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Neo4j

the benefits of graph databases

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What's the plan?

- Why now? – Four trends
- NoSQL overview
- Graph databases && Neo4j
- Conclusions
- Food

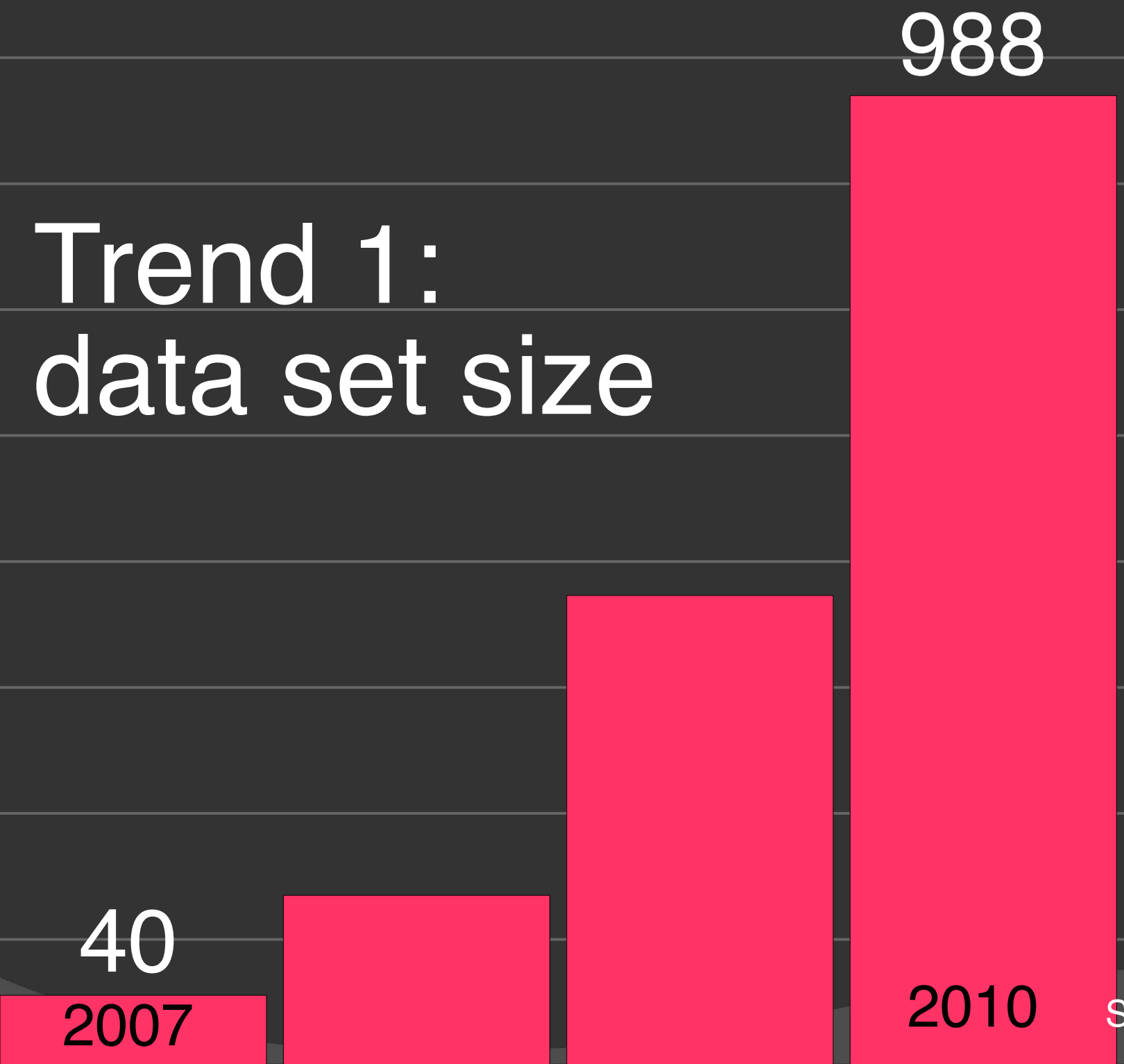
Trend 1: data set size

40

2007

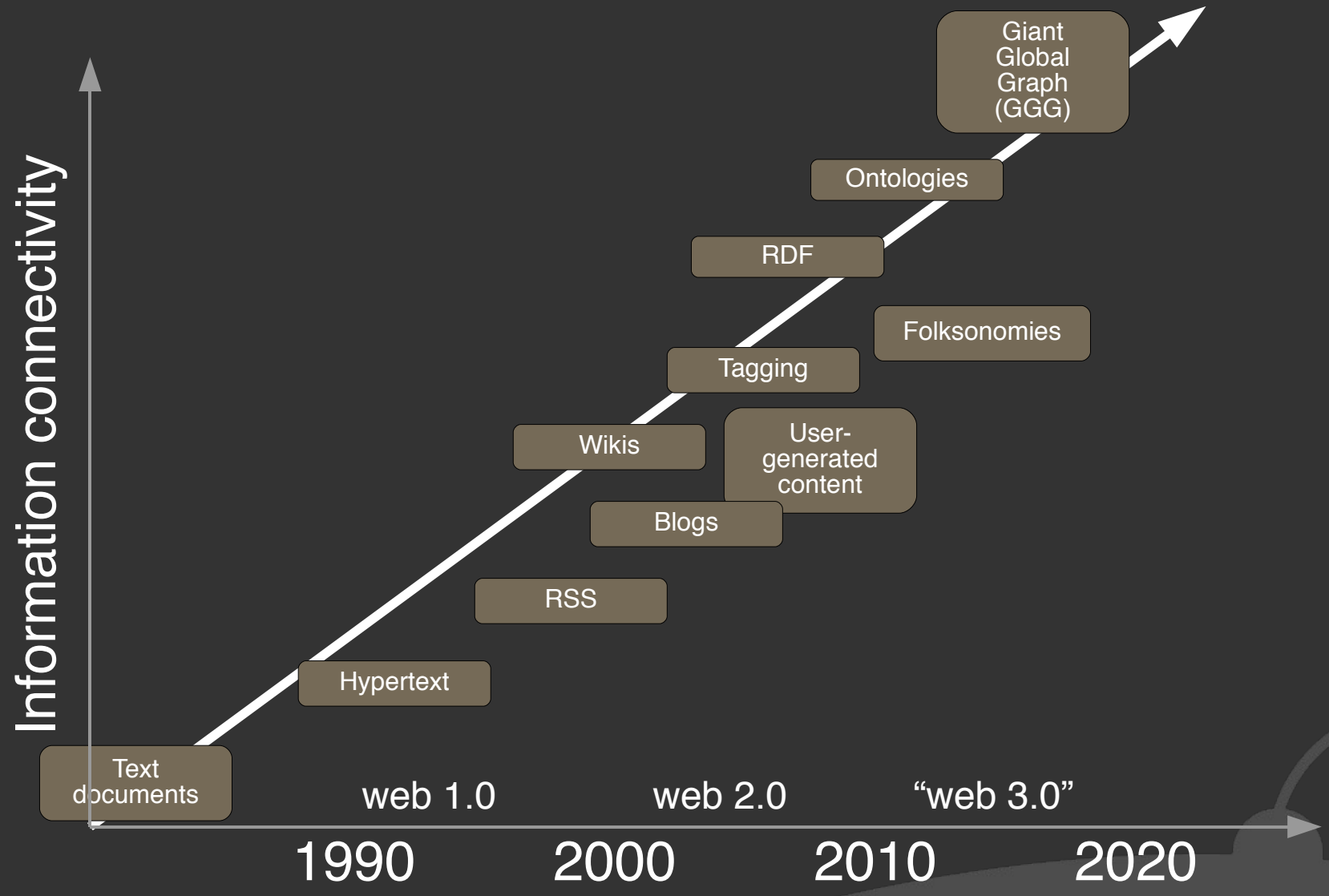
Source: IDC 2007

Trend 1: data set size



Source: IDC 2007

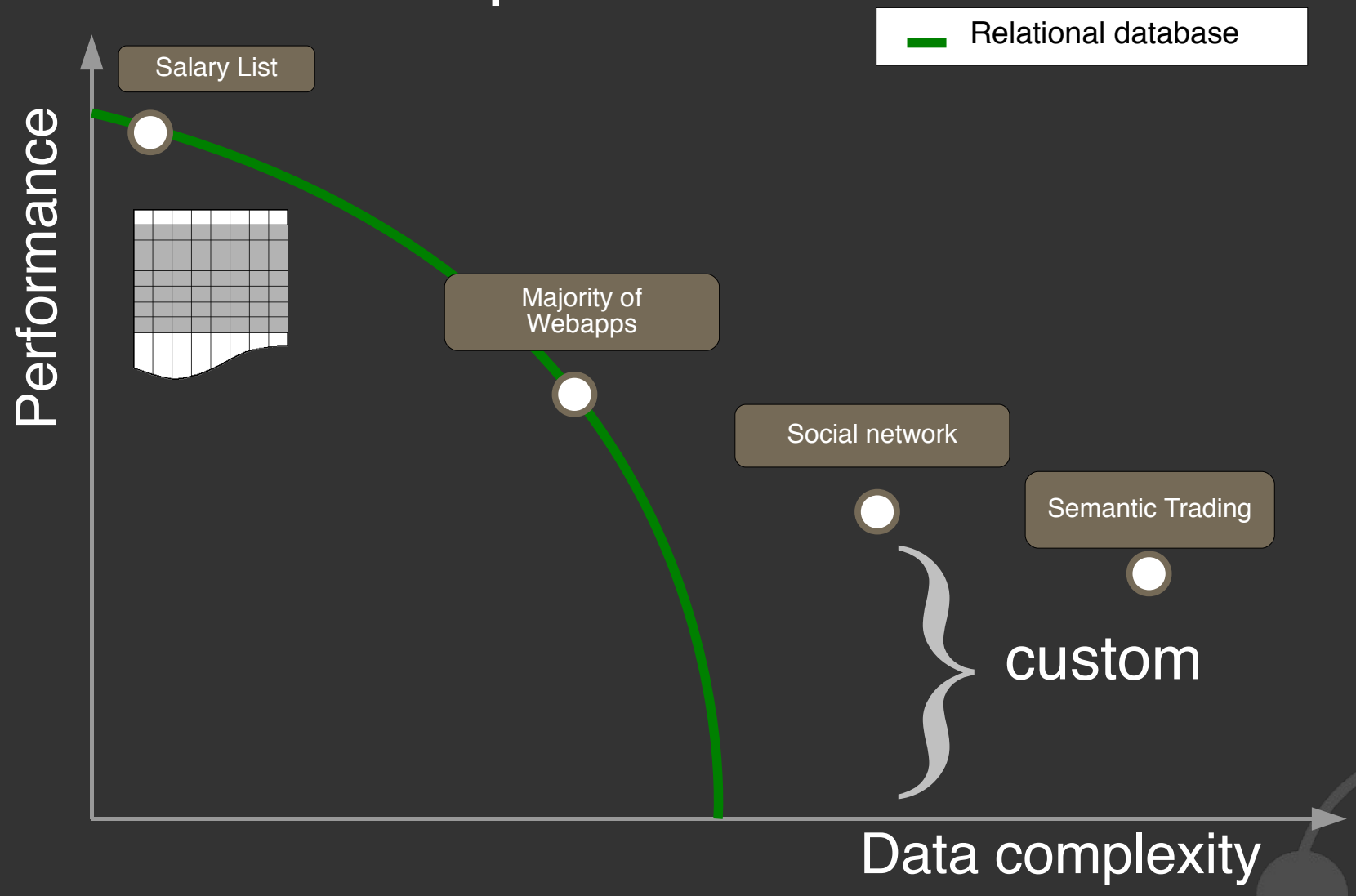
Trend 2: connectedness



Trend 3: semi-structure

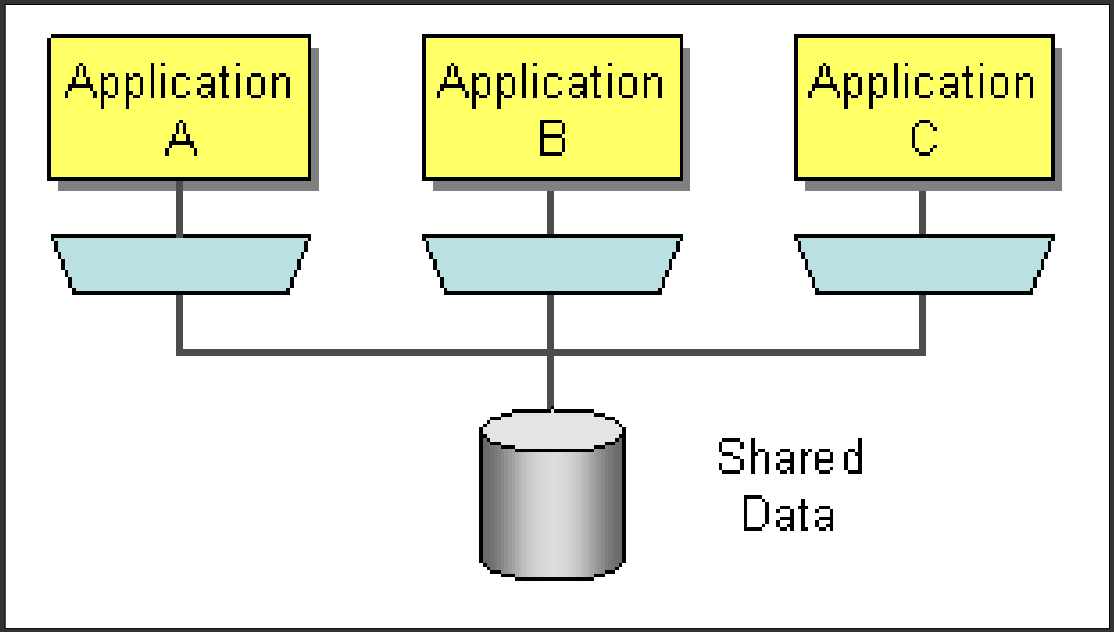
- Individualization of content!
  - In the salary lists of the 1970s, all elements had exactly one job
  - In the salary lists of the 2000s, we need 5 job columns! Or 8? Or 15?
- Trend accelerated by the decentralization of content generation that is the hallmark of the age of participation (“web 2.0”)

Aside: RDBMS performance



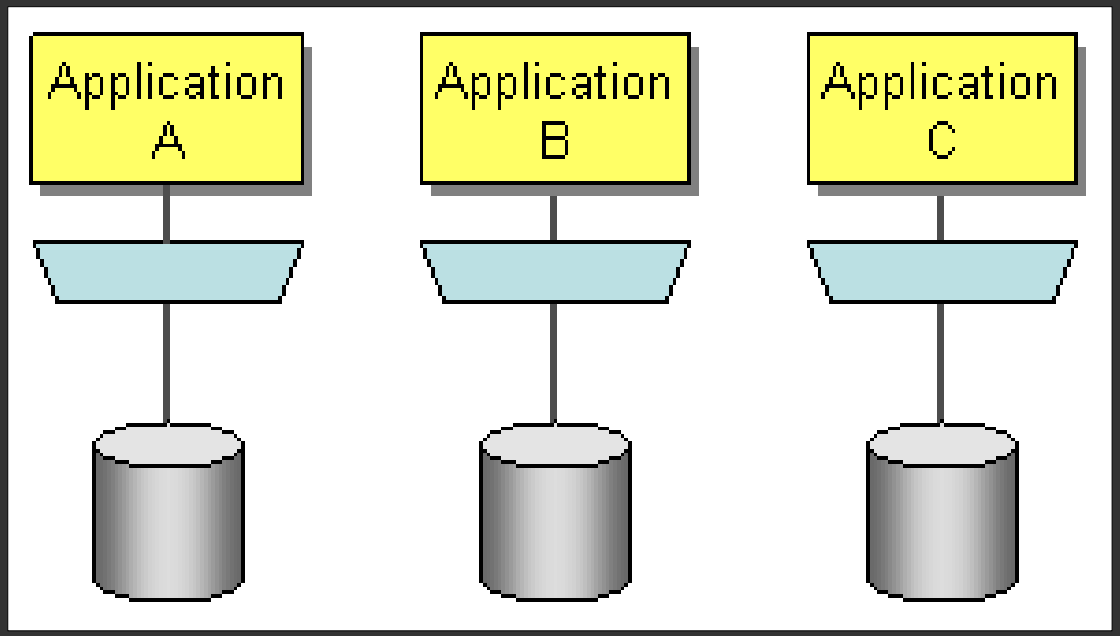
Trend 4: architecture

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.

NoSQL

overview

First off: the damn name

- NoSQL is NOT “Never SQL”
- NoSQL is NOT “No To SQL”
- NoSQL is NOT “WE HATE CHRIS' DOG”

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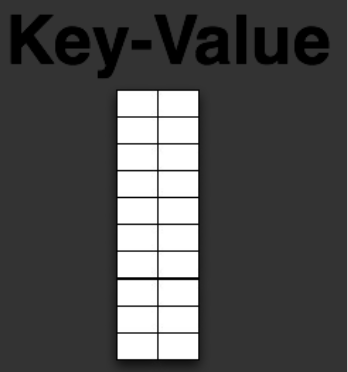
NoSQL

is simply

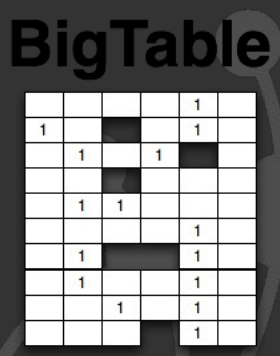
Not **O**nly **SQL**!

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

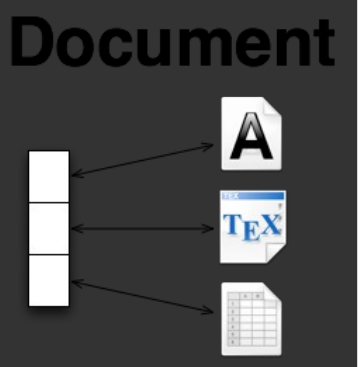


- BigTable clones
  - Based on Google's BigTable paper
  - Data model: big table, column families
  - Example: Hbase, Hypertable

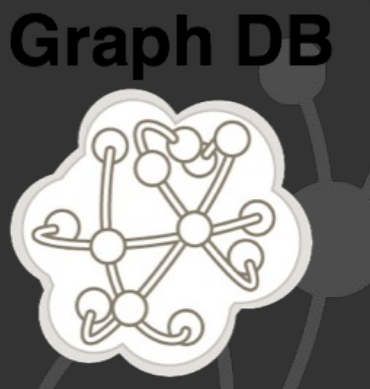


Four (emerging) NoSQL categories

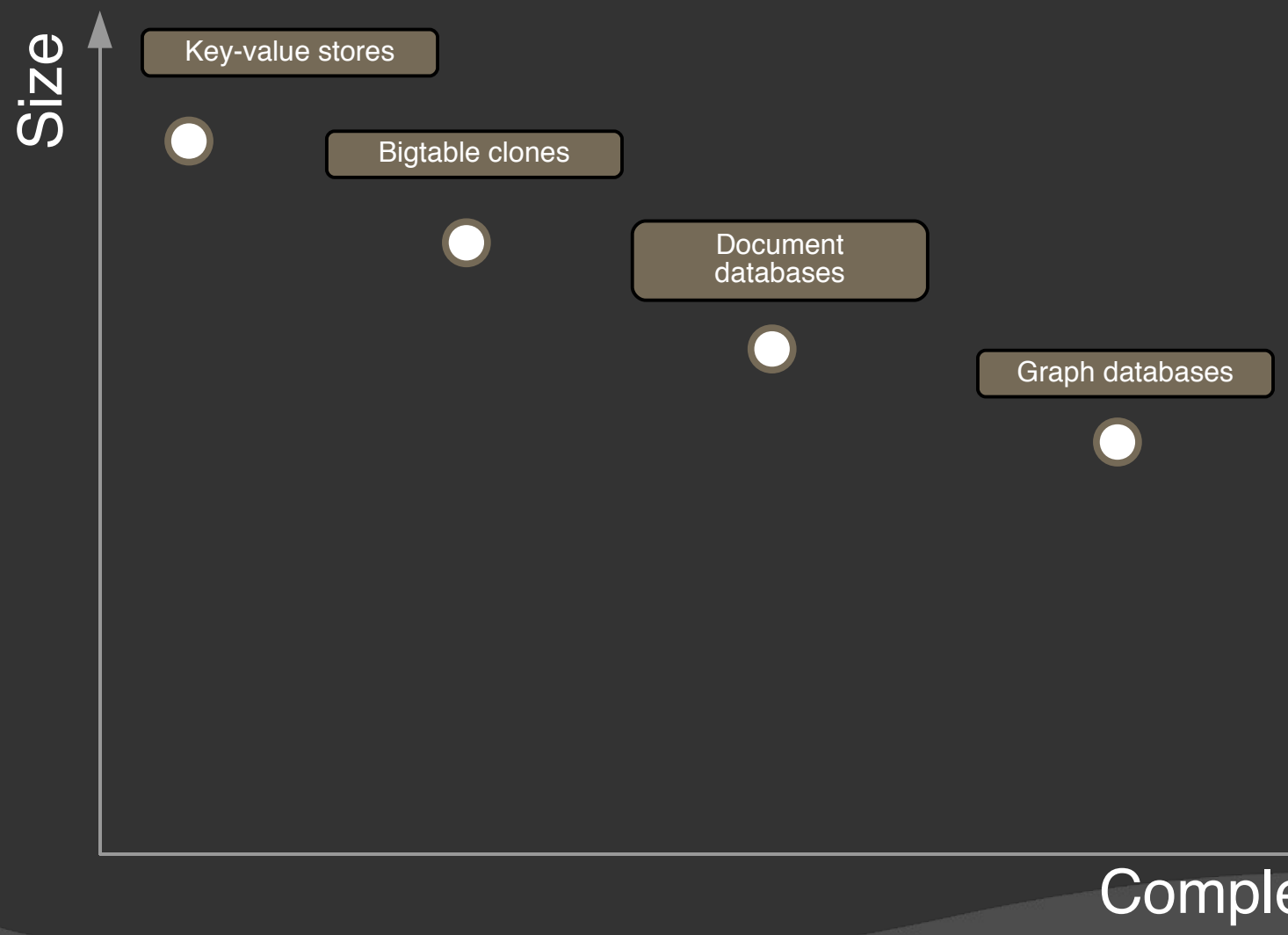
- Document databases
  - Inspired by Lotus Notes
  - Data model: collections of K-V collections
  - Example: CouchDB, MongoDB



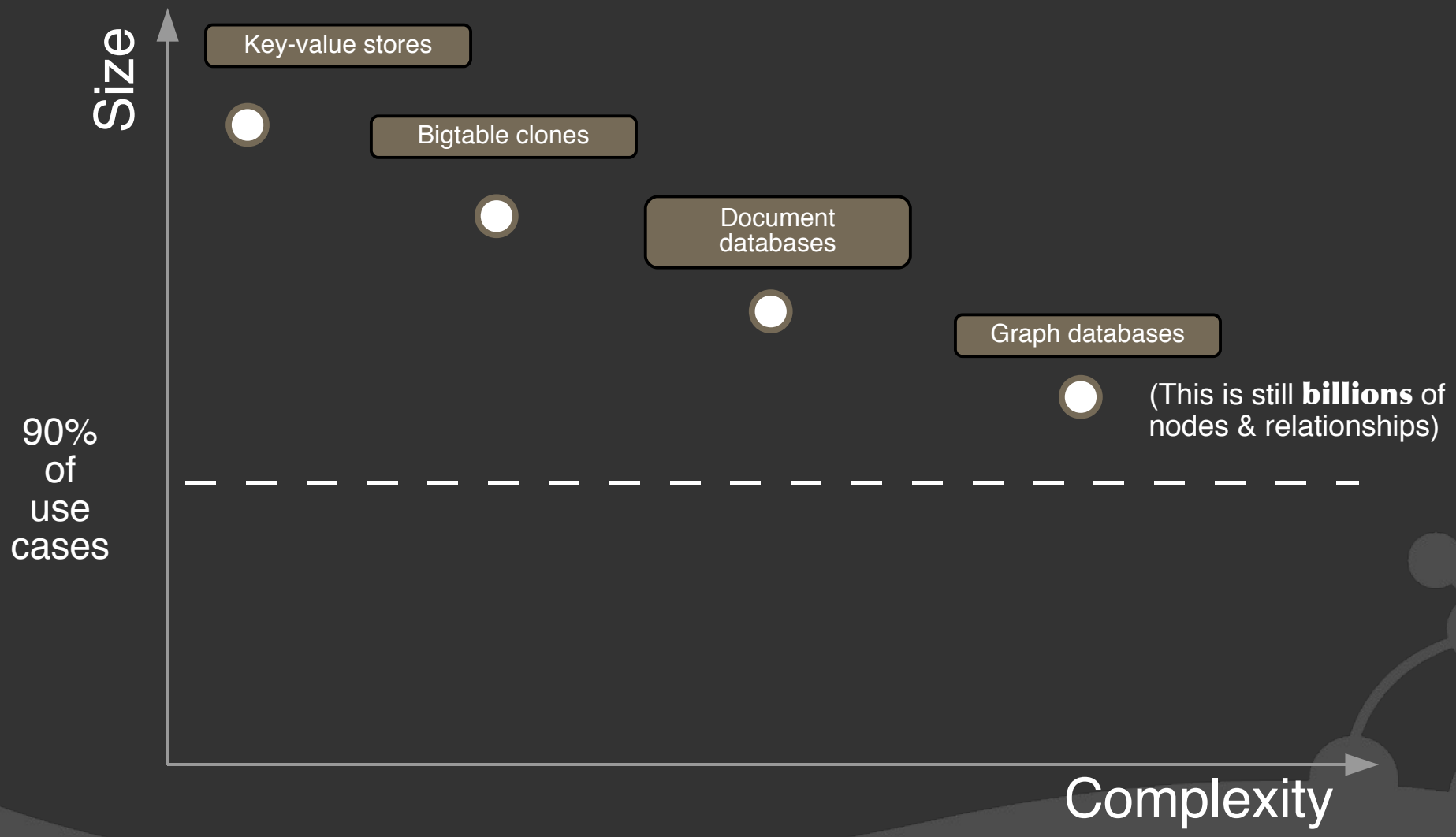
- Graph databases
  - Inspired by Euler & graph theory
  - Data model: nodes, rels, K-V on both
  - Example: AllegroGraph, VertexDB, Neo4j



NoSQL data models



NoSQL data models



Graph DBs

& Neo4j intro

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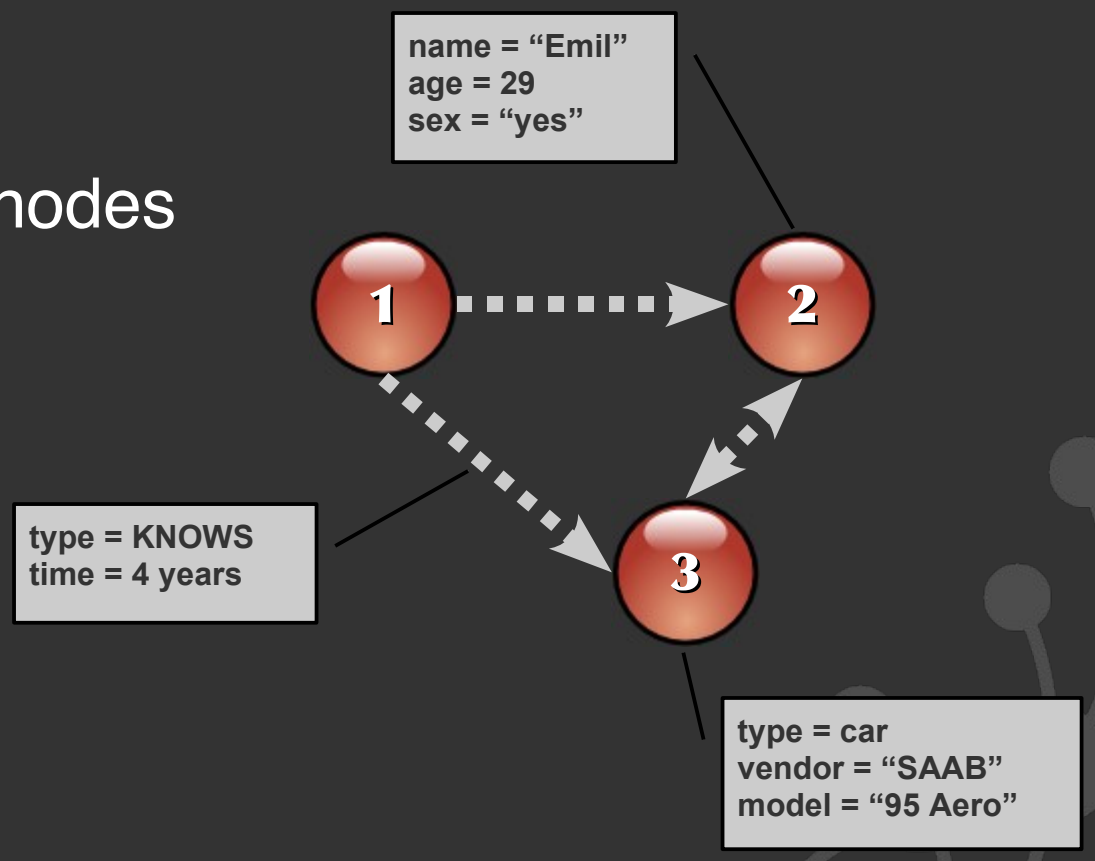
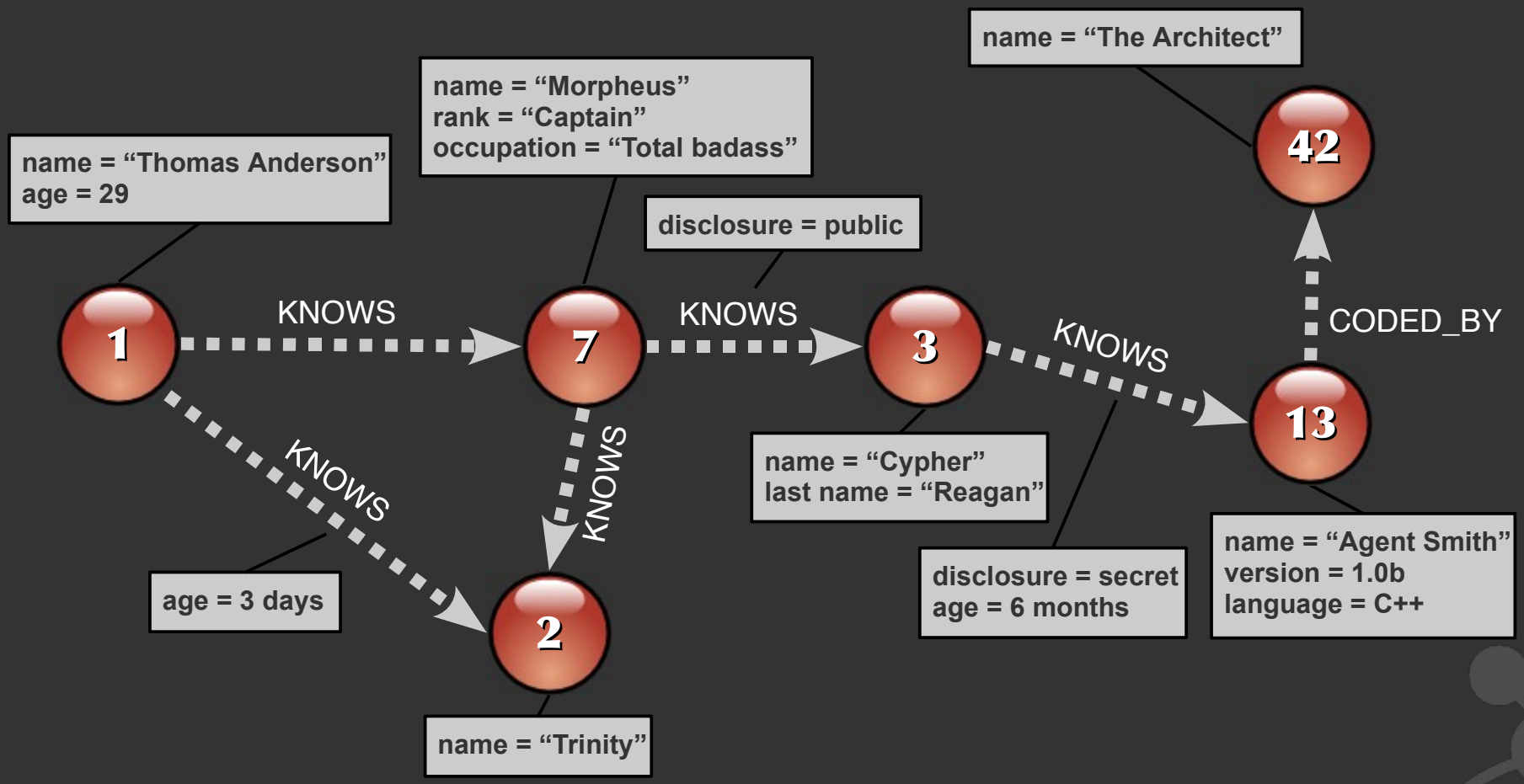
The Graph DB model: representation

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



Example: The Matrix



Code (1): Building a node space

```
NeoService neo = ... // Get factory


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

// Create Morpheus
Node morpheus = neo.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

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

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

// Create Morpheus
Node morpheus = neo.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();
```

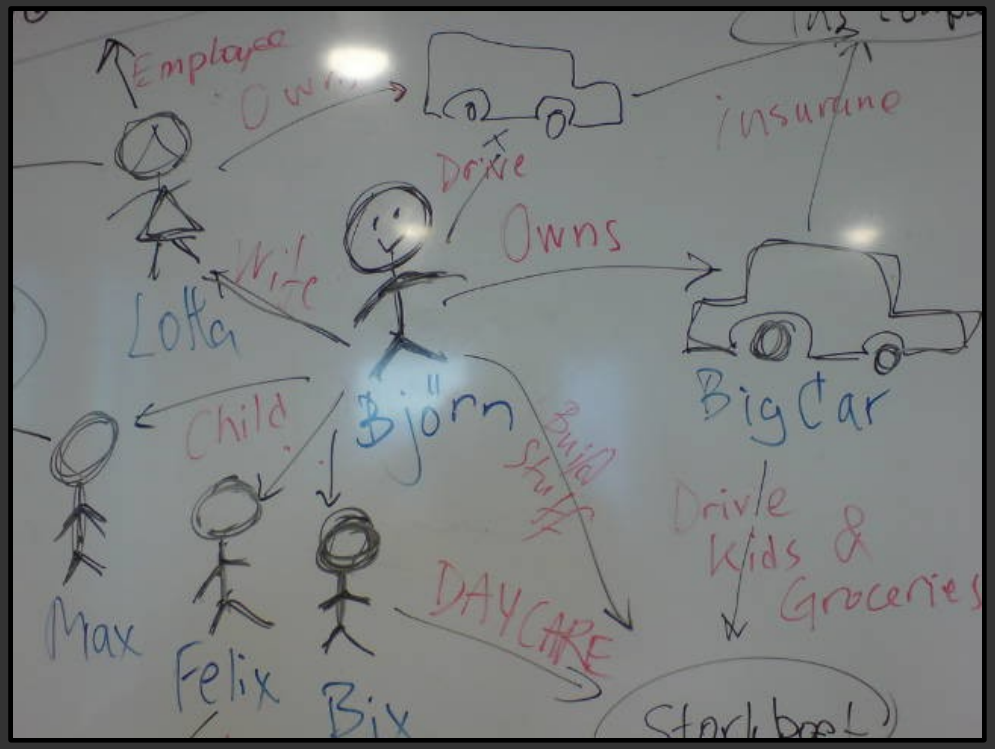
Code (1b): Defining RelationshipTypes

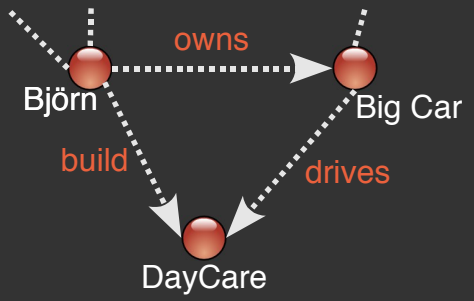
```
// In package org.neo4j.api.core
public interface RelationshipType
{
    String name();
}

// 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

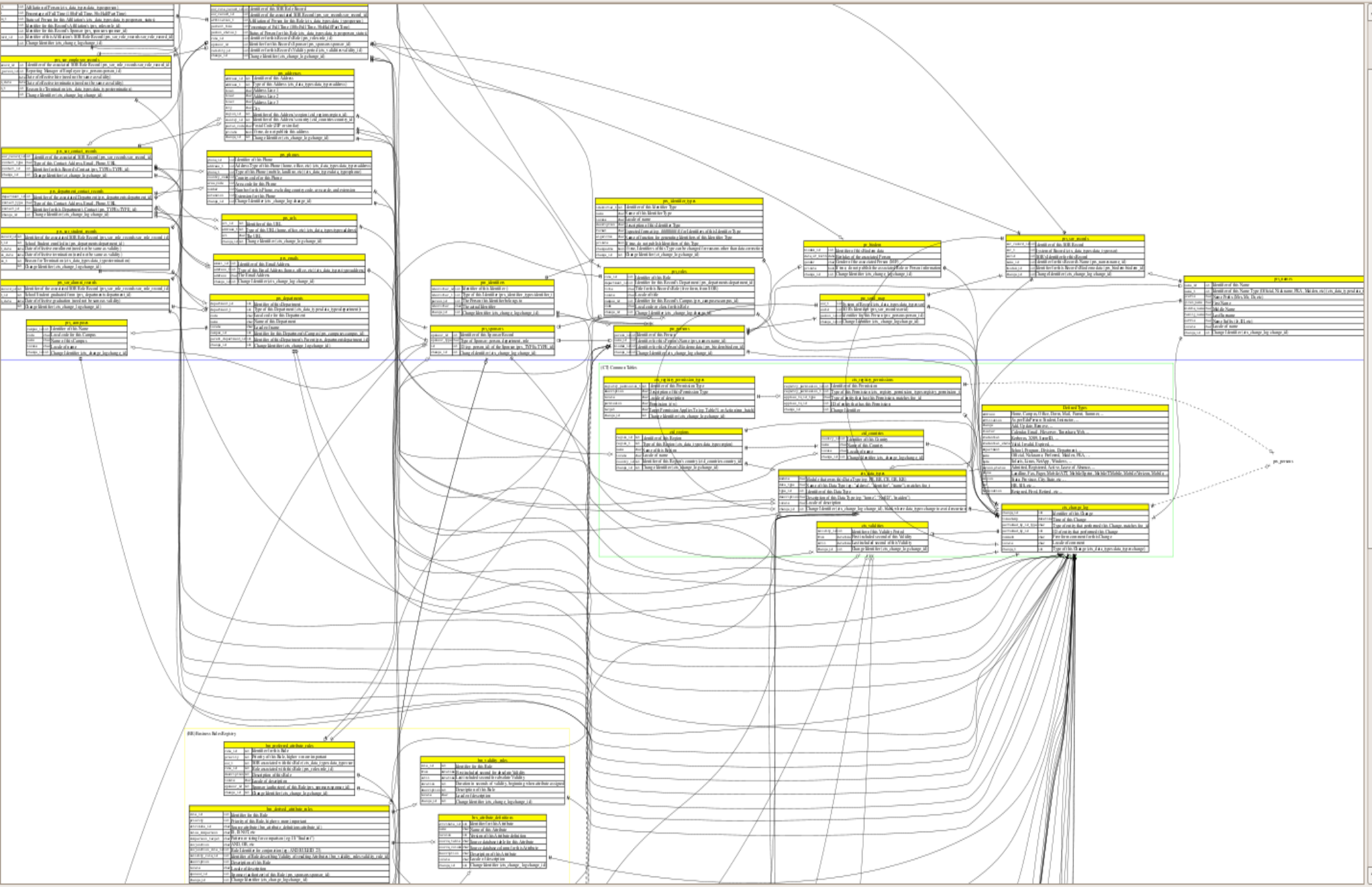




ORDATAMODEL

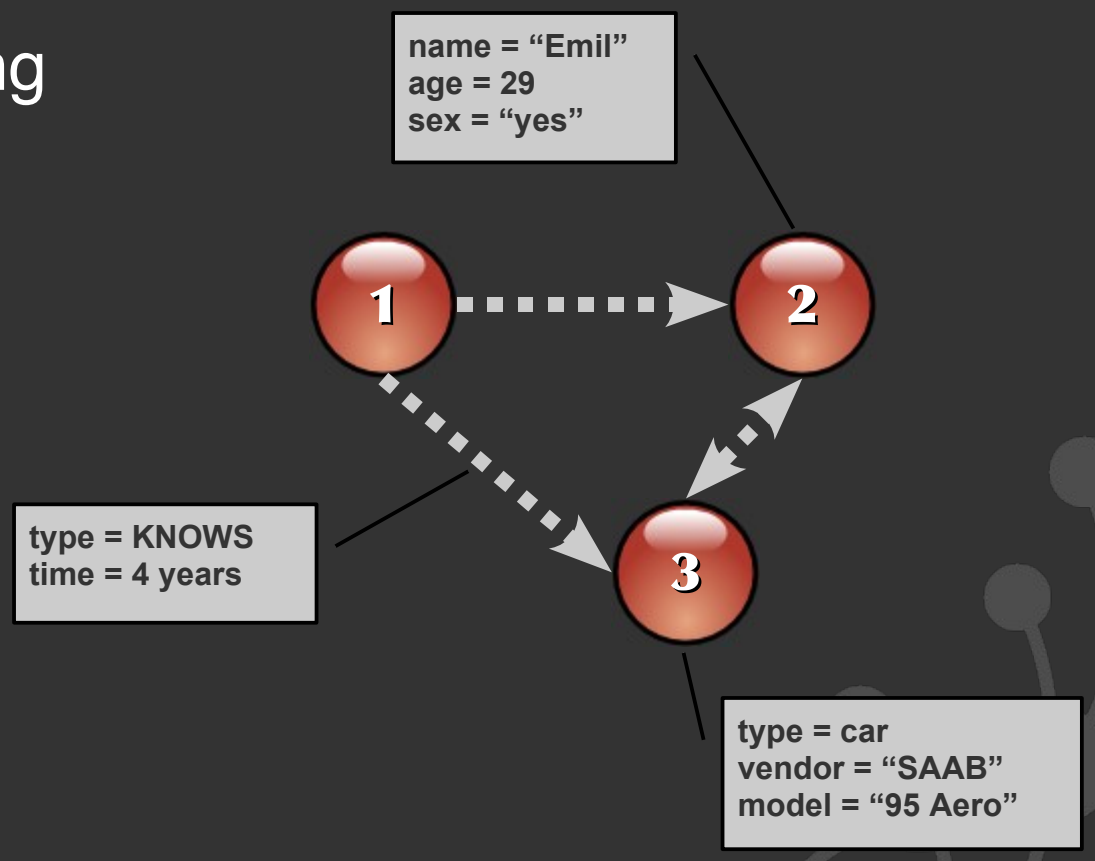
File Edit View Go Help

Previous Next 1 of 1 Continuous Best Fit Fit Width Zoom In Zoom Out 50%

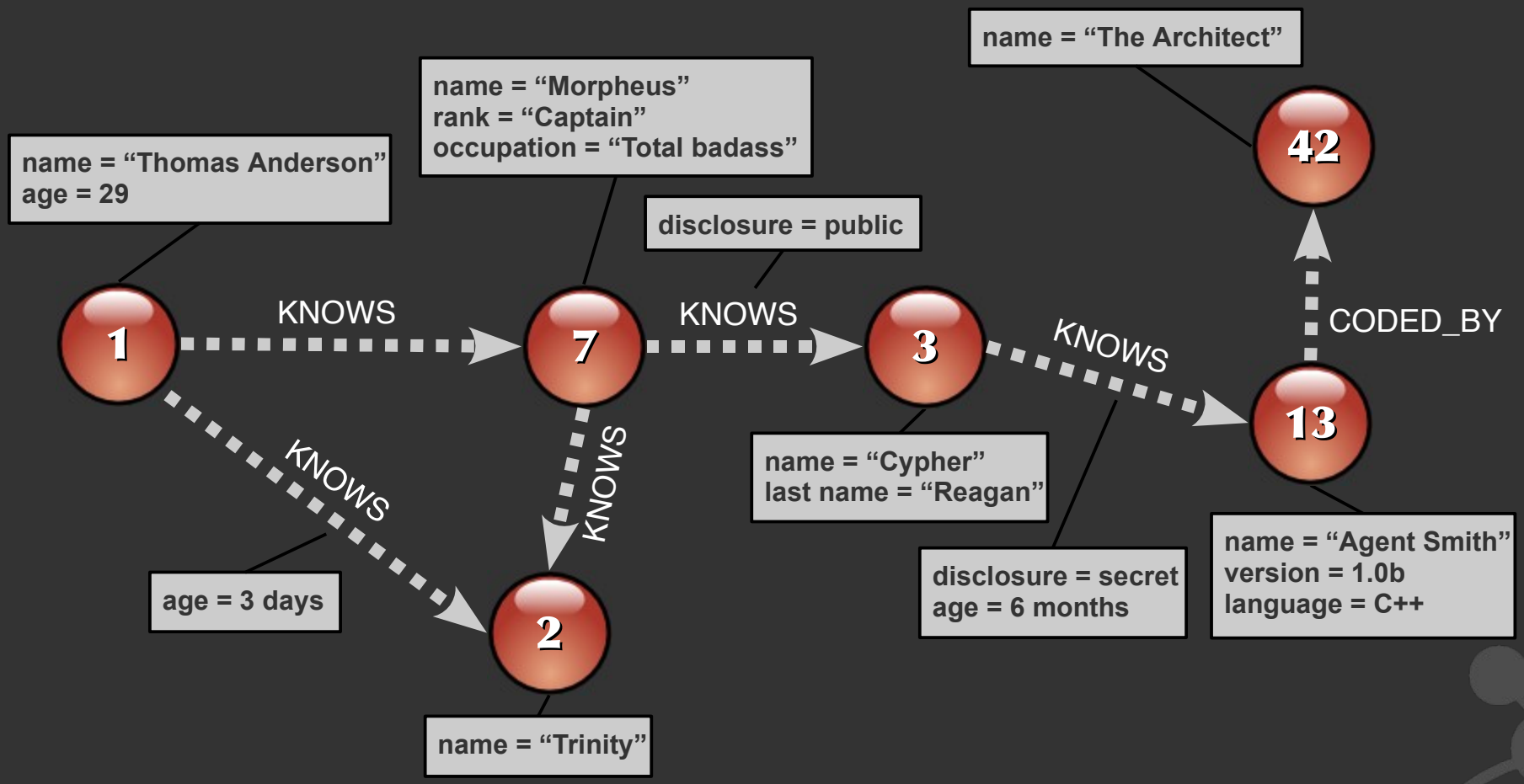


The Graph DB model: traversal

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



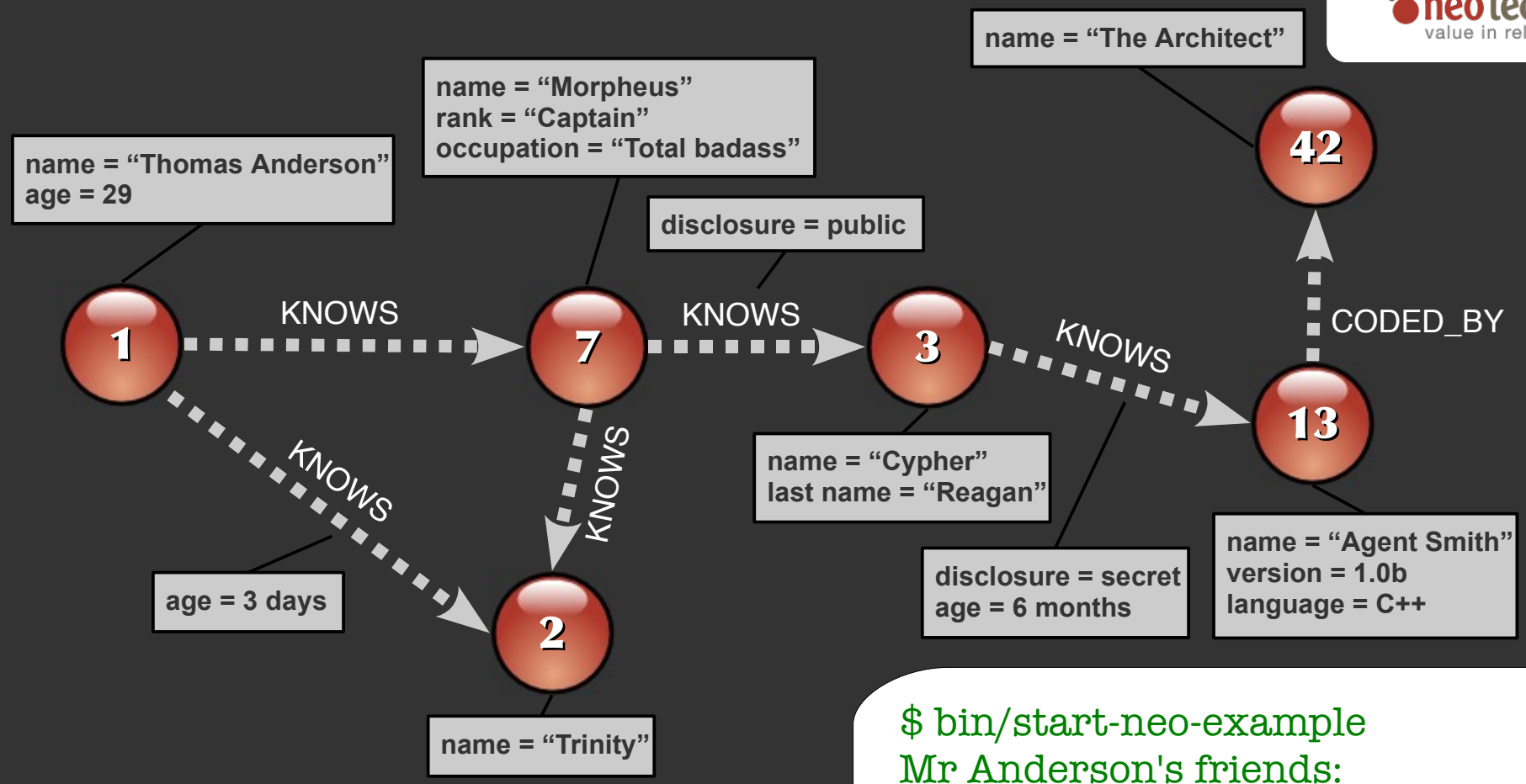
Example: Mr Anderson's friends



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" ) );
}
```

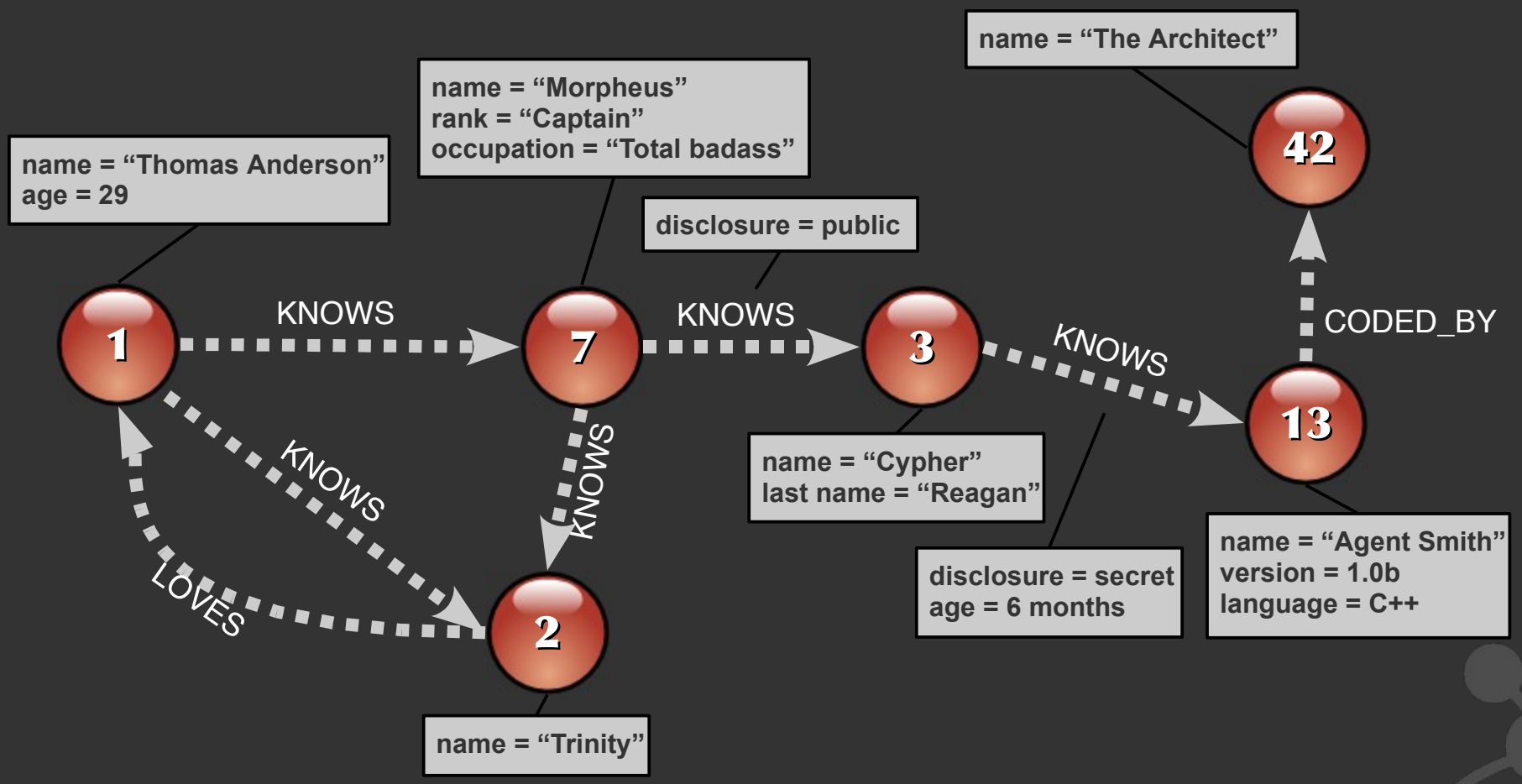



```
friendsTraverser = mrAnderson.traverse(
  Traverser.Order.BREADTH_FIRST,
  StopEvaluator.END_OF_GRAPH,
  ReturnableEvaluator.ALL_BUT_START_NODE,
  RelTypes.KNOWS,
  Direction.OUTGOING );
```

```
$ 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?

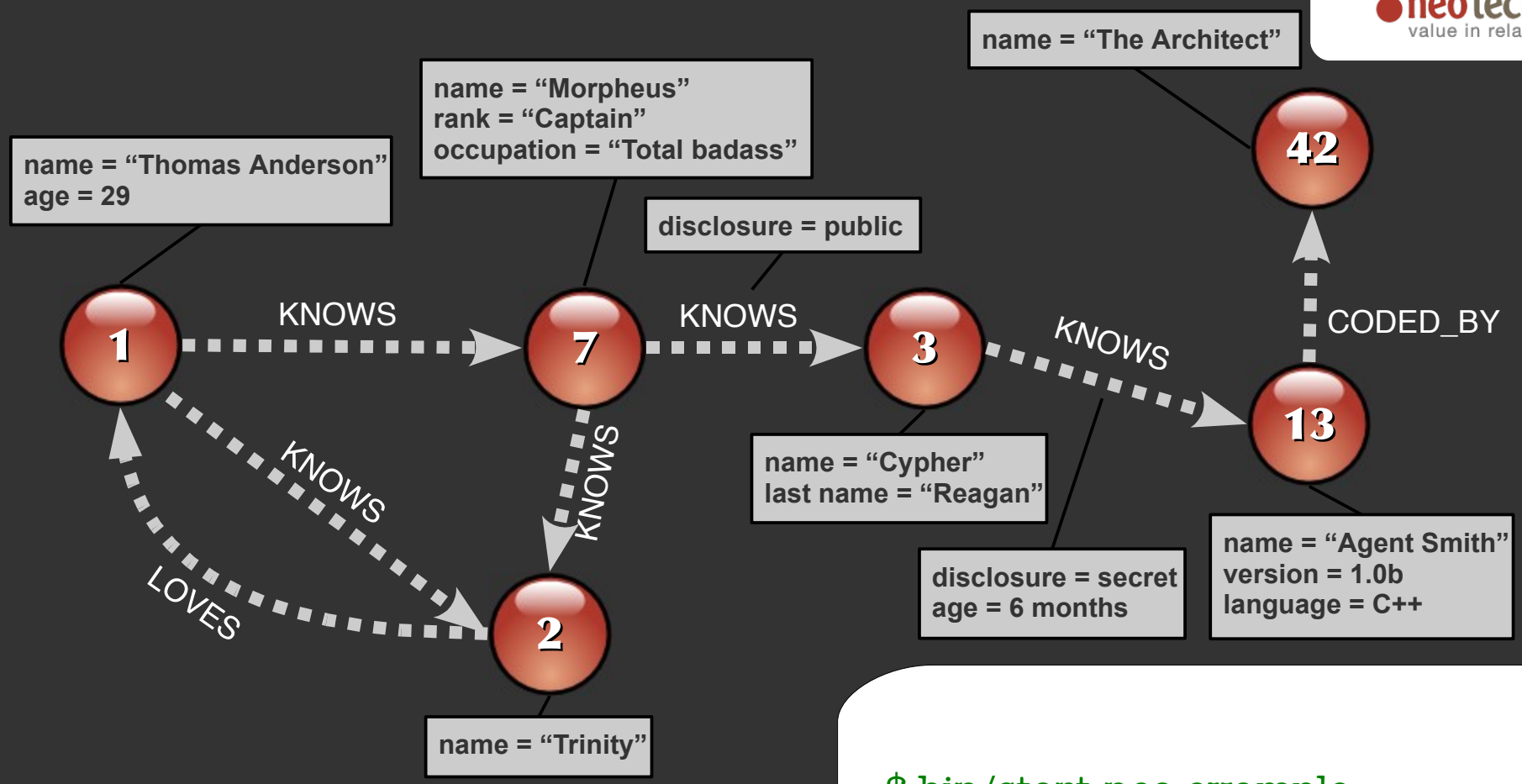


Code (3a): Custom traverser

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

Domain layer frameworks

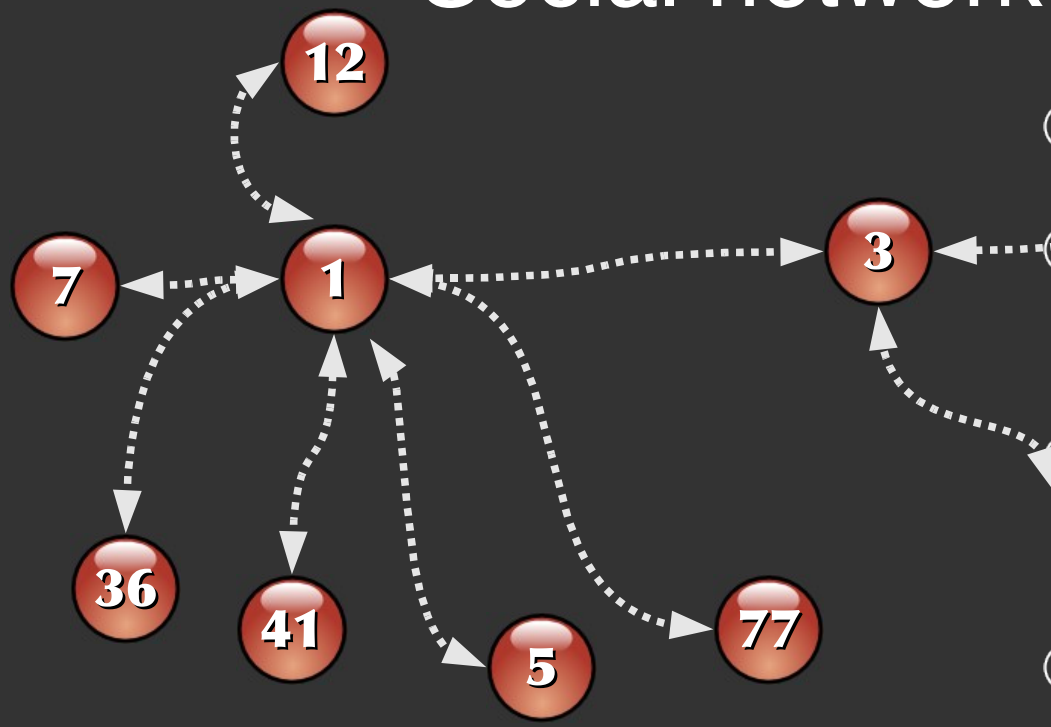
- Qi4j (www.qi4j.org)
  - Framework for doing DDD in pure Java5
  - Defines Entities / Associations / Properties
    - Sound familiar? Nodes / Rel's / Properties!
  - Neo4j is an "EntityStore" backend

- NeoWeaver (http://components.neo4j.org/neo-weaver)
  - Weaves Neo4j-backed persistence into domain objects in runtime (dynamic proxy / cglib based)
  - Veeeery alpha

Neo4j system characteristics

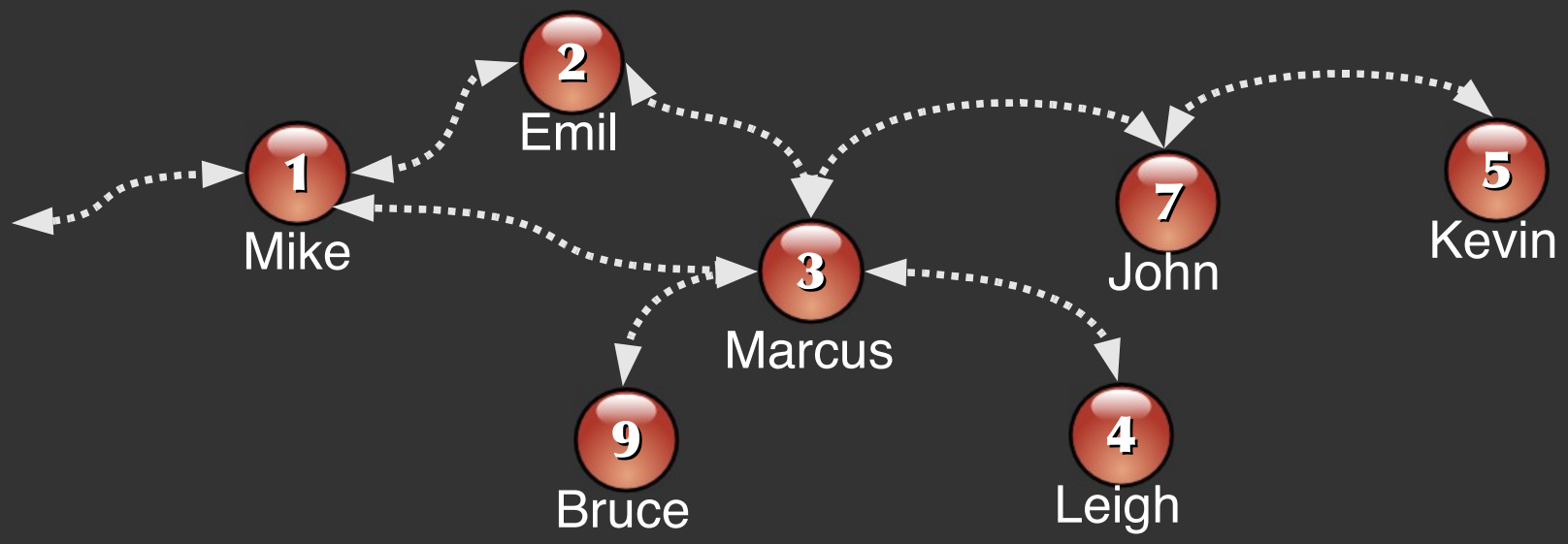
- Disk-based
  - Native graph storage engine with custom binary on-disk format
- Transactional
  - JTA/JTS, XA, 2PC, Tx recovery, deadlock detection, MVCC, etc
- Scales up (what's the x and the y?)
  - Several billions of nodes/rels/props on single JVM
- Robust
  - 6+ years in 24/7 production

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)		

Twitter / John Conwell: Got neo4j to do a do a loo ... - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://twitter.com/turboCodr/status/2399027431

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

twitter

Home Profile Find People Settings Help Sign out

Got neo4j to do a do a lookup in 2 seconds, that sql server did in 45 minutes. neo4j rocks!

6:28 AM Jun 30th from web

o_O

turboCodr

John Conwell

View Twitter in: **Standard** | Mobile

 About Us Contact Blog Status Apps API Search Help Jobs Terms Privacy

Done

Twitter / peepwl.com: Getting 40Mb/s write speed ... - Mozilla Firefox

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http://twitter.com/peepwl/status/2093181238

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

twitter

Home Profile Find People Settings Help Sign out

Getting 40Mb/s write speeds out of Neo4J+Lucene, go Neo go!

9:12 PM Jun 9th from twhirl

peepwl
peepwl.com

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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
+ ~~X~~

More consequences

- Ability to capture semi-structured information
  - => allowing individualization of content
- No predefined schema
  - => easier to evolve model
  - => can capture ad-hoc relationships
- Can capture non-normative relations
  - => easy to model specific links to specific sets
- All state is kept in transactional memory
  - => improves application concurrency

The Neo4j ecosystem

- Neo4j is an embedded database
  - Tiny teeny lil jar file
- Component ecosystem
  - index-util
  - neo-meta
  - neo-utils
  - pattern-match
  - sparql-engine
  - ...
- See http://components.neo4j.org

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
- Clojure
  - http://wiki.neo4j.org/content/Clojure
- Scala (incl RESTful API)
  - http://wiki.neo4j.org/content/Scala
- … .NET? Erlang?

Grails Plugin - Integration of Neo4j in Grails - Mozilla Firefox

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http://grails.org/plugin/neo4j

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GRAILS

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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

Done

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

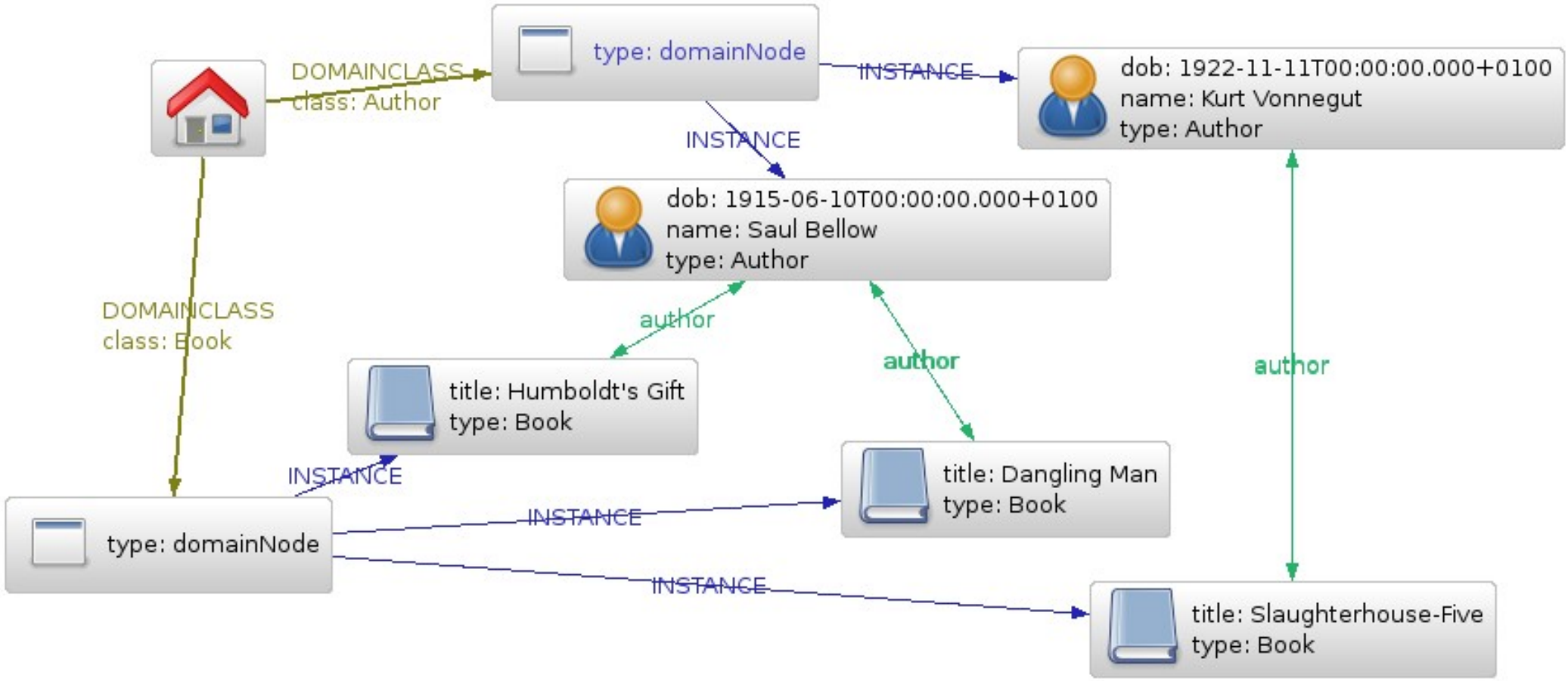
Blogroll
GroovyBlogs

Categories
Uncategorized

Archives
October 2009
September 2009

Meta
Log in

Grails Neoclipse screendump



Scale out – replication

- Rolling out Neo4j HA before end-of-year
  - Side note: ppl roll it today w/ REST frontends & onlinebackup
- 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

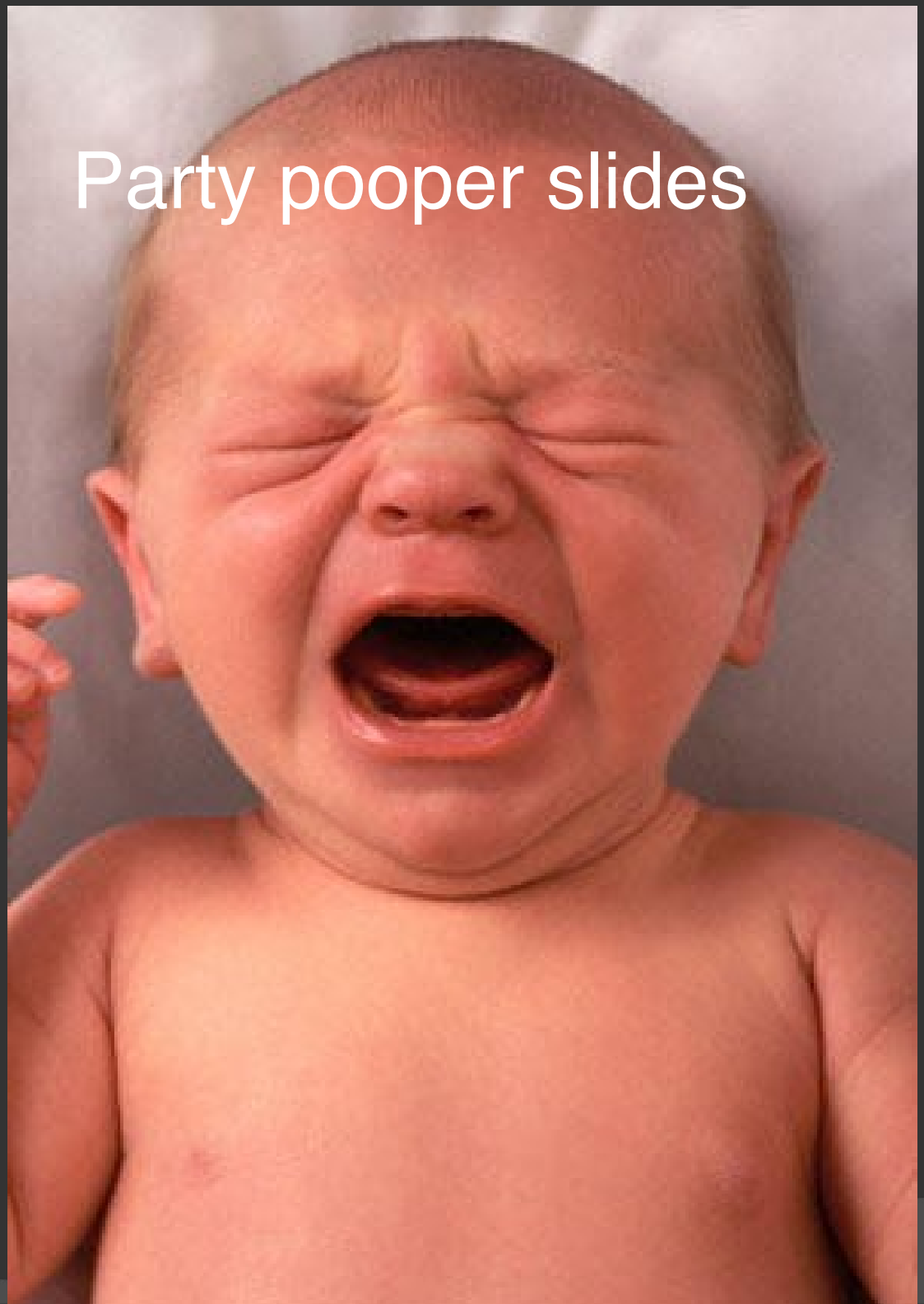
How ego are you? (aka other impls?)

- Franz' **AllegroGraph** (http://agraph.franz.com)
  - Proprietary, Lisp, RDF-oriented but real graphdb
- FreeBase **graphd** (http://bit.ly/13VITB)
  - In-house at Metaweb
- **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 up to 1M primitives it’s free for all uses!
- Download
  - http://neo4j.org
- Feedback
  - http://lists.neo4j.org

Party pooper slides



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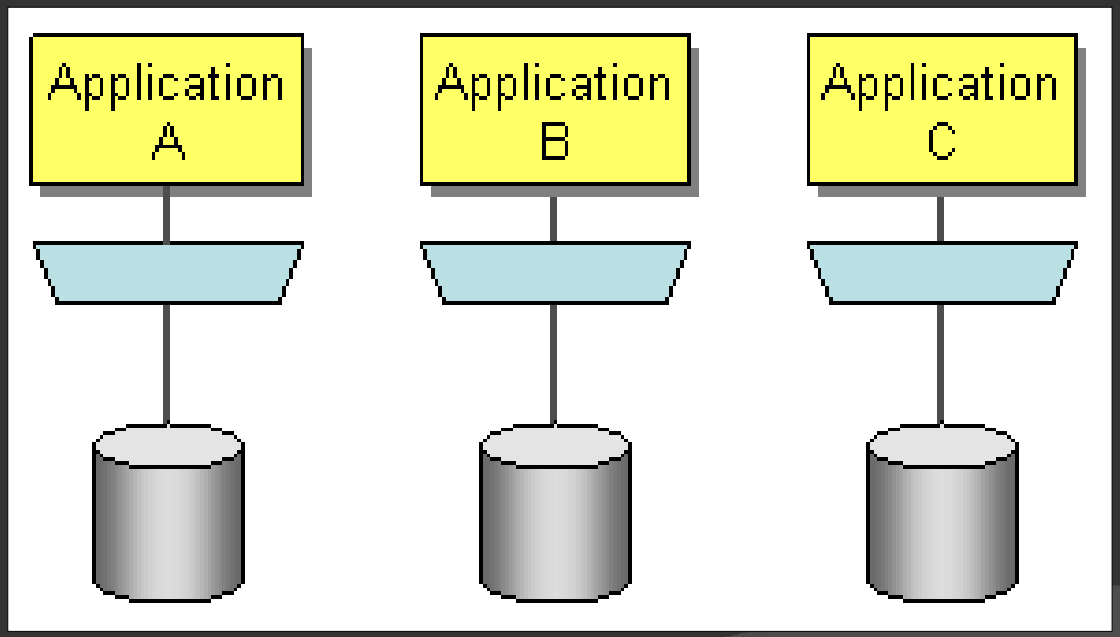
Poop 1

- Key-value stores?
  - => the awesome
  - … if you have 1000s of BILLIONS records OR you don't care about programmer productivity
- What if you had no variables at all in your programs except a single globally accessible hashtable?
- Would your software be maintainable?

Poop 2

- In a not-suck architecture...
- … the only thing that makes sense is to have an embedded database.



Poop 3

- Exposing your data model on the wire is bad. Period.
- Adding a couple of buzzwords doesn't make it less bad.
- If it was bad with SQL-over-sockets (hint: it was) then – surprise! – it's still bad even tho you use Hype-compliant(tm) JSON-over-REST.
- We don't want to couple everything to a specific data model again!

Poop 4

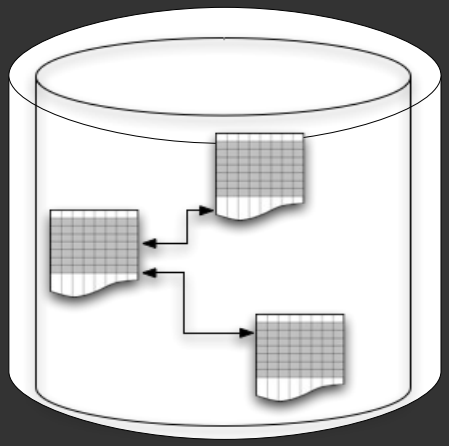
- *In-memory* database
- What the hell?
  - That's an oxymoron!
  - Up next: ascii-only JPEG
  - Up next: loopback-only web server
- If you're not durable, you're a cache!
- If you happen to asynchronously spill over to disk, you're a cache that asynchronously spills over to disk.

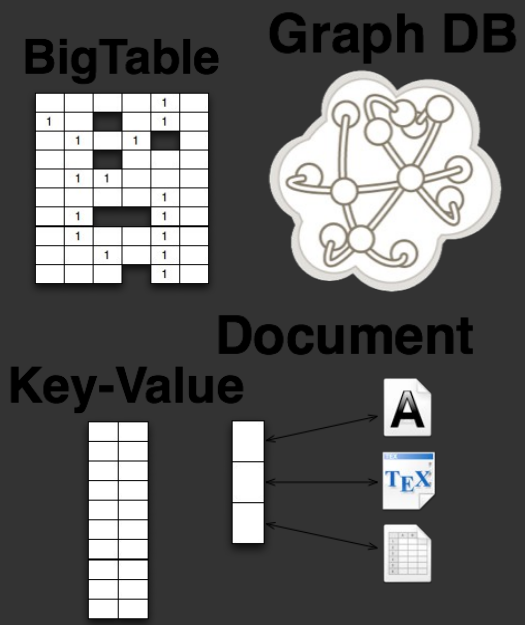
Ait

so, srsly?

Looking ahead: polyglot persistence

SQL && NoSQL





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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

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