



ALLEGHENY
COLLEGE

Introduction
to Database
Systems:
CS305
Neo4J

Oliver
Bonham-
Carter
Hang Zhao

A Missed
Discovery

Neo4J

Start Neo4j in
Docker

Open a
Project

Play Time

Finding Kevin Bacon

Shutting
Down

Consider this

Introduction to Database Systems: CS305 Neo4J

Oliver Bonham-Carter
Hang Zhao

21 November 2023

Meaningful Information Should Come From Data

Having data is a small part of it...

Introduction
to Database
Systems:
CS305
Neo4J

Oliver
Bonham-
Carter
Hang Zhao

A Missed
Discovery

Neo4J

Start Neo4j in
Docker

Open a
Project

Play Time

Finding Kevin Bacon

Shutting
Down

Consider this



- I have raw data to explore
- I want information and *meaning* from this data

Explore The Data

Introduction
to Database
Systems:

CS305
Neo4J

Oliver
Bonham-
Carter
Hang Zhao

A Missed
Discovery

Neo4J

Start Neo4j in
Docker

Open a
Project

Play Time

Finding Kevin Bacon

Shutting
Down

Consider this

humanGene	EnsNum	x00511204	x7d9d7119	x93904035
RMND5A	ENSG00000153561.11	16.0546348885	15.6436361402	151243.109382
RAD23A	ENSG00000179262.8	38.9356481105	21.5142980465	775745.038464
RAD17	ENSG00000152942.17	6.71326600879	5.55100617026	151541.361155
TTDN1 (C7orf11)	ENSG00000168303.6	1.85918994126	3.36634373043	49263.8903263
RAD54L	ENSG00000085999.10	0.00970150764521	4.41325732573	15129.8861733
UBE2N	ENSG00000177889.8	10.5477997615	8.83952862957	359788.007983
TMEM30A	ENSG00000112697.14	24.071953429	65.9105478055	702850.166466
POLG	ENSG00000140521.10	11.0086481904	14.6093304994	264802.654955
TIPIN	ENSG00000075131.8	1.0519040137	3.4787739239	46372.2363056
RECQL	ENSG0000004700.14	7.34079033224	13.8899052998	156082.413636
BRCA2 (FANCD1)	ENSG00000139618.13	0.0304680934309	2.60236876714	8123.47419519
RPA3	ENSG00000106399.10	2.73817849196	11.9965343474	98123.2266513
RNASEH2B	ENSG00000136104.17	2.25140800487	2.16690519349	51635.1402182
RAD18	ENSG00000070950.8	1.03082443513	5.06228468473	48787.2494237
CAMKK1	ENSG0000004660.13	0.715650842655	1.95868467159	87931.7903047

- I just collected some data and should store it in a database
- So, I have poured this data into some SQL tables I made
- I should now write some useful queries for some unique purpose
- Intelligence should result from these queries
- Right?

I Want To Know

What is the relationship between ...

Introduction
to Database
Systems:
CS305
Neo4J

Oliver
Bonham-
Carter
Hang Zhao

A Missed
Discovery

Neo4J

Start Neo4j in
Docker

Open a
Project

Play Time

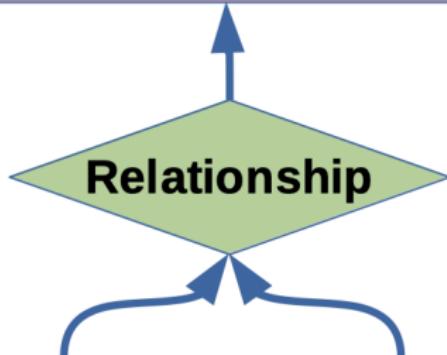
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Shutting
Down

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Discovery!



Attribute 1

Attribute 2

- I want to know what relationship(s) exist between my attributes
- This relationship would be an amazing discovery!



Explore The Data

So, I will take a stab using SQL to find meaning ...

Introduction
to Database
Systems:
CS305
Neo4J

Oliver
Bonham-
Carter
Hang Zhao

A Missed
Discovery

Neo4J

Start Neo4j in
Docker

Open a
Project

Play Time

Finding Kevin Bacon

Shutting
Down

Consider this

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RAD17	ENSG00000152942.17	6.71326600879	5.55100617026	151541.361155
TTDN1 (C7orf11)	ENSG00000168303.6	1.85918994126	3.36634373043	49263.8903263
RAD54L	ENSG00000085999.10	0.00970150764521	4.41325732573	15129.8861733
UBE2N	ENSG00000177889.8	10.5477997615	8.83952862957	359788.007983
TMEM30A	ENSG00000112697.14	24.071953429	65.9105478055	702850.166466
POLG	ENSG00000140521.10	11.0086481904	14.6093304994	264802.654955
TIPIN	ENSG00000075131.8	1.0519040137	3.4787739239	46372.2363056
RECQL	ENSG00000004700.14	7.34079033224	13.8899052998	156082.413636
BRCA2 (FANCD1)	ENSG00000139618.13	0.0304680934309	2.60236876714	8123.47419519
RPA3	ENSG00000106399.10	2.73817849196	11.9965343474	98123.2266513
RNASEH2B	ENSG00000136104.17	2.25140800487	2.16690519349	51635.1402182
RAD18	ENSG00000070950.8	1.03082443513	5.06228468473	48787.2494237
CAMKK1	ENSG00000004660.13	0.715650842655	1.95868467159	87931.7903047

What EnsNum do I want ... ?

```
SELECT humanGene WHERE EnsNum LIKE "E%";  
SELECT humanGene WHERE x00511204 like "16%";  
SELECT err ... what's for lunch?  
SELECT a soup and salad, I guess
```

- What was that pattern I was looking for?
- What happened to my quest to extract meaning from my data?

Using Databases

Data to Discovery

Introduction
to Database
Systems:
CS305
Neo4J

Oliver
Bonham-
Carter
Hang Zhao

A Missed
Discovery

Neo4J

Start Neo4j in
Docker

Open a
Project

Play Time

Finding Kevin Bacon

Shutting
Down

Consider this

SQL Schema

humanGene	EnsNum	x00511204	x7d9d7119	x93904035
RMND6A	ENSG00000153561.11	16.0546348886	15.6130361402	15.243.109382
RA23A	ENSG00000179202.5	58.9350481103	21.5142900405	775745.036404
RAD17	ENSG00000152942.17	6.7.326600079	5.55100617028	15.541.361155
TTDN1 (CTorf11)	ENSG00000168303.5	1.85918994126	3.36634373043	49253.8903263
NA061L	ENSG00000085899.10	0.039/0150/6/521	4.41326/326/3	15.25.8861.39
UBI2N	ENSG00000177869.8	10.5417997015	8.83952862957	359788.007983
TMFM3RNA	ENSG00000112687.14	24.571963429	65.9105478055	702850.1604466
POLG	ENSG00000140521.10	11.0006481904	14.6093304954	26482.654255
TIPIN	ENSG00000075131.5	1.0519040137	3.4787739239	46372.2363596
REXO1L	ENSG00000000470.14	7.340/9033224	13.8899052938	156362.413536
BRCA2 (FANCD1)	ENSG00000130618.13	0.3304580034309	2.00230876714	8123.47419510
RPA3	ENSG00000106356.10	2.73817648193	11.996/343474	98/23.2266513
RNASCII23	ENSG00000136254.17	2.25140800487	2.16690519349	51635.1402182
RAD18	ENSG00000070950.5	1.03382443513	5.06228468473	48787.2494237
CAVK11	ENSG000000004660.13	0./15850842659	1.95868816/259	8/031.790304/

Ideas and discovery

Knowledge!

Found Relationships

Queries





Missing Discoveries?

Where did my idea go?

Introduction
to Database
Systems:
CS305
Neo4J

Oliver
Bonham-
Carter
Hang Zhao

A Missed
Discovery

Neo4J

Start Neo4j in
Docker

Open a
Project

Play Time

Finding Kevin Bacon

Shutting
Down

Consider this



What stumped my discovery?

- Discoveries in data are first imagined, then verified
- The patterns that we can find are limited by our imaginations to find a *testable* cases to query
- Is there a way to find relationships without first knowing that they could exist?!

Databases, Visually

Introduction
to Database
Systems:
CS305
Neo4J

Oliver
Bonham-
Carter
Hang Zhao

A Missed
Discovery

Neo4J

Start Neo4j in
Docker

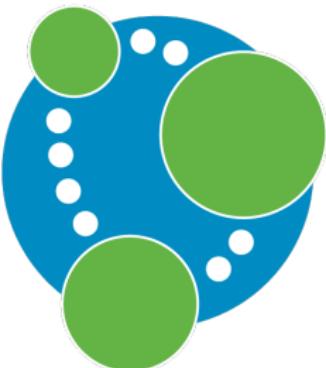
Open a
Project

Play Time

Finding Kevin Bacon

Shutting
Down

Consider this



neo4j

- A visual database system using methods from graph theory to use networks to determine relationships (edges) and discover meaning from connected data-points (nodes). Users are able to interact with the data in a network.

- <https://neo4j.com/>
- Graphgists Projects: <https://neo4j.com/graphgists/>

Networks Of Data

Relationships exist by connectivity

Introduction
to Database
Systems:
CS305
Neo4J

Oliver
Bonham-
Carter
Hang Zhao

A Missed
Discovery

Neo4J

Start Neo4j in
Docker

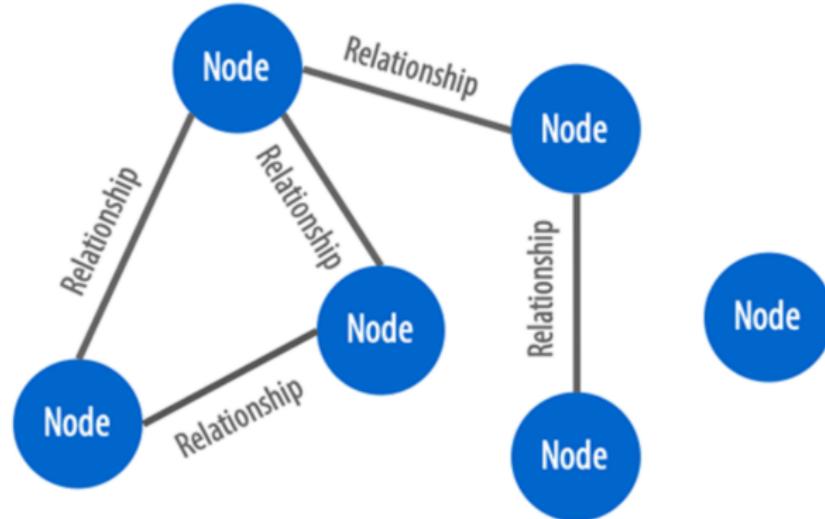
Open a
Project

Play Time

Finding Kevin Bacon

Shutting
Down

Consider this



- Nodes and edges represent inter-relationships
- Relationships are described by connections between nodes
- Single nodes have no immediate relationships with the others

Networks In Neo4J

Introduction
to Database
Systems:
CS305
Neo4J

Oliver
Bonham-
Carter
Hang Zhao

A Missed
Discovery

Neo4J

Start Neo4j in
Docker

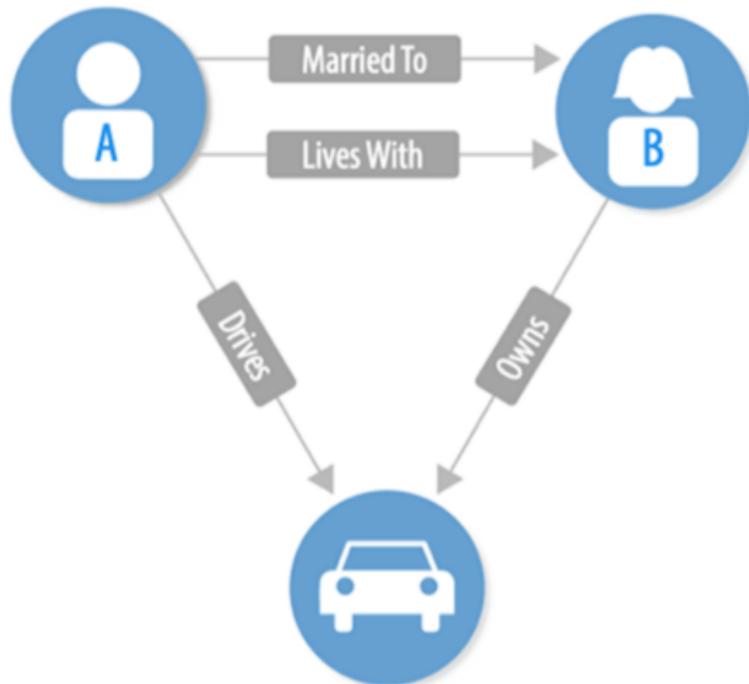
Open a
Project

Play Time

Finding Kevin Bacon

Shutting
Down

Consider this



- An acting schema: The relationships between nodes are built into the network

Networks In Neo4J

Introduction
to Database
Systems:
CS305
Neo4J

Oliver
Bonham-
Carter
Hang Zhao

A Missed
Discovery

Neo4J

Start Neo4j in
Docker

Open a
Project

Play Time

Finding Kevin Bacon

Shutting
Down

Consider this



Networks Of Data

Relationships exist by connectivity

Introduction
to Database
Systems:
CS305
Neo4J

Oliver
Bonham-
Carter
Hang Zhao

A Missed
Discovery

Neo4J

Start Neo4j in
Docker

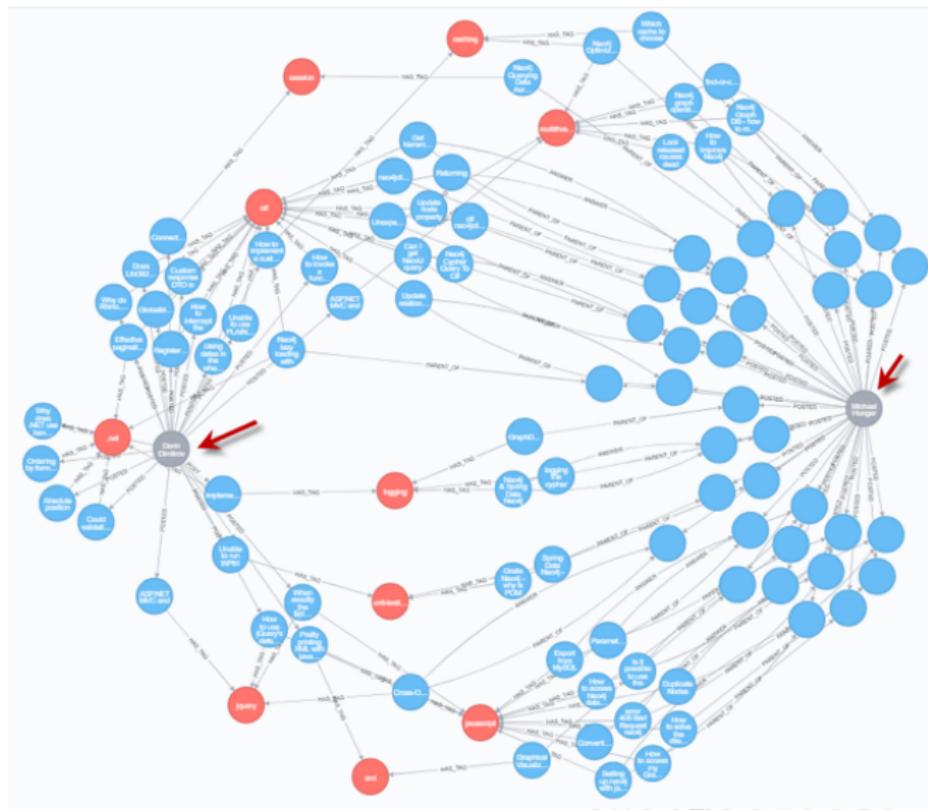
Open a
Project

Play Time

Finding Kevin Bacon

Shutting
Down

Consider this



Getting started with Neo4j in Docker

These files are located in sandbox/

Introduction
to Database
Systems:

CS305
Neo4J

Oliver
Bonham-
Carter
Hang Zhao



Windows

```
build_neo4j_windows.bat
```

MacOS and Linux

```
sh build_neo4j_macOSAndLinux.sh
```

You can **build** and **start** the container with this script. You will have to manually stop the container, as necessary.

Getting started with Neo4j in Docker

Specific Terminal commands

Introduction
to Database
Systems:

CS305
Neo4J

Oliver
Bonham-
Carter
Hang Zhao

A Missed
Discovery

Neo4J

Start Neo4j in
Docker

Open a
Project

Play Time

Finding Kevin Bacon

Shutting
Down

Consider this



Terminal Command to START Neo4j

```
docker start testneo4j # windows  
sudo docker start testneo4j # MacOS and Linux
```

Terminal Command to STOP Neo4j

```
docker stop testneo4j # windows  
sudo docker stop testneo4j # MacOS and Linux
```



Login

Introduction
to Database
Systems:
CS305
Neo4J

Oliver
Bonham-
Carter
Hang Zhao

A Missed
Discovery

Neo4J

Start Neo4j in
Docker

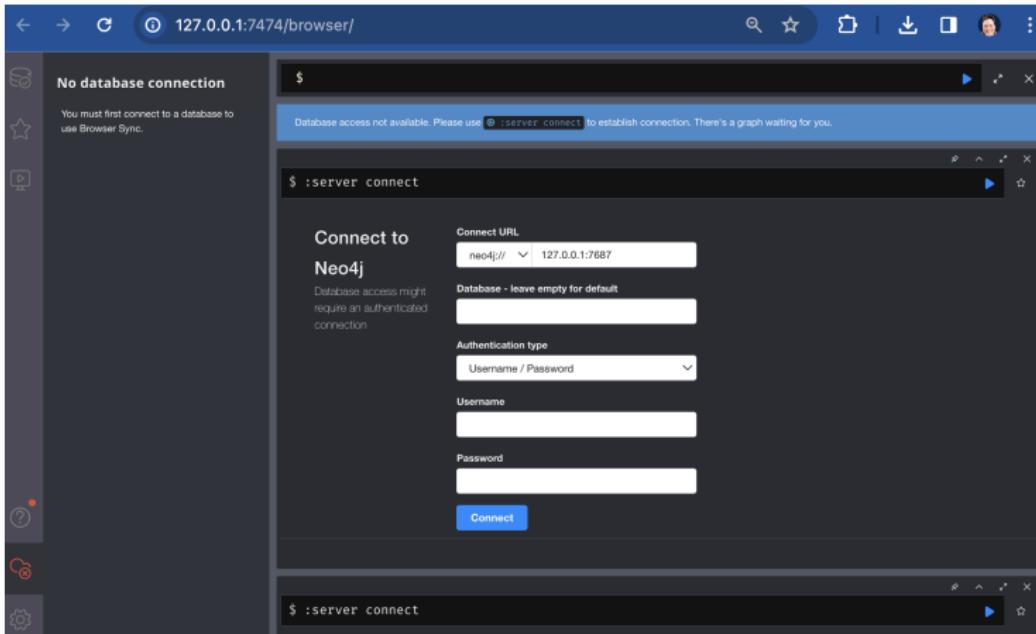
Open a
Project

Play Time

Finding Kevin Bacon

Shutting
Down

Consider this



● Open your browser and head to: <http://127.0.0.1:7474/browser/>

User and Password

Introduction
to Database
Systems:
CS305
Neo4J

Oliver
Bonham-
Carter
Hang Zhao

A Missed
Discovery

Neo4J

Start Neo4j in
Docker

Open a
Project

Play Time

Finding Kevin Bacon

Shutting
Down

Consider this

Note: The user and password variables are defined in the *build* files we used to create the Docker container.

- Your first login
 - **User:** neo4j
 - **Password:** password

Parameter in the build file

```
--env NE04J_AUTH=neo4j/password
```

Ready!

Introduction
to Database
Systems:
CS305
Neo4J

Oliver
Bonham-
Carter
Hang Zhao

A Missed
Discovery

Neo4J

Start Neo4j in
Docker

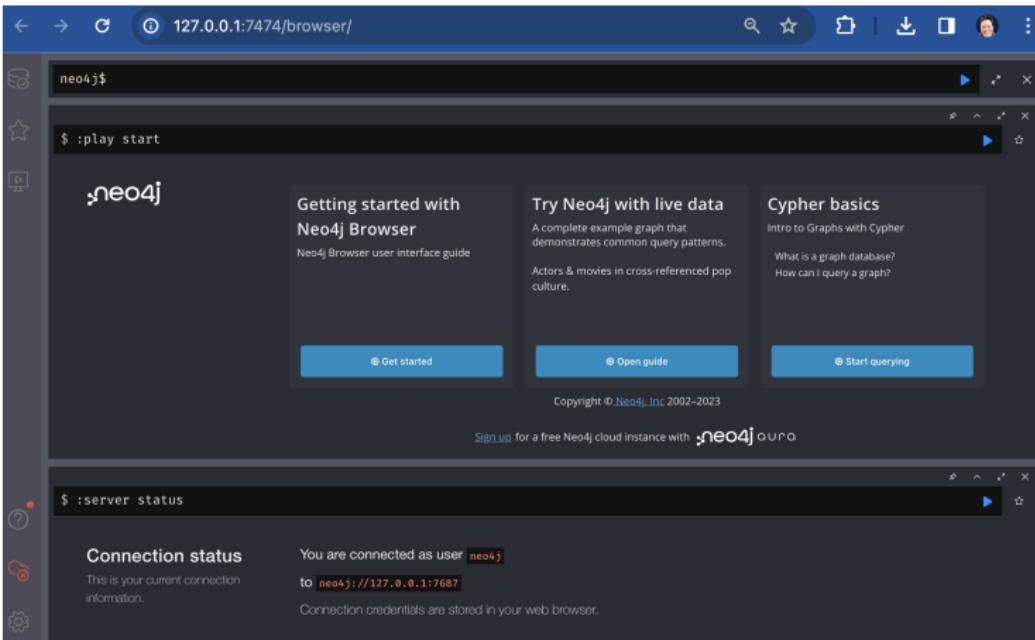
Open a
Project

Play Time

Finding Kevin Bacon

Shutting
Down

Consider this



The screenshot shows the Neo4j Browser interface running at `127.0.0.1:7474/browser/`. The top panel displays a terminal-like interface with the command `$:play start` and the Neo4j logo. Below this, there are three main sections: "Getting started with Neo4j Browser" (with a "Get started" button), "Try Neo4j with live data" (with a "Open guide" button), and "Cypher basics" (with a "Start querying" button). The bottom panel shows a terminal-like interface with the command `$:server status`. It displays the "Connection status" section, which shows the user is connected as "neo4j" to "neo4j://127.0.0.1:7687". A note states that connection credentials are stored in the web browser.

- If all has gone well, you should be ready to work

Ready!

Introduction
to Database
Systems:
CS305
Neo4J

Oliver
Bonham-
Carter
Hang Zhao

A Missed
Discovery
Neo4J
Start Neo4j in
Docker
Open a
Project
Play Time
Finding Kevin Bacon
Shutting
Down
Consider this

```
$ :play movie graph
```



- Type :play movie graph in the editor at the top.
- Now click right arrow

```
$ :play movie graph
```



Movie Graph

Pop-cultural
connections
between actors
and movies

The Movie Graph is a mini graph application containing actors and directors that are related through the movies they've collaborated on.

This guide will show you how to:

1. Create: insert movie data into the graph
2. Find: retrieve individual movies and actors
3. Query: discover related actors and directors
4. Solve: the Bacon Path



- Let's follow the built-in tutorial of film data (i.e., Directors, Actors, Producers, etc.)

Play!

Introduction
to Database
Systems:
CS305
Neo4J

Oliver
Bonham-
Carter
Hang Zhao

A Missed
Discovery

Neo4J

Start Neo4j in
Docker

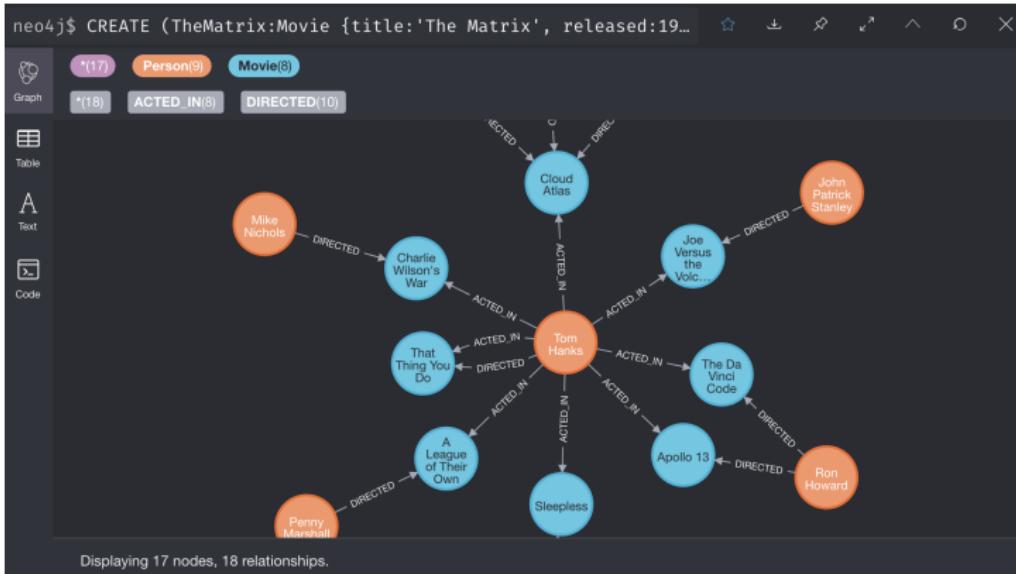
Open a
Project

Play Time

Finding Kevin Bacon

Shutting
Down

Consider this



- Take a moment to play with the graph!
- Drag the nodes around!



Play!

Sample code in Cypher script

Introduction
to Database
Systems:
CS305
Neo4J

Oliver
Bonham-
Carter
Hang Zhao

A Missed
Discovery

Neo4J

Start Neo4j in
Docker

Open a
Project

Play Time

Finding Kevin Bacon

Shutting
Down

Consider this

```
neo4j$ CALL db.schema.visualization
```



What is the Visual Schema?

```
CALL db.schema.visualization
```

More help?

Visit: <https://neo4j.com/developer/cypher/guide-cypher-basics/>



Play!

Sample code in Cypher script

Introduction
to Database
Systems:
CS305
Neo4J

Oliver
Bonham-
Carter
Hang Zhao

A Missed
Discovery

Neo4J

Start Neo4j in
Docker

Open a
Project

Play Time

Finding Kevin Bacon

Shutting
Down

Consider this

What are the node types?

```
CALL db.schema.nodeTypeProperties
```

What are the relationship types?

```
CALL db.relationshipTypes()
```

Display all nodes

```
MATCH (n) RETURN n
```

Who acted in what?

```
MATCH p=()-[r:ACTED_IN]->() RETURN p
```

Who reviewed what?

```
MATCH p=()-[r:REVIEWED]->() RETURN p LIMIT 25
```

Who produced what?

```
MATCH p=()-[r:PRODUCED]->() RETURN p LIMIT 25
```



Play!

Sample code in Cypher script

Introduction
to Database
Systems:
CS305
Neo4J

Oliver
Bonham-
Carter
Hang Zhao

A Missed
Discovery

Neo4J

Start Neo4j in
Docker

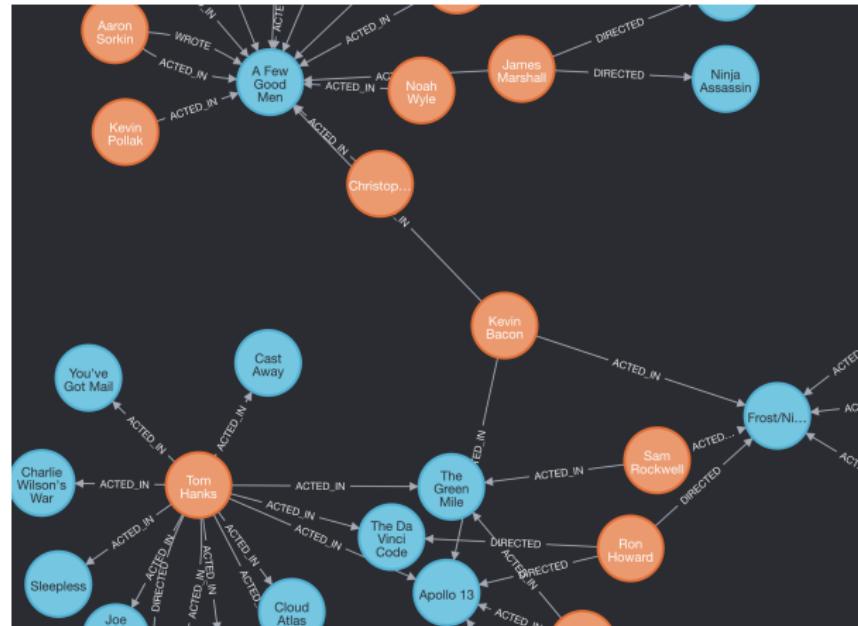
Open a
Project

Play Time

Finding Kevin Bacon

Shutting
Down

Consider this



Where is Kevin Bacon?

```
MATCH (bacon:Person {name:"Kevin Bacon"})-[*1..3]-(hollywood)
RETURN DISTINCT bacon, hollywood
```

How To Shut Down a Session

Introduction
to Database
Systems:
CS305
Neo4J

Oliver
Bonham-
Carter
Hang Zhao

A Missed
Discovery

Neo4J

Start Neo4j in
Docker

Open a
Project

Play Time

Finding Kevin Bacon

Shutting
Down

Consider this



Stop Neo4j container

```
docker stop testneo4j # Windows
```

```
sudo docker stop testneo4j # MacOS and Linux
```

Remove Neo4j container (if necessary!)

```
sudo docker image rm neo4j # MacOS and Linux
```

```
docker image rm neo4j # Windows
```

Consider This...

Introduction
to Database
Systems:
CS305
Neo4J

Oliver
Bonham-
Carter
Hang Zhao

A Missed
Discovery

Neo4J

Start Neo4j in
Docker

Open a
Project

Play Time

Finding Kevin Bacon

Shutting
Down

Consider this



THINK

- Can you work with data as nodes and edges in the movie network?
- Can you discover new relationships between the nodes?