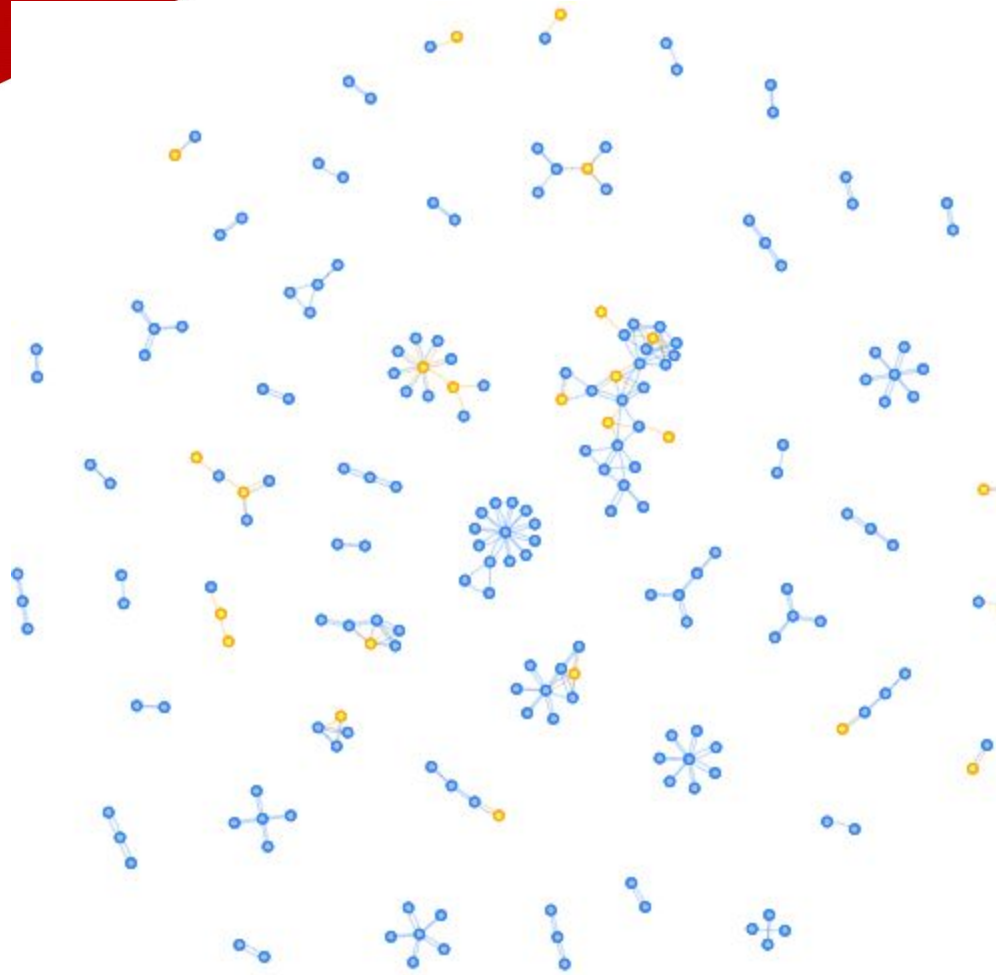

James Hayden
Samuel Hamilton
John Ashton
Letty Thomas
Lucy Thomas
William Thomas
Peter Thomas
Stephen Thomas
Clement Smith
Charles Thomas
(Ex. of Wheeler)
Edmund Plaxton
Richard Barnes
(codminist Jesse Wharton)
Joseph Hall
William Thomas
Jesse Thomas
John Thomas
Teressa Thomas
Susanna Thomas
Judah Thomas
John Thomas
Luke Thomas
Charity Thomas
David Thomas
Stephen Thomas
Betty Ann Eden
Alexander Scott
Henry Pike
William Thomas
Jeremiah Thomas
Walter Thomas
Dennis Thomas


Raphael Boarman
John Thomas
Elizabeth Thomas (White) = X
Elizabeth "Betty" Thomas Mingo = Henry Clapper
Mr. Wharton
Mrs. Elizabeth Pike = X
Henry Pike
Sophia Thomas
Judy (Judah) Thomas
Robert Thomas
Mrs. Smith — Basil Smith

- Visualization
- Dynamic vs pregenerated content

Future Developments

Part I: Linked Data



Link to other ontologies and resources

- VIAF (http://viaf.org/viaf/36978042.rdf)

Create visualization of ALL the relationships

- birds eye view of isolated individuals
- family networks
- social / legal networks

Analyze relationships through time and space

Break!

Ontology Workshop

- Look at case files
- Develop questions
- Design ontology that can find an answer

Part II: Ontology

Family	Legal	Labor	Social
parent of	judge of	enslaved by	neighbor of
child of	attorney for	had contract with	lives with

birth date	occupation	first name


```
<owl:DatatypeProperty rdf:about="#birth"/>
<owl:DatatypeProperty rdf:about="#sex"/>

<owl:ObjectProperty rdf:about="#familyRelationship">
   <rdfs:domain rdf:resource="#Person"/>
   <rdf:type rdf:resource="http://www.w3.org/2002/07/owl#SymmetricProperty"/>
</owl:ObjectProperty>

<owl:ObjectProperty rdf:about="#childOf">
   <owl:Inverseof rdf:resource="#parentOf"/>
   <rdfs:subPropertyOf rdf:resource="#familyRelationship"/>
</owl:ObjectProperty>
```

Example Case:
earlywashingtondc.org/cases/oscys.caseid.0181

Ontologies and Relationships:
earlywashingtondc.org/about/data

Break!

University of Nebraska Lincoln

Querying Datasets

- dbpedia
- http://catalog.data.gov/dataset
- earlywashingtondc.org

http://dbpedia.org/page/Francis_Scott_Key

http://dbpedia.org/sparql


```
SELECT *
FROM <dataset.url>
WHERE {
   ?s ?p ?o
}
```

```
select *
where {
    <http://dbpedia.org/resource/George_Washington> ?p ?o
}
LIMIT 100
```

```
PREFIX db:<http://dbpedia.org/resource/>

select *
where {
 db:George_Washington ?p ?o
}
LIMIT 100
```

```
PREFIX
db:<http://dbpedia.org/resource/>

select *
where {
 db:wikipedia_url ?p ?o
}
LIMIT 100
```

Examples and links here:
https://github.com/jduss4/presentations/

Questions and Discussion