Database Project

First Deliverable

1 Design Choices

The overall design choice we made was to stick as close as possible to the given data while keeping useful information and reducing redundancy.

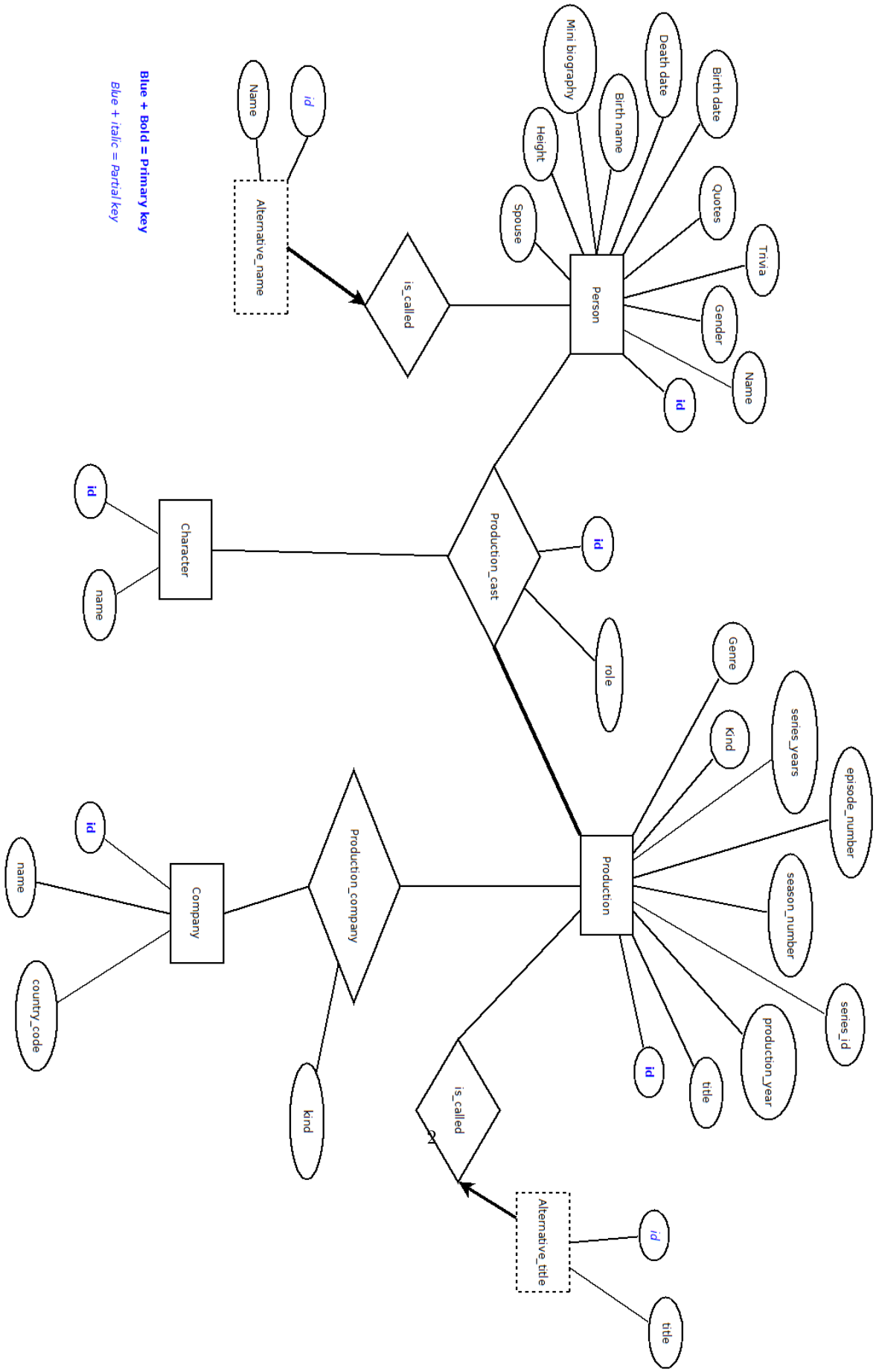
Let's start with real person in the universe, we obviously described them as an entity called Person. This entity is in a week entity relationship with the Alternative_name entity as it makes no sense to have an alternative name that is not linked to a person. We implemented the weak entity with "ON DELETE CASCADE" such that we never have existing alternative name linked to deleted Person in the database.

We decided to have a 3 way relationship with the Person, Character and Production entities as we felt that linking these entities in a relationship was the best way to form tuples that represent something that produces movies. If a person produces a movies but isn't a character then the character_id field is set to null, this way let's us link directly person to character in the same table. We also link Person and Character to Production_cast with many to many relationship because a person can produce several movies in different production and play many different character also since a character could be played by no real person (in computer generated movies for example) the arrow between Character and Production_cast doesn't need any constraint, Finally anyone in the production cast needs at least one production therefore we connected the relationship with a bold line between Production and Production_Cast. The rest is self explanatory.

The production entity also posses a weak entity relationship with an alternative title the exact same way as Person does with Alternative_name.

And finally we have that the Company entity produces Production. This is seen as a many to many relationship with attributes because a Company can produces several production, but a production can have zero (or many) company that produces it (indie movie or collaborative movies).

2 ER Model


Blue + Bold = Primary key
Blue + Italic = Partial key
Person
Mini biography
Death date
Birth date
Birth name
Height
Quotes
Spouse
Trivia
Gender
Name
id
Alternative_name
Name
id
is_called
Production_cast
id
role
Character
id
name
Production
Genre
Kind
series_years
episode_number
season_number
series_id
production_year
title
id
Production_company
Company
id
name
country_code
kind
is_called
Alternative_title
id
title

3 QL DDL code for table creation

```
CREATE TABLE Person
(
        id VARCHAR2(20) NOT NULL,
        Name VARCHAR2(300),
        Gender VARCHAR2(5),
        Trivia VARCHAR2(2000),
        Quotes VARCHAR2(2000),
        Birth_date DATE,
        Death_date DATE,
        Birth name VARCHAR2(300),
        Mini biography VARCHAR2(2000),
        Spouse VARCHAR2(300),
        Height FLOAT,

        PRIMARY KEY(id)
)

CREATE TABLE Characters
(
        id VARCHAR2(20) NOT NULL,
        name VARCHAR2(200),

        PRIMARY KEY(id)
)

CREATE TABLE Company
(
        id VARCHAR2(20) NOT NULL,
        country_code VARCHAR2(20),
        name VARCHAR2(210),

        PRIMARY KEY(id)
)

CREATE TABLE Production
(
        id VARCHAR2(20) NOT NULL,
        title VARCHAR2(370),
        production_year DATE,
        series_id CHAR(9), -- Here we fix the length to 9.
    --No id will be > than 999 999 999. And it's faster than VARCHAR
        season_number CHAR(5),
        episode_number CHAR(10),
        series_years_start DATE
```

```
        series_years_end DATE
        kind VARCHAR2(30),
        genre VARCHAR2(30),
        PROD_YEAR VARCHAR2(20)
    -- When we don't want to extract the date for the year

        PRIMARY KEY(id)
)


CREATE TABLE Alternative_title
(
        id VARCHAR2(20) NOT NULL,
        title VARCHAR2(330),
        prod_id VARCHAR2(20) NOT NULL,

        PRIMARY KEY (id, prod_id),
        FOREIGN KEY (prod_id) REFERENCES Production(id),
                ON DELETE CASCADE
)

CREATE TABLE Alternative_name
(
        id VARCHAR2(20) NOT NULL,
        Name VARCHAR2(300),
        person_id VARCHAR2(20) NOT NULL,

        PRIMARY KEY (id, person_id),
        FOREIGN KEY (person_id) REFERENCES Person(id),
                ON DELETE CASCADE
)

CREATE TABLE Production_cast
(
        ID NUMBER NOT NULL,
    --auto increments and is our SURROGATE KEY for this table
        production_id VARCHAR2(20) NOT NULL,
        person_id VARCHAR2(20) NOT NULL
        character_id VARCHAR2(20),
        role VARCHAR2(20) NOT NULL,

        PRIMARY KEY (ID),
        FOREIGN KEY (production_id) REFERENCES Production,
        FOREIGN KEY (person_id) REFERENCES Person,
        FOREIGN KEY (character_id) REFERENCES Characters
)
```

```
CREATE TABLE Production_company
(
        production_id VARCHAR2(20) NOT NULL,
        company_id VARCHAR2(20) NOT NULL,
        kind VARCHAR2(50),
        ID VARCHAR2(20) NOT NULL

        PRIMARY KEY (ID),
        FOREIGN KEY (production_id) REFERENCES Production,
        FOREIGN KEY (company_id) REFERENCES Company

)
```

Second Deliverable

4 Parsing Data

We used several "shell" scripts in order the parse the data. The first one was used just to convert "N" into "NULL" strings. For instance :

```
#!/bin/sh
awk -F $'\t' '{
        if ($3 ~ /^\\N/)
                print $1 "\t" $2 "\t" "NULL" "\t" $4
        else
                print
}' PRODUCTION_CAST.csv > PRODUCTION_CASTcorr.csv
```

We also used scripts to put dates in correct format and to split some columns. For example, the starting and ending years of series.

Finally, we also had to parse the height of person in the PERSON table to convert all values in centimetres

5 Interface

5.1 Connection

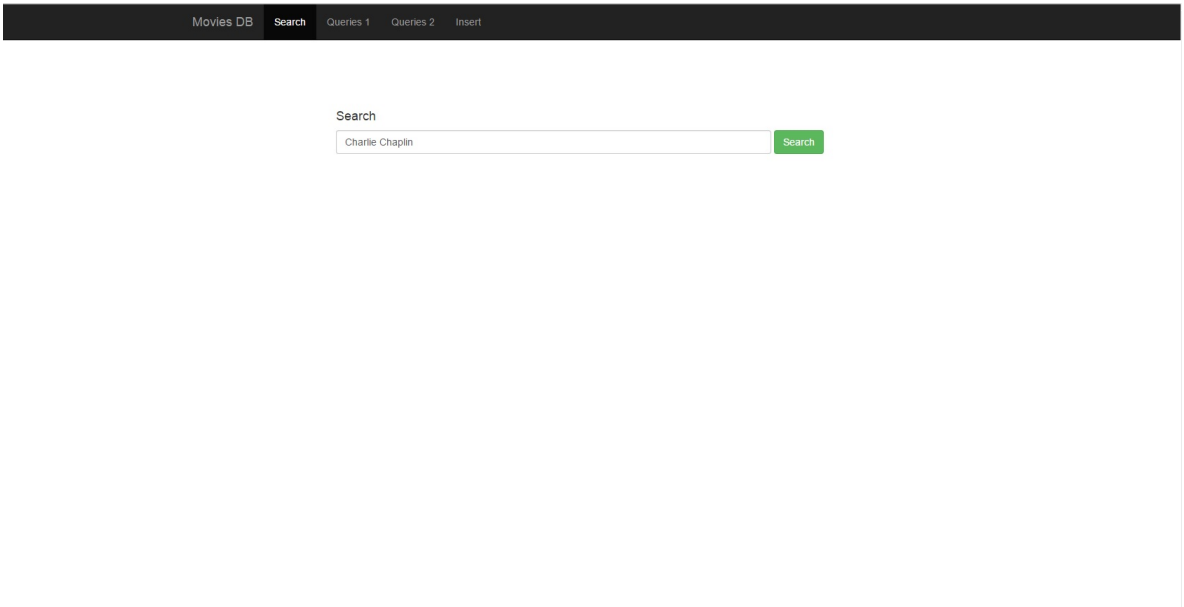
To connect to the furnished oracle database we have apache configured in our local machines with pdo_oci enabled. We can then query the database using oracle SQL syntax in php pages. For example :

```php
<?php //Example
try{
    $dbc = new PDO('oci:dbname=diassrv2.epfl.ch:1521/orcldias.epfl.ch;charset=CL8MSWIN1251', '*****', '*****');
    $req = $bdd->query('SELECT NAME FROM PERSON WHERE id=199');
    $data = $req->fetch();
    echo $data['NAME']; //will print the name of person with id 199
}
catch (Exception $e) {
    die('Erreur : ' . $e->getMessage());}
?>
```

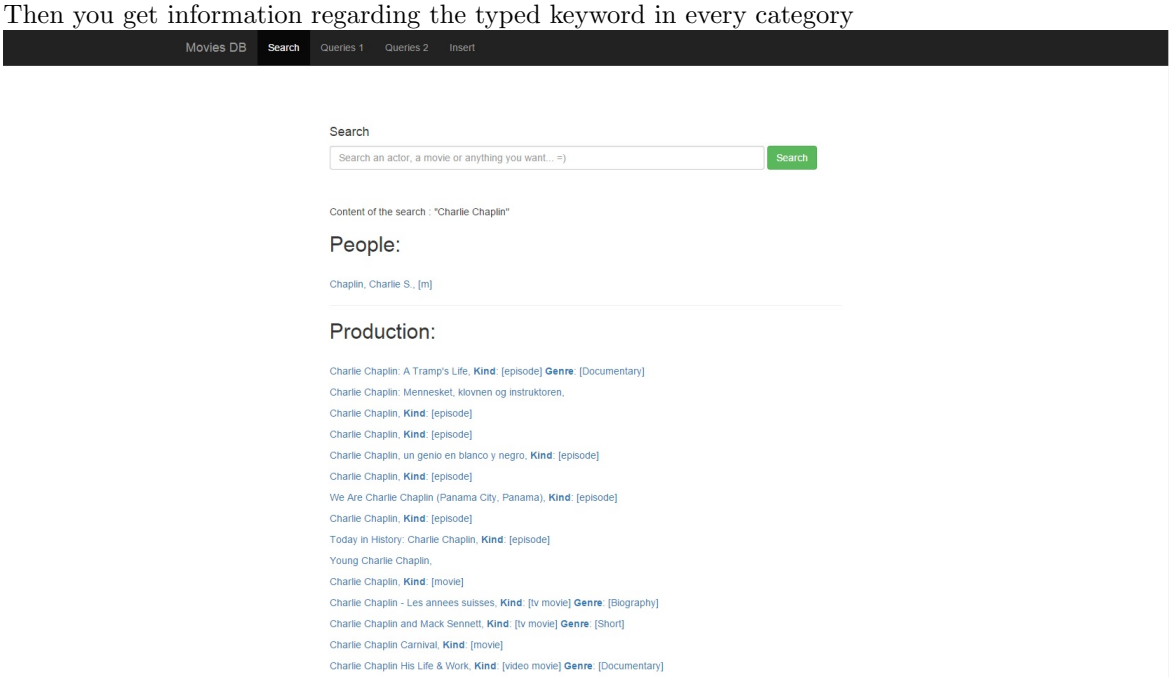
5.2 Search interface

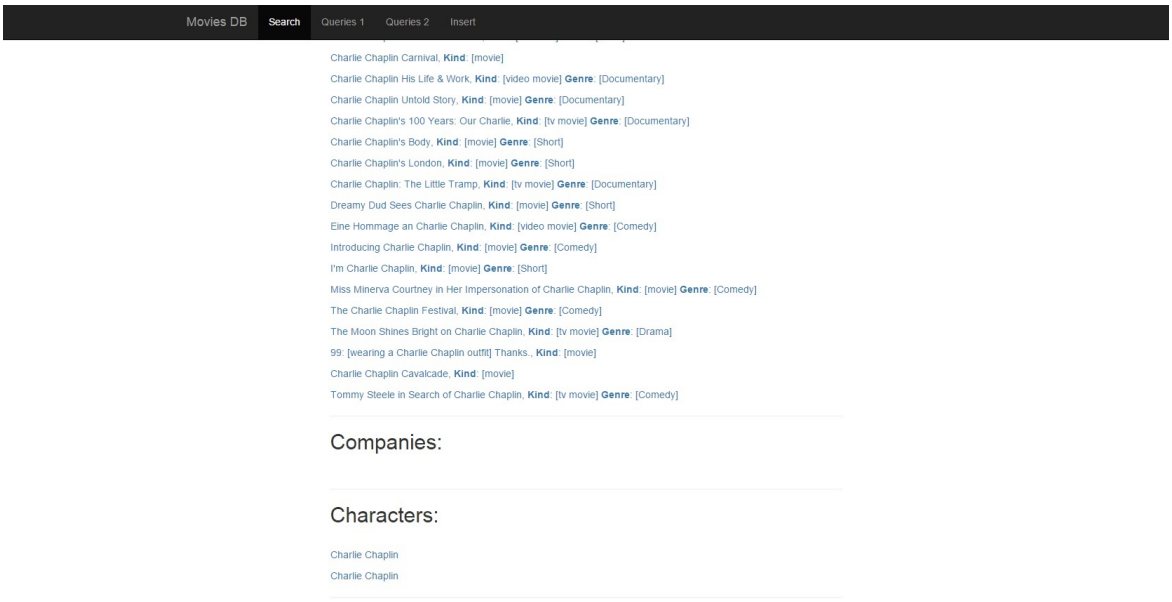
You can search person, companies, movies and characters through our interface. The following screenshots shows how you can interact with the website to get information and data.

First you query what youre looking for through a text-field form in html



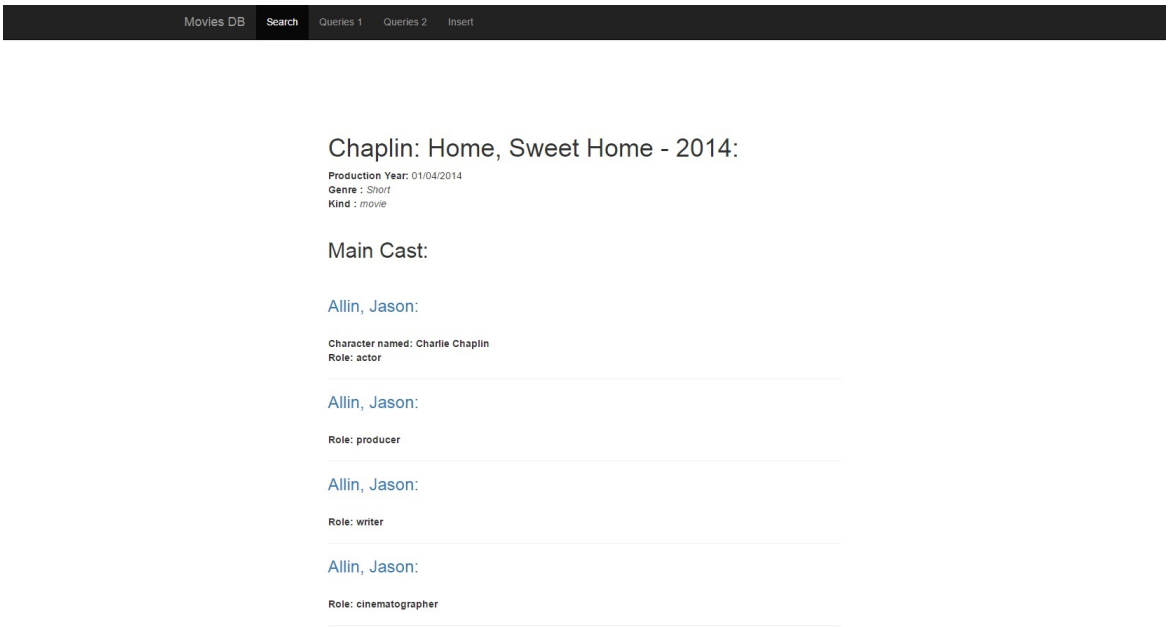
Then you get information regarding the typed keyword in every category



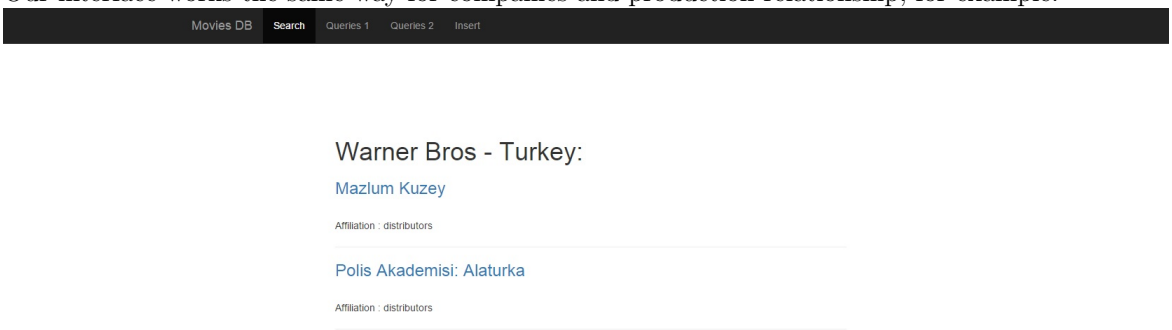


Then if youre interested in, let's say, a character named Charlie Chaplin you can click on the hyperlink with the name of the character youre interested in and youll get to a new page that gives all the known information related to that character.

You might then be interested in the Chaplin: Home, Sweet Home movie so if you click on the hyperlink youll get to a new page that will give all the known information related to that movie.



Seems like this was a lot of work for Allin, Jason!
Our interface works the same way for companies and production relationship, for example:



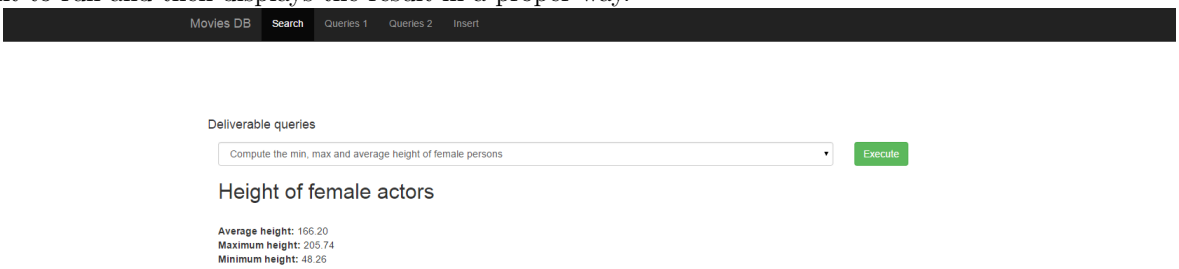
The way it works is we query the databases name fields in the Person, Production, Characters and Company table to get the the name and IDs of what the user is interested in (Note that since name format is not always perfect in our dataset, we try to use regex expression to get as good and precise data as possible but it can always be improved).

Then we have several php pages that given an id gets more information about either a character or a company and everything is linked through hyperlinks in case the user might want to get more

information about related content.

5.3 Predefined queries

For the predefined queries we have a select type of html form that lets you choose which query you want to run and then displays the result in a proper way.

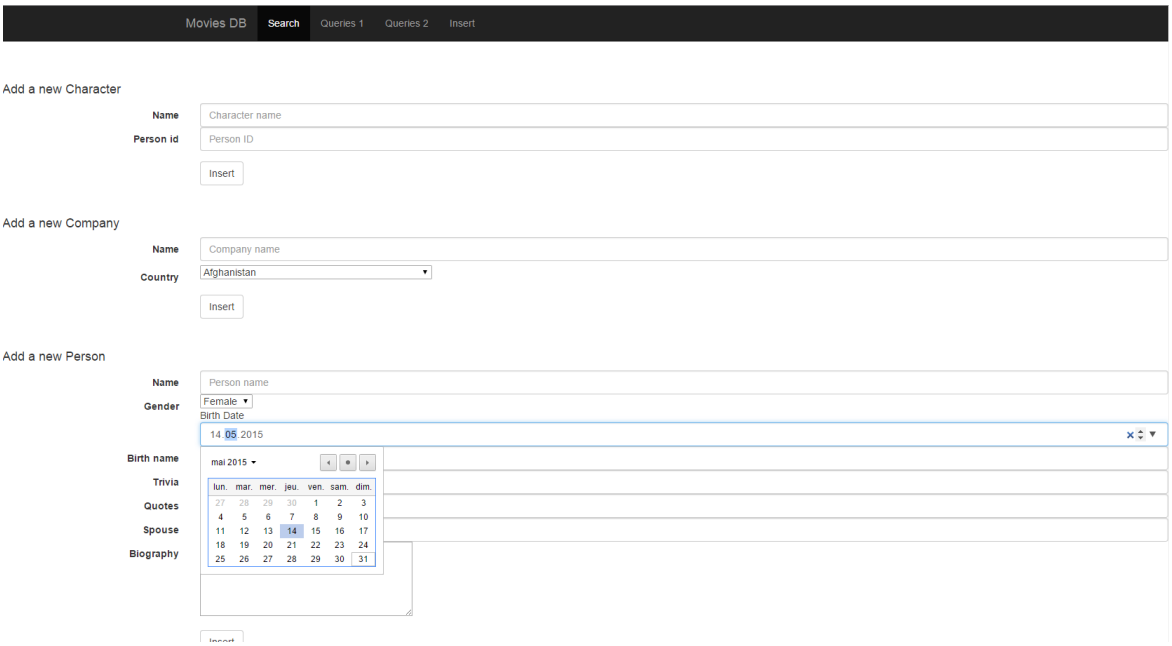


(Note that our menu still needs refining...)

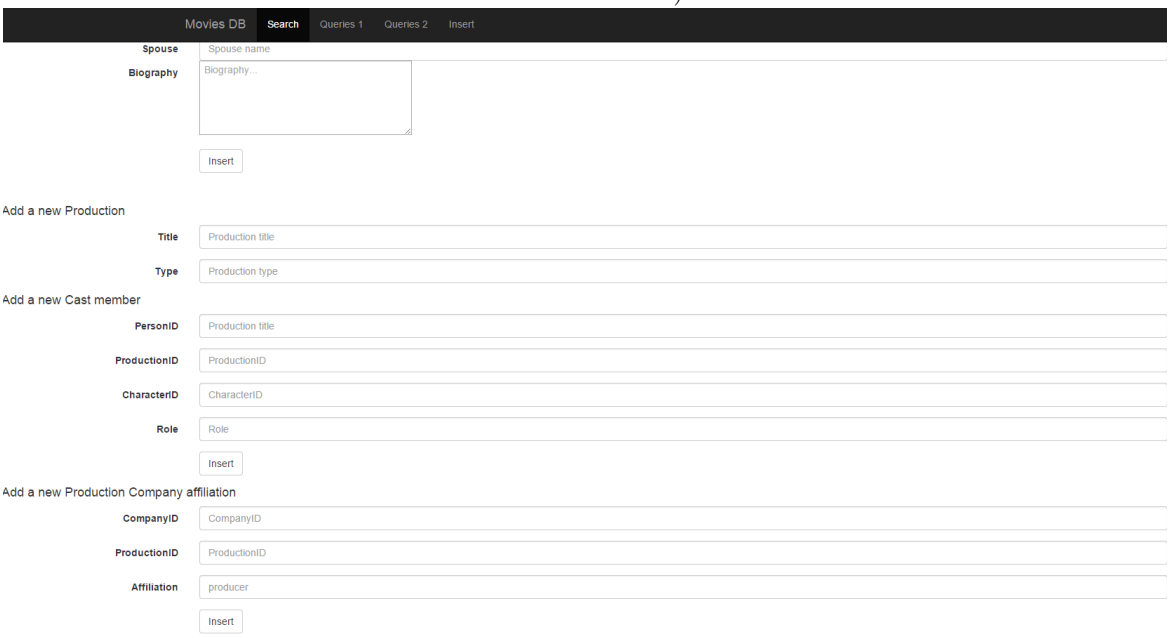
Since the queries are already precomputed, there is nothing much to say about it. Please refer to the part about the actual SQL query for more information!

5.4 Insertion and deletion

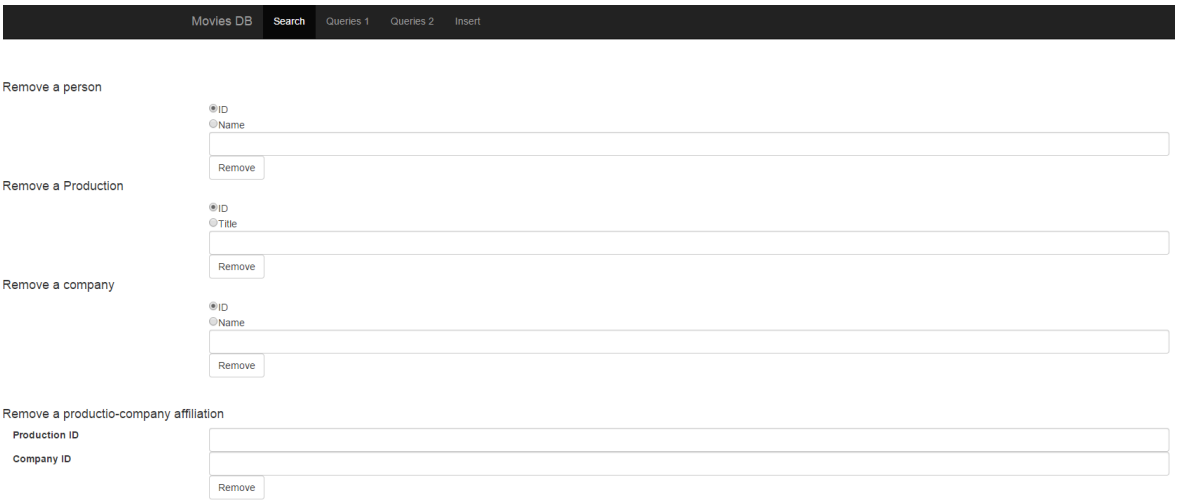
For the insertion of data we use html forms again to add entity instances into the database



To actually insert relationship we have another set of forms below: (note that IDs need to be known in order to insert data for relations and for characters)



To delete and remove entities you can either provide the name or the id to a form according to what kind of entity you want to remove. For relations you need to provide id of both entities related. (We could easily improve this part of the project if we spent more time in the web programming aspect of it but this isnt really our interest in this class so this is more a proof of concept since the query to delete data are easy to implement).



Since everything is linked with delete on cascade and foreign key references. Deleting a person, for example, in the Person table will automatically trigger deletion of any character she played and any production membership she was a part of. An SQL example of our code with an id reference would be: DELETE FROM PERSONS WHERE ID=$personID where $personID is gotten through a form $_POST variable in php.

6 Queries of deliverable 2

Here is the first set of queries in sql that a user can run in the interface :

```
/*a) Compute the number of movies per year.
Make sure to include tv and video movies.*/

SELECT prod_year as yearOfProd, COUNT(*)
FROM test_Production
WHERE prod_year != 0
GROUP BY prod_year
ORDER BY prod_year

/*b) Compute the ten countries with most production companies.*/
SELECT country_code, COUNT(*) as nombreProd
FROM test_Production_company pComp, test_Company comp
WHERE pComp.company_id = comp.id AND country_code is not null
GROUP BY country_code
ORDER BY nombreProd DESC
OFFSET 0 ROWS FETCH NEXT 10 ROWS ONLY
```

```
--c) Compute the min, max and average career duration. (A career length is implied by
SELECT MIN(duree) as mini, MAX(duree) as maxi, ROUND(AVG(duree)) as moyenne
FROM (SELECT MAX(prod_year)-MIN(prod_year)+1 duree
                FROM test_person p, test_prod_cast prodCast, test_production prod
                WHERE prod_year is not null and p.id=prodCast.person_id and prod.id=pr
                GROUP BY p.id ) tableDuree

--d) Compute the min, max and average number of actors in a production.
SELECT MIN(people) as mini, MAX(people) as maxi, ROUND(AVG(people)) as moyenne
FROM (
        SELECT COUNT(*) as people
        FROM test_person p, test_prod_cast prodCast, test_production prod
        WHERE p.id=prodCast.person_id
                AND prod.id=prodcast.production_id
                AND (prodCast.role LIKE 'actor' OR prodCast.role LIKE 'actress')
        GROUP BY prod.id
        ) peopleInProd

--e) Compute the min, max and average height of female persons.

SELECT MIN(height), MAX(height), AVG(height)
from person
WHERE gender LIKE 'f'

--f) List all pairs of persons and movies where the
--person has both directed the movie and acted in the movie.
--Do not include tv and video movies.
Select name,titlle
FROM test_production prod, test_person p,
        (SELECT pc1.production_id, pc1.person_id
                FROM test_prod_cast pc1, test_prod_cast pc2
                WHERE pc1.production_id=pc2.production_id
                        AND pc1.person_id = pc2.person_id
                        AND pc1.role LIKE 'actor'
                        AND pc2.role LIKE 'director'
        ) dbles
WHERE prod.id = dbles.production_id
AND p.id = dbles.person_id

/*g) List the three most popular character names.*/
SELECT COUNT(*) as appearances, c.name
FROM test_prod_cast prodCast
INNER JOIN characters c
ON prodCast.character_id=c.id
GROUP BY character_id, c.name
ORDER BY appearances DESC
OFFSET 0 ROWS FETCH NEXT 3 ROWS ONLY
```

Second Deliverable

7 Queries of deliverable 3

The running time of each query on OracleDB can be found in the sequel :

```
--a) 17.3 minutes
With innerQ as (
    SELECT production_id, name, anni
    FROM (
                SELECT production_id,
                        name,
                        EXTRACT(YEAR FROM birth_date) as anni,
                        ROW_Number() Over
            (PARTITION BY production_id order by birth_date) as rownb,
                        count(*) over(PARTITION BY production_id) CNT
                FROM production prod, prod_cast prodCast, person p
                WHERE prod.id=prodCast.production_id
                        AND p.id = prodCast.person_id
                        AND birth_date is not null
    ) tmp
    WHERE (ROWNB = 1 OR ROWNB = CNT))
SELECT p.titlle, p.id, b.name as Who, b.anni, a.anni-b.anni as AgeDiff
FROM innerQ a, innerQ b, production p
WHERE a.production_id = b.production_id
        AND a.name != b.name
        AND a.anni-b.anni >= 55
        AND a.production_id = p.id

--b) 11.9 secondes
SELECT *
FROM
  (
  SELECT prod_year, count(*) as productivity
  FROM production prod, prod_cast pc, person p
  WHERE  prod.id=pc.production_id AND pc.person_id=p.id AND p.id = 3429434
  -- id of person is given in request
  AND prod_year <> 0
  GROUP BY prod_year
  ORDER BY productivity DESC
  ) tmp
WHERE ROWNUM = 1

--c) 3 secondes
SELECT COUNT(*) as nbreProd, c.name, p.genre
```

```
    FROM production p, production_company pComp, company c
    WHERE p.id = pComp.production_id
     AND p.prod_year = 2015
    AND pComp.company_id = c.id
    GROUP BY c.name, p.genre
    ORDER BY p.genre, nbreProd DESC

--d) 22.8 minutes
SELECT pid, p1.name, p1id, p2.name, p2id
FROM person p1, person p2, (
    SELECT pc1.production_id as pid, pc1.person_id as p1id,
        pc2.person_id as p2id
    FROM prod_cast pc1, prod_cast pc2
    WHERE pc1.person_id < pc2.person_id
        AND pc1.production_id = pc2.production_id
    ) tmp
WHERE p1id = p1.id AND p2id = p2.id AND p1.name = p2.name

--e) 60 secondes
SELECT prod_year, avg(cnt)
FROM (
    SELECT production_id, prod_year, count(*) as cnt
    FROM prod_cast prodCast, production prod
    WHERE prodCast.production_id = prod.id and prod_year <> 0
        AND (role LIKE 'actor' or role like 'actress')
    GROUP BY prod_year, production_id
    ORDER BY prod_year
    ) tmp
GROUP BY prod_year
ORDER BY prod_year

--f) 1.5 secondes
SELECT ROUND(AVG(nbre)) as NumberOfEpisodes, season_number
FROM (
    SELECT COUNT(*) as nbre, series_id,
    season_number as season_number
    FROM production
    WHERE season_number is not null
    GROUP BY series_id, season_number) tmp
GROUP BY season_number
ORDER BY to_number(season_number)

--g) 1.22 secondes
SELECT AVG(nbreSeason)
FROM
        (SELECT COUNT(*) as nbreSeason, series_id
    FROM(
        SELECT COUNT(*), series_id, season_number
```

```
        FROM production
        WHERE kind LIKE 'episode'
        GROUP BY series_id, season_number ) as tmp
    GROUP BY series_id ) as tmp2

--h) 1.06 secondes
SELECT COUNT(*) as nbreSeason, series_id
FROM(
        SELECT series_id, season_number
        FROM production
        WHERE kind LIKE 'episode'
        GROUP BY series_id, season_number ) tmp
GROUP BY series_id
ORDER BY nbreSeason DESC
OFFSET 0 ROWS FETCH NEXT 10 ROWS ONLY

--i) 51 secondes
SELECT series_id, avg(cnt) as episodesPerSeason
FROM (
    SELECT *
    FROM (
      SELECT series_id, COUNT(*) OVER
          (PARTITION BY series_id, season_number ORDER BY series_id) as cnt
      FROM production
      WHERE kind LIKE 'episode'
      ) tmp
    GROUP BY series_id, CNT
    ORDER BY series_id
    ) tmp2
GROUP BY series_ID
ORDER BY episodesPerSeason DESC

--j) 44.7 secondes
SELECT p.name, prod.titlle, prod_year as ProductionYear,
    EXTRACT(YEAR from death_date) as deathYear
FROM person p, prod_cast prodCast, production prod
WHERE p.id = prodCast.person_id
AND prodCast.production_id = prod.id
AND (prodCast.role LIKE 'actor' or prodCast.role LIKE 'actress' or
prodCast.role LIKE 'director')
AND EXTRACT(YEAR from death_date) < prod_year
GROUP BY p.name, prod.titlle, prod_year, EXTRACT(YEAR from death_date)




--k) 8.2 secondes
```

```
SELECT prod_year, rownb as ranking, name
FROM company,
    (
    SELECT company_id, prod_year,
    ROW_NUMBER() over
    (PARTITION by prod_year order by count(*) DESC ) as rownb
    FROM production_company prodComp, production p
    WHERE p.id = prodComp.production_id
    AND prod_year != 0
    GROUP BY company_id, prod_year
    ) tmp
where rownb <= 3
AND company.id = company_id
ORDER BY prod_year

--l) 21.9 secondes
SELECT *
FROM PERSON
WHERE REGEXP_LIKE(TRIVIA, 'opera singer') OR
        REGEXP_LIKE(MINI_BIOGRAPHY, 'opera singer')
ORDER BY EXTRACT(YEAR from BIRTH_DATE);

--n) 18.6 minutes
WITH innerQ as (
SELECT character_id, company_id, cnt, country_code
FROM company c, (
    SELECT character_id, company_id, cnt,
        row_number() over
        (PARTITION BY company_id order by cnt desc) as rang
    FROM(
        SELECT character_id, company_id, count(*) as cnt
        FROM (
            SELECT DISTINCT pCast.production_id, character_id, company_id
            FROM prod_cast pCast, production_company pComp
            WHERE pCast.production_id = pComp.production_id
                AND character_id is not null
            ORDER BY company_id, production_id
            ) tmp
        GROUP BY company_id, character_id
        ORDER BY company_id, CNT DESC
        ) tmp2
    ) tmp3
WHERE RANG = 1 AND c.id = company_id
)
SELECT character_id, company_id, country_code
FROM (
  SELECT character_id, company_id, country_code, cnt, row_number() OVER
      (partition by country_code order by cnt DESC) as rang
```

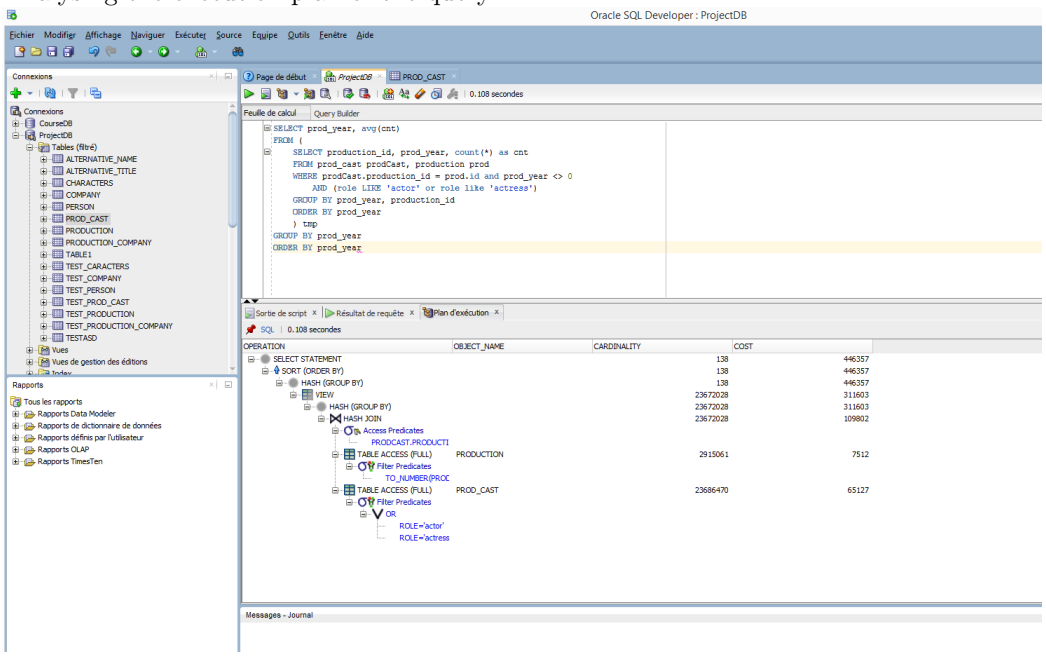
```
  FROM innerQ
  ) tmp
WHERE rang = 1
```

8 Query Optimisation

Query e)

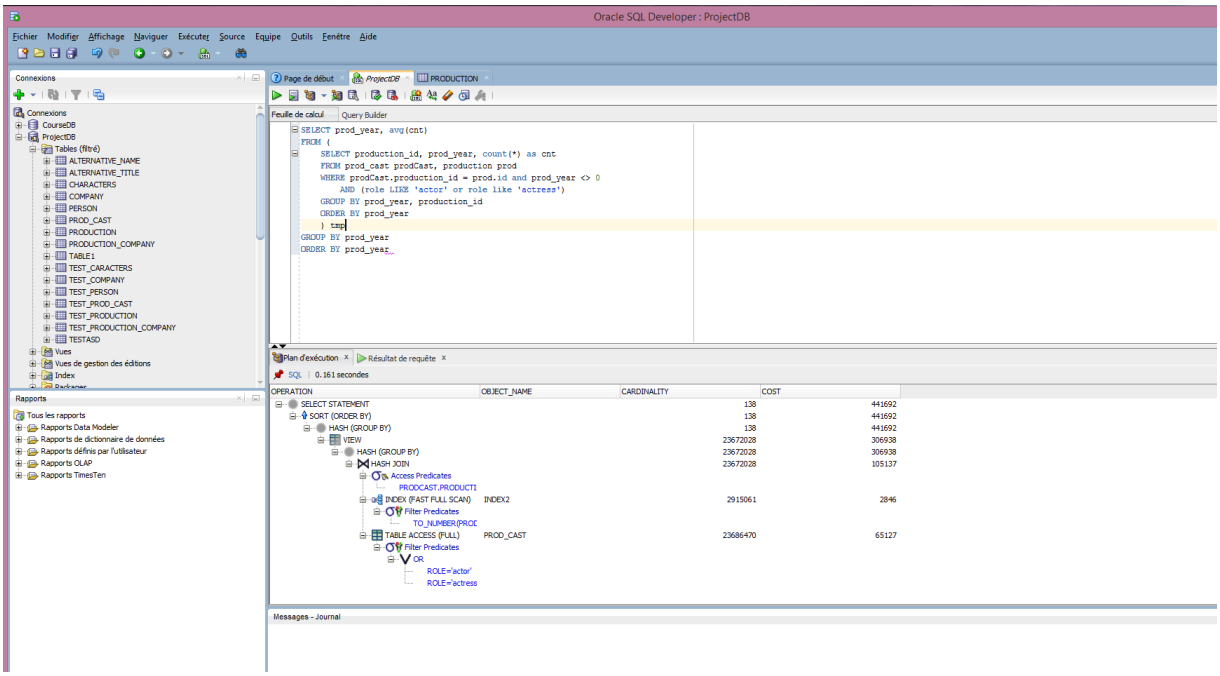
Analysis : Here we do a JOIN between the PROD_CAST and the PRODUCTION table over the production_id and we add a filter on the role such that we only get rows with actors and actress. We then group these rows by year of production and the id and we compute the average of the grouped number of rows per group of production_id and prod_year.

Analysing the execution plan of the query:



We can see that we could easily index the table accesses to prod_year and role to get better cost. The runtime without any index is about 55 seconds.

We first added an ascending index based on prod_year and production_id since that is the two selected fields on the second SELECT and we got the following execution plan :



Which shows a clear improve in IO cost of the access to prod_year (cost is 7512 without the index and 2846 with it)

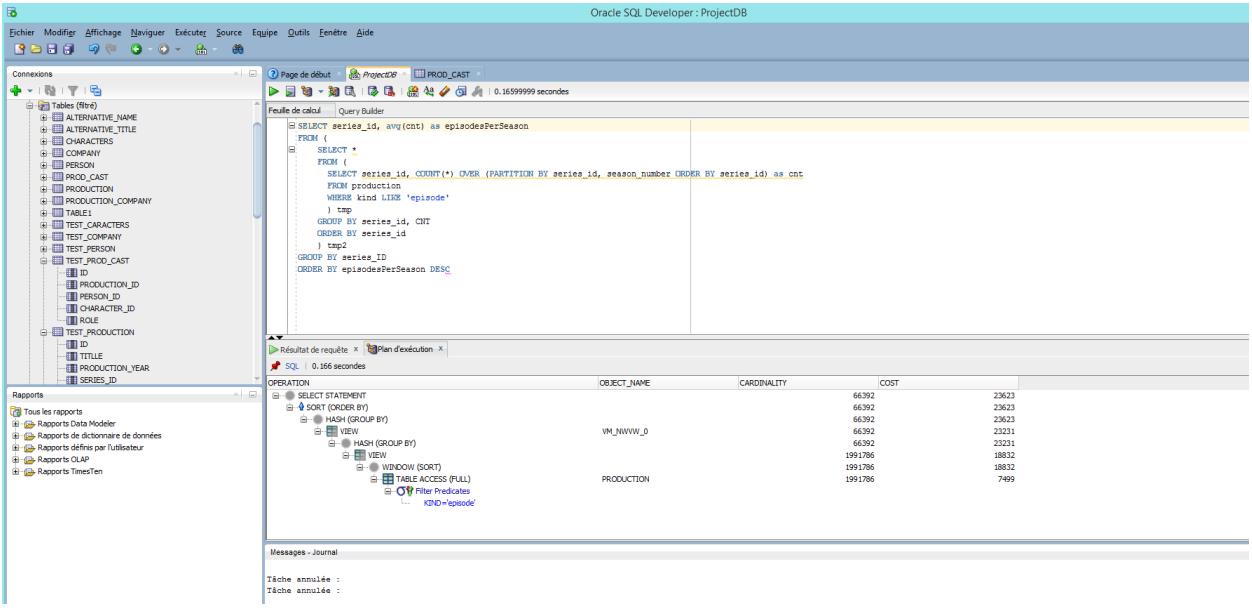
We then added an ascending index on the prod_cast table based on the role only to optimise the second (and way more costly) access but we had trouble with it. It seemed to work and to not do a FULL ACCESS in a small subset of the prod_cast table when we added this index in our test table but it doesn't seem to work in with the big table. There is probably a way to make it to work but we couldn't figure it out...

We didn't try to optimize the hash join with an hash index or something as we are not too familiar with it.

Query i)

Analysis: We first create a partition of PRODUCTION that contains all the production with Kind as episodes and then we group these partition by series_id and then we count the avg of how many of these we get to obtain the result. (We interpreted the query this way)

The execution of the query gives a runtime of 71 seconds. Here is the execution plan:



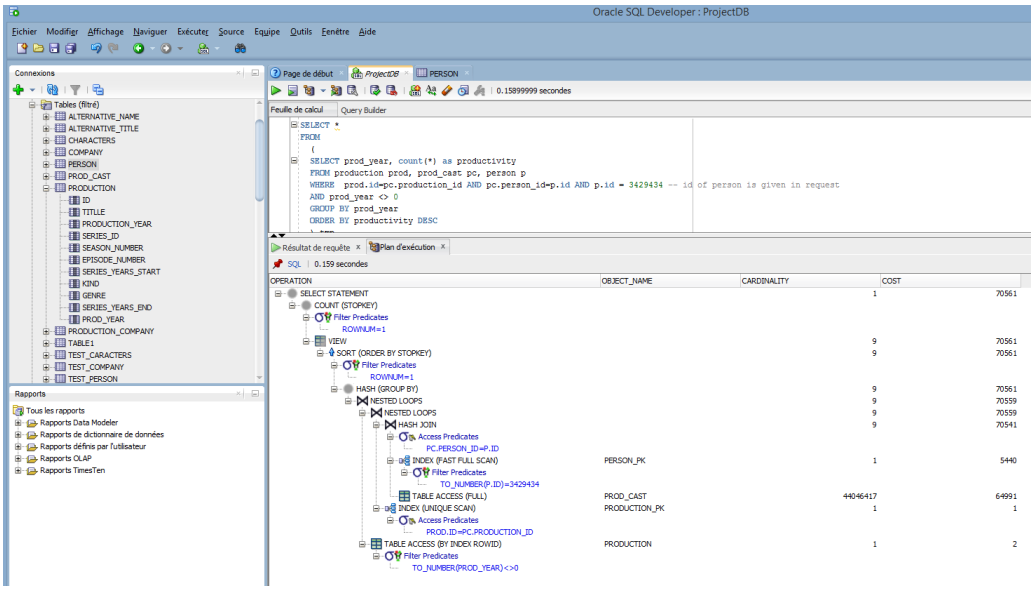
We can try to optimize the table access again for the kind by making a kind based index on the PRODUCTION table since this is what the execution table (kinda) tells us to do.

We tried adding this index but it didnt affect the query in any way, we are definitely missing something about how to build these indexes... The information given by SQL developer somewhat arent precise enough to understand what happens

Query b)

Analysis: For a given person id our query joins the person and the production_cast and the production table where the id matches and we group the rows by prod_year which means that we count all the production in the same year, next we order these row by their count and then we simply take the first line which is the line with the most production for a given year.

The query takes around 12 seconds to run without any index, and here is the execution plan given by SQL Developper:



We can see that the default indexes build where used to optimize the query! But we dont really see anything that could be optimized with our current understanding of indexing techniques...