DATA ENGINEERING CAPSTONE PROJECT

Business objective

For big corporation employee’s data from the 1980s, to design data model with all the tables to hold data, import the CSVs into a SQL database, transfer SQL database to HDFS/Hive, and perform analysis using Hive/Impala/Spark/SparkML using the data and create data and ML pipelines. Required to create end to end data pipeline and analyzing the data.

Contents

Data used and Description

Given tables with their attributes are -

1. Employees(employees.csv)
    - emp_no – Employee Id – Integer – Not Null
    - emp_titles_id – designation id – Not Null
    - birth_date – Date of Birth – Date Time – Not Null
    - first_name – First Name – Character – Not Null
    - last_name – Last Name – Character – Not Null
    - sex – Gender – Character – Not Null
    - hire_date – Employee Hire date –Date Time -Not Null
    - no_of_projects – Number of projects worked on – Integer – Not Null
    - Last_performance_rating – Last year performance rating – Character – Not Null
    - left – Employee left the organization – Boolean – Not Null
    - Last_date - Last date of employment (Exit Date) – Date Time

2. Titles(titles.csv)
    - title_id – Unique id of type of employee (designation id) – Character – Not Null
    - title – Designation – Character – Not Null

3. Salary(salaries.csv)
    - emp_no – Employee id – Integer – Not Null
    - Salary – Employee's Salary – Integer – Not Null

4. Departments(departments.csv)
    - dept_no - Unique id for each department – character – Not Null
    - dept_name – Department Name – Character – Not Null

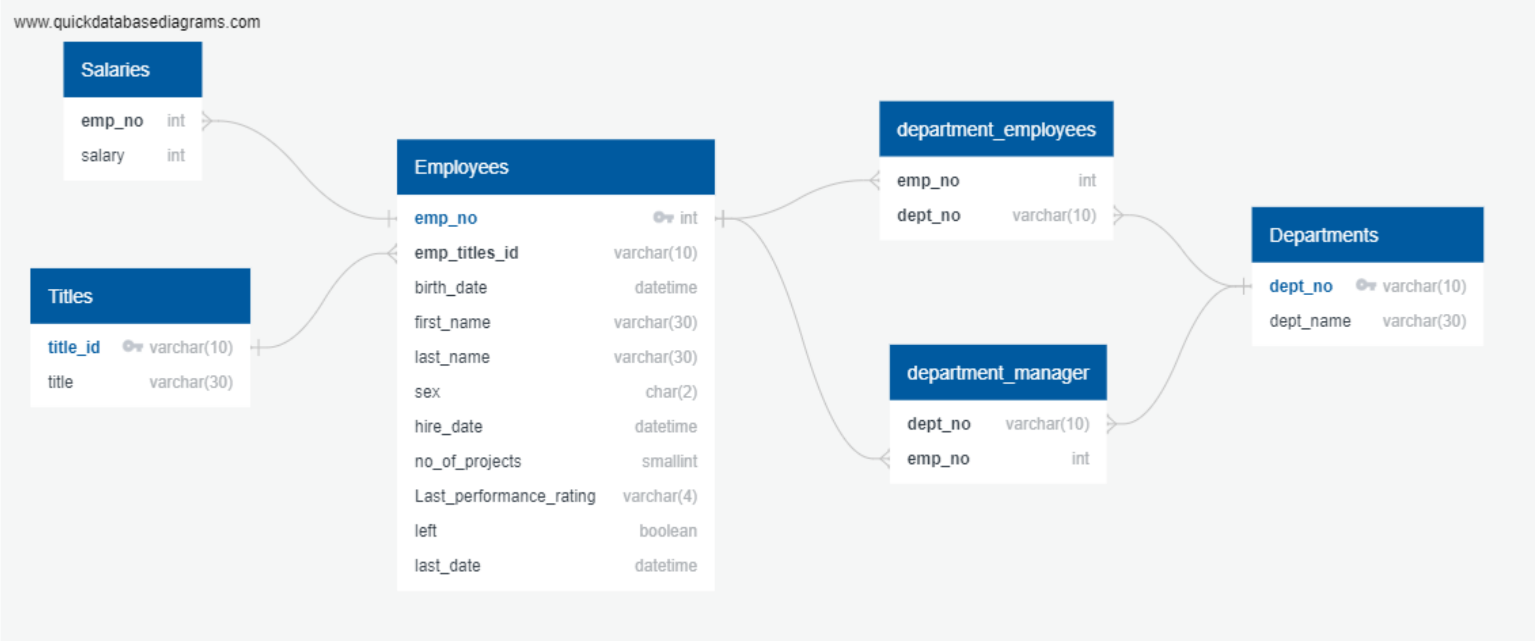
5. Department Managers (dept_manager.csv)
    - dept_no - Unique id for each department – character – Not Null
    - emp_no – Employee number (head of the department) – Integer – Not Null

6. Department Employees(dept_emp.csv)
    - emp_no – Employee id – Integer – Not Null
    - dept_no - Unique id for each department – character – Not Null

Technology stack used

- MySQL (to create database)
- Linux Commands
- Sqoop (Transfer data from MySQL Server to HDFS/Hive)
- HDFS (to store the data)
- Hive (to create database)
- Hive & Impala (to perform the EDA)
- SparkSQL (to perform the EDA)
- SparkML (to perform model building

ER Diagram (data model)



Salaries	
emp_no	int
salary	int

Titles	
title_id	varchar(10)
title	varchar(30)

Employees	
emp_no	int
emp_titles_id	varchar(10)
birth_date	datetime
first_name	varchar(30)
last_name	varchar(30)
sex	char(2)
hire_date	datetime
no_of_projects	smallint
Last_performance_rating	varchar(4)
left	boolean
last_date	datetime

department_employees	
emp_no	int
dept_no	varchar(10)

department_manager	
dept_no	varchar(10)
emp_no	int

Departments	
dept_no	varchar(10)
dept_name	varchar(30)

Create database & tables in MySQL server as per the above ER Diagram

MySQL codes:

1. Login to mysql from shell

```
 mysql -u anabig114225 -pBigdata123

show databases;

use databasename;
```

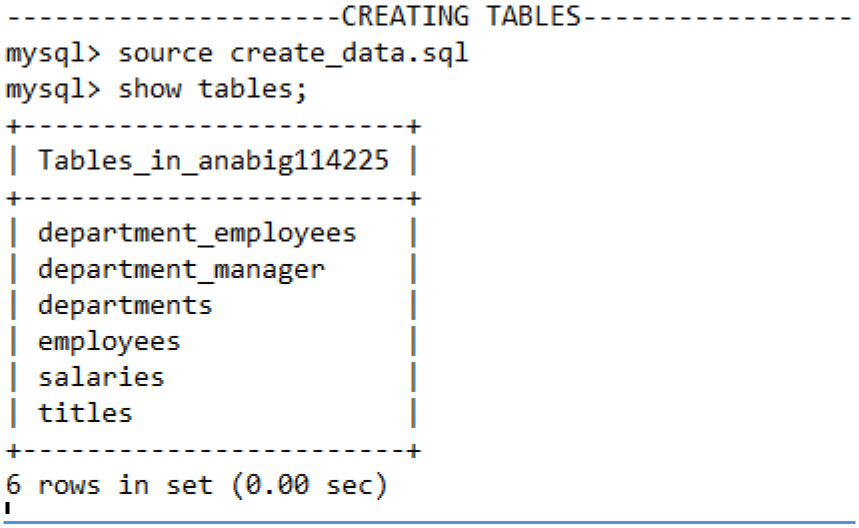
2. a) Create tables in mysql manually

```
CREATE TABLE employees(
emp_no int not null,
emp_titles_id varchar(10) not null,
birth_date varchar(20) not null,
first_name varchar(30) not null,
last_name varchar(30) not null,
sex char(2) not null,
hire_date varchar(20) not null,
no_of_projects smallint not null,
Last_performance_rating varchar(4) not null,
left_company boolean not null,
last_date varchar(20),
PRIMARY KEY(emp_no),
CONSTRAINT FK_title_id FOREIGN KEY (emp_titles_id) REFERENCES titles(title_id));

CREATE TABLE titles(
title_id varchar(10) not null,
title varchar(30) not null,
PRIMARY KEY(title_id),
 );

CREATE TABLE salaries(
emp_no int not null,
salary int not null,
CONSTRAINT FK_emp_no FOREIGN KEY (emp_no) REFERENCES employees(emp_no) );

CREATE TABLE departments(
dept_no varchar(10) not null,
dept_name varchar(30) not null,
PRIMARY KEY(dept_no) );

CREATE TABLE department_manager(
dept_no varchar(10) not null,
emp_no int not null,
CONSTRAINT FK_dept_no FOREIGN KEY (dept_no) REFERENCES departments(dept_no),
CONSTRAINT FK_emp_no1 FOREIGN KEY (emp_no) REFERENCES employees(emp_no) );

CREATE TABLE department_employees(
emp_no int not null,
dept_no varchar(10) not null,
CONSTRAINT FK_dept_no2 FOREIGN KEY (emp_no) REFERENCES employees(emp_no),
CONSTRAINT FK_emp_no2 FOREIGN KEY (dept_no) REFERENCES departments(dept_no) );
```

2.b) . OR create table using the .sql file where all the above create commands written

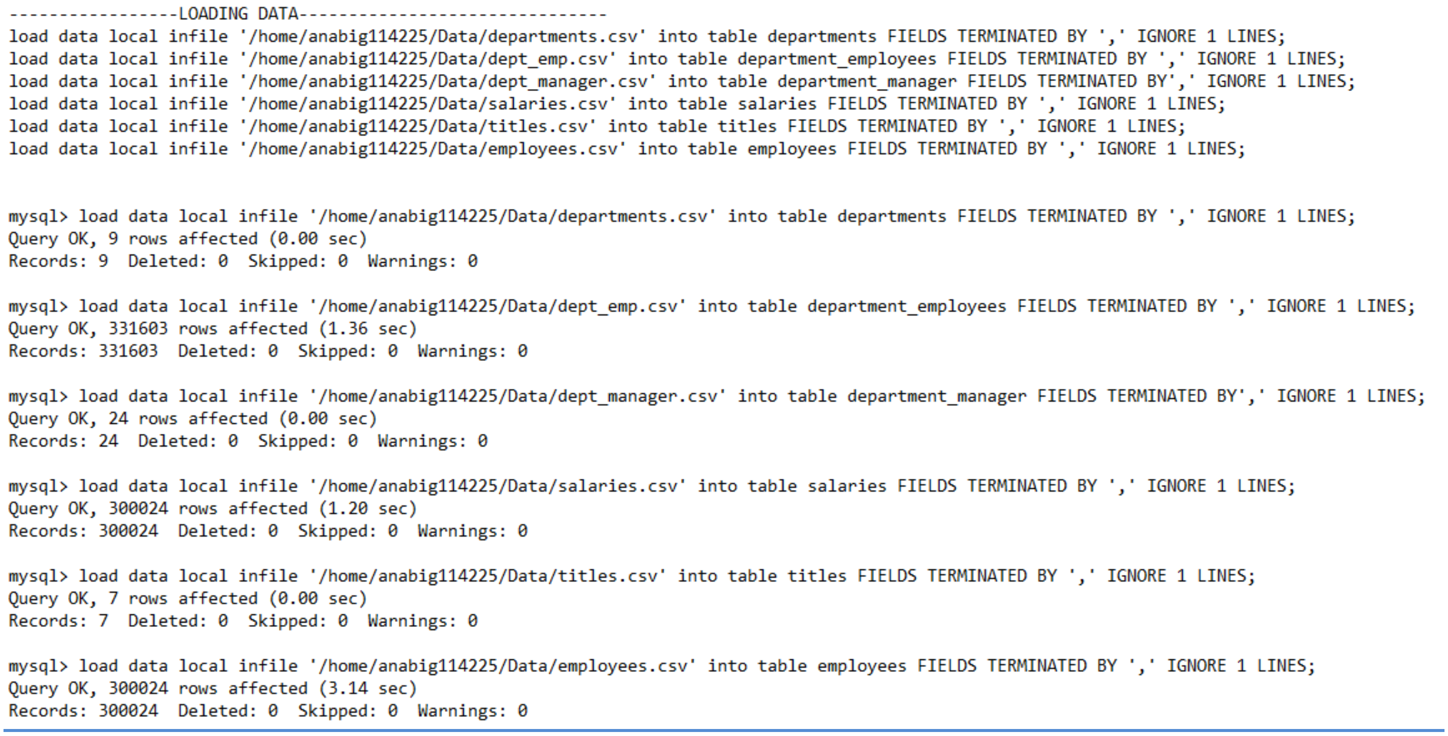
upload create_tabeles.sql to ftp (https://npbdh.cloudloka.com/ftp

run the below command to create tables under



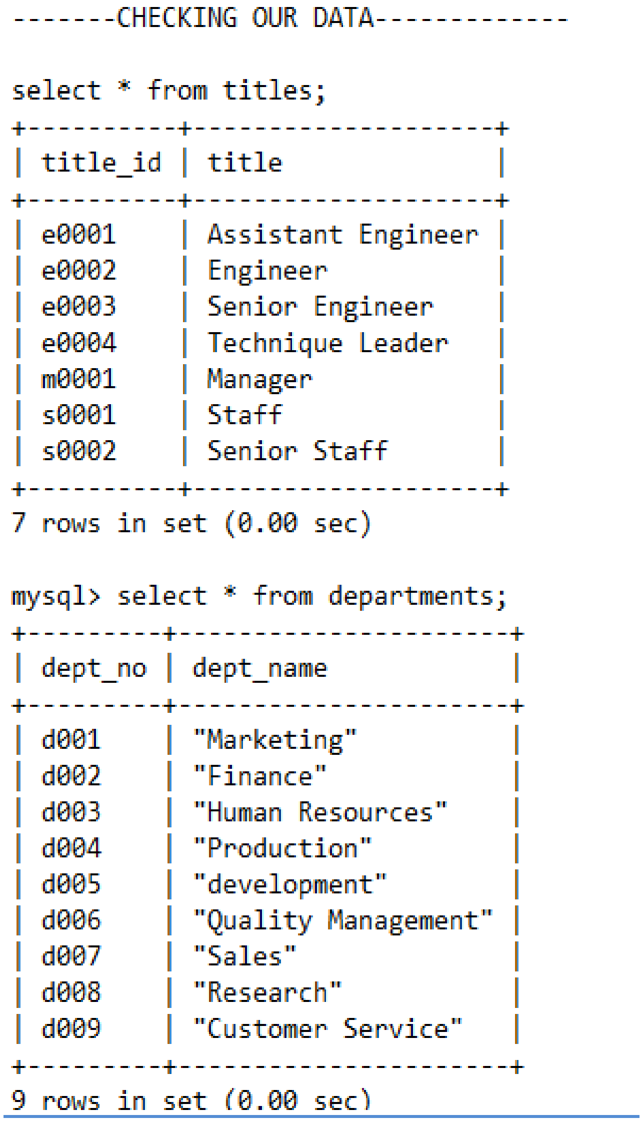
```
---------------------CREATING TABLES-----------------
mysql> source create_data.sql
mysql> show tables;
+-----------------------+
| Tables_in_anabig114225 |
+-----------------------+
| department_employees   |
| department_manager     |
| departments            |
| employees              |
| salaries               |
| titles                 |
+-----------------------+
6 rows in set (0.00 sec)
```

3. Loading data

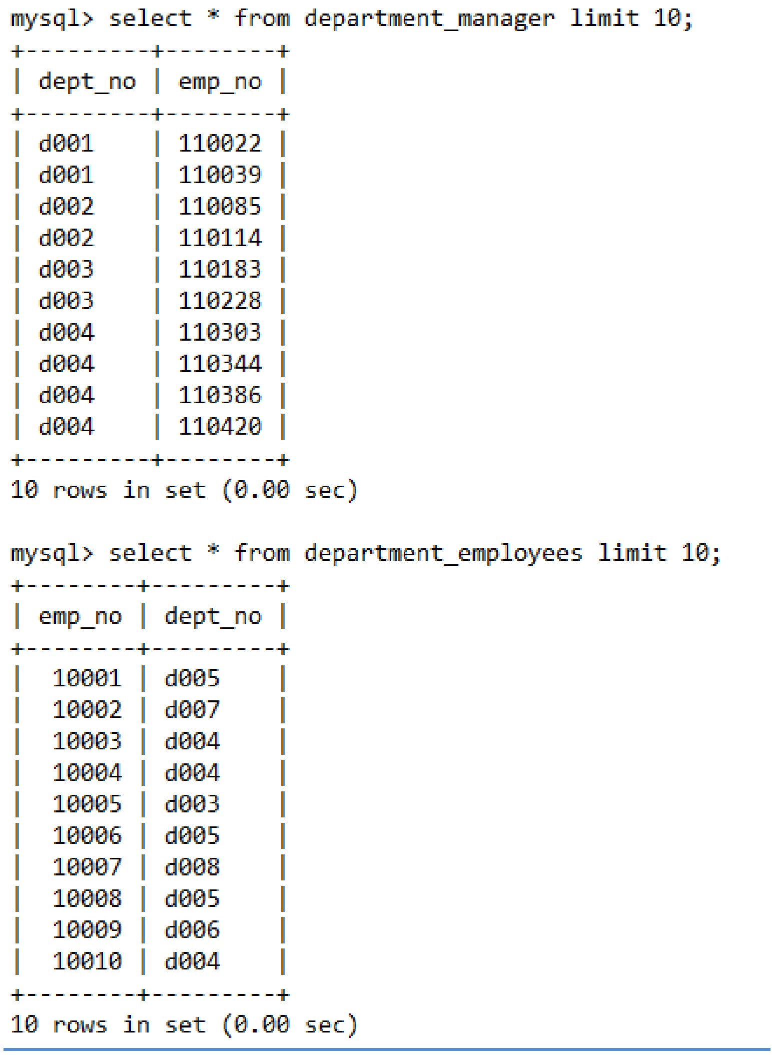


```
-----------------LOADING DATA-------------------------------
load data local infile '/home/anabig114225/Data/departments.csv' into table departments FIELDS TERMINATED BY ',' IGNORE 1 LINES;
load data local infile '/home/anabig114225/Data/dept_emp.csv' into table department_employees FIELDS TERMINATED BY ',' IGNORE 1 LINES;
load data local infile '/home/anabig114225/Data/dept_manager.csv' into table department_manager FIELDS TERMINATED BY',' IGNORE 1 LINES;
load data local infile '/home/anabig114225/Data/salaries.csv' into table salaries FIELDS TERMINATED BY ',' IGNORE 1 LINES;
load data local infile '/home/anabig114225/Data/titles.csv' into table titles FIELDS TERMINATED BY ',' IGNORE 1 LINES;
load data local infile '/home/anabig114225/Data/employees.csv' into table employees FIELDS TERMINATED BY ',' IGNORE 1 LINES;


mysql> load data local infile '/home/anabig114225/Data/departments.csv' into table departments FIELDS TERMINATED BY ',' IGNORE 1 LINES;
Query OK, 9 rows affected (0.00 sec)
Records: 9  Deleted: 0  Skipped: 0  Warnings: 0

mysql> load data local infile '/home/anabig114225/Data/dept_emp.csv' into table department_employees FIELDS TERMINATED BY ',' IGNORE 1 LINES;
Query OK, 331603 rows affected (1.36 sec)
Records: 331603  Deleted: 0  Skipped: 0  Warnings: 0

mysql> load data local infile '/home/anabig114225/Data/dept_manager.csv' into table department_manager FIELDS TERMINATED BY',' IGNORE 1 LINES;
Query OK, 24 rows affected (0.00 sec)
Records: 24  Deleted: 0  Skipped: 0  Warnings: 0

mysql> load data local infile '/home/anabig114225/Data/salaries.csv' into table salaries FIELDS TERMINATED BY ',' IGNORE 1 LINES;
Query OK, 300024 rows affected (1.20 sec)
Records: 300024  Deleted: 0  Skipped: 0  Warnings: 0

mysql> load data local infile '/home/anabig114225/Data/titles.csv' into table titles FIELDS TERMINATED BY ',' IGNORE 1 LINES;
Query OK, 7 rows affected (0.00 sec)
Records: 7  Deleted: 0  Skipped: 0  Warnings: 0

mysql> load data local infile '/home/anabig114225/Data/employees.csv' into table employees FIELDS TERMINATED BY ',' IGNORE 1 LINES;
Query OK, 300024 rows affected (3.14 sec)
Records: 300024  Deleted: 0  Skipped: 0  Warnings: 0
```

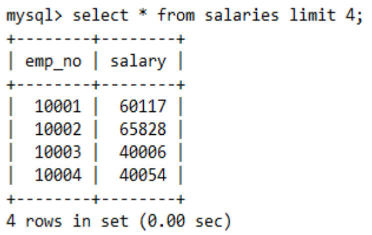
4. Verifing whether our data is properly inserted



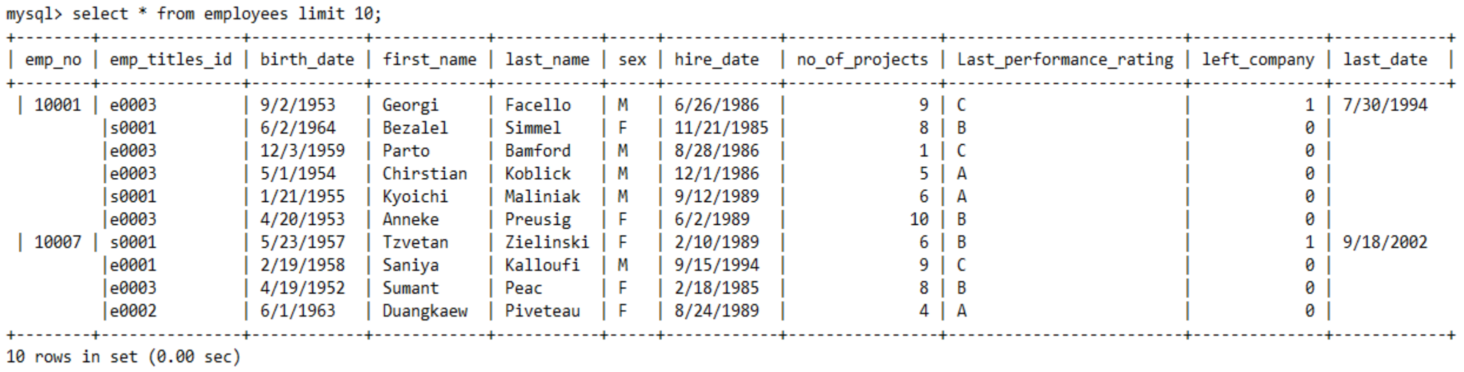
```
-------CHECKING OUR DATA-------------

select * from titles;
+----------+--------------------+
| title_id | title              |
+----------+--------------------+
| e0001    | Assistant Engineer |
| e0002    | Engineer           |
| e0003    | Senior Engineer    |
| e0004    | Technique Leader   |
| m0001    | Manager            |
| s0001    | Staff              |
| s0002    | Senior Staff       |
+----------+--------------------+
7 rows in set (0.00 sec)

mysql> select * from departments;
+---------+----------------------+
| dept_no | dept_name            |
+---------+----------------------+
| d001    | "Marketing"          |
| d002    | "Finance"            |
| d003    | "Human Resources"    |
| d004    | "Production"         |
| d005    | "development"        |
| d006    | "Quality Management" |
| d007    | "Sales"              |
| d008    | "Research"           |
| d009    | "Customer Service"   |
+---------+----------------------+
9 rows in set (0.00 sec)
```



```
mysql> select * from department_manager limit 10;
+---------+--------+
| dept_no | emp_no |
+---------+--------+
| d001    | 110022 |
| d001    | 110039 |
| d002    | 110085 |
| d002    | 110114 |
| d003    | 110183 |
| d003    | 110228 |
| d004    | 110303 |
| d004    | 110344 |
| d004    | 110386 |
| d004    | 110420 |
+---------+--------+
10 rows in set (0.00 sec)

mysql> select * from department_employees limit 10;
+--------+---------+
| emp_no | dept_no |
+--------+---------+
|  10001 | d005    |
|  10002 | d007    |
|  10003 | d004    |
|  10004 | d004    |
|  10005 | d003    |
|  10006 | d005    |
|  10007 | d008    |
|  10008 | d005    |
|  10009 | d006    |
|  10010 | d004    |
+--------+---------+
10 rows in set (0.00 sec)
```



```
mysql> select * from salaries limit 4;
+--------+--------+
| emp_no | salary |
+--------+--------+
|  10001 |  60117 |
|  10002 |  65828 |
|  10003 |  40006 |
|  10004 |  40054 |
+--------+--------+
4 rows in set (0.00 sec)
```



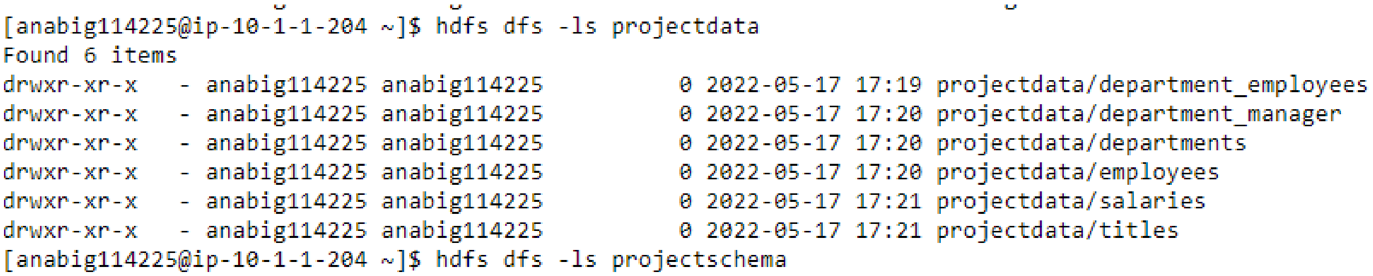
```
mysql> select * from employees limit 10;
+--------+--------------+------------+------------+-----------+-----+------------+----------------+--------------------------+--------------+-----------+
| emp_no | emp_titles_id | birth_date | first_name | last_name | sex | hire_date  | no_of_projects | Last_performance_rating | left_company | last_date  |
+--------+--------------+------------+------------+-----------+-----+------------+----------------+--------------------------+--------------+-----------+
 | 10001 | e0003        | 9/2/1953   | Georgi     | Facello   | M   | 6/26/1986  |              9 | C                        |            1 | 7/30/1994
         |s0001         | 6/2/1964   | Bezalel    | Simmel    | F   | 11/21/1985 |              8 | B                        |            0 |
         |e0003         | 12/3/1959  | Parto      | Bamford   | M   | 8/28/1986  |              1 | C                        |            0 |
         |e0003         | 5/1/1954   | Chirstian  | Koblick   | M   | 12/1/1986  |              5 | A                        |            0 |
         |s0001         | 1/21/1955  | Kyoichi    | Maliniak  | M   | 9/12/1989  |              6 | A                        |            0 |
         |e0003         | 4/20/1953  | Anneke     | Preusig   | F   | 6/2/1989   |             10 | B                        |            0 |
 | 10007 | s0001        | 5/23/1957  | Tzvetan    | Zielinski | F   | 2/10/1989  |              6 | B                        |            1 | 9/18/2002
         |e0001         | 2/19/1958  | Saniya     | Kalloufi  | M   | 9/15/1994  |              9 | C                        |            0 |
         |e0003         | 4/19/1952  | Sumant     | Peac      | F   | 2/18/1985  |              8 | B                        |            0 |
         |e0002         | 6/1/1963   | Duangkaew  | Piveteau  | F   | 8/24/1989  |              4 | A                        |            0 |
+--------+--------------+------------+------------+-----------+-----+------------+----------------+--------------------------+--------------+-----------+
10 rows in set (0.00 sec)
```

Create Sqoop job to transfer the data from MySQL to HDFS (Data required to store in Parque/Avro/Json format)

In shell

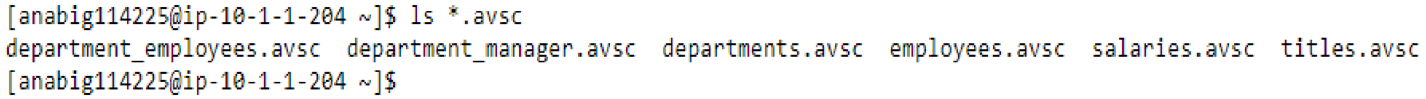
Importing the data using sqoop :- saving in avro format at new directory as projectdata

```
sqoop import-all-tables  --connect jdbc:mysql://ip-10-1-1-204.ap-south-1.compute.internal:3306/anabig114225 --username anabig114225 --password Bigdata123 --compression-codec=snappy --as-avrodatafile --warehouse-dir=/user/anabig114225/projectdata --m 1 --driver com.mysql.jdbc.Driver
```



```
[anabig114225@ip-10-1-1-204 ~]$ hdfs dfs -ls projectdata
Found 6 items
drwxr-xr-x   - anabig114225 anabig114225          0 2022-05-17 17:19 projectdata/department_employees
drwxr-xr-x   - anabig114225 anabig114225          0 2022-05-17 17:20 projectdata/department_manager
drwxr-xr-x   - anabig114225 anabig114225          0 2022-05-17 17:20 projectdata/departments
drwxr-xr-x   - anabig114225 anabig114225          0 2022-05-17 17:20 projectdata/employees
drwxr-xr-x   - anabig114225 anabig114225          0 2022-05-17 17:21 projectdata/salaries
drwxr-xr-x   - anabig114225 anabig114225          0 2022-05-17 17:21 projectdata/titles
[anabig114225@ip-10-1-1-204 ~]$ hdfs dfs -ls projectschema
```

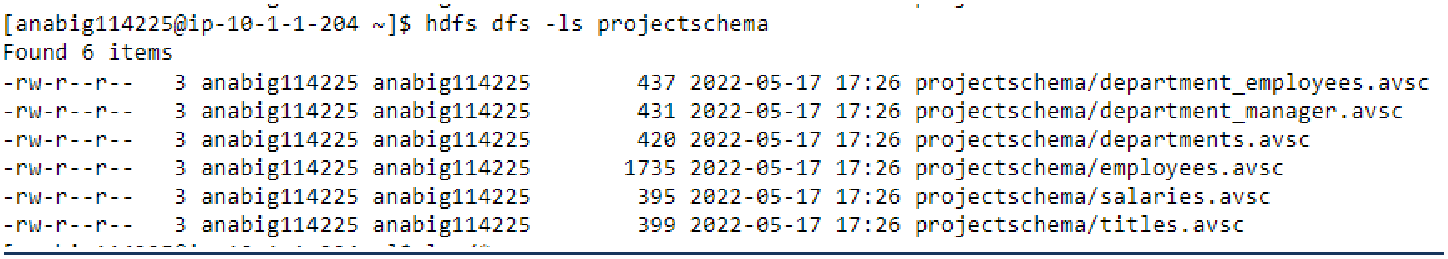
Locating the schema :- schema is saved as .avsc format



```
[anabig114225@ip-10-1-1-204 ~]$ ls *.avsc
department_employees.avsc  department_manager.avsc  departments.avsc  employees.avsc  salaries.avsc  titles.avsc
[anabig114225@ip-10-1-1-204 ~]$
```

creating a new directory as projectschema in hdfs where the schema will be saved

```
hdfs dfs -mkdir projectschema

hdfs dfs -copyFromLocal ~/*.avsc projectschema
```

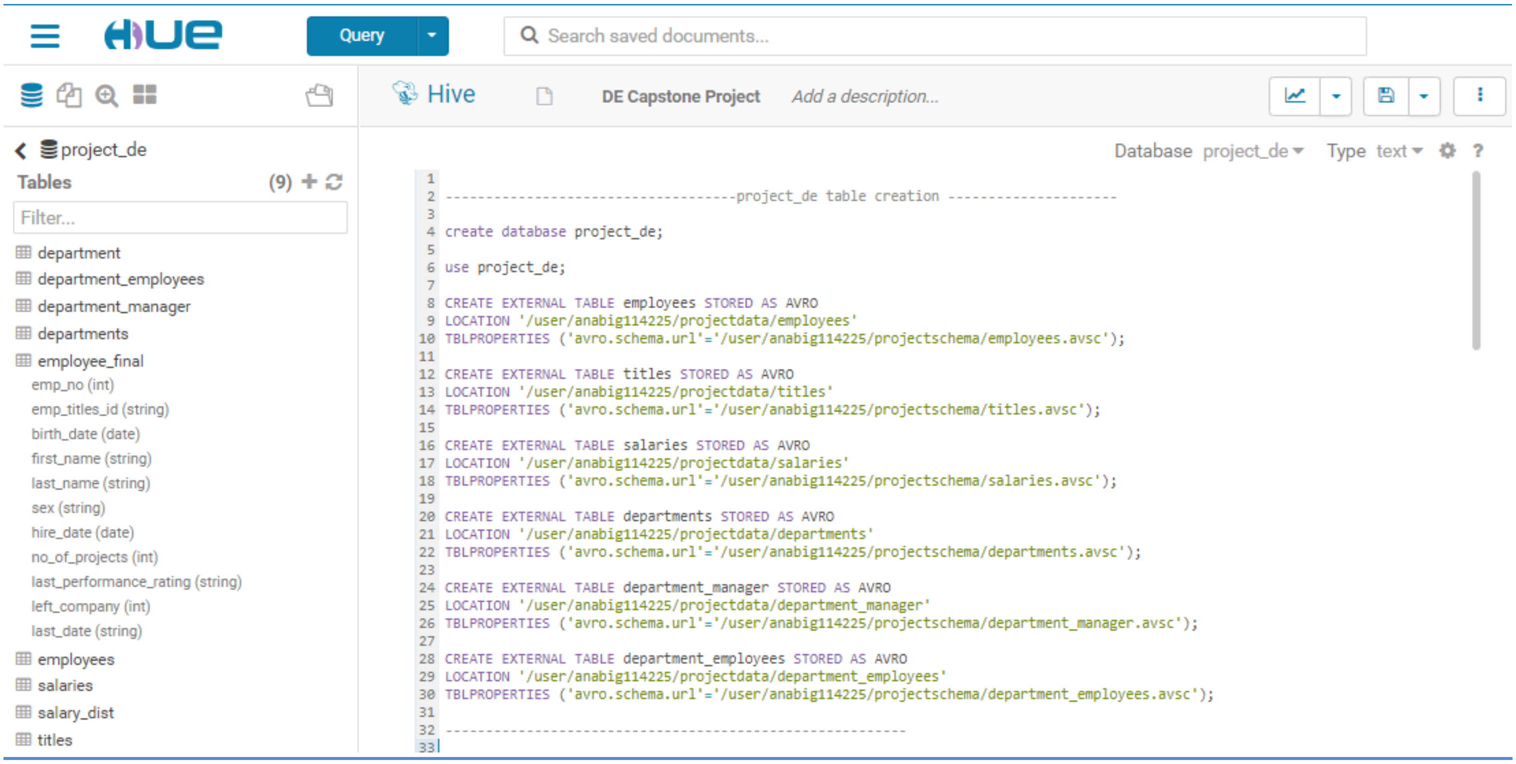


```
[anabig114225@ip-10-1-1-204 ~]$ hdfs dfs -ls projectschema
Found 6 items
-rw-r--r--   3 anabig114225 anabig114225        437 2022-05-17 17:26 projectschema/department_employees.avsc
-rw-r--r--   3 anabig114225 anabig114225        431 2022-05-17 17:26 projectschema/department_manager.avsc
-rw-r--r--   3 anabig114225 anabig114225        420 2022-05-17 17:26 projectschema/departments.avsc
-rw-r--r--   3 anabig114225 anabig114225       1735 2022-05-17 17:26 projectschema/employees.avsc
-rw-r--r--   3 anabig114225 anabig114225        395 2022-05-17 17:26 projectschema/salaries.avsc
-rw-r--r--   3 anabig114225 anabig114225        399 2022-05-17 17:26 projectschema/titles.avsc
```

Now data has been successfully transferred to HDFS.

Create database in Hive as per the above ER Diagram and load the data into Hive tables

```
create database project_de;
use project_de;

CREATE EXTERNAL TABLE employees STORED AS AVRO
LOCATION '/user/anabig114225/projectdata/employees'
TBLPROPERTIES ('avro.schema.url'='/user/anabig114225/projectschema/employees.avsc');

CREATE EXTERNAL TABLE titles STORED AS AVRO
LOCATION '/user/anabig114225/projectdata/titles'
TBLPROPERTIES ('avro.schema.url'='/user/anabig114225/projectschema/titles.avsc');

CREATE EXTERNAL TABLE salaries STORED AS AVRO
LOCATION '/user/anabig114225/projectdata/salaries'
TBLPROPERTIES ('avro.schema.url'='/user/anabig114225/projectschema/salaries.avsc');

CREATE EXTERNAL TABLE departments STORED AS AVRO
LOCATION '/user/anabig114225/projectdata/departments'
TBLPROPERTIES ('avro.schema.url'='/user/anabig114225/projectschema/departments.avsc');

CREATE EXTERNAL TABLE department_manager STORED AS AVRO
LOCATION '/user/anabig114225/projectdata/department_manager'
TBLPROPERTIES ('avro.schema.url'='/user/anabig114225/projectschema/department_manager.avsc');

CREATE EXTERNAL TABLE department_employees STORED AS AVRO
LOCATION '/user/anabig114225/projectdata/department_employees'
TBLPROPERTIES ('avro.schema.url'='/user/anabig114225/projectschema/department_employees.avsc');
```



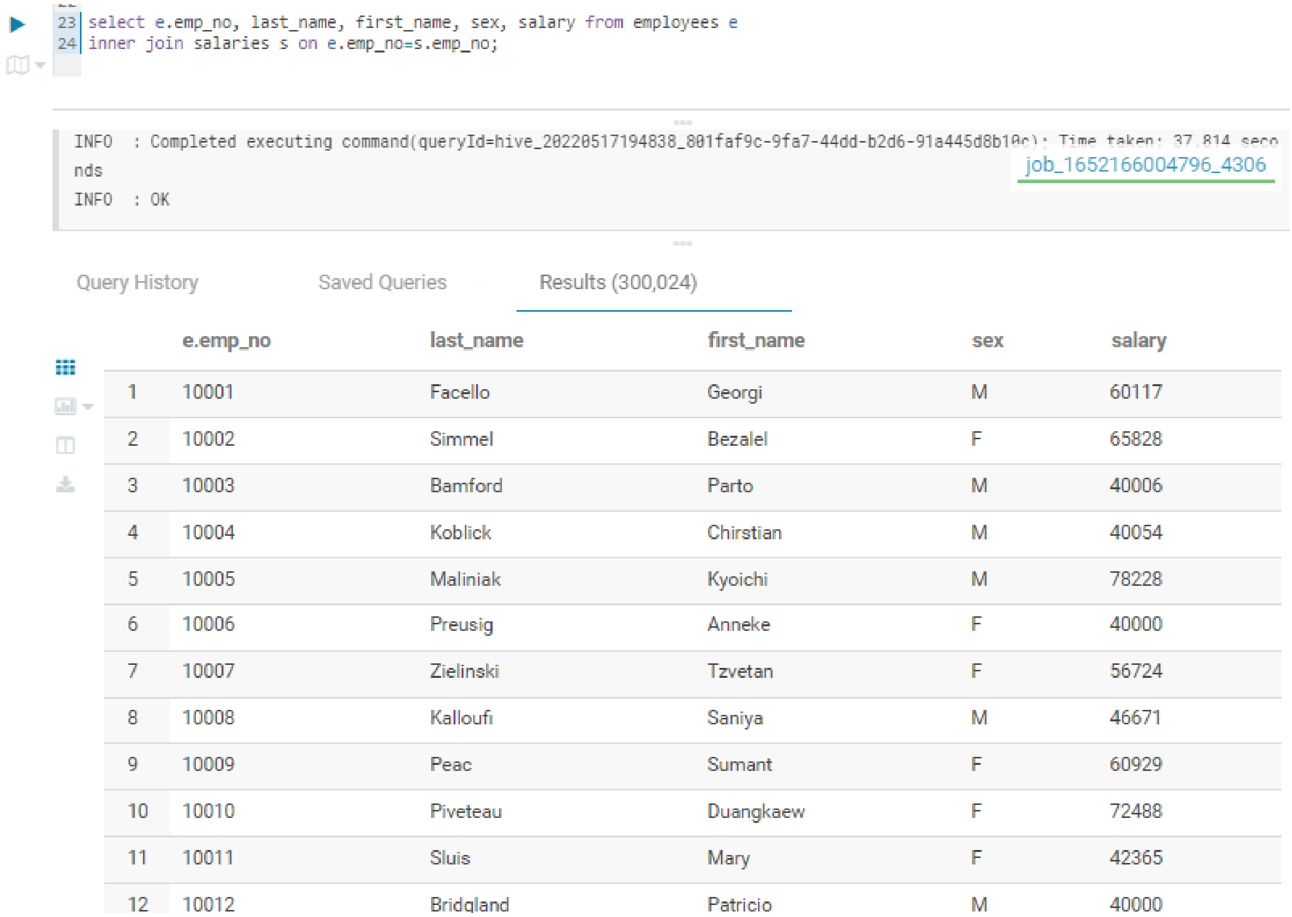
```

------------------------------------project_de table creation ---------------------

create database project_de;

use project_de;

CREATE EXTERNAL TABLE employees STORED AS AVRO
LOCATION '/user/anabig114225/projectdata/employees'
TBLPROPERTIES ('avro.schema.url'='/user/anabig114225/projectschema/employees.avsc');

CREATE EXTERNAL TABLE titles STORED AS AVRO
LOCATION '/user/anabig114225/projectdata/titles'
TBLPROPERTIES ('avro.schema.url'='/user/anabig114225/projectschema/titles.avsc');

CREATE EXTERNAL TABLE salaries STORED AS AVRO
LOCATION '/user/anabig114225/projectdata/salaries'
TBLPROPERTIES ('avro.schema.url'='/user/anabig114225/projectschema/salaries.avsc');

CREATE EXTERNAL TABLE departments STORED AS AVRO
LOCATION '/user/anabig114225/projectdata/departments'
TBLPROPERTIES ('avro.schema.url'='/user/anabig114225/projectschema/departments.avsc');

CREATE EXTERNAL TABLE department_manager STORED AS AVRO
LOCATION '/user/anabig114225/projectdata/department_manager'
TBLPROPERTIES ('avro.schema.url'='/user/anabig114225/projectschema/department_manager.avsc');

CREATE EXTERNAL TABLE department_employees STORED AS AVRO
LOCATION '/user/anabig114225/projectdata/department_employees'
TBLPROPERTIES ('avro.schema.url'='/user/anabig114225/projectschema/department_employees.avsc');

---------------------------------------------------------
```

Work on Exploratory data analysis as per the analysis requirement using Hive/Impala and Spark SQL (expecting to get the data from hive tables).

EDA outputs in hive

1. A list showing employee number, last name, first name, sex, and salary for each employee.

select e.emp_no, last_name, first_name, sex, salary from employees e
inner join salaries s on e.emp_no=s.emp_no;



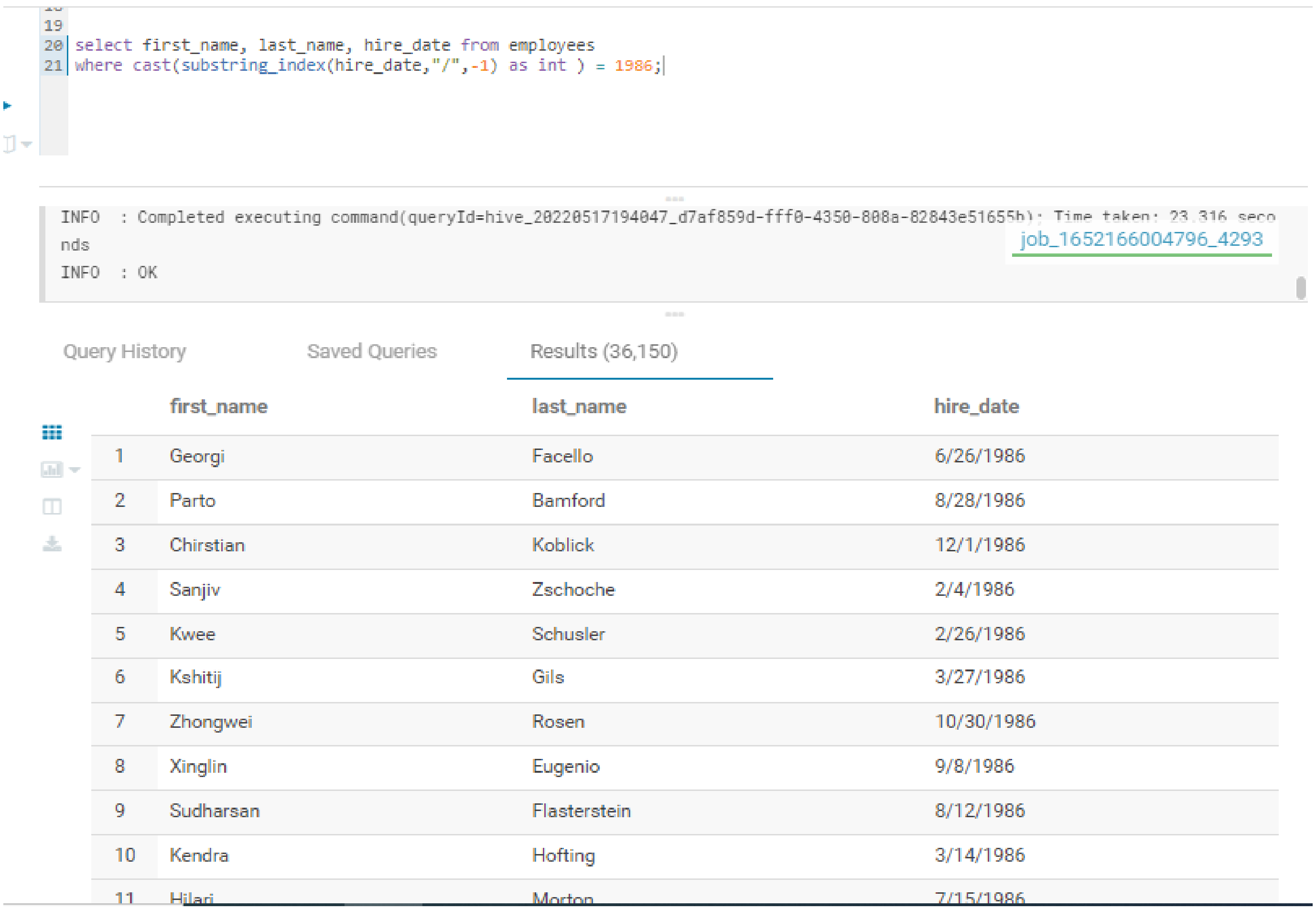
```
select e.emp_no, last_name, first_name, sex, salary from employees e
inner join salaries s on e.emp_no=s.emp_no;
```

```
INFO  : Completed executing command(queryId=hive_20220517194838_801faf9c-9fa7-44dd-b2d6-91a445d8b10c); Time taken: 37.814 seco
nds
INFO  : OK
```

	e.emp_no	last_name	first_name	sex	salary
1	10001	Facello	Georgi	M	60117
2	10002	Simmel	Bezalel	F	65828
3	10003	Bamford	Parto	M	40006
4	10004	Koblick	Chirstian	M	40054
5	10005	Maliniak	Kyoichi	M	78228
6	10006	Preusig	Anneke	F	40000
7	10007	Zielinski	Tzvetan	F	56724
8	10008	Kalloufi	Saniya	M	46671
9	10009	Peac	Sumant	F	60929
10	10010	Piveteau	Duangkaew	F	72488
11	10011	Sluis	Mary	F	42365
12	10012	Bridgland	Patricio	M	40000

2. A list showing first name, last name, and hire date for employees who were hired in 1986.

select first_name, last_name, hire_date from employees
where cast(substring_index(hire_date,"/",-1) as int) = 1986;



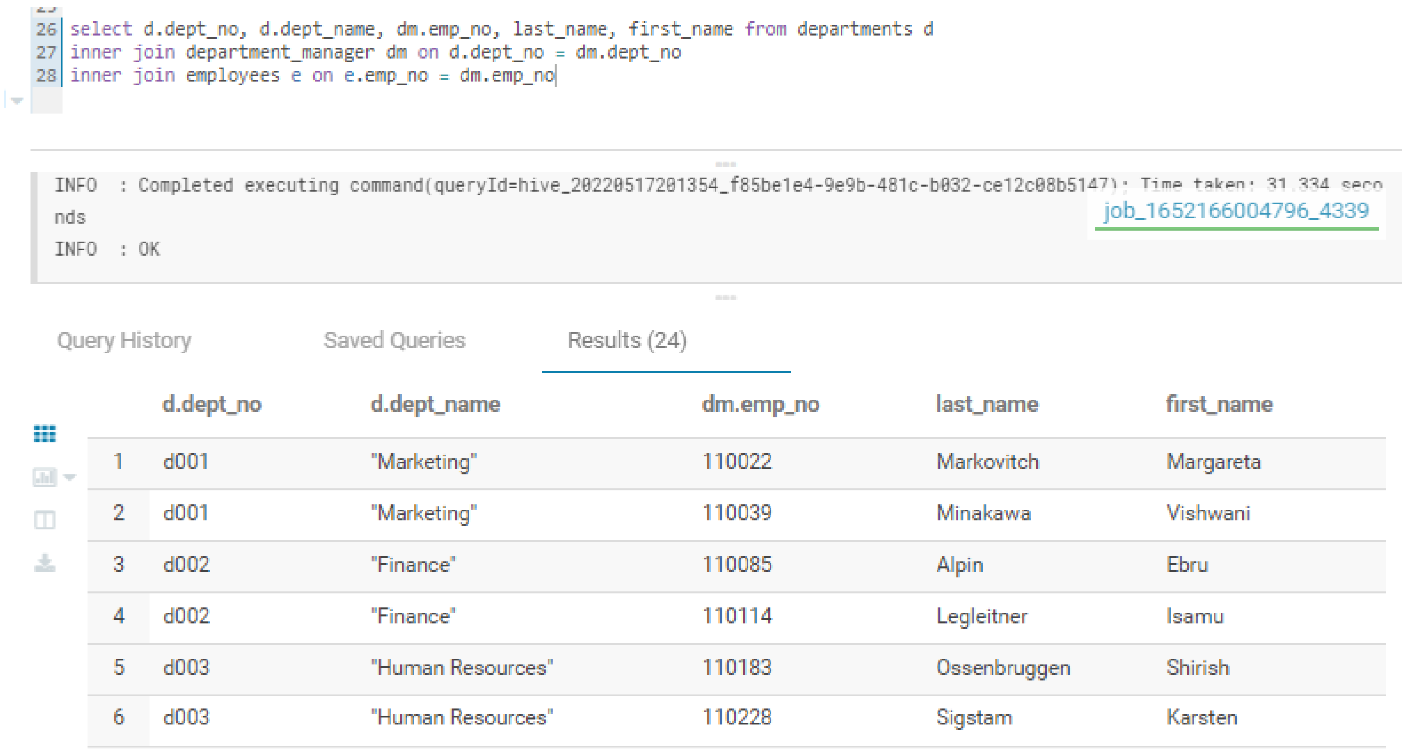
```
select first_name, last_name, hire_date from employees
where cast(substring_index(hire_date,"/",-1) as int ) = 1986;
```

```
INFO  : Completed executing command(queryId=hive_20220517194047_d7af859d-fff0-4350-808a-82843e51655b); Time taken: 23.316 seco
nds
INFO  : OK
```

	first_name	last_name	hire_date
1	Georgi	Facello	6/26/1986
2	Parto	Bamford	8/28/1986
3	Chirstian	Koblick	12/1/1986
4	Sanjiv	Zschoche	2/4/1986
5	Kwee	Schusler	2/26/1986
6	Kshitij	Gils	3/27/1986
7	Zhongwei	Rosen	10/30/1986
8	Xinglin	Eugenio	9/8/1986
9	Sudharsan	Flasterstein	8/12/1986
10	Kendra	Hofting	3/14/1986
11	Hilari	Morton	7/15/1986

3. A list showing the manager of each department with the following information: department number, department name, the manager's employee number, last name, first name.

select d.dept_no, d.dept_name, dm.emp_no, last_name, first_name from departments d
inner join department_manager dm on d.dept_no = dm.dept_no
inner join employees e on e.emp_no = dm.emp_no



```
select d.dept_no, d.dept_name, dm.emp_no, last_name, first_name from departments d
inner join department_manager dm on d.dept_no = dm.dept_no
inner join employees e on e.emp_no = dm.emp_no
```

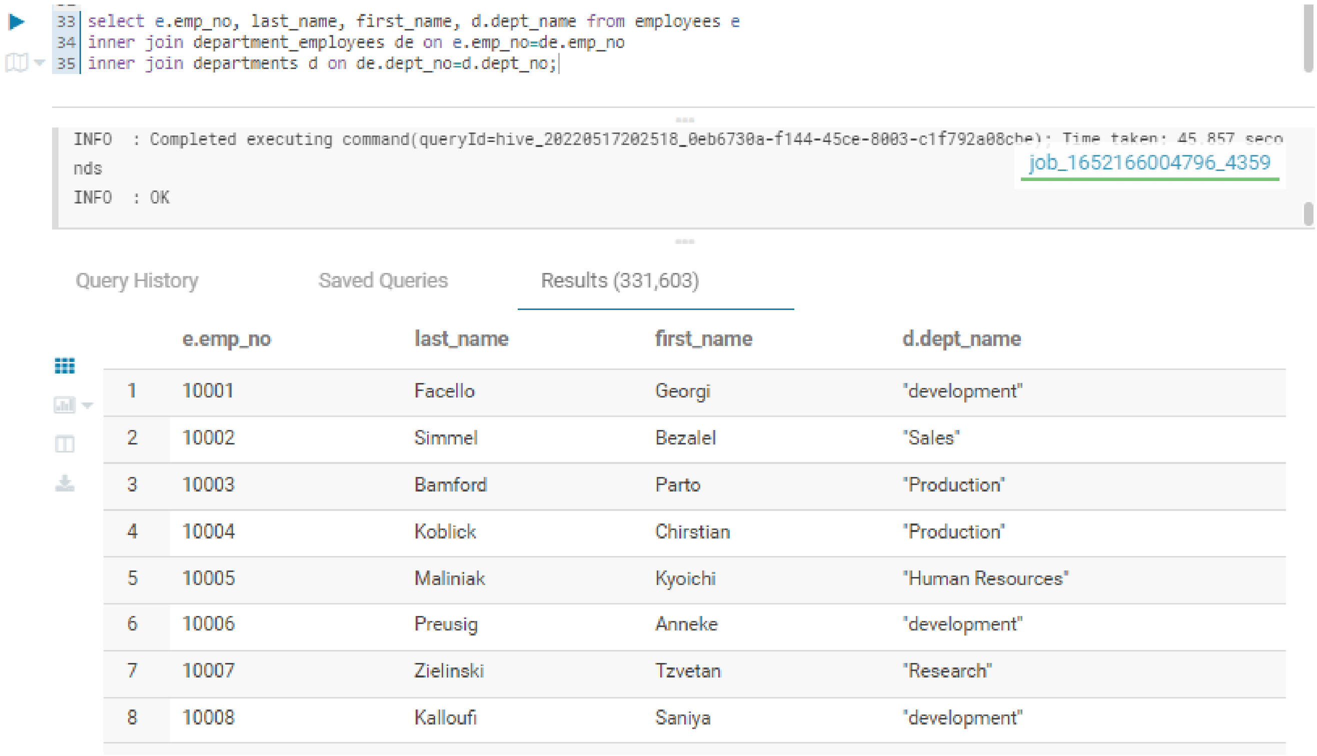
```
INFO  : Completed executing command(queryId=hive_20220517201354_f85be1e4-9e9b-481c-b032-ce12c08b5147): Time taken: 31.334 seco
nds
INFO  : OK
```

job_1652166004796_4339

	d.dept_no	d.dept_name	dm.emp_no	last_name	first_name
1	d001	"Marketing"	110022	Markovitch	Margareta
2	d001	"Marketing"	110039	Minakawa	Vishwani
3	d002	"Finance"	110085	Alpin	Ebru
4	d002	"Finance"	110114	Legleitner	Isamu
5	d003	"Human Resources"	110183	Ossenbruggen	Shirish
6	d003	"Human Resources"	110228	Sigstam	Karsten

4. A list showing the department of each employee with the following information: employee number, last name, first name, and department name.

select e.emp_no, last_name, first_name, d.dept_name from employees e
inner join department_employees de on e.emp_no=de.emp_no
inner join departments d on de.dept_no=d.dept_no;



```
select e.emp_no, last_name, first_name, d.dept_name from employees e
inner join department_employees de on e.emp_no=de.emp_no
inner join departments d on de.dept_no=d.dept_no;
```

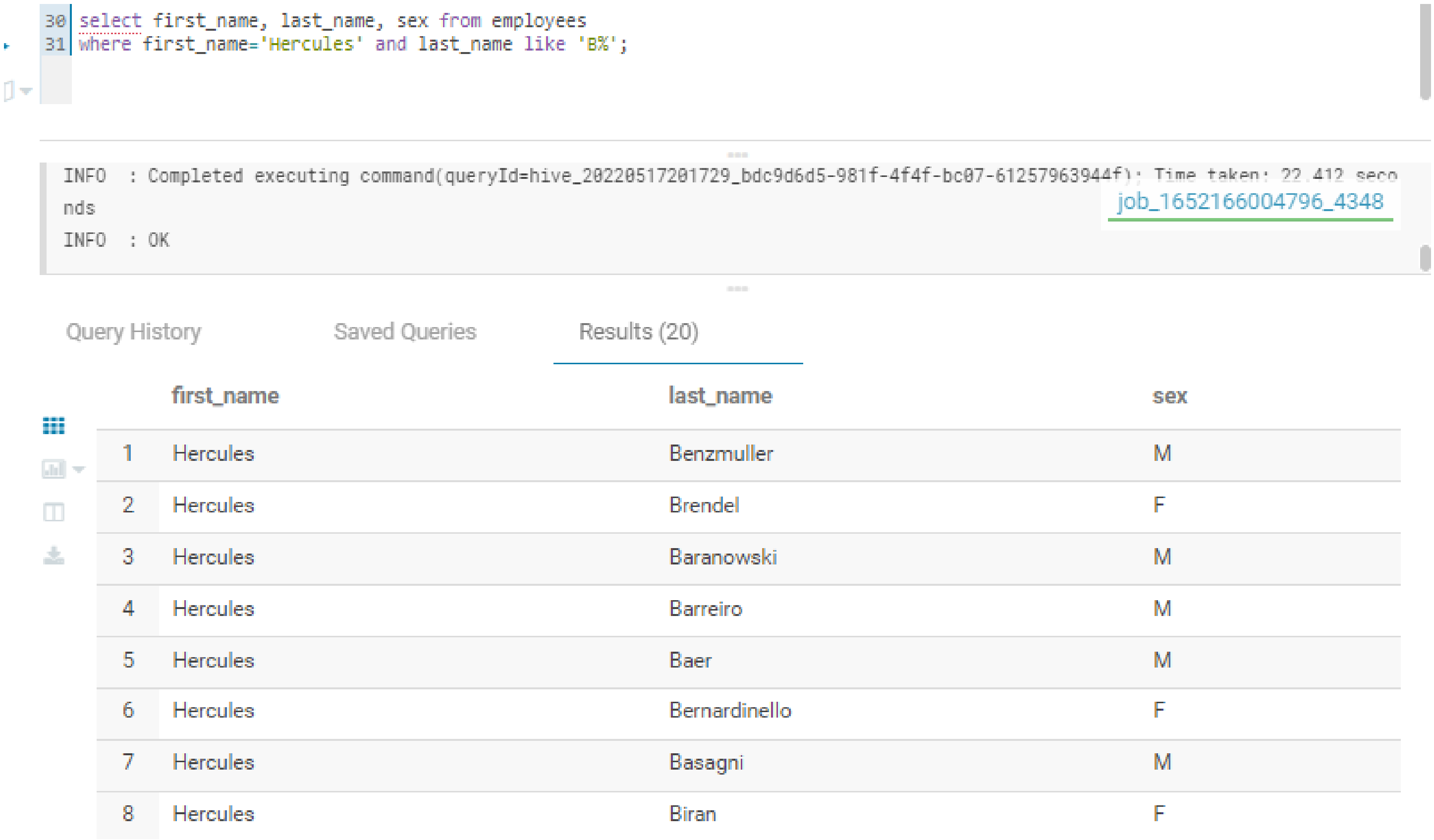
```
INFO  : Completed executing command(queryId=hive_20220517202518_0eb6730a-f144-45ce-8003-c1f792a08cbe): Time taken: 45.857 seco
nds
INFO  : OK
```

job_1652166004796_4359

	e.emp_no	last_name	first_name	d.dept_name
1	10001	Facello	Georgi	"development"
2	10002	Simmel	Bezalel	"Sales"
3	10003	Bamford	Parto	"Production"
4	10004	Koblick	Chirstian	"Production"
5	10005	Maliniak	Kyoichi	"Human Resources"
6	10006	Preusig	Anneke	"development"
7	10007	Zielinski	Tzvetan	"Research"
8	10008	Kalloufi	Saniya	"development"

5. A list showing first name, last name, and sex for employees whose first name is "Hercules" and last names begin with "B.“

select first_name, last_name, sex from employees
where first_name='Hercules' and last_name like 'B%';



```
select first_name, last_name, sex from employees
where first_name='Hercules' and last_name like 'B%';
```

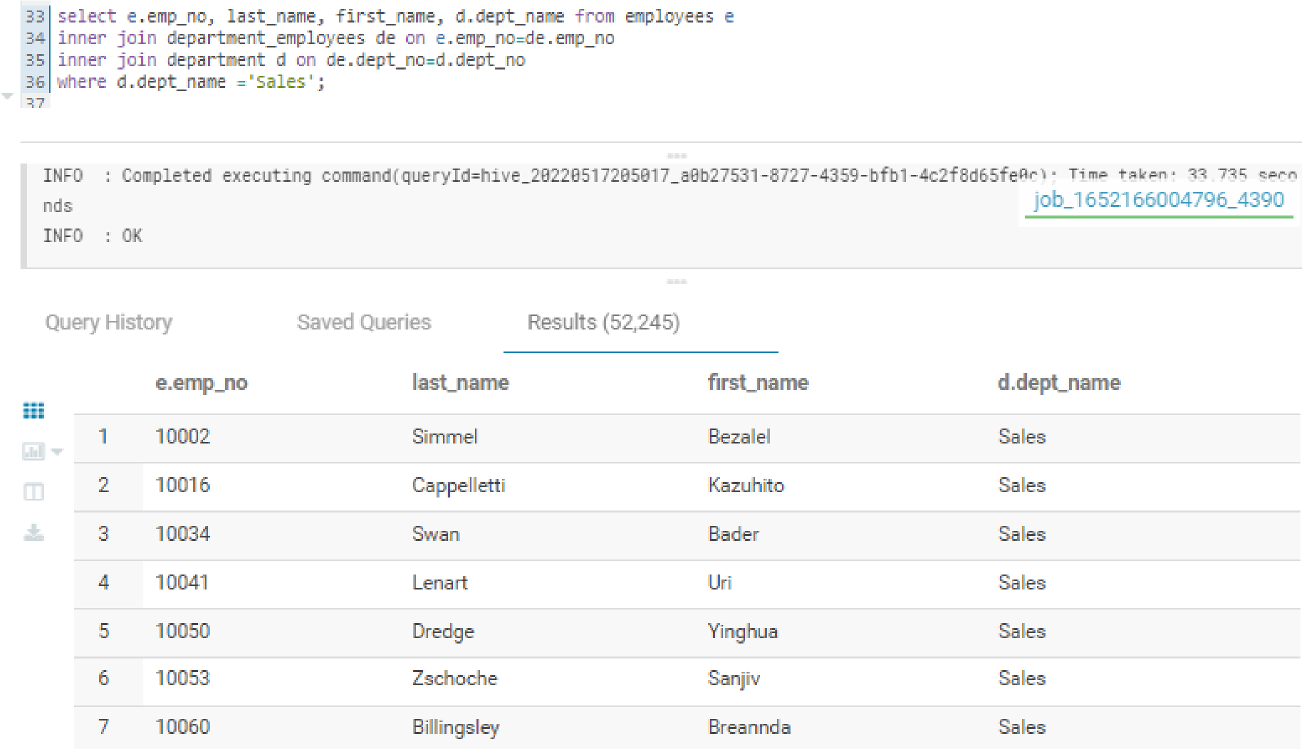
```
INFO  : Completed executing command(queryId=hive_20220517201729_bdc9d6d5-981f-4f4f-bc07-61257963944f); Time taken: 22.412 seco
nds
INFO  : OK
```

	first_name	last_name	sex
1	Hercules	Benzmuller	M
2	Hercules	Brendel	F
3	Hercules	Baranowski	M
4	Hercules	Barreiro	M
5	Hercules	Baer	M
6	Hercules	Bernardinello	F
7	Hercules	Basagni	M
8	Hercules	Biran	F

6. A list showing all employees in the Sales department, including their employee number, last name, first name, and department name.

create table department as
select dept_no, substr(dept_name, 2, length(dept_name)-2) as dept_name from departments;

select e.emp_no, last_name, first_name, d.dept_name from employees e
inner join department_employees de on e.emp_no=de.emp_no
inner join department d on de.dept_no=d.dept_no
where d.dept_name ='Sales';



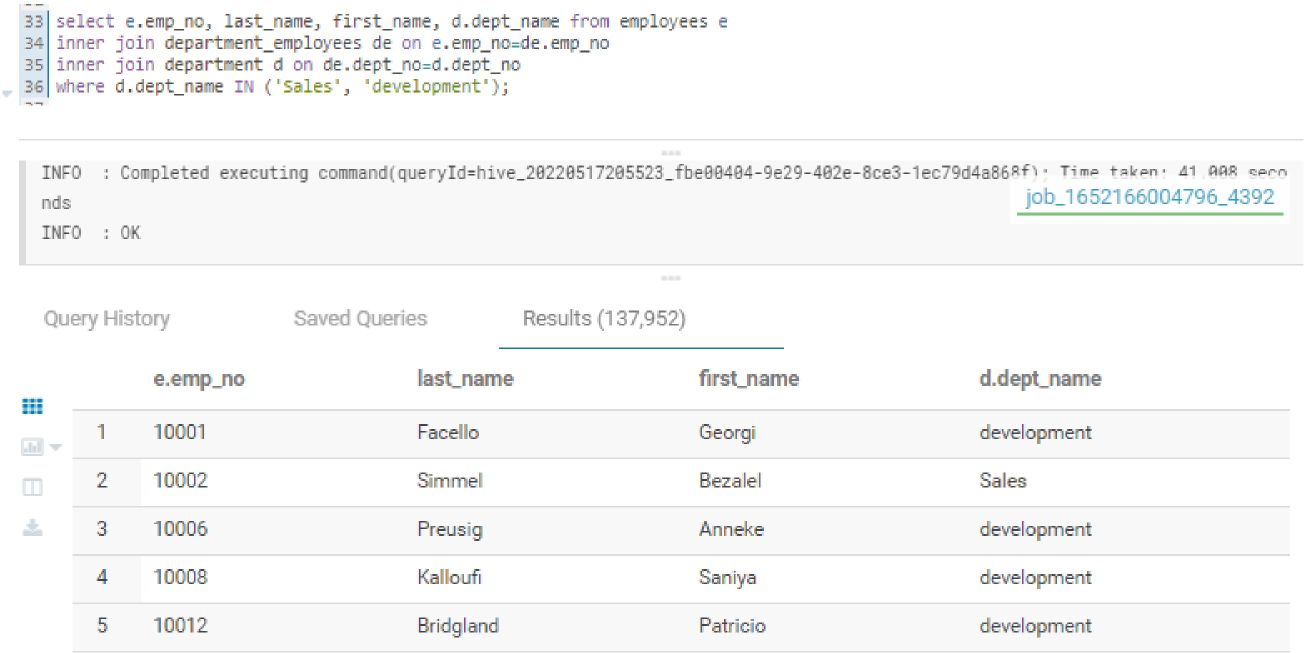
```
select e.emp_no, last_name, first_name, d.dept_name from employees e
inner join department_employees de on e.emp_no=de.emp_no
inner join department d on de.dept_no=d.dept_no
where d.dept_name ='Sales';
```

```
INFO  : Completed executing command(queryId=hive_20220517205017_a0b27531-8727-4359-bfb1-4c2f8d65fe0c); Time taken: 33.735 seco
nds
INFO  : OK
```

	e.emp_no	last_name	first_name	d.dept_name
1	10002	Simmel	Bezalel	Sales
2	10016	Cappelletti	Kazuhito	Sales
3	10034	Swan	Bader	Sales
4	10041	Lenart	Uri	Sales
5	10050	Dredge	Yinghua	Sales
6	10053	Zschoche	Sanjiv	Sales
7	10060	Billingsley	Breannda	Sales

7. A list showing all employees in the Sales and Development departments, including their employee number, last name, first name, and department name.

select e.emp_no, last_name, first_name, d.dept_name from employees e
inner join department_employees de on e.emp_no=de.emp_no
inner join department d on de.dept_no=d.dept_no
where d.dept_name IN ('Sales', 'development');



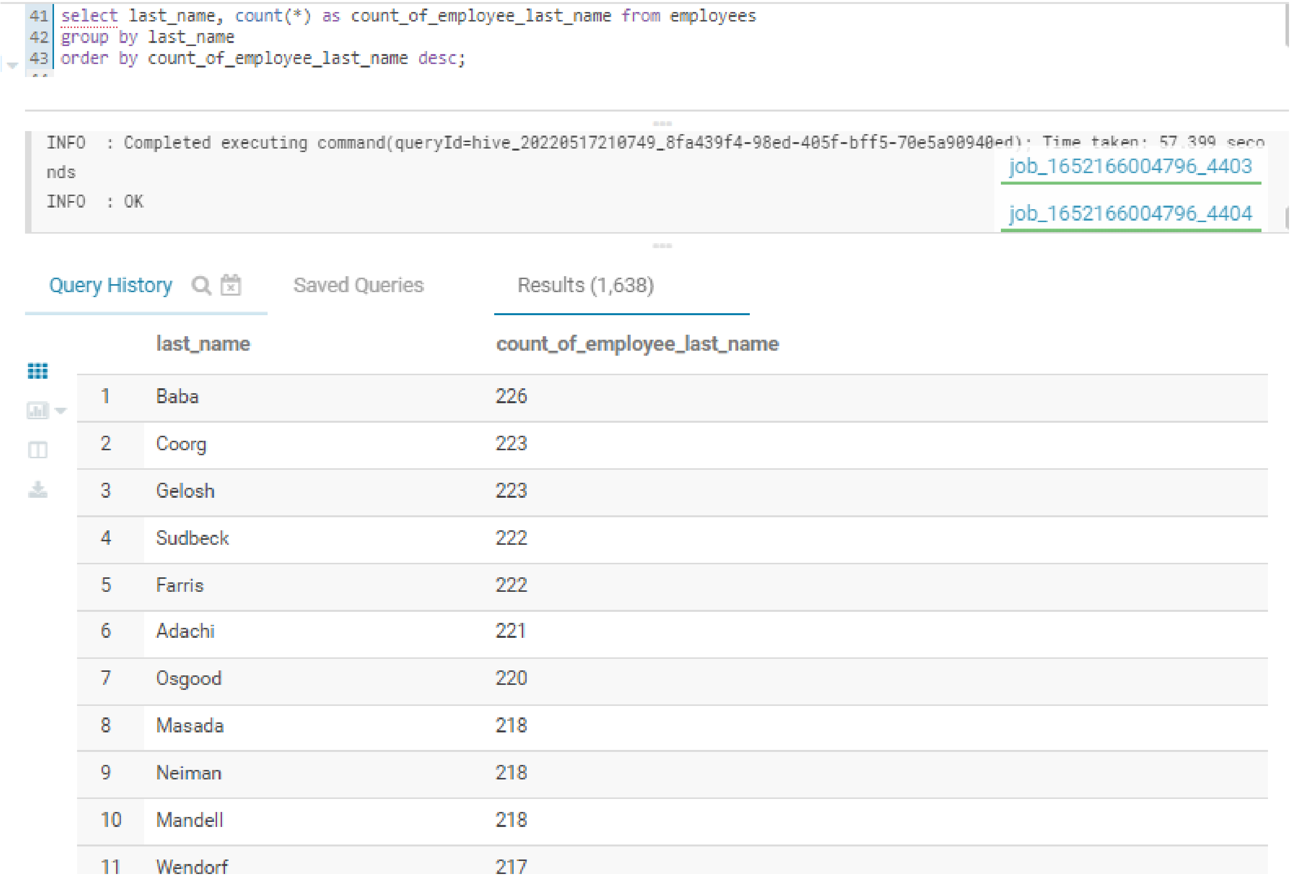
```
select e.emp_no, last_name, first_name, d.dept_name from employees e
inner join department_employees de on e.emp_no=de.emp_no
inner join department d on de.dept_no=d.dept_no
where d.dept_name IN ('Sales', 'development');
```

```
INFO  : Completed executing command(queryId=hive_20220517205523_fbe00404-9e29-402e-8ce3-1ec79d4a868f); Time taken: 41.008 seco
nds
INFO  : OK
```

	e.emp_no	last_name	first_name	d.dept_name
1	10001	Facello	Georgi	development
2	10002	Simmel	Bezalel	Sales
3	10006	Preusig	Anneke	development
4	10008	Kalloufi	Saniya	development
5	10012	Bridgland	Patricio	development

8. A list showing the frequency count of employee last names, in descending order. (i.e., how many employees share each last name

select last_name, count(*) as count_of_employee_last_name from employees
group by last_name
order by count_of_employee_last_name desc;



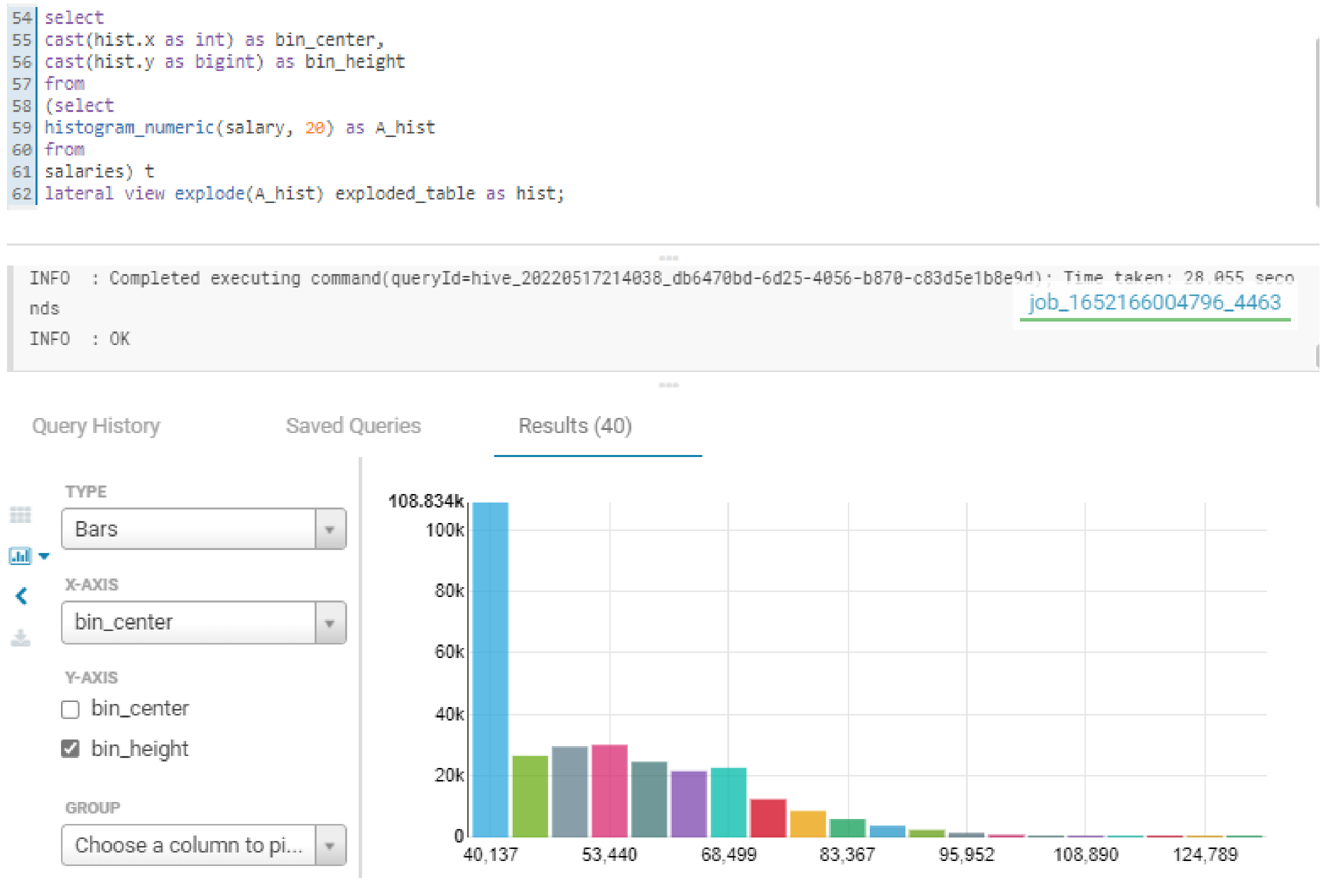
```
select last_name, count(*) as count_of_employee_last_name from employees
group by last_name
order by count_of_employee_last_name desc;
```

```
INFO  : Completed executing command(queryId=hive_20220517210749_8fa439f4-98ed-405f-bff5-70e5a90940ed); Time taken: 57.399 seco
nds
INFO  : OK
```

	last_name	count_of_employee_last_name
1	Baba	226
2	Coorg	223
3	Gelosh	223
4	Sudbeck	222
5	Farris	222
6	Adachi	221
7	Osgood	220
8	Masada	218
9	Neiman	218
10	Mandell	218
11	Wendorf	217

9. Histogram to show the salary distribution among the employees

select
cast(hist.x as int) as bin_center,
cast(hist.y as bigint) as bin_height
from
(select
histogram_numeric(salary, 20) as A_hist
from
salaries) t
lateral view explode(A_hist) exploded_table as hist;

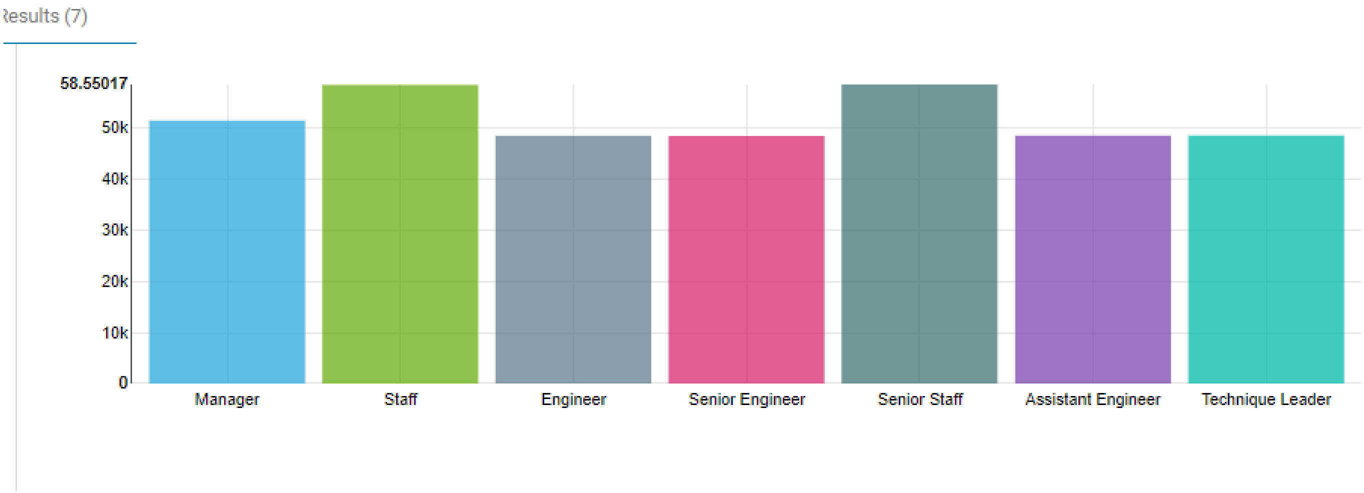


```
select
cast(hist.x as int) as bin_center,
cast(hist.y as bigint) as bin_height
from
(select
histogram_numeric(salary, 20) as A_hist
from
salaries) t
lateral view explode(A_hist) exploded_table as hist;
```

```
INFO  : Completed executing command(queryId=hive_20220517214038_db6470bd-6d25-4056-b870-c83d5e1b8e9d): Time taken: 28.055 seco
nds
INFO  : OK
```

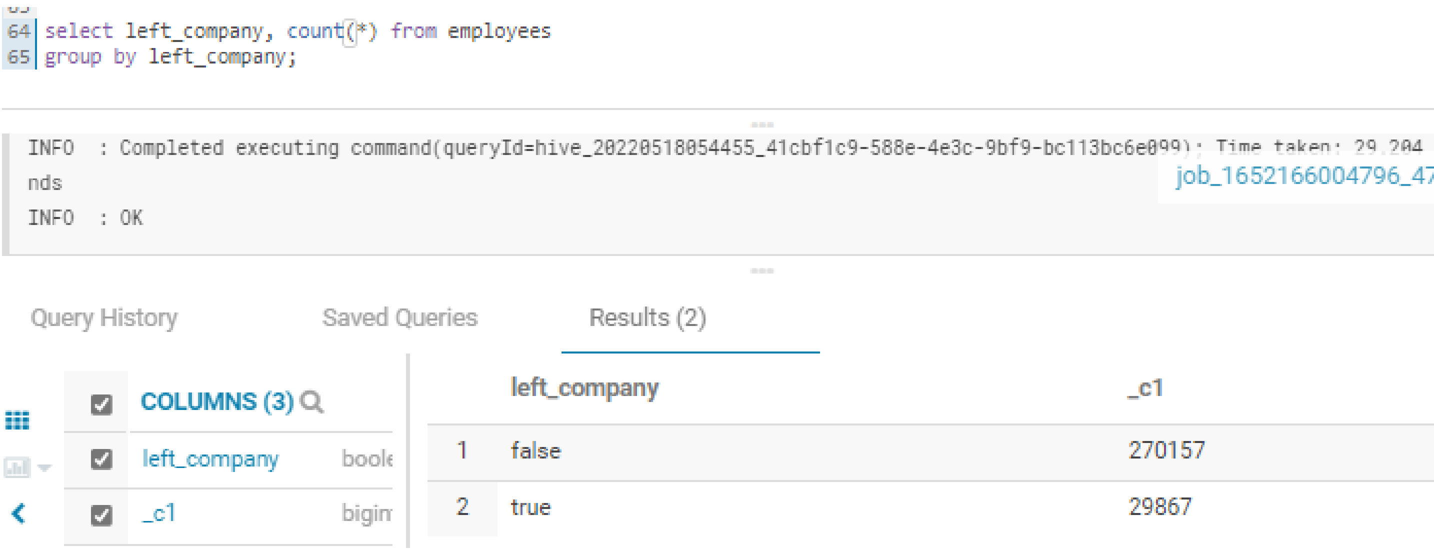
10. Bar graph to show the Average salary per title (designation)

select t.title, avg(s.salary) as avg_salary from titles t
inner join employees e on t.title_id = e.emp_titles_id
inner join salaries s on e.emp_no = s.emp_no
group by t.title;



11. Calculate employee tenure & show the tenure distribution among the employees

12. a) Count the number of employee's left and not left the company.
select left_company, count(*) from employees
group by left_company;



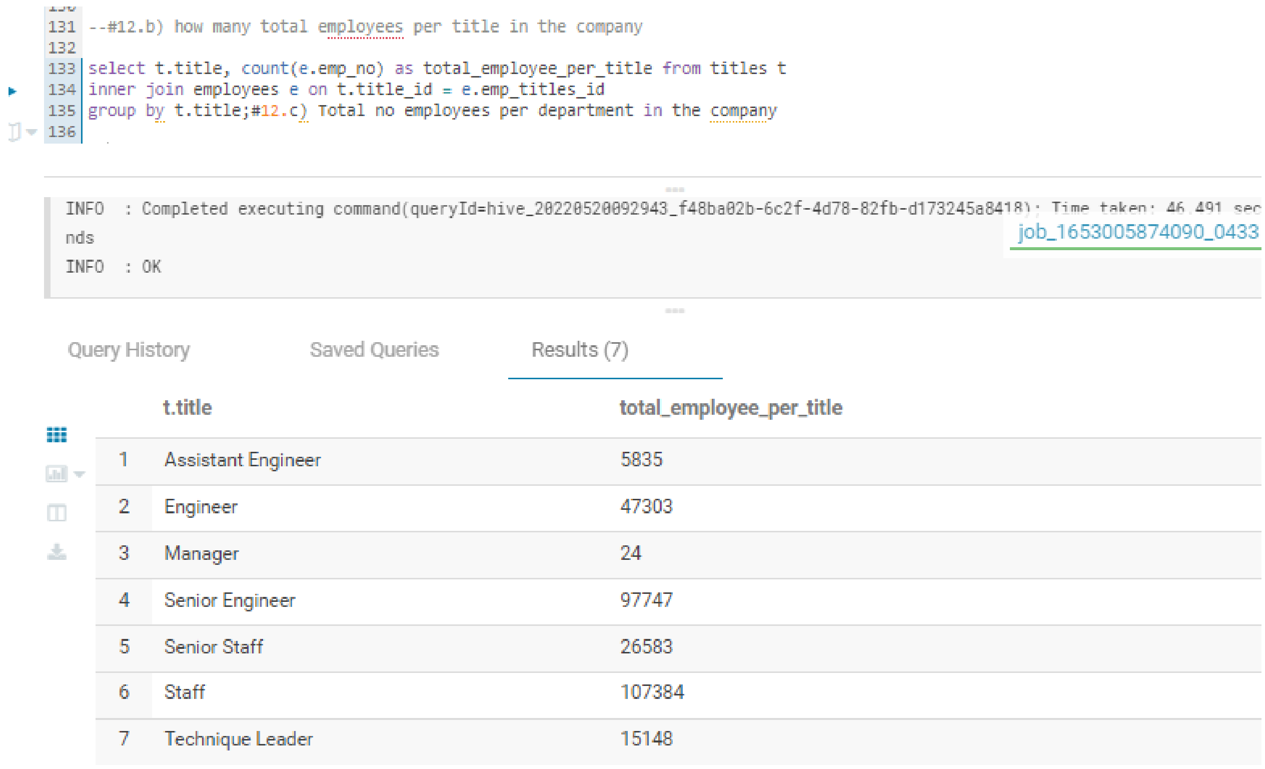
```
select left_company, count(*) from employees
group by left_company;
```

```
INFO  : Completed executing command(queryId=hive_20220518054455_41cbf1c9-588e-4e3c-9bf9-bc113bc6e099); Time taken: 29.204
nds
INFO  : OK
```

job_1652166004796_47

	left_company	_c1
1	false	270157
2	true	29867

12. b) how many total employees per title in the company
select t.title, count(e.emp_no) as total_employee_per_title from titles t
inner join employees e on t.title_id = e.emp_titles_id
group by t.title;



```
--#12.b) how many total employees per title in the company

select t.title, count(e.emp_no) as total_employee_per_title from titles t
inner join employees e on t.title_id = e.emp_titles_id
group by t.title;#12.c) Total no employees per department in the company
```

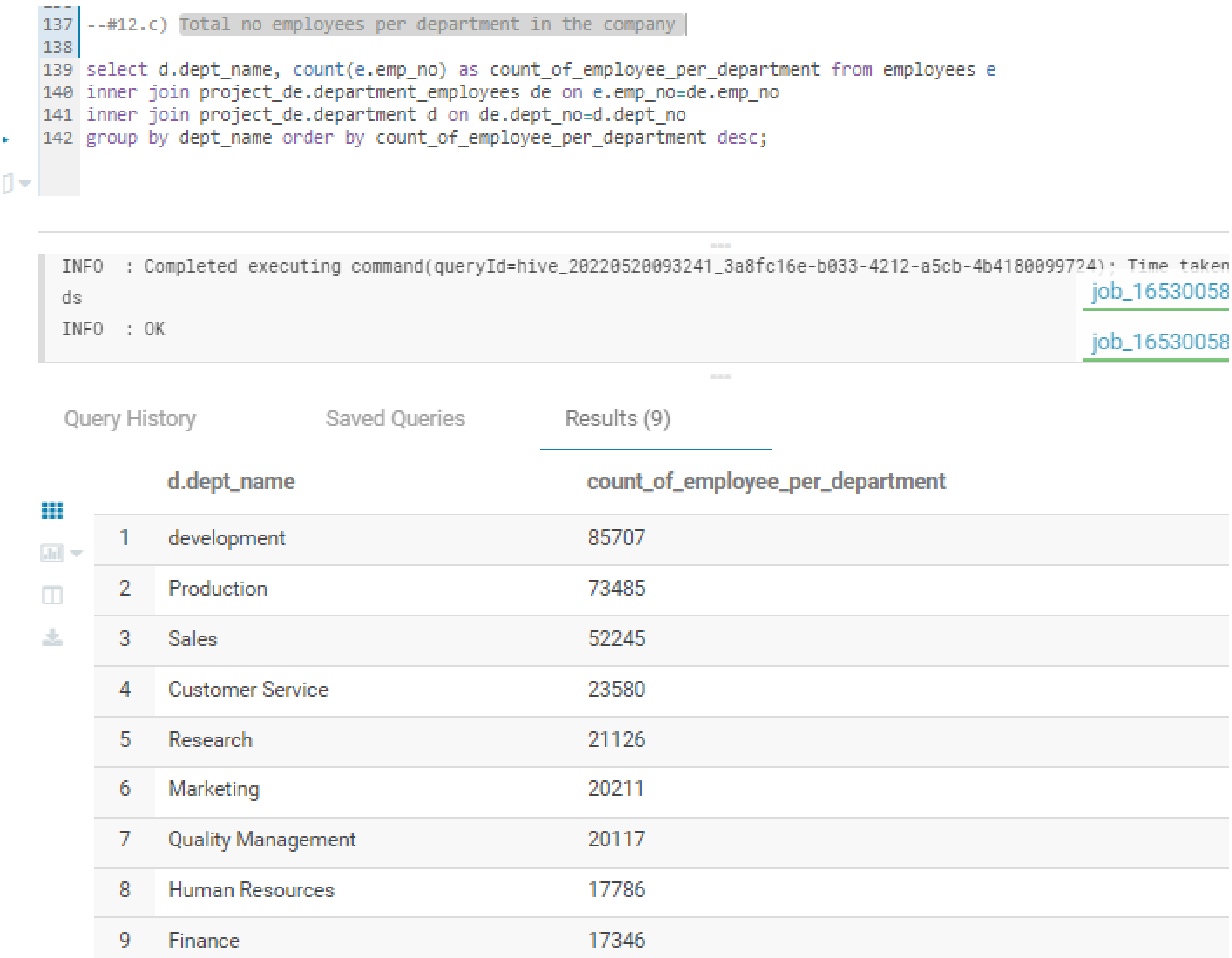
```
INFO  : Completed executing command(queryId=hive_20220520092943_f48ba02b-6c2f-4d78-82fb-d173245a8418); Time taken: 46.491 sec
nds
INFO  : OK
```

job_1653005874090_0433

	t.title	total_employee_per_title
1	Assistant Engineer	5835
2	Engineer	47303
3	Manager	24
4	Senior Engineer	97747
5	Senior Staff	26583
6	Staff	107384
7	Technique Leader	15148

12.c) Total no employees per department in the company

select d.dept_name, count(e.emp_no) as count_of_employee_per_department from employees e
inner join project_de.department_employees de on e.emp_no=de.emp_no
inner join project_de.department d on de.dept_no=d.dept_no
group by dept_name order by count_of_employee_per_department desc;



```
--#12.c) Total no employees per department in the company

select d.dept_name, count(e.emp_no) as count_of_employee_per_department from employees e
inner join project_de.department_employees de on e.emp_no=de.emp_no
inner join project_de.department d on de.dept_no=d.dept_no
group by dept_name order by count_of_employee_per_department desc;
```

```
INFO  : Completed executing command(queryId=hive_20220520093241_3a8fc16e-b033-4212-a5cb-4b4180099724); Time taken
ds
INFO  : OK
```

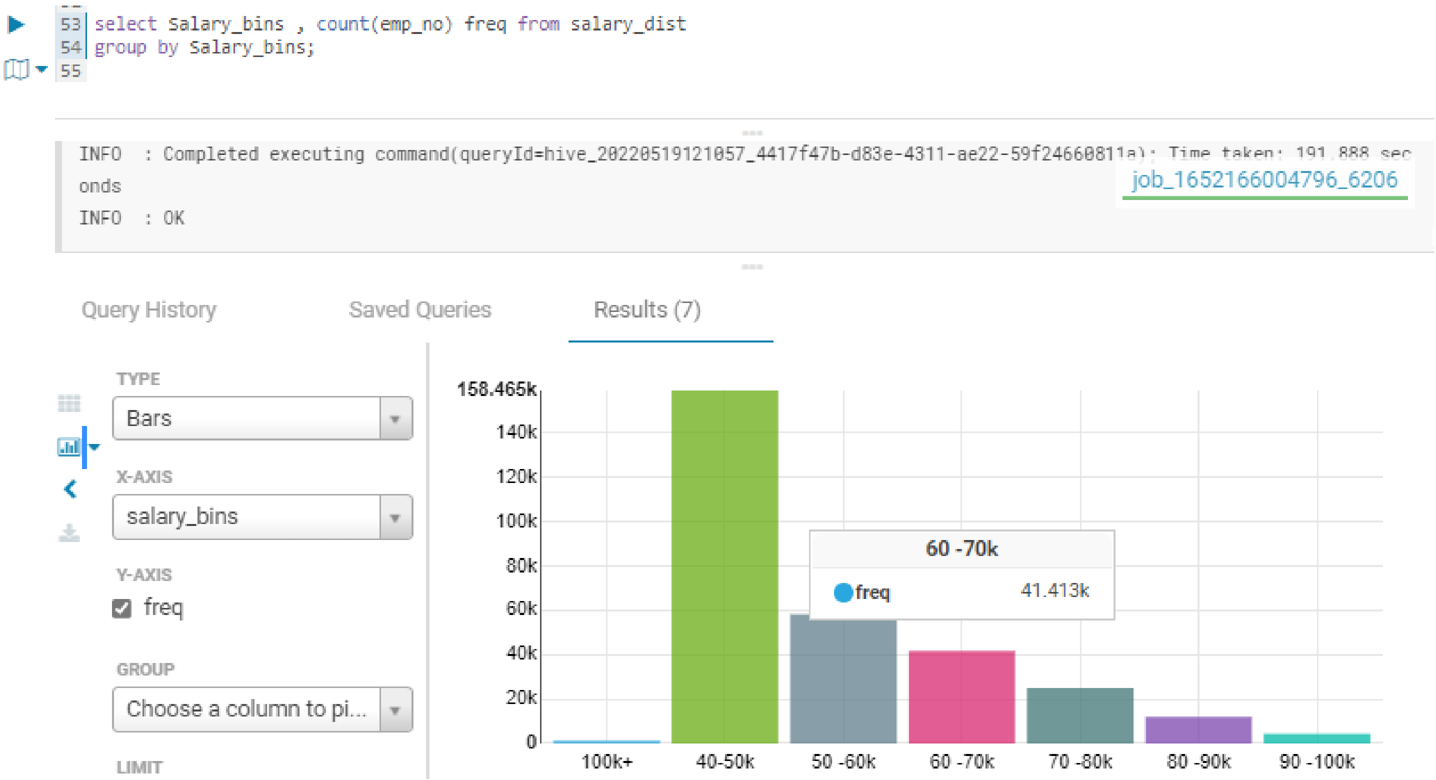
	d.dept_name	count_of_employee_per_department
1	development	85707
2	Production	73485
3	Sales	52245
4	Customer Service	23580
5	Research	21126
6	Marketing	20211
7	Quality Management	20117
8	Human Resources	17786
9	Finance	17346

12.d) top 3 department where employees are leaving the company

select d.dept_name, count(e.emp_no) as total_no_of_employees_left from project_de.employees e
inner join project_de.department_employees de on e.emp_no=de.emp_no
inner join project_de.department d on de.dept_no=d.dept_no
where left_company = "true" group by dept_name order by total_no_of_employees_left desc;

12. e) Create bins of Salary to show the frequency of number of employees in each salary group.

```
Create table  table salary_dist
select
case
when s.salary >= 40000 and s.salary < 50000   then '40-50k'
when s.salary >= 50000 and s.salary < 60000 then '50 -60k'
when s.salary >= 60000 and s.salary < 70000 then '60 -70k'
when s.salary >= 70000 and s.salary < 80000 then '70 -80k'
when s.salary >= 80000 and s.salary < 90000 then '80 -90k'
when s.salary >= 90000 and s.salary < 100000 then '90 -100k'
when s.salary >= 100000 then '100k+'
end as Salary_bins, e.emp_no
from employees e
inner join salaries s on e.emp_no = s.emp_no;

select Salary_bins , count(emp_no) freq from salary_dist
group by Salary_bins;
```

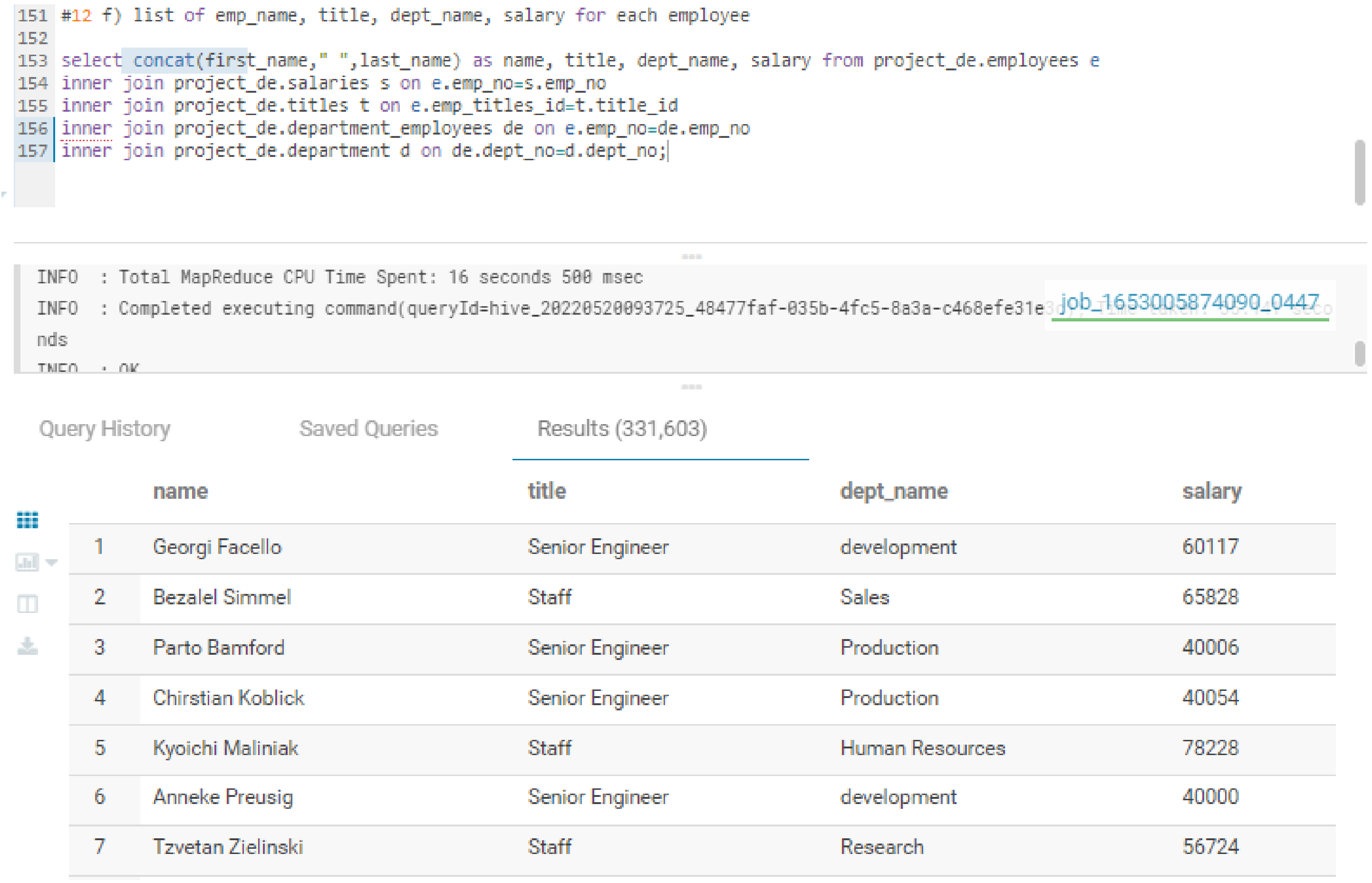


```
select Salary_bins , count(emp_no) freq from salary_dist
group by Salary_bins;
```

```
INFO  : Completed executing command(queryId=hive_20220519121057_4417f47b-d83e-4311-ae22-59f24660811a); Time taken: 191.888 sec
onds
INFO  : OK
```

12.f) list of emp_name, title, dept_name, salary for each employee

select concat(first_name," ",last_name) as name, title, dept_name, salary from project_de.employees e
inner join project_de.salaries s on e.emp_no=s.emp_no
inner join project_de.titles t on e.emp_titles_id=t.title_id
inner join project_de.department_employees de on e.emp_no=de.emp_no
inner join project_de.department d on de.dept_no=d.dept_no;

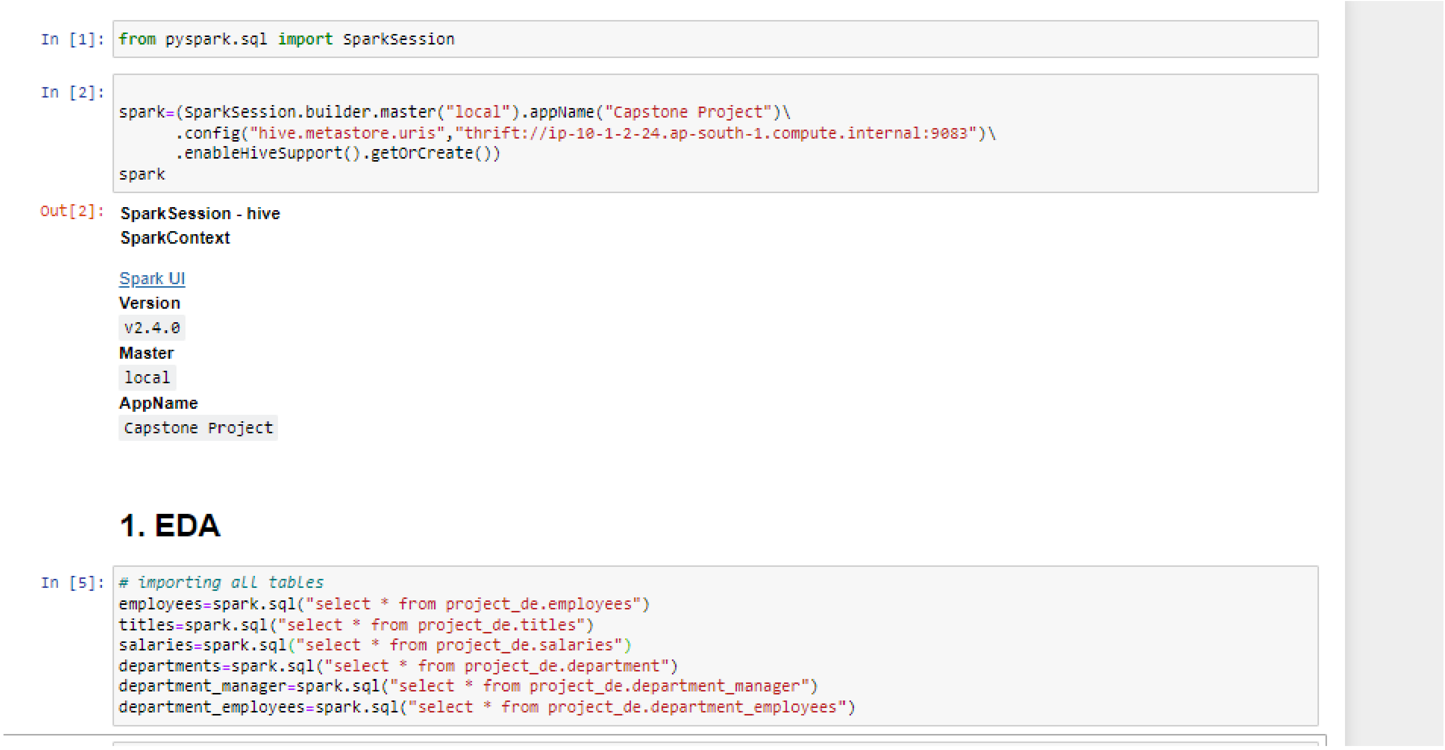


```
#12 f) list of emp_name, title, dept_name, salary for each employee

select concat(first_name," ",last_name) as name, title, dept_name, salary from project_de.employees e
inner join project_de.salaries s on e.emp_no=s.emp_no
inner join project_de.titles t on e.emp_titles_id=t.title_id
inner join project_de.department_employees de on e.emp_no=de.emp_no
inner join project_de.department d on de.dept_no=d.dept_no;
```

```
INFO  : Total MapReduce CPU Time Spent: 16 seconds 500 msec
INFO  : Completed executing command(queryId=hive_20220520093725_48477faf-035b-4fc5-8a3a-c468efe31e job_1653005874090_0447
nds
INFO  : OK
```

	name	title	dept_name	salary
1	Georgi Facello	Senior Engineer	development	60117
2	Bezalel Simmel	Staff	Sales	65828
3	Parto Bamford	Senior Engineer	Production	40006
4	Chirstian Koblick	Senior Engineer	Production	40054
5	Kyoichi Maliniak	Staff	Human Resources	78228
6	Anneke Preusig	Senior Engineer	development	40000
7	Tzvetan Zielinski	Staff	Research	56724

EDA outputs in SPARK



In [1]:
```
from pyspark.sql import SparkSession
```

In [2]:
```

spark=(SparkSession.builder.master("local").appName("Capstone Project")\
      .config("hive.metastore.uris","thrift://ip-10-1-2-24.ap-south-1.compute.internal:9083")\
      .enableHiveSupport().getOrCreate())
spark
```

Out[2]:

SparkSession - hive

SparkContext

Spark UI

Version

`v2.4.0`

Master

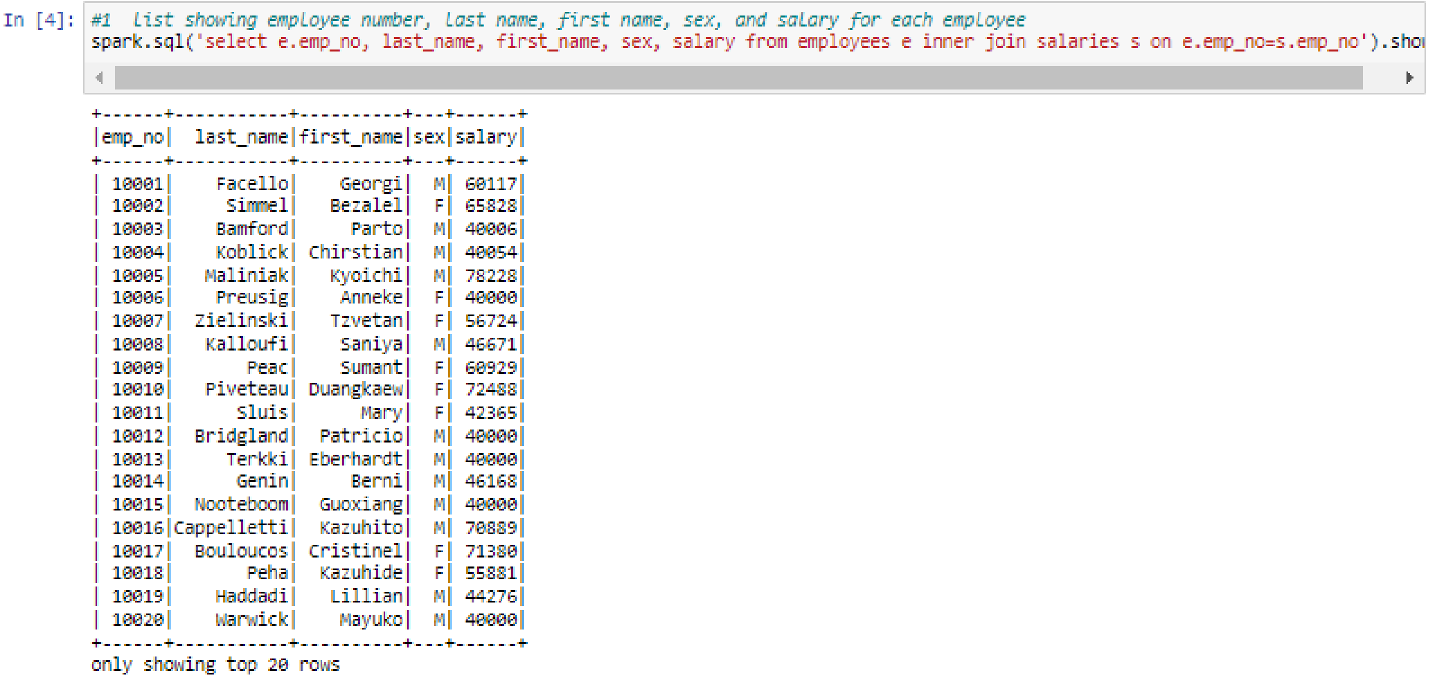
`local`

AppName

`Capstone Project`

1. EDA

In [5]:
```
# importing all tables
employees=spark.sql("select * from project_de.employees")
titles=spark.sql("select * from project_de.titles")
salaries=spark.sql("select * from project_de.salaries")
departments=spark.sql("select * from project_de.department")
department_manager=spark.sql("select * from project_de.department_manager")
department_employees=spark.sql("select * from project_de.department_employees")
```



In [4]:
```
#1  list showing employee number, last name, first name, sex, and salary for each employee
spark.sql('select e.emp_no, last_name, first_name, sex, salary from employees e inner join salaries s on e.emp_no=s.emp_no').sho
```

```
+------+-----------+----------+---+------+
|emp_no|  last_name|first_name|sex|salary|
+------+-----------+----------+---+------+
| 10001|    Facello|    Georgi|  M| 60117|
| 10002|     Simmel|   Bezalel|  F| 65828|
| 10003|    Bamford|     Parto|  M| 40006|
| 10004|    Koblick| Chirstian|  M| 40054|
| 10005|   Maliniak|   Kyoichi|  M| 78228|
| 10006|    Preusig|    Anneke|  F| 40000|
| 10007|  Zielinski|   Tzvetan|  F| 56724|
| 10008|   Kalloufi|    Saniya|  M| 46671|
| 10009|       Peac|    Sumant|  F| 60929|
| 10010|   Piveteau| Duangkaew|  F| 72488|
| 10011|      Sluis|      Mary|  F| 42365|
| 10012|  Bridgland|  Patricio|  M| 40000|
| 10013|     Terkki| Eberhardt|  M| 40000|
| 10014|      Genin|     Berni|  M| 46168|
| 10015|  Nooteboom|  Guoxiang|  M| 40000|
| 10016|Cappelletti|  Kazuhito|  M| 70889|
| 10017|  Bouloucos| Cristinel|  F| 71380|
| 10018|       Peha|  Kazuhide|  F| 55881|
| 10019|    Haddadi|   Lillian|  M| 44276|
| 10020|    Warwick|    Mayuko|  M| 40000|
+------+-----------+----------+---+------+
only showing top 20 rows
```

```
In [7]: #2. A list showing first name, last name, and hire date for employees who were hired in 1986.

        spark.sql('select first_name, last_name, hire_date from employees \
        where cast(substring_index(hire_date,"/",-1) as int ) = 1986').show()
```

```
+----------+------------+----------+
|first_name|   last_name| hire_date|
+----------+------------+----------+
|    Georgi|     Facello| 6/26/1986|
|     Parto|     Bamford| 8/28/1986|
| Chirstian|     Koblick| 12/1/1986|
|    Sanjiv|    Zschoche|  2/4/1986|
|      Kwee|    Schusler| 2/26/1986|
|   Kshitij|        Gils| 3/27/1986|
|  Zhongwei|       Rosen|10/30/1986|
|   Xinglin|     Eugenio|  9/8/1986|
| Sudharsan|Flasterstein| 8/12/1986|
|    Kendra|     Hofting| 3/14/1986|
|    Hilari|      Morton| 7/15/1986|
|     Akemi|       Birch| 12/2/1986|
|    Lunjin|      Giveon| 10/2/1986|
|    Xuejia|      Ullian| 8/22/1986|
|   Chikara|    Rissland| 1/23/1986|
|  Domenick|    Peltason| 3/14/1986|
|    Zissis|    Pintelas| 2/11/1986|
|     Perry|   Shimshoni| 9/18/1986|
|  Kazuhito| Encarnacion| 8/21/1986|
|   Xiadong|       Perry| 11/5/1986|
+----------+------------+----------+
only showing top 20 rows
```

In [9]:

```
#3. A list showing the manager of each department with the following information: department number, department name,
#  the manager's employee number, last name, first name.

spark.sql('select d.dept_no, d.dept_name, dm.emp_no, last_name, first_name from departments d \
inner join project_de.department_manager dm on d.dept_no = dm.dept_no \
inner join project_de.employees e on e.emp_no = dm.emp_no').show()
```

```
+-------+--------------------+------+------------+-----------+
|dept_no|           dept_name|emp_no|   last_name| first_name|
+-------+--------------------+------+------------+-----------+
|   d001|         "Marketing"|110022|  Markovitch|  Margareta|
|   d001|         "Marketing"|110039|    Minakawa|   Vishwani|
|   d002|           "Finance"|110085|       Alpin|       Ebru|
|   d002|           "Finance"|110114|  Legleitner|      Isamu|
|   d003|   "Human Resources"|110183|Ossenbruggen|    Shirish|
|   d003|   "Human Resources"|110228|     Sigstam|    Karsten|
|   d004|        "Production"|110303|     Wegerle|  Krassimir|
|   d004|        "Production"|110344|       Cools|     Rosine|
|   d004|        "Production"|110386|      Kieras|       Shem|
|   d004|        "Production"|110420|    Ghazalie|      Oscar|
|   d005|       "development"|110511|    Hagimont|   DeForest|
|   d005|       "development"|110567|    DasSarma|       Leon|
|   d006|"Quality Management"|110725|     Onuegbe|  Peternela|
|   d006|"Quality Management"|110765|     Hofmeyr|     Rutger|
|   d006|"Quality Management"|110800|     Quadeer|     Sanjoy|
|   d006|"Quality Management"|110854|       Pesch|       Dung|
|   d007|             "Sales"|111035|   Kaelbling| Przemyslawa|
|   d007|             "Sales"|111133|       Zhang|      Hauke|
|   d008|          "Research"|111400|     Staelin|       Arie|
|   d008|          "Research"|111534|      Kambil|     Hilary|
+-------+--------------------+------+------------+-----------+
only showing top 20 rows
```

In [11]:

```
#4. A list showing the department of each employee with the following information: employee number, last name, first
#   name, and department name.

spark.sql('select e.emp_no, last_name, first_name, d.dept_name from employees e \
inner join project_de.department_employees de on e.emp_no=de.emp_no \
inner join project_de.departments d on de.dept_no=d.dept_no').show()
```

```
+------+-----------+----------+--------------------+
|emp_no|  last_name|first_name|           dept_name|
+------+-----------+----------+--------------------+
| 10001|    Facello|    Georgi|       "development"|
| 10002|     Simmel|   Bezalel|             "Sales"|
| 10003|    Bamford|     Parto|        "Production"|
| 10004|    Koblick| Chirstian|        "Production"|
| 10005|   Maliniak|   Kyoichi|   "Human Resources"|
| 10006|    Preusig|    Anneke|       "development"|
| 10007|  Zielinski|   Tzvetan|          "Research"|
| 10008|   Kalloufi|    Saniya|       "development"|
| 10009|       Peac|    Sumant|"Quality Management"|
| 10010|   Piveteau| Duangkaew|"Quality Management"|
| 10010|   Piveteau| Duangkaew|        "Production"|
| 10011|      Sluis|      Mary|  "Customer Service"|
| 10012|  Bridgland|  Patricio|       "development"|
| 10013|     Terkki| Eberhardt|   "Human Resources"|
| 10014|      Genin|     Berni|       "development"|
| 10015|  Nooteboom|  Guoxiang|          "Research"|
| 10016|Cappelletti|  Kazuhito|             "Sales"|
| 10017|  Bouloucos| Cristinel|         "Marketing"|
| 10018|       Peha|  Kazuhide|       "development"|
| 10018|       Peha|  Kazuhide|        "Production"|
+------+-----------+----------+--------------------+
only showing top 20 rows
```

In [16]:

```
#5.A list showing first name, last name, and sex for employees whose first name is "Hercules" and last names begin with "B.”

spark.sql('select first_name, last_name, sex from employees where first_name="Hercules" and last_name like "B%"').show()
```

```
+----------+-------------+---+
|first_name|    last_name|sex|
+----------+-------------+---+
|  Hercules|    Benzmuller|  M|
|  Hercules|      Brendel|  F|
|  Hercules|   Baranowski|  M|
|  Hercules|     Barreiro|  M|
|  Hercules|         Baer|  M|
|  Hercules|Bernardinello|  F|
|  Hercules|      Basagni|  M|
|  Hercules|        Biran|  F|
|  Hercules|    Bernatsky|  M|
|  Hercules|         Bail|  F|
|  Hercules|        Birge|  F|
|  Hercules|      Bisiani|  F|
|  Hercules|       Bodoff|  M|
|  Hercules|        Biron|  F|
|  Hercules|      Buchter|  M|
|  Hercules|         Bain|  F|
|  Hercules|         Bahr|  M|
|  Hercules|         Baak|  M|
|  Hercules|     Benantar|  F|
|  Hercules|      Berstel|  F|
+----------+-------------+---+
```

In [18]:

```
#6. A list showing all employees in the Sales department, including their employee number, last name, first name, and
#  department name.

spark.sql('select e.emp_no, last_name, first_name, d.dept_name from employees e \
inner join project_de.department_employees de on e.emp_no=de.emp_no \
inner join project_de.department d on de.dept_no=d.dept_no \
where d.dept_name ="Sales"').show()
```

```
+------+------------+----------+---------+
|emp_no|   last_name|first_name|dept_name|
+------+------------+----------+---------+
| 10002|      Simmel|   Bezalel|    Sales|
| 10016| Cappelletti|  Kazuhito|    Sales|
| 10034|        Swan|     Bader|    Sales|
| 10041|      Lenart|       Uri|    Sales|
| 10050|      Dredge|   Yinghua|    Sales|
| 10053|    Zschoche|    Sanjiv|    Sales|
| 10060| Billingsley|  Breannda|    Sales|
| 10061|      Herber|       Tse|    Sales|
| 10068|     Brattka|  Charlene|    Sales|
| 10087|     Eugenio|   Xinglin|    Sales|
| 10088|    Syrzycki|  Jungsoon|    Sales|
| 10089|Flasterstein| Sudharsan|    Sales|
| 10093|     Desikan|   Sailaja|    Sales|
| 10095|      Morton|    Hilari|    Sales|
| 10099|     Sullins|    Valter|    Sales|
| 10101|      Heyers|     Perla|    Sales|
| 10107|        Baca|      Dung|    Sales|
| 10125|     Hiltgen|     Syozo|    Sales|
| 10136|    Pintelas|    Zissis|    Sales|
| 10148|       Azumi|    Douadi|    Sales|
+------+------------+----------+---------+
only showing top 20 rows
```

In [19]:
```
#7.A list showing all employees in the Sales and Development departments, including their employee number, last name,
#  first name, and department name.

spark.sql('select e.emp_no, last_name, first_name, d.dept_name from employees e \
inner join project_de.department_employees de on e.emp_no=de.emp_no \
inner join project_de.department d on de.dept_no=d.dept_no \
where d.dept_name IN ("Sales", "development")').show()
```

```
+------+-----------+----------+-----------+
|emp_no|  last_name|first_name|  dept_name|
+------+-----------+----------+-----------+
| 10001|    Facello|    Georgi|development|
| 10002|     Simmel|   Bezalel|      Sales|
| 10006|    Preusig|    Anneke|development|
| 10008|   Kalloufi|    Saniya|development|
| 10012|  Bridgland|  Patricio|development|
| 10014|      Genin|     Berni|development|
| 10016|Cappelletti|  Kazuhito|      Sales|
| 10018|       Peha|  Kazuhide|development|
| 10021|       Erde|     Ramzi|development|
| 10022|     Famili|    Shahaf|development|
| 10023| Montemayor|     Bojan|development|
| 10025|     Heyers| Prasadram|development|
| 10027|    Reistad|    Divier|development|
| 10028|   Tempesti|  Domenick|development|
| 10031|     Joslin|   Karsten|development|
| 10034|       Swan|     Bader|      Sales|
| 10037|   Makrucki|   Pradeep|development|
| 10040|    Meriste|     Weiyi|development|
| 10041|     Lenart|       Uri|      Sales|
| 10043|    Tzvieli|    Yishay|development|
+------+-----------+----------+-----------+
only showing top 20 rows
```

In [20]:
```
#8. A list showing the frequency count of employee last names, in descending order. ( i.e., how many employees share each last n

spark.sql('select last_name, count(*) as count_of_employee_last_name from employees \
group by last_name \
order by count_of_employee_last_name desc').show()
```

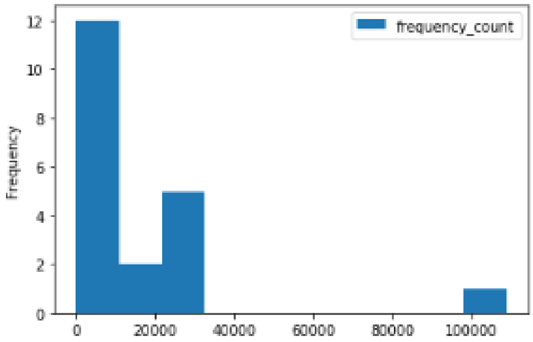
```
+-----------+---------------------------+
|  last_name|count_of_employee_last_name|
+-----------+---------------------------+
|       Baba|                        226|
|     Gelosh|                        223|
|      Coorg|                        223|
|    Sudbeck|                        222|
|     Farris|                        222|
|     Adachi|                        221|
|     Osgood|                        220|
|     Neiman|                        218|
|    Mandell|                        218|
|     Masada|                        218|
|Boudaillier|                        217|
|    Wendorf|                        217|
|     Mahnke|                        216|
|    Solares|                        216|
|     Pettis|                        216|
|   Cummings|                        216|
|     Emmart|                        215|
|    Kulisch|                        215|
|   Birjandi|                        215|
| Maksimenko|                        215|
+-----------+---------------------------+
only showing top 20 rows
```

```
In [25]: #9. Histogram to show the salary distribution among the employees

         salary_histogram=spark.sql('select cast(hist.x as int) as salary, cast(hist.y as bigint) as frequency_count from \
         (select histogram_numeric(salary, 20) as A_hist \
         from salaries) t \
         lateral view explode(A_hist) exploded_table as hist')
         salary_histogram.show()
```

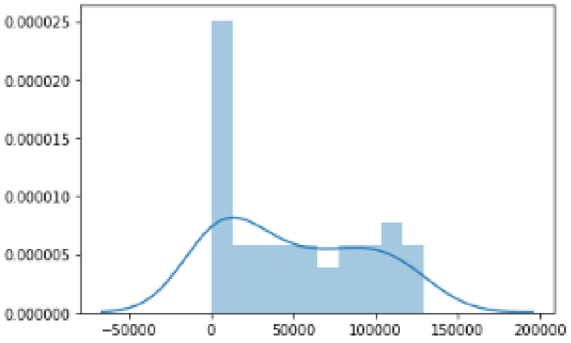
```
+------+---------------+
|salary|frequency_count|
+------+---------------+
| 40137|         108834|
| 44331|          26476|
| 48695|          29510|
| 53440|          30087|
| 58232|          24609|
| 62954|          21554|
| 68499|          22627|
| 74140|          12348|
| 78817|           8624|
| 83367|           6011|
| 87753|           3774|
| 91865|           2417|
| 95952|           1506|
|100321|            817|
|104612|            432|
|108890|            234|
|113916|            116|
|119213|             38|
|124789|              9|
|129492|              1|
+------+---------------+
```

```
In [43]: import pandas as pd
         import seaborn as sns
         import matplotlib.pyplot as plt
         %matplotlib inline
```

```
In [42]: salary_histogram.toPandas().plot(x='salary', y='frequency_count', kind = 'hist')

Out[42]: <matplotlib.axes._subplots.AxesSubplot at 0x7f9f3a717050>
```



```
In [85]: sns.distplot(salary_histogram.toPandas(), bins = 10, kde=True)

Out[85]: <matplotlib.axes._subplots.AxesSubplot at 0x7f9f3a2659d0>
```

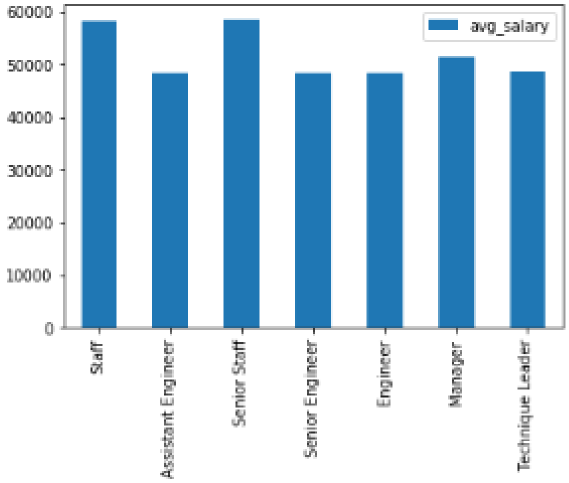


In [39]:
```
#10. Bar graph to show the Average salary per title (designation)

avg_bar=spark.sql('select t.title, avg(s.salary) as avg_salary from titles t \
inner join employees e on t.title_id = e.emp_titles_id \
inner join salaries s on e.emp_no = s.emp_no \
group by t.title')
avg_bar.show()
```

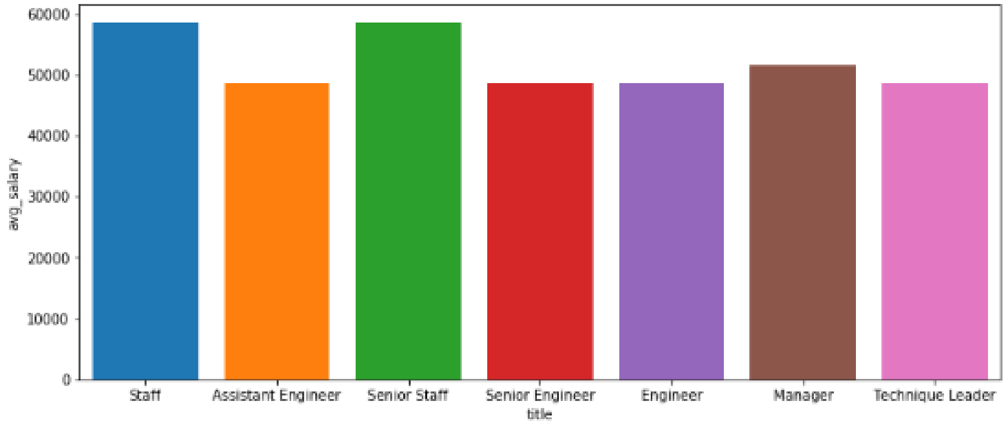
```
+------------------+------------------+
|             title|        avg_salary|
+------------------+------------------+
|             Staff| 58465.38285033152|
|Assistant Engineer| 48564.43444730077|
|      Senior Staff| 58550.17270435993|
|   Senior Engineer| 48506.79987109579|
|          Engineer|48535.336511426336|
|           Manager|51531.041666666664|
|  Technique Leader| 48582.89609189332|
+------------------+------------------+
```

In [52]:
```
avg_bar.toPandas().plot(x='title', y='avg_salary', kind ='bar')
```

Out[52]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f9f3aecfc50>
```



In [97]:
```
plt.figure(figsize=(12,5))
sns.barplot(data=avg_bar.toPandas(), x='title', y='avg_salary', saturation=1)
plt.show()
```

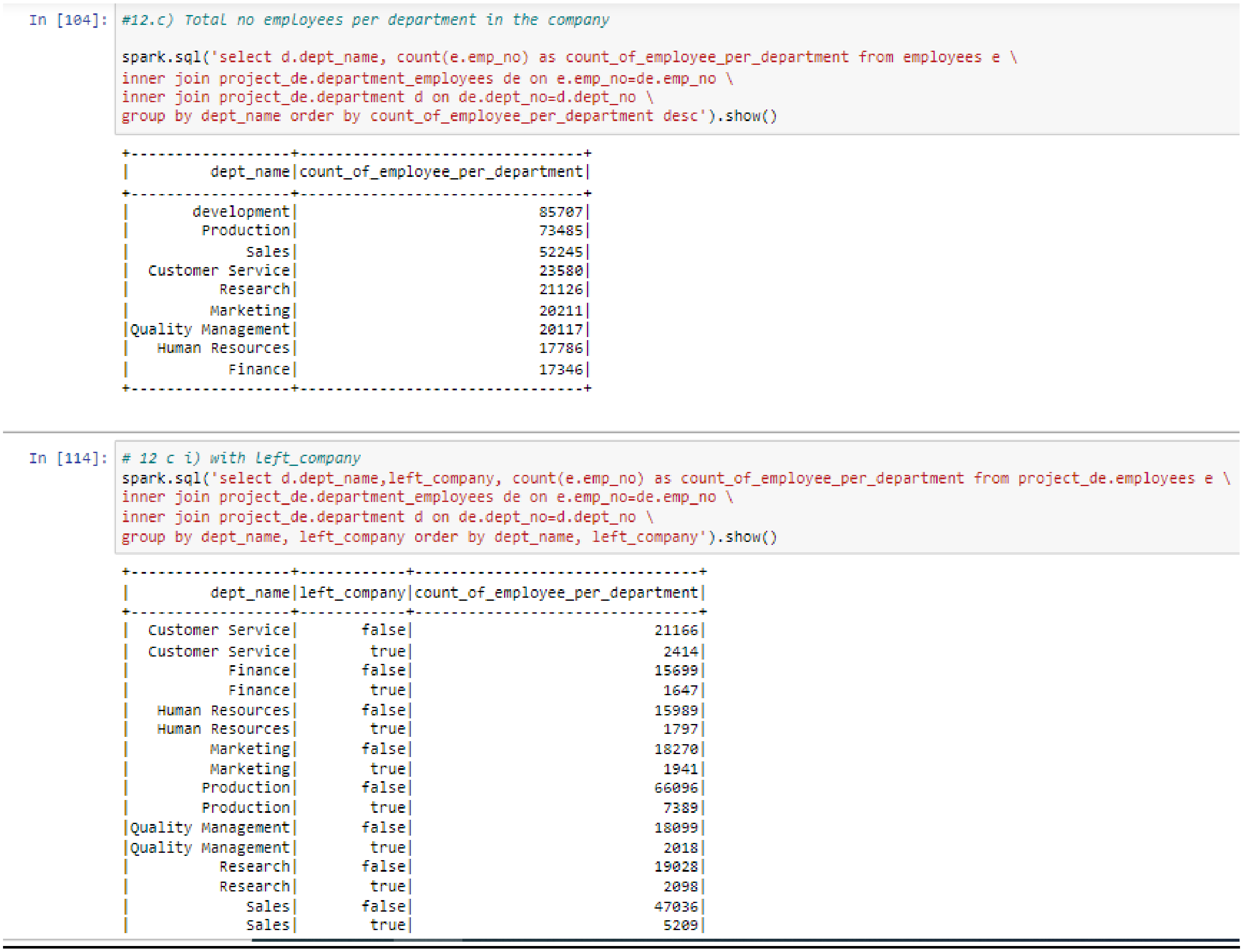


```
In [55]: #12.a) how many employee have left the company

         spark.sql('select left_company, count(*) as employees_left_company from project_de.employees group by left_company').show()
```

```
+------------+----------------------+
|left_company|employees_left_company|
+------------+----------------------+
|        true|                 29867|
|       false|                270157|
+------------+----------------------+
```

```
In [56]: #12.b) how many total employees per title in the company

         spark.sql('select t.title, count(e.emp_no) as total_employee_per_title from titles t \
         inner join employees e on t.title_id = e.emp_titles_id \
         group by t.title').show()
```

```
+------------------+------------------------+
|             title|total_employee_per_title|
+------------------+------------------------+
|             Staff|                  107384|
|Assistant Engineer|                    5835|
|      Senior Staff|                   26583|
|   Senior Engineer|                   97747|
|          Engineer|                   47303|
|           Manager|                      24|
|  Technique Leader|                   15148|
+------------------+------------------------+
```



```
In [104]: #12.c) Total no employees per department in the company

          spark.sql('select d.dept_name, count(e.emp_no) as count_of_employee_per_department from employees e \
          inner join project_de.department_employees de on e.emp_no=de.emp_no \
          inner join project_de.department d on de.dept_no=d.dept_no \
          group by dept_name order by count_of_employee_per_department desc').show()

          +-----------------+-------------------------------+
          |        dept_name|count_of_employee_per_department|
          +-----------------+-------------------------------+
          |      development|                          85707|
          |       Production|                          73485|
          |            Sales|                          52245|
          | Customer Service|                          23580|
          |         Research|                          21126|
          |        Marketing|                          20211|
          |Quality Management|                          20117|
          |  Human Resources|                          17786|
          |          Finance|                          17346|
          +-----------------+-------------------------------+
```

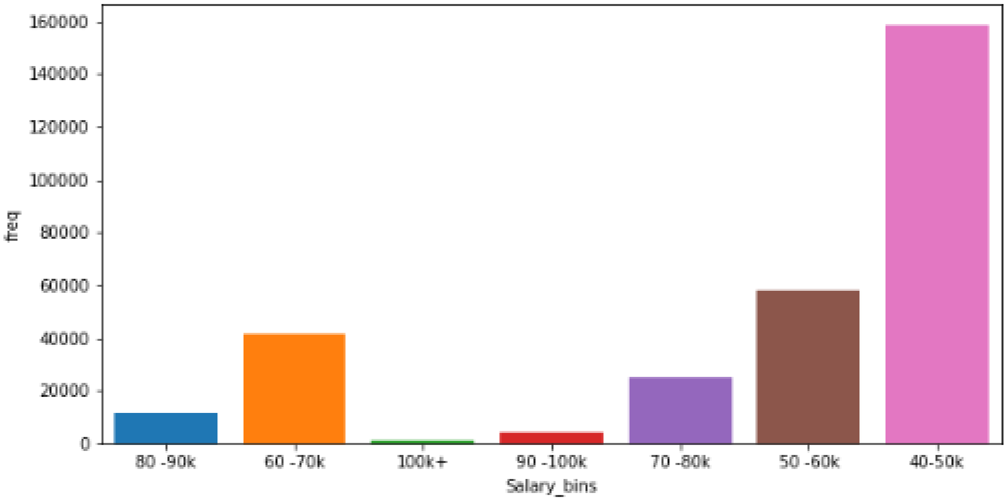
```
In [114]: # 12 c i) with left_company
          spark.sql('select d.dept_name,left_company, count(e.emp_no) as count_of_employee_per_department from project_de.employees e \
          inner join project_de.department_employees de on e.emp_no=de.emp_no \
          inner join project_de.department d on de.dept_no=d.dept_no \
          group by dept_name, left_company order by dept_name, left_company').show()

          +-----------------+------------+-------------------------------+
          |        dept_name|left_company|count_of_employee_per_department|
          +-----------------+------------+-------------------------------+
          | Customer Service|       false|                          21166|
          | Customer Service|        true|                           2414|
          |          Finance|       false|                          15699|
          |          Finance|        true|                           1647|
          |  Human Resources|       false|                          15989|
          |  Human Resources|        true|                           1797|
          |        Marketing|       false|                          18270|
          |        Marketing|        true|                           1941|
          |       Production|       false|                          66096|
          |       Production|        true|                           7389|
          |Quality Management|       false|                          18099|
          |Quality Management|        true|                           2018|
          |         Research|       false|                          19028|
          |         Research|        true|                           2098|
          |            Sales|       false|                          47036|
          |            Sales|        true|                           5209|
In [103]: #12.d) top 3 department where employees are leaving the company

          spark.sql('select d.dept_name, count(e.emp_no) as total_no_of_employees_left from project_de.employees e \
          inner join project_de.department_employees de on e.emp_no=de.emp_no \
          inner join project_de.department d on de.dept_no=d.dept_no \
          where left_company = "true" group by dept_name order by total_no_of_employees_left desc').show()
```

```
+------------------+--------------------------+
|         dept_name|total_no_of_employees_left|
+------------------+--------------------------+
|       development|                      8508|
|        Production|                      7389|
|             Sales|                      5209|
|  Customer Service|                      2414|
|          Research|                      2098|
|Quality Management|                      2018|
|         Marketing|                      1941|
|   Human Resources|                      1797|
|           Finance|                      1647|
+------------------+--------------------------+
```

```
In [71]: #12. e)
         salary_dist = spark.sql('select Salary_bins , count(emp_no) freq from project_de.salary_dist group by Salary_bins')
         salary_dist.show()
```

```
+-----------+------+
|Salary_bins|  freq|
+-----------+------+
|    80 -90k| 11845|
|    60 -70k| 41413|
|      100k+|  1288|
|   90 -100k|  4284|
|    70 -80k| 24814|
|    50 -60k| 57915|
|     40-50k|158465|
+-----------+------+
```

```
In [96]: plt.figure(figsize=(10,5))
         sns.barplot(data=salary_dist.toPandas(), x='Salary_bins', y='freq', saturation=1)
         plt.show()
```



In [123]:

```
#12 f) list of emp_name, title, dept_name, salary for each employee

spark.sql('select concat(first_name," ",last_name) as name, title, dept_name, salary from project_de.employees e \
inner join project_de.salaries s on e.emp_no=s.emp_no \
inner join project_de.titles t on e.emp_titles_id=t.title_id \
inner join project_de.department_employees de on e.emp_no=de.emp_no \
inner join project_de.department d on de.dept_no=d.dept_no').show()
```

```
+--------------------+------------------+------------------+------+
|                name|             title|         dept_name|salary|
+--------------------+------------------+------------------+------+
|      Georgi Facello|   Senior Engineer|       development| 60117|
|      Bezalel Simmel|             Staff|             Sales| 65828|
|        Parto Bamford|   Senior Engineer|        Production| 40006|
|   Chirstian Koblick|   Senior Engineer|        Production| 40054|
|    Kyoichi Maliniak|             Staff|   Human Resources| 78228|
|      Anneke Preusig|   Senior Engineer|       development| 40000|
|   Tzvetan Zielinski|             Staff|          Research| 56724|
|     Saniya Kalloufi|Assistant Engineer|       development| 46671|
|         Sumant Peac|   Senior Engineer|Quality Management| 60929|
|  Duangkaew Piveteau|          Engineer|Quality Management| 72488|
|  Duangkaew Piveteau|          Engineer|        Production| 72488|
|          Mary Sluis|             Staff|  Customer Service| 42365|
|  Patricio Bridgland|   Senior Engineer|       development| 40000|
|    Eberhardt Terkki|      Senior Staff|   Human Resources| 40000|
|         Berni Genin|          Engineer|       development| 46168|
|  Guoxiang Nooteboom|      Senior Staff|          Research| 40000|
|Kazuhito Cappelletti|             Staff|             Sales| 70889|
|  Cristinel Bouloucos|             Staff|         Marketing| 71380|
|        Kazuhide Peha|   Senior Engineer|       development| 55881|
|        Kazuhide Peha|   Senior Engineer|        Production| 55881|
+--------------------+------------------+------------------+------+
only showing top 20 rows
```

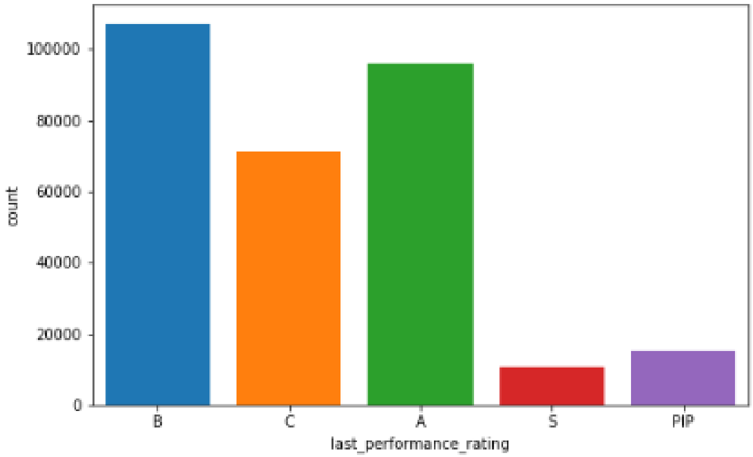
In [132]:

```
#12 g) performance wise count of employee at last year S being the top and PIP at last

performance=employees.groupBy('last_performance_rating').count()
performance.show()
```

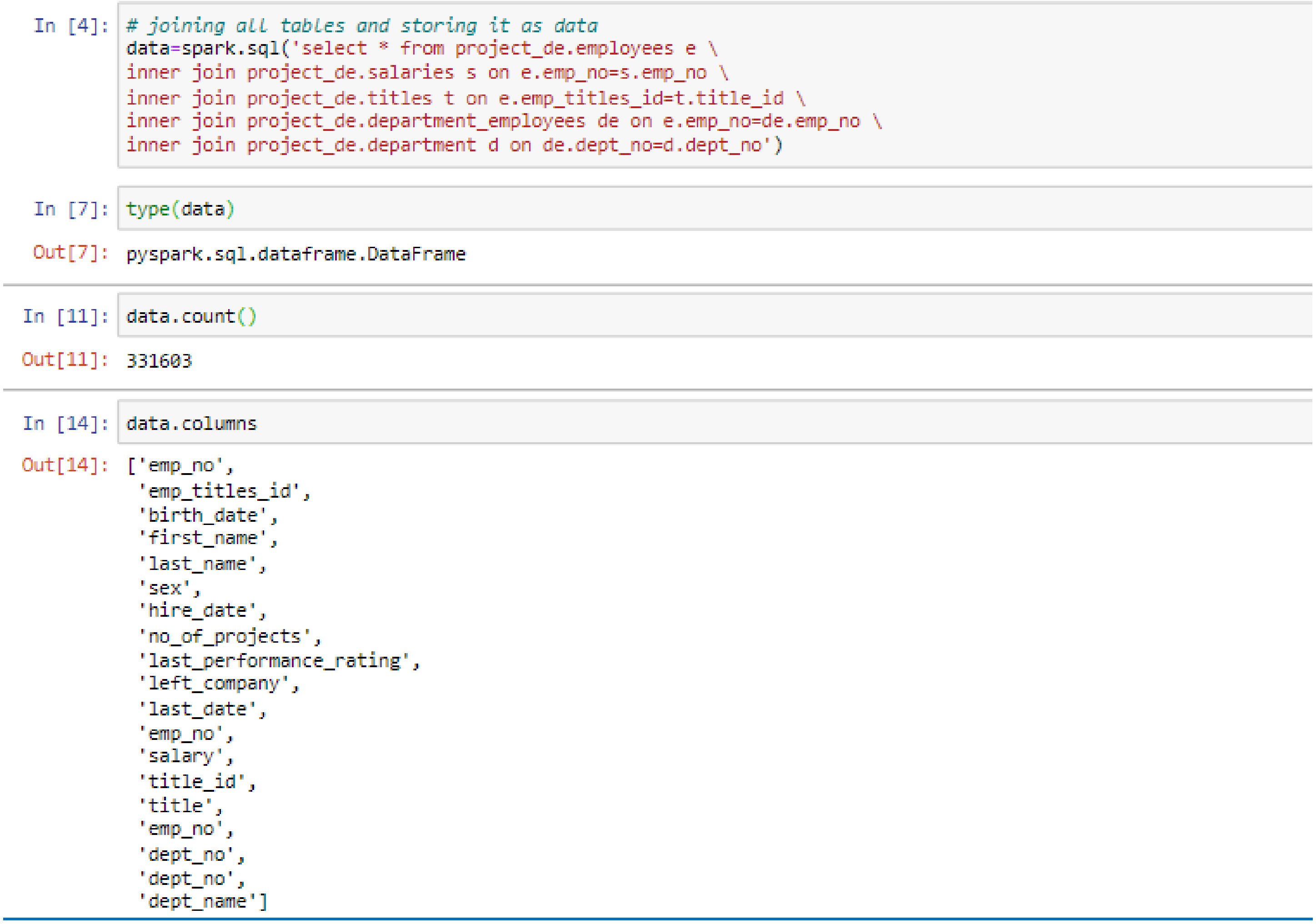
```
+-----------------------+------+
|last_performance_rating| count|
+-----------------------+------+
|                      B|107154|
|                      C| 71304|
|                      A| 95919|
|                      S| 10542|
|                    PIP| 15105|
+-----------------------+------+
```

In [134]:

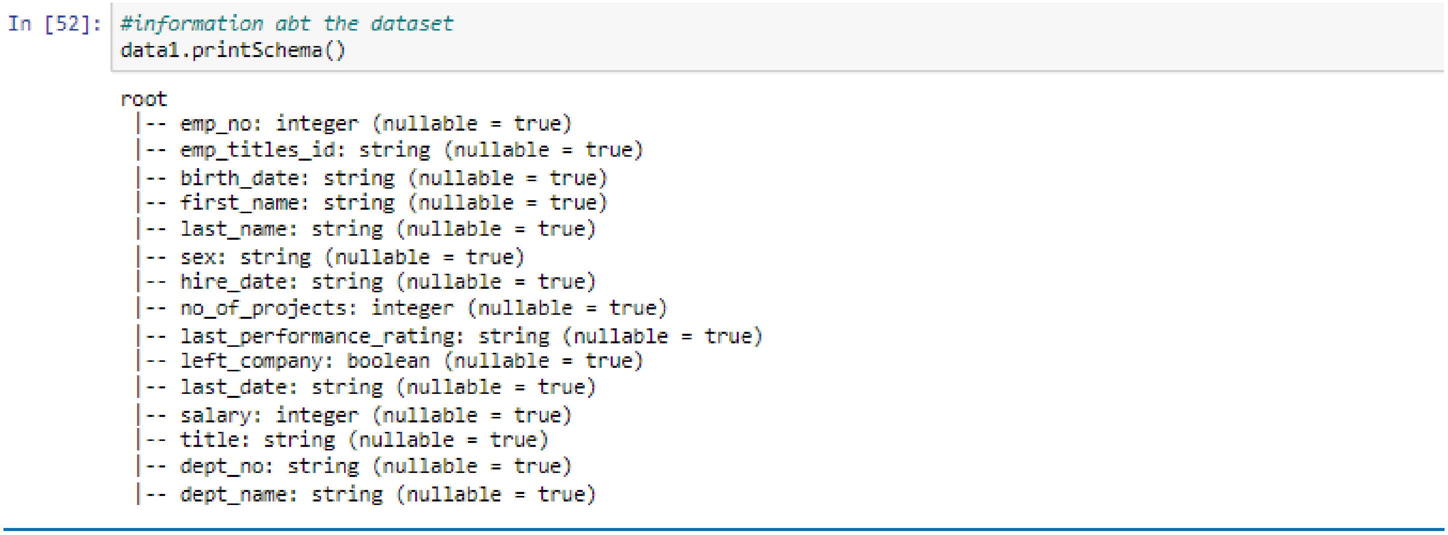
```
plt.figure(figsize=(8,5))
sns.barplot(data=performance.toPandas(), x='last_performance_rating', y='count', saturation=1)
plt.show()
```



Build ML Model : - Classification Model



```
In [4]:  # joining all tables and storing it as data
         data=spark.sql('select * from project_de.employees e \
         inner join project_de.salaries s on e.emp_no=s.emp_no \
         inner join project_de.titles t on e.emp_titles_id=t.title_id \
         inner join project_de.department_employees de on e.emp_no=de.emp_no \
         inner join project_de.department d on de.dept_no=d.dept_no')

In [7]:  type(data)

Out[7]:  pyspark.sql.dataframe.DataFrame

In [11]: data.count()

Out[11]: 331603

In [14]: data.columns

Out[14]: ['emp_no',
          'emp_titles_id',
          'birth_date',
          'first_name',
          'last_name',
          'sex',
          'hire_date',
          'no_of_projects',
          'last_performance_rating',
          'left_company',
          'last_date',
          'emp_no',
          'salary',
          'title_id',
          'title',
          'emp_no',
          'dept_no',
          'dept_no',
          'dept_name']
```



```
In [52]: #information abt the dataset
         data1.printSchema()

         root
          |-- emp_no: integer (nullable = true)
          |-- emp_titles_id: string (nullable = true)
          |-- birth_date: string (nullable = true)
          |-- first_name: string (nullable = true)
          |-- last_name: string (nullable = true)
          |-- sex: string (nullable = true)
          |-- hire_date: string (nullable = true)
          |-- no_of_projects: integer (nullable = true)
          |-- last_performance_rating: string (nullable = true)
          |-- left_company: boolean (nullable = true)
          |-- last_date: string (nullable = true)
          |-- salary: integer (nullable = true)
          |-- title: string (nullable = true)
          |-- dept_no: string (nullable = true)
          |-- dept_name: string (nullable = true)
```

converting the string dates to datetime

```
# selecting dates from data1 in b and coverting to pandas dataframe
b=data1.select('emp_no', 'birth_date', 'hire_date', 'last_date').toPandas()
```

```
b.head()
```

	emp_no	birth_date	hire_date	last_date
0	10001	9/2/1953	6/26/1986	7/30/1994\r
1	10002	6/2/1964	11/21/1985	\r
2	10003	12/3/1959	8/28/1986	\r
3	10004	5/1/1954	12/1/1986	\r
4	10005	1/21/1955	9/12/1989	\r

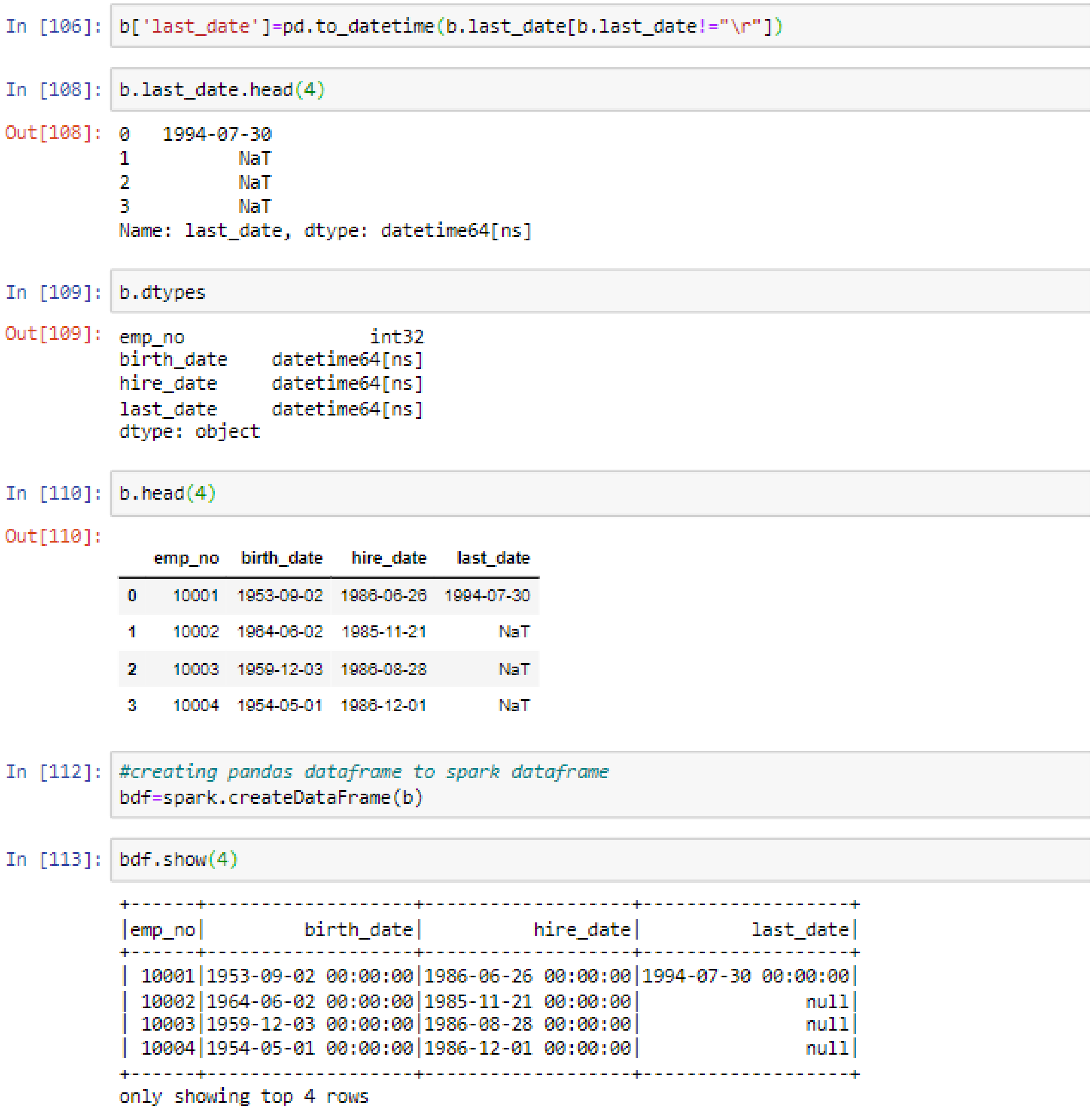
```
b.birth_date.head(2)
```

```
0     9/2/1953
1     6/2/1964
Name: birth_date, dtype: object
```

```
# coverting the string date to datetime
b.birth_date=pd.to_datetime(b.birth_date)
b.hire_date=pd.to_datetime(b.hire_date)
```

```
b.dtypes
```

```
emp_no                 int32
birth_date    datetime64[ns]
hire_date     datetime64[ns]
last_date             object
dtype: object
```



```
In [106]: b['last_date']=pd.to_datetime(b.last_date[b.last_date!="\r"])
```

```
In [108]: b.last_date.head(4)
```

```
Out[108]: 0   1994-07-30
          1          NaT
          2          NaT
          3          NaT
          Name: last_date, dtype: datetime64[ns]
```

```
In [109]: b.dtypes
```

```
Out[109]: emp_no                 int32
          birth_date    datetime64[ns]
          hire_date     datetime64[ns]
          last_date     datetime64[ns]
          dtype: object
```

```
In [110]: b.head(4)
```

Out[110]:

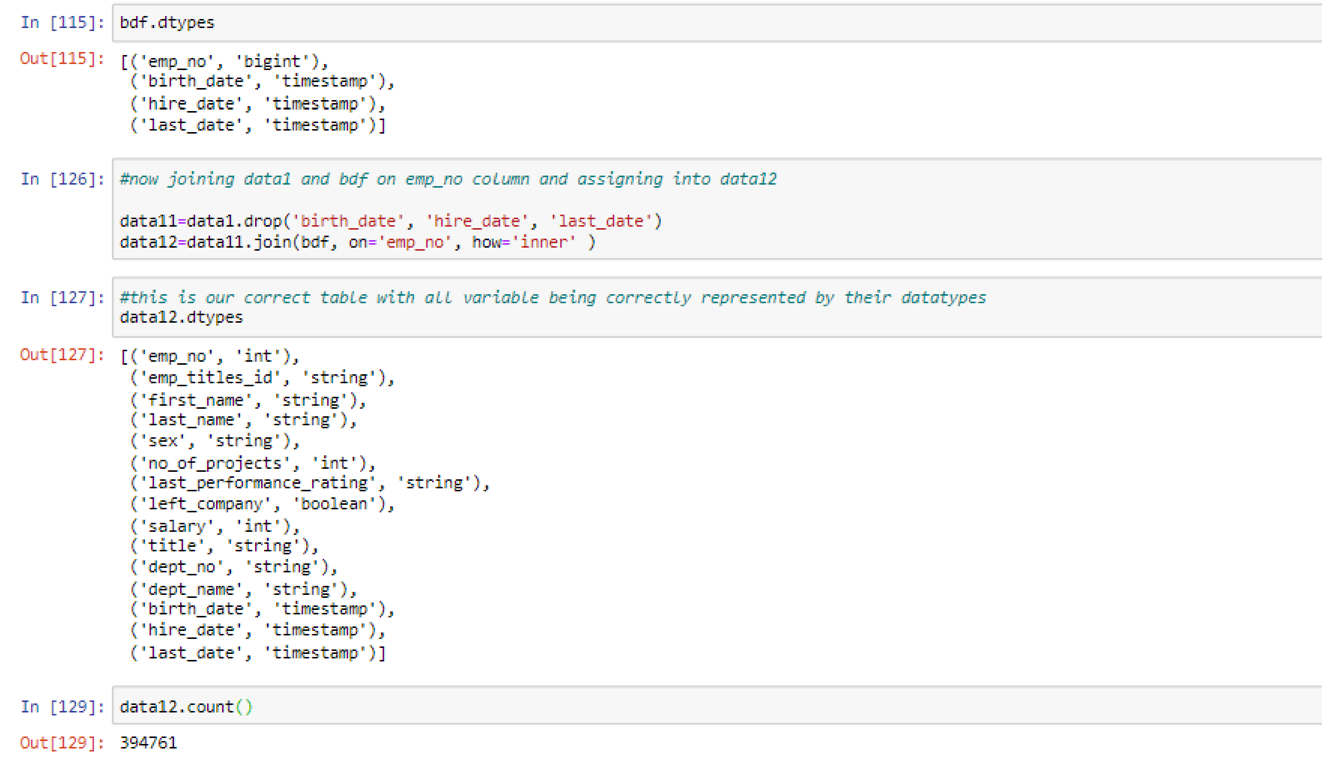
	emp_no	birth_date	hire_date	last_date
0	10001	1953-09-02	1986-06-26	1994-07-30
1	10002	1964-06-02	1985-11-21	NaT
2	10003	1959-12-03	1986-08-28	NaT
3	10004	1954-05-01	1986-12-01	NaT

```
In [112]: #creating pandas dataframe to spark dataframe
          bdf=spark.createDataFrame(b)
```

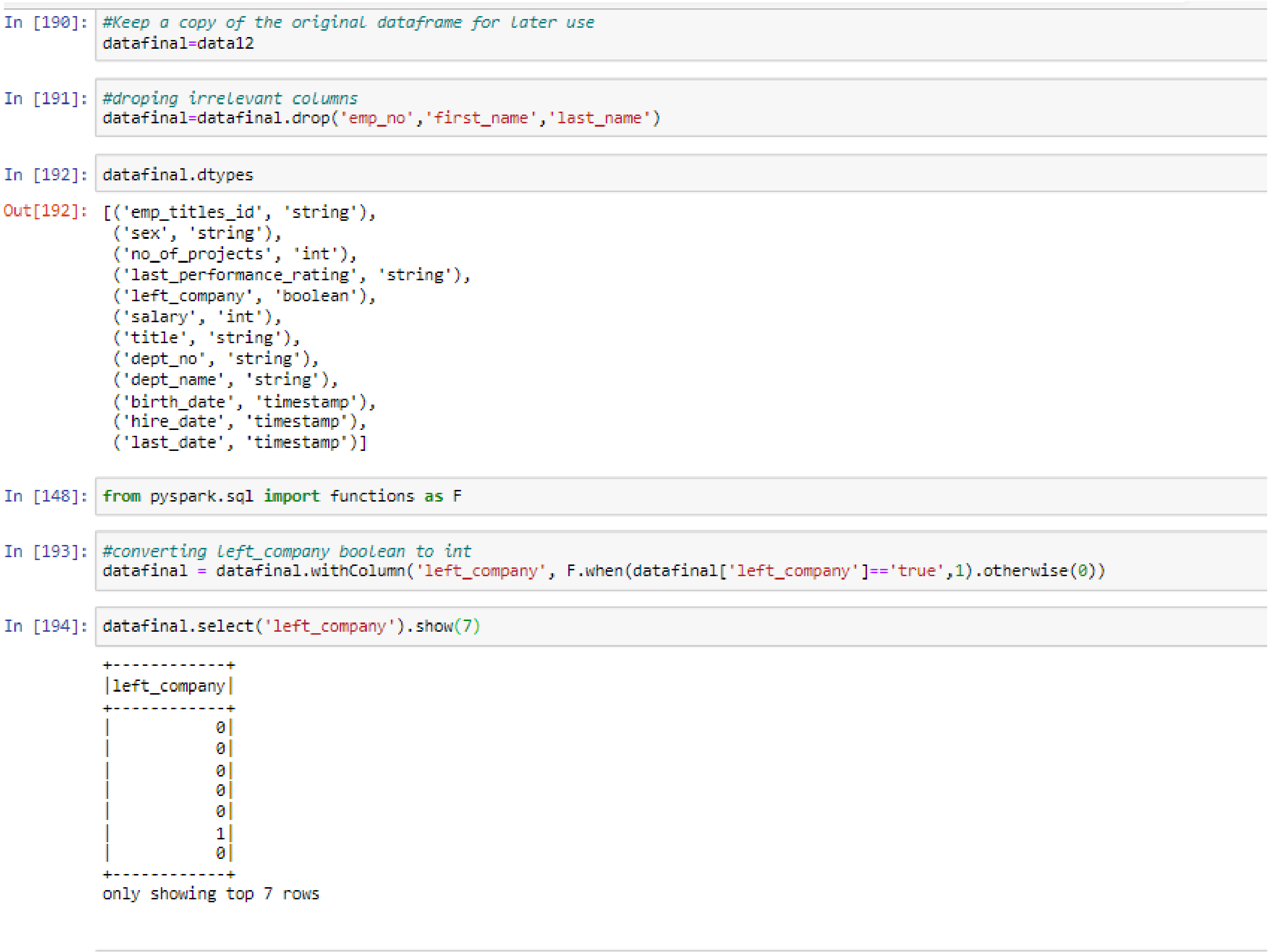
```
In [113]: bdf.show(4)
```

```
+------+-------------------+-------------------+-------------------+
|emp_no|         birth_date|          hire_date|          last_date|
+------+-------------------+-------------------+-------------------+
| 10001|1953-09-02 00:00:00|1986-06-26 00:00:00|1994-07-30 00:00:00|
| 10002|1964-06-02 00:00:00|1985-11-21 00:00:00|               null|
| 10003|1959-12-03 00:00:00|1986-08-28 00:00:00|               null|
| 10004|1954-05-01 00:00:00|1986-12-01 00:00:00|               null|
+------+-------------------+-------------------+-------------------+
only showing top 4 rows
```

Logistic Regression



```
In [115]: bdf.dtypes

Out[115]: [('emp_no', 'bigint'),
           ('birth_date', 'timestamp'),
           ('hire_date', 'timestamp'),
           ('last_date', 'timestamp')]

In [126]: #now joining data1 and bdf on emp_no column and assigning into data12

          data11=data1.drop('birth_date', 'hire_date', 'last_date')
          data12=data11.join(bdf, on='emp_no', how='inner' )

In [127]: #this is our correct table with all variable being correctly represented by their datatypes
          data12.dtypes

Out[127]: [('emp_no', 'int'),
           ('emp_titles_id', 'string'),
           ('first_name', 'string'),
           ('last_name', 'string'),
           ('sex', 'string'),
           ('no_of_projects', 'int'),
           ('last_performance_rating', 'string'),
           ('left_company', 'boolean'),
           ('salary', 'int'),
           ('title', 'string'),
           ('dept_no', 'string'),
           ('dept_name', 'string'),
           ('birth_date', 'timestamp'),
           ('hire_date', 'timestamp'),
           ('last_date', 'timestamp')]

In [129]: data12.count()

Out[129]: 394761
```



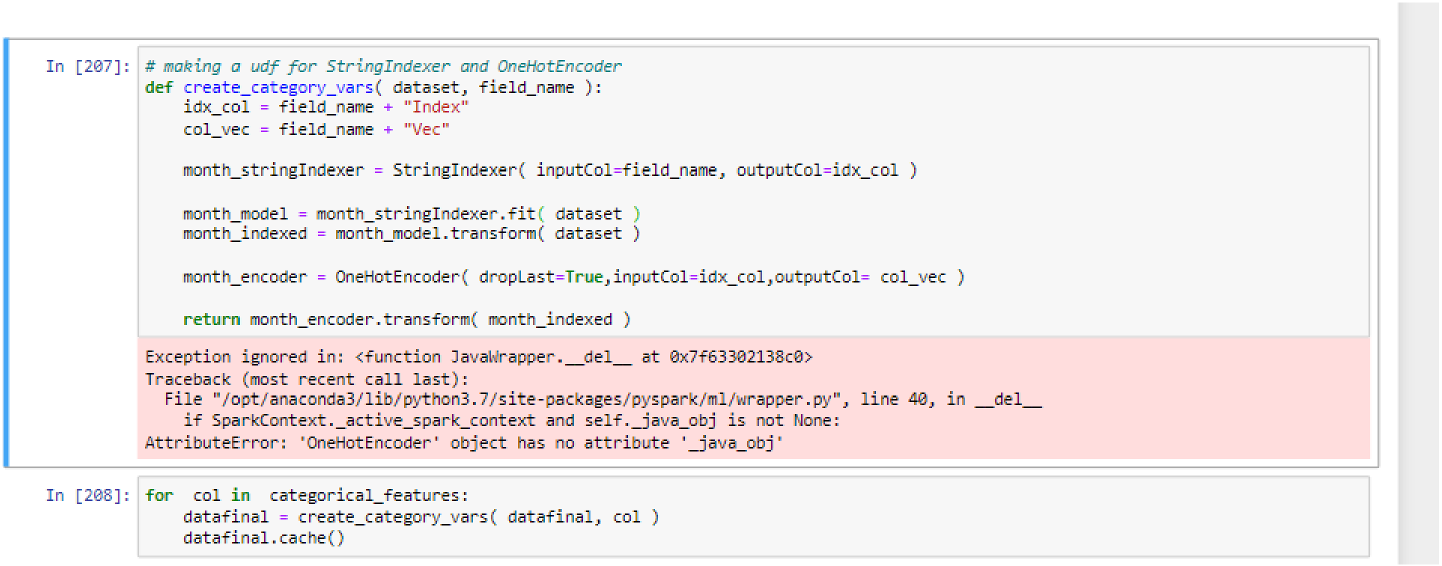
```
In [190]: #Keep a copy of the original dataframe for later use
          datafinal=data12

In [191]: #droping irrelevant columns
          datafinal=datafinal.drop('emp_no','first_name','last_name')

In [192]: datafinal.dtypes

Out[192]: [('emp_titles_id', 'string'),
           ('sex', 'string'),
           ('no_of_projects', 'int'),
           ('last_performance_rating', 'string'),
           ('left_company', 'boolean'),
           ('salary', 'int'),
           ('title', 'string'),
           ('dept_no', 'string'),
           ('dept_name', 'string'),
           ('birth_date', 'timestamp'),
           ('hire_date', 'timestamp'),
           ('last_date', 'timestamp')]

In [148]: from pyspark.sql import functions as F

In [193]: #converting left_company boolean to int
          datafinal = datafinal.withColumn('left_company', F.when(datafinal['left_company']=='true',1).otherwise(0))

In [194]: datafinal.select('left_company').show(7)

          +------------+
          |left_company|
          +------------+
          |           0|
          |           0|
          |           0|
          |           0|
          |           0|
          |           1|
          |           0|
          +------------+
          only showing top 7 rows
```

```
In [195]: #Columns that will be used as features and their types
          continuous_features = ['no_of_projects', 'salary']

          categorical_features = ['emp_titles_id','sex',
                                 'last_performance_rating', 'left_company',
                                 'title','dept_no','dept_name']
```

preprocessing data

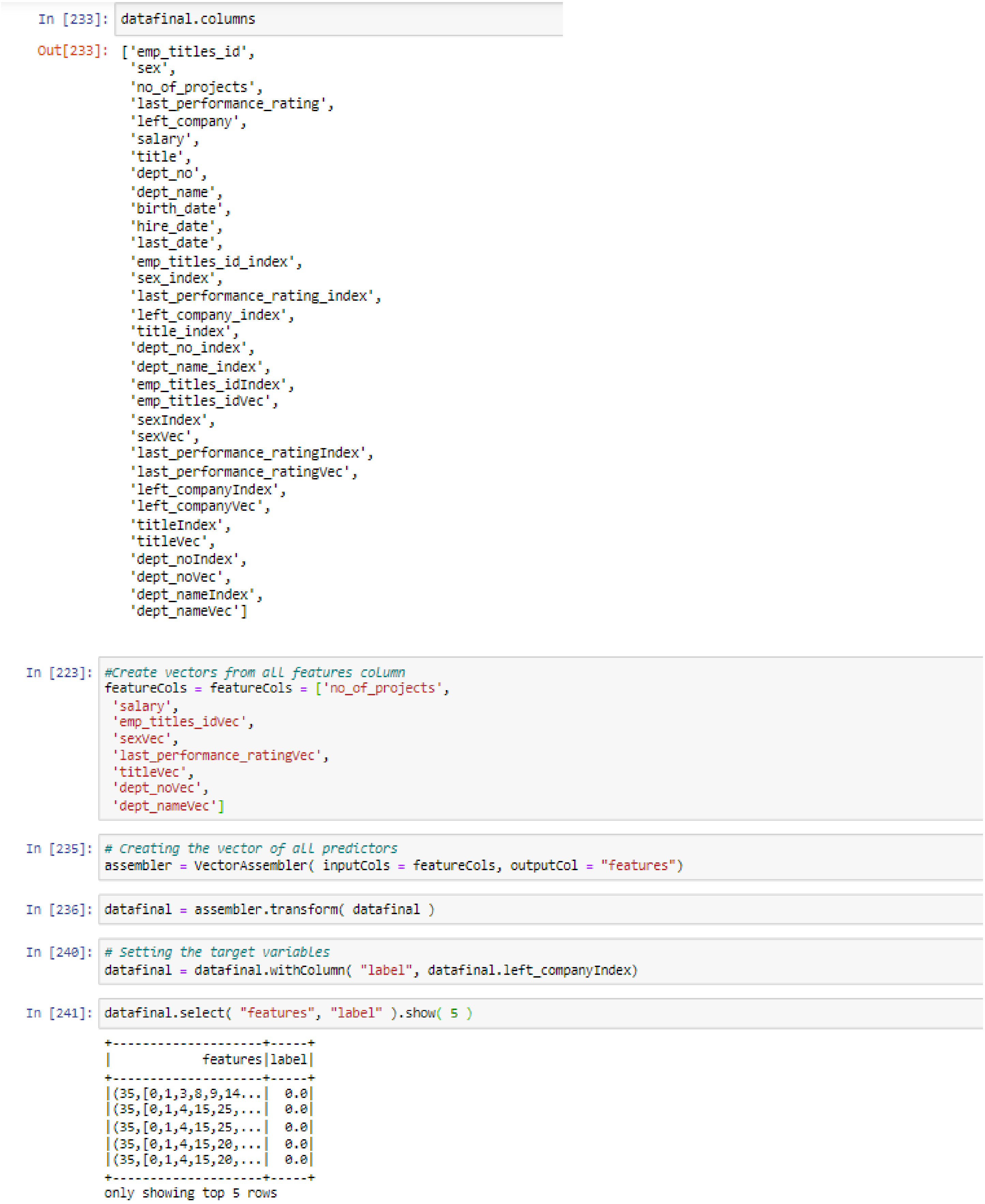
```
In [142]: #Encoding all categorical features
          from pyspark.ml.feature import OneHotEncoder, StringIndexer, VectorAssembler, PolynomialExpansion, VectorIndexer
```

```
In [196]: # create object of StringIndexer class and specify input and output column
          si_emp_titles_id = StringIndexer(inputCol='emp_titles_id',outputCol='emp_titles_id_index')
          si_sex = StringIndexer(inputCol='sex',outputCol='sex_index')
          si_last_performance_rating = StringIndexer(inputCol='last_performance_rating',outputCol='last_performance_rating_index')
          si_left_company = StringIndexer(inputCol='left_company',outputCol='left_company_index')
          si_title = StringIndexer(inputCol='title',outputCol='title_index')
          si_dept_no = StringIndexer(inputCol='dept_no',outputCol='dept_no_index')
          si_dept_name = StringIndexer(inputCol='dept_name',outputCol='dept_name_index')


          # transform the data
          datafinal = si_emp_titles_id.fit(datafinal).transform(datafinal)
          datafinal = si_sex.fit(datafinal).transform(datafinal)
          datafinal = si_last_performance_rating.fit(datafinal).transform(datafinal)
          datafinal = si_left_company.fit(datafinal).transform(datafinal)
          datafinal = si_title.fit(datafinal).transform(datafinal)
          datafinal = si_dept_no.fit(datafinal).transform(datafinal)
          datafinal = si_dept_name.fit(datafinal).transform(datafinal)


          # view the transformed data
          datafinal.select('emp_titles_id', 'emp_titles_id_index', 'sex', 'sex_index','last_performance_rating',
                          'last_performance_rating_index','left_company','left_company_index','title','title_index',
                          'dept_no','dept_no_index','dept_name','dept_name_index').show(10)
```



```
In [207]: # making a udf for StringIndexer and OneHotEncoder
          def create_category_vars( dataset, field_name ):
              idx_col = field_name + "Index"
              col_vec = field_name + "Vec"

              month_stringIndexer = StringIndexer( inputCol=field_name, outputCol=idx_col )

              month_model = month_stringIndexer.fit( dataset )
              month_indexed = month_model.transform( dataset )

              month_encoder = OneHotEncoder( dropLast=True,inputCol=idx_col,outputCol= col_vec )

              return month_encoder.transform( month_indexed )

          Exception ignored in: <function JavaWrapper.__del__ at 0x7f63302138c0>
          Traceback (most recent call last):
            File "/opt/anaconda3/lib/python3.7/site-packages/pyspark/ml/wrapper.py", line 40, in __del__
              if SparkContext._active_spark_context and self._java_obj is not None:
          AttributeError: 'OneHotEncoder' object has no attribute '_java_obj'
```

```
In [208]: for  col in  categorical_features:
              datafinal = create_category_vars( datafinal, col )
              datafinal.cache()
```



```
In [233]: datafinal.columns

Out[233]: ['emp_titles_id',
            'sex',
            'no_of_projects',
            'last_performance_rating',
            'left_company',
            'salary',
            'title',
            'dept_no',
            'dept_name',
            'birth_date',
            'hire_date',
            'last_date',
            'emp_titles_id_index',
            'sex_index',
            'last_performance_rating_index',
            'left_company_index',
            'title_index',
            'dept_no_index',
            'dept_name_index',
            'emp_titles_idIndex',
            'emp_titles_idVec',
            'sexIndex',
            'sexVec',
            'last_performance_ratingIndex',
            'last_performance_ratingVec',
            'left_companyIndex',
            'left_companyVec',
            'titleIndex',
            'titleVec',
            'dept_noIndex',
            'dept_noVec',
            'dept_nameIndex',
            'dept_nameVec']
```

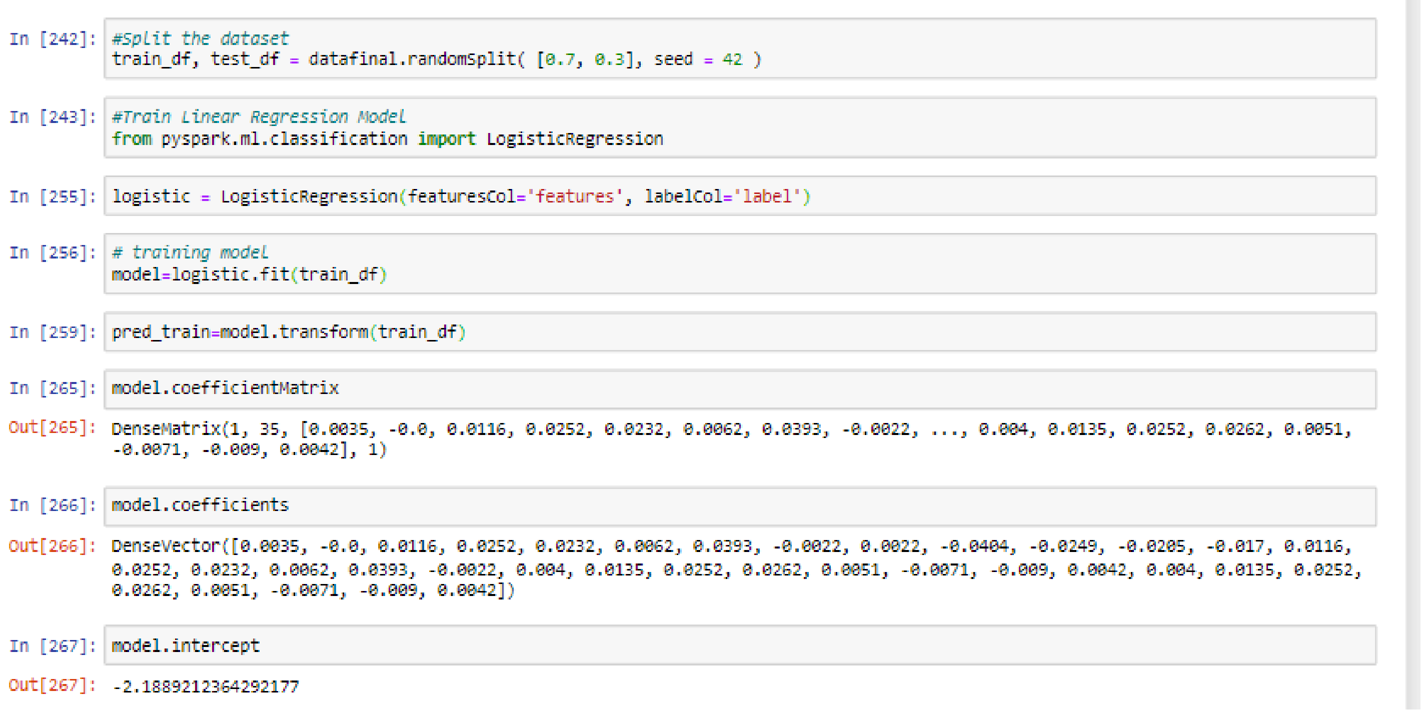
```
In [223]: #Create vectors from all features column
          featureCols = featureCols = ['no_of_projects',
           'salary',
           'emp_titles_idVec',
           'sexVec',
           'last_performance_ratingVec',
           'titleVec',
           'dept_noVec',
           'dept_nameVec']
```

```
In [235]: # Creating the vector of all predictors
          assembler = VectorAssembler( inputCols = featureCols, outputCol = "features")
```

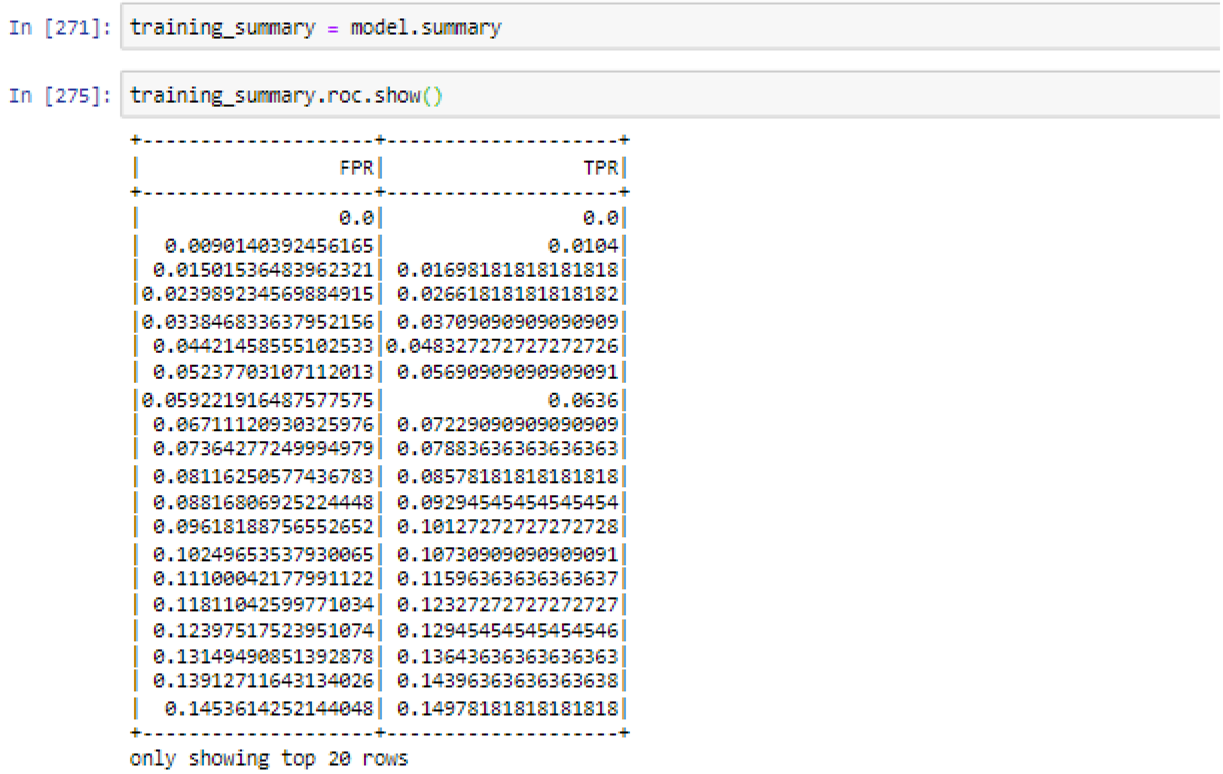
```
In [236]: datafinal = assembler.transform( datafinal )
```

```
In [240]: # Setting the target variables
          datafinal = datafinal.withColumn( "label", datafinal.left_companyIndex)
```

```
In [241]: datafinal.select( "features", "label" ).show( 5 )

          +--------------------+-----+
          |            features|label|
          +--------------------+-----+
          |(35,[0,1,3,8,9,14...|  0.0|
          |(35,[0,1,4,15,25,...|  0.0|
          |(35,[0,1,4,15,25,...|  0.0|
          |(35,[0,1,4,15,20,...|  0.0|
          |(35,[0,1,4,15,20,...|  0.0|
          +--------------------+-----+
          only showing top 5 rows
```



```
In [242]: #Split the dataset
          train_df, test_df = datafinal.randomSplit( [0.7, 0.3], seed = 42 )

In [243]: #Train Linear Regression Model
          from pyspark.ml.classification import LogisticRegression

In [255]: logistic = LogisticRegression(featuresCol='features', labelCol='label')

In [256]: # training model
          model=logistic.fit(train_df)

In [259]: pred_train=model.transform(train_df)

In [265]: model.coefficientMatrix

Out[265]: DenseMatrix(1, 35, [0.0035, -0.0, 0.0116, 0.0252, 0.0232, 0.0062, 0.0393, -0.0022, ..., 0.004, 0.0135, 0.0252, 0.0262, 0.0051,
          -0.0071, -0.009, 0.0042], 1)

In [266]: model.coefficients

Out[266]: DenseVector([0.0035, -0.0, 0.0116, 0.0252, 0.0232, 0.0062, 0.0393, -0.0022, 0.0022, -0.0404, -0.0249, -0.0205, -0.017, 0.0116,
          0.0252, 0.0232, 0.0062, 0.0393, -0.0022, 0.004, 0.0135, 0.0252, 0.0262, 0.0051, -0.0071, -0.009, 0.0042, 0.004, 0.0135, 0.0252,
          0.0262, 0.0051, -0.0071, -0.009, 0.0042])

In [267]: model.intercept

Out[267]: -2.1889212364292177
```



```
In [271]: training_summary = model.summary

In [275]: training_summary.roc.show()

          +--------------------+--------------------+
          |                 FPR|                 TPR|
          +--------------------+--------------------+
          |                 0.0|                 0.0|
          |  0.0090140392456165|              0.0104|
          | 0.01501536483962321| 0.01698181818181818|
          |0.023989234569884915| 0.02661818181818182|
          |0.033846833637952156| 0.03709090909090909|
          | 0.04421458555102533|0.048327272727272726|
          | 0.05237703107112013| 0.05690909090909091|
          |0.059221916487577575|              0.0636|
          | 0.06711120930325976| 0.07229090909090909|
          | 0.07364277249994979| 0.07883636363636363|
          | 0.08116250577436783| 0.08578181818181818|
          | 0.08816806925224448| 0.09294545454545454|
          | 0.09618188756552652| 0.10127272727272728|
          | 0.10249653537930065| 0.10730909090909091|
          | 0.11100042177991122| 0.11596363636363637|
          | 0.11811042599771034| 0.12327272727272727|
          | 0.12397517523951074| 0.12945454545454546|
          | 0.13149490851392878| 0.13643636363636363|
          | 0.13912711643134026| 0.14396363636363638|
          |  0.145361425214404 8| 0.14978181818181818|
          +--------------------+--------------------+
          only showing top 20 rows
```

Random Forest Classifier

In [276]:
```
from pyspark.ml import Pipeline
from pyspark.ml.classification import RandomForestClassifier
from pyspark.ml.feature import *
from pyspark.ml.evaluation import MulticlassClassificationEvaluator, BinaryClassificationEvaluator

from sklearn.metrics import confusion_matrix
from sklearn.metrics import precision_score
from sklearn.metrics import recall_score
```

In [277]:
```
def train(df, classifier):
    train, test = df.randomSplit([.7,.3])

    model = classifier.fit(train)

    pred = model.transform(test)

    eval_accuracy = (MulticlassClassificationEvaluator
            (labelCol="label", predictionCol="prediction", metricName="accuracy"))

    eval_precision = (MulticlassClassificationEvaluator
            (labelCol="label", predictionCol="prediction", metricName="weightedPrecision"))

    eval_recall = (MulticlassClassificationEvaluator
            (labelCol="label", predictionCol="prediction", metricName="weightedRecall"))

    eval_f1 = (MulticlassClassificationEvaluator
            (labelCol="label", predictionCol="prediction", metricName="f1"))

    accuracy = eval_accuracy.evaluate(pred)

    precision =  eval_precision.evaluate(pred)

    recall =  eval_recall.evaluate(pred)

    f1 =  eval_f1.evaluate(pred)

    print(f"""
    Accuracy  = {accuracy}
    Error     = {1-accuracy}
    Precision = {precision}
    Recall    = {recall}
    F1        = {f1}""")

    return model, pred
```

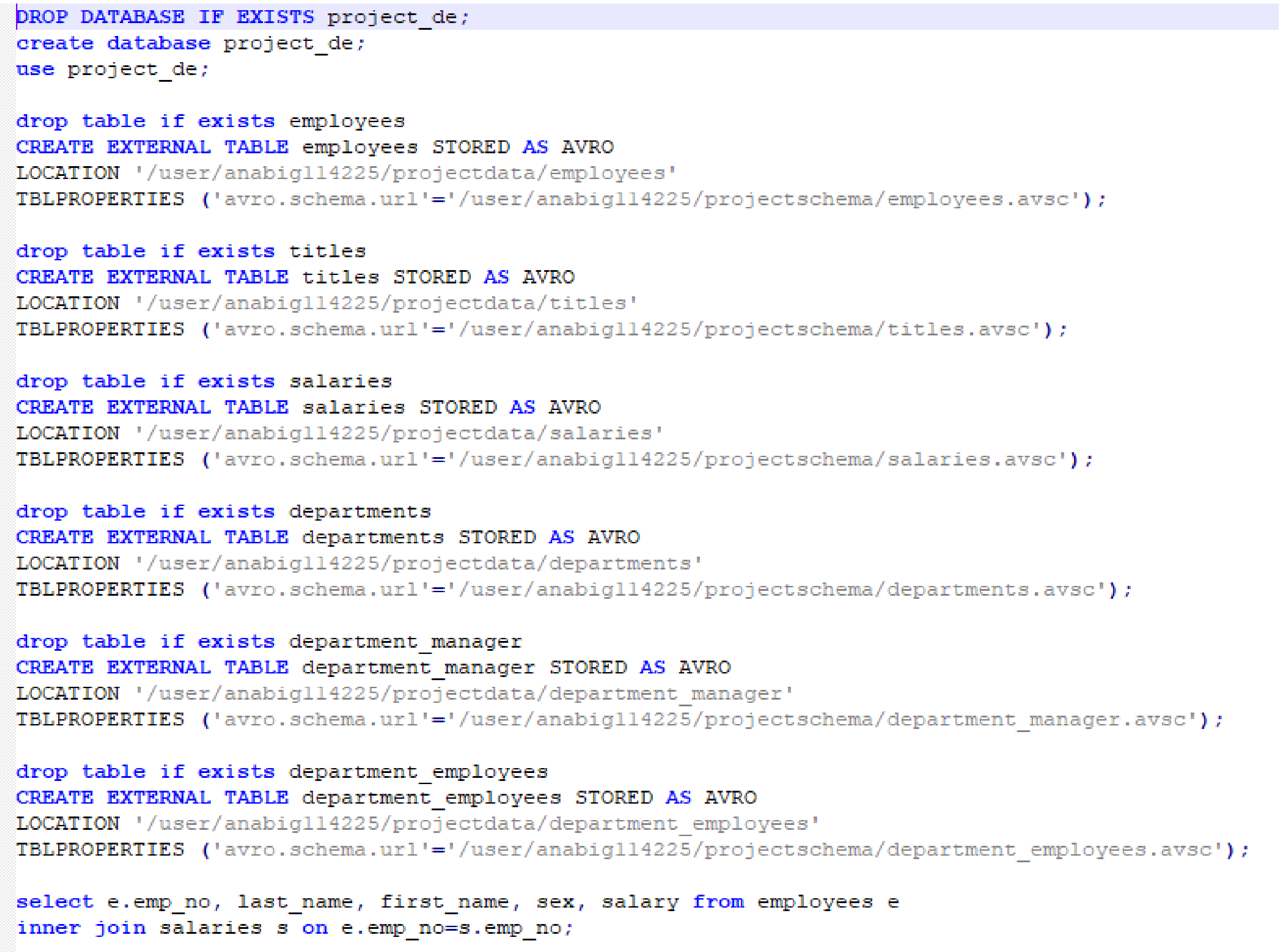
In [280]:
```
rf = RandomForestClassifier(labelCol="label", featuresCol="features")

_ , pred = train(datafinal,rf)

pred.select("prediction", "label", "features").show()
```

```
    Accuracy  = 0.9006221128232795
    Error     = 0.09937788717672047
    Precision = 0.811120190106268
    Recall    = 0.9006221128232795
    F1        = 0.8535312565646093
+----------+-----+--------------------+
|prediction|label|            features|
+----------+-----+--------------------+
|       0.0|  1.0|(35,[0,1,7,10,18,...|
|       0.0|  0.0|(35,[0,1,7,10,18,...|
|       0.0|  0.0|(35,[0,1,7,11,18,...|
|       0.0|  0.0|(35,[0,1,7,11,18,...|
|       0.0|  0.0|(35,[0,1,7,10,18,...|
|       0.0|  0.0|(35,[0,1,7,10,18,...|
|       0.0|  0.0|(35,[0,1,7,8,10,1...|
|       0.0|  0.0|(35,[0,1,7,8,10,1...|
|       0.0|  0.0|(35,[0,1,7,8,11,1...|
|       0.0|  0.0|(35,[0,1,7,8,10,1...|
|       0.0|  0.0|(35,[0,1,7,8,11,1...|
|       0.0|  0.0|(35,[0,1,7,8,11,1...|
|       0.0|  0.0|(35,[0,1,7,8,11,1...|
|       0.0|  0.0|(35,[0,1,7,8,11,1...|
|       0.0|  0.0|(35,[0,1,4,9,15,2...|
|       0.0|  0.0|(35,[0,1,4,9,15,2...|
|       0.0|  0.0|(35,[0,1,4,12,15,...|
|       0.0|  0.0|(35,[0,1,4,10,15,...|
|       0.0|  0.0|(35,[0,1,4,10,15,...|
|       0.0|  1.0|(35,[0,1,4,10,15,...|
+----------+-----+--------------------+
only showing top 20 rows
```

Create entire data pipeline and ML pipe line

Create .sql file with commands of create database and table with queries.

File - > create_database_table_pipeline_sql.sql

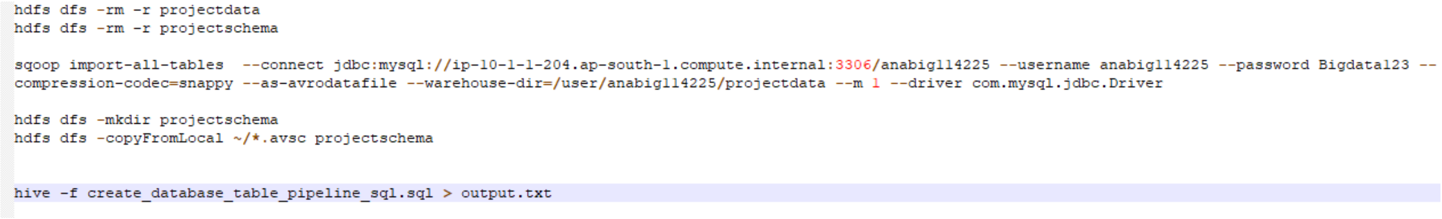


```
DROP DATABASE IF EXISTS project_de;
create database project_de;
use project_de;

drop table if exists employees
CREATE EXTERNAL TABLE employees STORED AS AVRO
LOCATION '/user/anabig114225/projectdata/employees'
TBLPROPERTIES ('avro.schema.url'='/user/anabig114225/projectschema/employees.avsc');

drop table if exists titles
CREATE EXTERNAL TABLE titles STORED AS AVRO
LOCATION '/user/anabig114225/projectdata/titles'
TBLPROPERTIES ('avro.schema.url'='/user/anabig114225/projectschema/titles.avsc');

drop table if exists salaries
CREATE EXTERNAL TABLE salaries STORED AS AVRO
LOCATION '/user/anabig114225/projectdata/salaries'
TBLPROPERTIES ('avro.schema.url'='/user/anabig114225/projectschema/salaries.avsc');

drop table if exists departments
CREATE EXTERNAL TABLE departments STORED AS AVRO
LOCATION '/user/anabig114225/projectdata/departments'
TBLPROPERTIES ('avro.schema.url'='/user/anabig114225/projectschema/departments.avsc');

drop table if exists department_manager
CREATE EXTERNAL TABLE department_manager STORED AS AVRO
LOCATION '/user/anabig114225/projectdata/department_manager'
TBLPROPERTIES ('avro.schema.url'='/user/anabig114225/projectschema/department_manager.avsc');

drop table if exists department_employees
CREATE EXTERNAL TABLE department_employees STORED AS AVRO
LOCATION '/user/anabig114225/projectdata/department_employees'
TBLPROPERTIES ('avro.schema.url'='/user/anabig114225/projectschema/department_employees.avsc');

select e.emp_no, last_name, first_name, sex, salary from employees e
inner join salaries s on e.emp_no=s.emp_no;
```

Create .sh file as mysql_sqoop_pipeline_sh.sh and execute it.

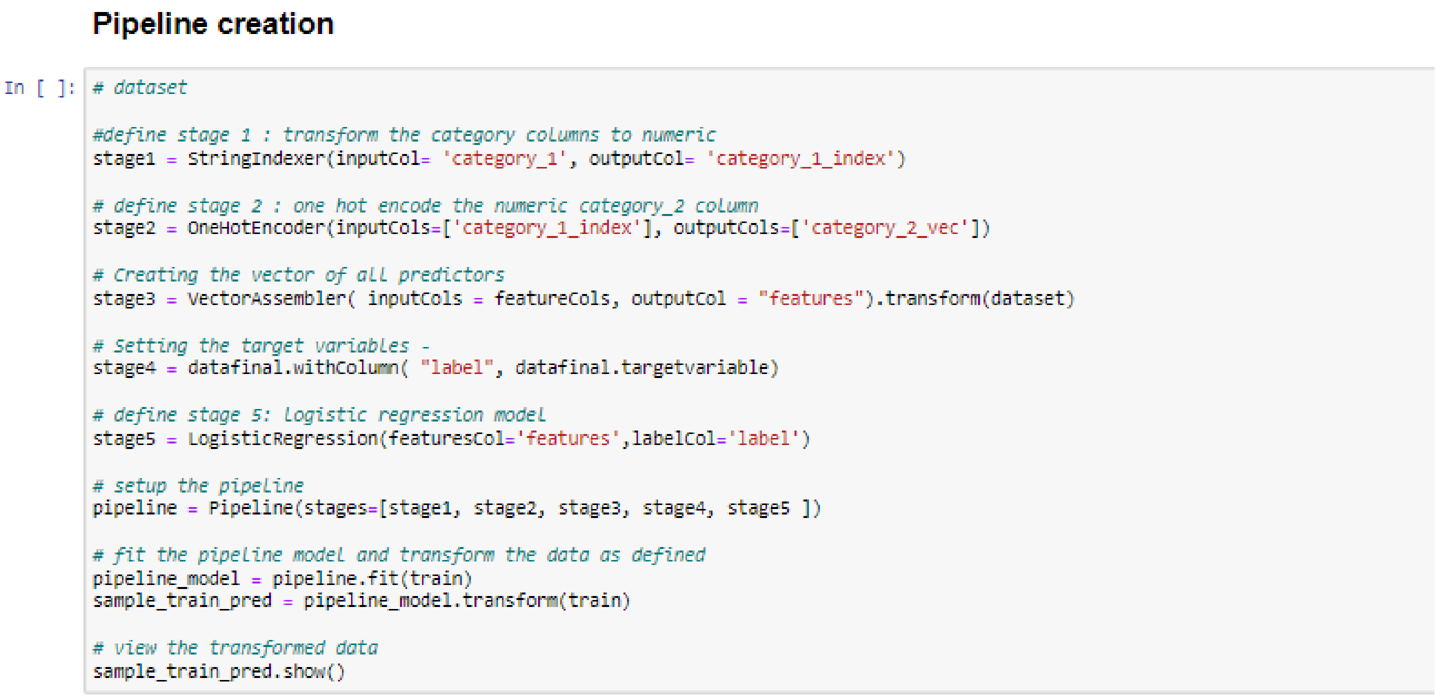
Commands are to be saved in mysql_sqoop_pipeline_sh.sh file are

```
hdfs dfs -rm -r projectdata
hdfs dfs -rm -r projectschema

sqoop import-all-tables  --connect jdbc:mysql://ip-10-1-1-204.ap-south-1.compute.internal:3306/anabig114225 --username anabig114225 --password Bigdata123 --compression-codec=snappy --as-avrodatafile --warehouse-dir=/user/anabig114225/projectdata --m 1 --driver com.mysql.jdbc.Driver

hdfs dfs -mkdir projectschema
hdfs dfs -copyFromLocal ~/*.avsc projectschema
hive -f create_database_table_pipeline_sql.sql > output.txt
```



```
hdfs dfs -rm -r projectdata
hdfs dfs -rm -r projectschema

sqoop import-all-tables  --connect jdbc:mysql://ip-10-1-1-204.ap-south-1.compute.internal:3306/anabig114225 --username anabig114225 --password Bigdata123 --
compression-codec=snappy --as-avrodatafile --warehouse-dir=/user/anabig114225/projectdata --m 1 --driver com.mysql.jdbc.Driver

hdfs dfs -mkdir projectschema
hdfs dfs -copyFromLocal ~/*.avsc projectschema


hive -f create_database_table_pipeline_sql.sql > output.txt
```

Create entire ML pipeline



Pipeline creation

```
In [ ]: # dataset

        #define stage 1 : transform the category columns to numeric
        stage1 = StringIndexer(inputCol= 'category_1', outputCol= 'category_1_index')

        # define stage 2 : one hot encode the numeric category_2 column
        stage2 = OneHotEncoder(inputCols=['category_1_index'], outputCols=['category_2_vec'])

        # Creating the vector of all predictors
        stage3 = VectorAssembler( inputCols = featureCols, outputCol = "features").transform(dataset)

        # Setting the target variables -
        stage4 = datafinal.withColumn( "label", datafinal.targetvariable)

        # define stage 5: logistic regression model
        stage5 = LogisticRegression(featuresCol='features',labelCol='label')

        # setup the pipeline
        pipeline = Pipeline(stages=[stage1, stage2, stage3, stage4, stage5 ])

        # fit the pipeline model and transform the data as defined
        pipeline_model = pipeline.fit(train)
        sample_train_pred = pipeline_model.transform(train)

        # view the transformed data
        sample_train_pred.show()
```

Challenges

- Creating the data tables as per their correct data type and then importing it to MySQL
- Deciding in which format to import the tables from MySQL into HDFS
- Finding. avsc schema files of table and then saving them on hdfs into new directory
- Creating table in hive using the format as specified earlier while importing the tables, With mentioning data location and schema location.
- Taking hive tables to spark
- Conveting datatypes of variables
- Building sparkML with different techniques
- Finding wayouts to create data pipeline and ML pipeline

Way ahead or Conclusion

On whole it's way very good learning project assimilating all interconnecting all tools mysql, sqoop, hdfs, hive, spark, sparkML for transferring the data tables, schemas and doing analysis on them. All of the tools being integrated into this one single project of data engineering.