
neotechnology
value in relationships

No SQL?

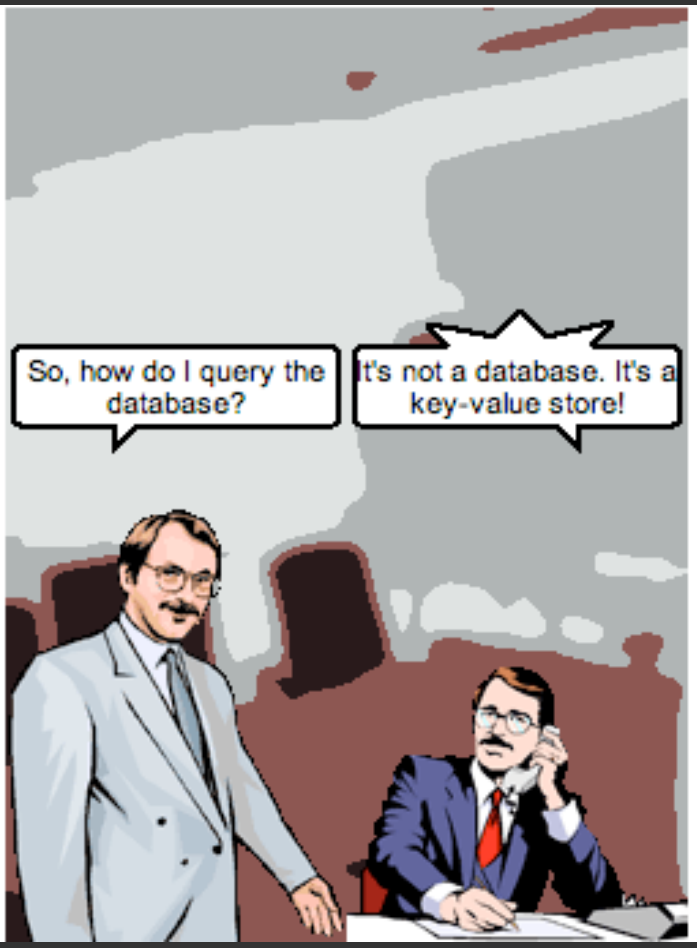

Image credit: http://browsertoolkit.com/fault-tolerance.png

No SQL?

Image credit: http://browsertoolkit.com/fault-tolerance.png

No SQL?

Image credit: http://browsertoolkit.com/fault-tolerance.png

Neo4j

the benefits of graph databases + a NOSQL overview

QCon London 2010

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What's the plan?

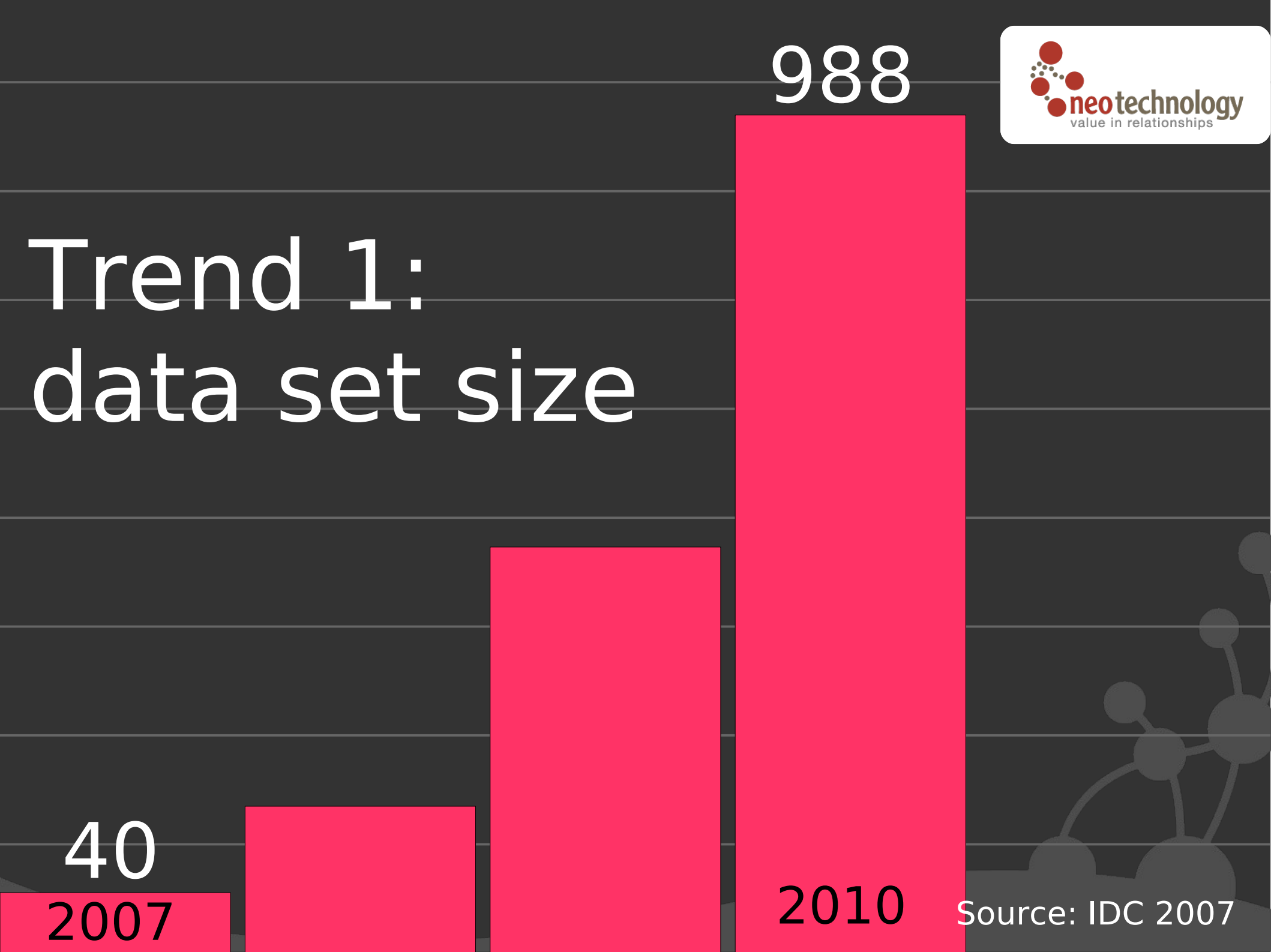
- Why now? – Four trends
- NOSQL overview
- Graph databases && Neo4j
- A production example of Neo4j
- Conclusions

Trend 1:
data set size

40

2007

Source: IDC 2007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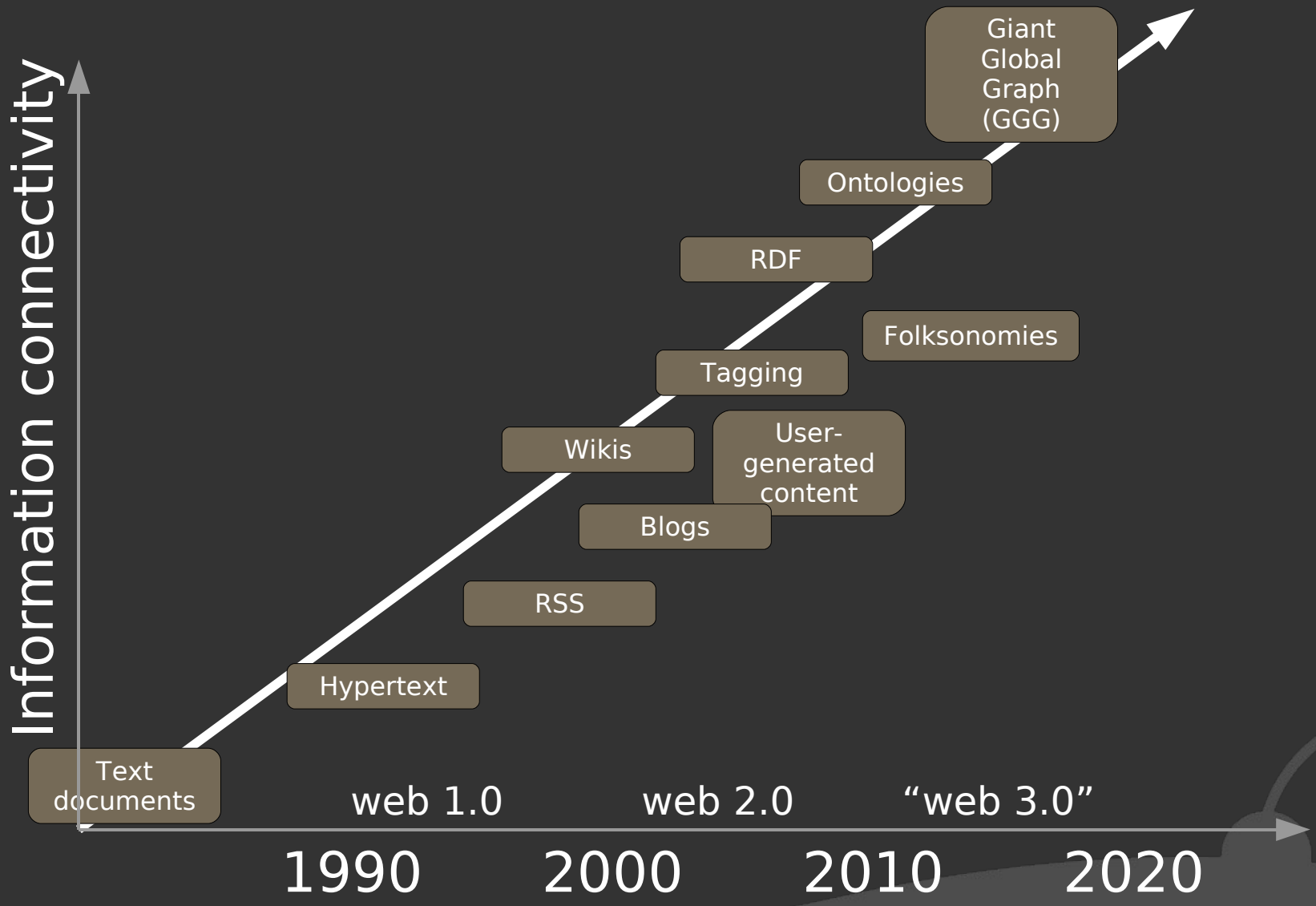
neotechnology
value in relationships
Trend 1:
data set size
40
2007
2010
Source: IDC 2007

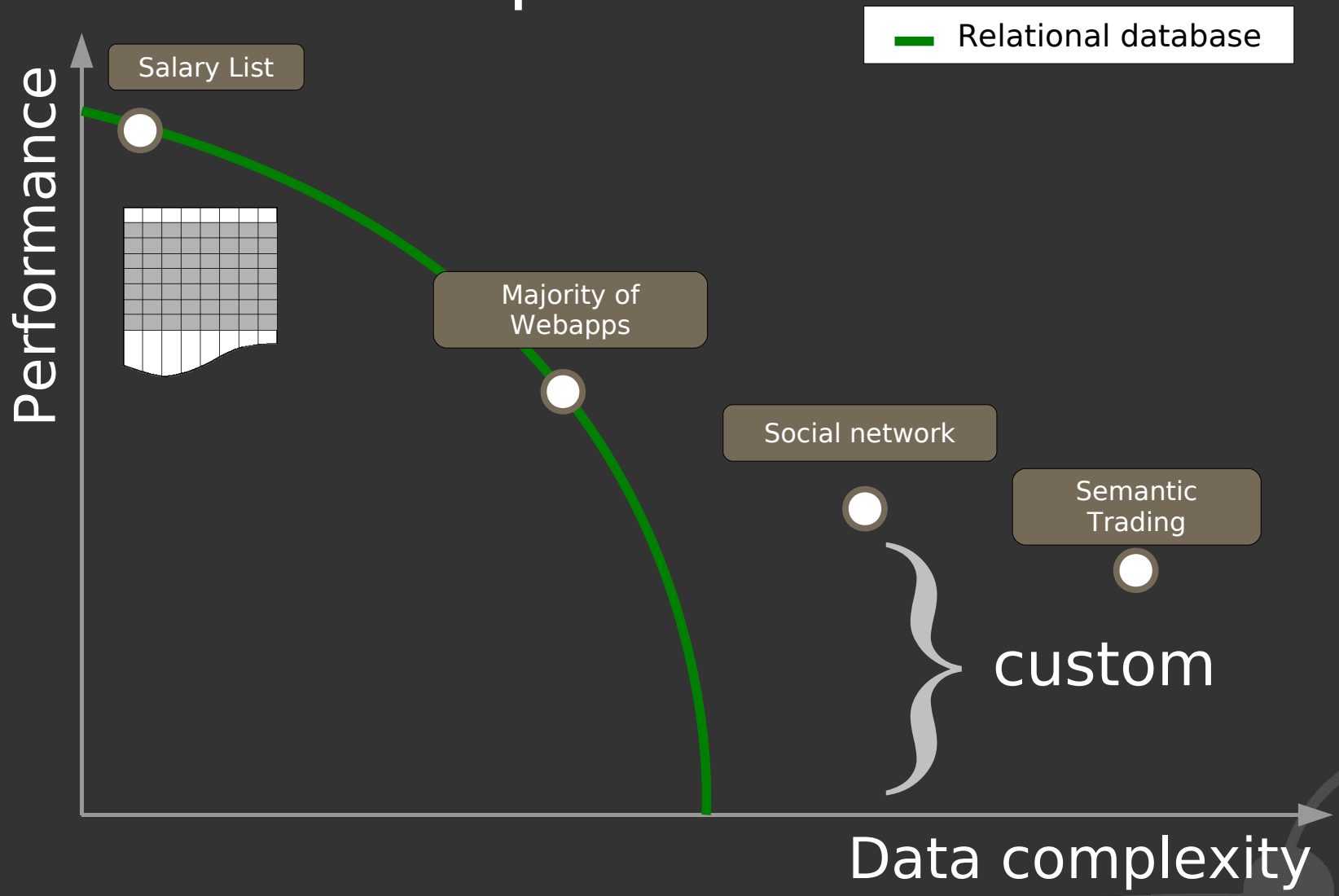
Trend 2: connectedness



Trend 3: semi-structure

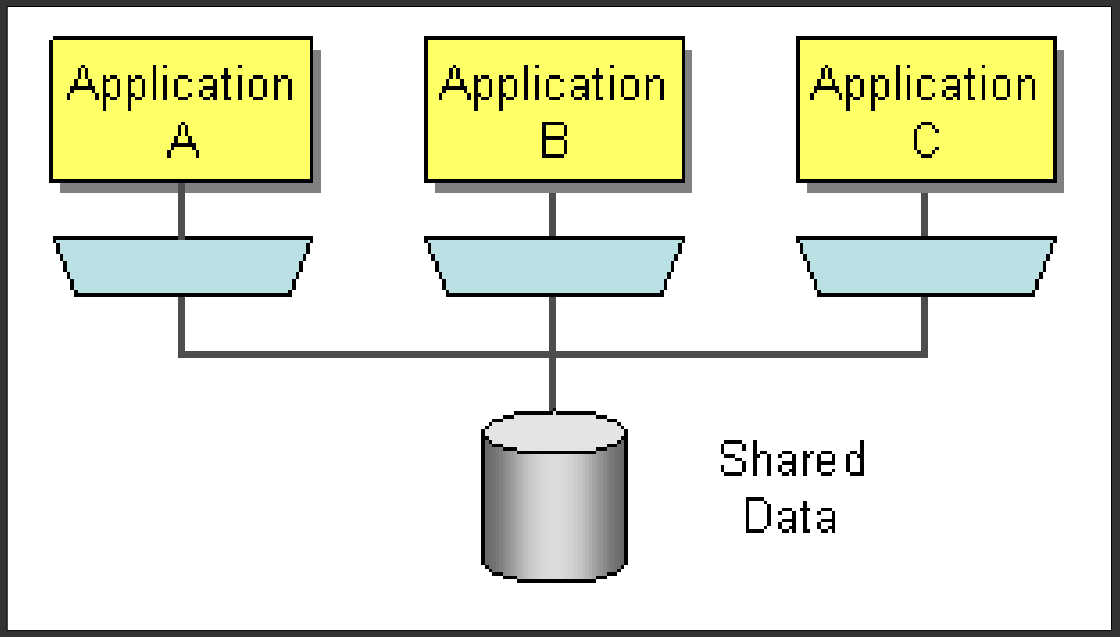
- Individualization of content!
  - In the salary lists of the 1970s, all elements had exactly one job
  - In the salary lists of the 2000s, we need 5 job columns! Or 8? Or 15?
- Trend accelerated by the decentralization of content generation that is the hallmark of the age of participation (“web 2.0”)

Aside: RDBMS performance



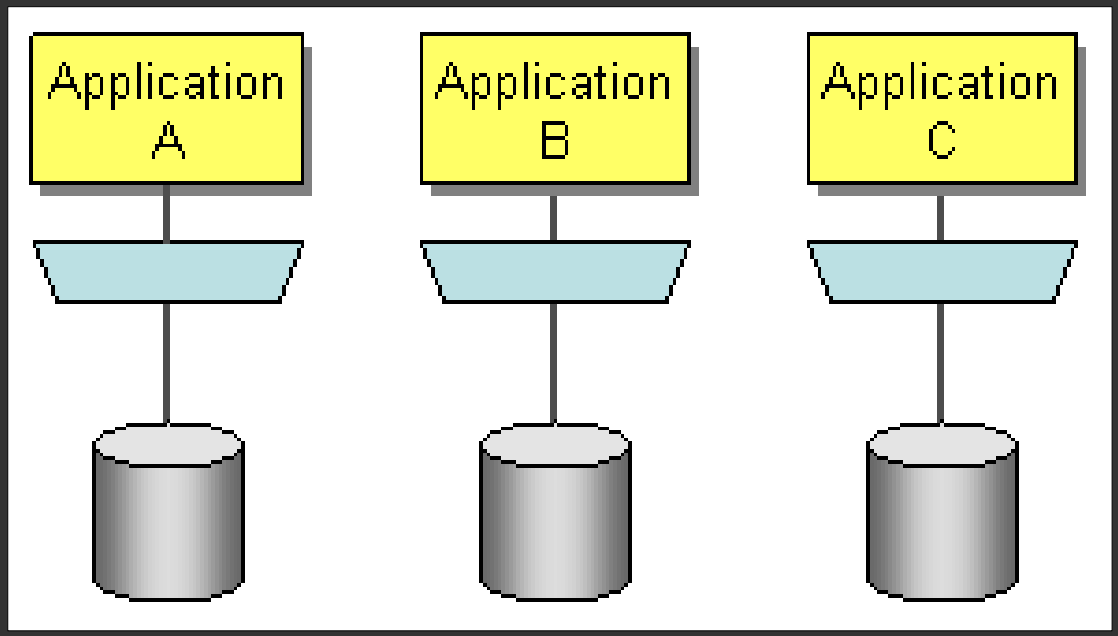
Trend 4: architecture

1990s: Database as integration hub



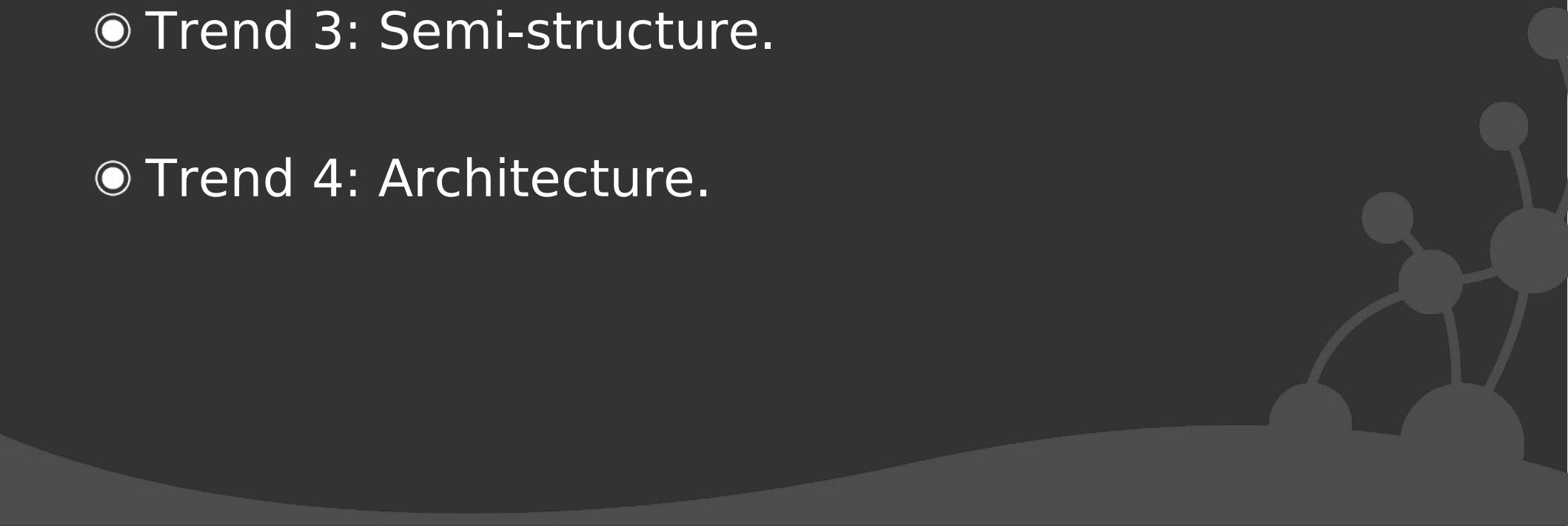
Trend 4: architecture

2000s: (Slowly towards...)
Decoupled services with own backend



Why NOSQL 2009?

- Trend 1: Size.
- Trend 2: Connectivity.
- Trend 3: Semi-structure.
- Trend 4: Architecture.




neotechnology
value in relationships
NOSQL
overview

First off: the name

- NoSQL is NOT “Never SQL”
- NoSQL is NOT “No To SQL”

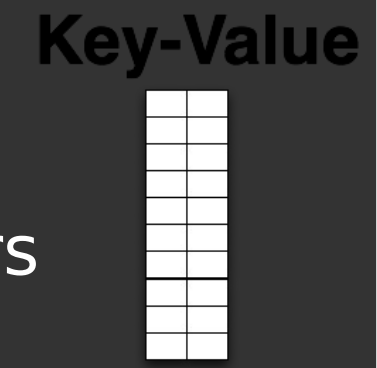
NOSQL

is simply

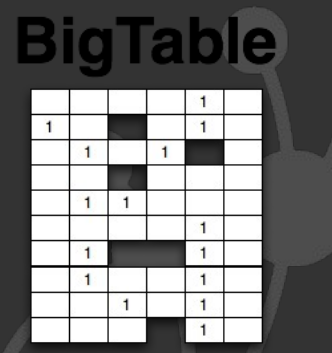
Not **O**nly **SQL**!

Four (emerging) NOSQL categories

- Key-value stores
  - Based on Amazon's Dynamo paper
  - Data model: (global) collection of K-V pairs
  - Example: Dynomite, Voldemort, Tokyo*

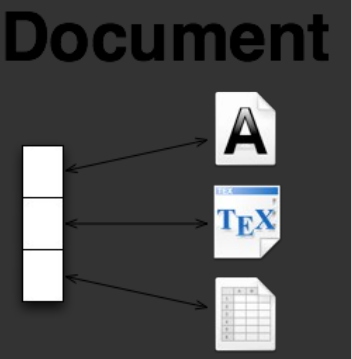


- BigTable clones
  - Based on Google's BigTable paper
  - Data model: big table, column families
  - Example: HBase, Hypertable, Cassandra

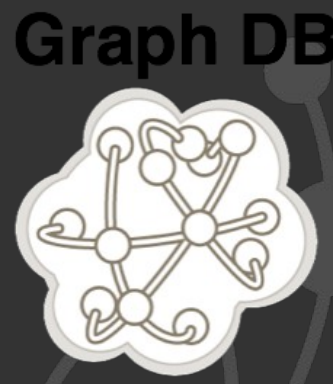


Four (emerging) NOSQL categories

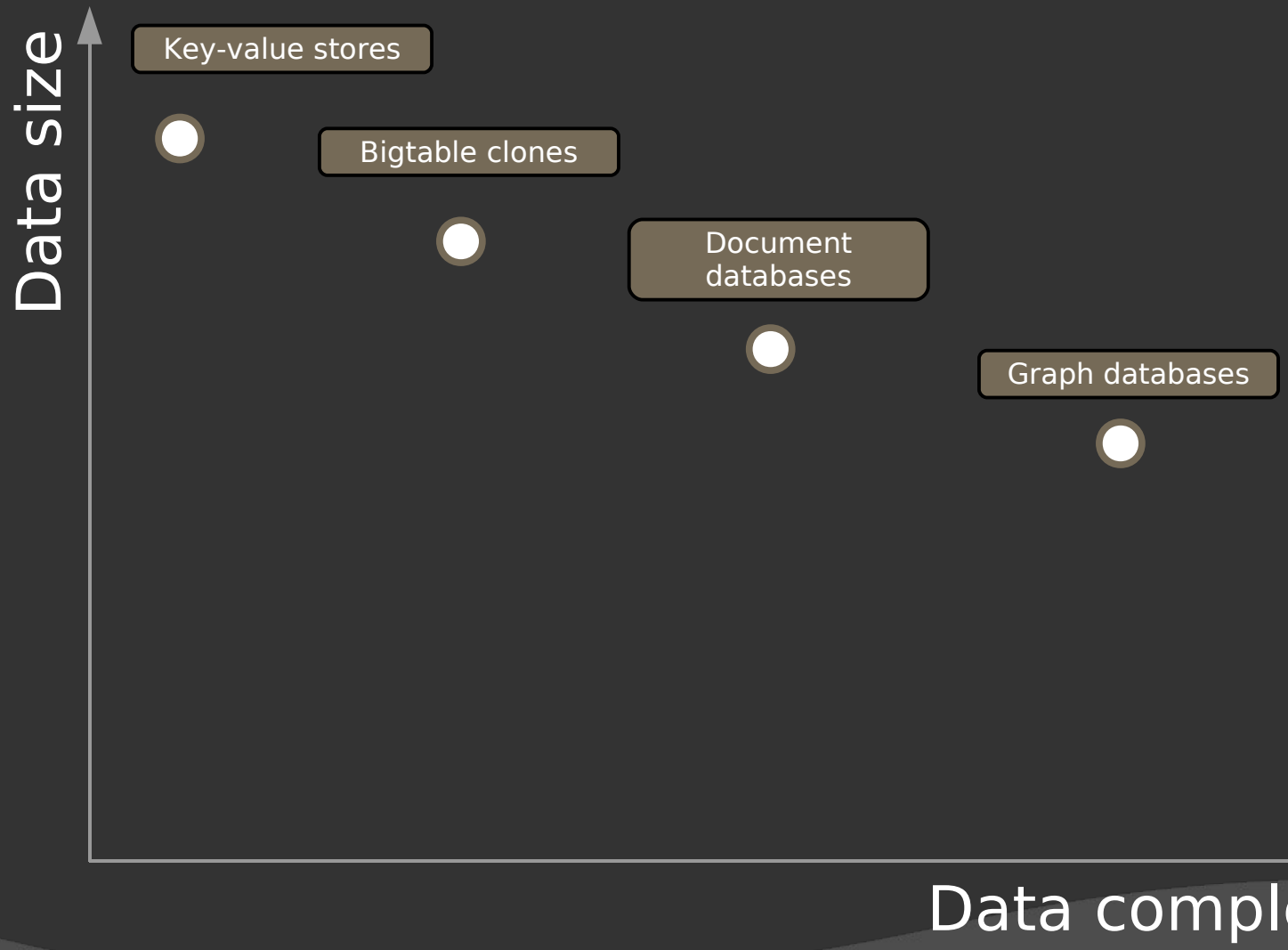
- Document databases
  - Inspired by Lotus Notes
  - Data model: collections of K-V collections
  - Example: CouchDB, MongoDB



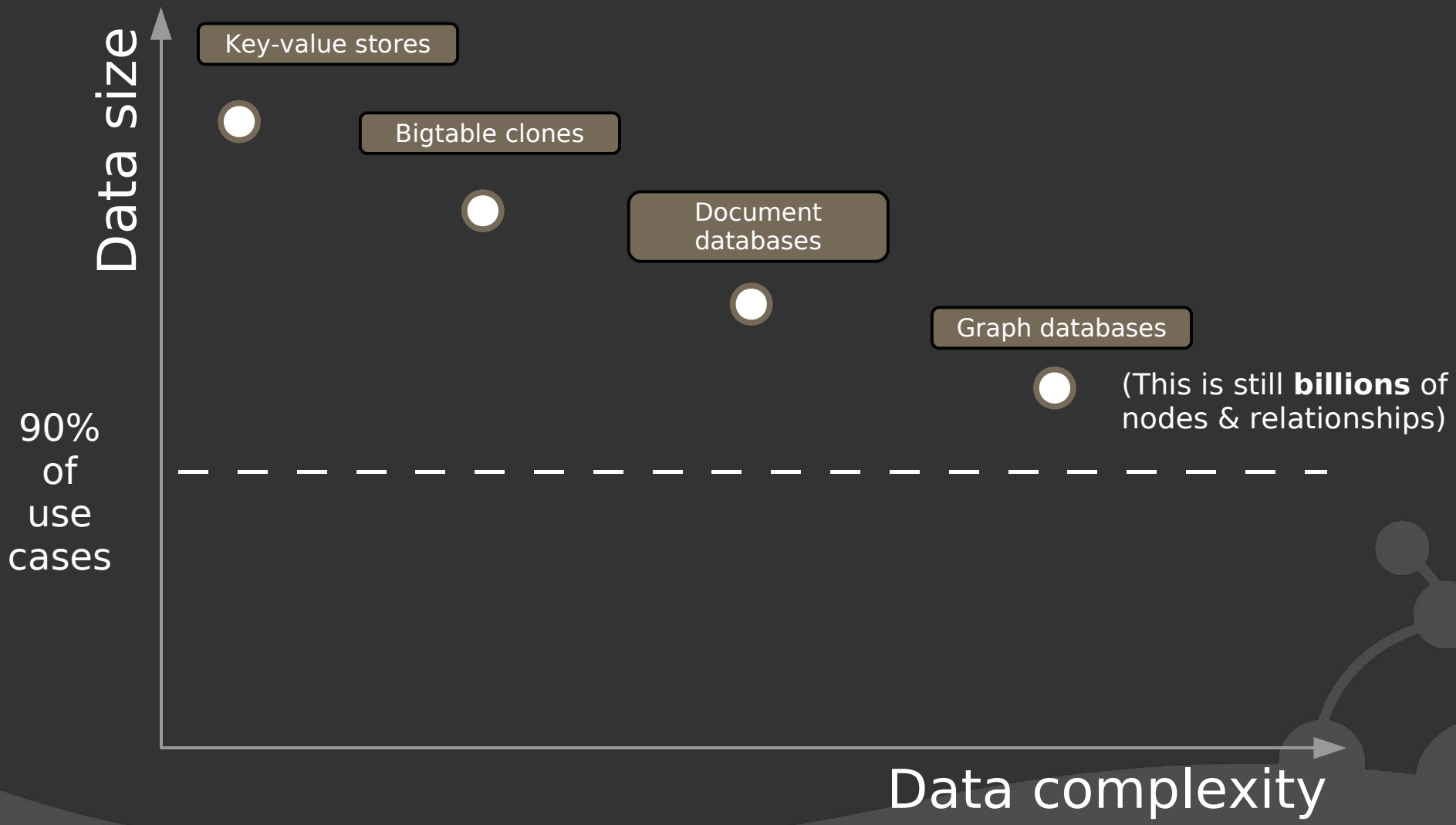
- Graph databases
  - Inspired by Euler & graph theory
  - Data model: nodes, rels, K-V on both
  - Example: AllegroGraph, Sones, Neo4j



NOSQL data models



NOSQL data models

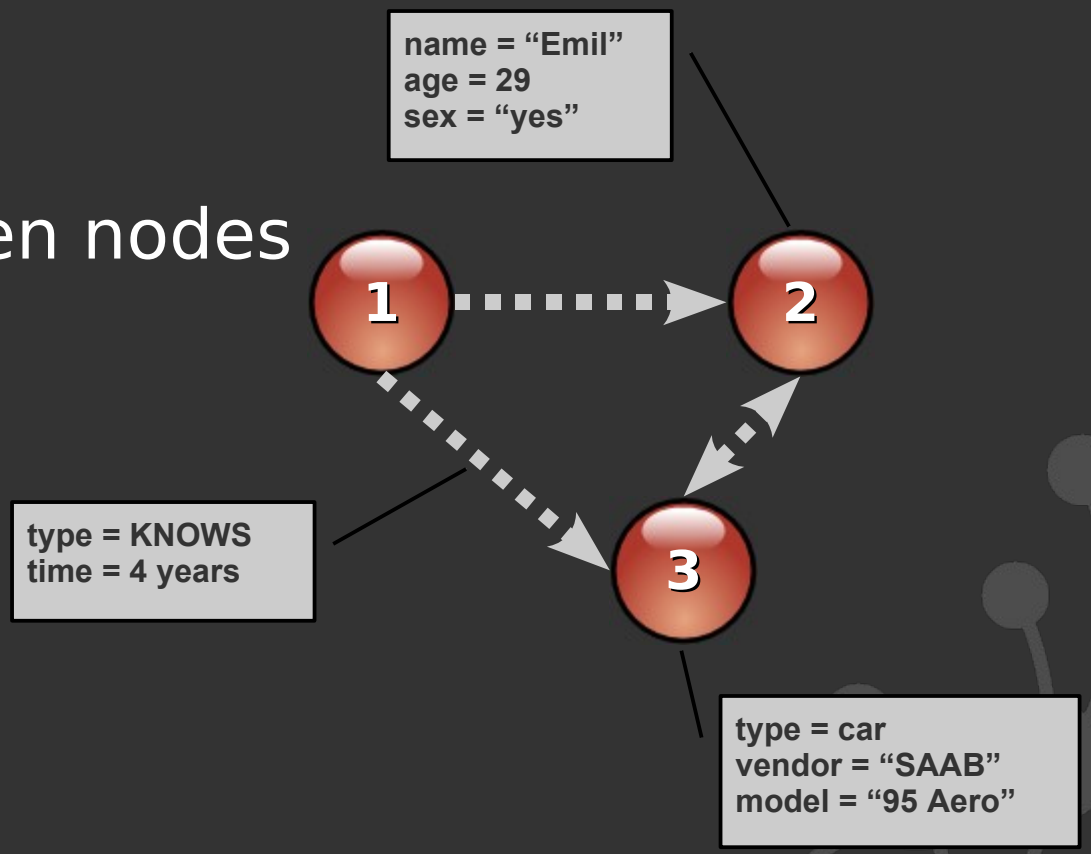


Graph DBs

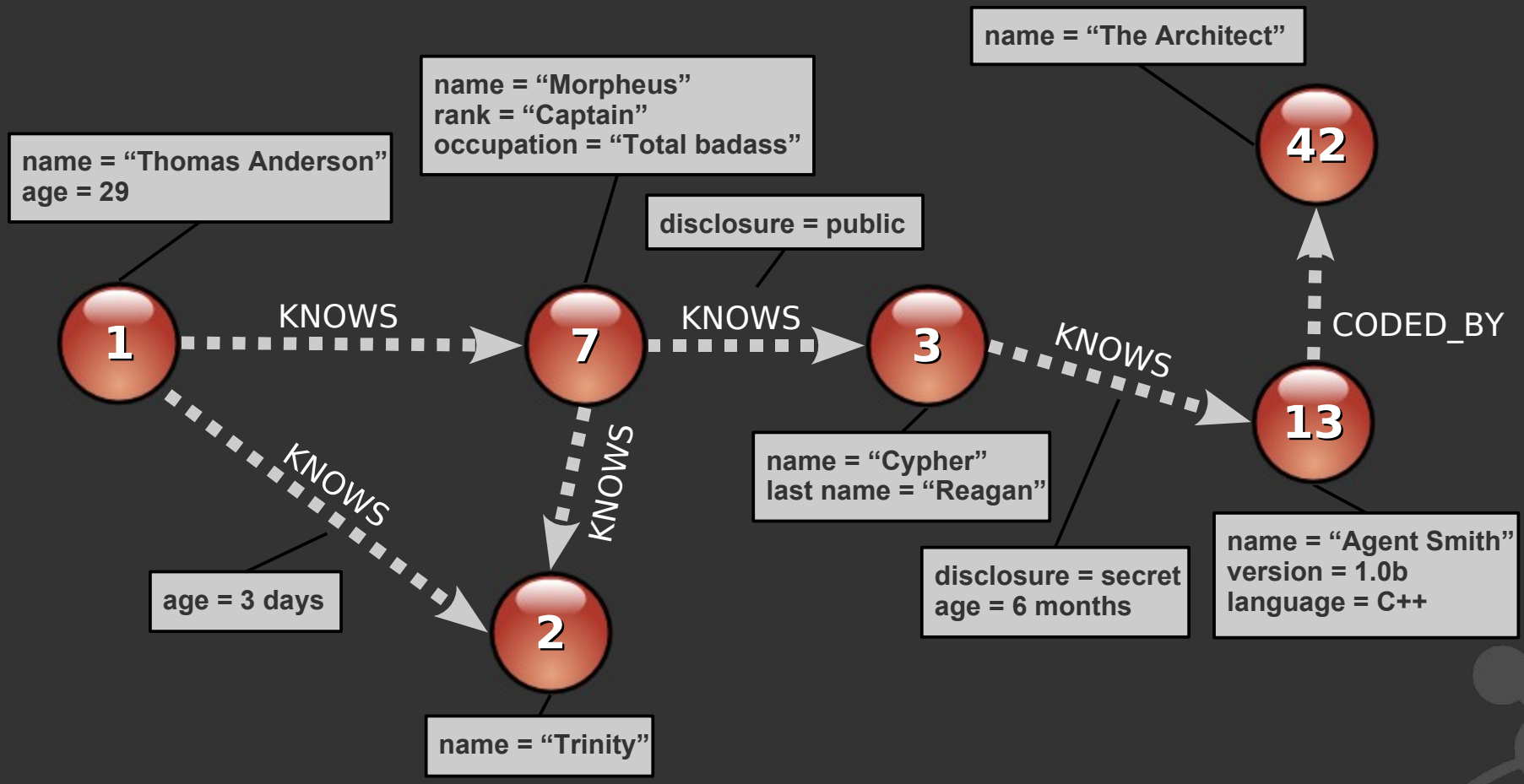
& Neo4j intro

The Graph DB model: representation

- Core abstractions:
  - Nodes
  - Relationships between nodes
  - Properties on both



Example: The Matrix



Code (1): Building a node space

```
GraphDatabaseService graphDb = ... // Get factory


// Create Thomas 'Neo' Anderson
Node mrAnderson = graphDb.createNode();
mrAnderson.setProperty( "name", "Thomas Anderson" );
mrAnderson.setProperty( "age", 29 );

// Create Morpheus
Node morpheus = graphDb.createNode();
morpheus.setProperty( "name", "Morpheus" );
morpheus.setProperty( "rank", "Captain" );
morpheus.setProperty( "occupation", "Total bad ass" );

// Create a relationship representing that they know each other
mrAnderson.createRelationshipTo( morpheus, RelTypes.KNOWS );
// ...create Trinity, Cypher, Agent Smith, Architect similarly
```

Code (1): Building a node space

```
GraphDatabaseService graphDb = ... // Get factory
Transaction tx = neo.beginTx();

// Create Thomas 'Neo' Anderson
Node mrAnderson = graphDb.createNode();
mrAnderson.setProperty( "name", "Thomas Anderson" );
mrAnderson.setProperty( "age", 29 );

// Create Morpheus
Node morpheus = graphDb.createNode();
morpheus.setProperty( "name", "Morpheus" );
morpheus.setProperty( "rank", "Captain" );
morpheus.setProperty( "occupation", "Total bad ass" );

// Create a relationship representing that they know each other
mrAnderson.createRelationshipTo( morpheus, RelTypes.KNOWS );
// ...create Trinity, Cypher, Agent Smith, Architect similarly

tx.commit();
```

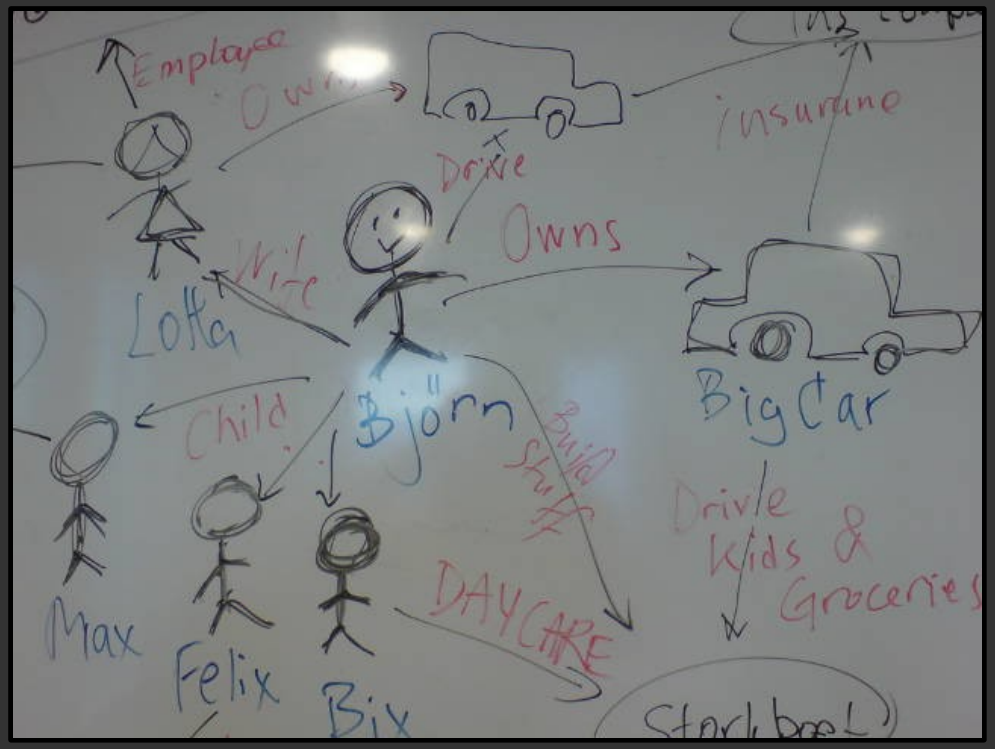
Code (1b): Defining RelationshipTypes

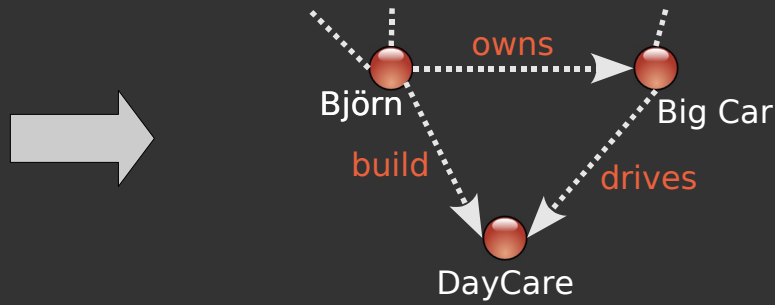
```
// In package org.neo4j.graphdb
public interface RelationshipType
{
    String name();
}

// In package org.yourdomain.yourapp
// Example on how to roll dynamic RelationshipTypes
class MyDynamicRelType implements RelationshipType
{
    private final String name;
    MyDynamicRelType( String name ){ this.name = name; }
    public String name() { return this.name; }
}

// Example on how to kick it, static-RelationshipType-like
enum MyStaticRelTypes implements RelationshipType
{
    KNOWS,
    WORKS_FOR,
}
```

Whiteboard friendly





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Previous Next
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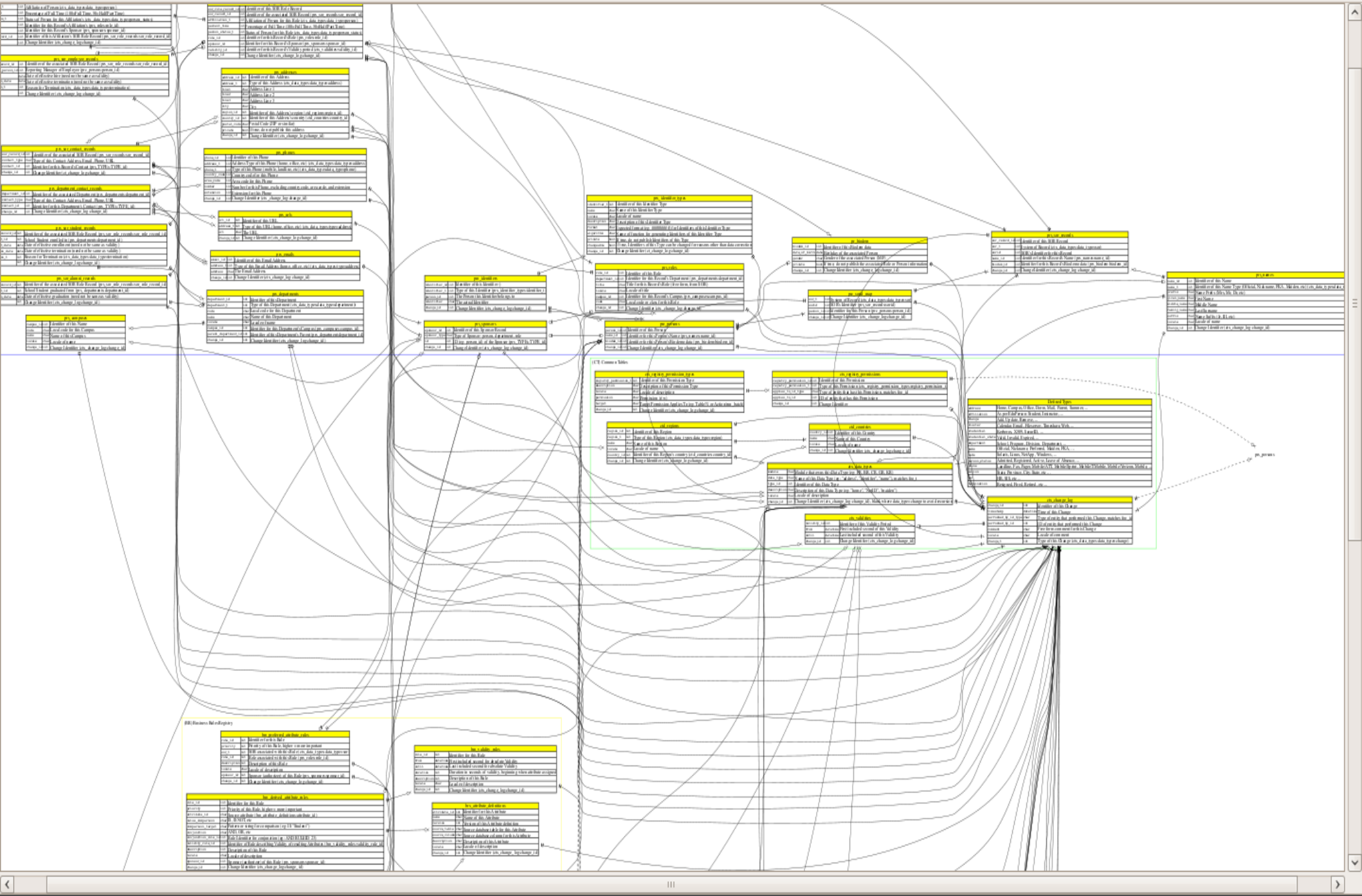
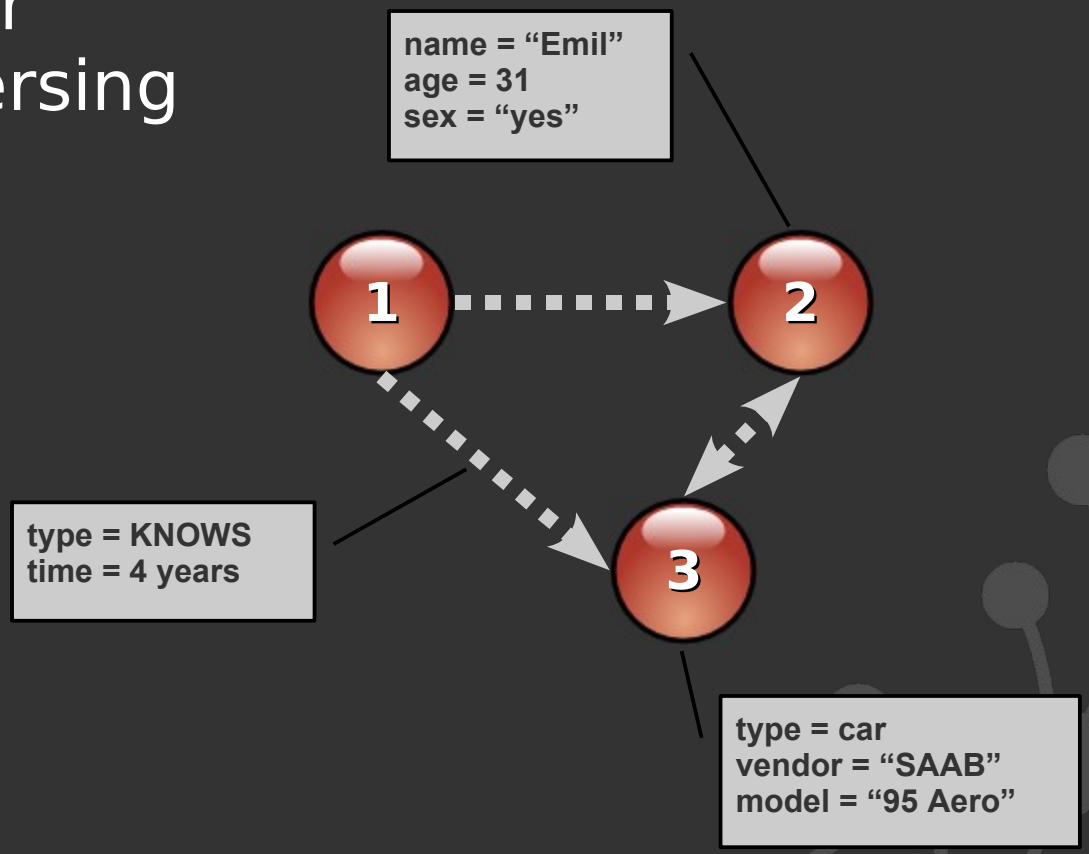
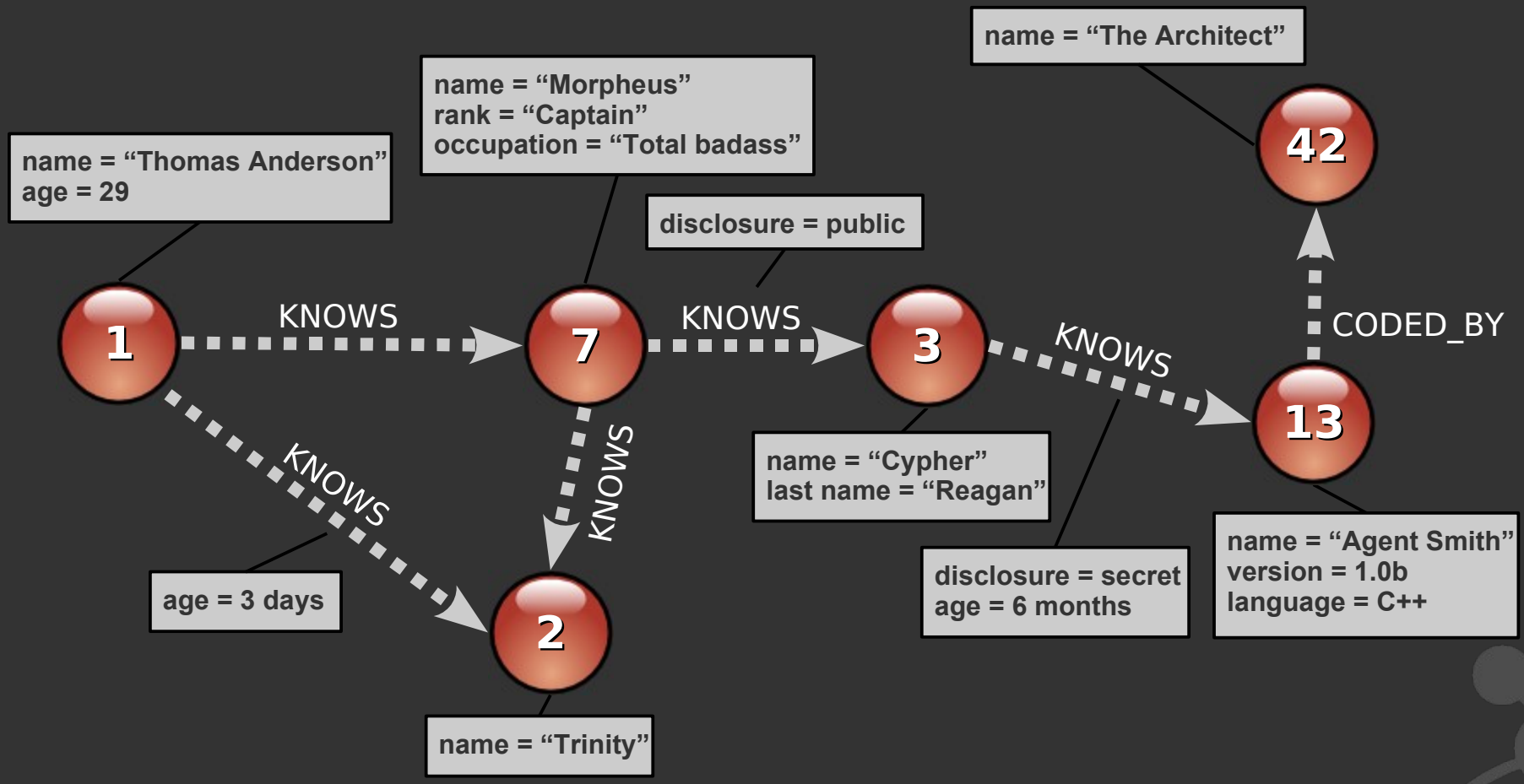


The Graph DB model: traversal

- Traverser framework for high-performance traversing across the node space



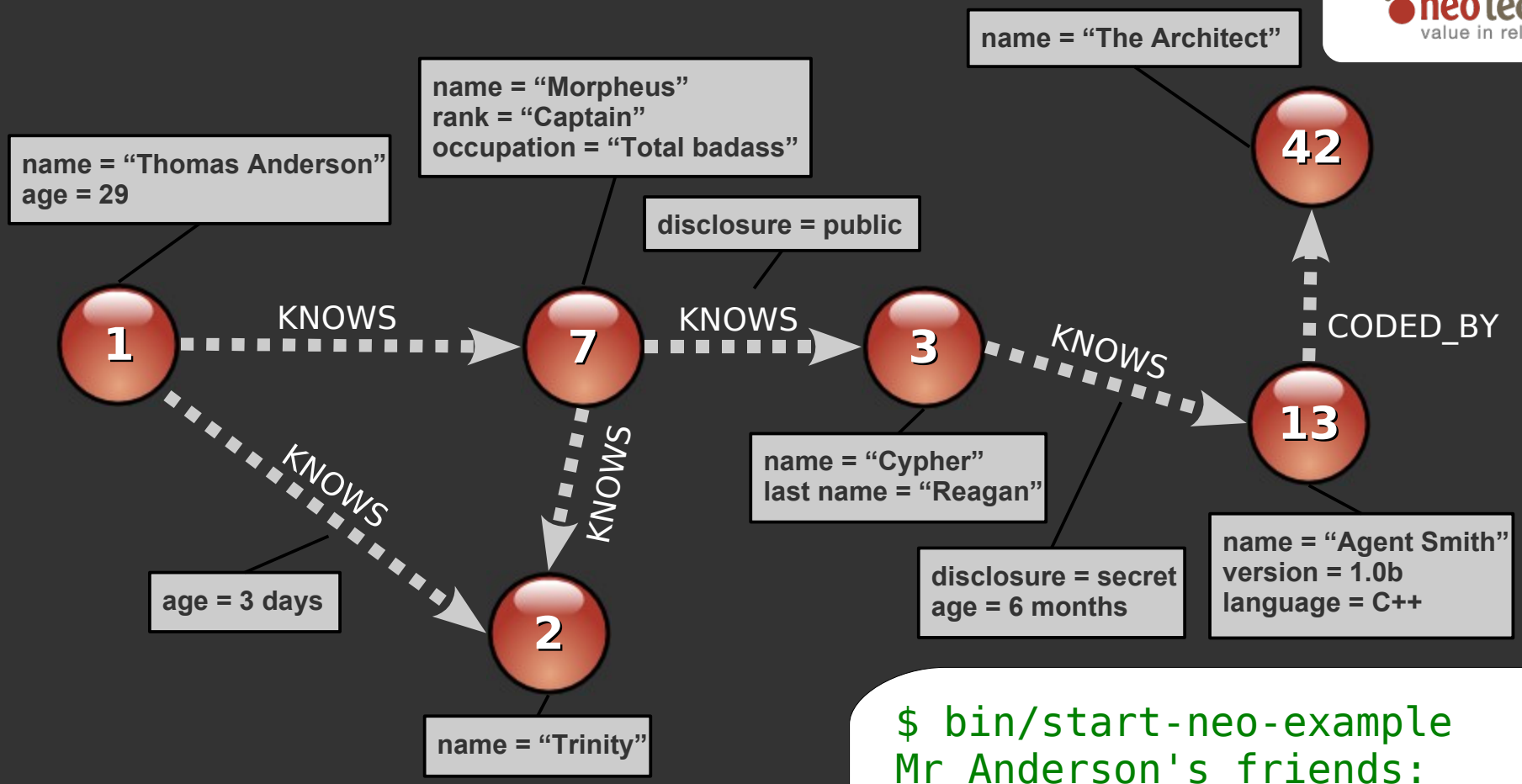
Example: Mr Anderson's friends



Code (2): Traversing a node space

```
// Instantiate a traverser that returns Mr Anderson's friends
Traverser friendsTraverser = mrAnderson.traverse(
    Traverser.Order.BREADTH_FIRST,
    StopEvaluator.END_OF_GRAPH,
    ReturnableEvaluator.ALL_BUT_START_NODE,
    RelTypes.KNOWS,
    Direction.OUTGOING );

// Traverse the node space and print out the result
System.out.println( "Mr Anderson's friends:" );
for ( Node friend : friendsTraverser )
{
    System.out.printf( "At depth %d => %s%n",
        friendsTraverser.currentPosition().getDepth(),
        friend.getProperty( "name" ) );
}
```

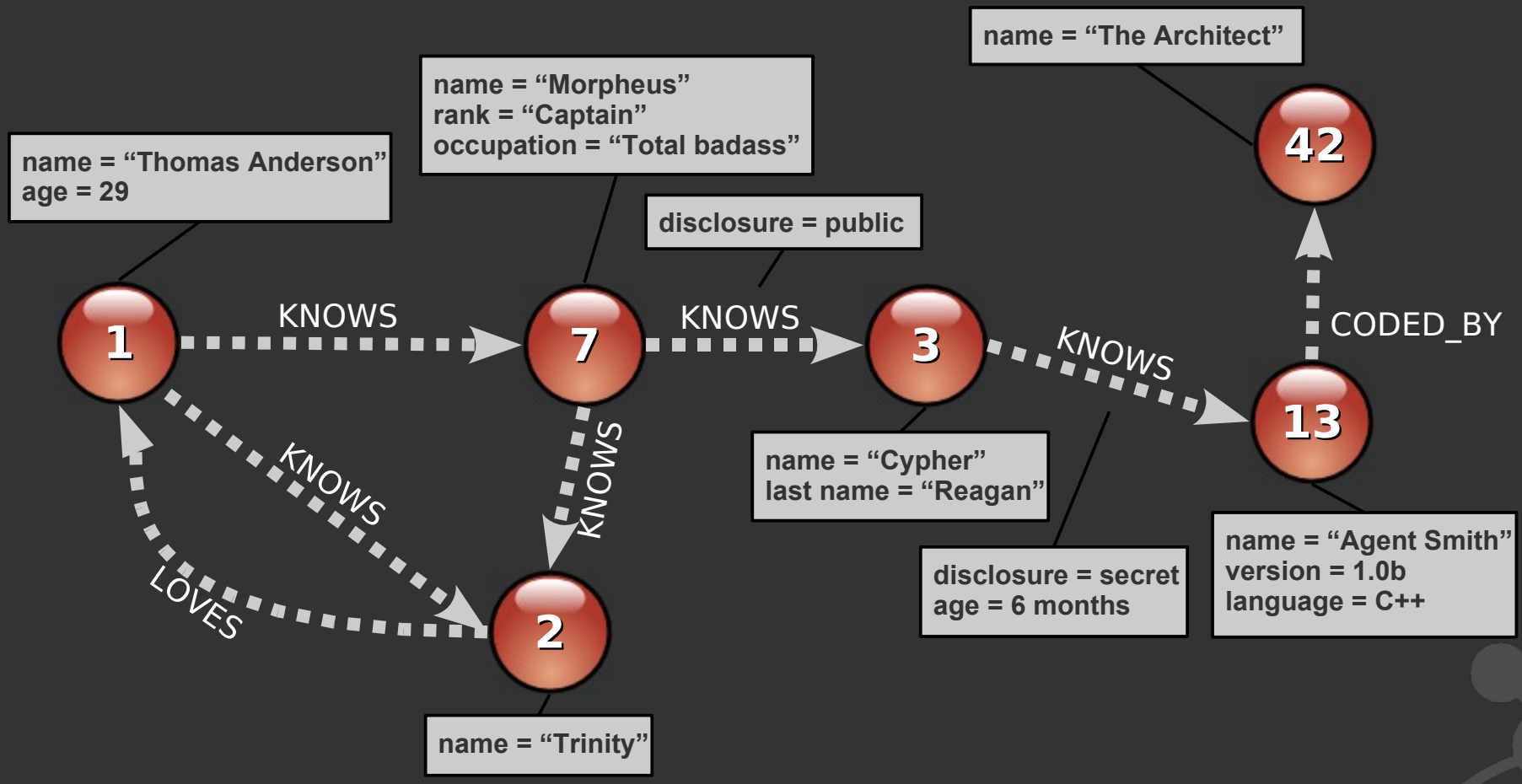



```
friendsTraverser = mrAnderson.traverse(
  Traverser.Order.BREADTH_FIRST,
  StopEvaluator.END_OF_GRAPH,
  ReturnableEvaluator.ALL_BUT_START_NODE,
  RelTypes.KNOWS,
  Direction.OUTGOING );
```

```
$ bin/start-neo-example
Mr Anderson's friends:

At depth 1 => Morpheus
At depth 1 => Trinity
At depth 2 => Cypher
At depth 3 => Agent Smith
$
```

Example: Friends in love?

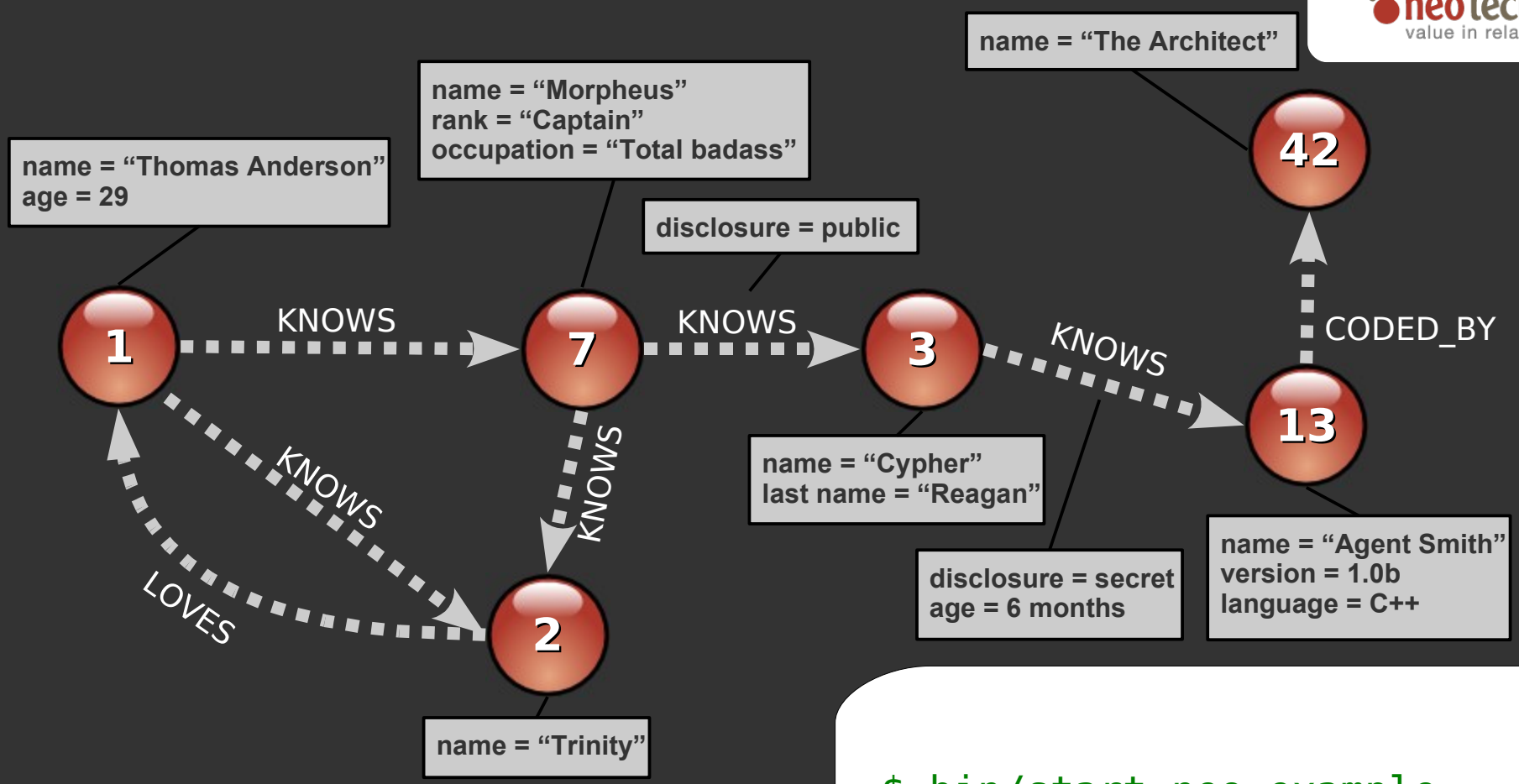


Code (3a): Custom traverser

```
// Create a traverser that returns all "friends in love"
Traverser loveTraverser = mrAnderson.traverse(
    Traverser.Order.BREADTH_FIRST,
    StopEvaluator.END_OF_GRAPH,
    new ReturnableEvaluator()
    {
        public boolean isReturnableNode( TraversalPosition pos )
        {
            return pos.currentNode().hasRelationship(
                RelTypes.LOVES, Direction.OUTGOING );
        }
    },
    RelTypes.KNOWS,
    Direction.OUTGOING );
```

Code (3a): Custom traverser

```
// Traverse the node space and print out the result
System.out.println( "Who's a lover?" );
for ( Node person : loveTraverser )
{
    System.out.printf( "At depth %d => %s%n",
        loveTraverser.currentPosition().getDepth(),
        person.getProperty( "name" ) );
}
```




```
new ReturnableEvaluator()
{
  public boolean isReturnableNode(
    TraversalPosition pos)
  {
    return pos.currentNode().
      hasRelationship( RelTypes.LOVES,
        Direction.OUTGOING );
  }
},
```

```
$ bin/start-neo-example
Who’s a lover?

At depth 1 => Trinity
$
```

Bonus code: domain model

- How do you implement your domain model?
- Use the delegator pattern, i.e. every domain entity wraps a Neo4j primitive:

```
// In package org.yourdomain.yourapp
class PersonImpl implements Person
{
    private final Node underlyingNode;
    PersonImpl( Node node ){ this.underlyingNode = node; }

    public String getName()
    {
        return (String) this.underlyingNode.getProperty( "name" );
    }
    public void setName( String name )
    {
        this.underlyingNode.setProperty( "name", name );
    }
}
```

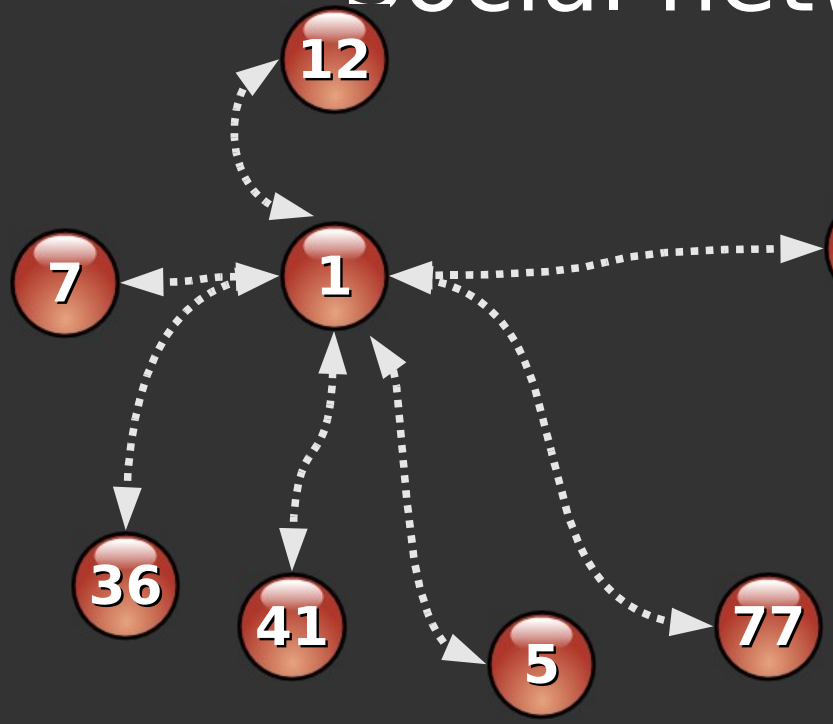
Domain layer frameworks

- Qi4j (www.qi4j.org)
  - Framework for doing DDD in pure Java5
  - Defines Entities / Associations / Properties
    - Sound familiar? Nodes / Rel's / Properties!
  - Neo4j is an "EntityStore" backend
- Jo4neo (http://code.google.com/p/jo4neo)
  - Annotation driven
  - Weaves Neo4j-backed persistence into domain objects at runtime

Neo4j system characteristics

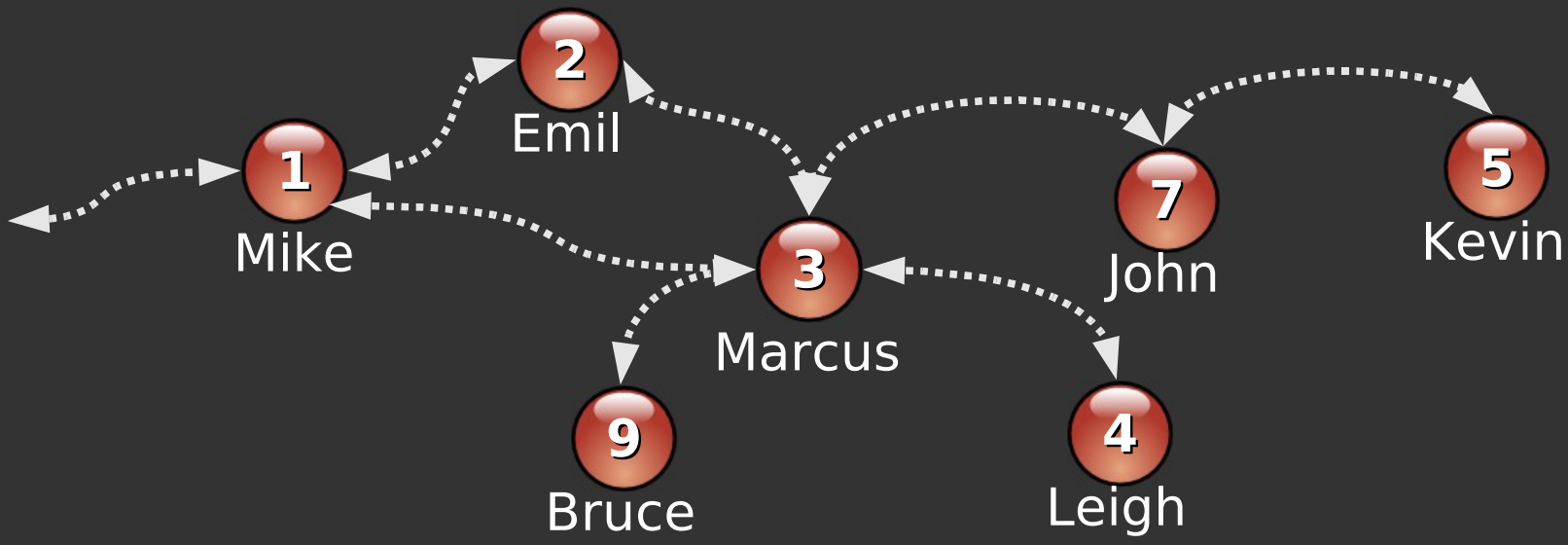
- Disk-based
  - Native graph storage engine with custom binary on-disk format
- Transactional
  - JTA/JTS, XA, 2PC, Tx recovery, deadlock detection, MVCC, etc
- Scales up
  - Many **billions** of nodes/rels/props on single JVM
- Robust
  - 6+ years in 24/7 production

Social network *pathExists()*

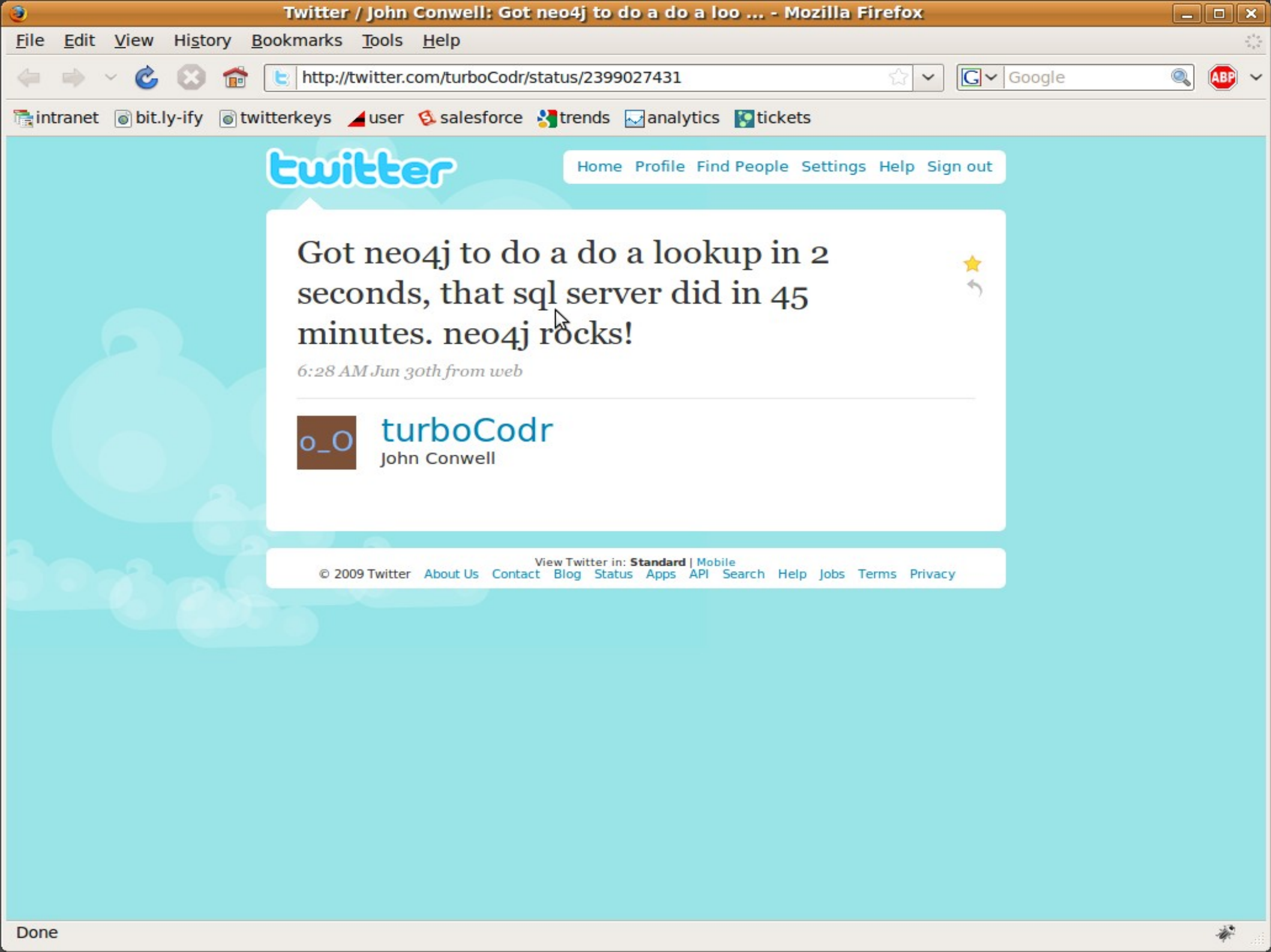


- ~1k persons
- Avg 50 friends per person
- pathExists(a, b) limit depth 4
- Two backends
- Eliminate disk IO so warm up caches

Social network *pathExists()*



	# persons	*query time*
Relational database		
Graph database (Neo4j)		
Graph database (Neo4j)		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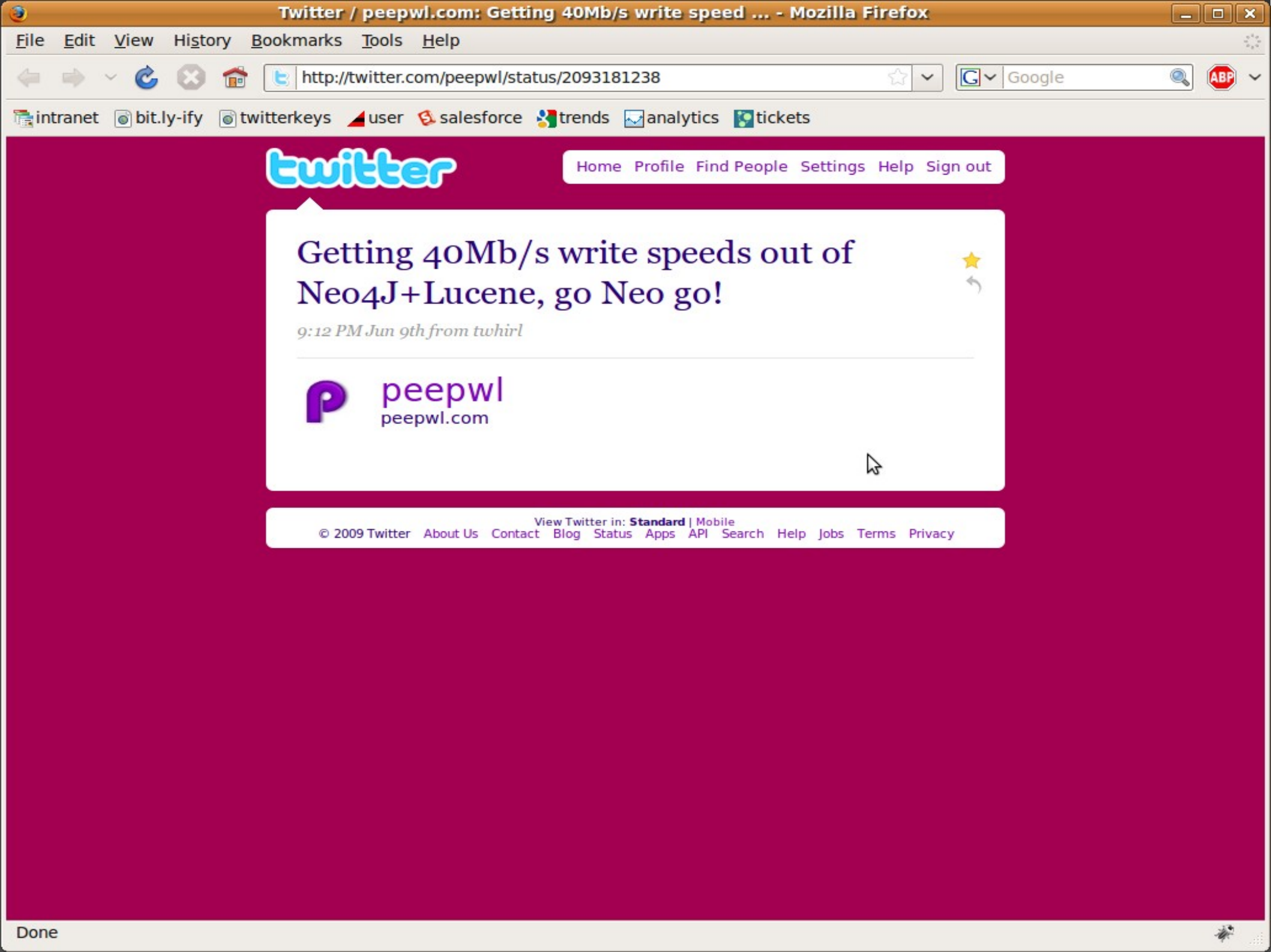
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Getting 40Mb/s write speeds out of Neo4J+Lucene, go Neo go!
9:12 PM Jun 9th from twhirl
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peepwl.com
View Twitter in: Standard | Mobile
© 2009 Twitter About Us Contact Blog Status Apps API Search Help Jobs Terms Privacy
Done

Pros & Cons compared to RDBMS

+ No O/R impedance mismatch (*whiteboard friendly*)
+ Can easily evolve schemas
+ Can represent semi-structured info
+ Can represent graphs/networks (*with* performance)

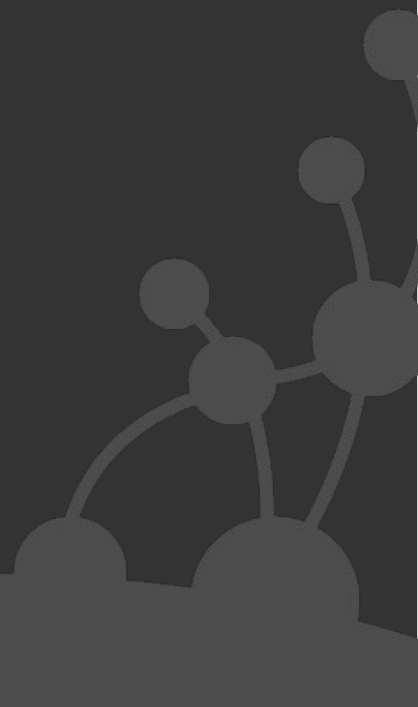
- Lacks in tool and framework support
- Few other implementations => potential lock in
+ ~~No~~ support for ad-hoc queries

Query languages

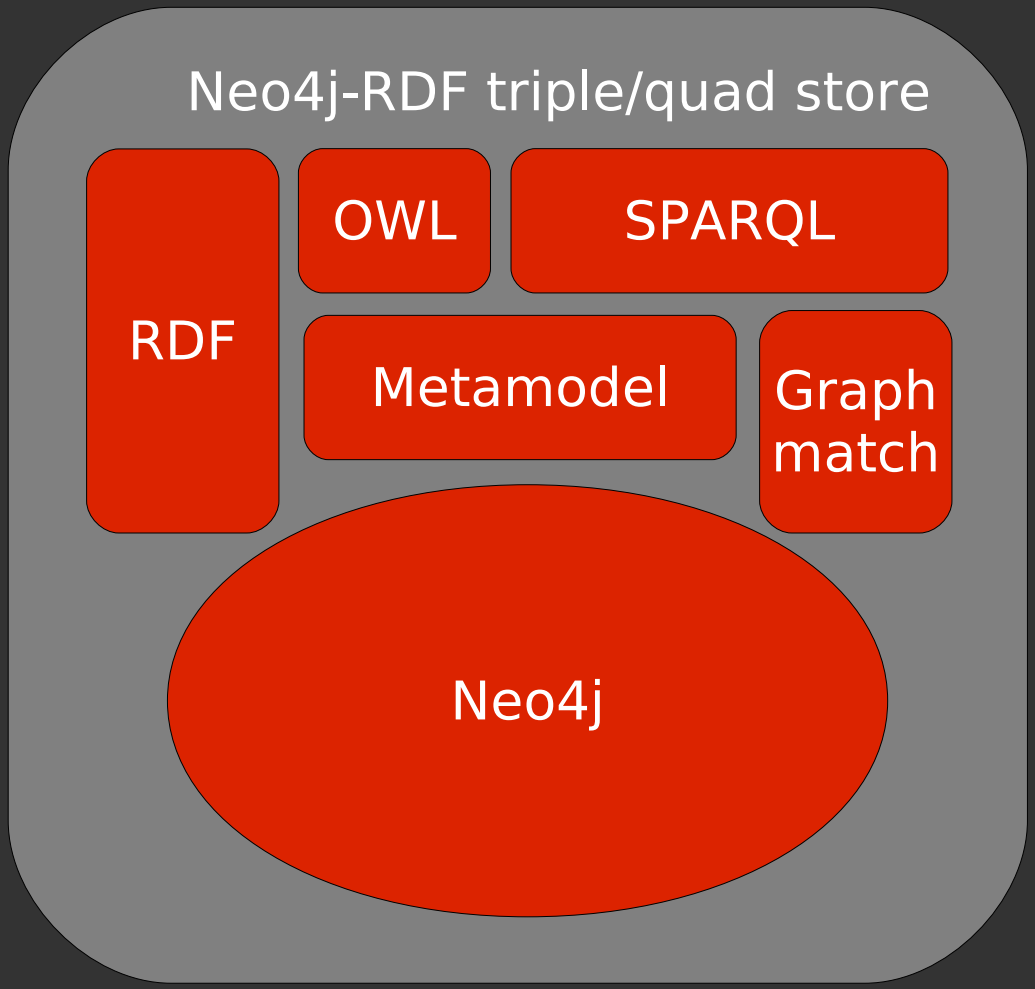
- SPARQL – “SQL for linked data”
  - Ex: ”SELECT ?person WHERE {
    ?person neo4j:KNOWS ?friend .
    ?friend neo4j:KNOWS ?foe .
    ?foe neo4j:name “Larry Ellison” .
    }”
- Gremlin – “perl for graphs”
  - Ex: ”./outE[@label='KNOWS']/inV[@age > 30]/@name”

The Neo4j ecosystem

- Neo4j is an embedded database
  - Tiny teeny lil jar file
- Component ecosystem
  - index
  - meta-model
  - graph-matching
  - remote-graphdb
  - sparql-engine
  - ...
- See http://components.neo4j.org



Example: Neo4j-RDF



Language bindings

- Neo4j.py – bindings for Jython and CPython
  - http://components.neo4j.org/neo4j.py
- Neo4jrb – bindings for JRuby (incl RESTful API)
  - http://wiki.neo4j.org/content/Ruby
- Neo4jrb-simple
  - http://github.com/mdeiters/neo4jr-simple
- Clojure
  - http://wiki.neo4j.org/content/Clojure
- Scala (incl RESTful API)
  - http://wiki.neo4j.org/content/Scala

Integration of Neo4j in Grails

Download

(0 Ratings)

AUTHOR(S):	Stefan Armbruster
CURRENT RELEASE:	0.1
GRAILS VERSION:	1.1.1 > *
TAGS	neo4j persistence

Fisheye Docs Edit Plugin

Installation Description Faq Screenshots

Edit View Info

The plugin's goal is to provide an alternative approach for storing Grails domain classes: in the Neo4j database.

Neo4j is a relative new and very interesting approach for persitence in a non-SQLish way. Neo4j is a graph database and uses the concept of

Nodes

A node is the basic building block. It normally represents a “something”, a entity.

Relationships

1. Create your sample application:

```
grails create-app neo4jtest; cd neo4jtest
```

2. Remove the hibernate plugin:

```
grails uninstall-plugin hibernate
```

3. Add the Neo4j plugin:

```
grails install-plugin neo4j
```

4. create some sample domain classes:

```
grails create-domain-class Author
grails create-domain-class Book
```

5. create a controller for the domain class

```
grails create-controller Author
grails create-controller Book
```

6. modify the domain classes:

```
class Author {

    String name
    Date dob

    static hasMany = [ books: Book ]
}
```

and

```
class Book {
    String title
    static belongsTo = [author:Author]
}
```

7. modify the controller to use dynamic scaffolding:

```
class AuthorController {
    def scaffold = true
}
```

```
class BookController {
    def scaffold = true
}
```

8. start up the application:

```
grails run-app
```

9. use it, love it: go to http://localhost:8080/neo4jtest, add some authors and books.
10. to explore the Neo4j node space created with your grails app, check out Neoclipse.

Gnome and CTI (computer-telephone-integration)

Tag Cloud

cti gnome grails linux neo4j telephone ubuntu

Blogroll

- GroovyBlogs

Categories

- Uncategorized

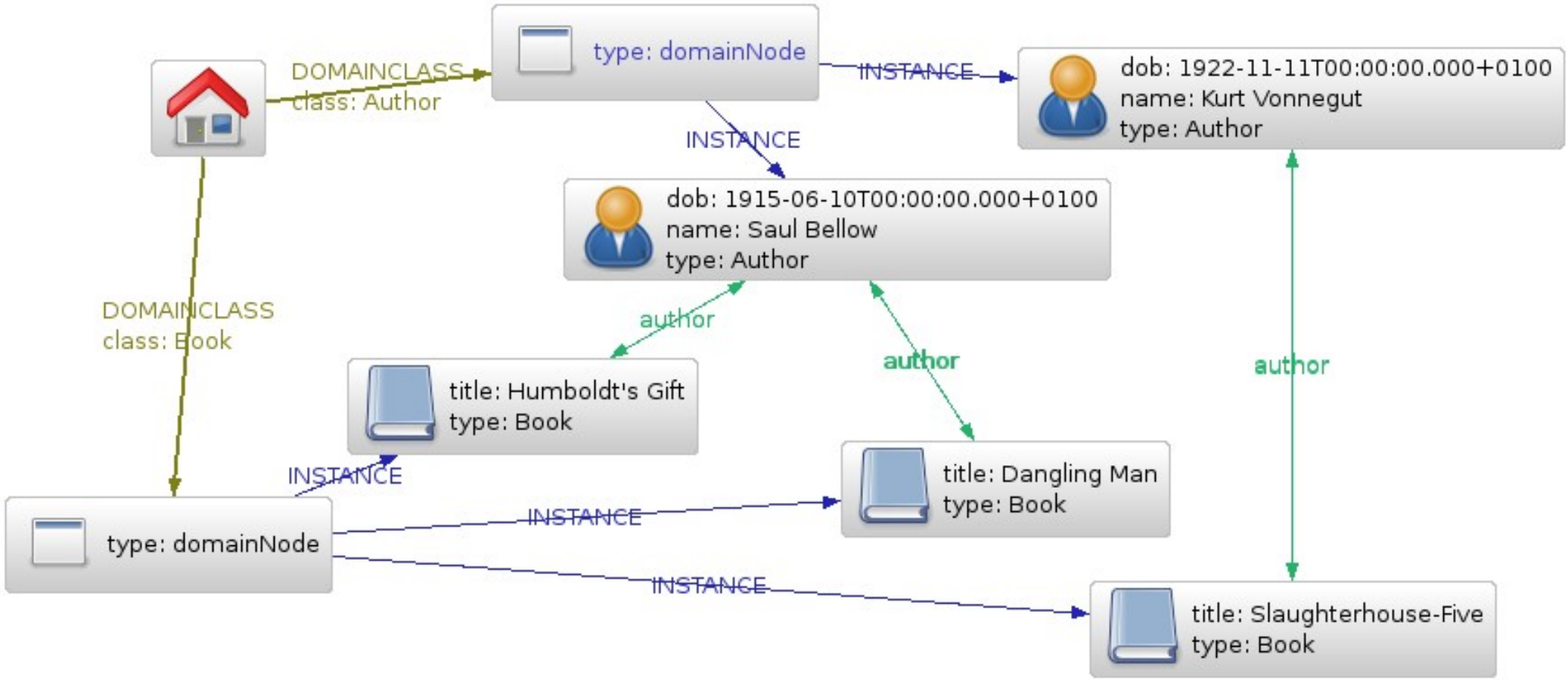
Archives

- October 2009
- September 2009

Meta

- Log in

Grails Neoclipse screendump



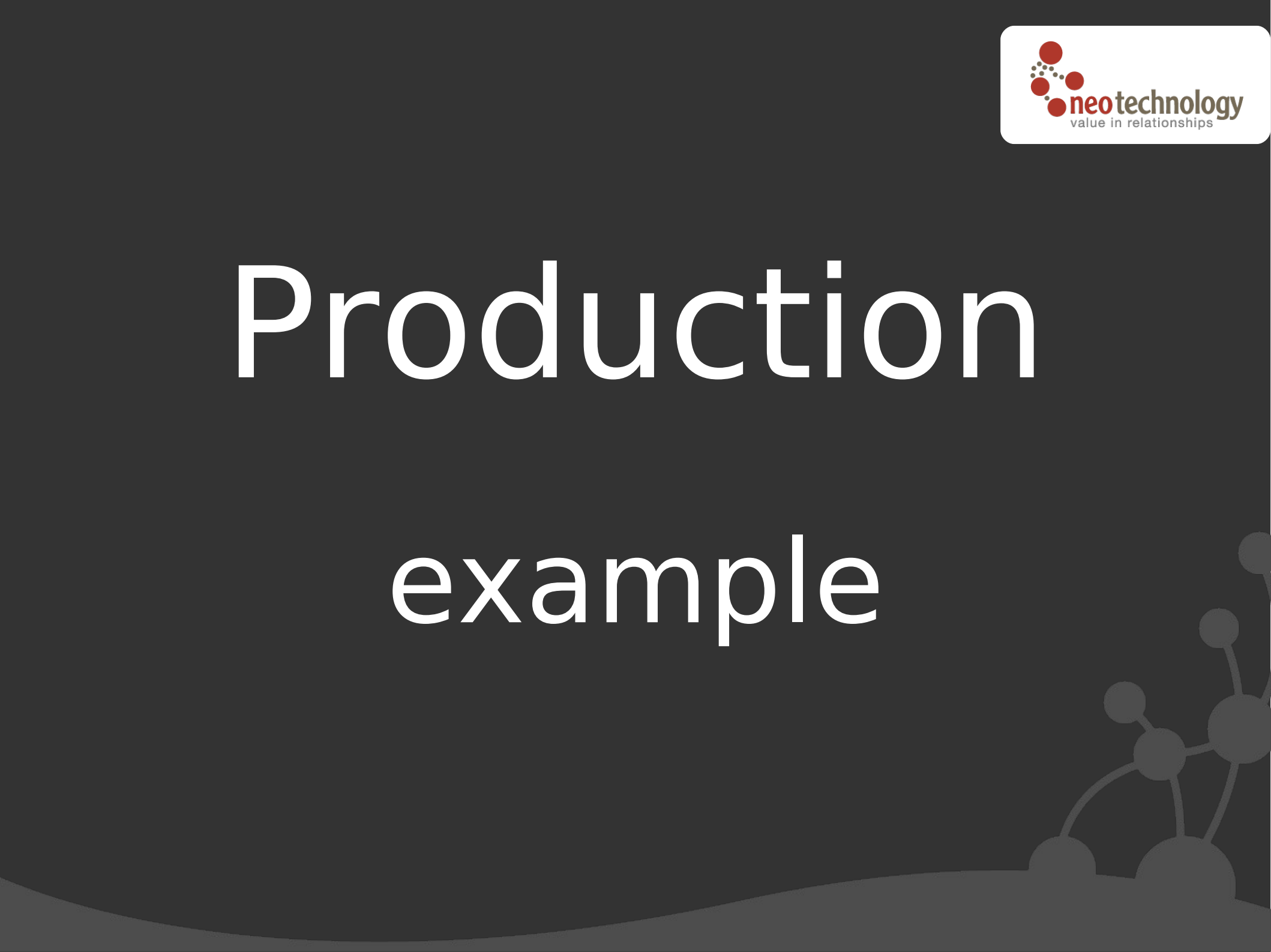
Scale out – replication

- Rolling out Neo4j HA... soon :)
- Master-slave replication, 1st configuration
  - MySQL style... ish
  - Except all instances can write, synchronously between writing slave & master (strong consistency)
  - Updates are asynchronously propagated to the other slaves (eventual consistency)
- This can handle billions of entities...
- ... but not 100B

Scale out – partitioning

- Sharding possible today
  - … but you have to do manual work
  - … just as with MySQL
  - Great option: shard on top of resilient, scalable OSS app server 

, see: www.codecauldron.org
- Transparent partitioning? Neo4j 2.0
  - 100B? Easy to say. Sliiiiightly harder to do.
  - Fundamentals: BASE & eventual consistency
  - Generic clustering algorithm as base case, but give lots of knobs for developers


neotechnology
value in relationships
Production
example

Case: Enterprise Content Management

- Background:
  - Enterprise Content Management (think: “CMS but also with non-web content,” or “big filesystem on the webotubes”)
  - Thousands of users
  - Various content types: PDFs, images, videos, doc files, organization-specific XML formats
  - “Multi-tentant SaaS”

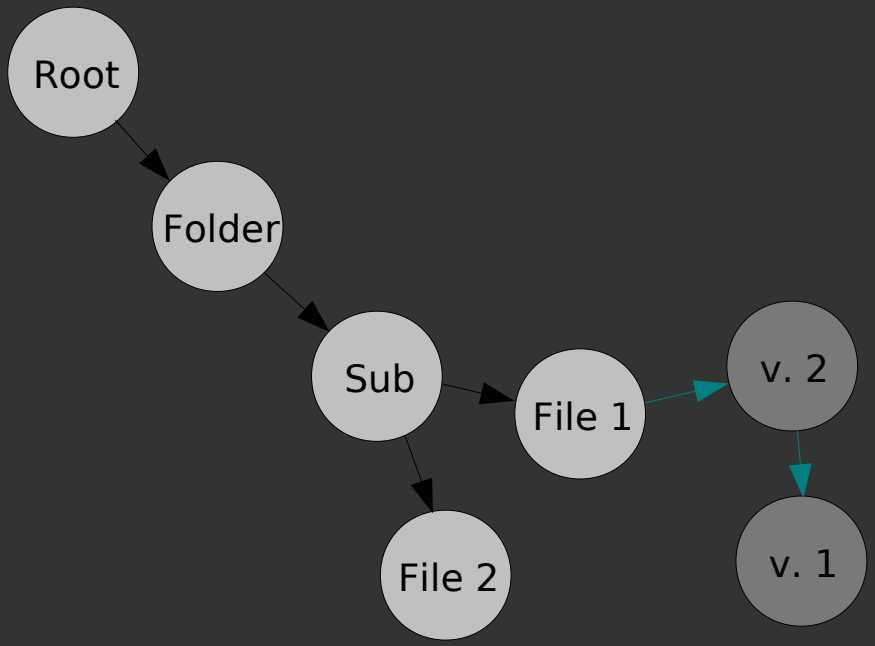
Outline

- A saga in three parts
  - Part I: we're a file system on the web
  - Part II: sharing is caring
  - Part III: profit

Part I: We're a file system on the web

- Let's get something out there
  - We shall store files in folders
  - Ya know, versions are kinda cool

Part I: concept model



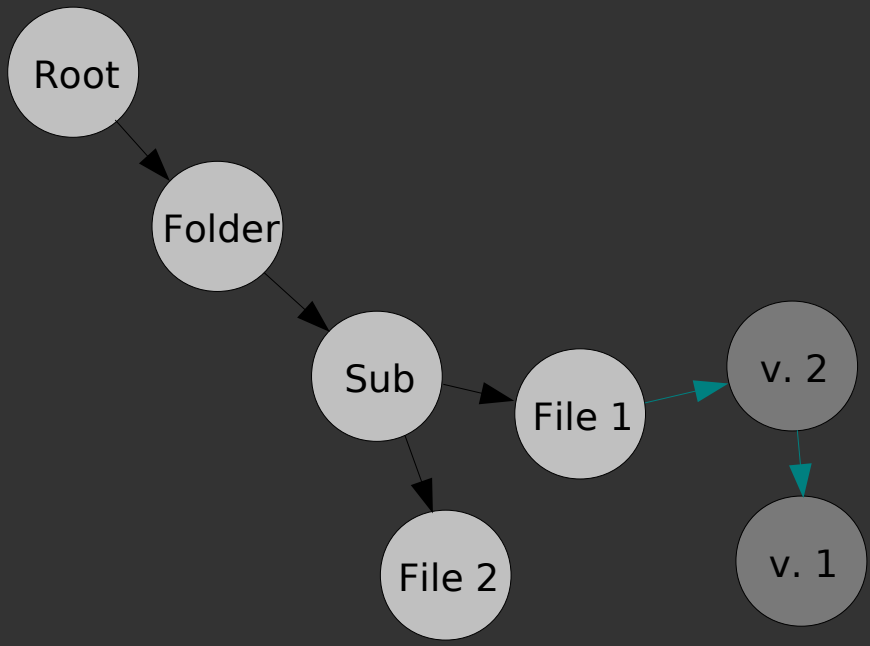
Part I: SQL? NOSQL?

- So hmm, this whole relational database thingie...

- Modeling hierarchies?
  - Doable but kinda painful.
  - Sucky code. And hmm, quite a lot of joins.

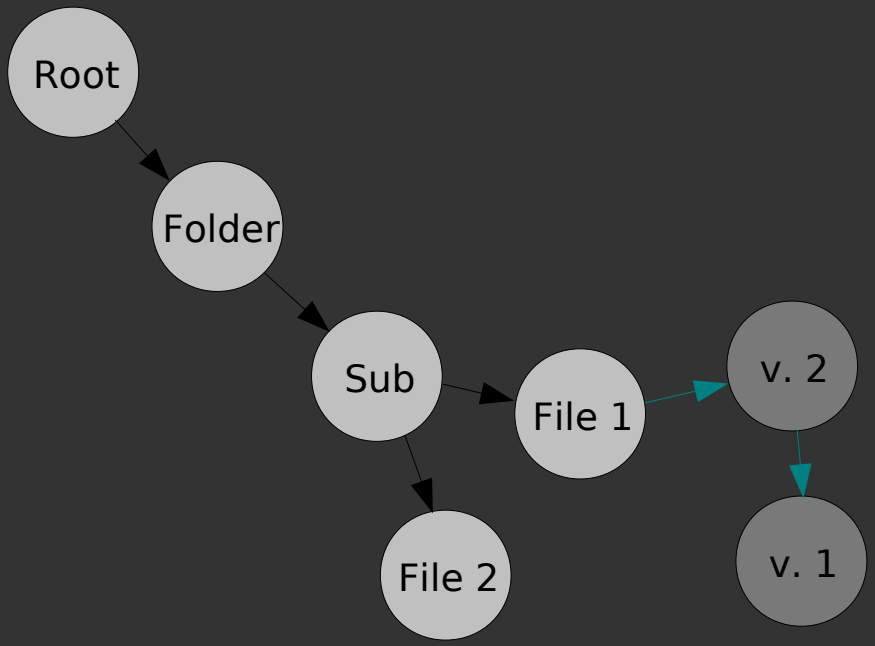
- Activity feeds
  - Wouldn't it be cool if you could subscribe to a folder and get changes fed to you.
  - Whoa, massive amount of joins!
  - Denormalization, write explosion, code complexity.

Part I: concept model



How do you represent this in a graph database?

Tadaa!



How do you implement activity feeds?

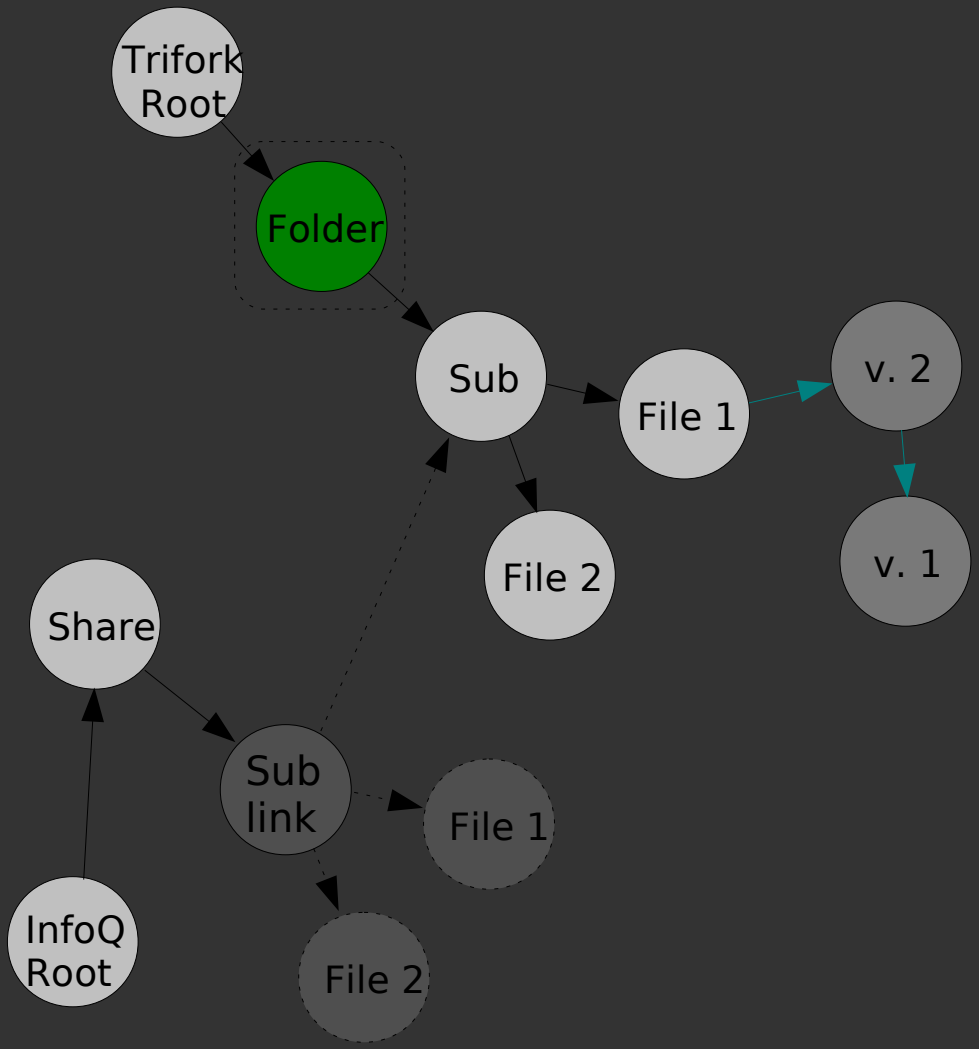
Easier when you do ~1M traversals per second. :)

No need to denormalize and aggregate events at each folder level.

Part II: Sharing is caring

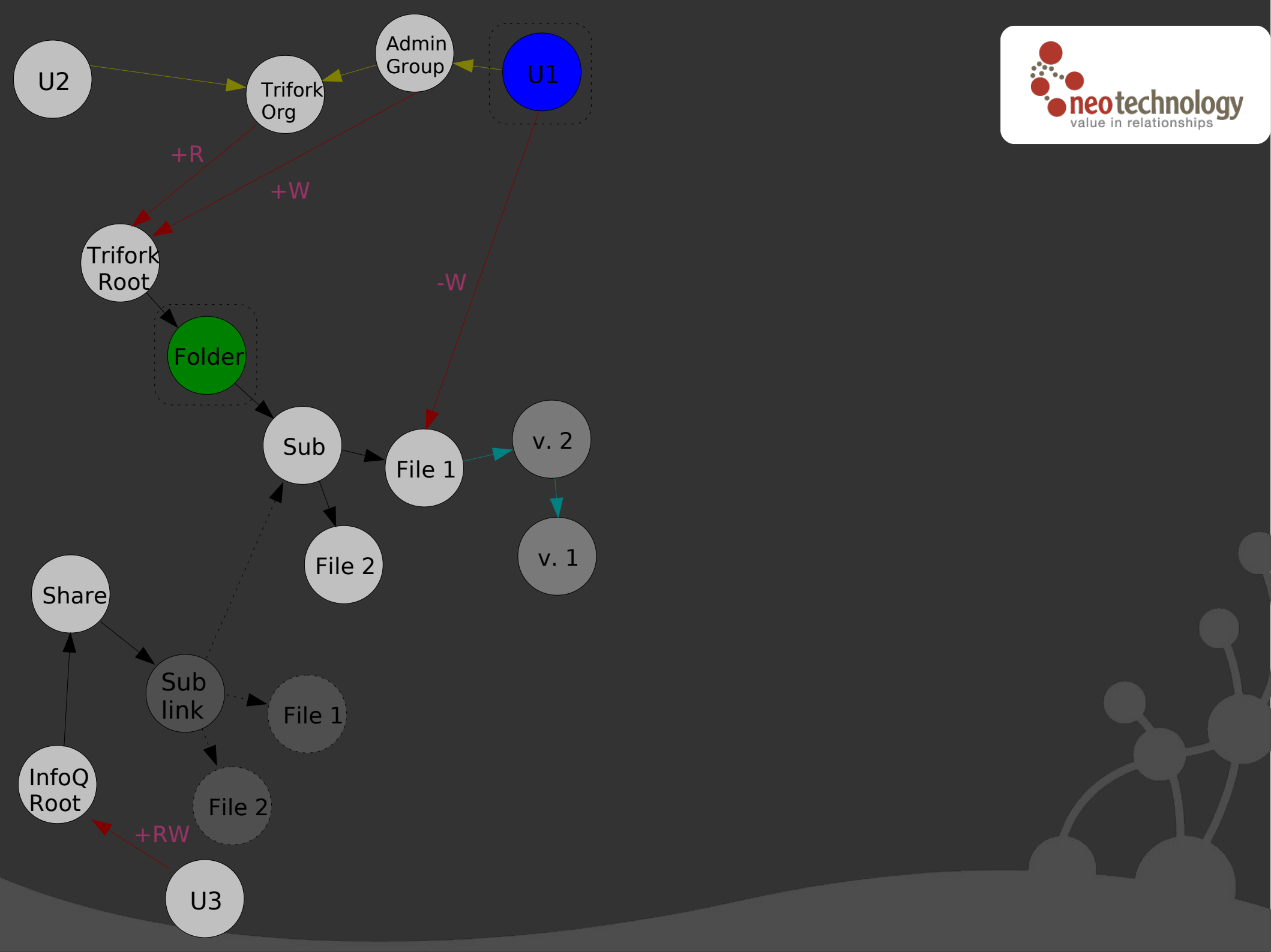
- We're oh-so SaaS and multi-tentant
- Would be useful if we could share content between organizations
  - Since we're all kinda running on top of the same system (not just same software) anyway

Part II: concept model (a)



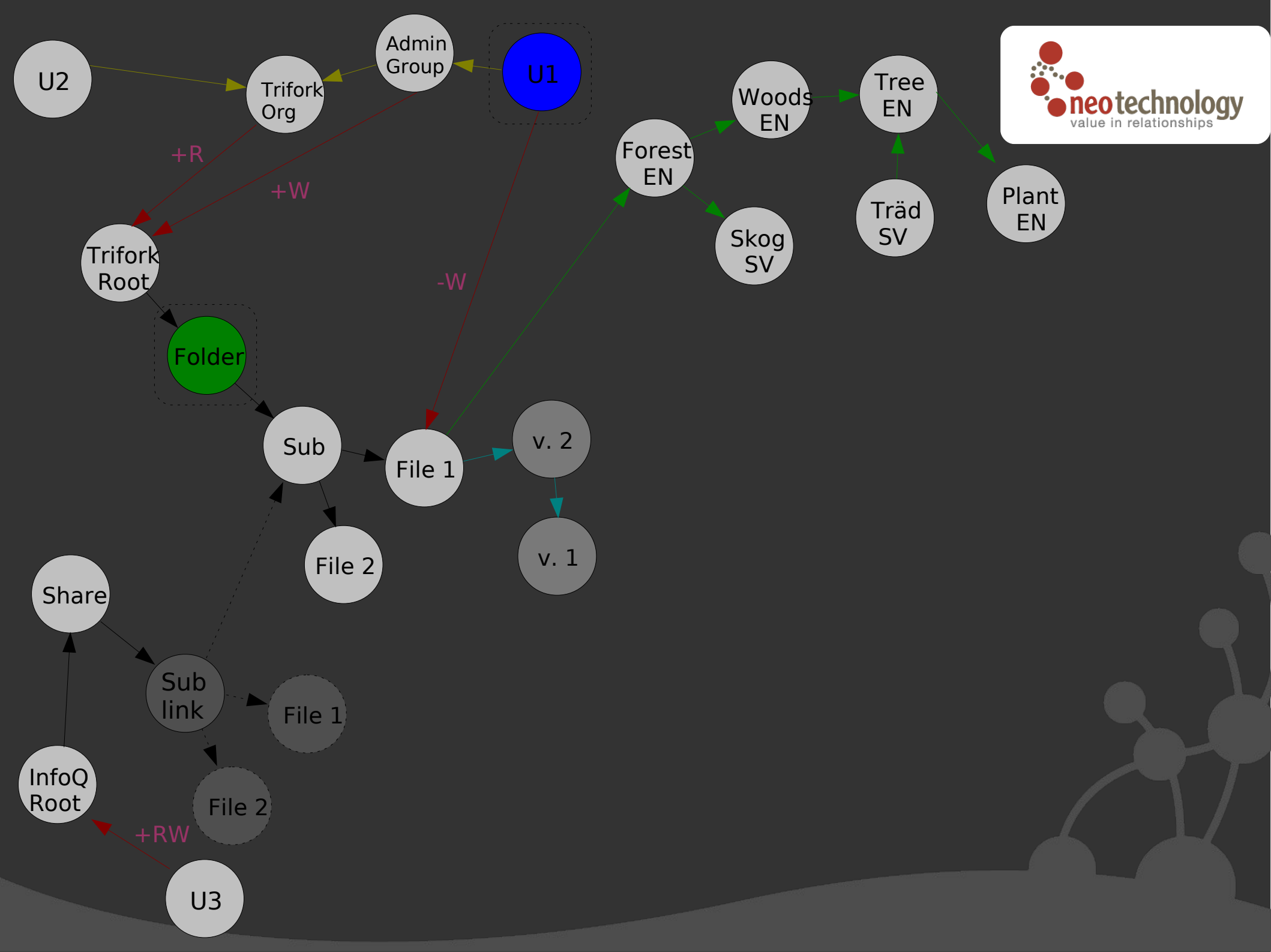
Part II: Security

- Whoa, guys, security?
- Customer sez: we need to model organizations
  - And suborganizations
  - And hierarchical user groups
- Customer sez: and add some security to all that
  - So add ACLs
  - And incremental security


U2
Trifork Org
Admin Group
U1
+R
+W
Trifork Root
-W
Folder
Sub
File 1
v. 2
File 2
v. 1
Share
Sub link
File 1
InfoQ Root
File 2
+RW
U3
neotechnology
value in relationships

Part II: Keyword translations

- Customer sez: we need to cut costs
  - Ouch
  - But we spend a lot of time on manually translating keyword lists and things like that
- Let's model that in the graph!
- Also, this whole graph thing is really kinda flexible... so let's throw in some topologies while we're at it!


U2
Trifork Org
Admin Group
U1
+R
+W
-W
Trifork Root
Folder
Sub
File 1
File 2
v. 2
v. 1
Forest EN
Woods EN
Tree EN
Plant EN
Träd SV
Skog SV
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Share
Sub link
File 1
File 2
InfoQ Root
+RW
U3

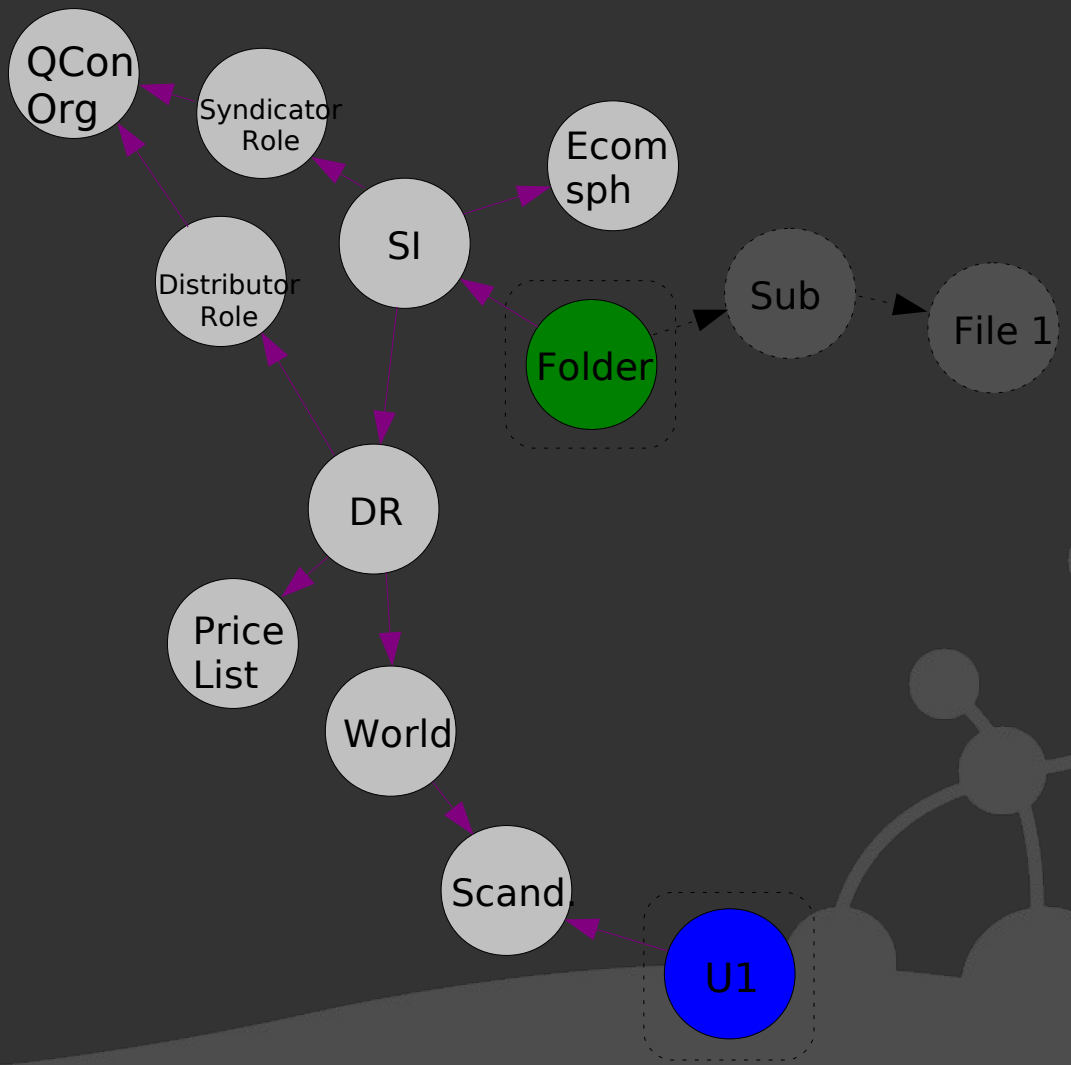
Part III: profit

- Customer sez:
  - I heart the cash
  - If my customers make money, I make money
  - Developers: “Gives me multi-tentant ecommerce!”

- Owait, say waht?

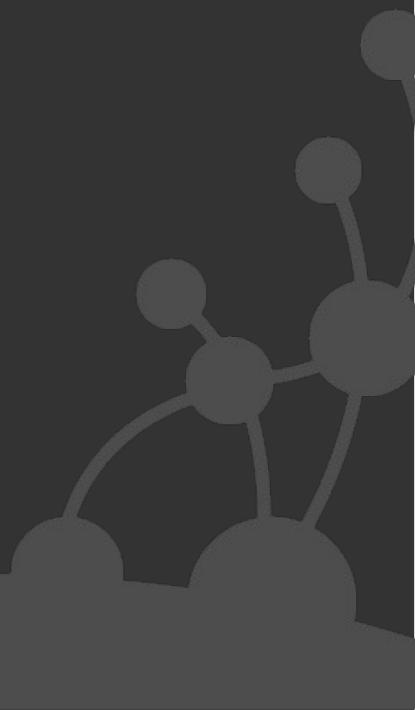
Part III: multi-tentant e-commerce?

- Conceptual breakdown:
  - Every org can “enable e-commerce,” thereby making their content sellable
  - Within every org, one should be able to model a supply chain of creator → syndicator → distributor → customer
  - The distributor assigned by region and sets price:
    - E.x. one dist for Scand, one for the UK
  - Due to inter-org sharing (remember?), the same content can belong to several e-commerce “spheres”


QCon Org
Syndicator Role
Ecom sph
SI
Distributor Role
Sub
File 1
Folder
DR
Price List
World
Scand.
U1

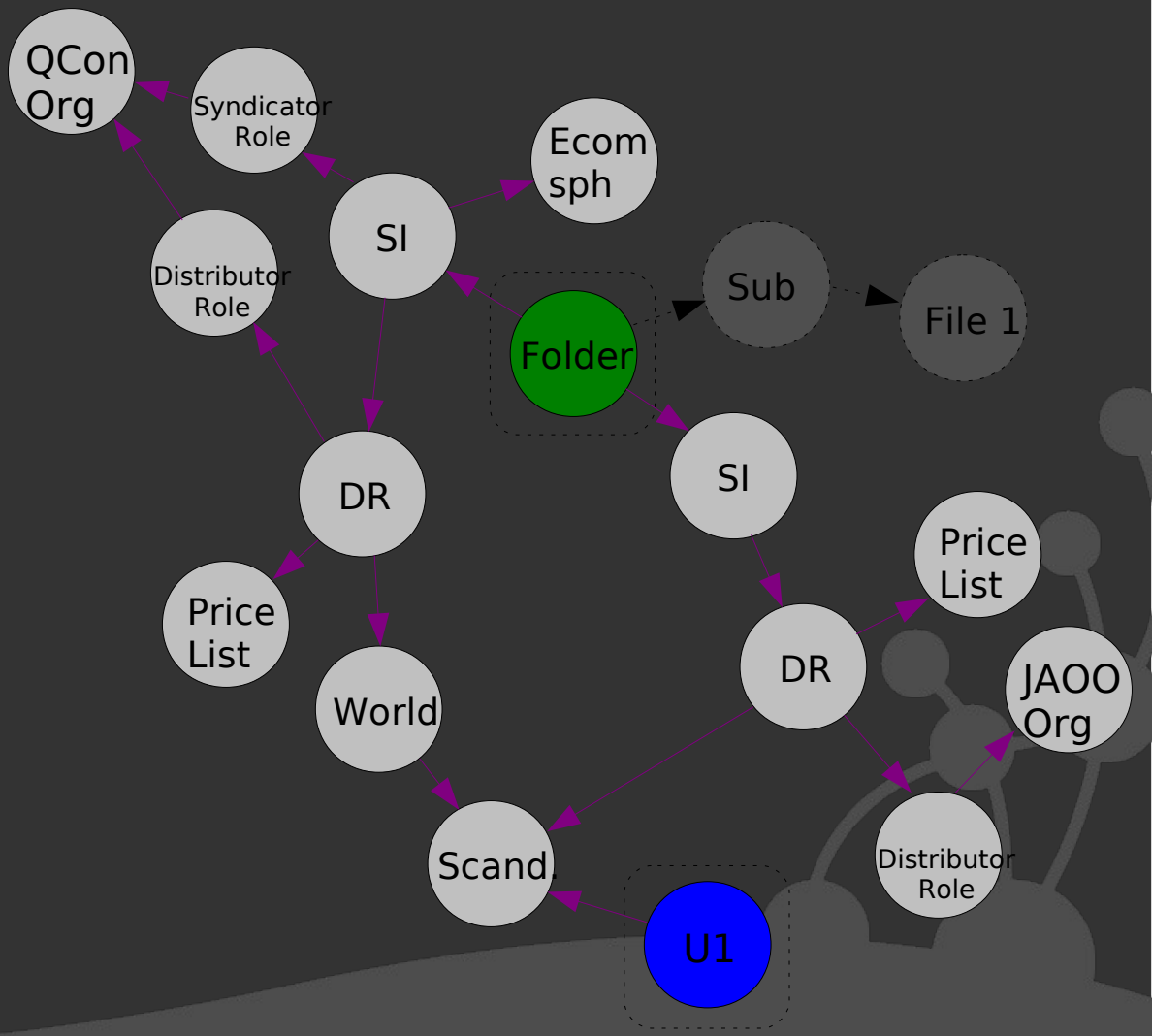
Finding the price

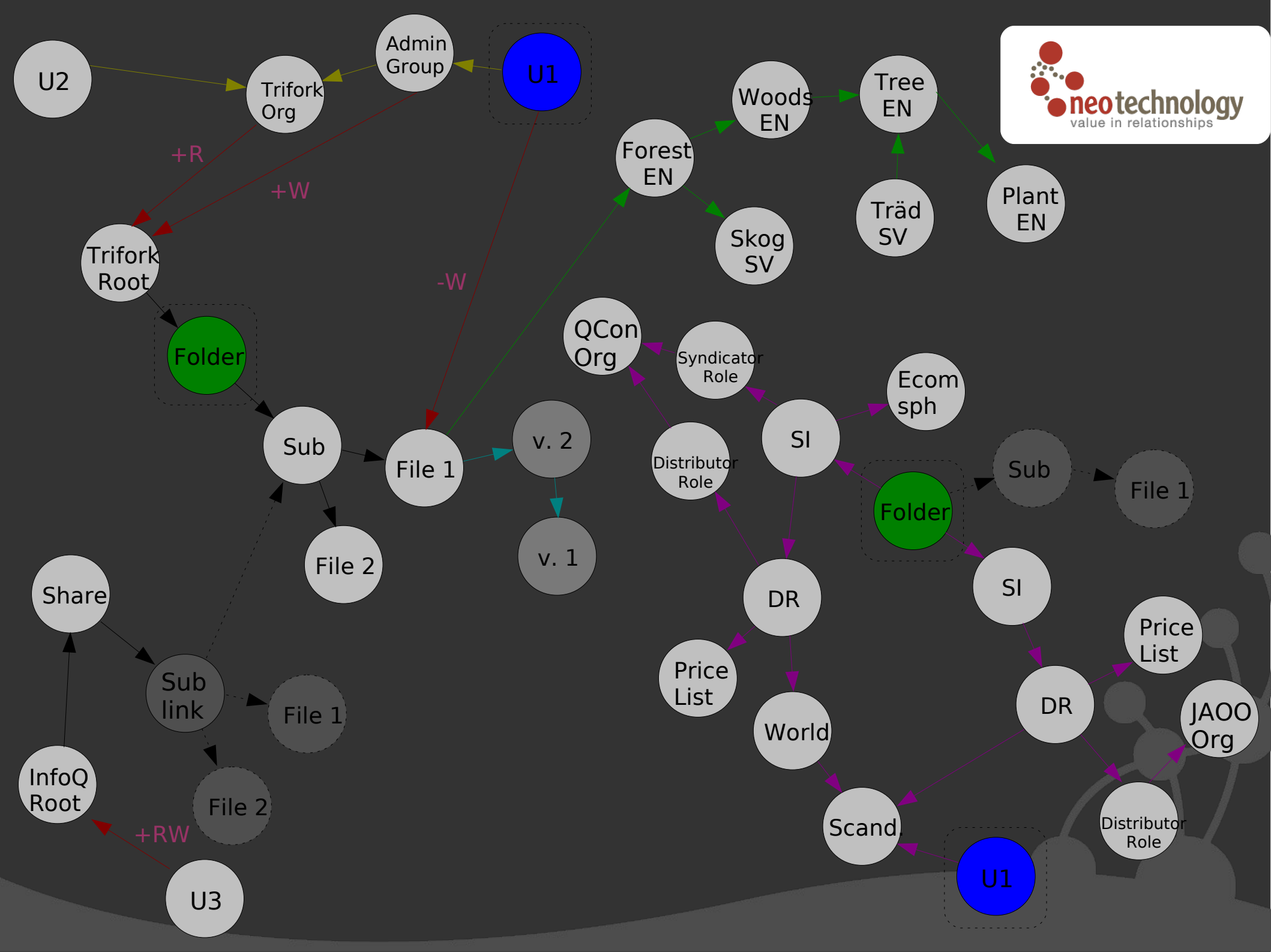
- So how do you actually figure out the price
  - Throw the distributor
  - Which is regionally bound
  - Per content
  - Per e-commerce sphere
- That's a shortest path algo!



Finding the price:

Equivalent to finding the shortest path from U1 to File1 along “purple and black” relationship types.




U2
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Tree EN
Forest EN
Skog SV
Träd SV
Plant EN
QCon Org
Syndicator Role
Distributor Role
SI
Ecom sph
Folder
Sub
File 1
DR
SI
Price List
Price List
DR
JAOO Org
World
Scand
Distributor Role
U1
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value in relationships

ECM conclusions

- One example of an evolving model
- Site had a lots of content, lots of users
  - High read load
  - Moderate write load
  - Only backend: Neo4j
- “You go to a graph database for the performance... but you stay for the flexibility!”

How ego are you? (aka other impls?)

- Franz' **AllegroGraph** (http://agraph.franz.com)
  - Proprietary, Lisp, RDF-oriented but real graphdb
- Sones **graphDB** (http://sones.com)
  - Proprietary, .NET, cloud-only, req invite for test
- **Kloudshare** (http://kloudshare.com)
  - Graph database in the cloud, still stealth mode
- Google **Pregel** (http://bit.ly/dP9IP)
  - We are oh-so-secret
- Some academic papers from ~10 years ago
  - G = {V, E} #FAIL

Conclusion

- Graphs && Neo4j => teh awesome!
- Available NOW under AGPLv3 / commercial license
  - AGPLv3: “if you’re open source, we’re open source”
  - If you have proprietary software? Must buy a commercial license
  - But the first one is free!
- Download
  - http://neo4j.org
- Feedback
  - http://lists.neo4j.org

Twitter / julianbrowne: Going to play with Neo4j t ... - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://twitter.com/julianbrowne/status/2455417887

Google

intranet bit.ly-ify twitterkeys user salesforce trends analytics tickets

:julianbrowne twitter

Home Profile Find People Settings Help Sign out

Going to play with Neo4j this w/e. Seems to me that even after arguments about ACID/scale/CAP it's just more human & agile to be graph-based

5:42 PM Jul 3rd from web

julianbrowne

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Done

Questions?

Image credit: lost again! Sorry :(


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