LET'S MAKE A KNOWLEDGE GRAPH!
A HANDS-ON, INTERACTIVE, LINKED DATA WORKSHOP

PHUSE CSS 2019

Silver Spring, MD
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INSTRUCTOR

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Content from:

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PREPARATION

- Your laptop [Power up!]
- Copy of:
  1. Exercises
  2. Graph Editor Introduction
  3. Info sheet
  4. SPARQL reference
- Log in to Cloud Server

Workshop Files, Presentation PDF:

https://github.com/phuse-org/LinkedDataWorkshop/CSS2019

(for later)

OUTLINE

0. What is a Knowledge Graph?
1. Create Your Study Graph
2. Query Your Graph
3. Extend to Other Graphs (Federated Query)
4. Ontology and Inference
5. Merge Studies
6. Discussion

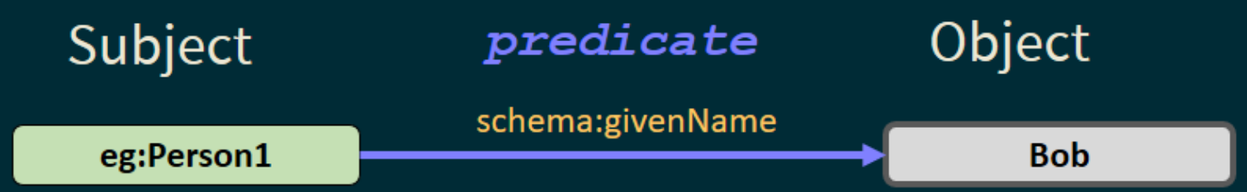
WHAT IS A KNOWLEDGE GRAPH?

- An interconnected network of information consisting of meaningful relationships that are understandable by both people and computers.
- Built on Linked Data

WHAT IS LINKED DATA?

- Data that has meaningful (semantic) relationships
- Resource Description Framework (RDF)

RDF TRIPLE DESCRIBING PERSON 1

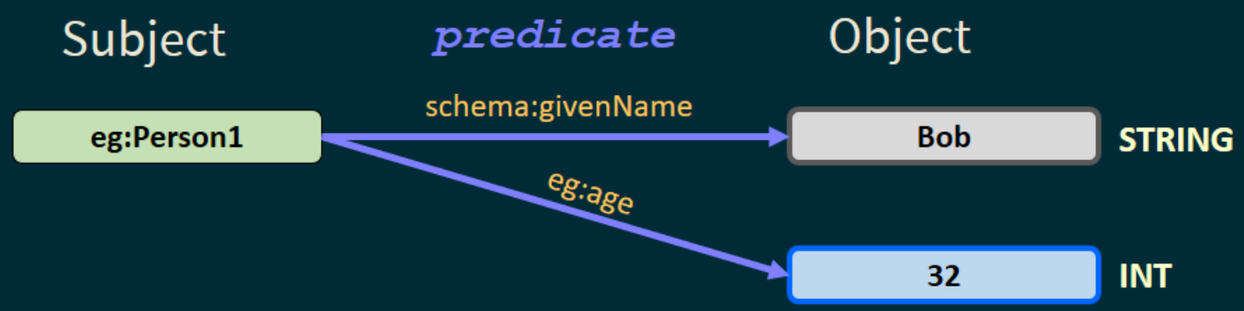


Identifier — Key=Value Pair

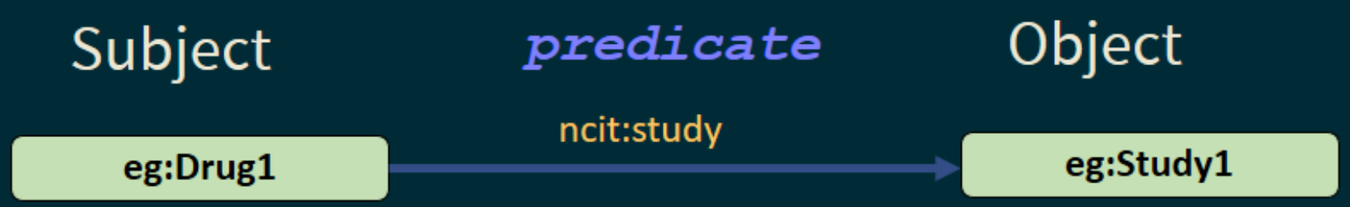
Person 1 — **givenName='Bob'**

" Person1 *has given name* 'Bob' "

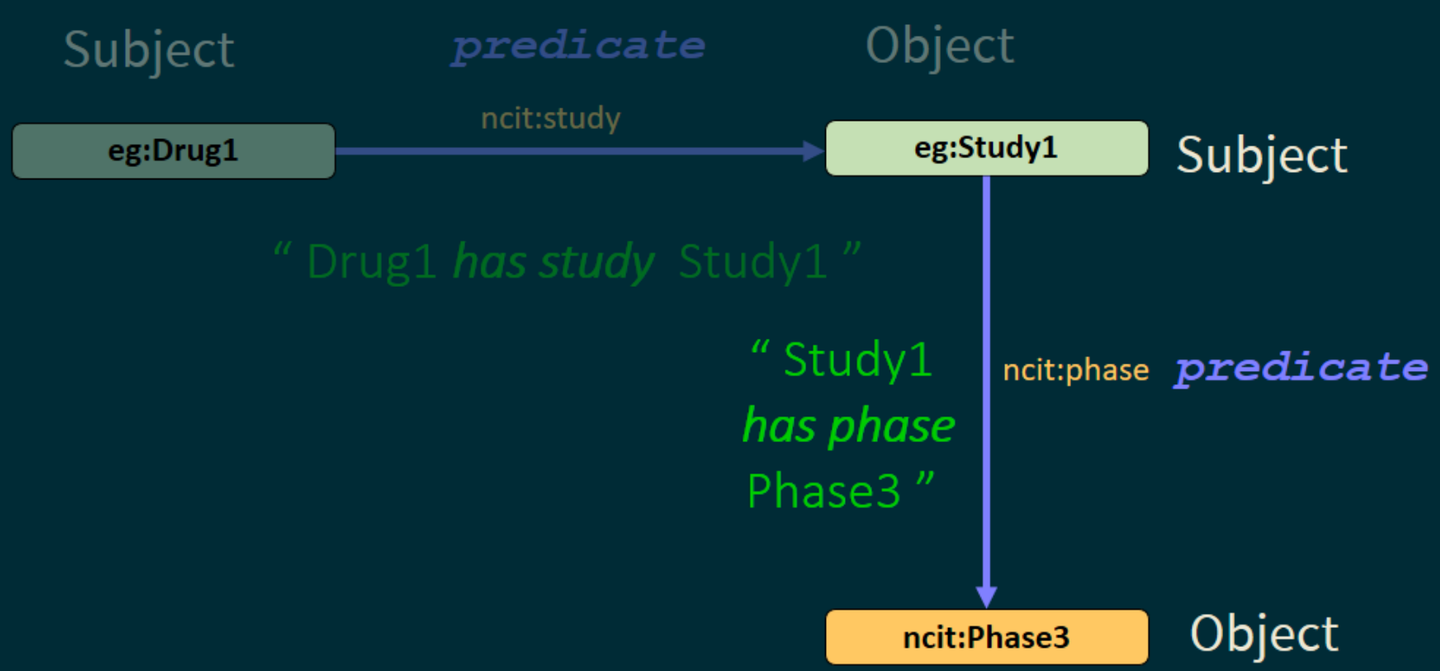
PERSON 1 NAME AND AGE



" Person1 *has given name* 'Bob', age 32 "



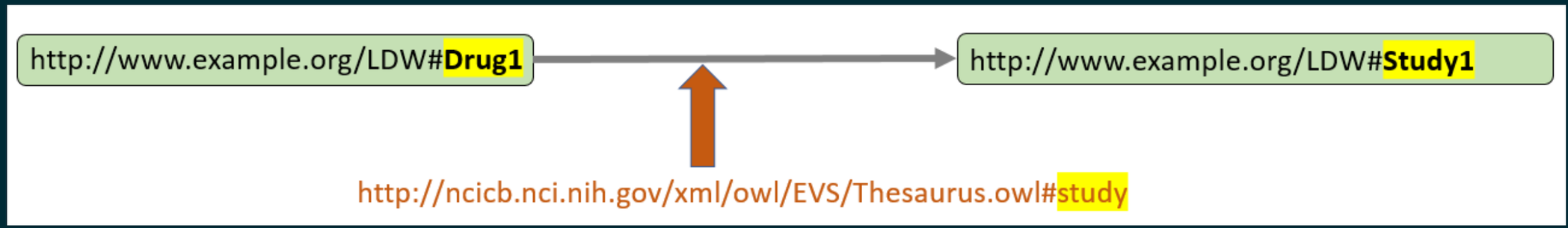
" Drug1 *has study* Study1 "


Subject
predicate
Object
ncit:study
eg:Drug1
eg:Study1
Subject
“ Drug1 has study Study1 ”
“ Study1
has phase
Phase3 ”
ncit:phase
predicate
ncit:Phase3
Object

"THINGS" NEED UNIQUE IDENTIFIERS

IRI: INTERNATIONALIZED RESOURCE IDENTIFIER

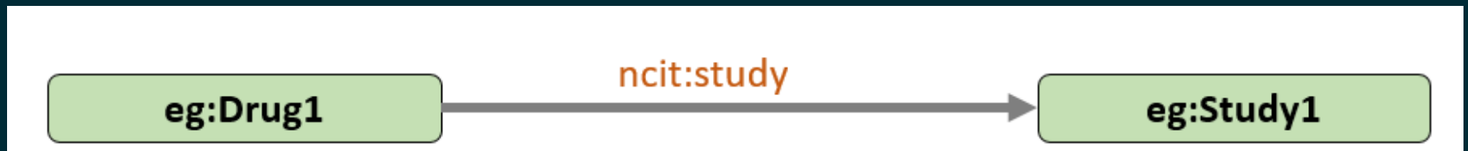
- Unique Identifier
- Uses HTTP://xx.xx.xx/***XXXX***



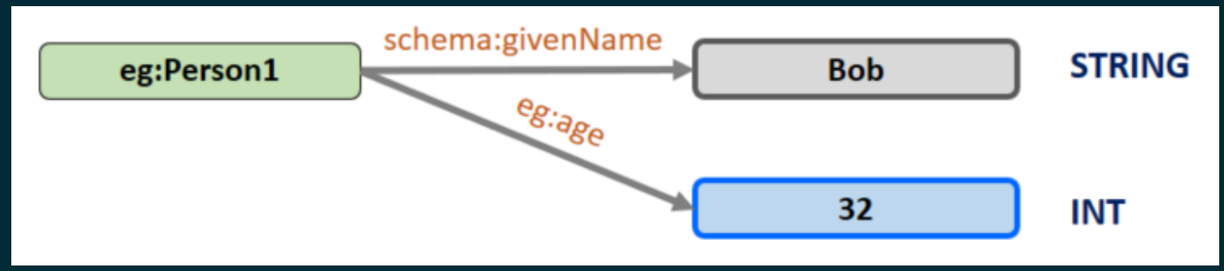
WORKSHOP PREFIXES

- Prefixes shorten IRIs for readability

```
@prefix eg: <http://example.org/LDWorkshop#> .
@prefix ncit: <http://ncicb.nci.nih.gov/xml/owl/EVS/Thesaurus.owl#> .
@prefix schema: <http://schema.org/> .
```



LITERALS



- ***string***
- number
  - ***integer (INT)***
- date

No links *from* a literal

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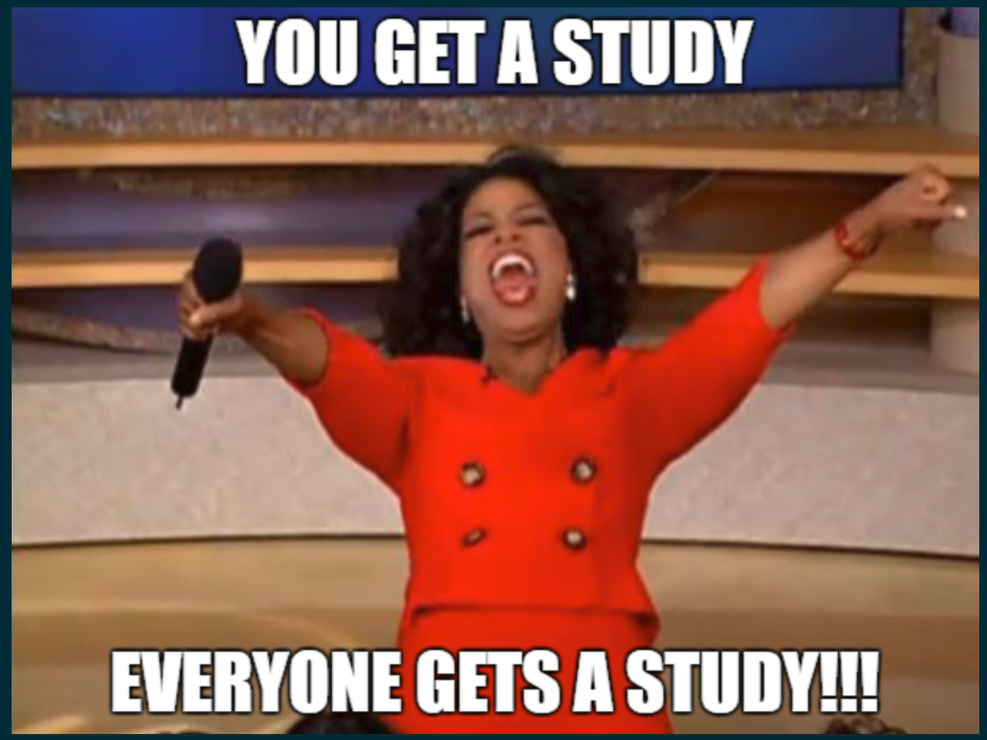
YOU GET A STUDY
EVERYONE GETS A STUDY!!!

INTRODUCTION TO THE GRAPH EDITOR

See your handout

Reference: .../doc/**Graph Editor Introduction.pdf**

EXERCISE

1. Create Your Study Graph

2. Query Your Graph

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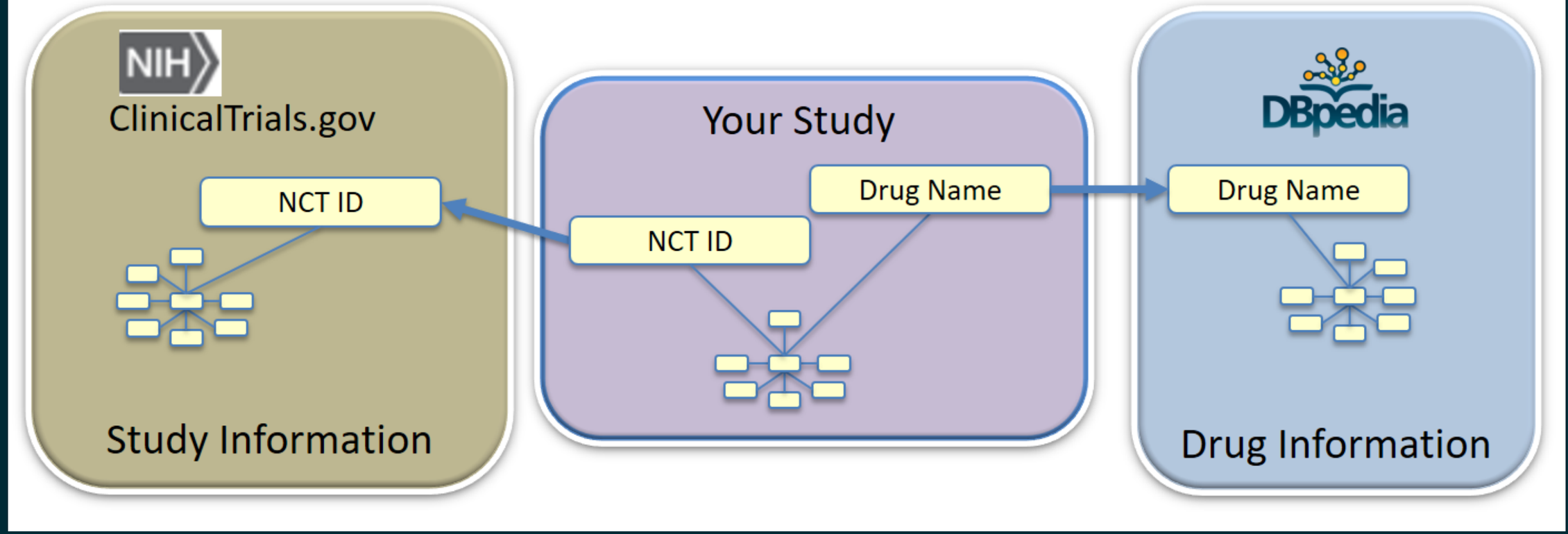
NIH
ClinicalTrials.gov
NCT ID
Study Information
Your Study
Drug Name
NCT ID
DBpedia
Drug Name
Drug Information

EXERCISE

1. Link to ClinicalTrials.gov

2. Link to DBPedia

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Ontology and Inference

Ontology

A vocabulary of things and how they relate to each other

- ...just more nodes and links
- Tools: Protege, TopBraid

Reasoner

An *engine* that applies the ontology to the graph and ***infers*** values and relationships not in your original data.

THINK ABOUT THAT AGAIN:

Ontologies and Reasoning create **values** and **relations** not in your original data!

StudyOntology.TTL

A SUBSET OF THE STUDY ONTOLOGY FILE

```
eg:randomizedTo rdf:type owl:ObjectProperty ;
                rdfs:domain eg:RandomizedHumanStudySubject ;
                rdfs:range eg:TrtArm .
###############################################################
#   Classes
###############################################################

schema:Person rdf:type owl:Class .

eg:HumanStudySubject rdf:type owl:Class ;
                     rdfs:subClassOf schema:Person .

eg:RandomizedHumanStudySubject rdf:type owl:Class ;
                               rdfs:subClassOf eg:HumanStudySubject .
```

1.

```
eg:randomizedTo  rdf:type     owl:ObjectProperty ;
                 rdfs:domain  eg: RandomizedHumanStudySubject ;
                 rdfs:range   ncit:TrtArm .
```

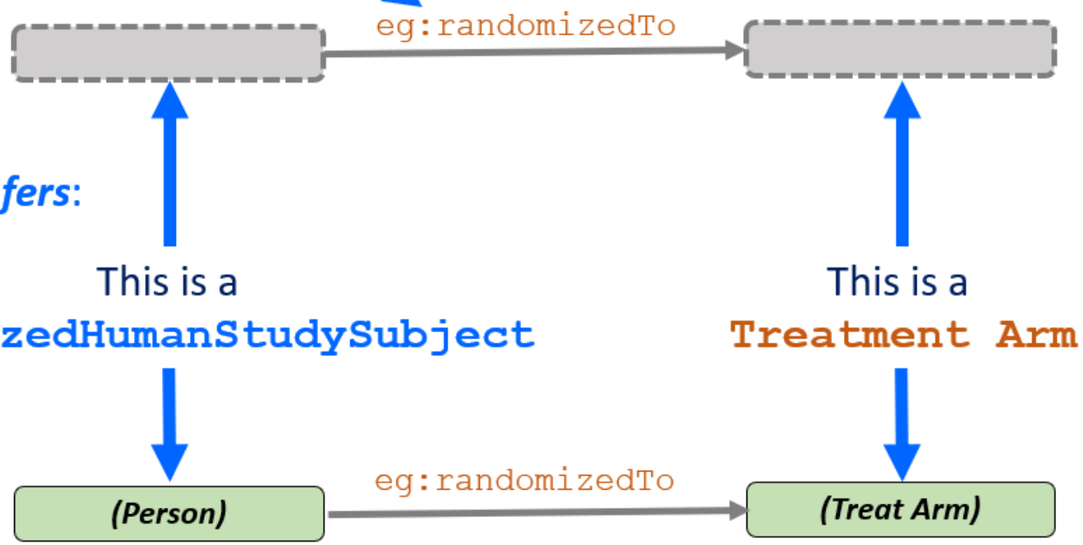
Reasoner sees relation:

2.

Reasoner ***Infers***:

3.

Therefore:



1.

Reasoner classes and subclasses

```
eg:RandomizedHumanStudySubject rdf:type owl:Class ;
                               rdfs:subClassOf eg:HumanStudySubject .

eg:HumanStudySubject rdf:type owl:Class ;
                     rdfs:subClassOf schema:Person .
```

2.

- Thing
  - Person
    - HumanStudySubject
      - RandomizedHumanStudySubject

3.

Therefore:

This is a **RandomizedHumanStudySubject**, **HumanStudySubject**, **Person**, and **Thing**

EXERCISE

3. Ontology and Inference

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5. **Merge Studies**
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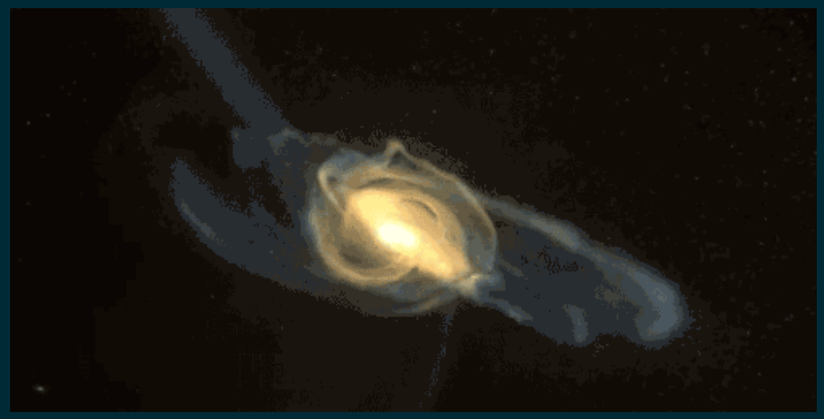
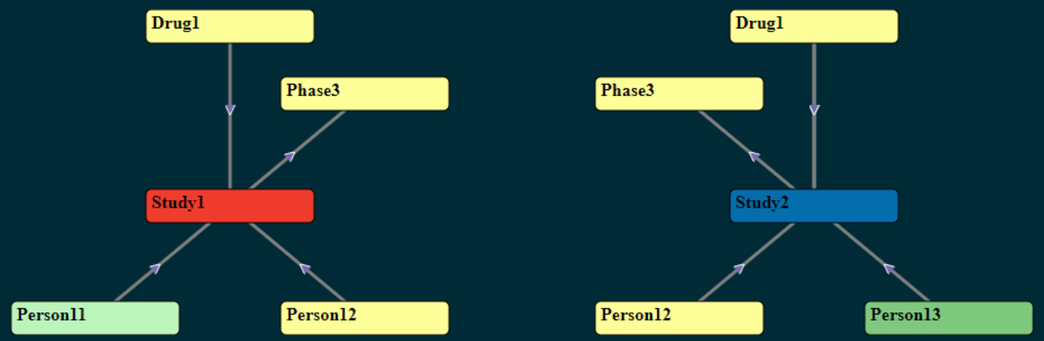
When IRIs are the **same**, merging is automagic!

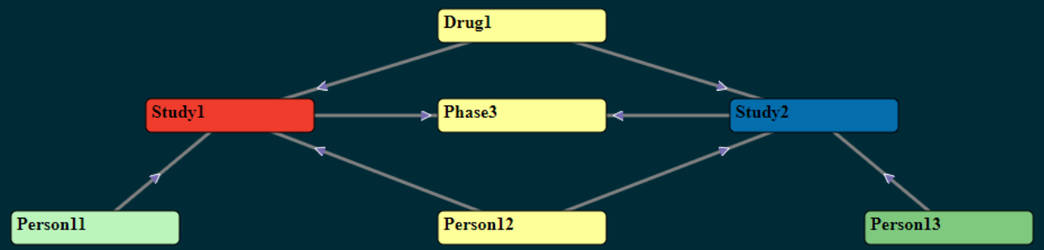
WITH RDF, MERGING BE LIKE:



What? How?

GRAPH MERGE


Drug1
Phase3
Study1
Person11
Person12
Drug1
Phase3
Study2
Person12
Person13


Drug1
Study1
Phase3
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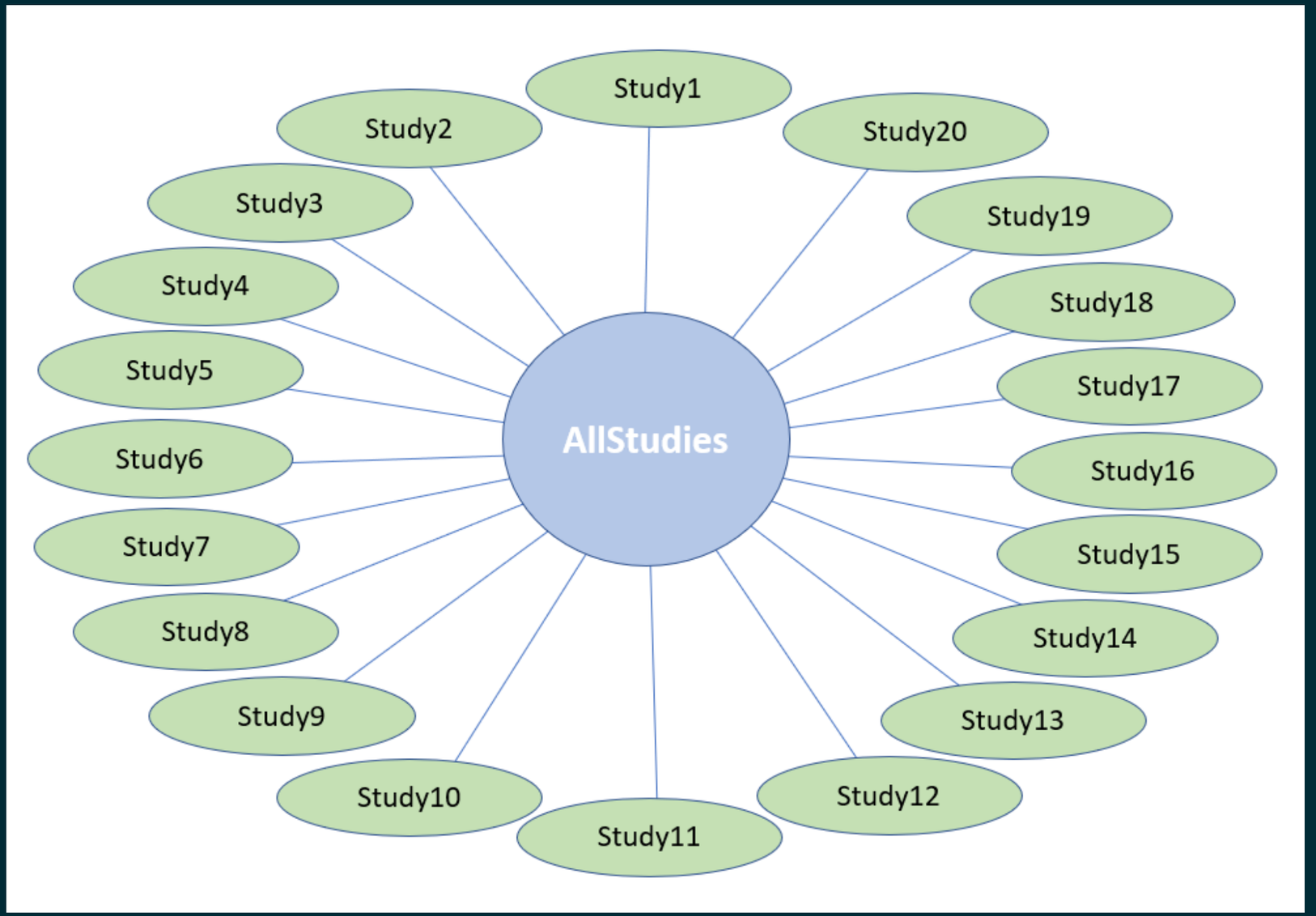
Person11
Person12
Person13


Study1
Study2
Study20
Study3
Study19
Study4
Study18
Study5
Study17
AllStudies
Study6
Study16
Study7
Study15
Study8
Study14
Study9
Study13
Study10
Study12
Study11

EXERCISE

4. Merge Studies

ALLSTUDIES DATA POOL

BONUS!

Visualize your Data Pool.

`AllStudiesPoolVis.R`

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6. **Discussion...after final words**

ACKNOWLEDGEMENTS

- YOU!
- PhUSE
  - Lauren - Prep Webinars and coordination
  - PhUSE Admin Team
  - Nolan Nichols (Genentech)
  - Johannes Ulander (S-Cubed)
- Stardog Union
  - Servers, graph database
  - John Bresnahan - server cloning

RESOURCES

Stardog Union

- fetch.stardog.com/phuse/
- www.stardog.com

RESOURCES

- Workshop materials, including the Graph Editor, SPARQL scripts, PDF of this presentation: https://github.com/phuse-org/LinkedDataWorkshop/CSS2019

And watch this space:

- https://github.com/phuse-org/LinkedDataEducation

RESOURCES

Linked Data Introduction
https://www.youtube.com/watch?v=4x_xzT5eF5Q
SPARQL in 11 Minutes
https://www.youtube.com/watch?v=FvGndkpa4K0

PHUSE PROJECT BREAKOUT SESSION

"Going Translational With Linked Data"

When: Monday 13:00 - 17:00pm
Where: Fenton Room

Topics

- Terminology mapping
- MedDRA as RDF
- Project Endpoint
- ...Other?

DISCUSSION