Graph Database Topics.

Assignments – Neo4j

You will be querying three Neo4j databases, provided to you together with the software. These databases are: (1) A greph representation of the Northwind operational database, denoted **northwindhg.db**; (2) A database containing information about movies, denoted **movies.db**; (3) A database containing historical information about the world cups, from the start through the 2014 world cup, denoted **worldcup.db**.

Once you login to your account (in Linux), you need to go to the /tmp forlder. Once there, open a terminal and type the following commands:

```
cd /tmp
tar xJf /serveur/neo4j.tar.xz
cd neo4j
```

At this point, you are about to start the Neo4j server. First, you need to choose the database you will work with. For this, you go to the **conf** folder, and edit the **neo4j.conf** file. You will find something like this:

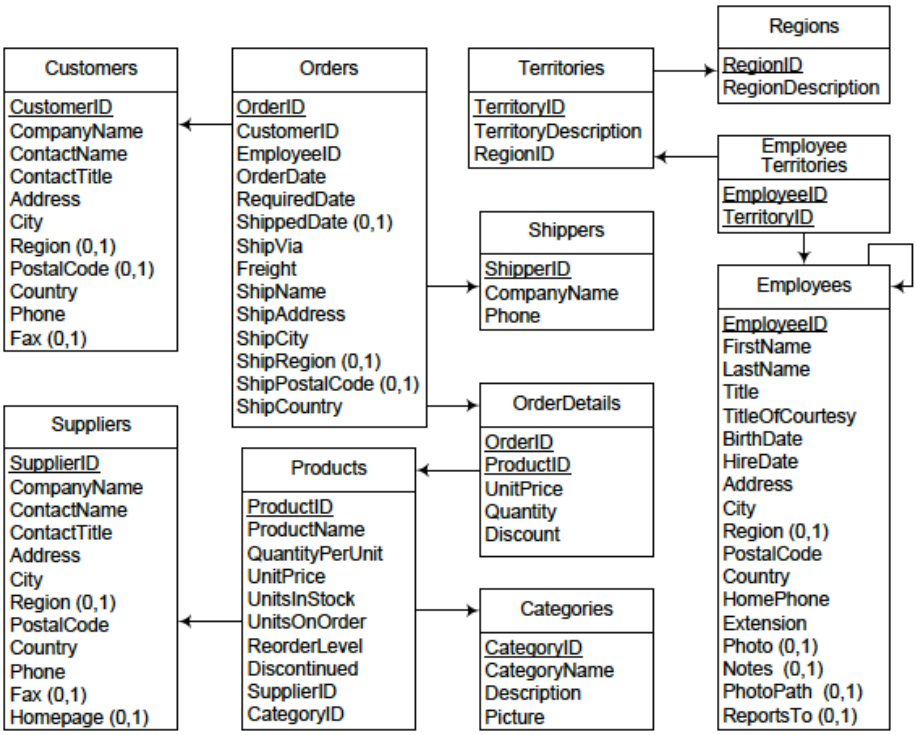
```
#dbms.active_database=graph.db
#dbms.active_database=trajectories-NYC-4sq.db
#dbms.active_database=trajectories.db
#dbms.active_database=worldcup.db
#dbms.active_database=web.db
#dbms.active_database=telco.db
dbms.active_database=northwindhg.db
#dbms.active_database=movies.db
#dbms.active_database=calls.db
```

Since dbms.active_database=northwindhg.db is unmarked, when you start the server, you will also load the **northwindhg.db** database. To change it to the **movies.db**, you mark #dbms.active_database =northwindhg.db, and unmark dbms.active_database=movies.db. Save the changes, and quit the file. Then you run: `./bin/neo4j console`

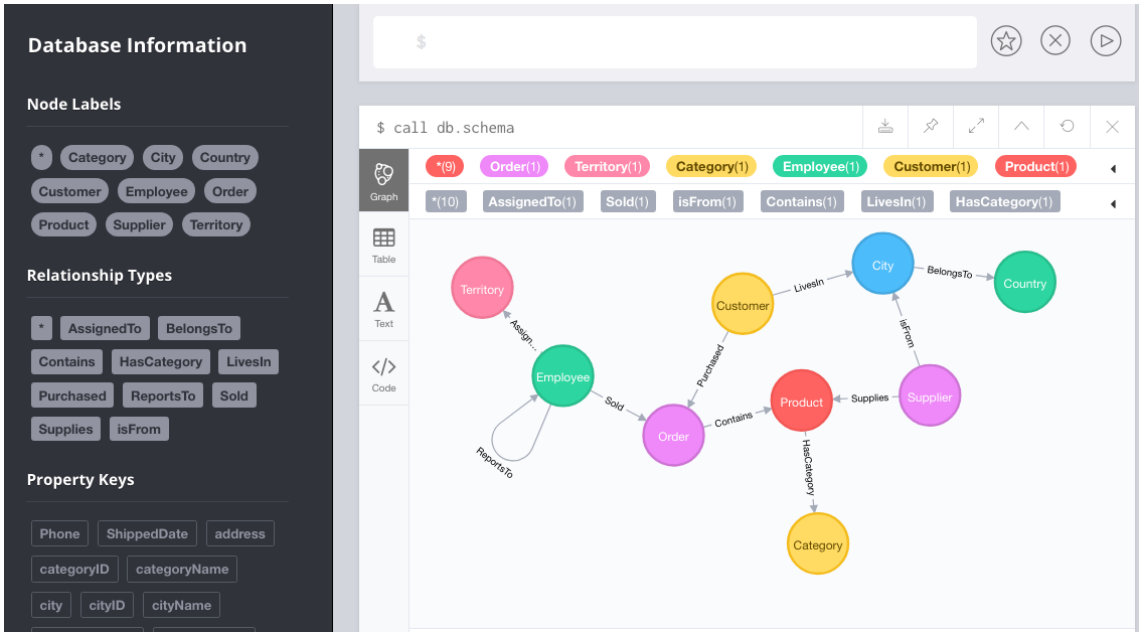
And the server starts. Then, open a browser, and type the following url: **localhost:7474.**
Now you can start writing Cypher queries.

Assignment 1.

Consider the Northwind database, whose schema is:



This database has been exported to Neo4j, and you can find it at: /……../data/databases/northwindhg.db. The graph schema is:



Write in Cypher the following queries over the northwindhg.db database:

1 - List products and their unit price.

```
MATCH (p:Product)
RETURN p.productName, p.unitPrice
ORDER BY p.unitPrice DESC
```

2 - List information about products 'Chocolade' & 'Pavlova'.

```
MATCH (p:Product)
WHERE p.productName IN ['Chocolade','Pavlova']
RETURN p
```

3 - List information about products with names starting with a "C", whose unit price is greater than 50.

```
MATCH (p:Product)
WHERE p.productName STARTS WITH "C" AND p.unitPrice > 100
RETURN p.productName, p.unitPrice;
```

4 - Same as 3, but considering the sales price, not the product's price.

```
MATCH (p:Product) <- [c:Contains] - (o:Order)
WHERE p.productName STARTS WITH "C" AND ToInt(c.unitPrice) > 15
RETURN distinct p.productName, p.unitPrice,c.unitPrice;
```

5 - Total amount purchased by customer and product.

```
MATCH (c:Customer)
OPTIONAL MATCH (p:Product)<-[pu:Contains]-(:Order)<-[:Purchased]-(c)
RETURN c.companyName,p.productName, toInt(sum(toint(pu.unitPrice) *toInt
(pu.quantity))) AS volume
ORDER BY volume DESC;
```

6 - Top 10 employees, considering the number of orders sold.

```
MATCH (:Order)<-[:Sold]-(e:Employee)
RETURN e.firstName,e.lastName, count(*) AS Ordenes
ORDER BY Ordenes DESC LIMIT 10
```

7 - For each employee, list the assigned territories.

```
MATCH (t:Territory)<-[:AssignedTo]-(e:Employee)
RETURN t.name, collect(e.lastName);
```

8 - For each city, list the companies settled in that city.

```
MATCH (c:City)<-[:LivesIn]-(c1:Customer)
RETURN c.cityName, COLLECT(c1.companyName);
```

9 - How many persons an employee reports to, either directly or transitively?

```
MATCH (e:Employee)
OPTIONAL MATCH (e)<-[rel:ReportsTo*]-(report)
RETURN report.lastName AS employee, COUNT(rel) AS reports
```

10 - To whom do persons called “Robert” report to?

```
MATCH  (e:Employee)<-[:ReportsTo*]-(sub:Employee)
WHERE sub.firstName = 'Robert'
RETURN  e.firstName,e.lastName,sub.lastName
```

11 - Who does not report to anybody?

```
MATCH (e:Employee)
WHERE
NOT (e)-[:ReportsTo]->()
RETURN  e.firstName as TopBoss
```

12 - Suppliers, number of categories they supply, and a list of such categories

```
MATCH (s:Supplier)-->(:Product)-->(c:Category)
WITH s.companyName as Company, collect(distinct c.categoryName) as Categories
WITH Company, Categories, length(Categories) AS Cantidad ORDER BY Cantidad DESC
RETURN Company, Cantidad, Categories;
```

13 - Suppliers who supply beverages

```
MATCH (c:Category {categoryName:"Beverages"})<--(:Product)<--(s:Supplier)
RETURN DISTINCT s.companyName as ProduceSuppliers;
```

14 - Customer who purchases the largest amount of beverages

```
MATCH (cust:Customer)-[:Purchased]->(:Order)-[o:Contains]->(p:Product),
        (p)-[:HasCategory]->(c:Category {categoryName:"Beverages"})
RETURN DISTINCT cust.companyName as CustomerName, SUM(toInteger(o.quantity))
AS
TotalProductsPurchased ORDER BY TotalProductsPurchased DESC
LIMIT 1;
```

15 - List the 5 most popular products (considering number of orders)

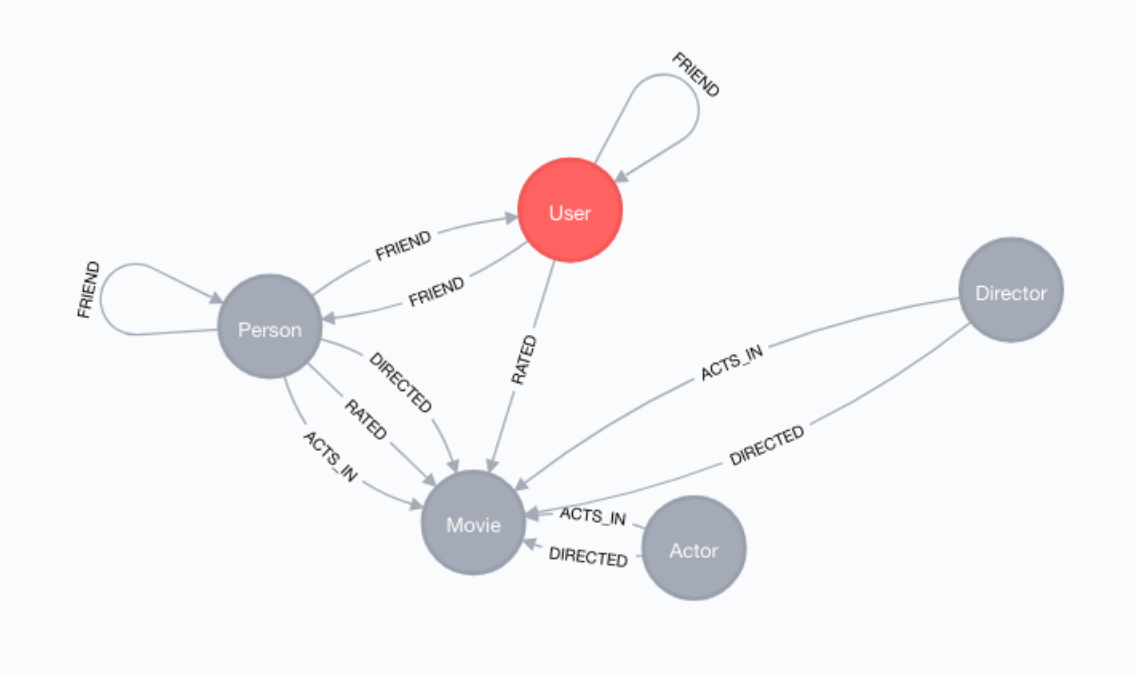
```
MATCH (c:Customer)-[:Purchased]->(o:Order)-[o1:Contains]->(p:Product)
return c.companyName, p.productName, count(o1) as orders
order by orders desc
LIMIT 5
```

16 - Products ordered by customers from the same country than their suppliers

```
MATCH  (c:Customer)-[r:LivesIn]->(cy:City) -->(co:Country)
WITH co,c MATCH  (s:Supplier) WHERE co.countryName=s.country
WITH s,co,c  MATCH   (s)-[su:Supplies]->(p:Product) <-[:Contains]-(o:Order)<-
[:Purchased]-(c)
RETURN c,s,co,p
```

Assignment 2.

Switch to the movies.db database. For this, **stop the server**, using the ctrl-c command in the terminal. Then, edit the neo4j.conf as explained, and unmark the movies.db line. Then, star the server again. When you open the browser and type the url localhost:7474, you´ll have the neo4j database available. The schema is (you can get this writing call db.schema at the prompt):



Write in Cypher the following queries over the movies.db database:

1 - Actors who played in two movies directed by the same director. Return the actor, the films, and the director.

```
MATCH p=(v1:Actor)-[r1:ACTS_IN]->(m1:Movie)<-[dm1:DIRECTED]-(d1:Director)-
        [dm2:DIRECTED]->(m2:Movie)<-[r2:ACTS_IN]-(v2:Actor)
WHERE m1.title <> m2.title AND v1.name=v2.name
RETURN v1.name, m1.title, m2.title,d1.name
```

2 - Actors who played in the same film with Kevin Bacon.

```
MATCH (v1:Actor)-[r1:ACTS_IN]->(m1:Movie)<-[r2:ACTS_IN]-(v2:Actor)
WHERE v1.name = 'Kevin Bacon'  AND v1.name<>v2.name
RETURN v1.name,v2.name,m1.title
```

3 - Actors who played in a movie directed by Robert De Niro.

```
MATCH (v1:Actor)-[r1:ACTS_IN]->(m1:Movie)<-[r2:DIRECTED]-(v2:Director)
WHERE v2.name = 'Robert De Niro'  AND v1.name<>v2.name
RETURN v1.name,v2.name,m1.title
```

4 - For each actor, list the number of actors she played with in a movie.

```
MATCH (v1:Actor)-[r1:ACTS_IN]->(m1:Movie)<-[r2:ACTS_IN]-(v2:Actor)
WHERE v1.name<>v2.name
RETURN v1.name, count(distinct v2.name) as friends order by friends desc
```

5 - Actors who played in a movie with Samuel L. Jackson.

```
MATCH (v1:Actor)-[r1:ACTS_IN]->(m1:Movie)<-[r2:ACTS_IN]-(v2:Actor)
WHERE v1.name= 'Samuel L. Jackson' and v1.name<>v2.name
RETURN v1.name, v2.name, m1.title
```

6 - Shortest path between Robert De Niro and Kevin Bacon.

```
MATCH (v1:Actor{name:'Robert De Niro'}),(v2:Actor{name:'Kevin Bacon'})
WITH v1,v2
MATCH p= ShortestPath((v1)-[*]-(v2))
RETURN p, length(p) as l
```

7 - Shortest path between Kevin Bacon and Stephen Lang.

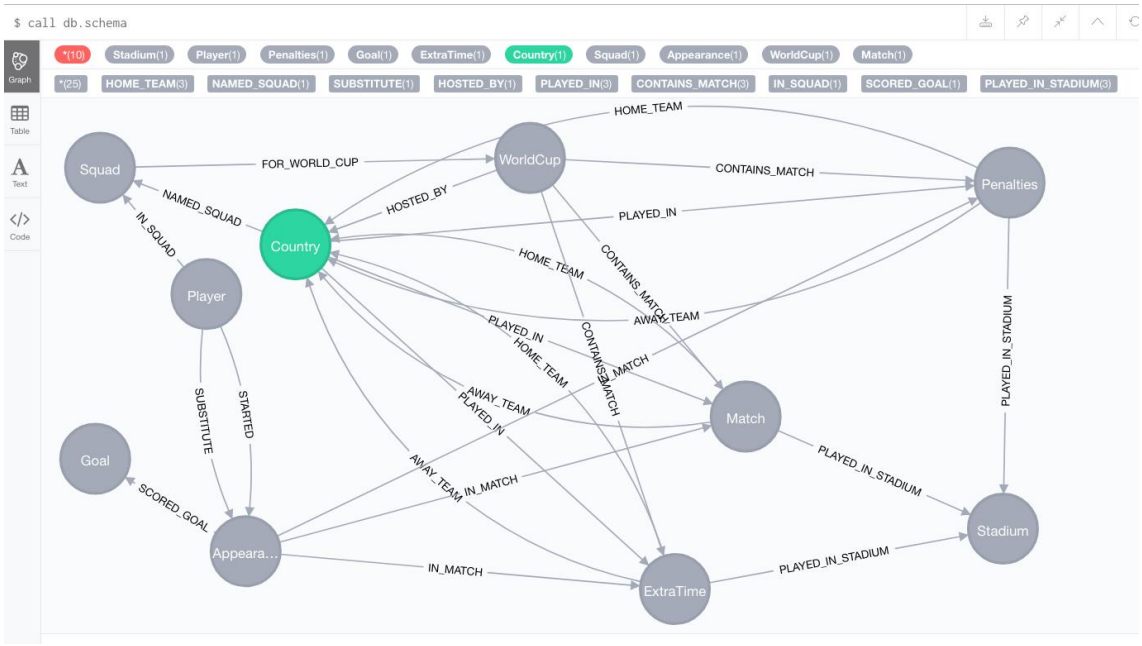
```
MATCH (v1:Actor{name:Stephen Lang'}),(v2:Actor{name:'Kevin Bacon'})
WITH v1,v2
MATCH p= ShortestPath((v1)-[*]-(v2))
RETURN p, length(p) as l
```

8 - Shortest path between Kevin Bacon and any other actor.

```
MATCH (v1:Actor), v2:Actor{name:'Kevin Bacon'})
WITH v1,v2
MATCH p= ShortestPath((v1)-[*]-(v2))
RETURN p, length(p) as l
```

Assignment 3.

Switch to the worldcup.db database, doing the **same steps as in Assignment 2.** Now, the database is **worldcup.db**. The schema is:



Write in Cypher the following queries over the worldcup.db database:

1 - Who hosted the world cup?

```
MATCH (wc:WorldCup)-[:HOSTED_BY]->(country)
RETURN wc.name, wc.year, country.name
ORDER BY wc.year
```

2 - Who hosted the World Cup more than once, and when.

```
MATCH (host:Country)<-[:HOSTED_BY]-(wc)
WITH wc, host ORDER BY wc.year
WITH host, count(*) AS times, collect(wc.year) AS years
WHERE times > 1
return host.name, times, years
```

3 - Hosts that won the World Cup, and the result of the final match.

```
MATCH (match:Match {round: "Final"})<-[hostPlayed:PLAYED_IN]-(host:Country),
        (host)<-[:HOSTED_BY]-(worldCup),
        (worldCup)-[:CONTAINS_MATCH]->(match),
        (match)<-[oppositionPlayed:PLAYED_IN]-(opposition)
```

```
WHERE (hostPlayed.score > oppositionPlayed.score)
OR (hostPlayed.penalties > oppositionPlayed.score)
RETURN host.name, worldCup.year, hostPlayed.score + "-" + oppositionPlayed.score
AS score, opposition.name
ORDER BY worldCup.year
```

4 - Top scorers per world cup.

```
MATCH (player)-->(stats)-[:SCORED_GOAL]->(goal),
          (stats)-[:IN_MATCH]->()<-[:CONTAINS_MATCH]-(wc:WorldCup)
WHERE goal.type IN ["goal", "penalty"]
WITH  player.name AS player, count(*) AS goals,
         collect(DISTINCT wc.year) AS competitions
UNWIND competitions AS competition
WITH player, goals, competition ORDER BY player, goals, competition
RETURN player, goals, collect(competition) AS competitions
ORDER BY goals DESC
LIMIT 5
```

5 - Top scorer playing in the 2018 World Cup.

```
MATCH (player:Player)-->(stats)-[:SCORED_GOAL]->(goal),
           (stats)-[:IN_MATCH]->()<-[:CONTAINS_MATCH]-(wc:WorldCup)
WHERE goal.type IN ["goal", "penalty"]
WITH  player, count(*) AS goals
ORDER BY goals DESC
MATCH (player)-[:IN_SQUAD]->(squad:Squad {year: 2018}),
           (squad:Squad)<-[:NAMED_SQUAD]-(country)
RETURN player.name, country.name, goals
```

6 - Which hosts won the World Cup that they hosted?

```
MATCH (match:Match {round: "Final"})<-[hostPlayed:PLAYED_IN]-(host:Country),
           (host)<-[:HOSTED_BY]-(worldCup),
(worldCup)-[:CONTAINS_MATCH]->(match),
(match)<-[oppositionPlayed:PLAYED_IN]-(opposition)
WHERE (hostPlayed.score > oppositionPlayed.score) OR (hostPlayed.penalties ->
          oppositionPlayed.score)
RETURN host.name
ORDER BY worldCup.year
```

7 - Which countries have never won a match at a World Cup?

```
MATCH (away:Country)-[awayPlayed:PLAYED_IN]->(match:Match)<-
           [homePlayed:PLAYED_IN]-(home:Country)
WHERE (homePlayed.score > awayPlayed.score)
WITH collect(distinct home) as home
```

```
MATCH (losers:Country)
WHERE NOT losers IN home
RETURN (losers)
```

8 - What's the highest number of goals scored in a World Cup match?

```
MATCH(match:Match)
RETURN max(match.h_score + match.a_score) as max_goals
```

9 - Which stadium has hosted the most World Cup matches?

```
MATCH (stad:Stadium)<-[:PLAYED_IN_STADIUM]-(match:Match)
RETURN stad.name, count(match) as cant
ORDER BY cant DESC
LIMIT 1
```

10- Which country has scored the most goals across all World Cups?

```
MATCH(c1:Country)-[r:PLAYED_IN]->(match:Match)
RETURN c1.name, sum(r.score) as sum_goals
ORDER BY sum_goals DESC
LIMIT 1
```

11 - Which country has participated in the most World Cups?

```
MATCH(c1:Country)-[r:NAMED_SQUAD]->(squad:Squad)-[:FOR_WORLD_CUP]
        ->(wc:WorldCup)
RETURN c1.name, count(c1) as cant
ORDER BY cant DESC
LIMIT 1
```

12 - Which hosts won the World Cup that they hosted?

```
MATCH (match:Match {round: "Final"})<-[hostPlayed:PLAYED_IN]-(host:Country),
        (host)<-[:HOSTED_BY]-(worldCup),
        (worldCup)-[:CONTAINS_MATCH]->(match),
        (match)<-[oppositionPlayed:PLAYED_IN]-(opposition)
WHERE (hostPlayed.score > oppositionPlayed.score) OR (hostPlayed.penalties >
         oppositionPlayed.score)
RETURN host.name
ORDER BY worldCup.year
```

13 - Which countries have never won a match at a World Cup?

```
MATCH (away:Country)-[awayPlayed:PLAYED_IN]->(match:Match)<-
        [homePlayed:PLAYED_IN]-(home:Country)
WHERE (homePlayed.score > awayPlayed.score)
WITH collect(distinct home) as home
MATCH (losers:Country)
```

```
WHERE NOT losers IN home
RETURN (losers)
```

14 - What's the highest number of goals scored in a World Cup match?

```
MATCH(match:Match)
RETURN max(match.h_score + match.a_score) as max_goals
```

15 - Which stadium has hosted the most World Cup matches?

```
MATCH (stad:Stadium)<-[:PLAYED_IN_STADIUM]-(match:Match)
RETURN stad.name, count(match) as cant
ORDER BY cant DESC
LIMIT 1
```

16 - Which country has scored the most goals across all World Cups?

```
MATCH(c1:Country)-[r:PLAYED_IN]->(match:Match)
RETURN c1.name, sum(r.score) as sum_goals
ORDER BY sum_goals DESC
LIMIT 1
```

17 - Which country has participated in the most World Cups?

```
MATCH(c1:Country)-[r:NAMED_SQUAD]->(squad:Squad)-[:FOR_WORLD_CUP]
        ->(wc:WorldCup)
RETURN c1.name, count(c1) as cant
ORDER BY
```