TP - Neo4J

NoSQL databases

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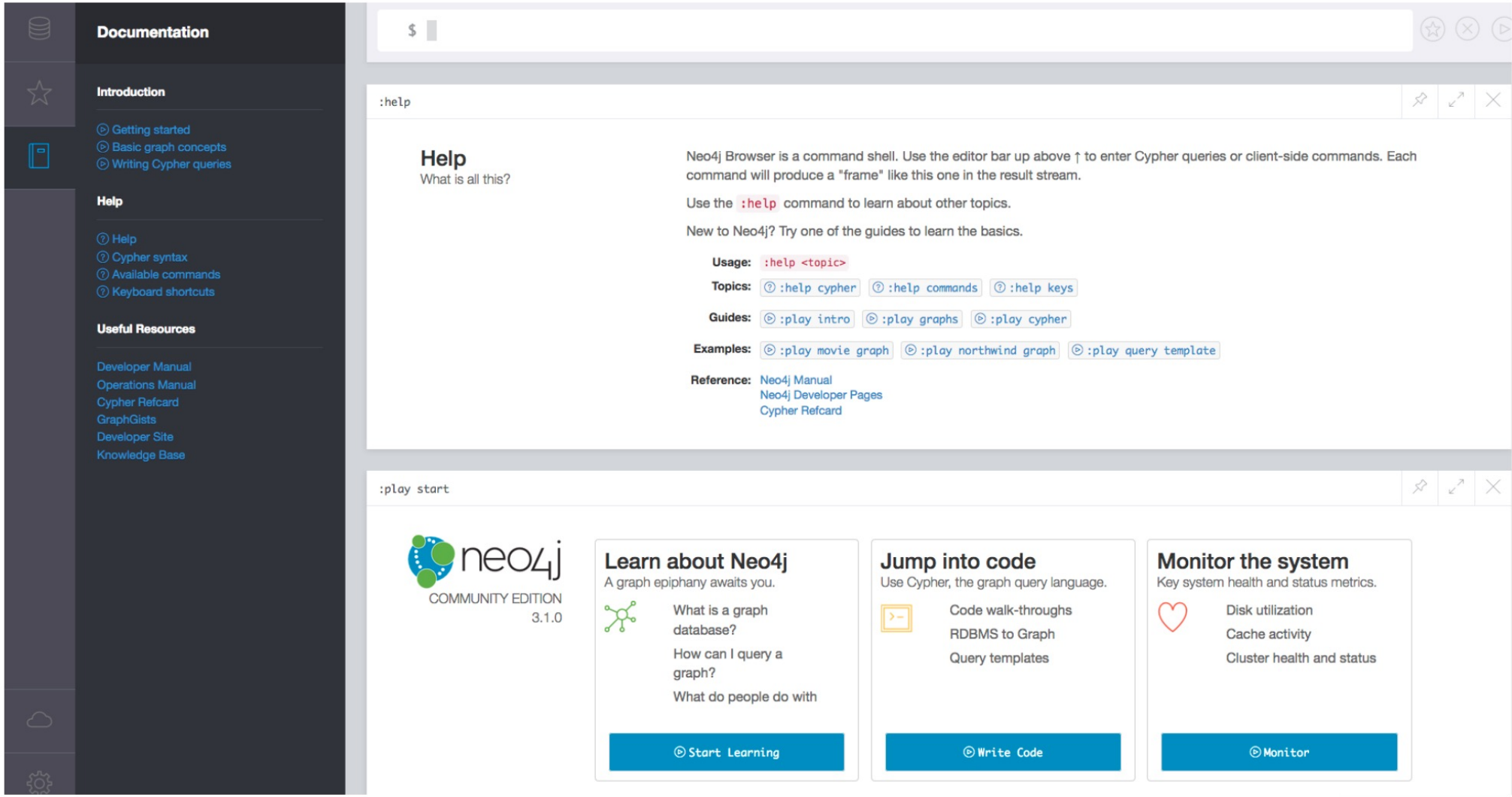
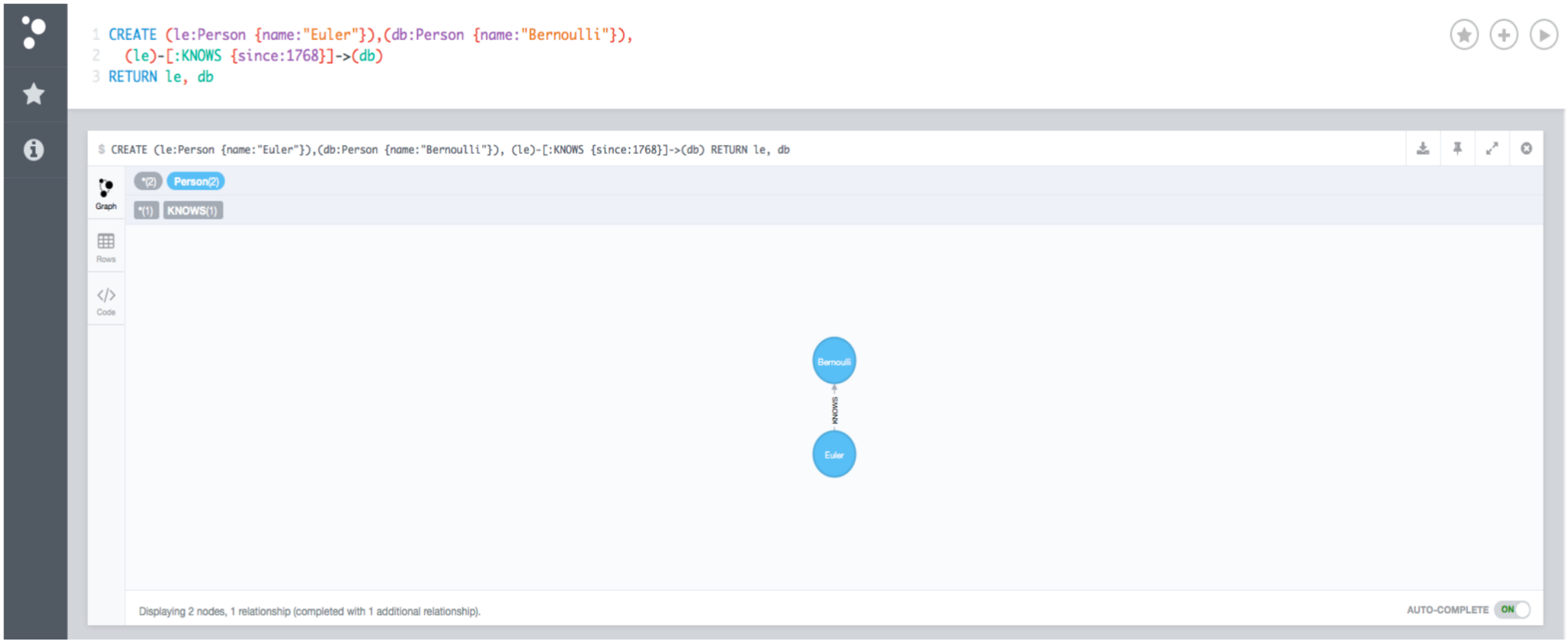
Neo4J browser

Help

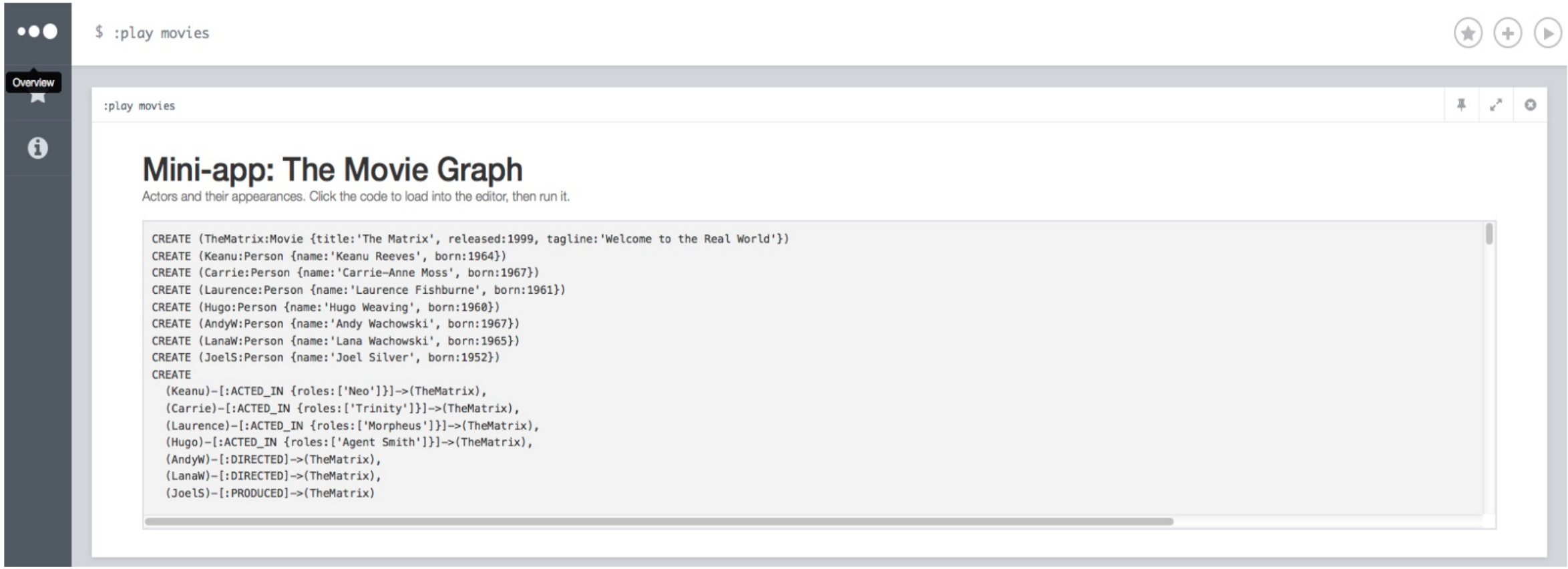


Queries and visualization



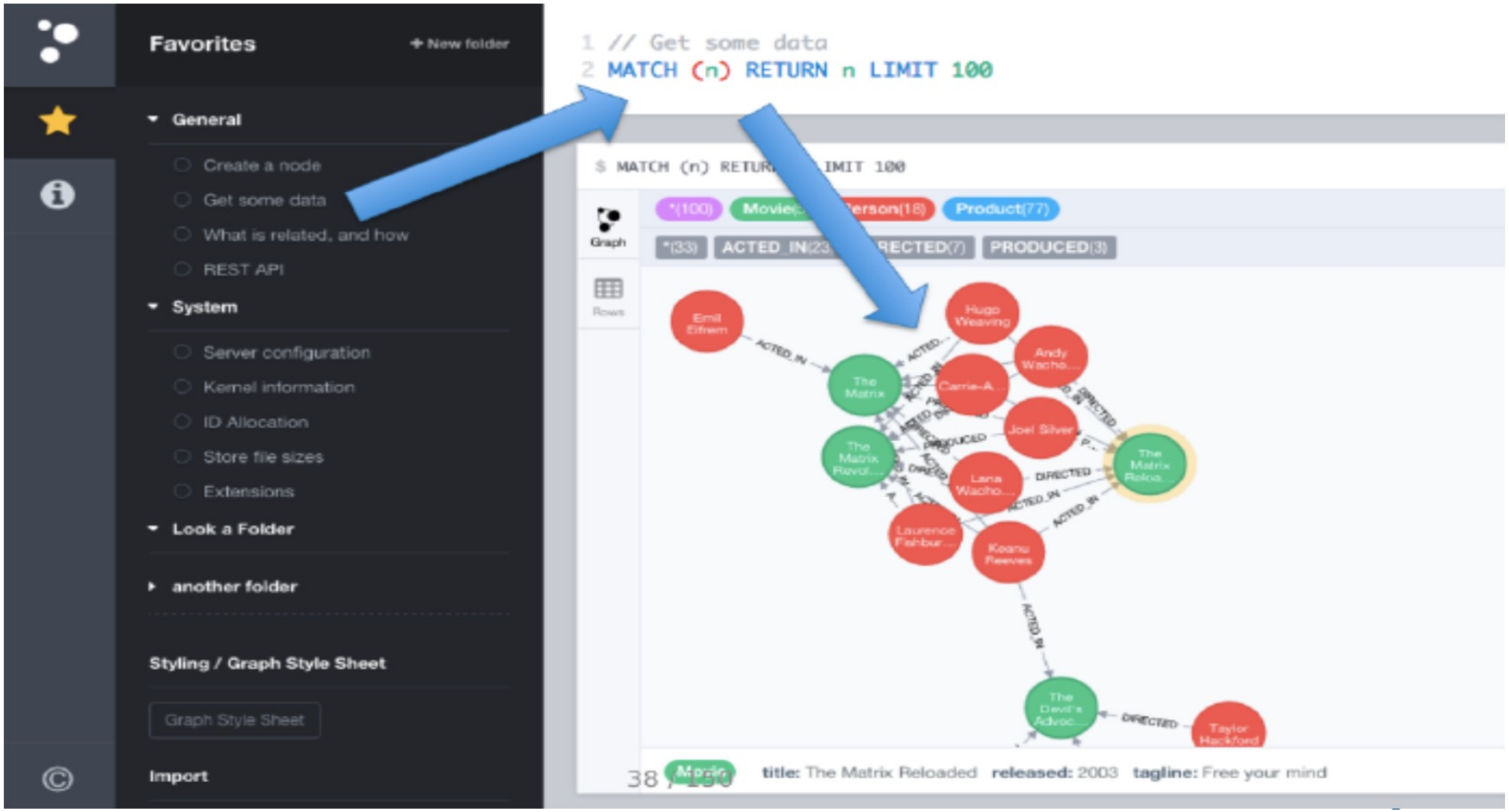
Import dataset

:play movies



Neo4j browser – Display data

- Example: MATCH (n)-[r]->(n2) RETURN r, n1, n2 LIMIT 25

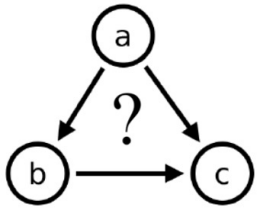


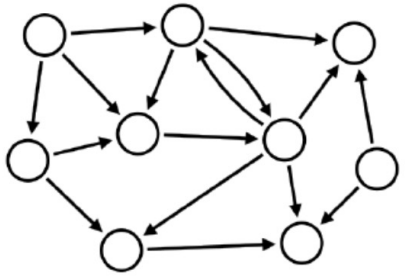
Introduction to Cypher

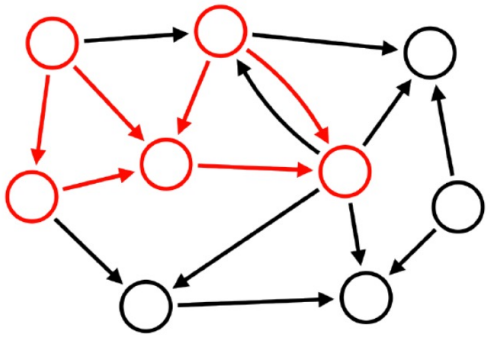
Cypher - definition

- **Neo4j Query language**
- **Pattern-Matching Declarative Language**
- **SQL-Like**
- **Suitable for graphs**

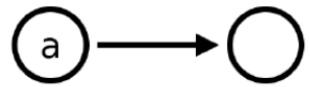
Principle





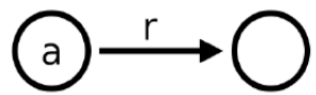


Two nodes, one relationship



(a)--> ()

```
MATCH (a) --> ()
RETURN a.name
```



(a)-[r]-> ()

```
MATCH (a) –[r]-> ()
RETURN a.name, type(r)
```

Optional match

- We look for the node a with its relationships if they exist

```
OPTIONAL MATCH (a) –[r]-> ()
RETURN a.name, type(r)
```

Two nodes, a known relationship

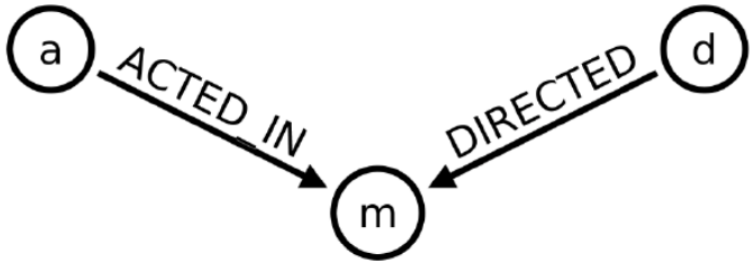
(a)-[:ACTED_IN]-> (m)

MATCH (a) –[:ACTED_IN]-> (m)
RETURN a.name, m.title

- **Returning the properties of the relations**

MATCH (a) –[r:ACTED_IN]-> (m)
RETURN a.name,r.roles, m.title

Paths



- **MATCH (a) –[:ACTED_IN]-> (m) <-[:DIRECTED] – (d)**
- **RETURN a.name, m.title, d.name**

Queries on « Movies » example (1/3)

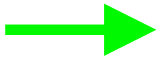
- Display the actor « Tom Hanks »

```
MATCH (tom {name: "Tom Hanks"}) RETURN tom
```

- Display the movie which title is « Cloud Atlas »

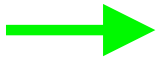
```
MATCH (cloudAtlas {title: "Cloud Atlas"}) RETURN cloudAtlas
```

- Display 10 persons



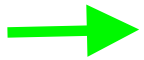
```
MATCH (people:Person) RETURN people.name LIMIT 10
```

- Display movies released in the '90s



```
MATCH (nineties:Movie) WHERE nineties.released > 1990
AND nineties.released < 2000 RETURN nineties.title
```

- Which actors have played in the same movie as Tom Hanks?



```
MATCH (tom:Person {name:"Tom Hanks"})-[:ACTED_IN]->(m)<-
[:ACTED_IN]-(coActors) RETURN coActors.name
```

Queries on « Movies »

- **Display Tom Hanks' movies**
- **Who directed the film "Cloud Atlas"?**
- **Which director also played in a movie?**

```
MATCH (tom:Person {name: "Tom Hanks"})-[:ACTED_IN]->(tomHanksMovies)
    RETURN tom,tomHanksMovies
```

```
MATCH (cloudAtlas {title: "Cloud Atlas"})<-[:DIRECTED]-(directors) RETURN
    directors.name
```

```
MATCH (tom:Person {name:"Tom Hanks"})-[:ACTED_IN]->(m)<-[:ACTED_IN]-
    (coActors) RETURN coActors.name
```

m representes movie

```
MATCH (a) –[:ACTED_IN]-> (m) <-[:DIRECTED] – (a)
RETURN a.name, m.title
```

How people are related to "Cloud Atlas"...

```
MATCH (people:Person)-[relatedTo]-(:Movie {title: "Cloud Atlas"}) RETURN
    people.name, Type(relatedTo), relatedTo
```

Queries on « Movies » example (2/3)

```
MATCH (a) –[:ACTED_IN]-> (m) <-[:DIRECTED] – (d)
RETURN a.name, m.title, d.name
```

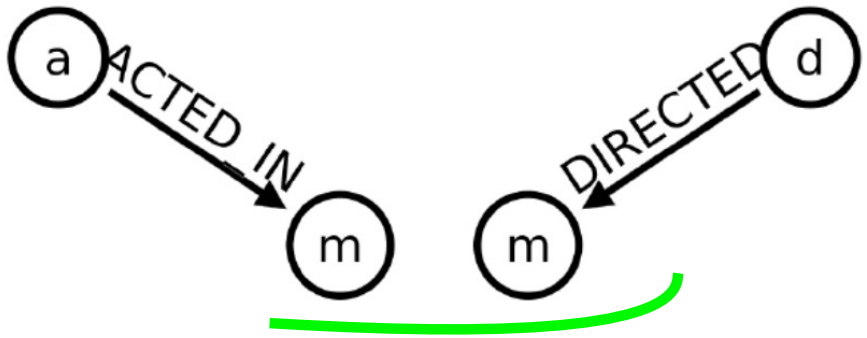
a.name	m.title	d.name
"Keanu Reeves"	"The Matrix"	"Andy Wachowski"
"Keanu Reeves"	"The Matrix Reloaded"	"Andy Wachowski"
"Noah Wyle"	"A Few Good Men"	"Rob Reiner"
"Tom Hanks"	"Cloud Atlas"	"Andy Wachowski"

Alias

```
MATCH (a) –[:ACTED_IN]-> (m) <-[:DIRECTED] – (d)
RETURN a.name AS actor , m.title AS movie, d.name
AS director
```

actor	movie	director
“Keanu Reeves”	“The Matrix”	“Andy Wachowski”
“Keanu Reeves”	“The Matrix Reloaded”	“Andy Wachowski”
“Noah Wyle”	“A Few Good Men”	“Rob Reiner”
“Tom Hanks”	“Cloud Atlas”	“Andy Wachowski”

More queries



1st way

```
MATCH (a) –[:ACTED_IN]-> (m), (m) <-[:DIRECTED] – (d)
RETURN a.name, m.title, d.name
```

2nd way:

```
MATCH (a) –[:ACTED_IN]-> (m), (d) -[:DIRECTED] –> (m)
RETURN a.name, m.title, d.name
```

Aggregation functions

- Count(x) – The number of occurrences
- Min(x) – minimum value
- Max(x) – maximum value
- Avg(x) – average
- Sum(x) – sum
- Collect(x) – Aggregates data in a table

Example – count(*)

```
MATCH (a) –[:ACTED_IN]-> (m) <-[:DIRECTED] – (d)
RETURN a.name, d.name, count(*)
```

a.name	d.name	count(*)
"Aaron Sorkin"	"Rob Reiner"	2
"Keanu Reeves"	"Andy Wachowski"	3
"Hugo Weaving"	"Tom Tykwer"	1

```
MATCH (a) –[:ACTED_IN]-> (m) <-[:DIRECTED] – (d)
RETURN a.name AS actor, d.name AS director , count(m)
AS count
```

SORT and limit

```
MATCH (a) –[:ACTED_IN]-> (m) <-[:DIRECTED] – (d)
RETURN a.name AS actor, d.name AS director ,
count(m) AS count
ORDER BY count DESC
LIMIT 5
```

Aggregation - collect

```
MATCH (a) –[:ACTED_IN]-> (m) <-[:DIRECTED] – (d)
RETURN a.name AS actor, d.name AS director ,
collect (m.title) AS list
```

Find all the nodes

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

Directors who directed movies with Tom Hanks as actor

```
MATCH (tom:Person) – [:ACTED_IN] ->
(movie:Movie), (director:Person) – [:DIRECTED] ->
(movie:Movie)
WHERE tom.name="Tom Hanks"
RETURN director.name
```

director.name
Mike Nichols
Robert Zemeckis
Penny Marshall
Robert Zemeckis
Ron Howard
Frank Darabont
Ron Howard

DISTINCT

```
MATCH (tom:Person) – [:ACTED_IN] ->
(movie:Movie), (director:Person) – [:DIRECTED] ->
(movie:Movie)
WHERE tom.name="Tom Hanks"
RETURN DISTINCT director.name
```

Index creation

- The 'Person' nodes, indexed by their 'name'

```
CREATE INDEX ON :Person(name)
```

- The nodes 'Movie', indexed by their 'title'

```
CREATE INDEX ON :Movie(title)
```

Conditions

- Find movies where Tom Hanks and Kevin Bacon played

- MATCH (tom:Person) –[:ACTED_IN] -> (movie), (kevin:Person)-[:ACTED_IN]->(movie)
- WHERE tom.name="Tom Hanks " AND kevin.name= "Kevin Bacon"
- RETURN movie.title

Conditions on the properties

- The films where Keanu Rives played the role of "Neo »

```
MATCH (actor:Person) –[r:ACTED_IN] -> (movie)
WHERE actor.name= ”Keanu Reeves " AND  ”Neo ”
   IN (r.roles)
RETURN movie.title
```

- 2nd solution:

```
MATCH (actor:Person) –[r:ACTED_IN] -> (movie)
WHERE actor.name= ”Keanu Reeves " AND ANY( x
   IN r.roles WHERE x=‘’Neo”)
RETURN movie.title
```

Conditions with comparison

- Find actors who have played with Tom Hanks and who are older than him

```
MATCH (tom:Person) –[r:ACTED_IN] -> (movie),
    (a:Person)-[:ACTED_IN]->(movie)
WHERE tom.name= ”Tom Hanks "
    AND a.born < tom.born
RETURN DISTINCT a.name, (tom.born-a.born) AS
    diff
```

Conditions on patterns (1/2)

- Actors who have worked with Gene Hackman and who have previously directed films (are also directors)

```
MATCH (gene:Person)-[:ACTED_IN]->(movie),
      (n)-[:ACTED_IN]->(movie)
WHERE gene.name="Gene Hackman"
  AND (n)-[:DIRECTED]->()
RETURN DISTINCT n.name
```

CONDITIONS on patterns (2/2)

- Actors who worked with " Keanu Rives ", but not when he played with " Hugo Weaving ’’

```
MATCH (keanu:Person)-[:ACTED_IN]->(movie),
      (n)-[:ACTED_IN]->(movie),
      (hugo:Person)
WHERE keanu.name=« Keanu Reeves » AND
      hugo.name=« Hugo Weaving »
      AND NOT (hugo)-[:ACTED_IN]->(movie)
RETURN DISTINCT n.name
```

String Comparison

```
MATCH (a) –[:ACTED_IN]-> (matrix:Movie)
WHERE matrix.title='The Matrix' AND a.name
CONTAINS 'Emil'
RETURN a.name
```

- =~ "regexp »

CONTAINS

STARTS WITH

ENDS WITH

Exercise

- **Display 5 directors who have directed the largest number of films**

Update with CYPHER

Node creation

```
CREATE (p:Person {name: 'Me'})
```

```
MATCH (p:Person)
WHERE p.name='Me'
RETURN p
```

- Example with 2 properties:

```
CREATE (m:Movie {title: 'Mystic River', released:
1993})
```

Creation with MERGE

```
MERGE (p:Person {name: 'Me'})
RETURN p
```

•Guarantees unique creation
With some options:

```
MERGE (p:Person {name: 'Me'})
ON CREATE SET p.created=timestamp()
ON MATCH SET p.accessed= colaesce(p.accessed,0)+1
RETURN p
```

ON CREATE SET – Executed when creating

ON MATCH SET – Executed when Matching

Adding properties

```
MATCH (p:Person)
WHERE p.name='Me'
//Add property
SET p.born='1980'
RETURN p
```

Modifying properties

```
MATCH (p:Person)
WHERE p.name='Me'
//ajout de la propriété
SET p.born='1985'
RETURN p
```

Adding Relationships

```
MATCH (movie:Movie),(kevin:Person)
WHERE movie.title='Mystic River' AND kevin.name='Kevin Bacon'
//creation of relationship
MERGE (kevin) –[:ACTED_IN {roles:['Sean']}]-> (movie)
```

```
MATCH (kevin)-[:ACTED_IN] -> (movie)
WHERE kevin.name ='Kevin Bacon'
RETURN movie.title
```

Modifying a Relationship Property

- Change the role of Kevin Bacon in the movie Mystic River from "Sean" to "Sean Devine »

```
MATCH (kevin:Person)-[r:ACTED_IN] -> (movie:Movie)
WHERE kevin.name =’Kevin Bacon’ and movie.title=‘Mystic River’
SET r.roles=[‘Sean Devine’]
RETURN r.roles
```

Delete a Node

```
MATCH (emil:Person)
WHERE emil.name = 'Emil Eifrem'
DELETE emil
```

- The relationships still exist

Delete a Node

```
MATCH (emil:Person) –[r]-()
WHERE emil.name = ‘Emil Eifrem’
DELETE r
```

Deleting nodes and all relationships

```
OPTIONAL MATCH (emil) –[r]-()
where emil.name = "Emil Eifrem"
DELETE emil, r
```

NOT TO DO!!!

- Deleting all content from the database

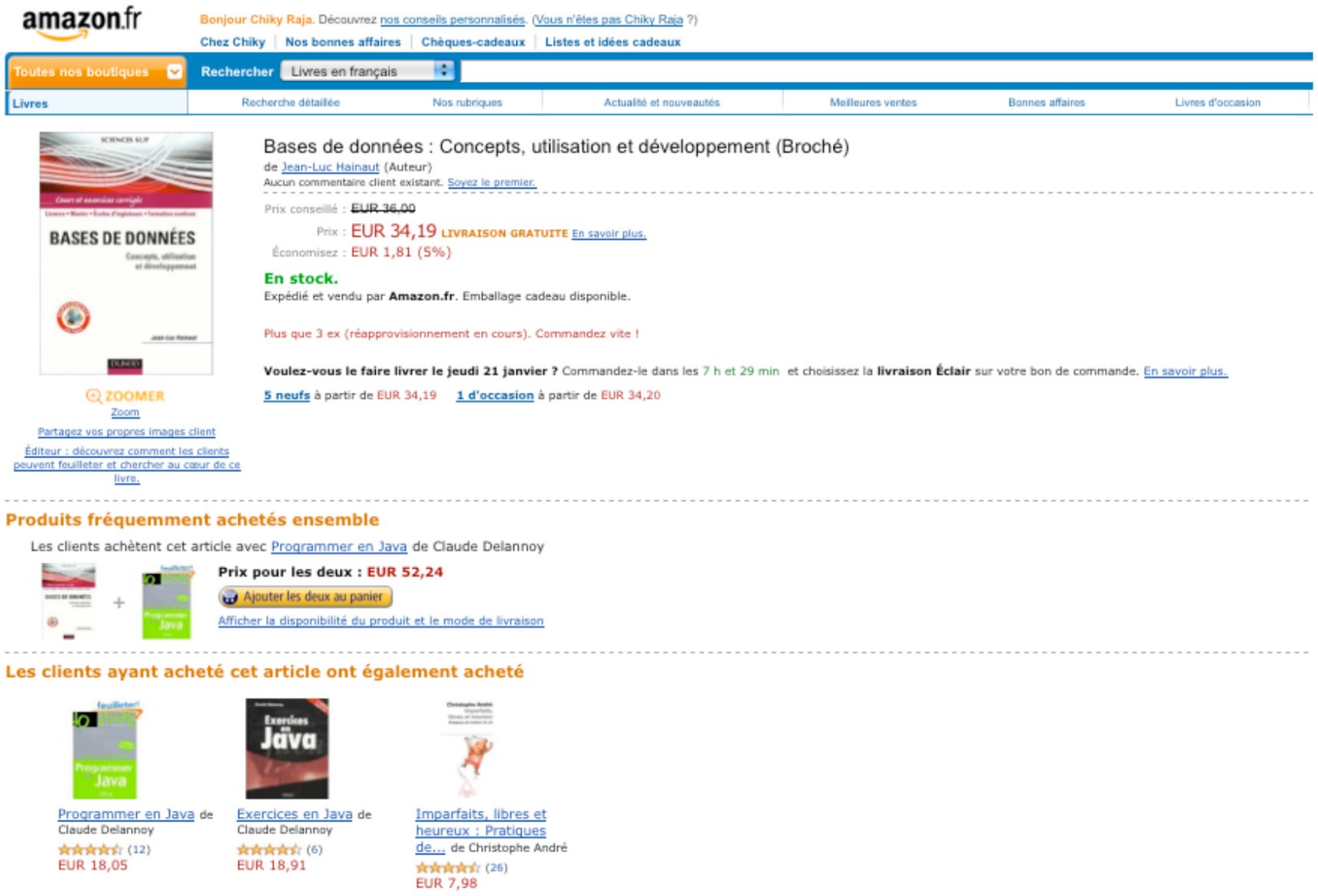
```
MATCH (n)
OPTIONAL MATCH (n) –[r]-()
DELETE n, r
```

Exercise

- **Add the KNOWS relationship between all the actors in the same movie**

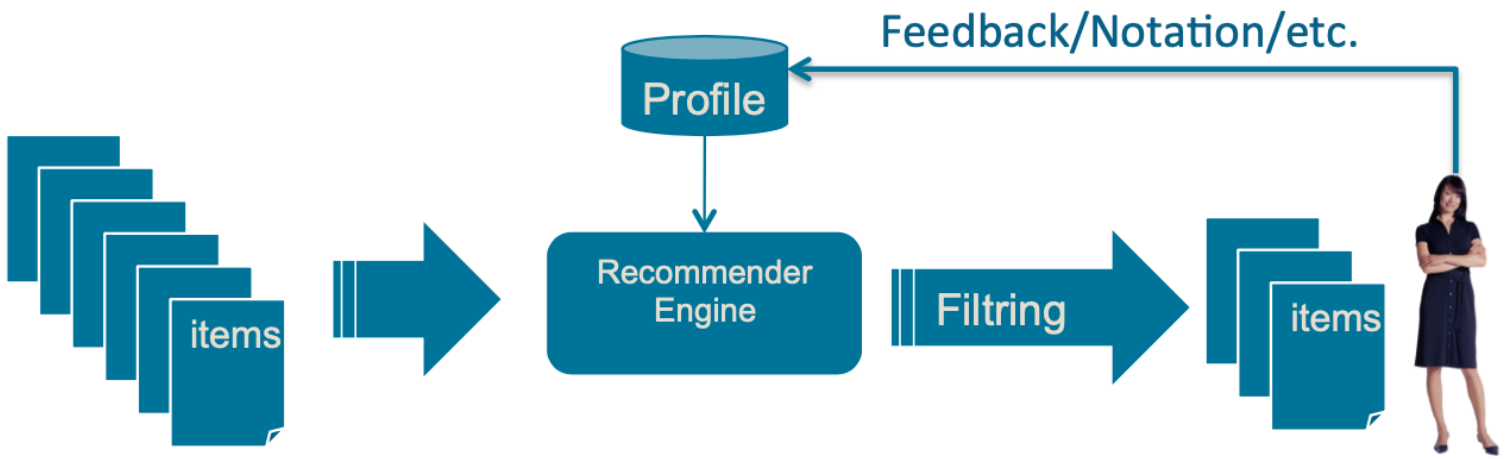
Recommendation

Recommendations: Overview

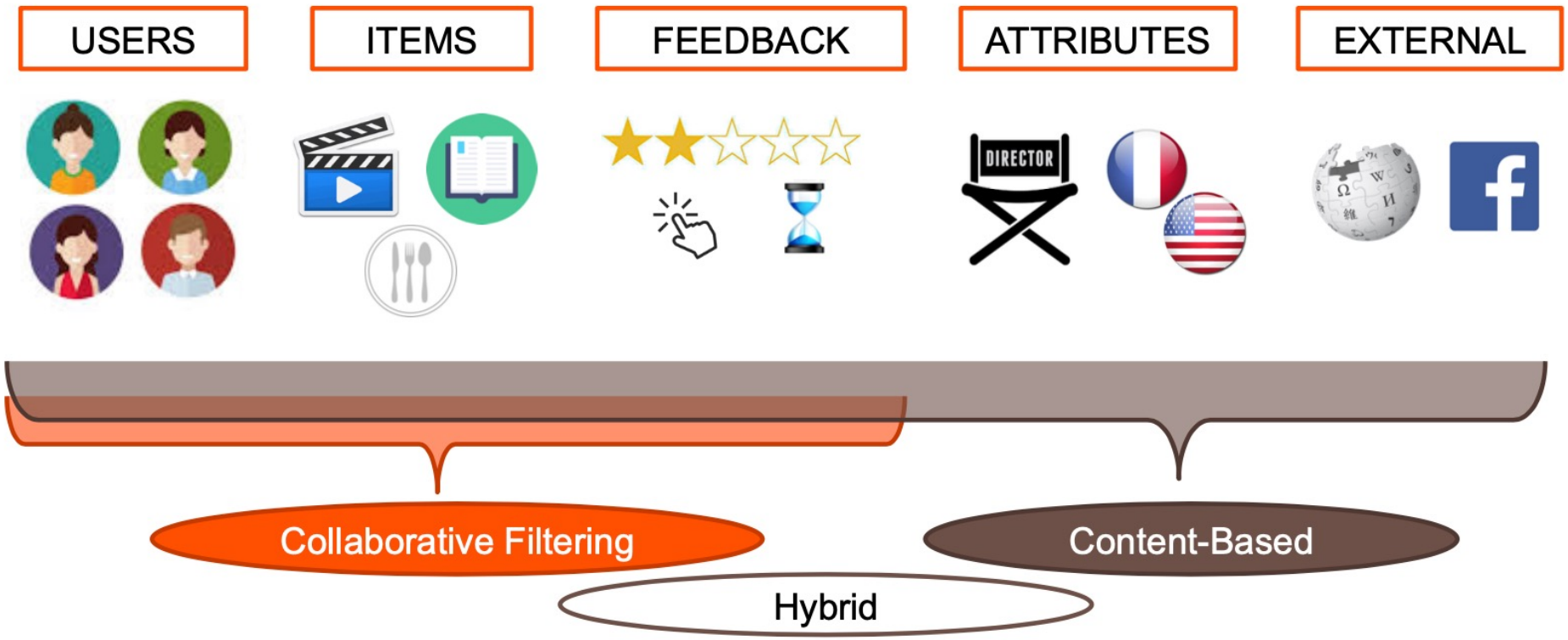


Definition

- **Recommend= "strongly advise something to someone"**
  Recommnder system system: a variety of processes aimed at providing information to people in line with their interests.



Recommender Systems



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Two categories

- **Content-based systems**
  - It is based on the content of the elements visited and look for similarities. The content (documents, articles, etc.) are composed of feature vectors and the similarity calculations are done according to these vectors

- **Collaborative filtering systems**
  - Predict the preferences of articles / objects of users taking into account opinions (notes, votes, etc.) made by "similar" users

Recommendation and graphs

- Items / users and their characteristics can be represented by nodes
- The relations between the users, the items, the users-items can be represented naturally by the relationships in a graph
- The recommendation logic can be implemented in a graph DB

Exercise

- **Recommend 3 actors with whom Keanu Reeves could work but this has never been the case**

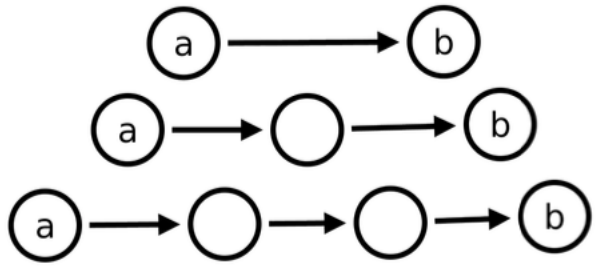
Go further...

Matching many relationships

```
MATCH (a)-[:ACTED_IN|:DIRECTED]->()<-
[:ACTED_IN|:DIRECTED]-(b)
MERGE (a)-[:KNOWS]-(b);
```

(Creation of the KNOWS relationship between the actors and directors who worked together)

Path with variable length



(a)-[*n]->(b)

- **Friends of friends:**

```
MATCH (keanu:Person)-[:KNOWS*]->(fof)
WHERE keanu.name="Keanu Reeves" AND NOT
(keanu)-[:KNOWS]-(fof)
RETURN DISTINCT fof.name;
```

Length of the relationship

```
MATCH p=shortestpath((keanu:Person)-[:KNOWS*]->(demi:Person))
WHERE keanu.name="Keanu Reeves" AND NOT demi.name="Demi moore"
RETURN length(rels(p));
```