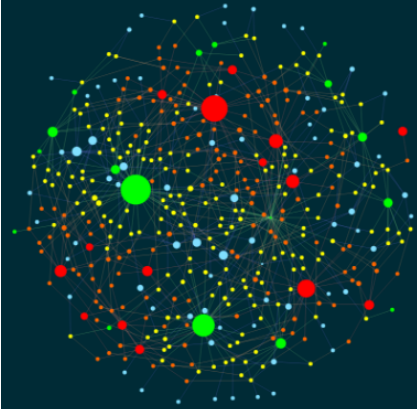




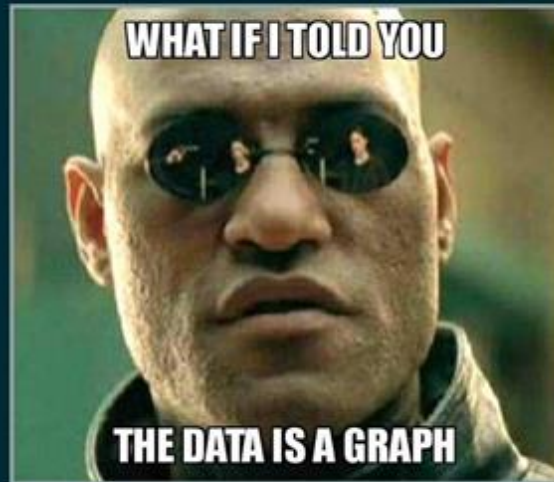
INTERACTIVE VISUALIZATION OF LINKED DATA

Tim Williams
Principal Statistical Systems Analyst
UCB BioSciences
Raleigh, NC USA





TAKE VISUALIZATION TO THE NEXT LEVEL



QUIZ: Name the Sci-Fi Movie upon which these meme is based.



PHUSE 2016 CONFERENCE DATA

A SURROGATE FOR CLINICAL TRIALS DATA



PHUSE 2016

PRESENTATIONS AND REGISTRATIONS

Your guide to the event

Monday 10th October

Time	Girona	Tarragona	Location
08:00-09:00	Registration		
09:00-10:30	How to Captivate Your Audience With Your Work Alok Jha		
10:30-11:00	Morning Break		
11:00-11:30	CD01 Protocol Representation: The Forgotten CDISC Model Jeff Abolafia, Rho & Frank Dilorio, CodeCrafter	AD01 The TFL Workbench: Tools to Standardise and Accelerate Table, Figure, and Listing (TFL) Programming Iain Humphreys & Handberg Frenzel, PRA Health Sciences	IS01 Kiera
11:30-12:00	CD05 CDASH V2.0: What is it Good For? Eanna Kieley, Interviv Health	AD05 ICON's DIAMOND or an Enhanced Way to Automated Statistical Reporting Nathalie Fuchs, ICON	IS05 Your Evl G
12:00-12:30	CD03 DIY: Create your Own SDTM Mapping Framework Bart van Bakel, OCS Consulting		IS03 or is Baha
12:30-13:30	Lunch Break		
13:30-14:00	CD04 Assessing CDISC Therapeutic Area User Guides in a Machine Readable Format Johannes Ulander & Nils Both, S-Cubed	AD06 Efficiency and Delivery Driven By Metadata Magnus Mengeth, LimeLogic	IS04 for it Beth
14:00-14:30	CD06 Device Domains: Examples of their Use in Clinical Trials Oksana Volevtskaya, Chiltern	AD08 Making the Leap from Excel to a Database used for Reporting Shaif Chowdhury, Marco Ackermann & Mid Zobair, Shaif Consultancy	IS08 Its In Jenni Shaif Mark
14:30-15:00	CD08 Analysis Datasets for Baseline Characteristics and Exposure Time for Multi-stage Clinical Trials Kimberly Umari, Lukasz Khola & Wei Liu, Boehr	AD03 QC of the «CRF» Using SAS Rune Pedersen & Nils Both, S-Cubed App	IS03 to St Hand Hant PRA

Attendees-2016-02Aug16.xlsx [Read-Only] - Microsoft Excel

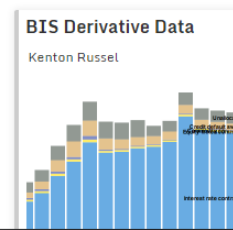
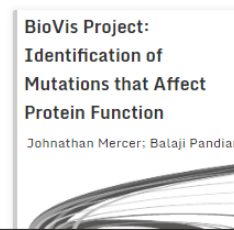
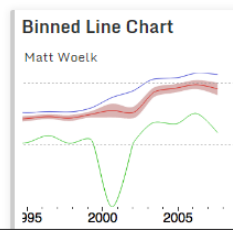
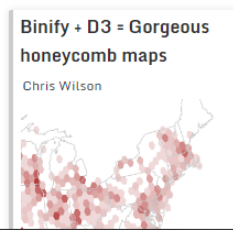
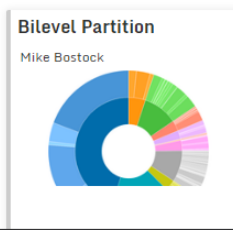
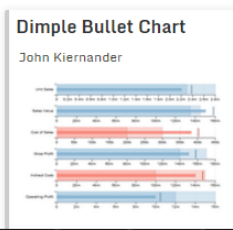
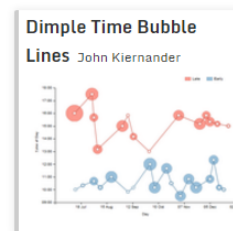
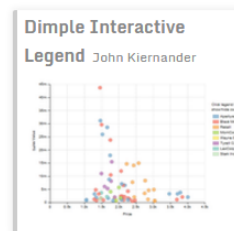
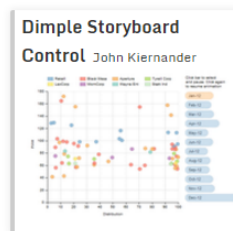
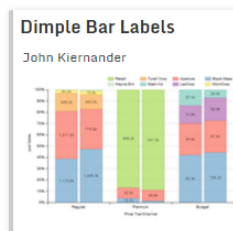
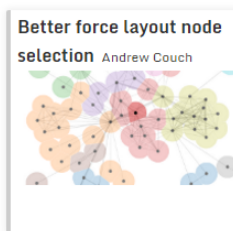
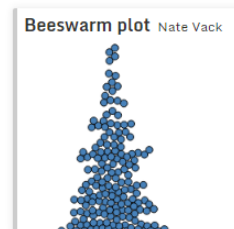
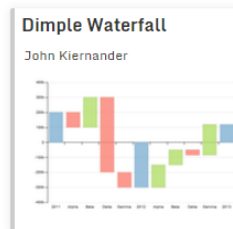
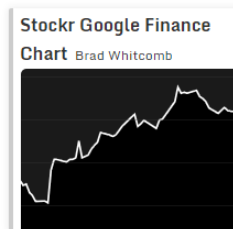
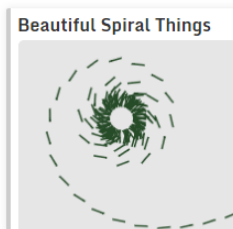
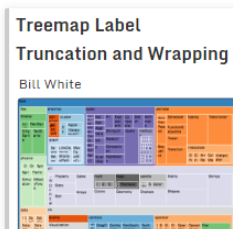
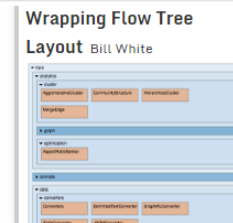
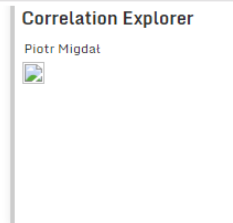
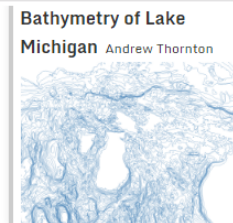
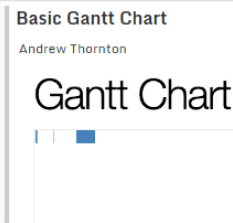
	A	B	C	D	E
1	Title	Lastname	Firstname	Company	Country
2	Mrs	Whitworth	Tora	Spring AM	United Kingdom
3	Mrs	Bamford	Tracy	PhUSE	United Kingdom
4	Mr	Bamford	Stephen	Business & Decision Life Scienc	United Kingdom
5	Mr	Van Reusel	Peter	Business & Decision Life Scienc	Belgium
6	Mrs	Meurer	Claudia	Merck	Germany
7	Mrs	Rostgaard Stender	Karina	Novo Nordisk	Denmark
8	Mr	Ziegler	Joachim	Boehringer Ingelheim	Germany
9	Mrs	Carlsheimer	Å...sa	Trialbee	Sweden
10	Mr	BÄhl	JÄrgen	Boehringer Ingelheim	Germany
11	Mr	Baermann	Heiko	Bayer	Germany
12	Mr	Salter	John	Teslar Consulting	United Kingdom
13	Mr	Banga	Rohit	Document IT ApS	Denmark
14	Mr	Cieslok	Christopher	Document IT	Denmark
15	Ms	Kiemele	Nelli	Boehringer Ingelheim	Germany
16	Mr	Hirst	John	Boehringer Ingelheim	United Kingdom
17	Mr	Travell	Matthew	Mundipharma Research	United Kingdom
18	Mr	Schwarz	Hans-Joerg	Kantar Health	Germany



QUIZ: What are the 3 D's of D3?



- Author
- Chart Type
- Title
- Untagged 1575
- Map 236
- Reusable 98
- Network 69
- Bar Chart 62
- Line Chart 58
- Math 46
- Scatterplot 41
- Area Chart 34
- Pie Chart 27
- Bubble Chart 25
- Tree 23
- Voronoi 17
- Chord Diagram 15
- Parallel Coordinates 15
- Stacked Bar Chart 14
- Sankey 14
- Choropleth 14
- Experiment 12
- Heatmap 11
- Cartogram 11
- Sunburst 11
- Streamgraph 10
- Lollipop 10
- Histogram 9
- Table 9
- Treemap 9

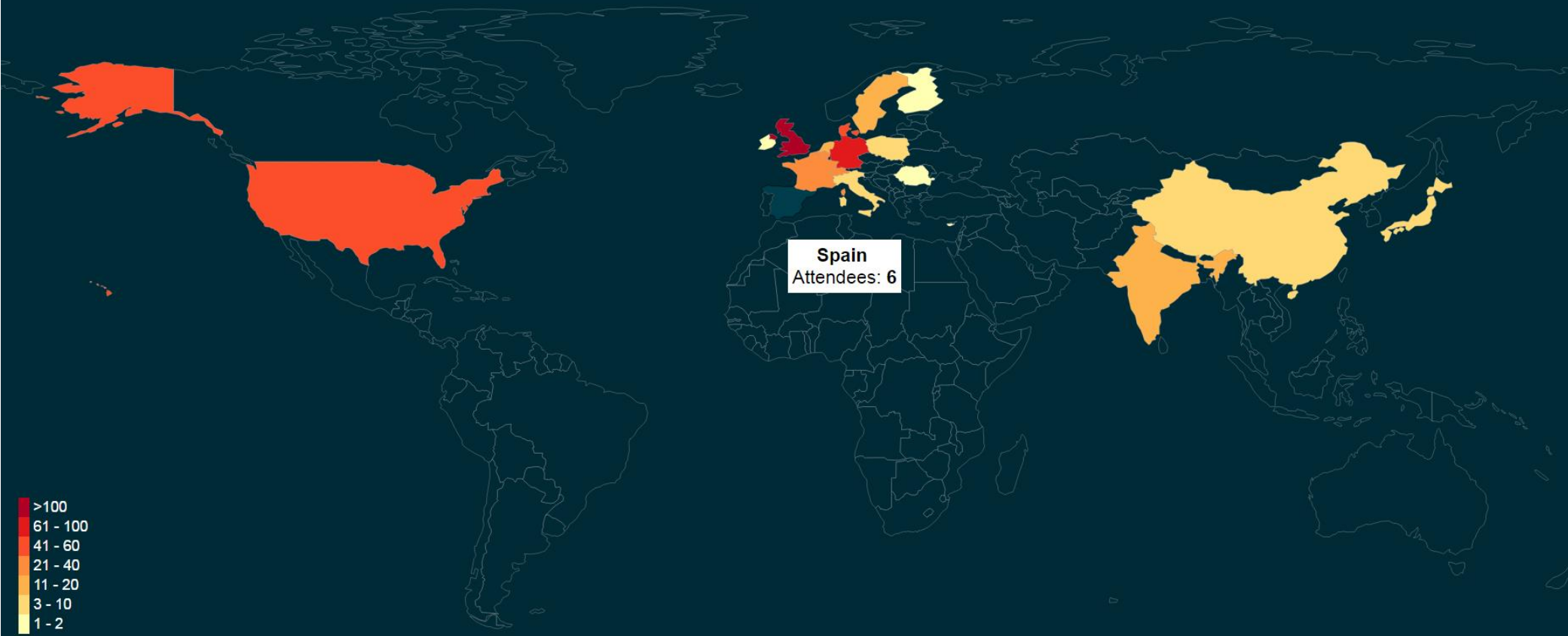


PHUSE 2016 REGISTRATIONS

World Map



ATTENDEES BY COUNTRY

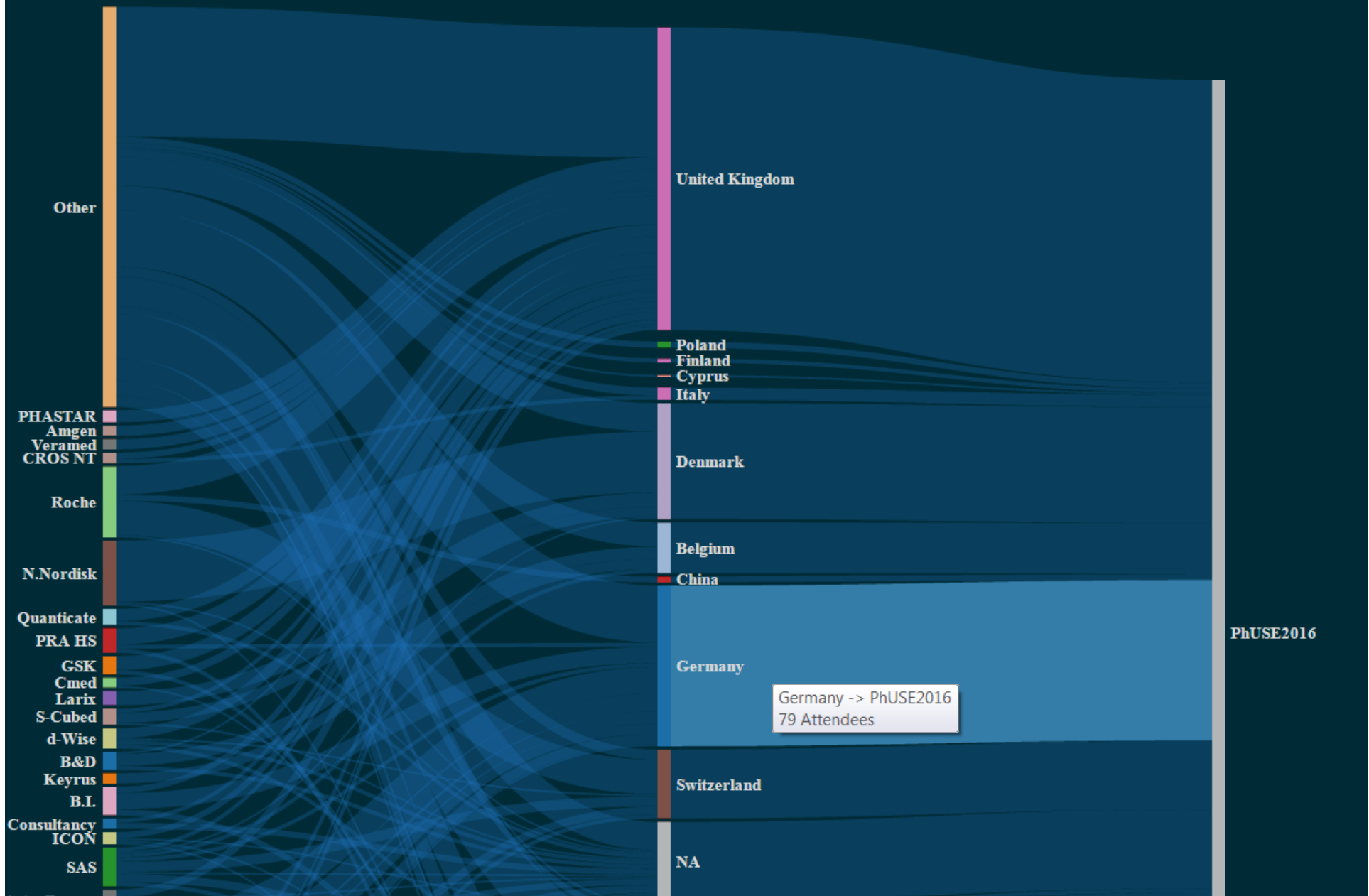


PHUSE 2016 REGISTRATIONS

Sankey Plot

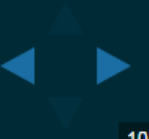


PHUSE 2016 REGISTRATIONS



DATA AS A NETWORK GRAPH

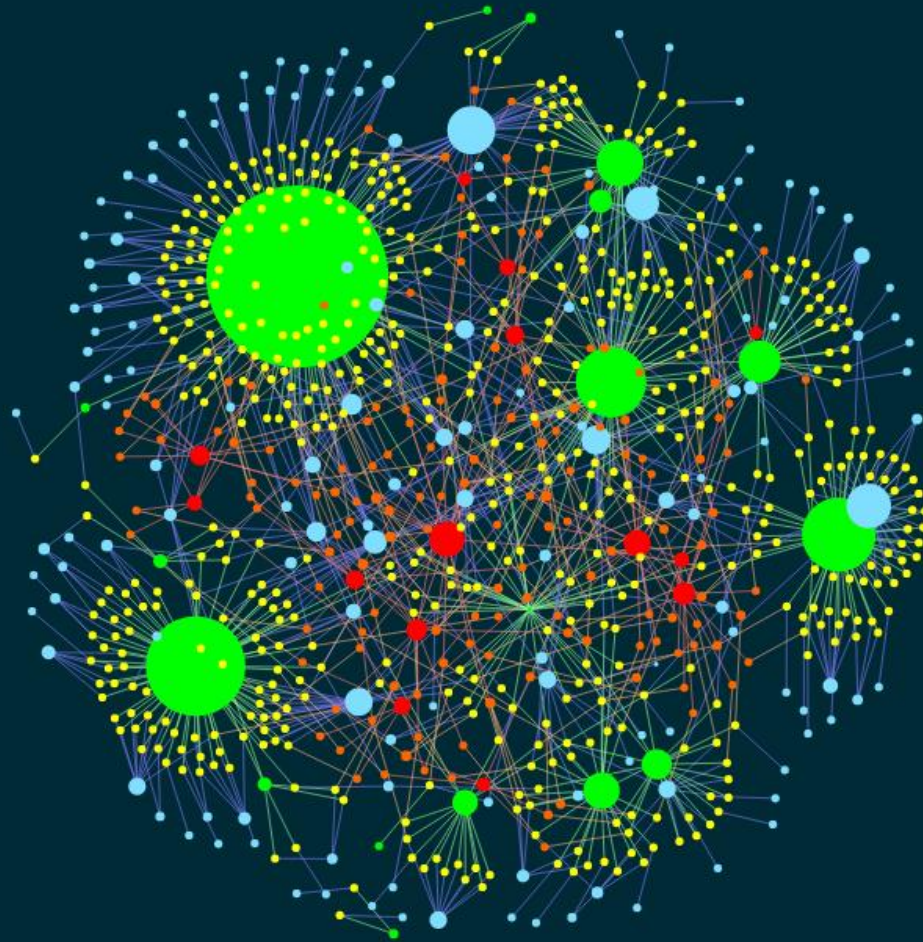
PhUSE 2016 Registrations and Presentations



PHUSE 2016 REGISTRATIONS AND PRESENTATIONS

LEGEND

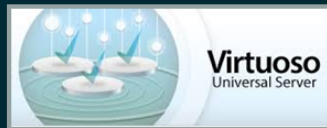
- Person
- Country
- Organization
- Presentation
- Stream



TWO TYPES OF GRAPH DATA STORES



Property Graph



Resource Description Framework (RDF)



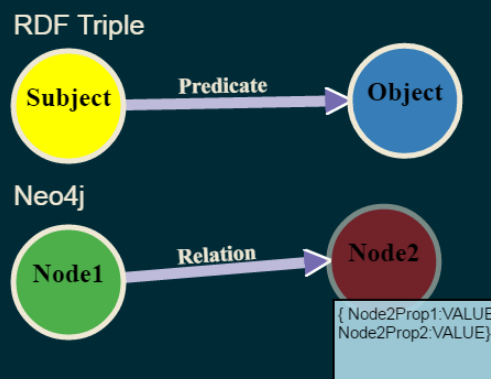
NEO4J AND RDF : NODES & EDGES

A Comparison

...more covered at the PhUSE Workshop
"Semantics 101 for Pharma"



NEO4J AND RDF : NODES & EDGES



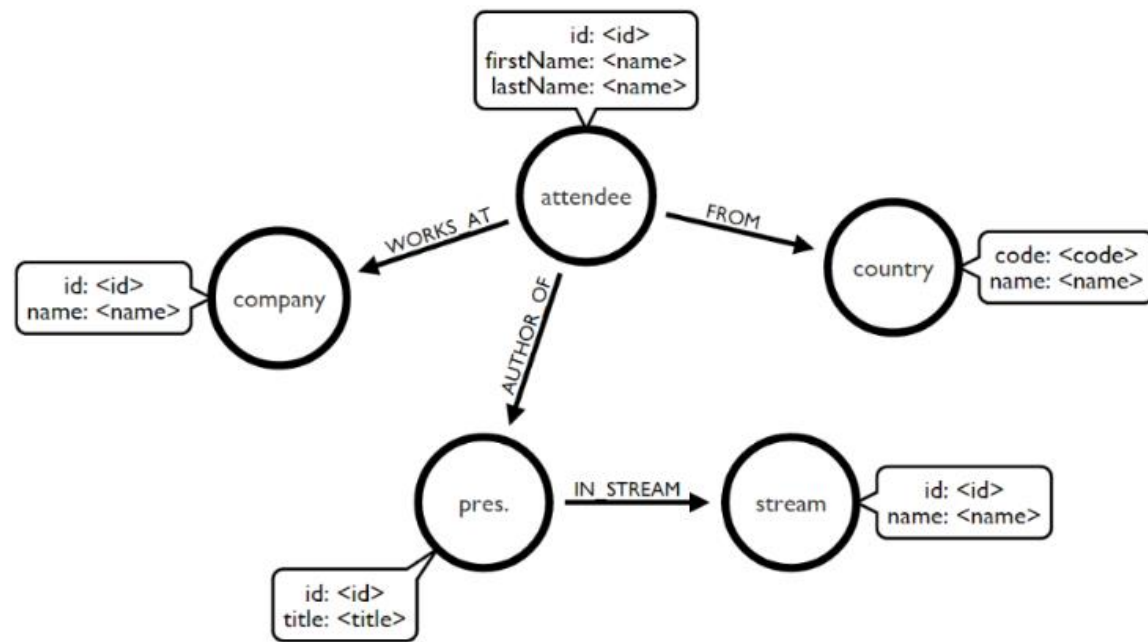
...more covered at the PhUSE Workshop "Semantics 101 for Pharma"



PART 1

NE04J





CYPHER QUERY *ASCII ART*

Where is Tim from and where does he work?

```
MATCH a = (company)-[:WORKS_AT]-(attendee)-[:FROM]-(country)
WHERE attendee.firstName='Tim' AND attendee.lastName='Williams'
RETURN a;
```

Run the query in Neo4j



\$ MATCH a = (company) - [:WORKS_AT] - (attendee) - [:FROM] - (count...



Graph



Rows



Text



Code

*(3)

Country(1)

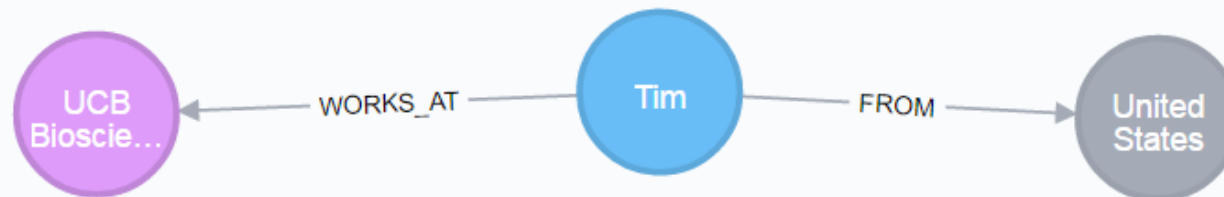
Organization(1)

Person(1)

*(2)

FROM(1)

WORKS_AT(1)



QUERY 2: COLLABORATION

Find Presentations where more than one Company cooperated

```
MATCH (p:Presentation)<-[:CONTRIB_TO]-(:Person)-[:WORKS_AT]->(o:Organization)
WHERE NOT (o.name = 'NA')
WITH p, count(DISTINCT o) as contribOrganizations
WHERE contribOrganizations >1
RETURN p
```

Run the query in Neo4j



\$ MATCH (p:Presentation)<-[:CONTRIB_TO]-(:Person)-[:WORKS_AT]->(o:Organization) WHERE...



Graph



Rows



Text



Code

*(10)

Presentation(10)



PART 2

RESOURCE DESCRIPTION FRAMEWORK



FOLLOW THE TRAIL OF DATA

- By Query
- By Mouse click



THE WEB BROWSER



- HTTP - protocol
- URL - Linked Data *URLs*
- HTML5, CSS3, JavaScript
 - Presentation and Visualization
- *Free* toolset

QUIZ: What did Yoda actually say? "Truly wonderful the...???"



RDF

```
study:obs10 a          study:Study ;  
             rdfs:label "Study8" ;  
             study:hasStudyPhase code:phase-PHASE3 ;
```

Subject

Predicate

Object

<http://www.example.org/study/obs10>

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

<http://www.example.org/study/Study>

<http://www.example.org/study/obs10>

<http://www.w3.org/2000/01/rdf-schema#label>

"Study8"

<http://www.example.org/study/obs10>

<http://www.example.org/study/hasStudyPhase>

<http://www.example.org/study/code/phase-PHASE3>

CTRL-CLICK IN D3JS

```
var nodes = svg.selectAll("g.node")
  .data(dataset.nodes)
  .enter()
  .append("g")
  .on("click", function (d) {
    if (d3.event.ctrlKey) {{location.href = d.url;}}
  });
```

Example location.href values:

```
http://bio2rdf.org/clinicaltrials:NCT00175890
```

```
http://localhost:8890/describe/?uri=http://www.example.org/study/obs10
```



FOLLOW THE TRAIL OF DATA

...NOT SO MAGIC AFTER ALL

- By Query
 - SPARQL
- By Mouse click
 - URI's as clickable hyperlinks



STUDY DATA POOLS

Force Network Graph



Studies contributing to data pools

Legend

Pool

Phase 1

Phase 2

Phase 3

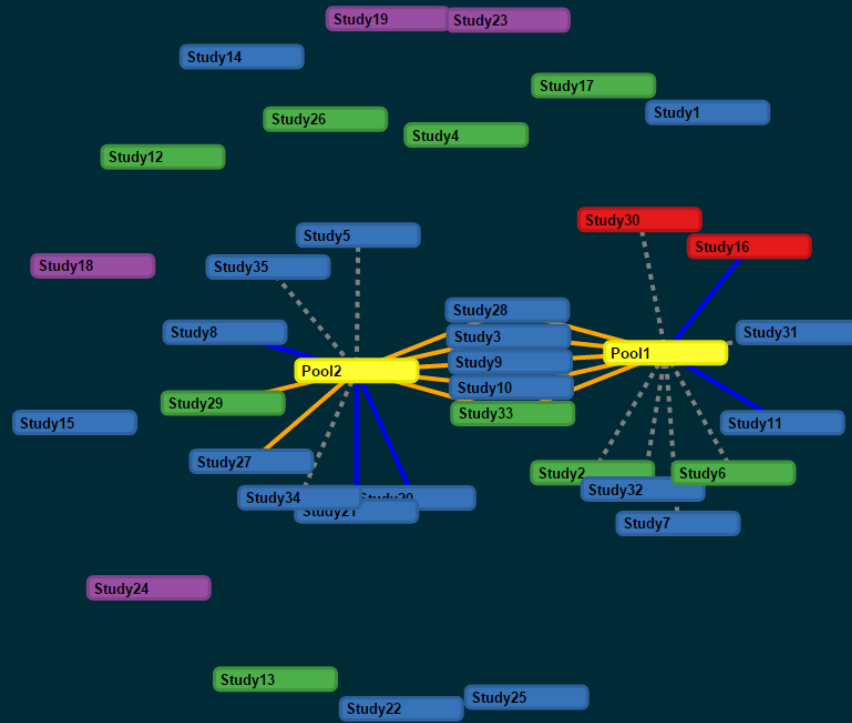
Phase 4

Evaluation

Reference

QandA

.....



About: Study31 [Goto](#) [Sponge](#) [NotDistinct](#) [Permalink](#)

An Entity of Type : <http://www.example.org/study/Study>, within Data Space : [localhost:8890](#) associated with source [document\(s\)](#)

Type: <http://www.example.org/study/Study>

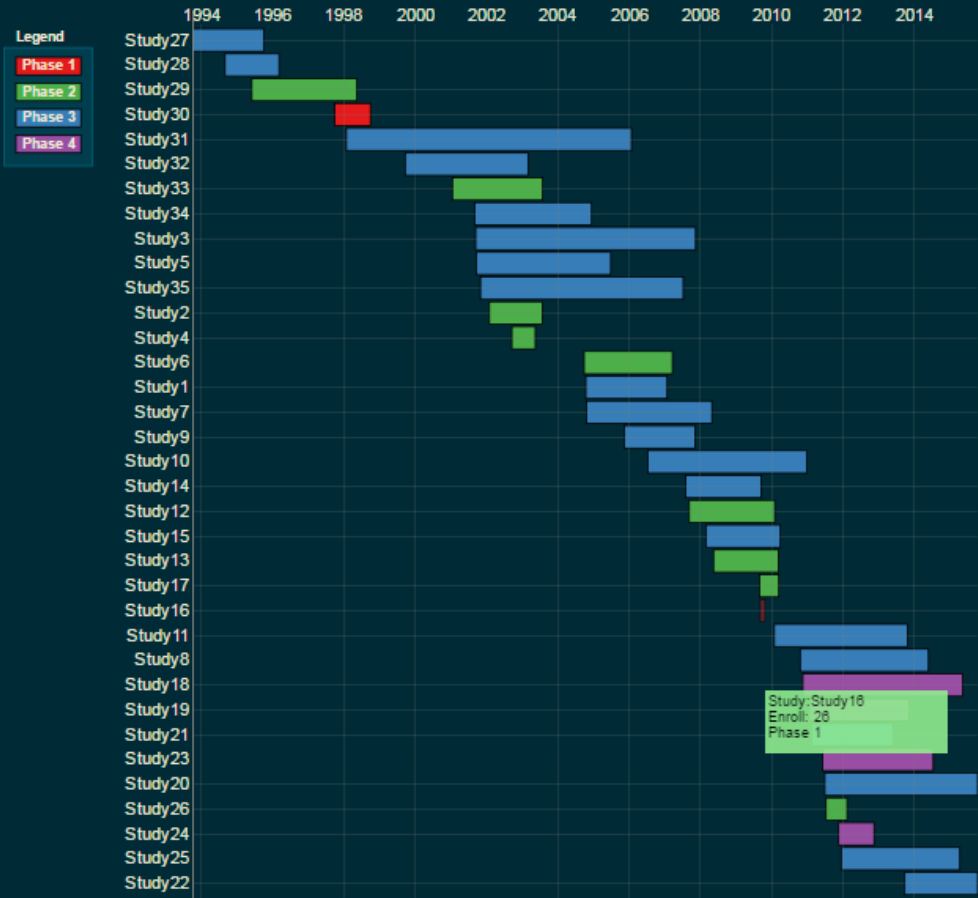
Attributes	Values
rdf:type	http://www.example.org/study/Study
rdfs:label	Study31
http://www.example...udy/hasAeCodeVers	MedDRA-6-0
http://www.example.org/study/hasAgeGroup	Pediatric
http://www.example...hasCompletionDate	2006-01-25(xsd:dateTime)
http://www.example...udy/hasContribRel	http://www.example.org/study/contribRel21
http://www.example.org/study/hasControl	Not Applicable
http://www.example...dy/hasCountryCode	Canada Mexico United States of America
http://www.example...udy/hasMaximumAge	16 years
http://www.example.../hasMedcnCodeVers	WHODRUG-2002Q4
http://www.example...hasMikadoProtocol	http://www.foo.bar/Product1/Study31/protocol
http://www.example...udy/hasMinimumAge	4 years
http://www.example.org/study/hasNctId	http://www.example.org/study/NCT00150709
http://www.example.org/study/hasOrgId	http://www.example.org/study/Study31
http://www.example...dy/hasSeizureType	http://www.example.org/study/code/seizuretype-NOTSPECIFIED
http://www.example...tudy/hasStartDate	1998-01-26(xsd:dateTime)
http://www.example...sStudyDescription	Long Term Follow-up Study 4-16 years
http://www.example...tudy/hasStudyPath	E:/Products/Product1/Study31/data
http://www.example...udy/hasStudyPhase	Phase 3
http://www.example...y/hasTSDomainPath	E:/Products/Product1/Study31/data/tsDomain
http://www.example...tudy/isRandomized	No

GANTT CHART

Gantt to Linked Data



CLINICAL TRIALS GANTT CHART



About: **Study16** [Goto](#) [Sponge](#) [NotDistinct](#) [Permalink](#)

An Entity of Type : <http://www.example.org/study/Study>, within Data Space : localhost:8890 associated with source [document\(s\)](#)

Type: <http://www.example.org/study/Study> ▼ [New Facet based on Instances of this Class](#)

Attributes	Values
rdf:type	http://www.example.org/study/Study
rdfs:label	Study16
http://www.example.org/study/hasAeCodeVers	MedDRA-12-1
http://www.example.org/study/hasAgeGroup	Adult
http://www.example.org/study/hasCompletionDate	2009-10-25(xsd:dateTime)
http://www.example.org/study/hasContribRel	http://www.example.org/study/contribRel13
http://www.example.org/study/hasControl	None
http://www.example.org/study/hasCountryCode	United Kingdom
http://www.example.org/study/hasMaximumAge	55 years
http://www.example.org/study/hasMedcnCodeVers	http://www.example.org/study/code/medcncodevers-N/A
http://www.example.org/study/hasMikadoProtocol	http://www.foo.bar/Product1/Study16/protocol
http://www.example.org/study/hasMinimumAge	20 years
http://www.example.org/study/hasNctId	http://www.example.org/study/NCT00985348
http://www.example.org/study/hasOrgId	http://www.example.org/study/Study16
http://www.example.org/study/hasSeizureType	http://www.example.org/study/code/seizuretype-NOTAPPLICABLE
http://www.example.org/study/hasStartDate	2009-09-07(xsd:dateTime)
http://www.example.org/study/hasStudyDescription	BE dry syrup vs tabs
http://www.example.org/study/hasStudyPath	E:/Products/Product1/Study16/data
http://www.example.org/study/hasStudyPhase	Phase 1
http://www.example.org/study/hasTSDomainPath	E:/Products/Product1/Study16/data/tsDomain
http://www.example.org/study/isRandomized	Yes

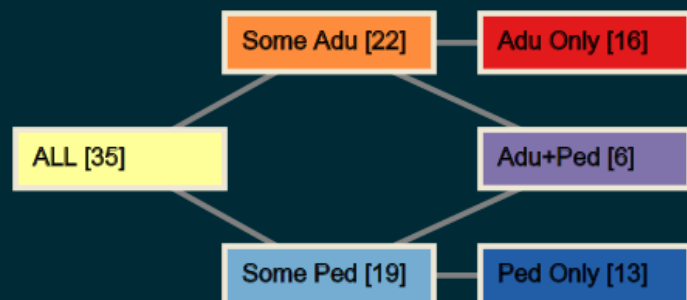
QUERIES FROM A CHART

Execute SPARQL from D3



AGE CATEGORY QUERY

<Shift+Click> to List Studies in each Age Category
Ensure CORS is activated



Obs	Study	AgeGroup	MinAge	MaxAge	Phase	Control	Randomized
http://www.example.org/study/obs3	Study1	Pediatric	1 month	less than 4 years	Phase 3	Placebo	Yes
http://www.example.org/study/obs13	Study11	Pediatric	4 years	Less than 16 years	Phase 3	Not Applicable	No
http://www.example.org/study/obs14	Study12	Pediatric	4 years	16 years	Phase 2	Not Applicable	No
http://www.example.org/study/obs15	Study13	Pediatric	1 month	4 years	Phase 2	Not Applicable	No
http://www.example.org/study/obs21	Study19	Pediatric	1 month	11 months	Phase 4	Not Applicable	No
http://www.example.org/study/obs4	Study2	Pediatric	4 years	12 years	Phase 2	None	Yes
http://www.example.org/study/obs23	Study21	Pediatric	4 years	<16 years	Phase 3	Not Applicable	No
http://www.example.org/study/obs32	Study30	Pediatric	6 years	12 years	Phase 1	Not Applicable	No
http://www.example.org/study/obs33	Study31	Pediatric	4 years	16 years	Phase 3	Not Applicable	No
http://www.example.org/study/obs34	Study32	Pediatric	4 years	16 years	Phase 3	Placebo	Yes
http://www.example.org/study/obs6	Study4	Pediatric	1 month	less than 4 years	Phase 2	Not Applicable	No
http://www.example.org/study/obs8	Study6	Pediatric	4 years	16 years	Phase 2	Placebo	Yes
http://www.example.org/study/obs9	Study7	Pediatric	1 month	16 years	Phase 3	Not Applicable	No

STUDIES TO PUBLICATIONS

AN EXAMPLE WITH R, RRDF, AND VIRTUSO

Force Network Graph





Study



Abstract



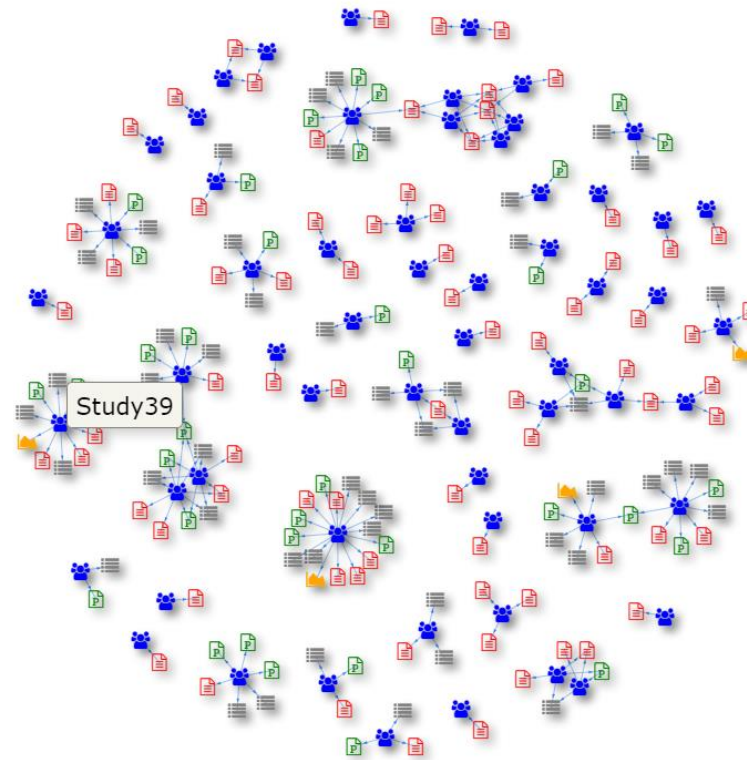
Manuscript

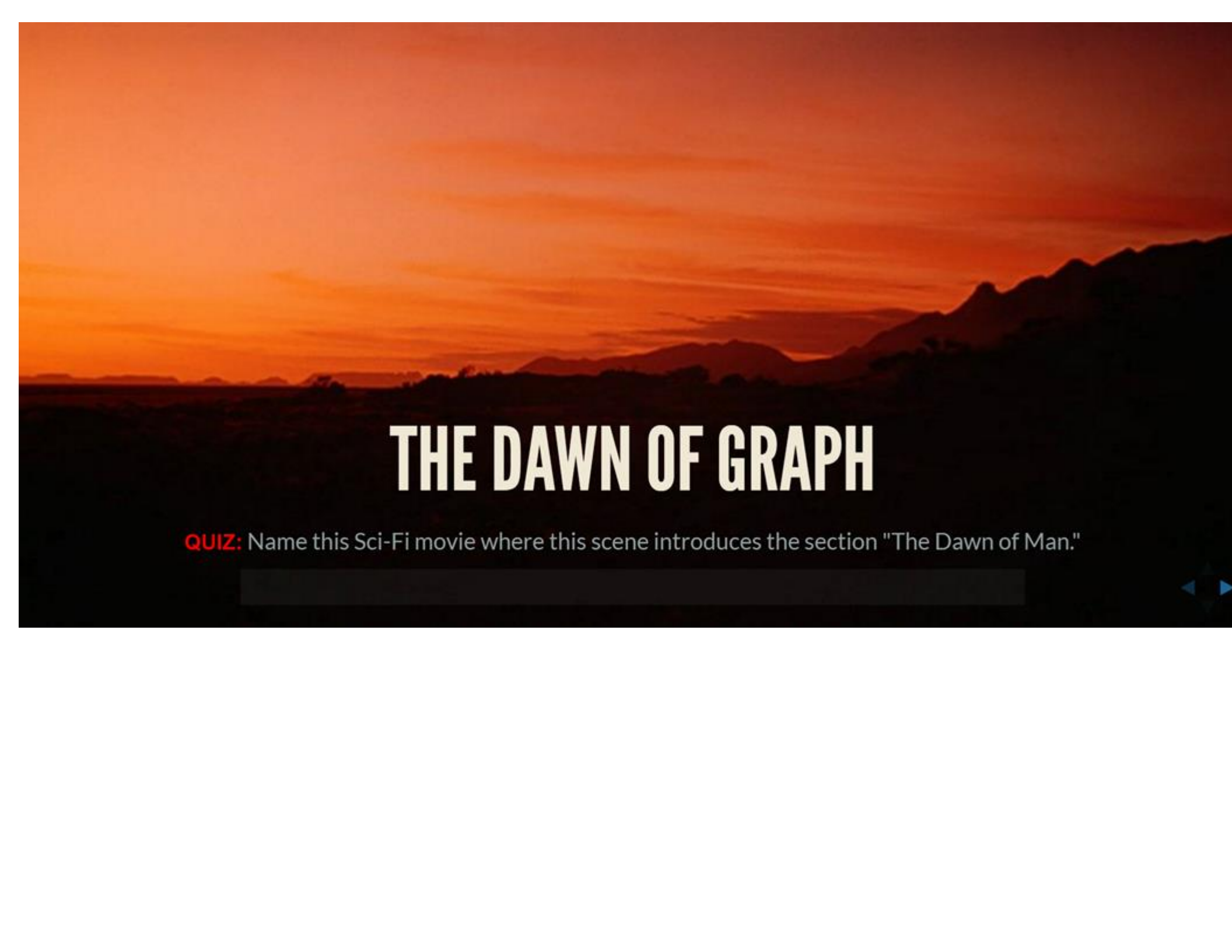


Poster



Presentation





THE DAWN OF GRAPH

QUIZ: Name this Sci-Fi movie where this scene introduces the section "The Dawn of Man."



Thank you!



RESOURCES

Neo4j	http://neo4j.com
Virtuoso RDF Quad Store	http://http://virtuoso.openlinksw.com
D3	http://d3js.org
Arrows - Create Graph Diagrams	https://github.com/apcj/arrows
PhUSE Semantic Technology Wiki	http://www.phusewiki.org/ Search: "Semantic Technology"
reveal.js - Presentation Framework	http://lab.hakim.se/reveal-js



BONUS SECTION

MANAGING PROGRAM DEPENDENCIES WITH NEO4J



```
$ match(n) return n
```

* (48) CSS (8) CSV (4) Cyper (1) Excel Sheet (5) HTML (9) JS (10) JSON (8) Neo4j (1) RScript (5) Virtuoso (1)

* (71) CREATE\$ (7) INCLUDE\$ (24) INLCUDE\$ (5) LINK\$ TO (13) **QUERY\$ (5)** READ\$ (16) UPLOAD\$ TO (1)

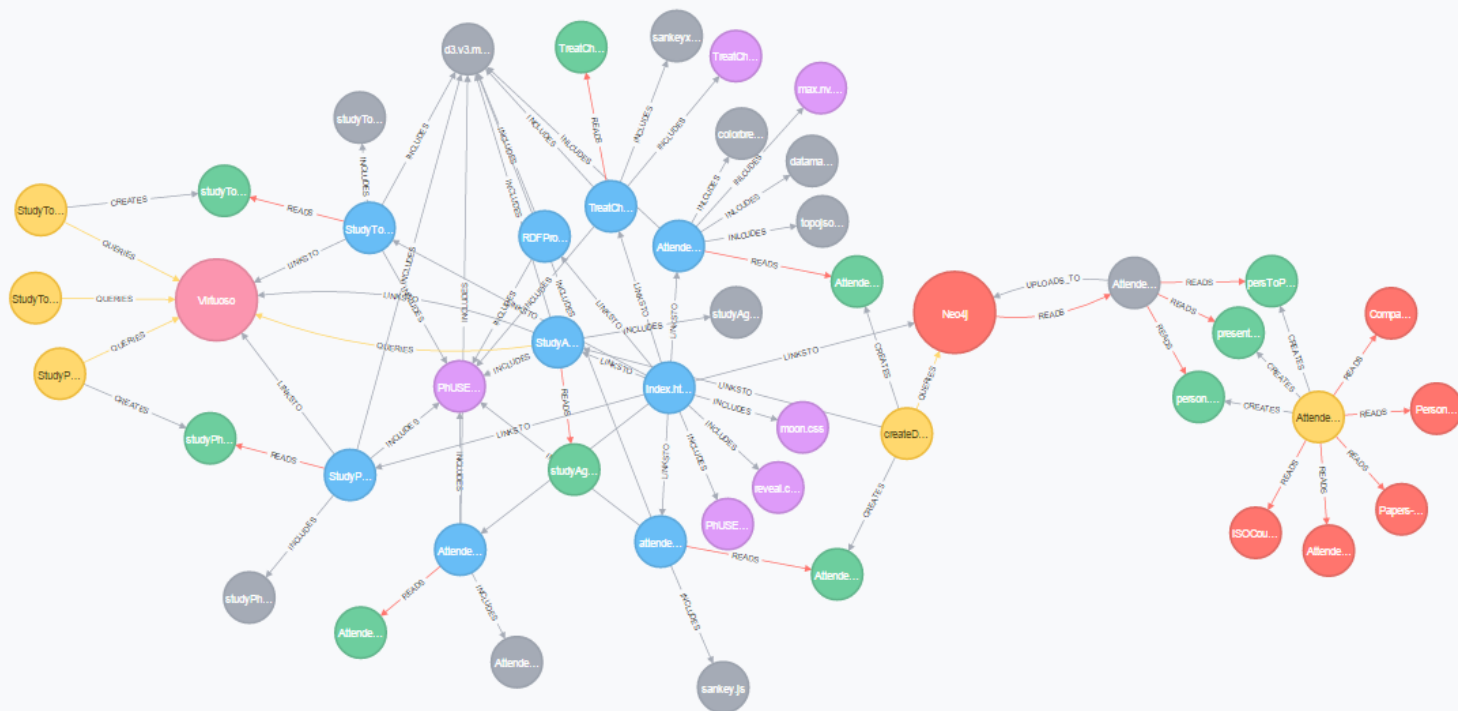


IMAGE ATTRIBUTIONS

Images not listed below are attributed to the author.



www.memegenerator.net



www.memegenerator.net



www.memegenerator.net



www.neo4j.com



<http://virtuoso.openlinksw.com/>



https://en.wikipedia.org/wiki/D3.js#/media/File:Logo_D3.svg



<http://bit.ly/21ipaJN>



<http://bit.ly/2bbX4dB>



2001 : A Space Odyssey. MGM Studios

