

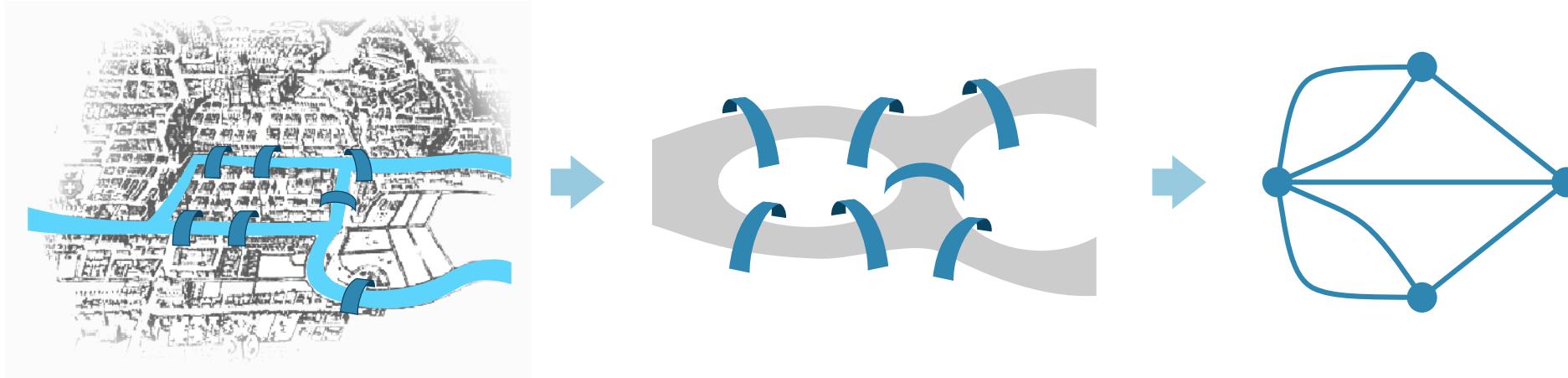
Graph databases

- why and how

About me

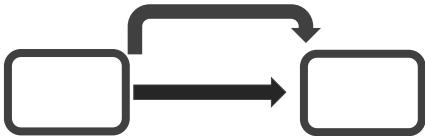
- Chief Software Architect at **ITMAGINATION**
- Architect in one of the biggest .NET project in Poland.
- Interested in distributed systems and digging into data.
- Running a pet project **COOK.it**

Graph



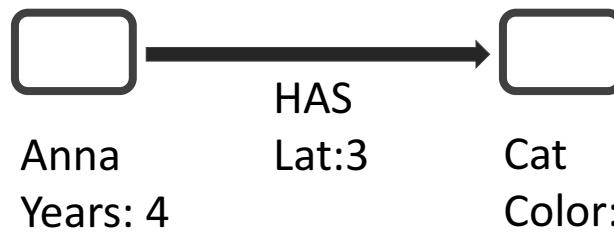
$$G=(E, V)$$

Graph

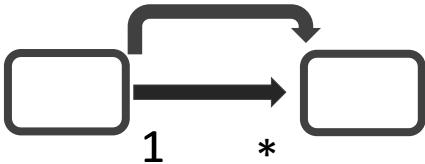
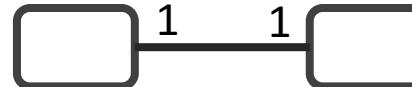


Anna

Cat



Graph



Anna

Cat

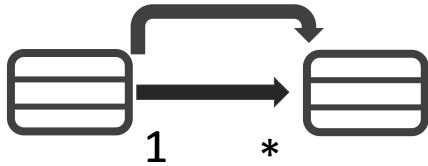


Anna
Years: 4

HAS
Lat:3

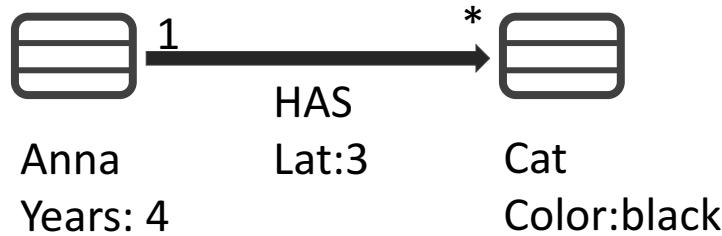
Cat
Color:black

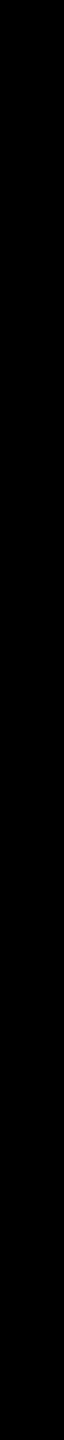
Graph



Anna

Cat





A bit of history

Relational database history

- 1970 – Edgar F. Codd – the relational model
- What else happened in the 70s?
 - RAM got „cheaper” – only 734\$ for 1 MB (24 Mbit)
 - IBM 3310 offers 100MB disc
 - 1971 Intel 4004 – 740kHz, 8 bit (1000 kHz = 1 MHz)
 - 1974 Intel 8008 – 800kHz, 16 bit (1000 MHz = 1 GHz)
 - 1977 Oracle, Apple 1
 - 1978 Intel 8086 – 4MHz- 10MHz (1000 MHz = 1 GHz)



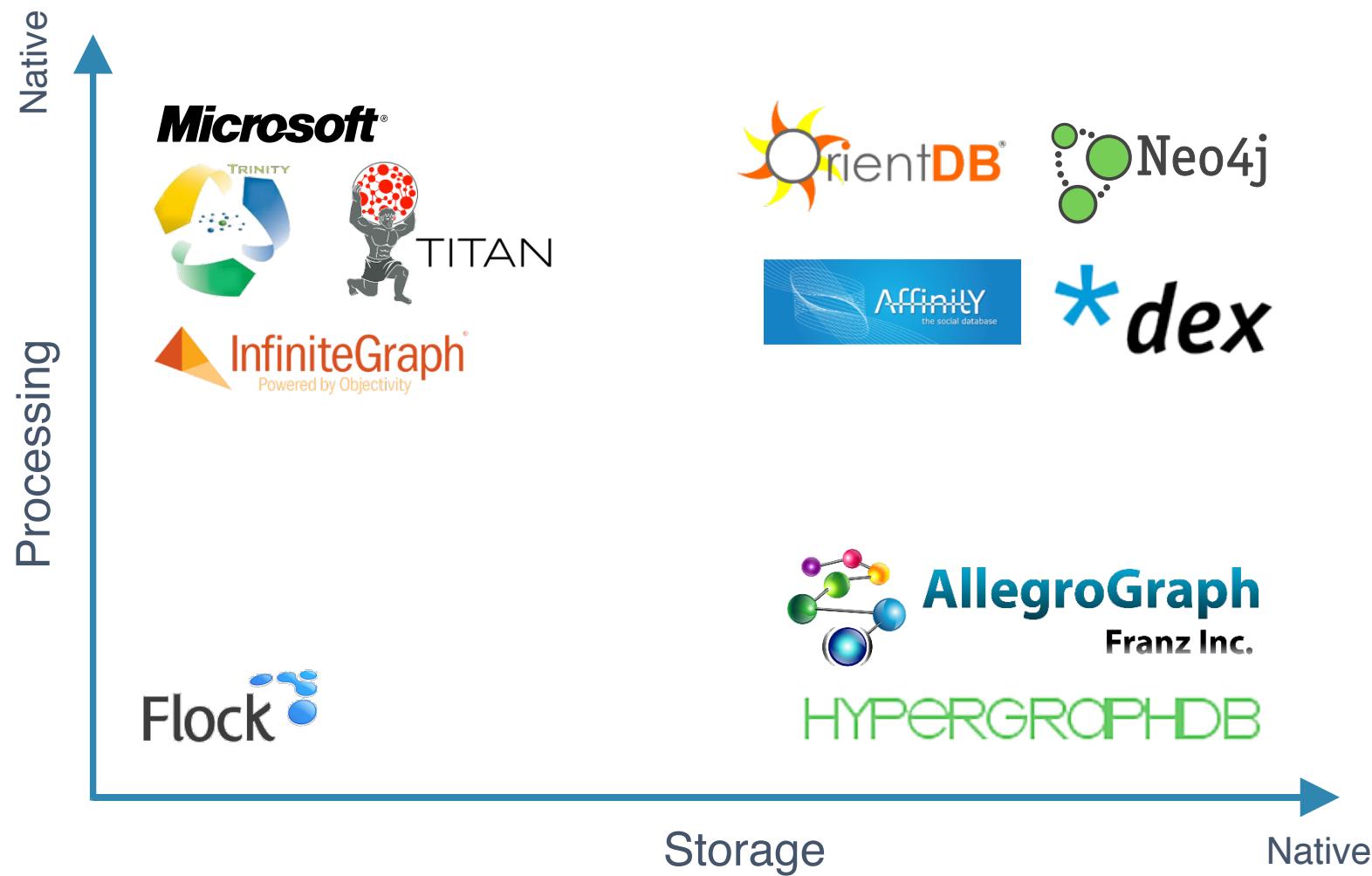
Graph database history

- 1736 – Bridge problem
- 1852 – Map-coloring problem
- 1936 – The book „Graph theory”
- 1969 – The map problem is partly solved
- 1994 – The map problem is solved
- 2002 – Pentium 4 3,8GHz
- 2003 – First commercial graph databases



КАТАЛОГ
НИКС.РУ
WWW.NIX.RU

Current state





Usage

Suggestions

The screenshot shows an Amazon product page for the book "Writing High-Performance .NET Code" by Ben Watson. The page includes the book cover, author information, customer reviews, price (\$22.49), and a summary of the book's content. Below the main product details, there is a section titled "Frequently Bought Together" showing three related books: "Adaptive Code via C#", "Microsoft .NET - Architecting Applications for the Enterprise", and another copy of "Writing High-Performance .NET Code". A "Price for all three: \$87.33" button is available. At the bottom, there is a section titled "Customers Who Bought This Item Also Bought" featuring several other books related to .NET development.

Writing High-Performance .NET Code Paperback – July 23, 2014
by Ben Watson • (Author)
★ ★ ★ ★ + 33 customer reviews

Look inside

WRITING HIGH-PERFORMANCE .NET CODE

BEN WATSON

Kindle \$9.99 Paperback \$22.49

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Do you want your .NET code to have the absolute best performance it can? This book demystifies the CLR, teaching you how and why to write code with optimum performance. Learn critical lessons from a person who helped design and build one of the largest high-performance .NET systems in the world. This book does not just teach you how the CLR works—it teaches you exactly what you need to do now to obtain the best performance today. It will expertly guide you through the nuts and bolts of extreme performance optimization in .NET, complete with in-depth examinations of CLR functionality.

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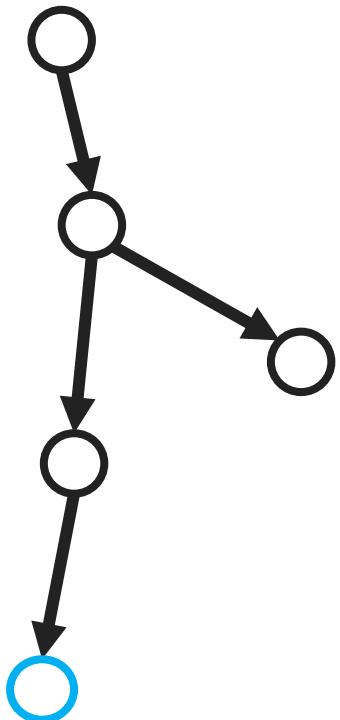
Adaptive Code via C# Agile coding with design patterns and SOLID principles (Developer Reference) by Gary McLean Hall Paperback \$34.46

Microsoft .NET - Architecting Applications for the Enterprise (2nd Edition) (Developer Reference) by Dino Esposito Paperback \$30.38

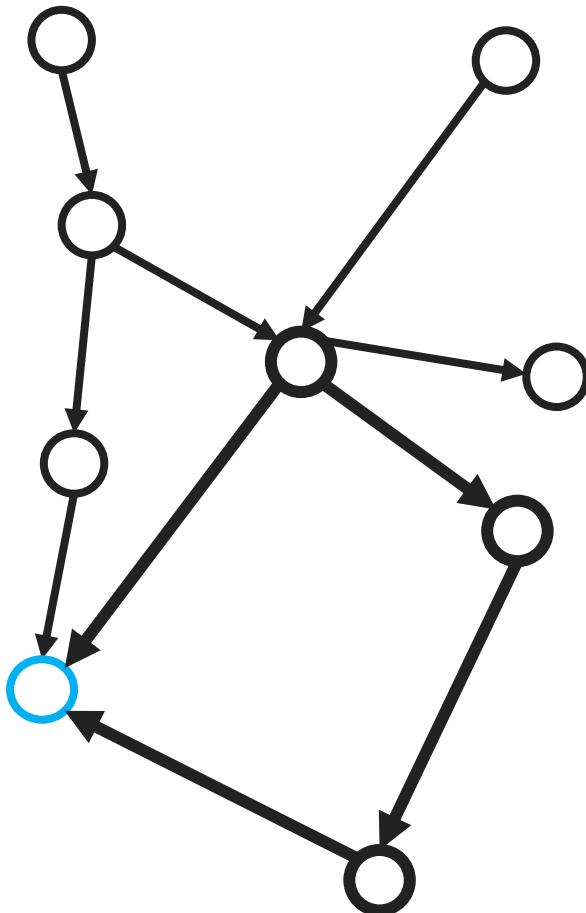
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- C# Design Patterns Essentials
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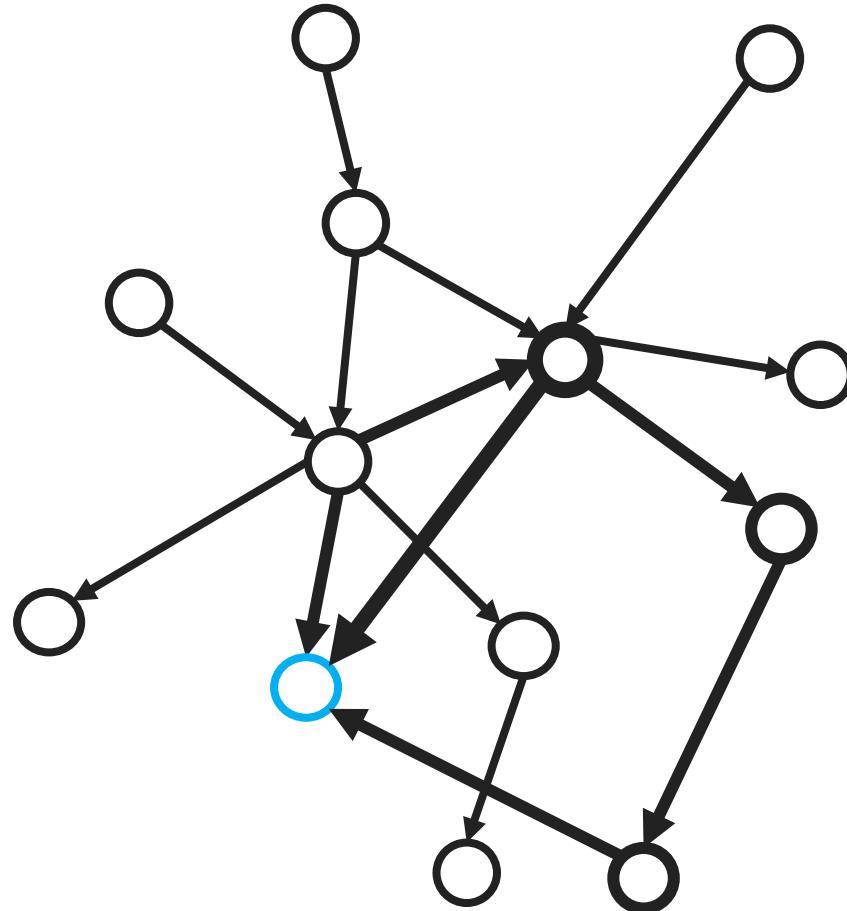
Suggestions



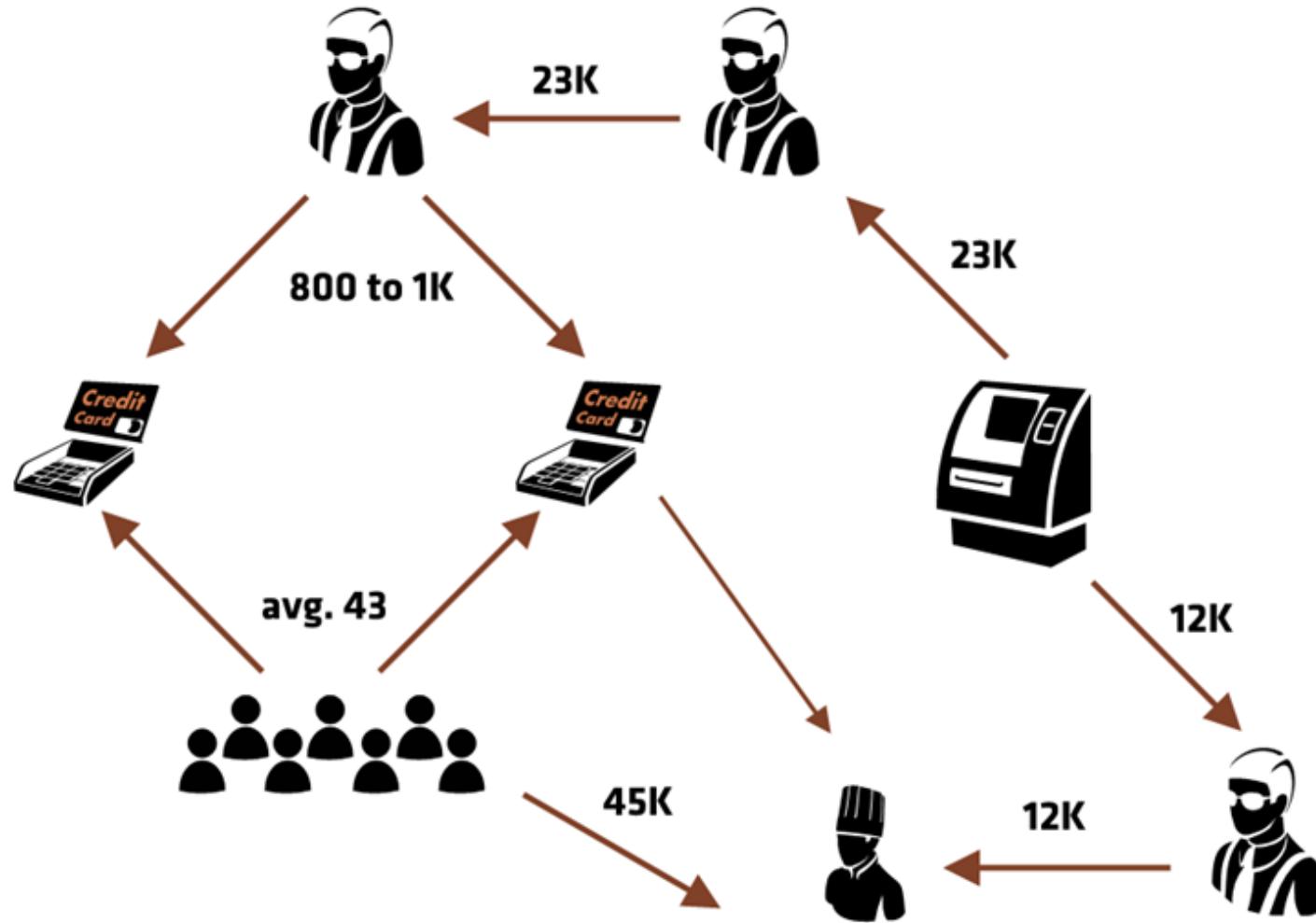
Suggestions



Suggestions



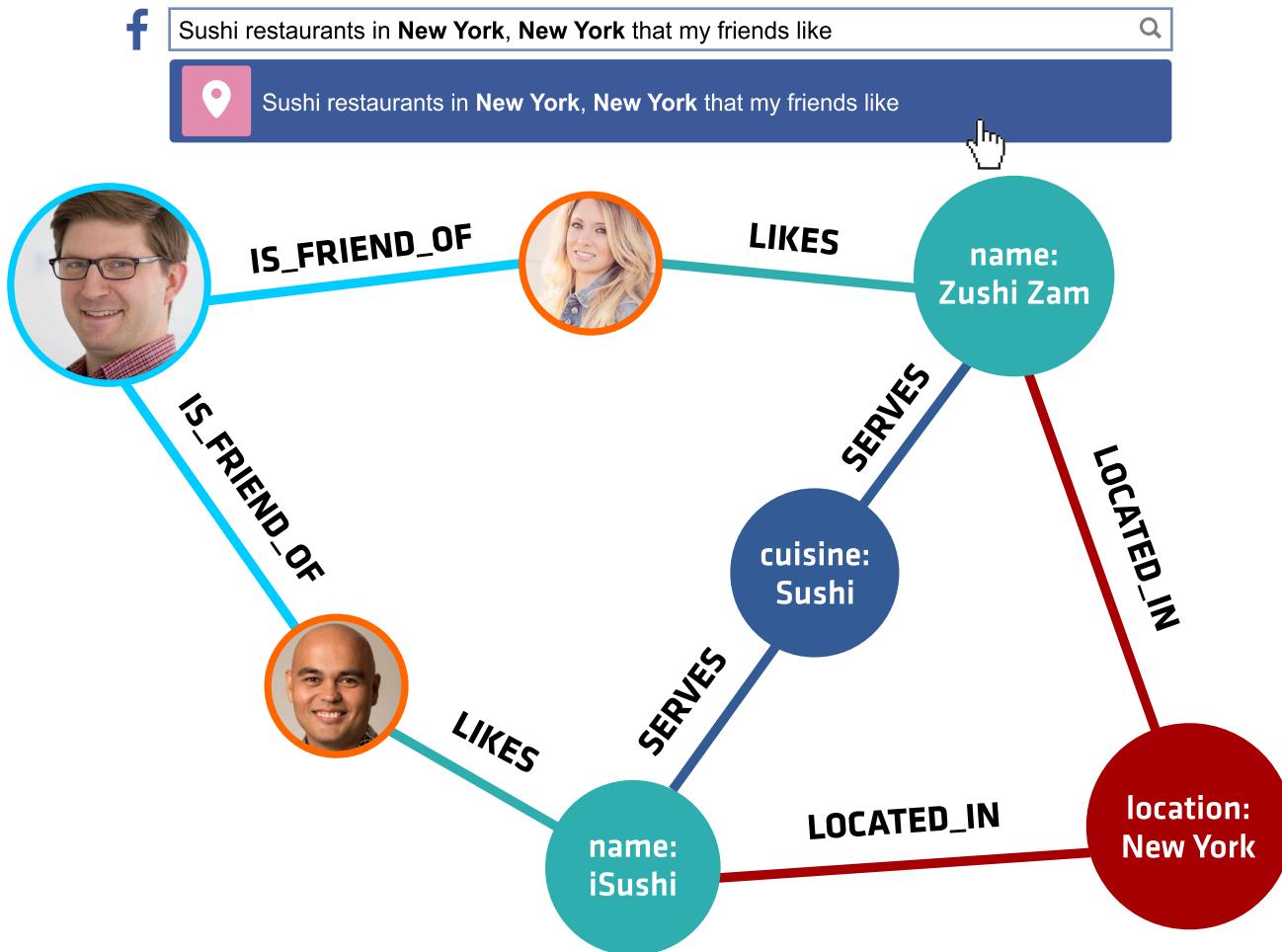
Money laundering



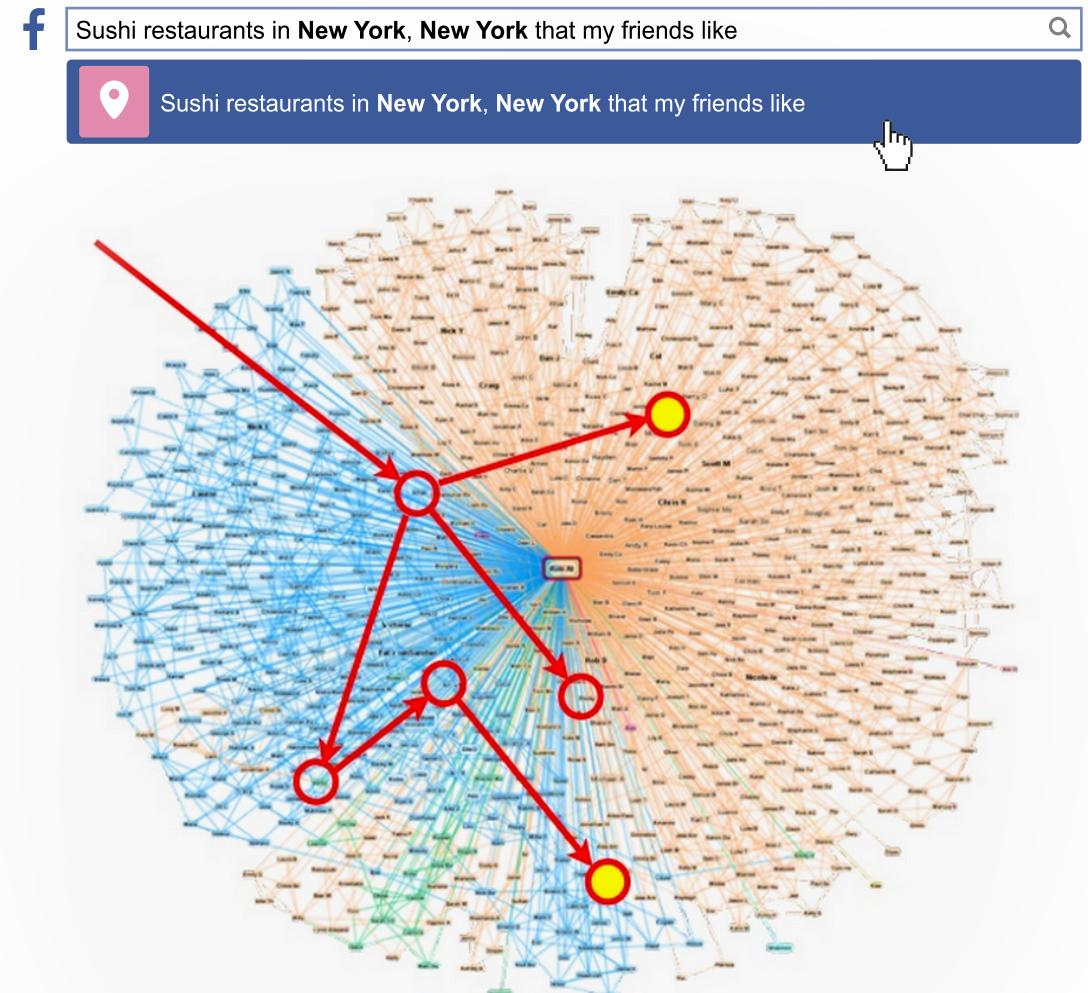
Money laundering



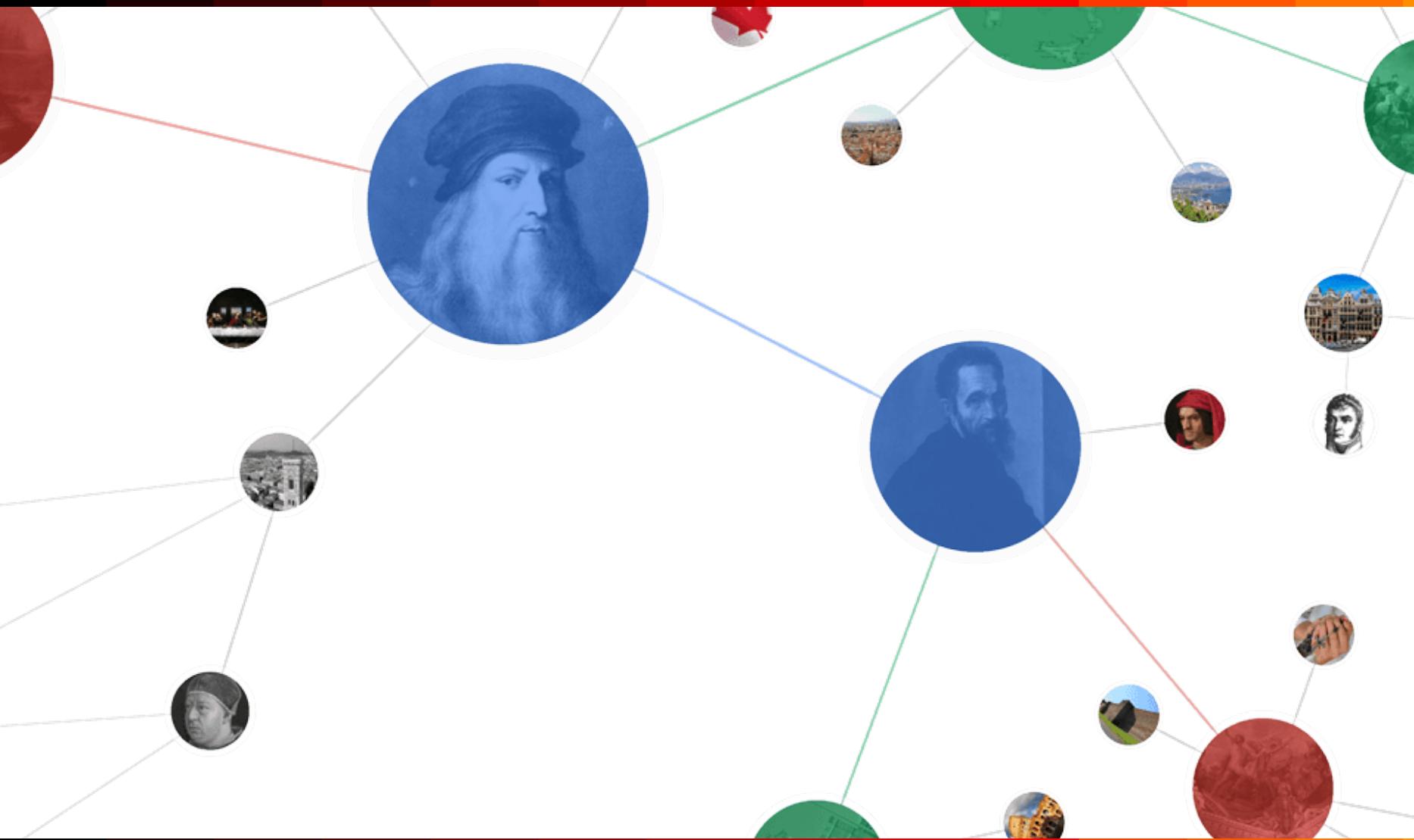
NLP



NLP

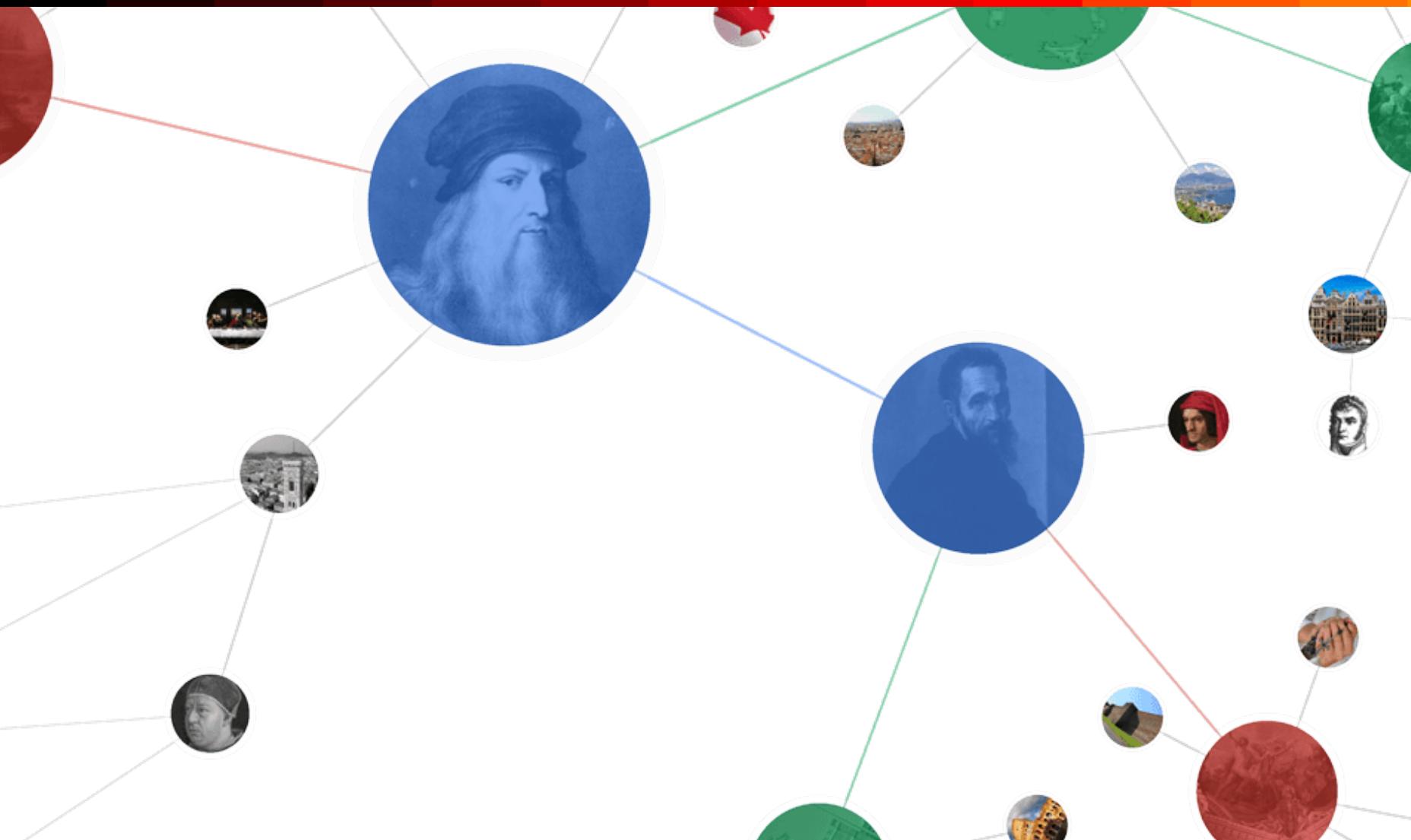


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New York Times



Spock

Fictional Character

Spock, commonly Mr. Spock, is a fictional character in the Star Trek media franchise. Spock was first portrayed by Leonard Nimoy in the original Star Trek series, and also appears in the animated Star ...
[WikiPedia](#)

Played by: [Leonard Nimoy](#)

Species: [Vulcan](#)

Postings: [USS Enterprise \(NCC-1701\)](#), [USS Enterprise \(NCC-1701-A\)](#)

Rank: [Captain](#)

Occupations: [Federation ambassador](#)

Affiliations: [Starfleet](#), [United Federation of Planets](#)

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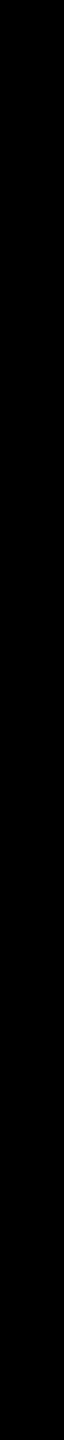
Pierre de
Fermat



Augustin-...
Cauchy



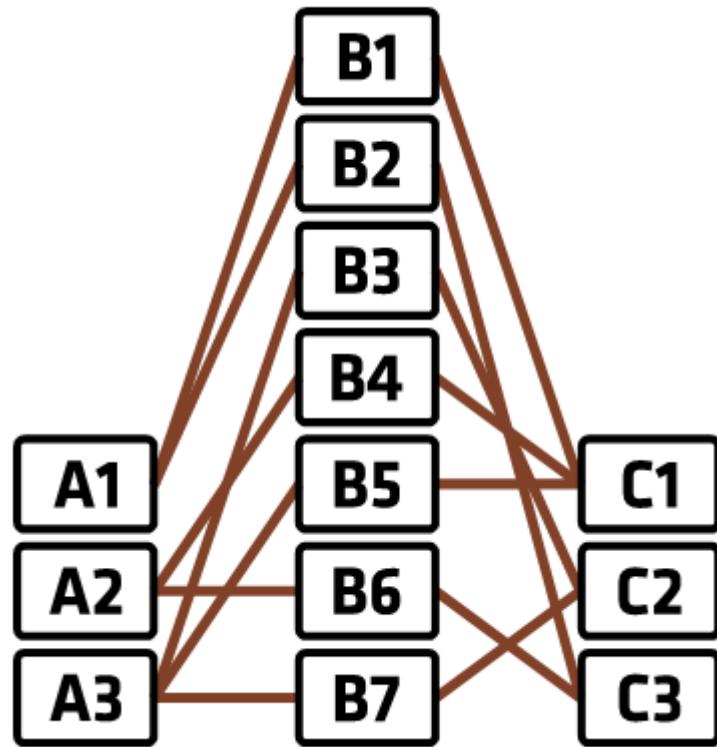
Isaac
Newton



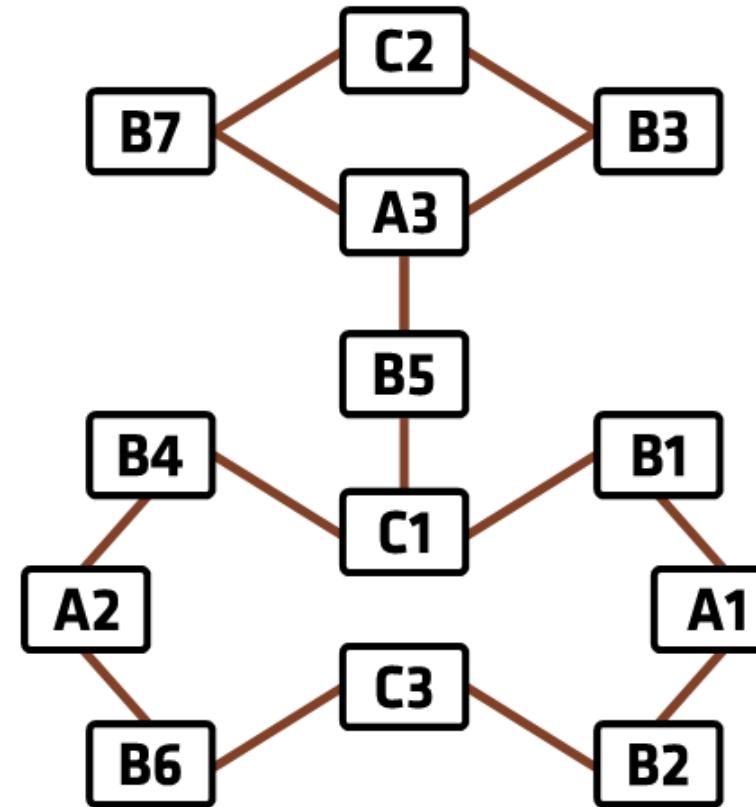
Performance

Performance – think different

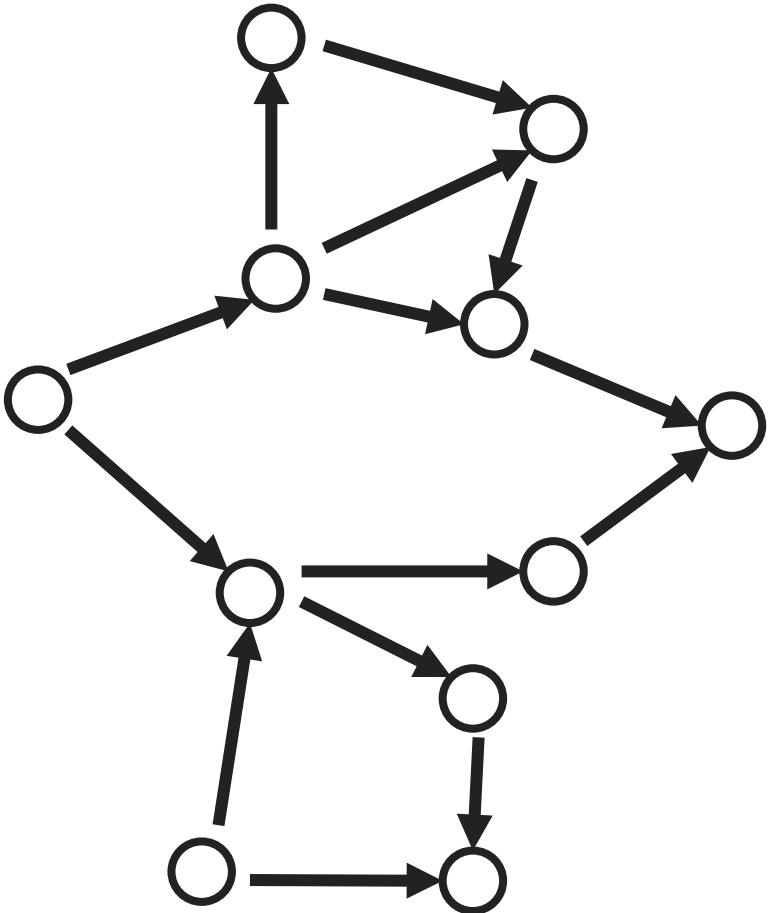
Relational



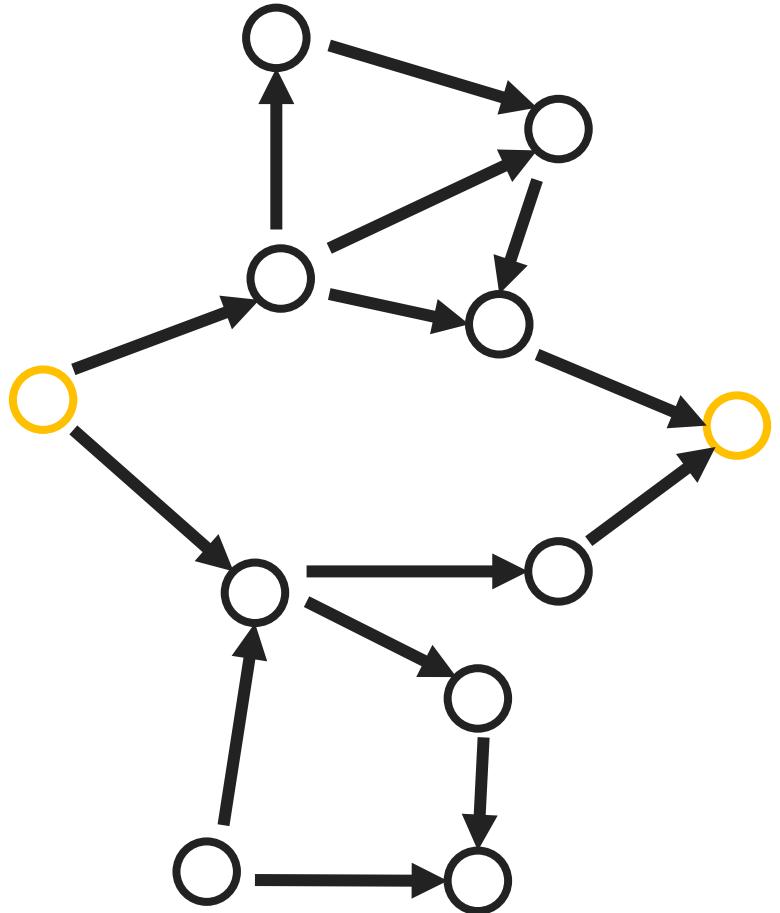
Graph



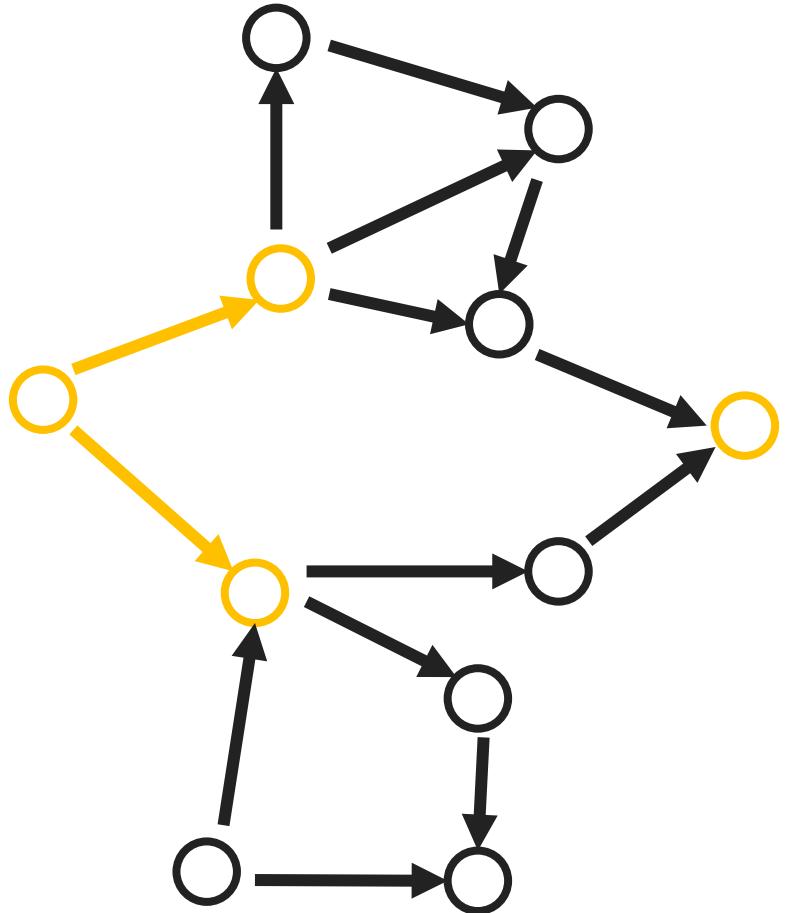
Performance – traversing



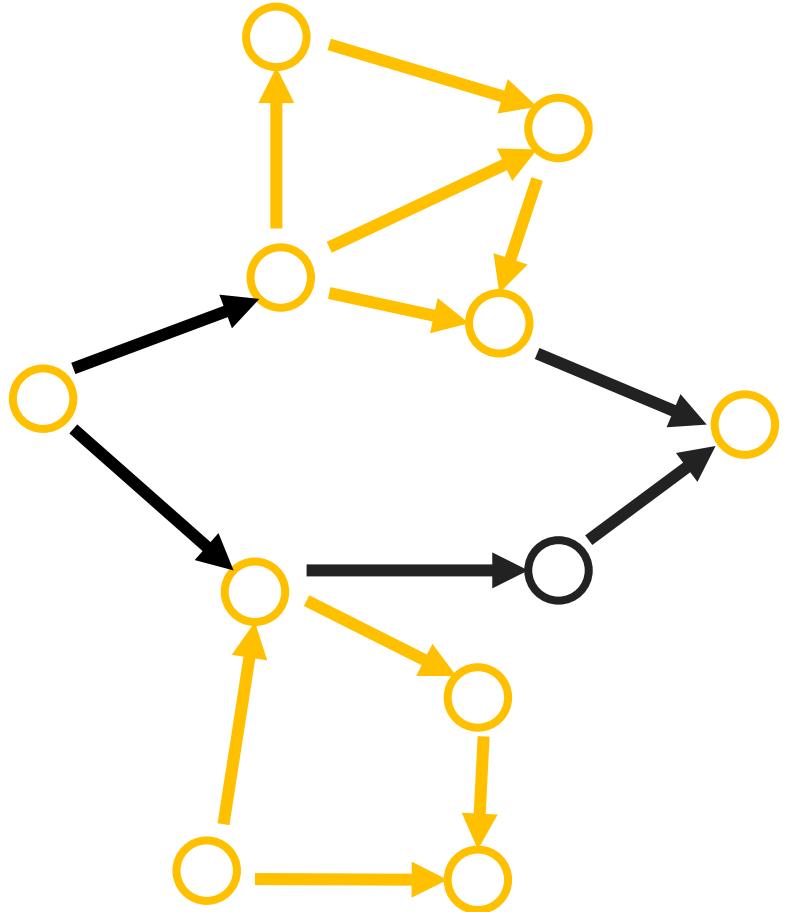
Performance – traversing



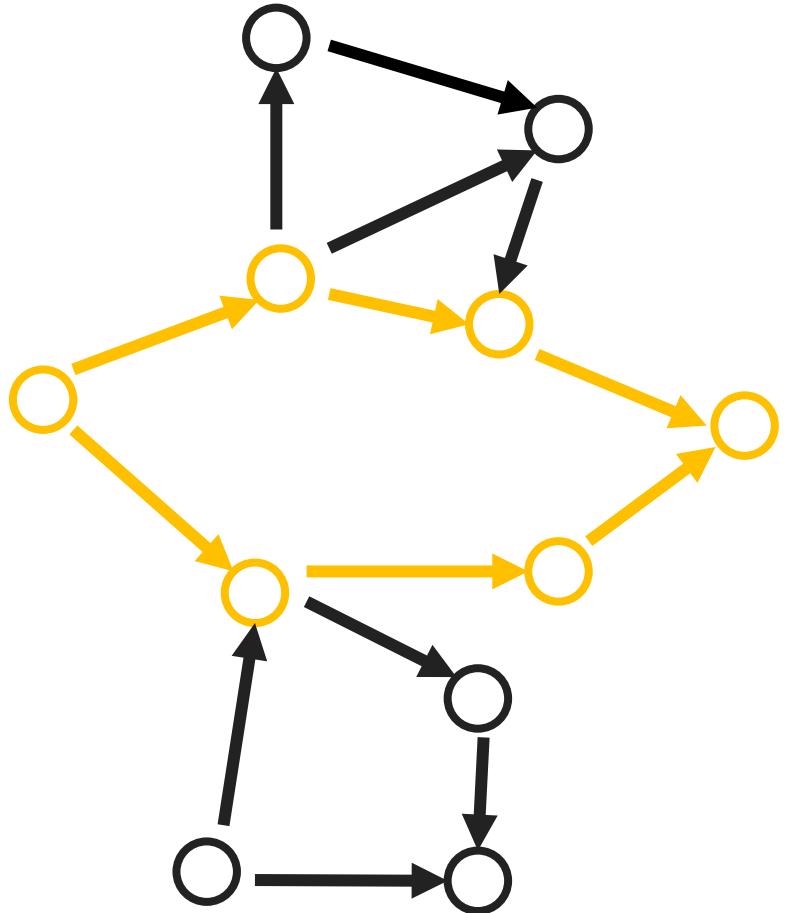
Performance – traversing



Performance – traversing



Performance – traversing



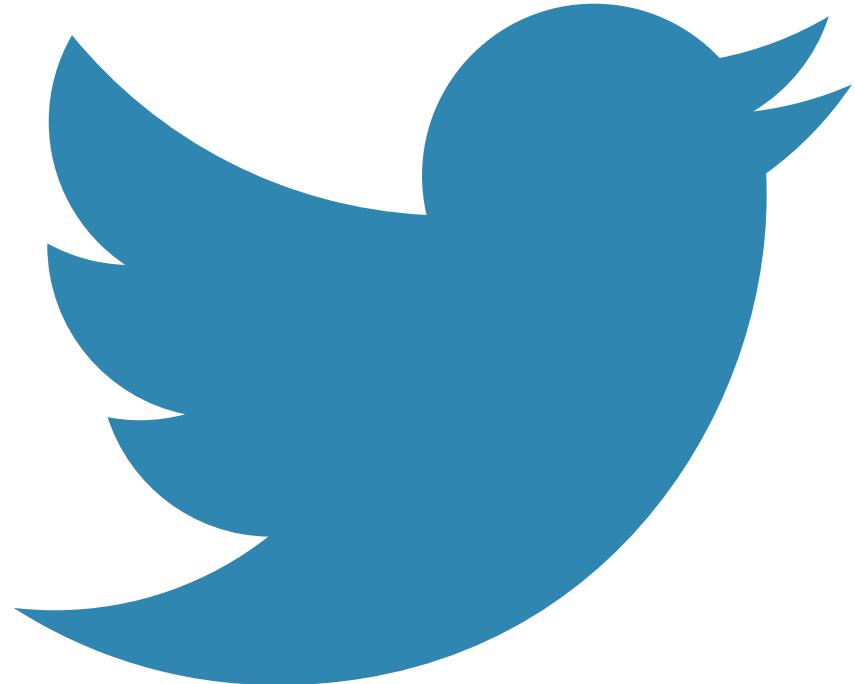
Performance – tests

Twitter from 2009

- 1,67 billion watches
- 41,7 million users

Operations

- Account creation – 1%
- Tweeting – 15%
- Read – 76%
- Recommendations – 7%



Source: <https://dzone.com/articles/titan-provides-real-time-big>

Performance – tests



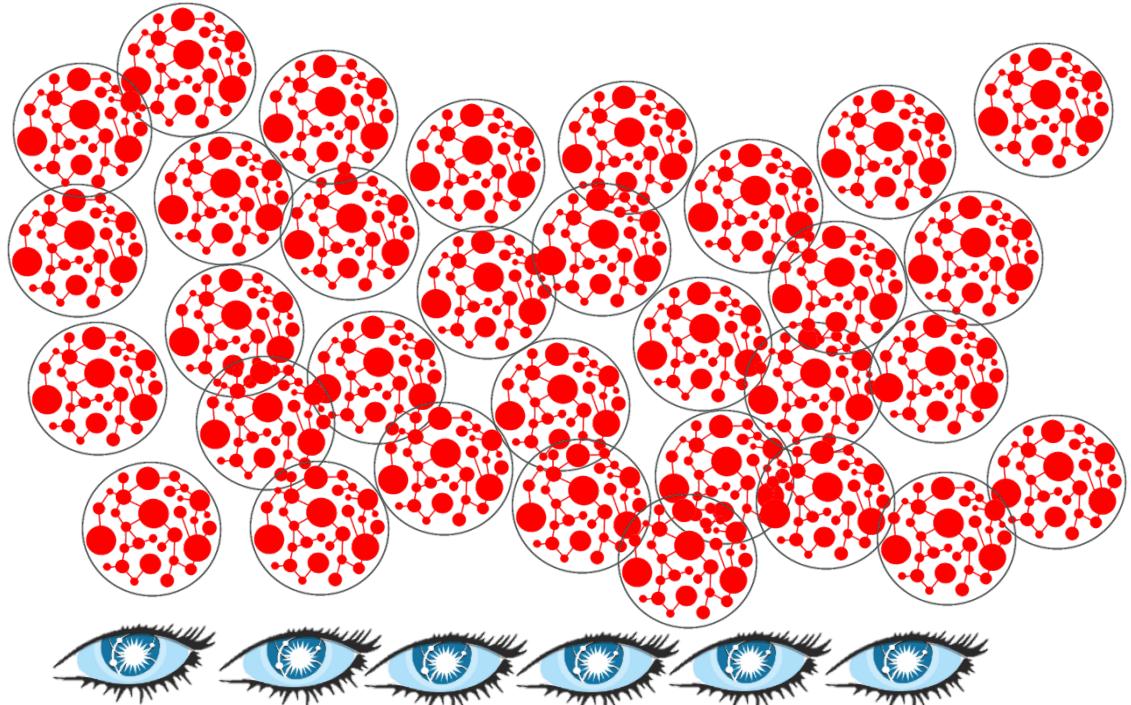
Data storage

- 6 c1.4xl Casandra nodes



Computation

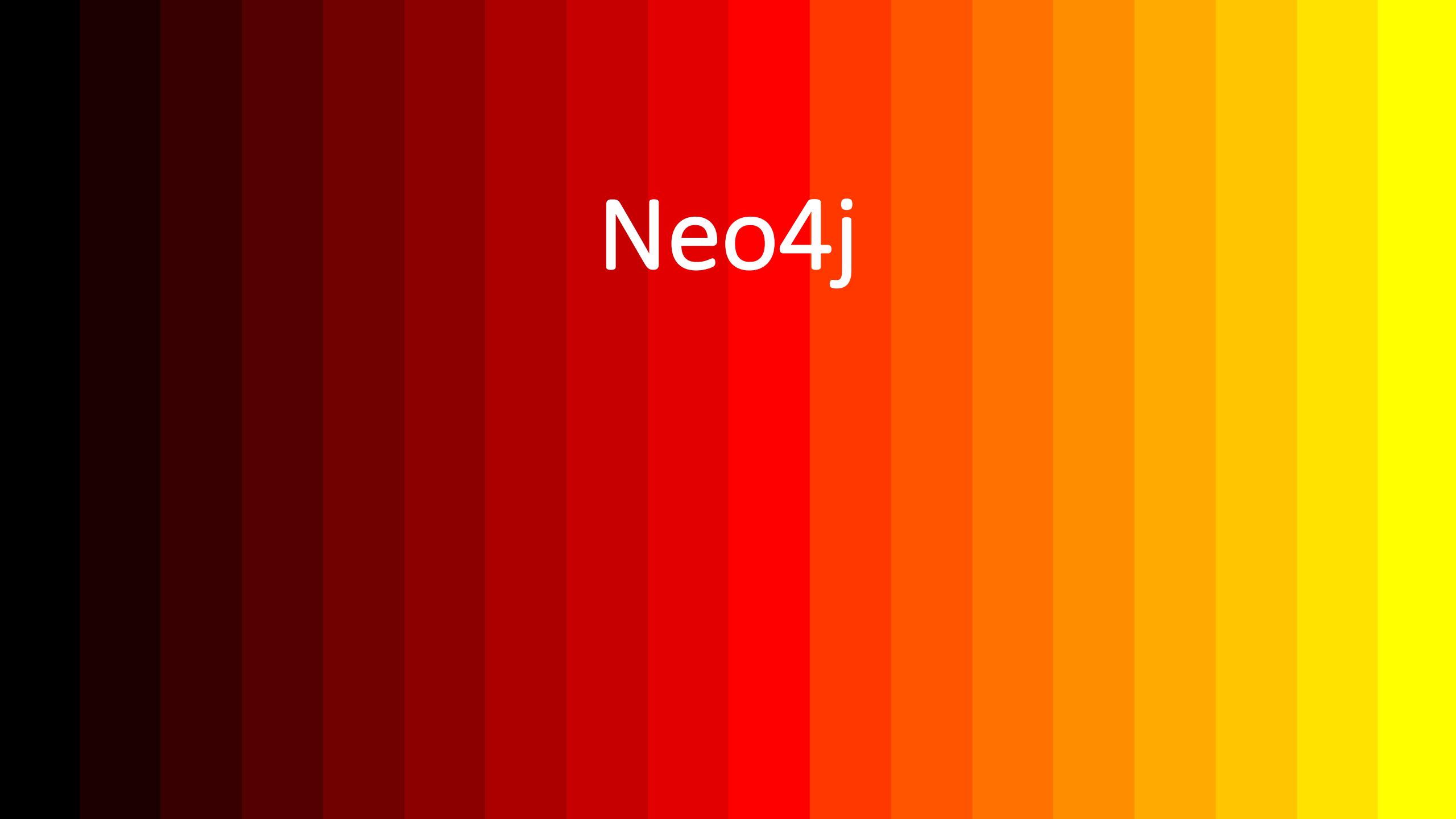
- 40 m1.small
- Write and read



Source: <https://dzone.com/articles/titan-provides-real-time-big>

Performance – tests

Transaction type	Trx numer	Weighted arithmetic mean	Standard deviation
Account creation	379,019	115,15ms	5,88ms
Tweeting	7,580,955	18,54ms	6,34ms
Read	37.936,184	6,29ms	1,62ms
Recommendations	3.793,863	67,65ms	13,89ms
Total	49.690.061		
Time	2,3h		
Average	5.900 trx/sek		
Peek	10,300 trx/sek		



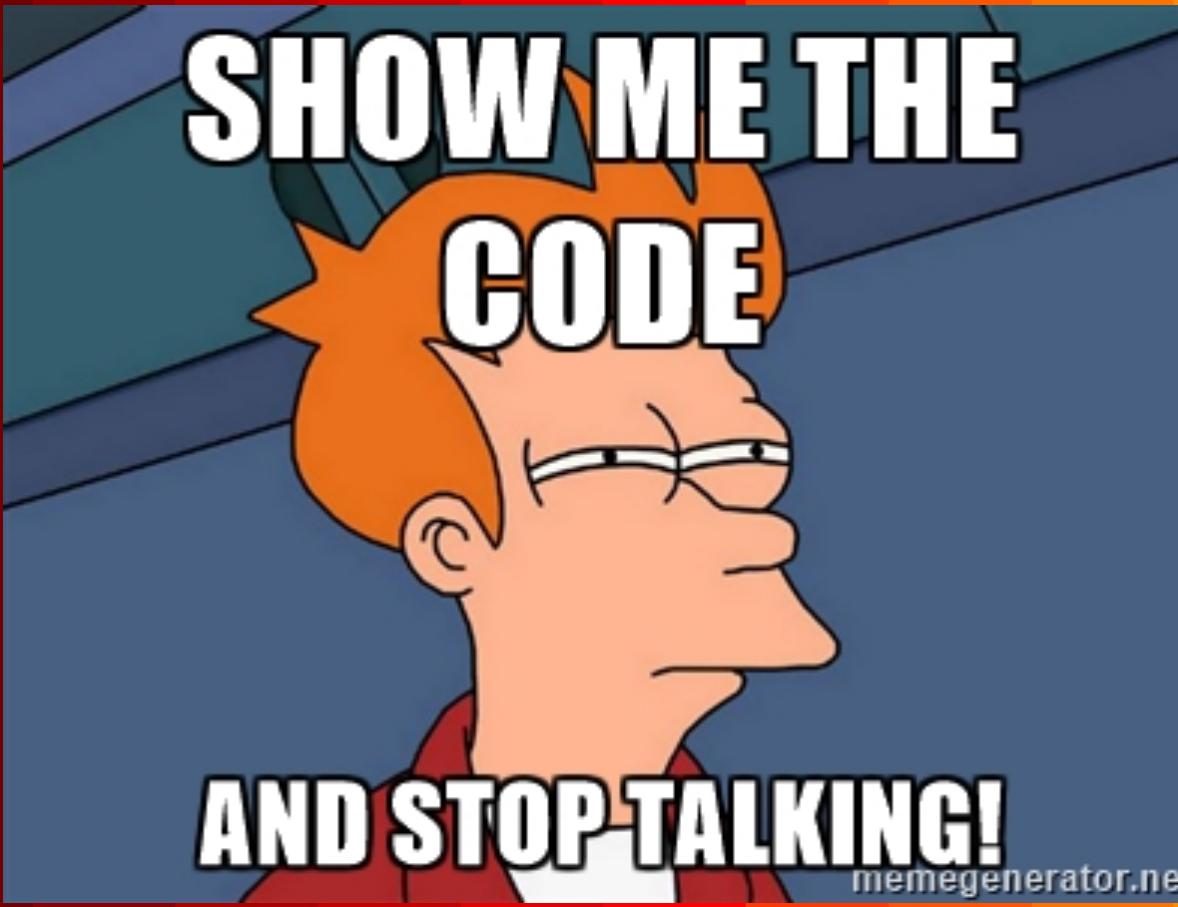
The background of the image features a vertical color bar on the right side, transitioning from black at the top to white at the bottom. This color bar is composed of several horizontal stripes of varying widths, creating a textured appearance. The colors range from deep black to bright white, with intermediate shades of dark grey, blue, green, and yellow.

Neo4j

Neo4j



- db-engines.com – 21 in all databases, no 1 in graph databases
- Drivers:
 - Java
 - .NET
 - JavaScript
 - Python
 - Ruby
 - PHP
 - and R, Go, Clojure, Perl, Haskell
- Cypher is a standardized graph query language
- There is a free version



**SHOW ME THE
CODE**

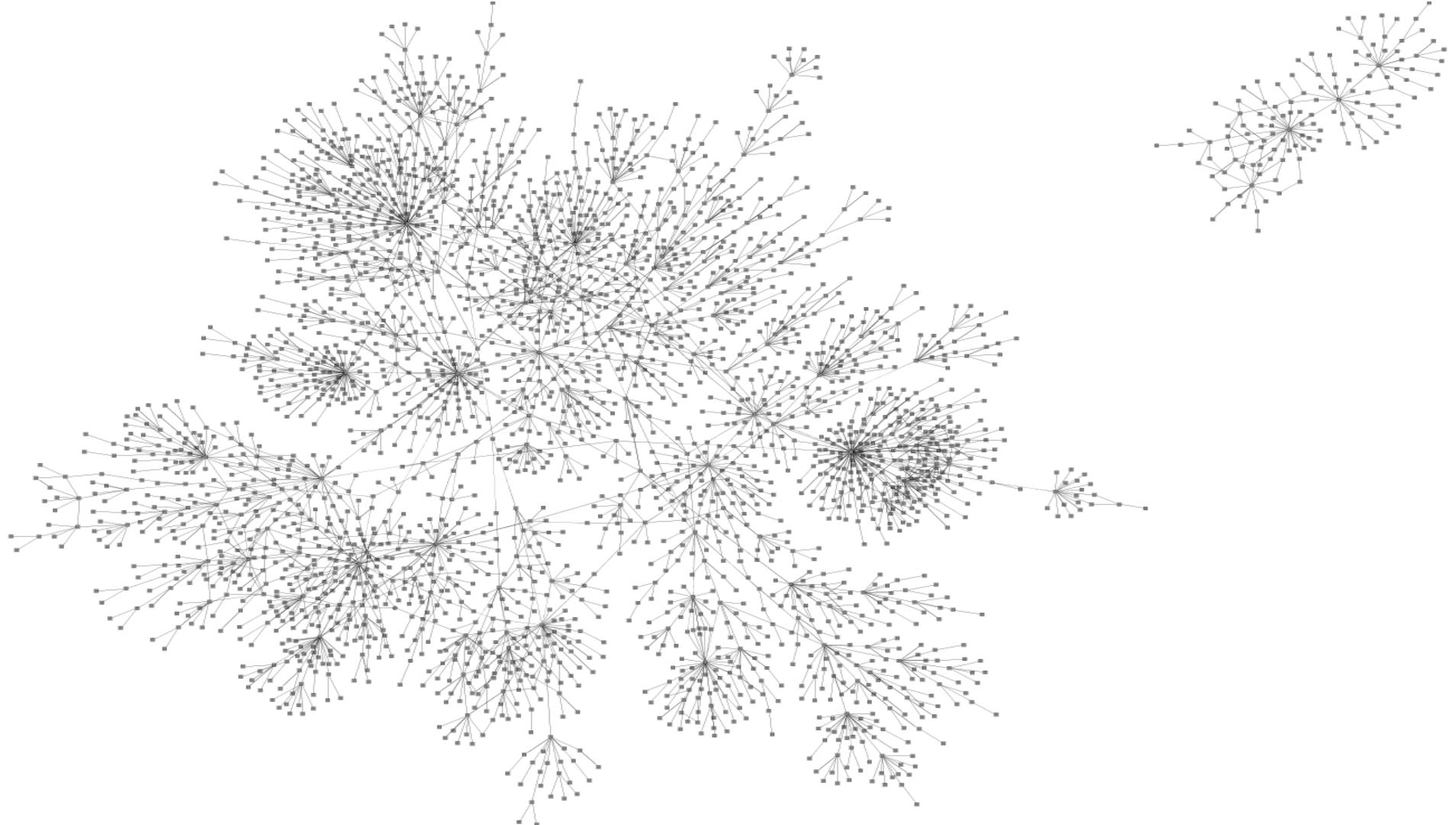
AND STOP TALKING!

memegenerator.net

Cypher - cookit

Ingredients:

- ~3000 ingredients
- ~3300 edges
- 9th level deep
- 8 main ingredient groups



Cypher - cookit

Question:

Find recipes that use products from categories **fish (2)** and **sweet drinks (3)**

```
MATCH (r:Recipe) - [:CONTAINS] -> (n:Ingredient),
(n) - [:FROM|SPECYFICATION*0..9] - (soda:Ingredient {Name:'Sweet drinks'}),
(n) - [:FROM|SPECYFICATION*0..9] - (fish:Ingredient {Name:'Fish'})

RETURN r, n
LIMIT 100
```

When to use

When to use

- Hierarchical data
- Relations are more important than data
- Searching patterns in data
- Better data visualization
- Get the sense from data

When NOT to use:

- Data manipulation heavy systems
- Big data \diamond ACID transactions
- **Instead of relational database**

Questions?

J

