



OLTP + OLAP ftw!

QCon San Francisco

November 8, 2016

ABOUT ME

- Developed web apps for 5 years including e-commerce, business workflow, more.
- Worked at Google for 8 years on Google Apps, Cloud Platform
- Technologies: Python, Java, BigQuery, Oracle, MySQL, OAuth

ryan@neo4j.com
@ryguyrg

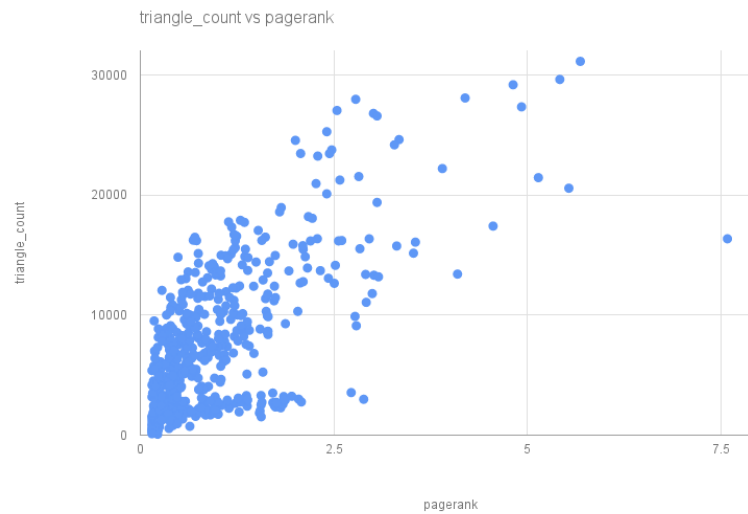
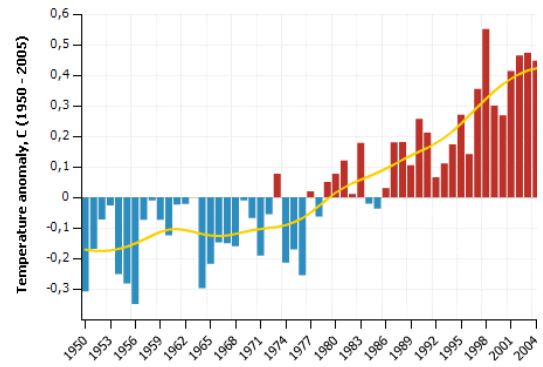
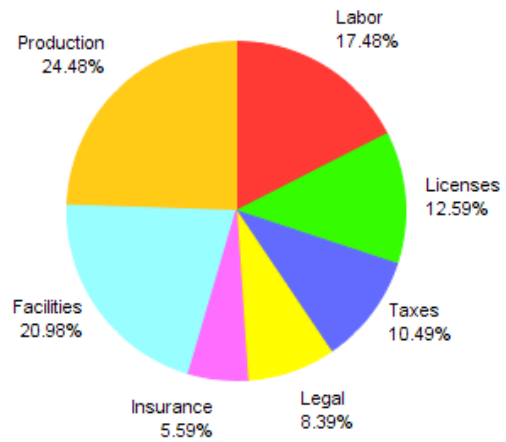


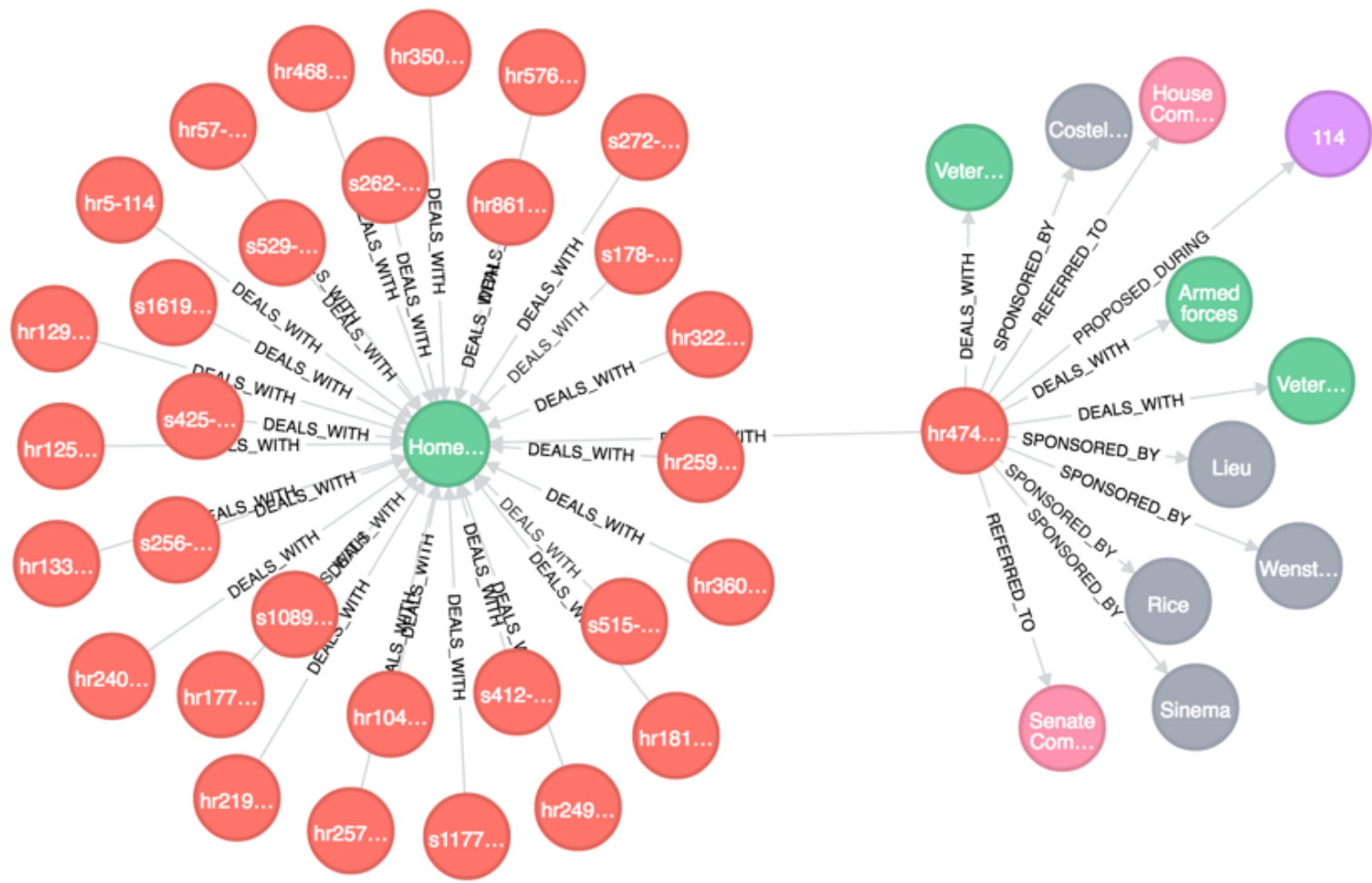
Talking about Today

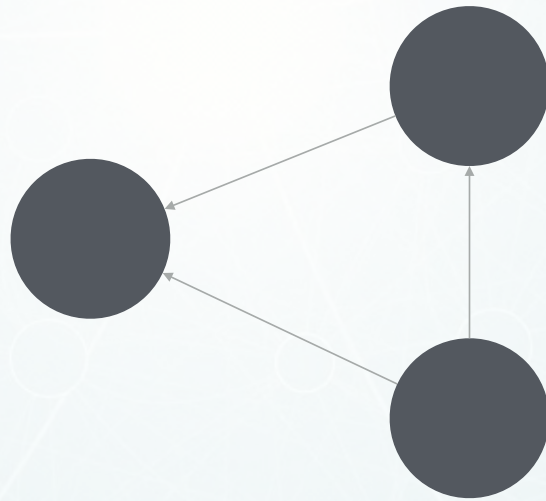
- **Quick intro to Graph DBs**
- **How Analytics works with Neo4j - then, now, and soon!**
- **Our patriotic duty to combine the two**

The background of the slide features a light blue gradient with a complex network graph pattern. The graph consists of numerous white circular nodes of varying sizes, interconnected by thin white lines. The nodes are distributed across the entire frame, creating a dense, interconnected web of connections. The overall aesthetic is clean and technical, typical of a presentation on computer science or data analysis.

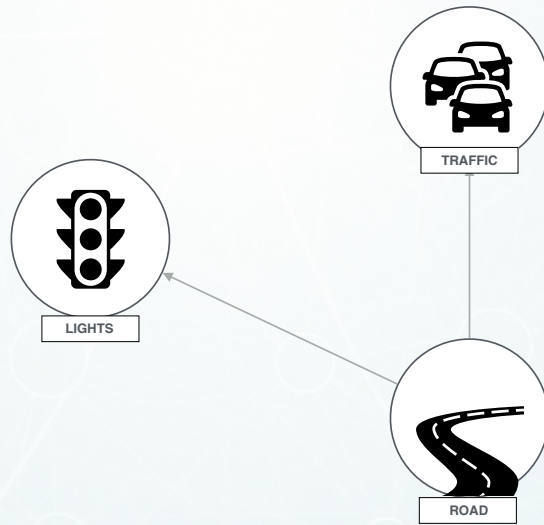
What is a Graph?



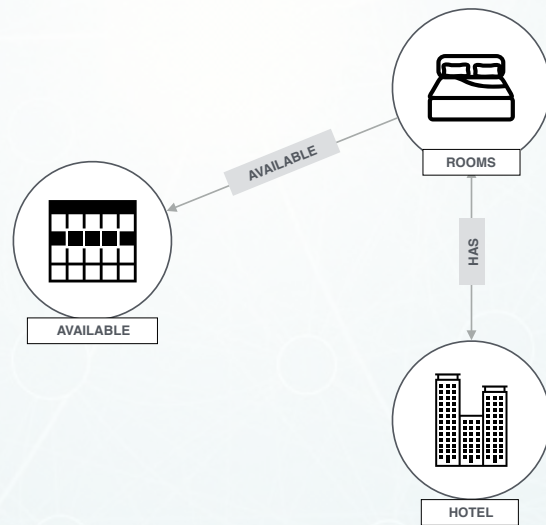




A Graph Is Connected Data



A Graph Is Connected Data

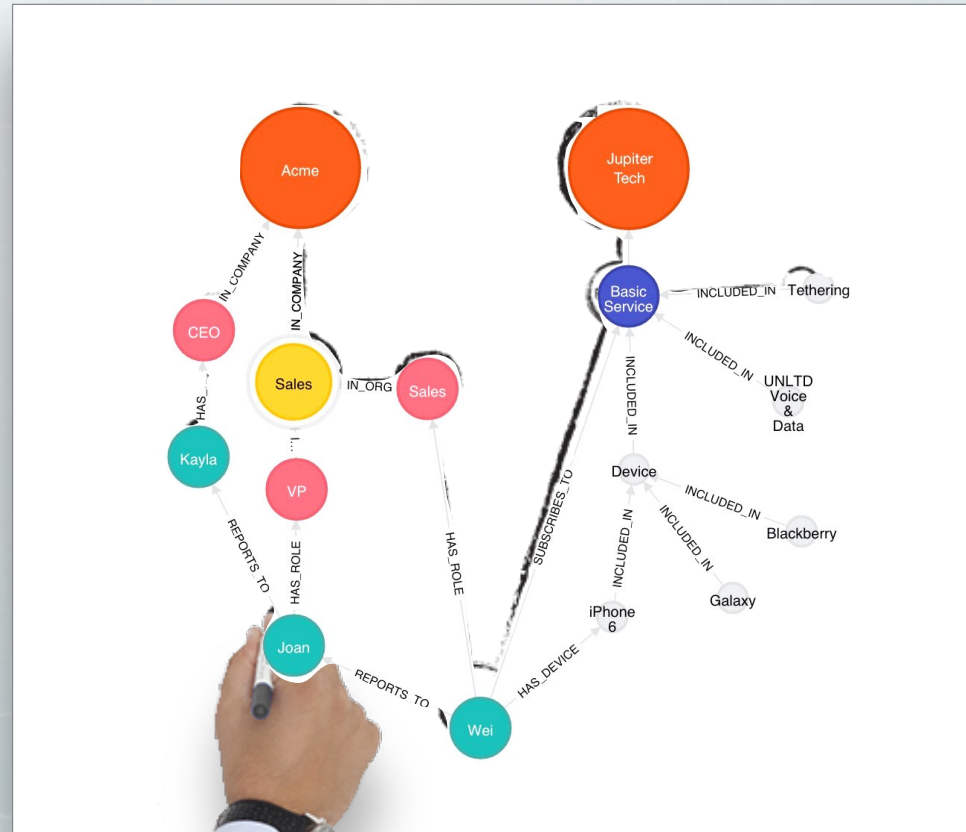


A Graph Is Connected Data



What does a Graph look like?

Whiteboard Model is the Physical Model



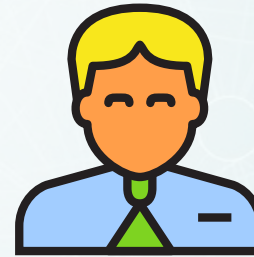
Graphing Love



Ann

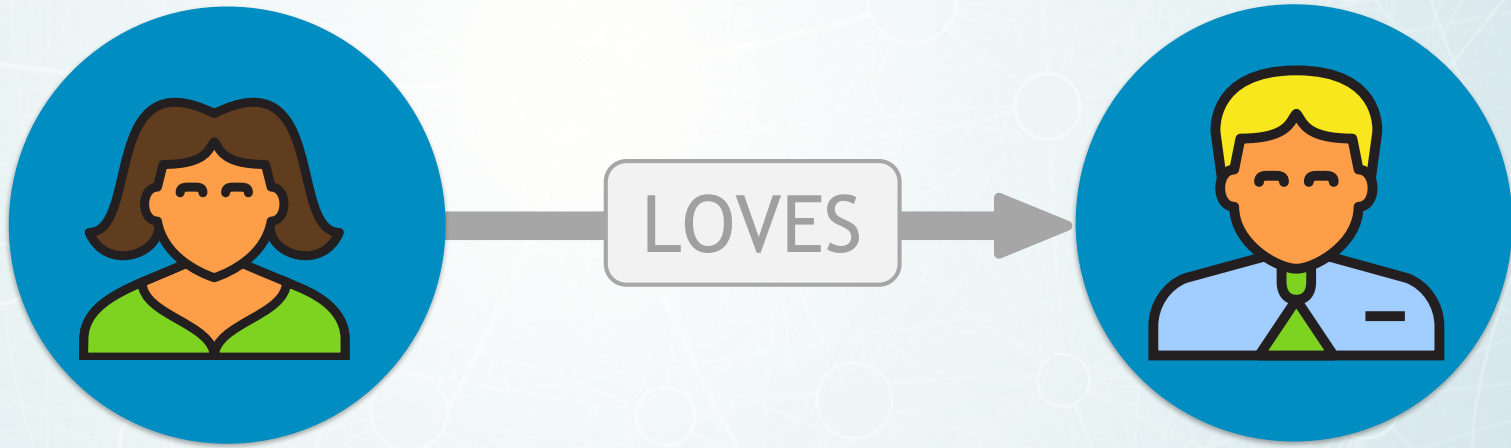


Loves



Dan

Property Graph Model



NODE

NODE

```
CREATE (:Person { name:"Ann" }) - [:LOVES]-> (:Person { name:"Dan" })
```

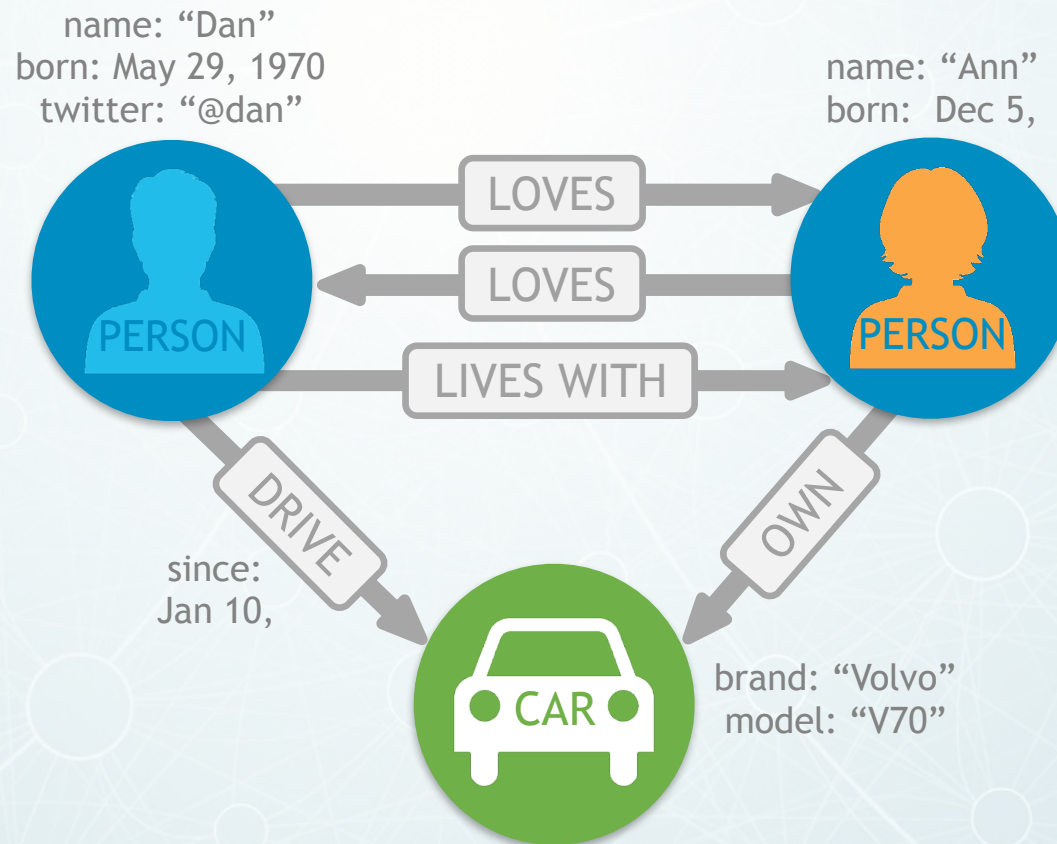
LABEL

PROPERTY

LABEL

PROPERTY

Property Graph Model: Extended



The background of the slide features a light blue gradient with a complex network graph pattern. The graph consists of numerous small, light blue circles (nodes) connected by thin, light blue lines (edges), creating a dense, interconnected web of connections across the entire background.

GRAPHS FOR OLTP

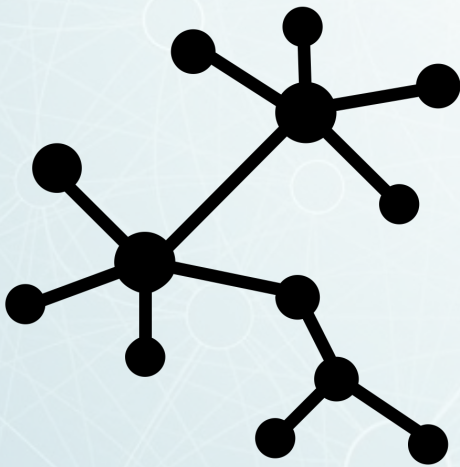
The background of the slide is a light blue color with a complex network of thin white lines connecting various sized white circles, creating a web-like or molecular structure. The text is centered in the middle of this background.

Intuitivness

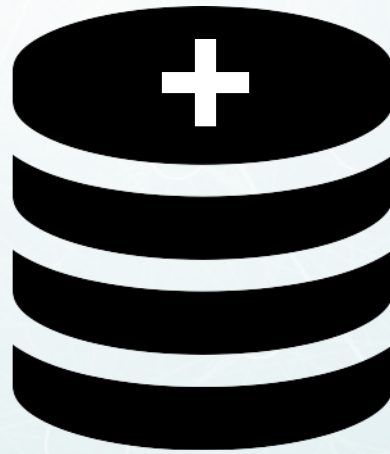
Speed

Agility

What about Neo4j?



CREATE MODEL



LOAD DATA



QUERY DATA

CYPHER!!!!

(Graphs) - [:ARE] -> (Everywhere)

How do you Query?





Neo4j 2.3.0



Node labels

- Category
- Customer
- Employee
- Order
- Product
- Supplier



Relationship types

- PART_OF
- PRODUCT
- PURCHASED
- REPORTS_TO
- SOLD
- SUPPLIES

Property keys

- _GA_TIMER_MODULE_NR
- address
- categoryID
- categoryName
- city
- code
- companyName
- contactName
- contactTitle
- country
- created_at
- customerID
- customerName
- description
- discontinued
- distance
- employeeID
- favorites
- fax
- firstName
- followers
- following
- homePage
- id
- id_str
- lastName
- location
- method
- name
- nodeRank
- orderId
- phone
- picture
- postalCode
- productID
- productName
- profile_image_url



\$

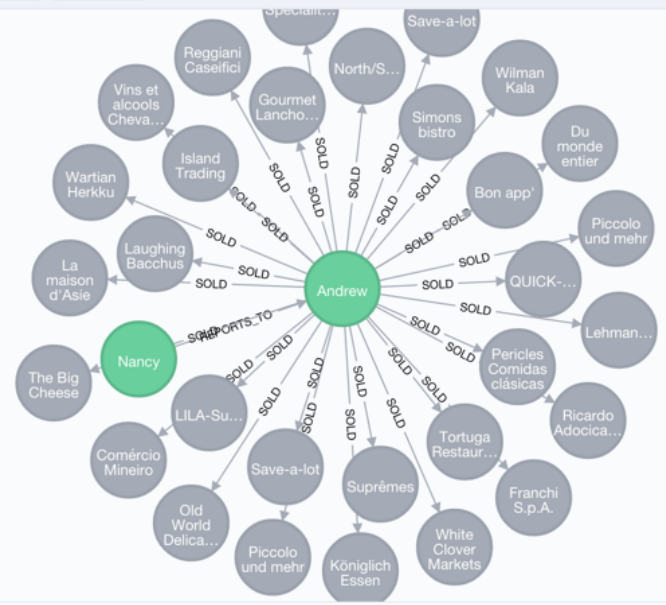


\$ MATCH (e:Employee)-[:REPORTS_TO]-(sub:Employee) OPTIONAL MATCH (e)-[]-(o:...



*(32) Employee(2) Order(30)

*(31) REPORTS_TO(1) SOLD(30)



Displaying 32 nodes, 31 relationships (completed with 31 additional relationships).

AUTO-COMPLETE ON

\$ MATCH (e:Employee)-[:REPORTS_TO]-(sub:Employee) OPTIONAL MATCH (e)-[]-(o:...



*(22) Employee(2) Order(20)

*(21) REPORTS_TO(1) SOLD(20)



How do you use Neo4j?

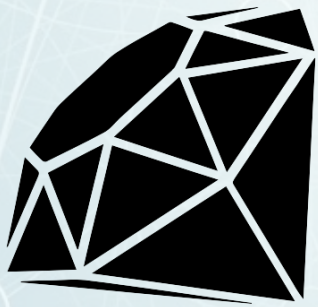


Official Language Drivers

JS



Community Language Drivers



php

Extending Neo4j





John Resig ✓
@jeresig



Following

Really digging @neo4j. What use to be a bunch of complicated analysis scripts are now a handful of simple Cypher queries.

← Reply ↻ Retweeted ★ Favorited ⋮ More

RETWEETS

38

FAVORITES

31





David Meza

@davidmeza1



Following

i love Neo4j because i can explore relationships faster than you can say sql join [#neo4joy](#)

RETWEETS

2

LIKES

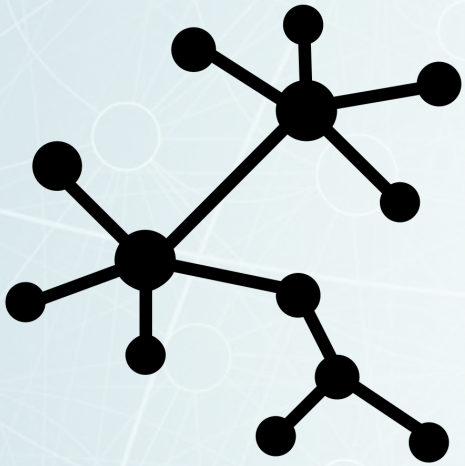
7



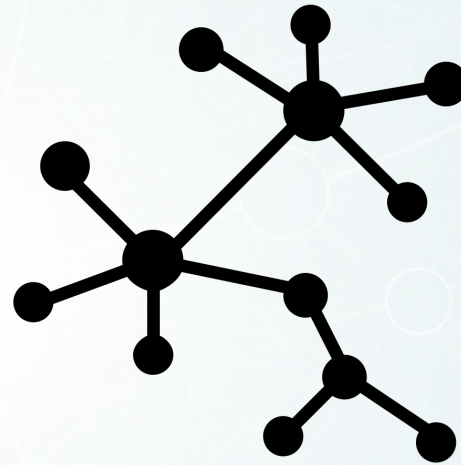
11:33 AM - 7 Dec 2015

The background features a light blue gradient with a complex network graph pattern. The graph consists of numerous small, light blue circles (nodes) connected by thin, white lines (edges), creating a dense, interconnected web of connections across the entire frame.

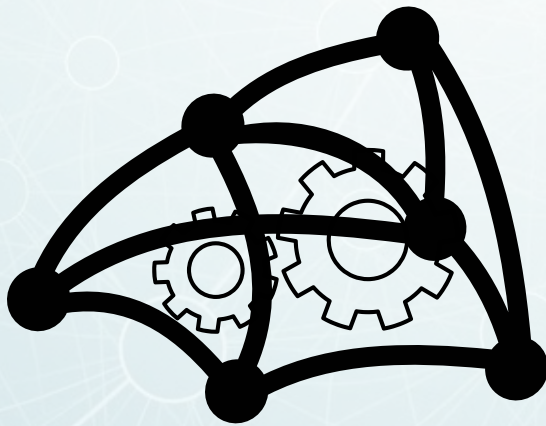
GRAPHS FOR ANALYTICS



(1) DATA IN GRAPH



(3) RESULTS IN GRAPH



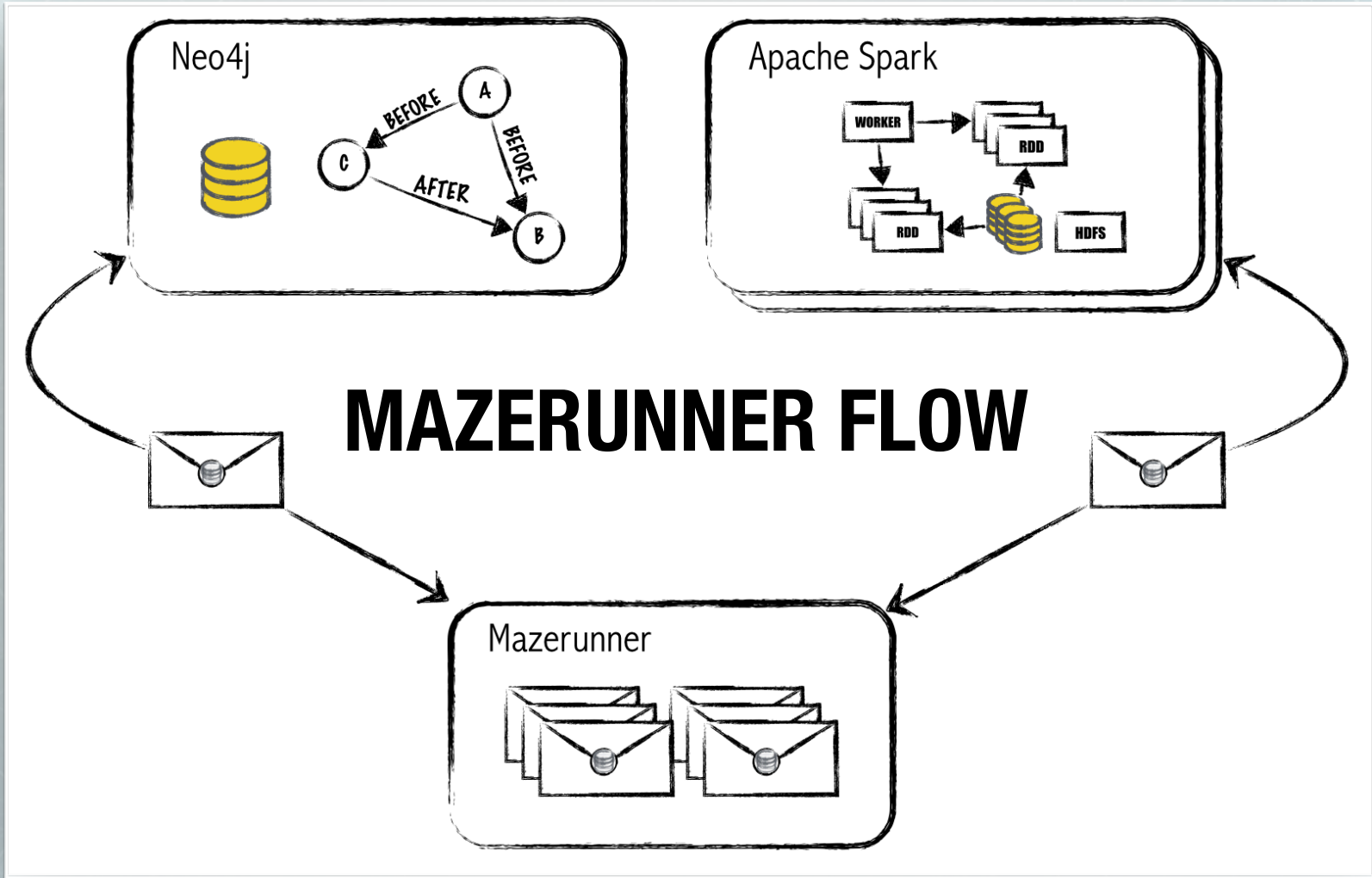
(2) ANALYZE RELATIONSHIPS



(4) QUERY GRAPH



Spark's API for graph processing



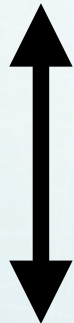


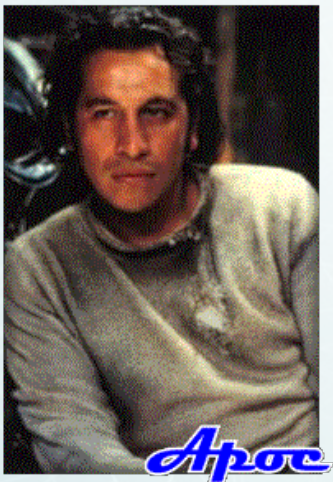
NEO4J SPARK CONNECTOR

Neo4j Spark Connector



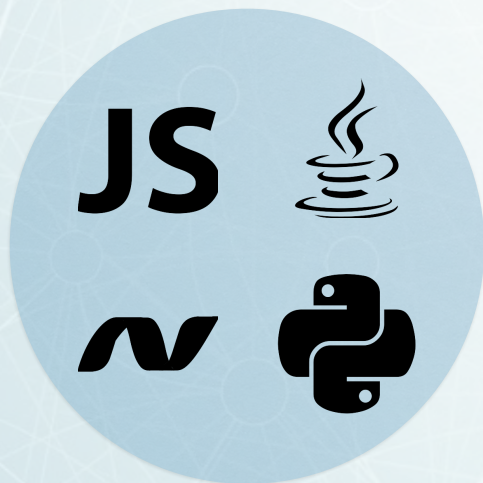
CYPHER over BOLT





APOC Library

APOC Library





Guillermo Szeliga

@gszeliga



I can't believe that [@neo4j](#) is actually real.
Seems like a dream come true

Reply

Retweeted

Favorited

More


1

RETWEET

3


FAVORITES



The background of the slide features a light blue gradient with a subtle, repeating pattern of interconnected white circles and lines, resembling a network graph or a molecular structure. The circles vary in size and are connected by thin, light-colored lines, creating a complex web of connections across the entire background.




GRAPHS FOR RECOMMENDATIONS

☰ SUPERSHOP 🛒






Kitchen Aid Empire Red Stand Mixer
★★★★★ (14 reviews) \$219.99 + ADD TO CART

Frequently bought together:

 \$44.99 RVSA Rotor Vegetable Slicer/Shredder ★★★★★ (14 reviews)	 \$30.99 KPRA 3-piece Pasta Roller and Cutter Set ★★★★★ (14 reviews)	 \$200.99 KSM1APC Spiralizer Attachment ★★★★★ (14 reviews)
--	--	--

People who bought this item also bought this:

 \$44.99 RVSA Rotor Vegetable Slicer/Shredder ★★★★★ (14 reviews)	 \$30.99 KPRA 3-piece Pasta Roller and Cutter Set ★★★★★ (14 reviews)	 \$200.99 KSM1APC Spiralizer Attachment ★★★★★ (14 reviews)
--	--	--

The main product

Related products

People who bought X also bought Y

Recommendations (In Real-Time)

☰ SUPERSHOP 



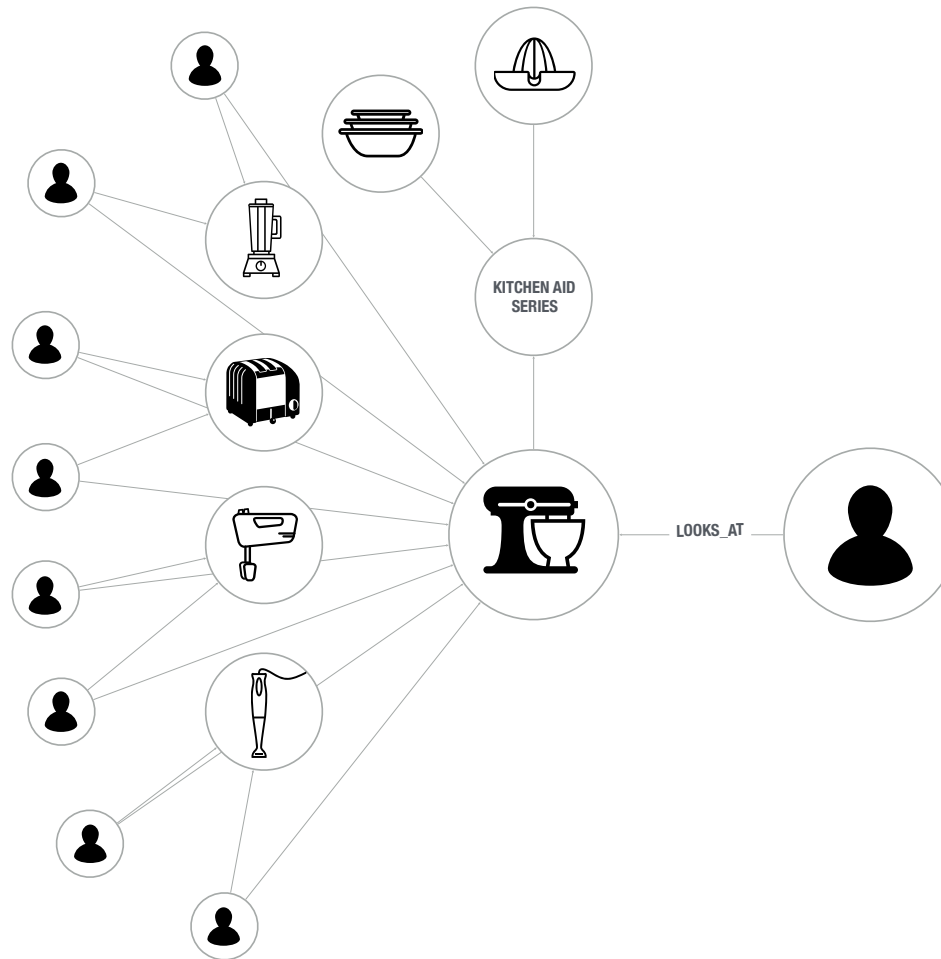
Kitchen Aid Empire Red Stand Mixer **\$219.99**
 ★★★★★ (14 reviews) + ADD TO CART

Frequently bought together:

		
\$44.99 RVSA Rotor Vegetable Slicer/Shredder ★★★★★ (14 reviews)	\$30.99 KPRA 3-piece Pasta Roller and Cutter Set ★★★★★ (14 reviews)	\$200.99 KSM1APC Spiralizer Attachment ★★★★★ (14 reviews)

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☰ **SUPERSHOP** 



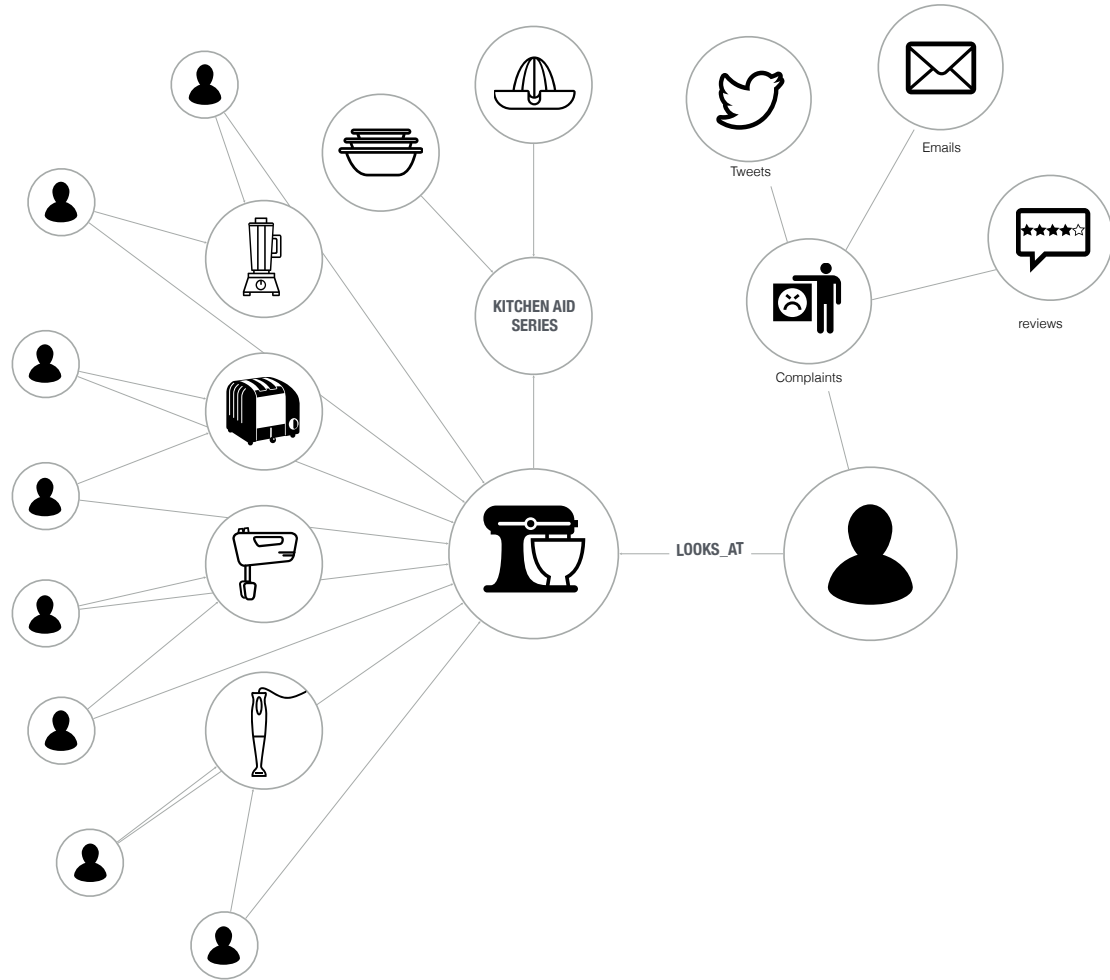
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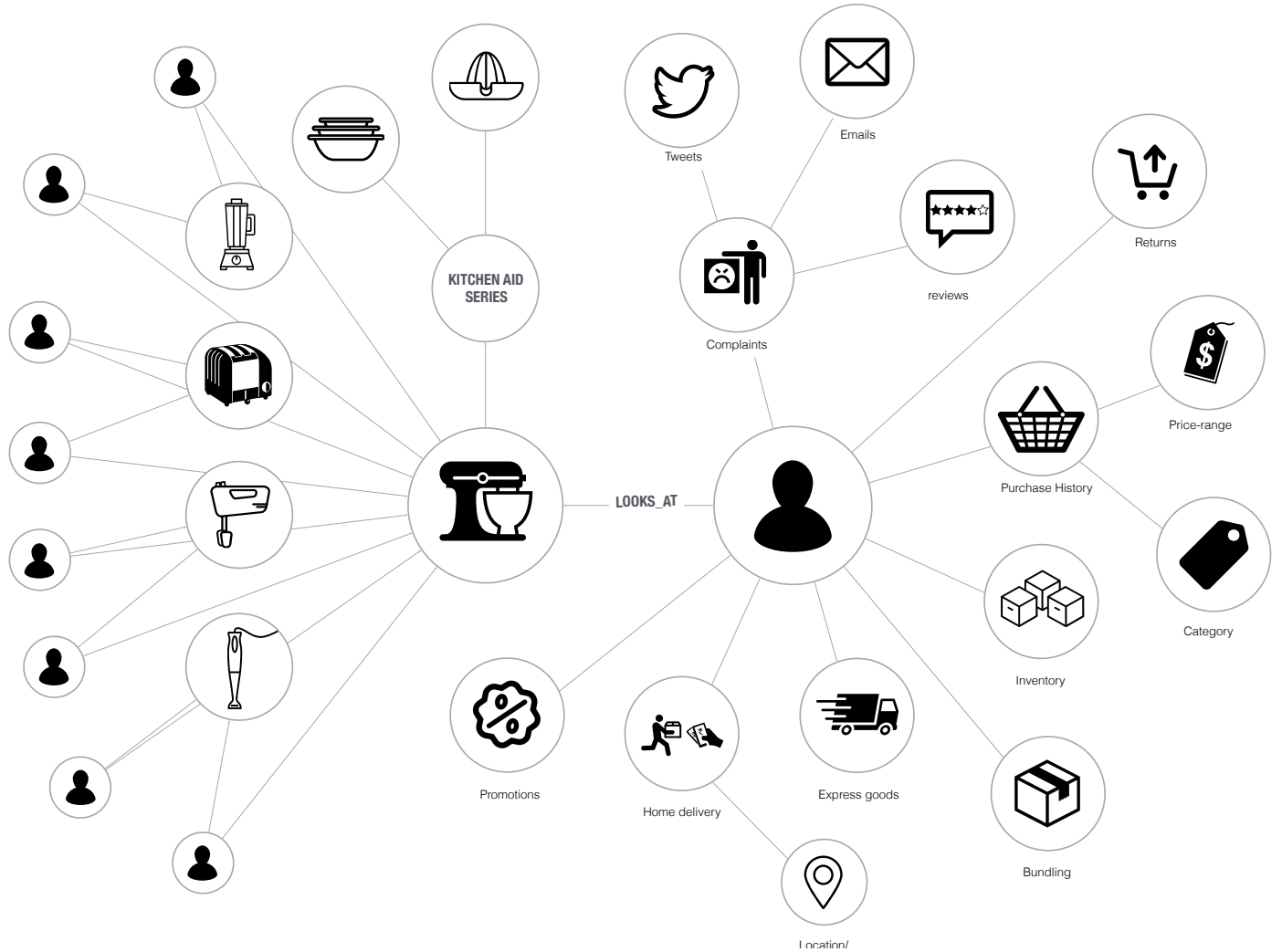



☰ **SUPERSHOP** 




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 ★★★★★ (14 reviews) + ADD TO CART


 <p>Naked Surf I Minimalist Surfboard Wall Rack I... by StoreYourBoard \$24.99 Prime ★★★★★ (57)</p>	 <p>Best Choice Products Surfing Surf Beach O... by Best Choice Products \$89.72 ★★★★★ (86)</p>
 <p>North Gear 6ft Foam Surfboard by North Gear \$79.99</p>	 <p>8' Performance Soft Top Foamboard Long Surf... by Greco Surf \$249.99</p>




☰ **SUPERSHOP** 




Kitchen Aid Empire Red Stand Mixer **\$219.99**
 ★★★★★ (14 reviews) + ADD TO CART



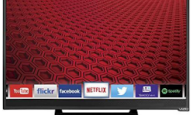
Sony KDL48R510C 48-Inch (47.6" Measured...
 by Sony
 Click for product details
 ✓Prime
 ★★★★★ (273)



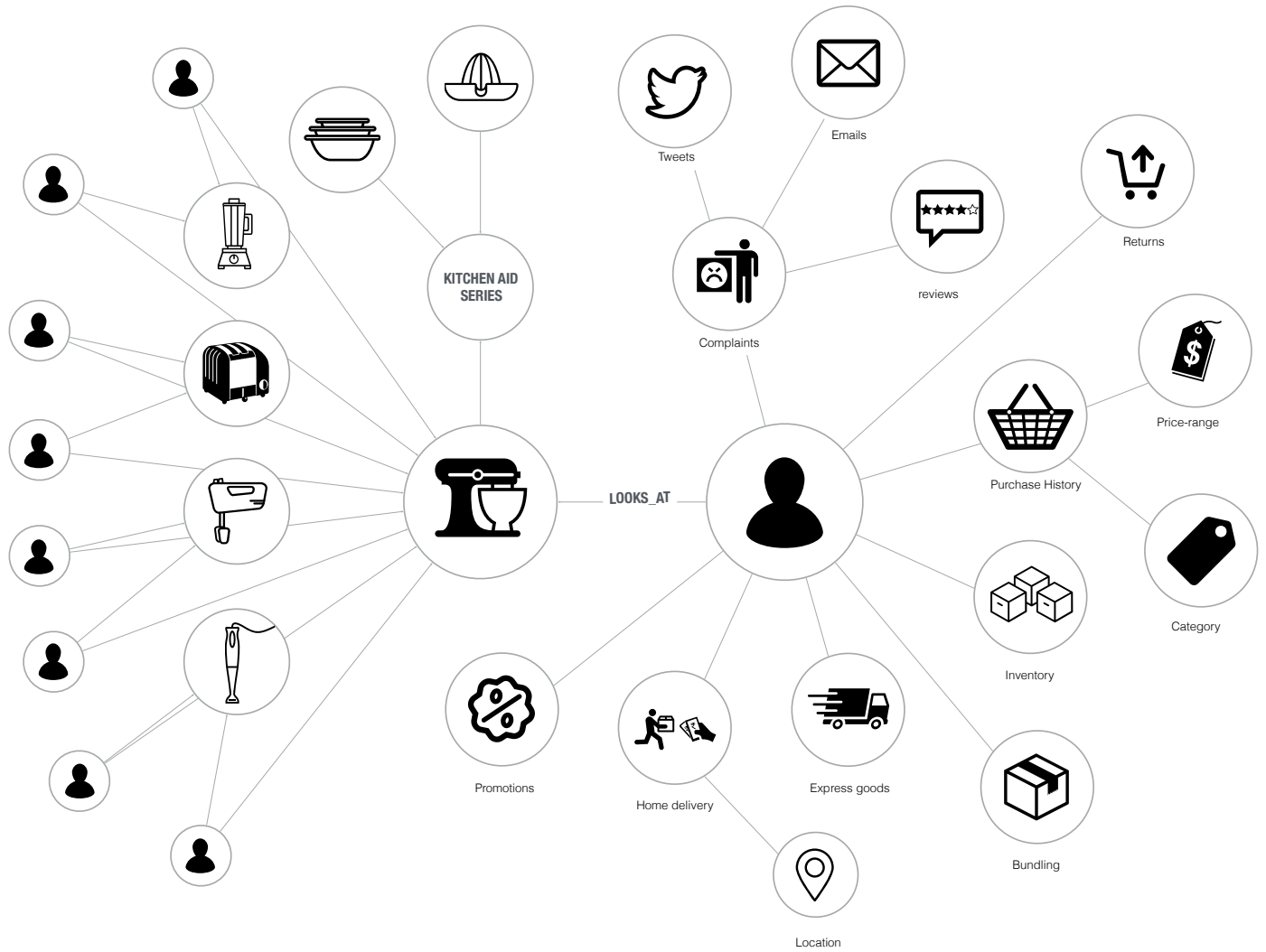
TCL 32D2700 32-Inch 720p LED TV (2015 M...
 by TCL
\$159.99 ✓Prime
 ★★★★★ (284)



LG Electronics 43LF5400 43-Inch 108...
 by LG
 Click for product details



Vizio E24-C1 24-Inches 1080p Smart LED TV (...
 by VIZIO
\$169.00 ✓Prime



☰ **SUPERSHOP** 



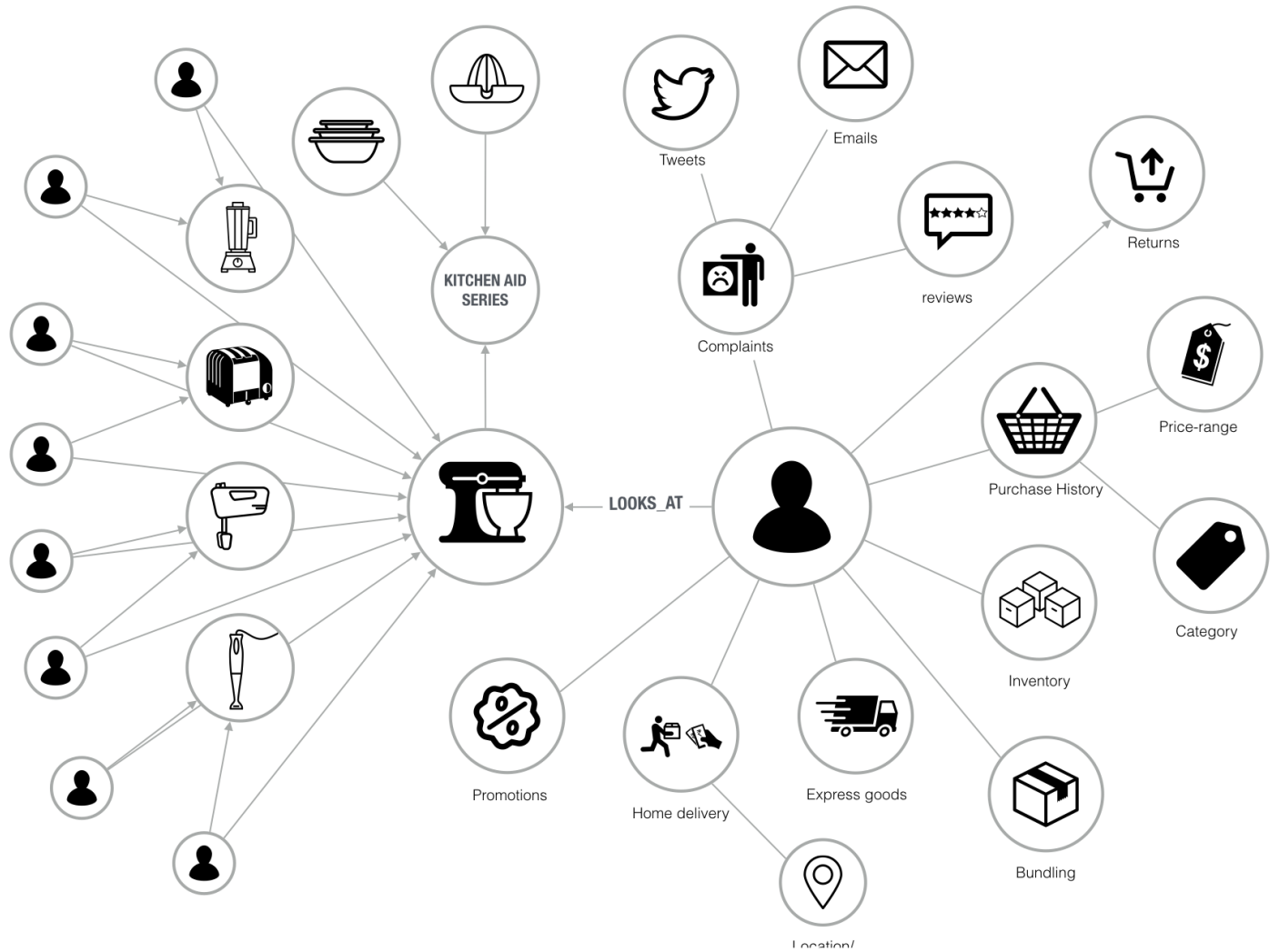
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The background of the slide is a light blue gradient with a complex network diagram. The diagram consists of numerous white circles of varying sizes connected by thin white lines, creating a web-like structure that fills the entire background. The circles and lines are more prominent in the center and fade out towards the edges.

Simple Recommendations

Content Filtering: Article Recommendations

```
1 MATCH (u:User)-[:LIKED]->(:URL)-[:IS_ABOUT]->(k:Keyword)
2 WHERE u.name = "lyonwj"
3 WITH k, count(*) AS num
4 RETURN k.text, num ORDER BY num DESC LIMIT 10
```

k.text	num
neo4j	3
montana	3
algorithm	2
businesses	2
data	2
owner	2
server	2
problem	2
database	2
web	2

Returned 10 rows in 24 ms.

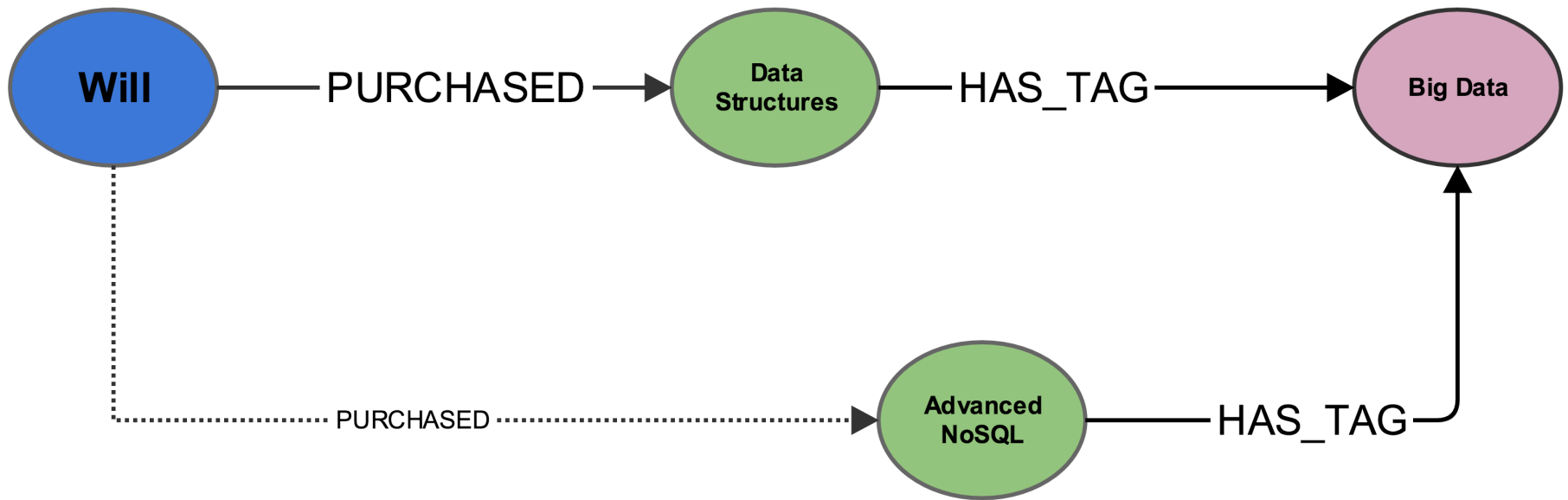
Content Filtering: Article Recommendations

```
1 // Recommend articles
2 MATCH (u:User)-[:LIKED]->(article:URL)-[:IS_ABOUT]->(k:Keyword)
3 WHERE u.name = "lyonwj"
4 MATCH (k)<-[:IS_ABOUT]-(rec:URL) WHERE NOT (u)-[:LIKED]->(rec)
5 WITH rec, collect(DISTINCT k.text) AS keywords
6 RETURN rec.title, size(keywords) AS weight, keywords ORDER BY weight DESC LIMIT 10
```

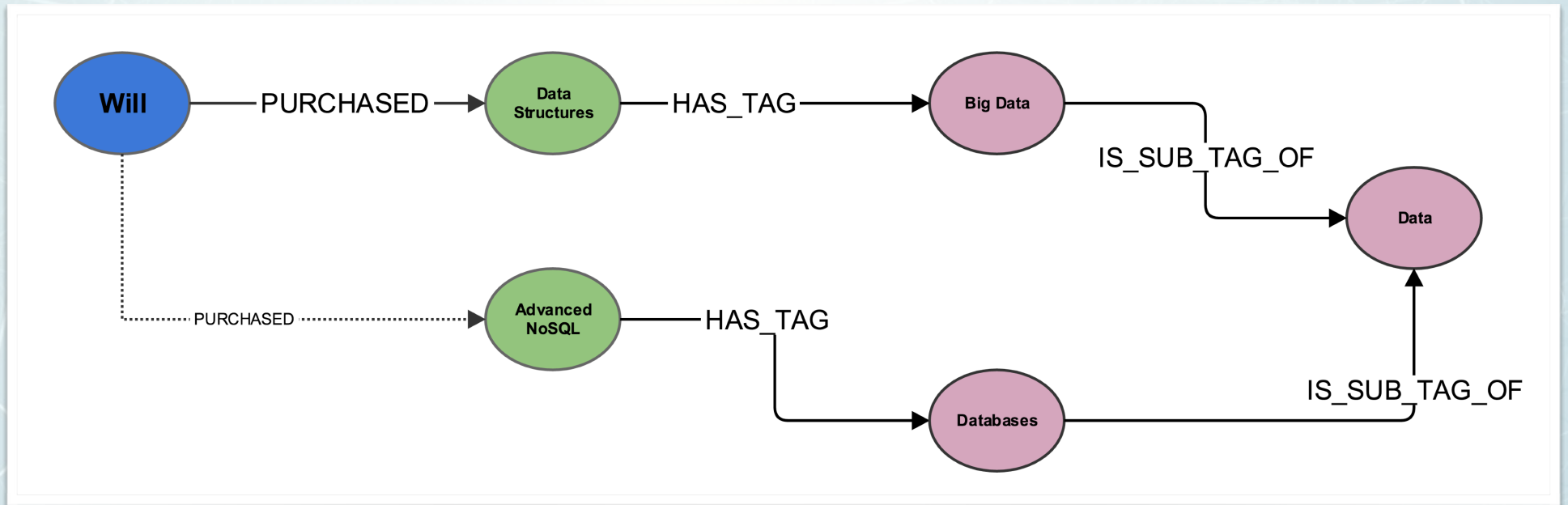
rec.title	weight	keywords
City of Missoula to seek court supervision of Mountain Water Co.	5	[water, problem, missoula, court, city]
A Visit to the Strange, Secretive World of David Bowie's 'Lazarus'	5	[mr, reading, script, main, world]
South Carolina governor to urge tolerance for immigrants in State of Union response	4	[state, response, presidential, south]
My first day at San Quentin State Prison — Medium	4	[state, medium, man, day]
Florida's Death Machine Loses Again	4	[state, court, machine, law]
Google self-driving cars would have caused 10 accidents in 2015 without test drivers taking control	4	[drivers, cars, 2015, system]
South Carolina governor to urge tolerance for immigrants in State of Union response	4	[state, response, presidential, south]
My first day at San Quentin State Prison — Medium	4	[state, medium, man, day]
Watch tonight: Obama gives his last State of the Union speech	3	[state, article, owner]
Political Prediction Market: Bernie Sanders (slowly) gains on Hillary Clinton	3	[winning, state, political]

Returned 10 rows in 23 ms.

Content Filtering: Product Recommendations



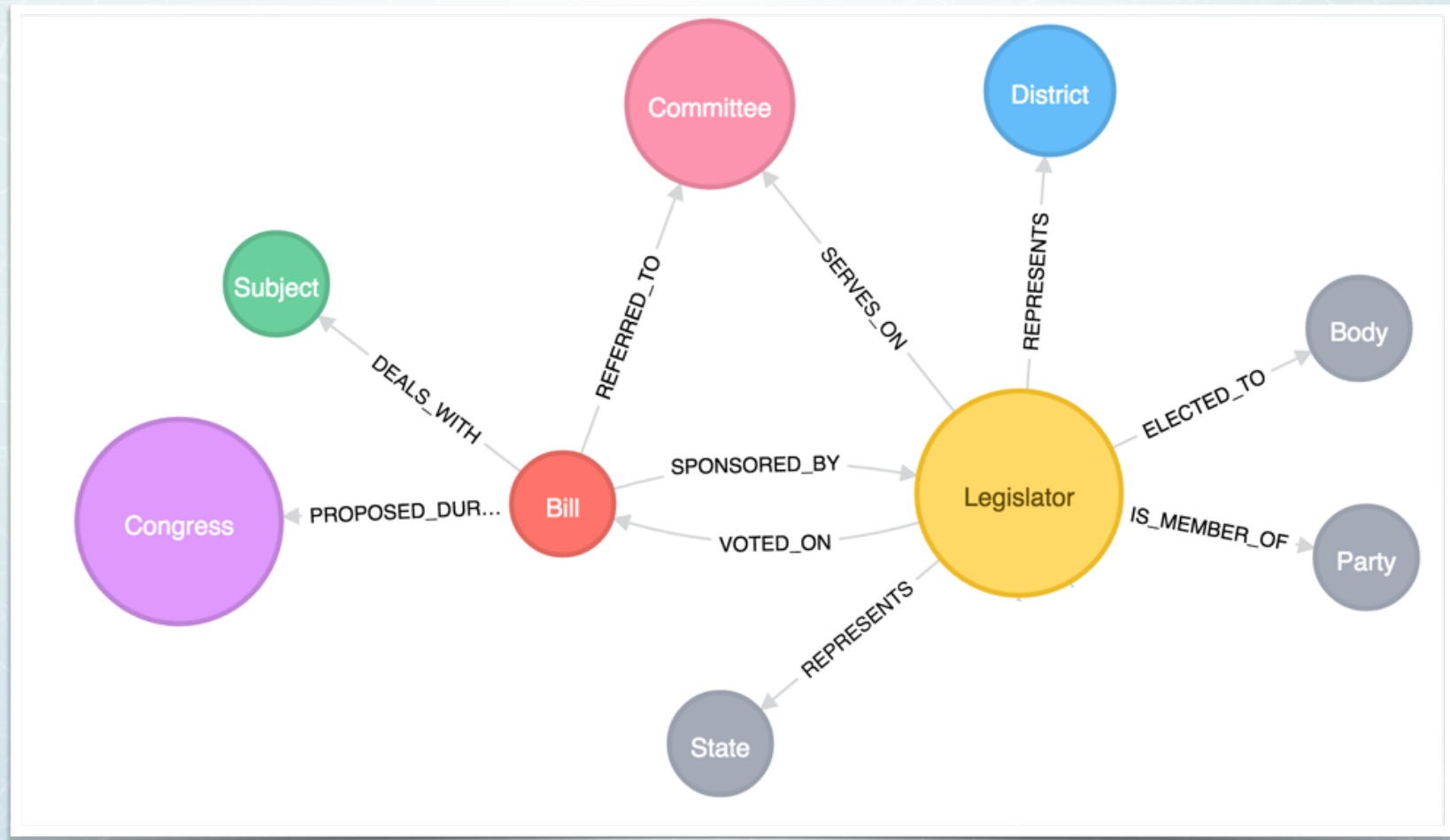
Content Filtering: Product Recommendations



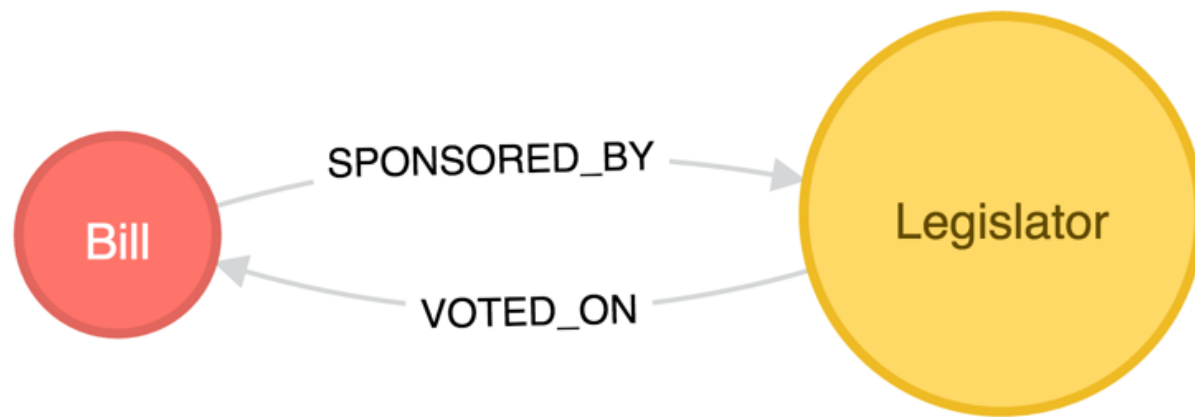


Our Patriotic Duty

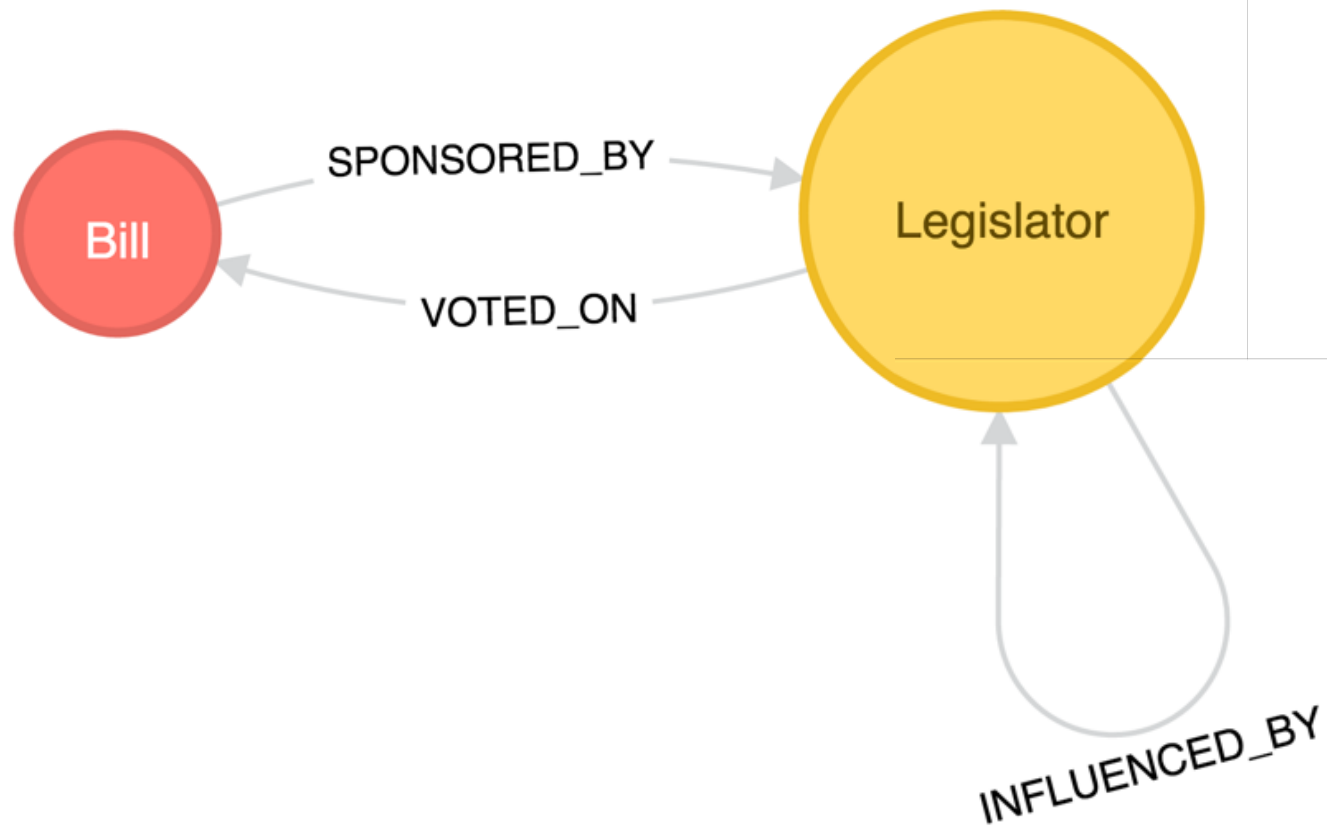
Legislative Graph

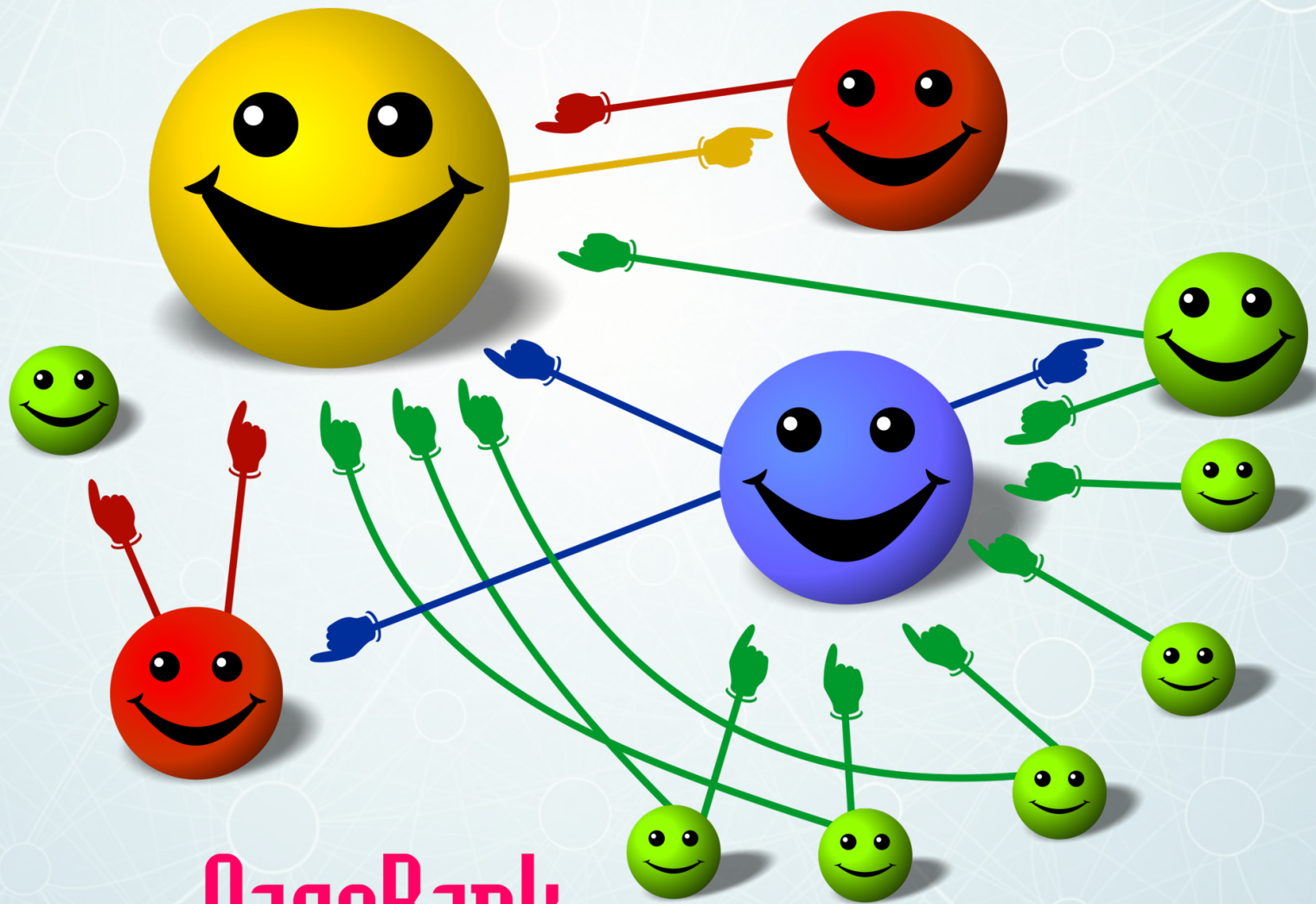


Determining Influence



Determining Influence





PageRank

Executing PageRank

```
1 MATCH (l:Legislator)
2 WITH collect(l) AS nodes
3 CALL apoc.algo.pageRankWithConfig(nodes, {types: 'INFLUENCED_BY'}) YIELD
  node, score
4 SET node.pagerank = score
```



Most Influential Senators

```
1 MATCH (l:Legislator) WHERE EXISTS(l.pagerank) WITH l, l.pagerank as pg
2 MATCH (l)-[:ELECTED_TO]->(b:Body {type: "Senate"})
3 RETURN l.firstName + l.lastName as name, pg ORDER BY pg DESC LIMIT 10;
```

\$ MATCH (l:Legislator) WHERE EXISTS(l.pagerank) WITH l, l.pagerank as pg MATCH (l)-[:ELECT...



Rows

name	pg
OrrinHatch	1.98969
CharlesGrassley	1.78147
BenjaminCardin	1.49014
JohnThune	1.42174
MikeLee	1.37878
LamarAlexander	1.37011
JerryMoran	1.34828
JohnCornyn	1.32145
JohnBarrasso	1.30451
JeffFlake	1.27582



Code

Returned 10 rows in 492 ms.

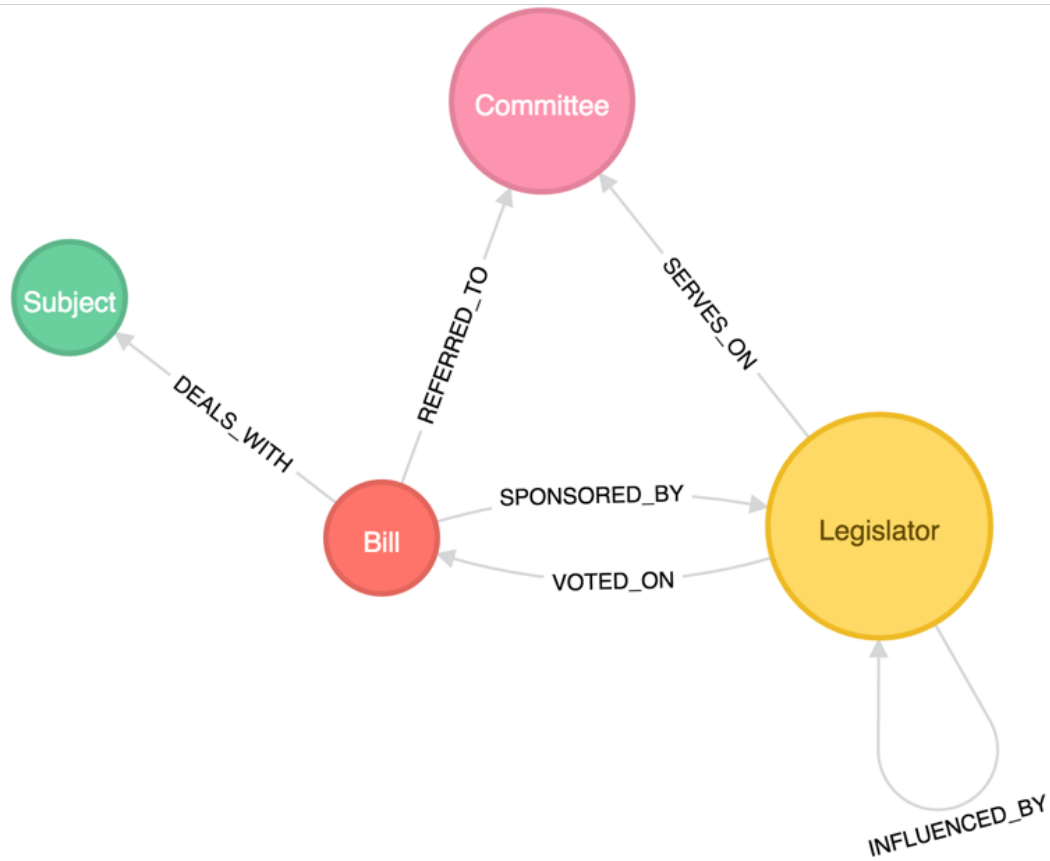
Most Influential Representatives

name	pg
DianeBlack	1.45343
BrettGuthrie	1.21654
CarolynMaloney	1.21216
RosaDeLauro	1.17221
ErikPaulsen	1.11089
BobGoodlatte	1.07024
ChristopherSmith	0.99679
CharlesBoustany	0.98916
SamJohnson	0.95875
MatthewCartwright	0.85049

Recommend to Me:

**Member of Congress who can get ~~me~~ a Tesla
everyone ^**

Subject Matter ~~Experts~~



Combining Analytics + Subgraph Traversal

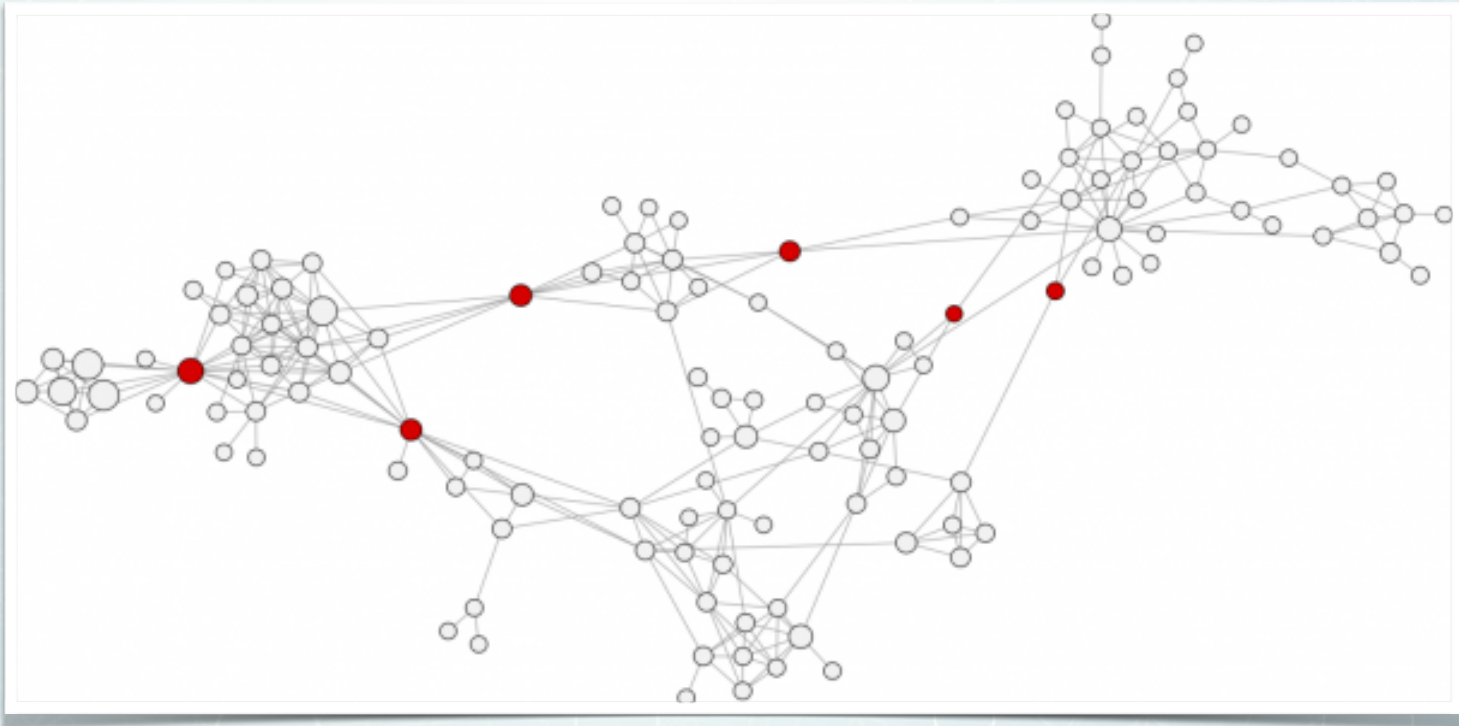
```
MATCH (l:Legislator) WHERE EXISTS(l.pagerank) WITH l, l.pagerank as pg
MATCH (l)-[r:SERVES_ON]->(c:Committee)
MATCH (c)-[:REFERRED_TO]-(:Bill)-[d:DEALS_WITH]->(s:Subject)
WHERE s.title = "Hybrid, electric, and advanced technology vehicles"
MATCH (l)-[:IS_MEMBER_OF]->(p:Party)
```

name	pg	committee	rank	party
Orrin Hatch	1.98969	Senate Committee on Finance	1	Republican
Charles Grassley	1.78147	Senate Committee on Finance	2	Republican
Benjamin Cardin	1.49014	Senate Committee on Environment and Public Works	3	Democrat
Benjamin Cardin	1.49014	Senate Committee on Finance	8	Democrat
Diane Black	1.45343	House Committee on Ways and Means	15	Republican
Diane Black	1.45343	House Committee on the Budget	6	Republican
John Thune	1.42174	Senate Committee on Finance	7	Republican
Mike Lee	1.37878	Senate Committee on Armed Services	12	Republican
Mike Lee	1.37878	Senate Committee on Energy and Natural Resources	4	Republican
Lamar Alexander	1.37011	Senate Committee on Energy and Natural Resources	11	Republican

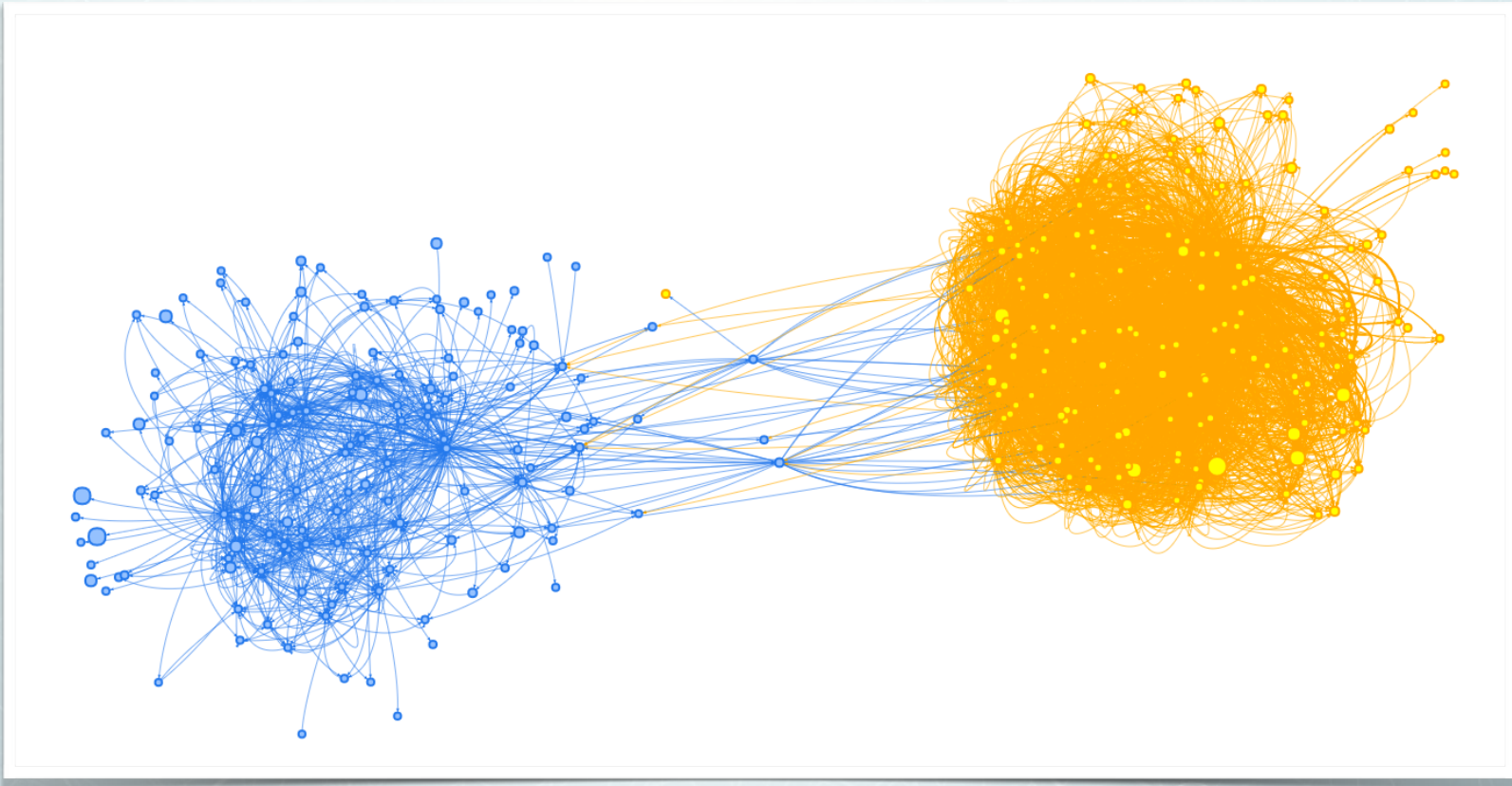
Other Graph Algorithms

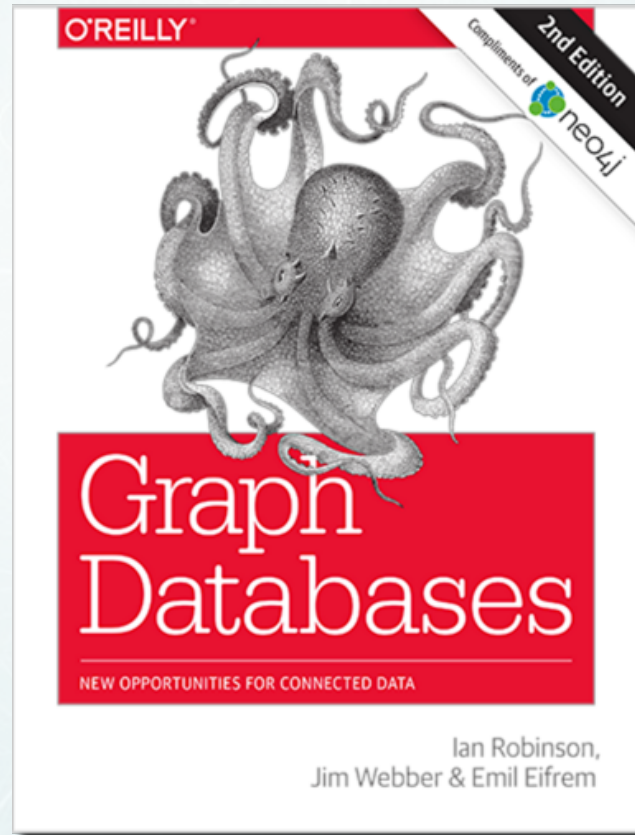
- **Community Detection**
- **Centrality (Betweenness, Closeness)**
- **aStar (dijkstra with $h(0)$)**

Betweenness Centrality



Community Detection





graphdatabases.com

THANK YOU!



Ryan Boyd

@ryguyrg ryan@neo4j.com