Top Scorer: A Soccer Analytics Navigator

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FINAL REPORT

Introduction

Our goal was to create an Emulation Based File Distribution System (EDFS) with intuitive UI that will help user to perform all basic HDFS commands. User can upload a csv file onto the EDFS and partition it based on user argument. The user will be able to perform certain search and analytics functions that will use Partition based Map-Reduce to deduce the output.

Datasets:

The following three datasets will be used in this project, namely:

- **epl-goalScorer(20-21).csv**
- **LaLiga-goalScorer(20-21).csv**
- **Bundesliga-goalScorer(20-21).csv**

These datasets are part of '****Goal Dataset - Top 5 European Leagues'** from Kaggle**.** They were scraped using python's beautiful soup library.

Features of the Dataset include:

1. ID - unique ID for each row
2. player_name - name of the Soccer player
3. games - number of games played in the season
4. time - total number of minutes the player played that season
5. goals - number of goals scored in the season
6. xG - expected goals of the player
7. assists - number of assists provided in the season
8. xA - expected assists of the player
9. shots - number of shots taken during the season

EDFS Implementation:

EDFS has been emulated using two different ways. One of the ways involves the use of MySQL database while the other uses MongoDB.

A] EDFS implementation with SQL:

The following seven commands have been implemented in python scripts that will allow the user to make use of various functionalities like storing and retrieving data, creating, or deleting directories and viewing contents of the directories or file.

A namenode table has been created where the meta data associated with files or directories will be maintained based on the modifications made by the user to the file system. The data node maintains the actual data uploaded by the user.

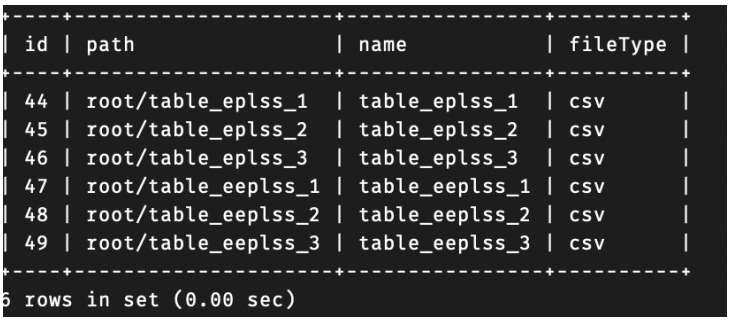
The table has 4 columns:

1) Id – This field assigns an id to all the meta data. It is set as AUTO INCREMENT and PRIMARY KEY for the table.

2) Path – This field stores the path of all the Directories and Files created in the EDFS.

3) Name – This field stores the name of the file added to the EDFS.

4) Type – This field stores the type of the newly created file/directory.



id	path	name	fileType
44	root/table_eplss_1	table_eplss_1	csv
45	root/table_eplss_2	table_eplss_2	csv
46	root/table_eplss_3	table_eplss_3	csv
47	root/table_eeplss_1	table_eeplss_1	csv
48	root/table_eeplss_2	table_eeplss_2	csv
49	root/table_eeplss_3	table_eeplss_3	csv

6 rows in set (0.00 sec)

Fig. 1- Namenode

The actual data will be held in the data node. For example, if a user uploads a csv and decides to divide it in 3 partitions, we will create three datanodes with name ‘table_filename_1, table_filename_2, and table_filename_3’

Tables_in_dsci551
namenode3
new
new1
new2
new24
new3
new34
new4
table_dog_1
table_dog_2
table_dog_3
table_eeplss_1
table_eeplss_2
table_eeplss_3
table_epl_1
table_epl_2
table_epl_3

Fig. 2 – csv being stored as Datanode

```
mysql> select * from table_eeplss_1 limit 1;
+------+-------------+-------+------+-------+--------------------+---------+-------------------+-------+-------------+--------------+-----+----------+------+-------------------+-------------------+-------------------+
| id   | player_name | games | time | goals | xG                 | assists | xA                | shots | key_passes | yellow_cards | red_cards | pos | team     | npg  | npXG              | xGChain           | xGBuildup         |
+------+-------------+-------+------+-------+--------------------+---------+-------------------+-------+-------------+--------------+-----+----------+------+-------------------+-------------------+-------------------+
| 647  | Harry Kane  | 35    | 3097 | 23    | 22.17485890910029  | 14      | 7.577093588188291 | 138   | 49          | 1            | 0         | F   | Tottenham | 19   | 19.1301834397018  | 24.995648321695622 | 4.451256847940385 |
+------+-------------+-------+------+-------+--------------------+---------+-------------------+-------+-------------+--------------+-----+----------+------+-------------------+-------------------+-------------------+
1 row in set (0.00 sec)

mysql>
```

Fig. 3 – csv data as Datanode

EDFS commands:

1) **makeDir** – This function takes name as an argument from the user, and it does 2 tasks. Firstly, it creates a new folder or directory. Subsequently, it will add meta data created in the namenode.

```
~/Documents/551DB/Final Project > /opt/homebrew/bin/python3 "/Users/shreyanshkhandelwal/Documents/551DB/Final Project/hdfs.py"
Enter name of the directory: test
~/Documents/551DB/Final Project >
```

```
+----+---------------------+----------------+----------+
| id | path                | name           | fileType |
+----+---------------------+----------------+----------+
| 44 | root/table_eplss_1  | table_eplss_1  | csv      |
| 45 | root/table_eplss_2  | table_eplss_2  | csv      |
| 46 | root/table_eplss_3  | table_eplss_3  | csv      |
| 47 | root/table_eeplss_1 | table_eeplss_1 | csv      |
| 48 | root/table_eeplss_2 | table_eeplss_2 | csv      |
| 49 | root/table_eeplss_3 | table_eeplss_3 | csv      |
| 50 | root/test           | test           | dir      |
+----+---------------------+----------------+----------+
7 rows in set (0.00 sec)
```

Fig. 4 – Namenode after upload function

2) **ls** – This function simply just shows all the directories and files present. It takes no argument from user and outputs a list of paths to showcase the list of present files/directories.

```
120  ls()
121

PROBLEMS  OUTPUT  DEBUG CONSOLE  TERMINAL  JUPYTER

~/Documents/551DB/Final Project > /opt/homebrew/bin/python3 "/Users/shreyanshkhandelwal/Documents/551DB/Final Project/hdfs.py"
('root/table_eplss_1',)
('root/table_eplss_2',)
('root/table_eplss_3',)
('root/table_eeplss_1',)
('root/table_eeplss_2',)
('root/table_eeplss_3',)
('root/test',)
~/Documents/551DB/Final Project >
```

Fig. 5 ls function output

3) **cat** – This function takes name of the file as input from the user and outputs the content of the file. If the type of the file is a csv it will show a data frame in the output whereas if the type is txt, it will simply show all the content like a nano would.
For example, if the user gives input as ‘epl-goalScorer(20-21).csv’ as input it will show the data in a pandas data frame.

```
121   cat('eepls')
122

PROBLEMS   OUTPUT   DEBUG CONSOLE   TERMINAL   JUPYTER

~/Documents/551DB/Final Project > /opt/homebrew/bin/python3 "/Users/shreyanshkhandelwal/Documents/551DB/Final Project/hdfs.py"
     Unnamed: 0    id            player_name  games  time  goals         xG  ...  red_cards  position         team_title  npg       npxG    xGChain  xGBuildup
0             0   647             Harry Kane     35  3097     23  22.174859  ...          0         F        Tottenham   19  19.130183  24.995648   4.451257
1             1  1250         Mohamed Salah     37  3085     22  20.250847  ...          0     F M S          Liverpool   16  15.683834  28.968234   9.800236
2             2  1228        Bruno Fernandes     37  3117     18  16.019454  ...          0       M S  Manchester United    9   8.407840  26.911412  11.932285
3             3   453          Son Heung-Min     37  3139     17  11.023287  ...          0     F M S        Tottenham   16  10.262118  20.671916   6.608751
4             4   822        Patrick Bamford     38  3085     17  18.401863  ...          0       F S             Leeds   15  16.879525  23.394953   4.131796
..          ...   ...                   ...    ...   ...    ...        ...  ...        ...       ...              ...  ...        ...        ...        ...
517         517  9415  Jaden Philogene-Bidace      1     1      0   0.000000  ...          0         S      Aston Villa    0   0.000000   0.056044   0.056044
518         518  9423        Gaetano Berardi      2   113      0   0.074761  ...          0       D S             Leeds    0   0.074761   0.231278   0.231278
519         519  9524         Anthony Elanga      1    67      0   0.000000  ...          0         M  Manchester United    0   0.000000   0.000000   0.000000
520         520  9540            Femi Seriki      1     1      0   0.000000  ...          0         S    Sheffield United    0   0.000000   0.000000   0.000000
521         521  9552        Tyrese Francois      1    13      0   0.000000  ...          0         S             Fulham    0   0.000000   0.000000   0.000000

[522 rows x 19 columns]
~/Documents/551DB/Final Project >
```

Fig 6. Concat output

4) **remove** – This function simply just deletes the directory or file specified by the user. It takes name of the file as an argument from user and deletes it from both the namenode and datanode table.

```
mysql> select * from namenode3;
+----+---------------------+----------------+----------+
| id | path                | name           | fileType |
+----+---------------------+----------------+----------+
| 47 | root/table_eeplss_1 | table_eeplss_1 | csv      |
| 48 | root/table_eeplss_2 | table_eeplss_2 | csv      |
| 49 | root/table_eeplss_3 | table_eeplss_3 | csv      |
| 50 | root/test           | test           | dir      |
+----+---------------------+----------------+----------+
4 rows in set (0.01 sec)
```

Fig 7. Namenode output before delete

```
127   remove()
128

PROBLEMS   OUTPUT   DEBUG CONSOLE   TERMINAL   JUPYTER

~/Documents/551DB/Final Project > /opt/homebrew/bin/python3 "/Users/shreyanshkhandelwal/Documents/551DB/Final Project/hdfs.py"
Enter name of the directory or file you want to delete: eepls
removed
~/Documents/551DB/Final Project >
```

```
mysql> select * from namenode3;
+----+-----------+------+----------+
| id | path      | name | fileType |
+----+-----------+------+----------+
| 50 | root/test | test | dir      |
+----+-----------+------+----------+
1 row in set (0.00 sec)
```

Fig 8. Namenode output after delete

5) **Upload** – This function will ask the user to upload the csv files. It will then update 2 tables. Firstly, it will create an entry in the namenode and then it will store the data in the datanode table.

```
mysql> select * from namenode3;
+-----+----------------------+-----------------+----------+
| id  | path                 | name            | fileType |
+-----+----------------------+-----------------+----------+
| 50  | root/test            | test            | dir      |
| 51  | root/table_eplGoal_1 | table_eplGoal_1 | csv      |
| 52  | root/table_eplGoal_2 | table_eplGoal_2 | csv      |
| 53  | root/table_eplGoal_3 | table_eplGoal_3 | csv      |
+-----+----------------------+-----------------+----------+
4 rows in set (0.00 sec)
```

Fig 9. Name node data after upload operation

```
mysql> show tables;
+--------------------+
| Tables_in_dsci551 |
+--------------------+
| namenode3          |
| table_eplGoal_1    |
| table_eplGoal_2    |
| table_eplGoal_3    |
+--------------------+
4 rows in set (0.01 sec)
```

Fig 10. Data gets stored in parts

```
mysql> select * from table_eplGoal_3 limit 5;
+------+-----------------+-------+------+-------+---------------------+---------+---------------------+-------+-------------+-------------+-----+-----------------+-----+---------------------+---------------------+---------------------+
| id   | player_name     | games | time | goals | xG                  | assists | xA                  | shots | key_passes | yellow_cards | red_cards | pos | team            | npg | npxG                | xGChain             | xGBuildup           |
+------+-----------------+-------+------+-------+---------------------+---------+---------------------+-------+-------------+-------------+-----+-----------------+-----+---------------------+---------------------+---------------------+
| 1699 | Shkodran Mustafi | 3     | 43   | 0     | 0.0                 | 0       | 0.0                 | 0     | 0           | 0           | 0   | S   | Arsenal         | 0   | 0.0                 | 0.0647247657179832  | 0.0647247657179832  |
| 1719 | Javier Manquillo | 13    | 823  | 0     | 0.0231618583202362  | 0       | 0.2976967543363571  | 1     | 5           | 1           | 0   | D S | Newcastle United | 0   | 0.0231618583202362  | 1.4320279778912663  | 1.1111693522196157  |
| 1735 | Jack Stephens   | 18    | 1544 | 0     | 0.8943033330142498  | 0       | 0.4556563608348369  | 6     | 6           | 2           | 0   | D M S | Southampton     | 0   | 0.8943033330142498  | 3.081087851896882   | 2.751403072848916   |
| 1739 | Eric Bailly     | 11    | 826  | 0     | 0.0487859137356281  | 0       | 0.0                 | 1     | 0           | 3           | 0   | D S | Manchester United | 0   | 0.0487859137356281  | 1.1188668683171272  | 1.1188668683171272  |
| 1747 | Kevin Long      | 8     | 635  | 0     | 0.6100033670663834  | 0       | 0.0173680447041988  | 2     | 1           | 2           | 0   | D S | Burnley         | 0   | 0.6100033670663834  | 0.502235908061266   | 0.502235908061266   |
+------+-----------------+-------+------+-------+---------------------+---------+---------------------+-------+-------------+-------------+-----+-----------------+-----+---------------------+---------------------+---------------------+
5 rows in set (0.01 sec)
```

Fig 11. Data in one of the partitions

6) **getPartitionLoc** – This function will allow users to get path of their file partitions that is created by the EDFS.

```
128    getPartitionLoc('eplGoal',3)

PROBLEMS   OUTPUT   DEBUG CONSOLE   TERMINAL   JUPYTER

~/Documents/551DB/Final Project > /opt/homebrew/bin/python3 "/Users/shreyanshkhandelwal/Documents/551DB/Final Project/hdfs.py"
root/table_eplGoal_3
~/Documents/551DB/Final Project >
```

Fig 12. Path of the partition is displayed as an output

7) **readPartition** – This function will read a particular partition of the uploaded csv and return the data frame of that partition.

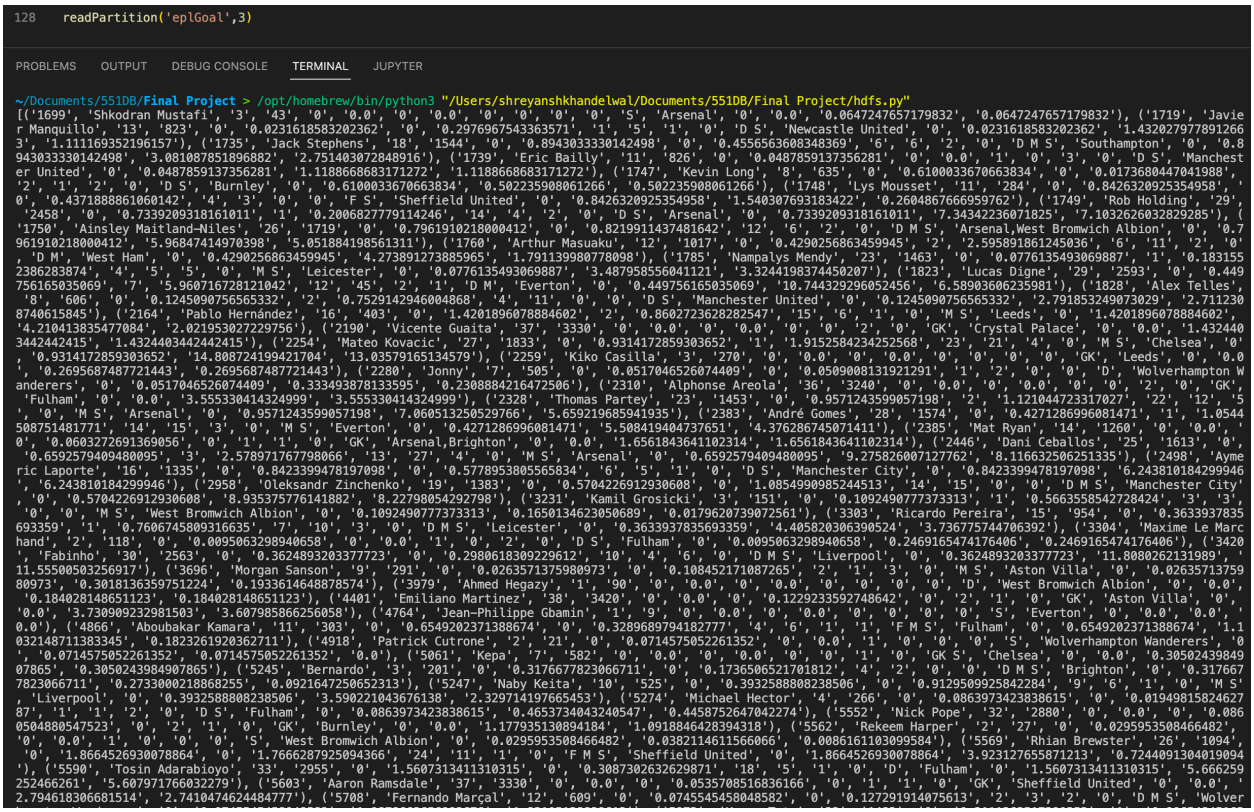


Fig 12. Reading individual partition

B] EDFS implementation with MongoDB:

In MongoDB, the namenode with meta data and the data node is maintained in the form of collections. The namenode collection will include the path, file type and name of the file uploaded or directory created by the user.

1) makedir - the name of the directory to be created will be passed as an input to the function. The namenode collection will be updated with the metadata of the directory that has been created.

Fig 13. Name node after creating files

2) ls - The file contents inside the directory will be listed. No input is required in order to execute this function.

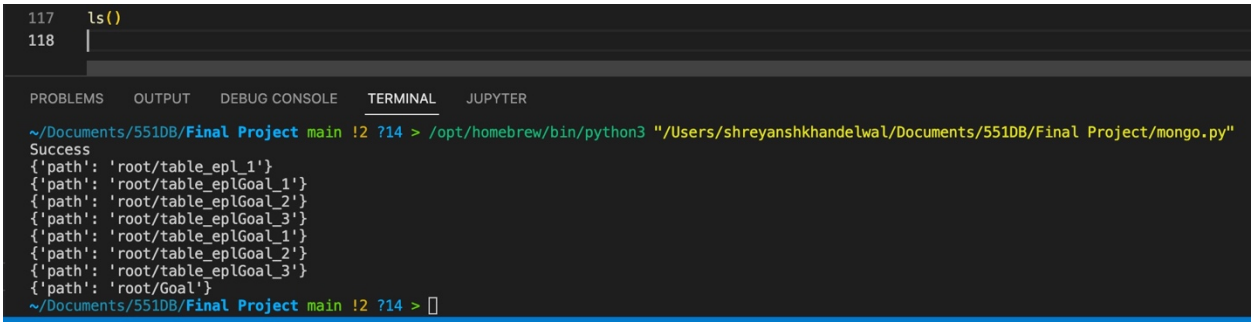


Fig 14. Displaying contents of directory

3) cat - This function will be used to simply display the contents of a file that has been input by the user.

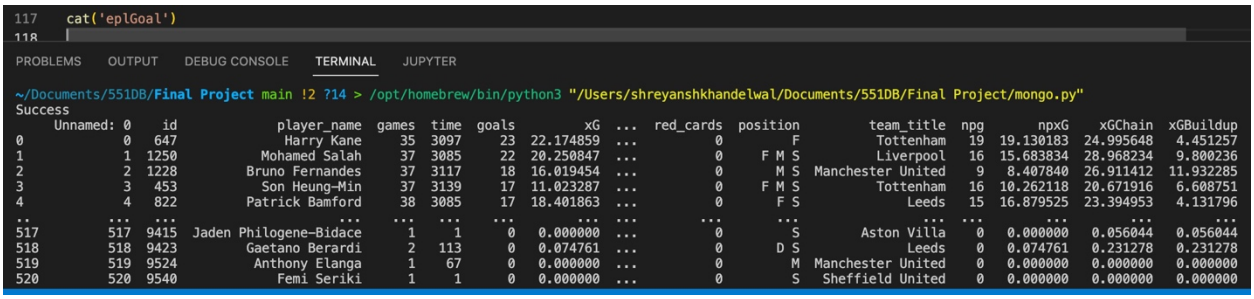


Fig 15. Displaying contents using cat operation

4) remove – The name of the file to be deleted will be passed as an input by the user. the function will simply delete the collection that holds the data associated with the file name and the metadata in the namenode collection will be updated accordingly.

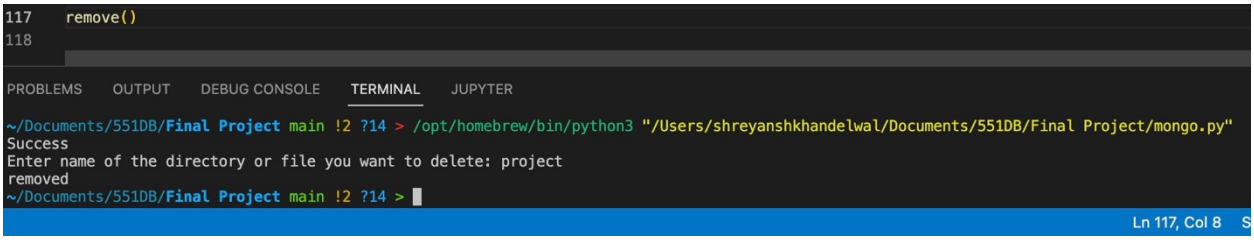


Fig 16. Deleting a folder or directory

5) upload - the name of the file and the number of partitions will be passed as an input by the user. the file will be stored in parts in different collection depending upon the number of partitions input. The metadata will be maintained in the name node collection.

Fig 17. Datanode after upload

6) getPartitionLoc - The location of the file name that has been passed as an input by the user will be returned. The path can be returned by querying the namenode collection.

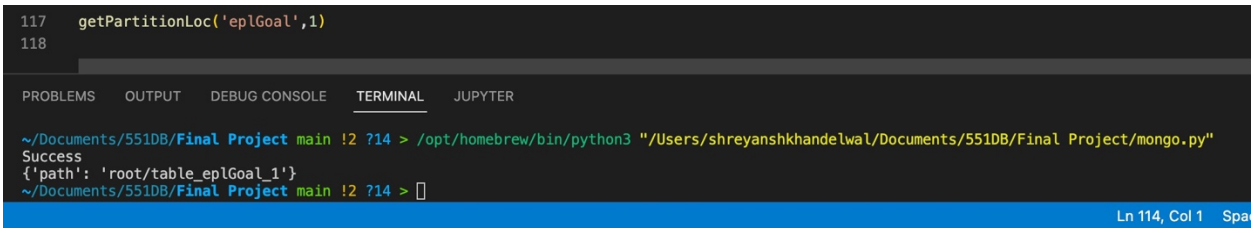


Fig 18. Path of the partition of the file

7) readPartition - The contents of a specific partition of the file name input by the user will be displayed. The file name and the part to be displayed will be input by the user.

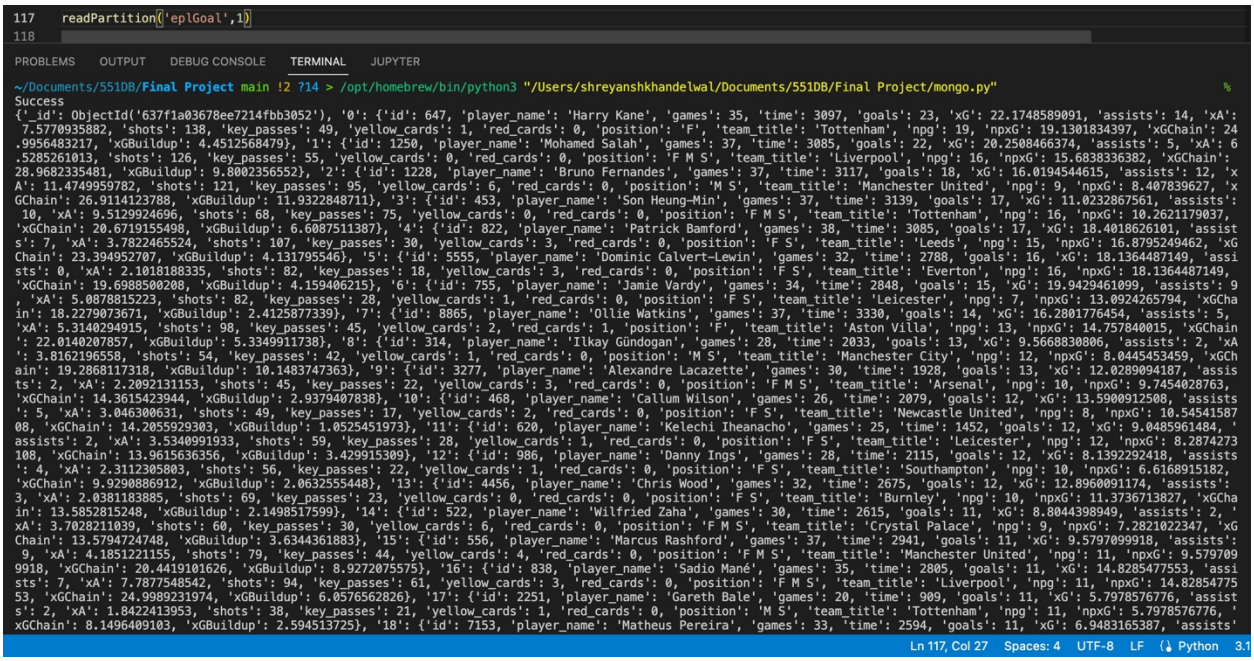


Fig 19. reading content of a particular partition of a file

PMR

Three search analytics functions have been implemented using the concept of map reduce. The search analytics functions will be executed on every individual partition of a file. The results obtained will be combined and the final response to the query will be returned to the user.

- **Function 1:** Search and return a list of names of players who have scored goals greater than user input

```
mysql> select player_name from table_eepls_1 where goals>10;
+----------------------+
| player_name          |
+----------------------+
| Harry Kane           |
| Mohamed Salah        |
| Bruno Fernandes      |
| Son Heung-Min        |
| Patrick Bamford      |
| Dominic Calvert-Lewin |
| Jamie Vardy          |
| Ollie Watkins        |
| Ilkay Gündogan       |
| Alexandre Lacazette  |
| Callum Wilson        |
| Kelechi Iheanacho    |
| Danny Ings           |
| Chris Wood           |
| Wilfried Zaha        |
| Marcus Rashford      |
| Sadio Mané           |
| Gareth Bale          |
| Matheus Pereira      |
+----------------------+
19 rows in set (0.01 sec)
```

```
17  goals('eeplss', 1, 10)

PROBLEMS  OUTPUT  DEBUG CONSOLE  TERMINAL  JUPYTER

~/Documents/551DB/Final Project > /opt/homebrew/bin/python3 "/Users/shreyanshkhandelwal/Documents/551DB/Final Project/pmr.py"
[('Harry Kane',), ('Mohamed Salah',), ('Bruno Fernandes',), ('Son Heung-Min',), ('Patrick Bamford',), ('Dominic Calvert-Lewin',), ('Jamie Vardy',), ('Ollie Watkins',), ('Ilkay Gündogan',), ('Alexandre Lacazette',), ('Callum Wilson',), ('Kelechi Iheanacho',), ('Danny Ings',), ('Chris Wood',), ('Wilfried Zaha',), ('Marcus Rashford',), ('Sadio Mané',), ('Gareth Bale',), ('Matheus Pereira',)]
~/Documents/551DB/Final Project >
```

Fig 20. Output of first search and analytics function

- **Function 2:** Search and return a list of names of players who have collected xG between the range provided by the user

```
mysql> select player_name, goals from table_eeplss_1 where xG>10 and xG<15;
+---------------------------+-------+
| player_name               | goals |
+---------------------------+-------+
| Son Heung-Min             | 17    |
| Alexandre Lacazette       | 13    |
| Callum Wilson             | 12    |
| Chris Wood                | 12    |
| Sadio Mané                | 11    |
| Pierre-Emerick Aubameyang | 10    |
| Michail Antonio           | 10    |
| Raheem Sterling           | 10    |
| Roberto Firmino           | 9     |
| Che Adams                 | 9     |
| Neal Maupay               | 8     |
| Richarlison               | 7     |
| Timo Werner               | 6     |
+---------------------------+-------+
13 rows in set (0.00 sec)

mysql>
```

```
24  xG('eeplss', 1, 10, 15)

PROBLEMS  OUTPUT  DEBUG CONSOLE  TERMINAL  JUPYTER

~/Documents/551DB/Final Project > /opt/homebrew/bin/python3 "/Users/shreyanshkhandelwal/Documents/551DB/Final Project/pmr.py"
[('Son Heung-Min',), ('Alexandre Lacazette',), ('Callum Wilson',), ('Chris Wood',), ('Sadio Mané',), ('Pierre-Emerick Aubameyang',), ('Michail Antonio',), ('Raheem Sterling',), ('Roberto Firmino',), ('Che Adams',), ('Neal Maupay',), ('Richarlison',), ('Timo Werner',)]
~/Documents/551DB/Final Project >
```

Fig 21. Output of second search and analytics function

- **Function 3:** Return a list of players who have scored the number of goals given by the user.

```
mysql> select player_name goals from table_eeplss_1 where goals=13;
+----------------------+
| goals                |
+----------------------+
| Ilkay Gündogan       |
| Alexandre Lacazette  |
+----------------------+
2 rows in set (0.00 sec)

mysql>
```

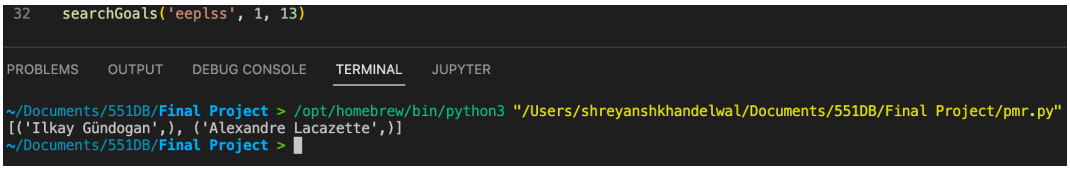


Fig 22. Output of third search and analytics function

Web Interface for user:

A user-friendly interface has been implemented. The left page has a menu which offers the user to select from the seven different it's HDFS functionalities. Based on the function selected from the menu, the user will be directed to a web page. The user will be prompted to pass the required input parameters. Technologies used are HTML CSS JavaScript and Python flask. Flask server act as a bridge between the front end and the back end. The Python script will be executed in the back end based on the user input.

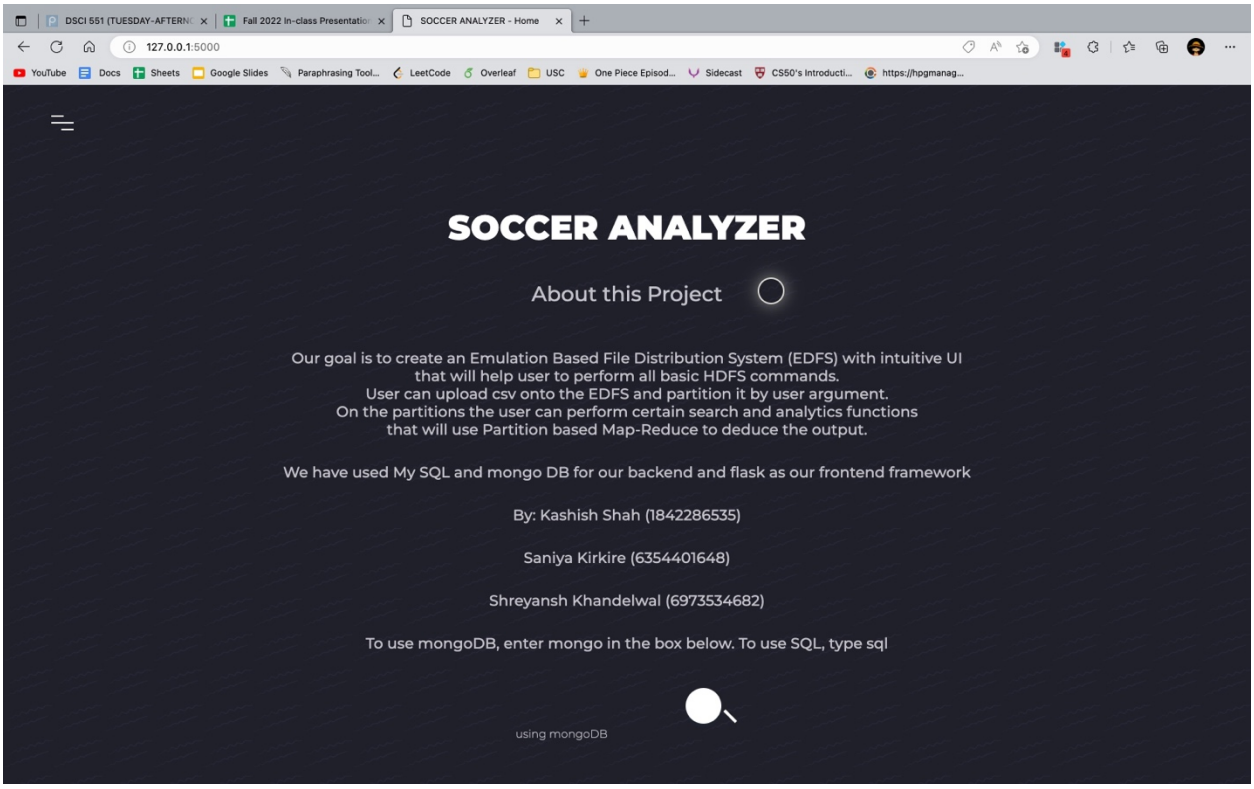


Fig 23. Website Homepage

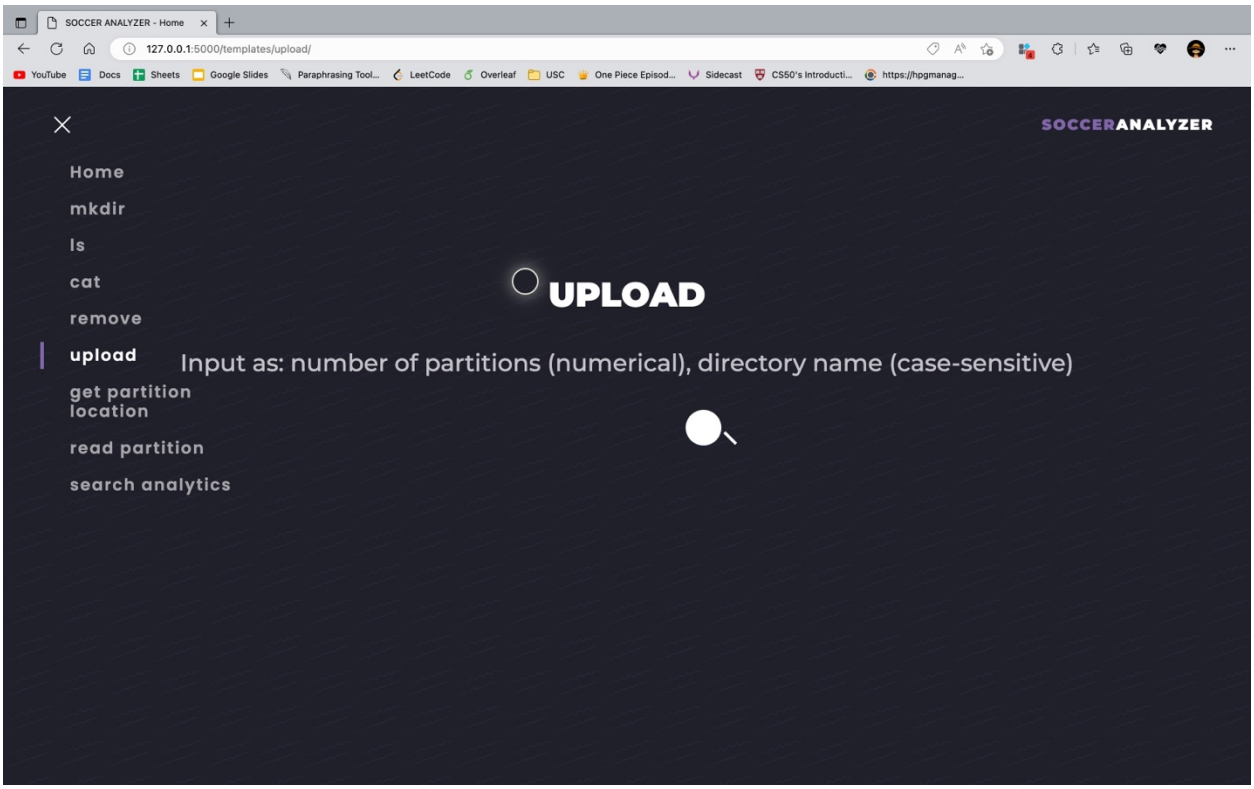


Fig 24. Upload function

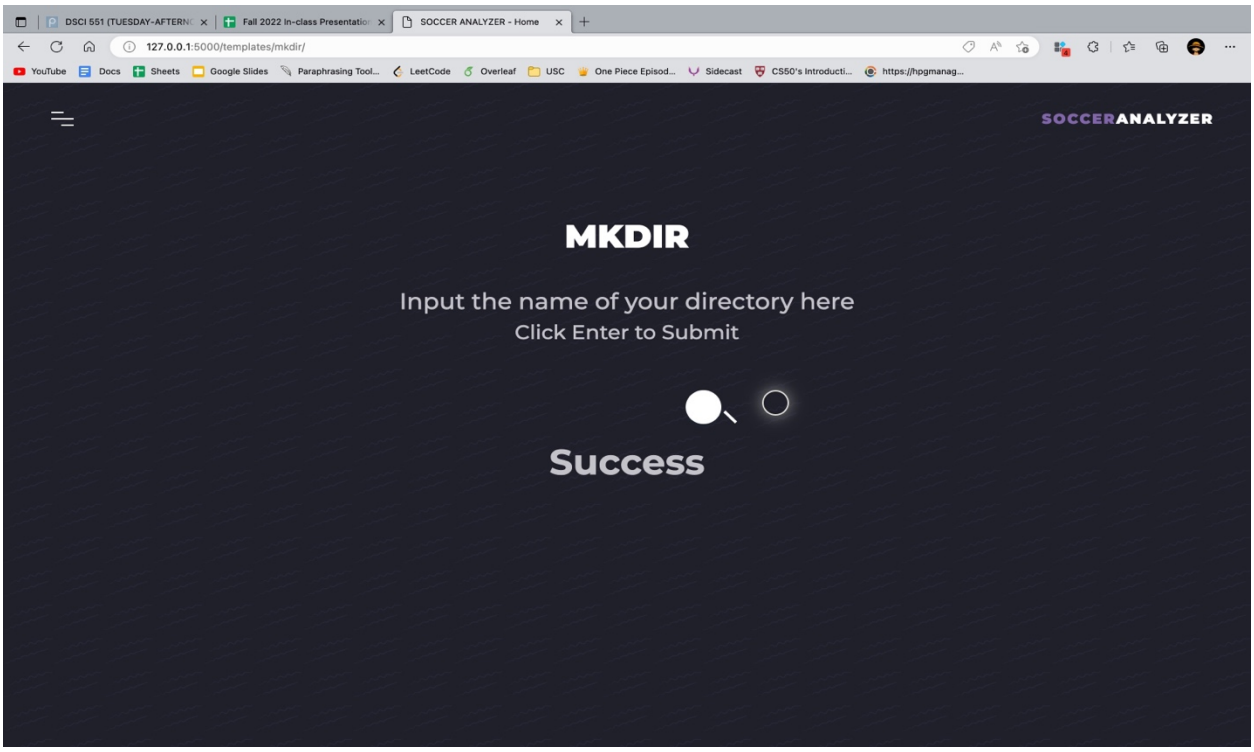


Fig 25. Make directory command

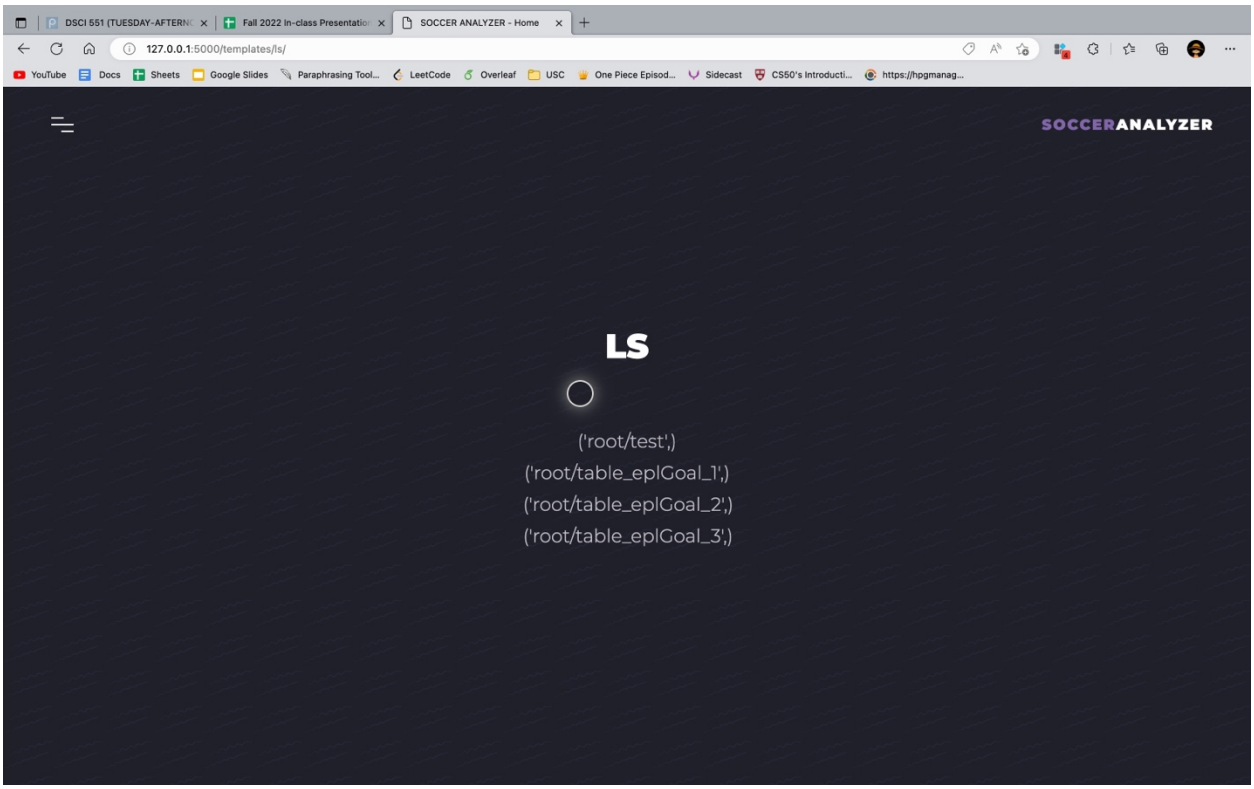
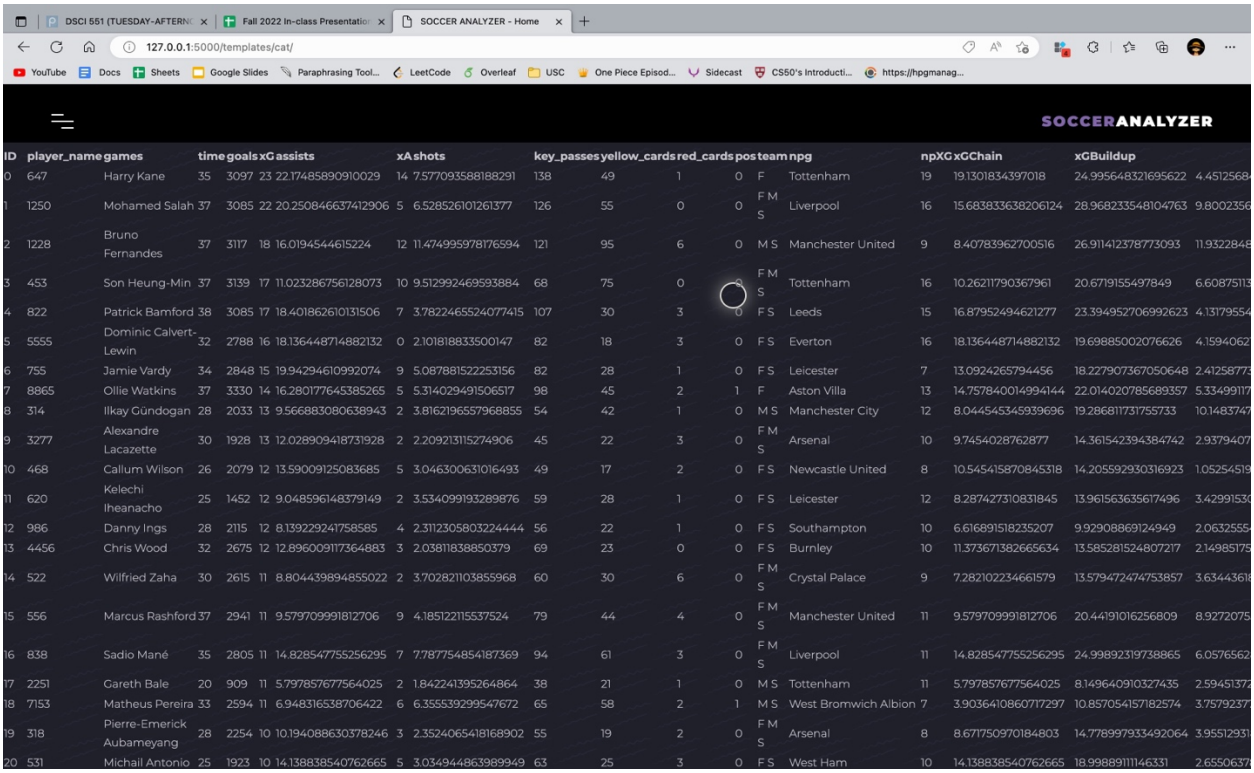


Fig 26. Ls command



ID	player_name	games	time	goals	xG	assists	xA	shots	key_passes	yellow_cards	red_cards	pos	team	npg	npXG	xGChain	xGBuildup
0	647	Harry Kane	35	3097	23	22.174858909010029	14	7.577093588188291	138	49	1	0	F	Tottenham	19	19.13018343970 18	24.995648321695622	4.4512568
1	1250	Mohamed Salah	37	3085	22	20.250846637412906	5	6.528526101261377	126	55	0	0	F M S	Liverpool	16	15.683833638206124	28.968233548104763	9.8002356
2	1228	Bruno Fernandes	37	3117	18	16.0194544615224	12	11.474995978176594	121	95	6	0	M S	Manchester United	9	8.40783962700516	26.911412378773093	11.9322848
3	453	Son Heung-Min	37	3139	17	11.023286756128073	10	9.512992469593884	68	75	0	0	F M S	Tottenham	16	10.26211790367961	20.6719155497849	6.6087511
4	822	Patrick Bamford	38	3085	17	18.401862610131506	7	3.7822465524077415	107	30	3	0	F S	Leeds	15	16.87952494621277	23.3949527069926 23	4.1317955
5	5555	Dominic Calvert-Lewin	32	2788	16	18.136448714882132	0	2.101818833500147	82	18	3	0	F S	Everton	16	18.136448714882132	19.69885002076626	4.1594062
6	755	Jamie Vardy	34	2848	15	19.94294610992074	9	5.087881522253156	82	28	1	0	F S	Leicester	7	13.0924265794456	18.227907367050648	2.4125877
7	8865	Ollie Watkins	37	3330	14	16.2801776453852 65	5	5.314029491506517	98	45	2	1	F	Aston Villa	13	14.757840014994144	22.014020785689357	5.3349911
8	314	Ilkay Gündogan	28	2033	13	9.566883080638943	2	3.8162196557968855	54	42	1	0	M S	Manchester City	12	8.044545345939696	19.286811731755733	10.148374
9	3277	Alexandre Lacazette	30	1928	13	12.028909418731928	2	2.209213115274906	45	22	3	0	F M S	Arsenal	10	9.7454028762877	14.361542394384742	2.9379407
10	468	Callum Wilson	26	2079	12	13.59009125083685	5	3.046300631016493	49	17	2	0	F S	Newcastle United	8	10.545415870845318	14.205592930316923	1.0525451
11	620	Kelechi Iheanacho	25	1452	12	9.048596148379149	2	3.534099193289876	59	28	1	0	F S	Leicester	12	8.287427310831845	13.961563635617496	3.4299153
12	986	Danny Ings	28	2115	12	8.139229241758585	4	2.3112305803224444	56	22	1	0	F S	Southampton	10	6.616891518235207	9.92908869124949	2.0632555
13	4456	Chris Wood	32	2675	12	12.896009117364883	3	2.03811838850379	69	23	0	0	F S	Burnley	10	11.373671382665634	13.585281524807217	2.1498517
14	522	Wilfried Zaha	30	2615	11	8.804439894855022	2	3.702821103855968	60	30	6	0	F M S	Crystal Palace	9	7.282102234661579	13.5794724747538 57	3.6344361
15	556	Marcus Rashford	37	2941	11	9.5797099918127 06	9	4.185122115537524	79	44	4	0	F M S	Manchester United	11	9.5797099918127 06	20.44191016256809	8.9272075
16	838	Sadio Mané	35	2805	11	14.828547755256295	7	7.787754854187369	94	61	3	0	F M S	Liverpool	11	14.828547755256295	24.998923197388 65	6.0576562
17	2251	Gareth Bale	20	909	11	5.7978576775640 25	2	1.842241395264864	38	21	1	0	M S	Tottenham	11	5.7978576775640 25	8.1496409103274 35	2.5945137
18	7153	Matheus Pereira	33	2594	11	6.948316538706422	6	6.355539299547672	65	58	2	1	M S	West Bromwich Albion	7	3.9036410860717297	10.857054157182574	3.7579237
19	318	Pierre-Emerick Aubameyang	28	2254	10	10.194088630378246	3	2.3524065418168902	55	19	2	0	F M S	Arsenal	8	8.671750970184803	14.778997933492064	3.9551293
20	531	Michail Antonio	25	1923	10	14.138838540762665	5	3.034944863989949	63	25	3	0	F S	West Ham	10	14.138838540762665	18.998891111463 31	2.6550637

Fig 27. Cat command output

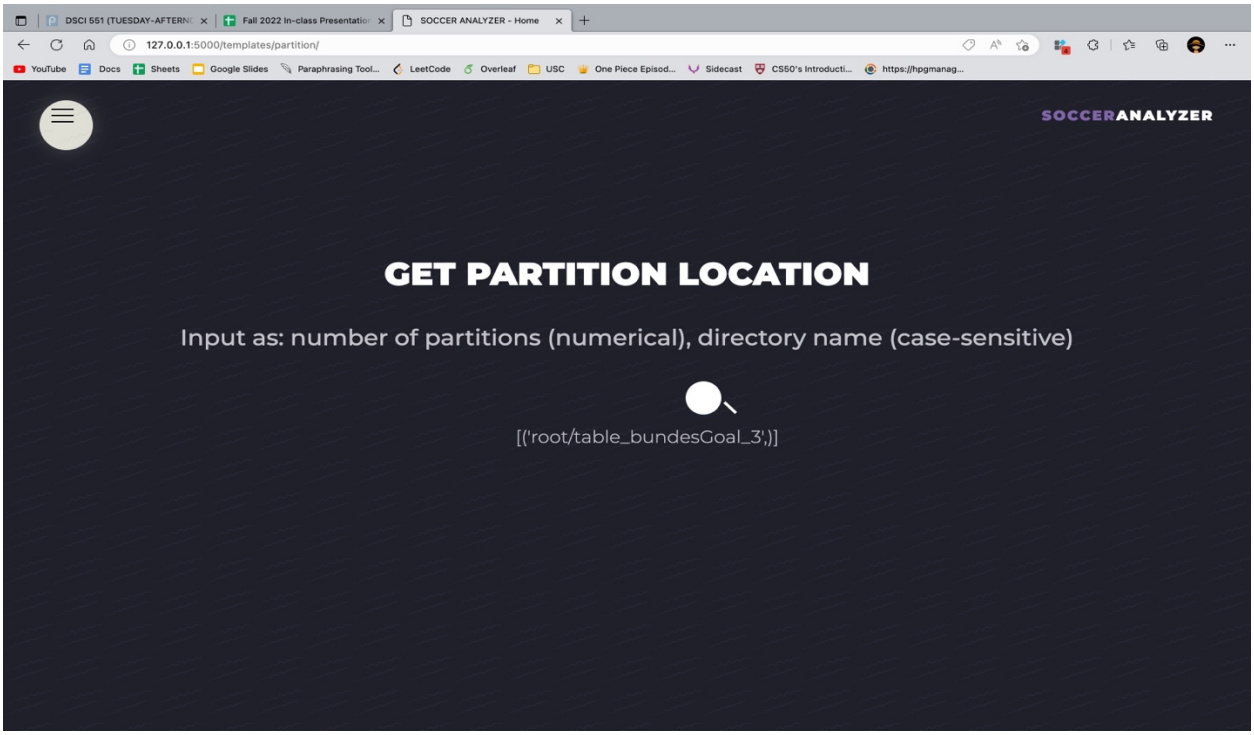
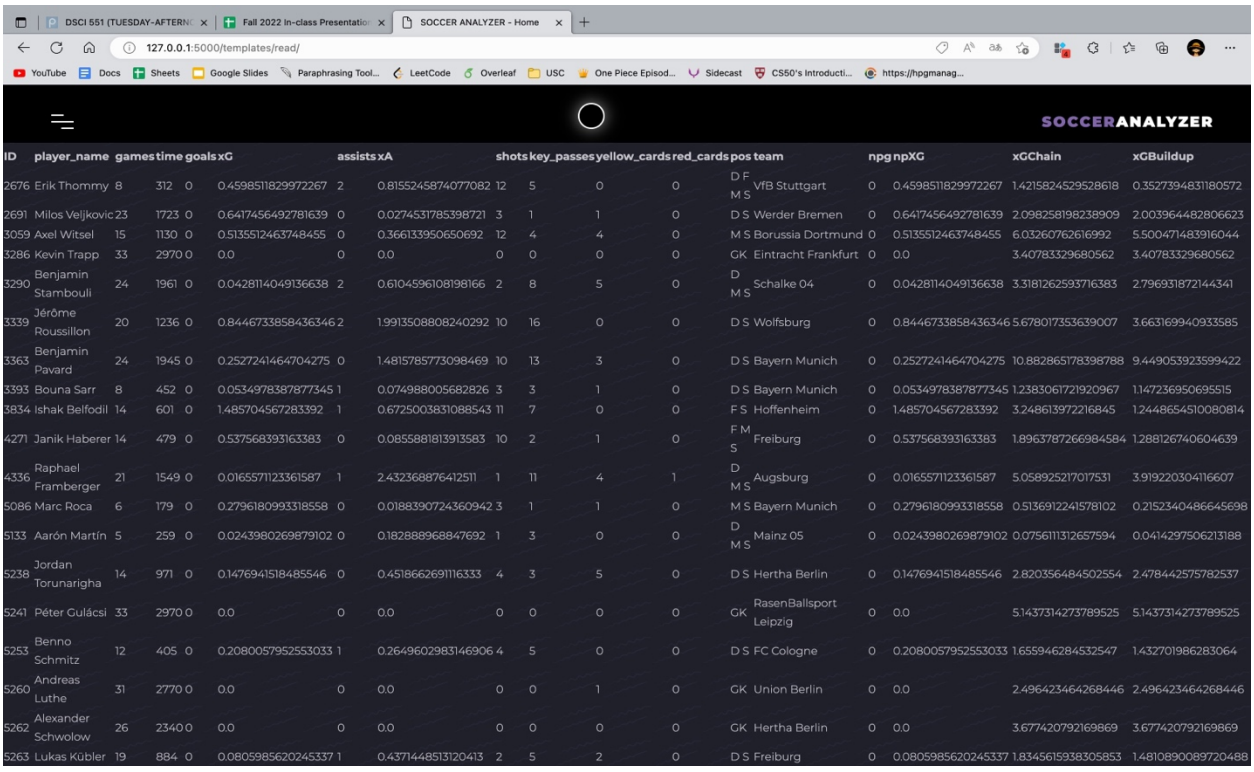


Fig 28. Get partition location function output



ID	player_name	games	time	goals	xG	assists	xA	shots	key_passes	yellow_cards	red_cards	pos	team	npg	npxG	xGChain	xGBuildup
2676	Erik Thommy	8	312	0	0.4598511829972267	2	0.8155245874077082	12	5	0	0	D F M S	VfB Stuttgart	0	0.4598511829972267	1.4215824529528618	0.3527394831180572
2691	Milos Veljkovic	23	1723	0	0.6417456492781639	0	0.0274531785398721	3	1	1	0	D S	Werder Bremen	0	0.6417456492781639	2.098258198238909	2.0039644828064623
3059	Axel Witsel	15	1130	0	0.5135512463748455	0	0.366133950650692	12	4	4	0	M S	Borussia Dortmund	0	0.5135512463748455	6.032607626216992	5.5004714831916044
3286	Kevin Trapp	33	2970	0	0.0	0	0.0	0	0	0	0	GK	Eintracht Frankfurt	0	0.0	3.407833296805562	3.407833296805562
3290	Benjamin Stambouli	24	1961	0	0.0428114049136638	2	0.6104596108198166	2	8	5	0	D M S	Schalke 04	0	0.0428114049136638	3.3181262593716383	2.796931872144341
3339	Jérôme Roussillon	20	1236	0	0.8446733858436346	2	1.9913508808240292	10	16	0	0	D S	Wolfsburg	0	0.8446733858436346	5.678017353639007	3.663169940933585
3363	Benjamin Pavard	24	1945	0	0.2527241464704275	0	1.4815785773098469	10	13	3	0	D S	Bayern Munich	0	0.2527241464704275	10.882865178398788	9.449053923599422
3393	Bouna Sarr	8	452	0	0.0534978387877345	1	0.074988005682826	3	3	1	0	D S	Bayern Munich	0	0.0534978387877345	1.2383061721920967	1.147236950695515
3834	Ishak Belfodil	14	601	0	1.485704567283392	1	0.6725003831088543	11	7	0	0	F S	Hoffenheim	0	1.485704567283392	3.248613972216845	1.2448654510080814
4271	Janik Haberer	14	479	0	0.537568393163383	0	0.0855881813913583	10	2	1	0	F M S	Freiburg	0	0.537568393163383	1.8963787266984584	1.288126740604639
4336	Raphael Framberger	21	1549	0	0.0165571123361587	1	2.432368876412511	1	11	4	1	D M S	Augsburg	0	0.0165571123361587	5.058925217017531	3.919220304116607
5086	Marc Roca	6	179	0	0.2796180993318558	0	0.0188390724360942	3	1	1	0	M S	Bayern Munich	0	0.2796180993318558	0.5136912241578102	0.2152340486645698
5133	Aarón Martín	5	259	0	0.0243980269879102	0	0.182888968847692	1	3	0	0	D M S	Mainz 05	0	0.0243980269879102	0.0756111312657594	0.0414297506213188
5238	Jordan Torunarigha	14	971	0	0.1476941518485546	0	0.4518662691116333	4	3	5	0	D S	Hertha Berlin	0	0.1476941518485546	2.820356484502554	2.478442575782537
5241	Péter Gulácsi	33	2970	0	0.0	0	0.0	0	0	0	0	GK	RasenBallsport Leipzig	0	0.0	5.1437314273789525	5.1437314273789525
5253	Benno Schmitz	12	405	0	0.2080057952553033	1	0.2649602983146906	4	5	0	0	D S	FC Cologne	0	0.2080057952553033	1.655946284532547	1.432701986283064
5260	Andreas Luthe	31	2770	0	0.0	0	0.0	0	0	1	0	GK	Union Berlin	0	0.0	2.496423464268446	2.496423464268446
5262	Alexander Schwolow	26	2340	0	0.0	0	0.0	0	0	0	0	GK	Hertha Berlin	0	0.0	3.677420792169869	3.677420792169869
5263	Lukas Kübler	19	884	0	0.0805985620245337	1	0.4371448513120413	2	5	2	0	D S	Freiburg	0	0.0805985620245337	1.8345615938305853	1.4810890089720488

Fig 29. Read partition output

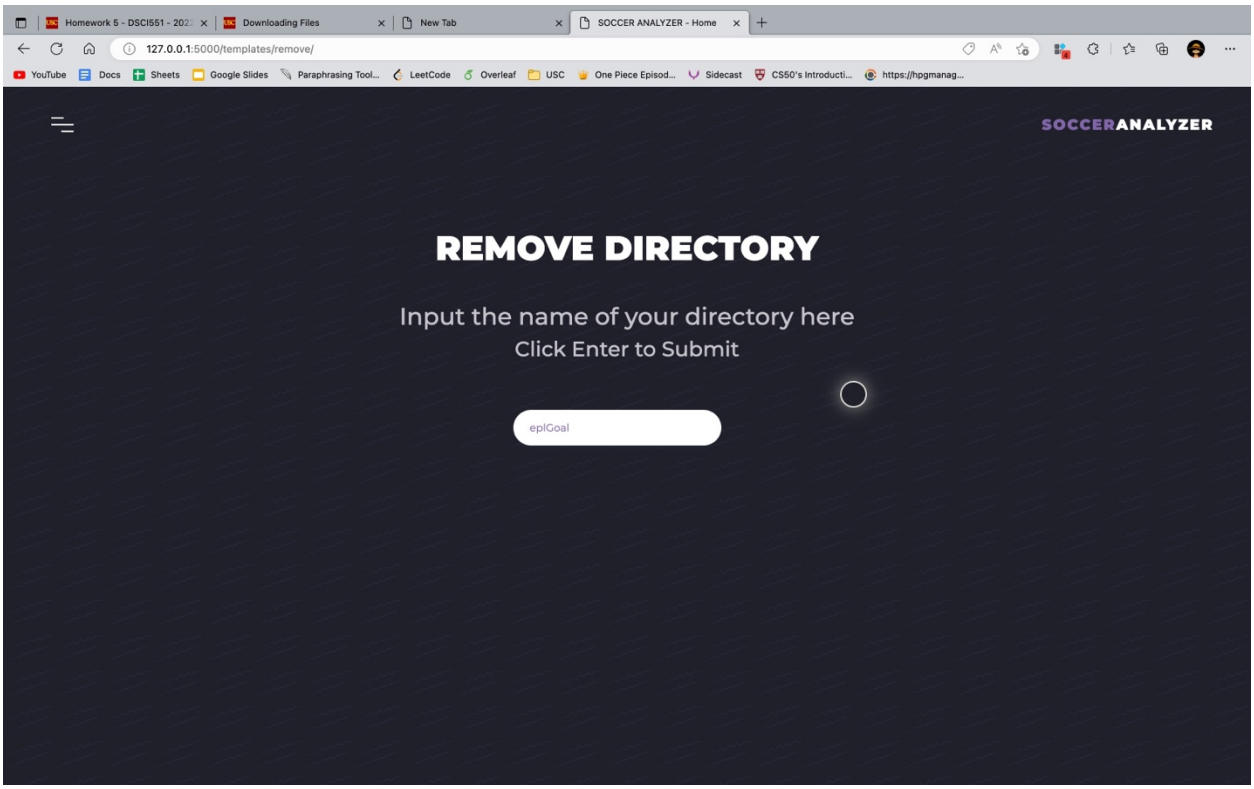


Fig 30. Remove directory

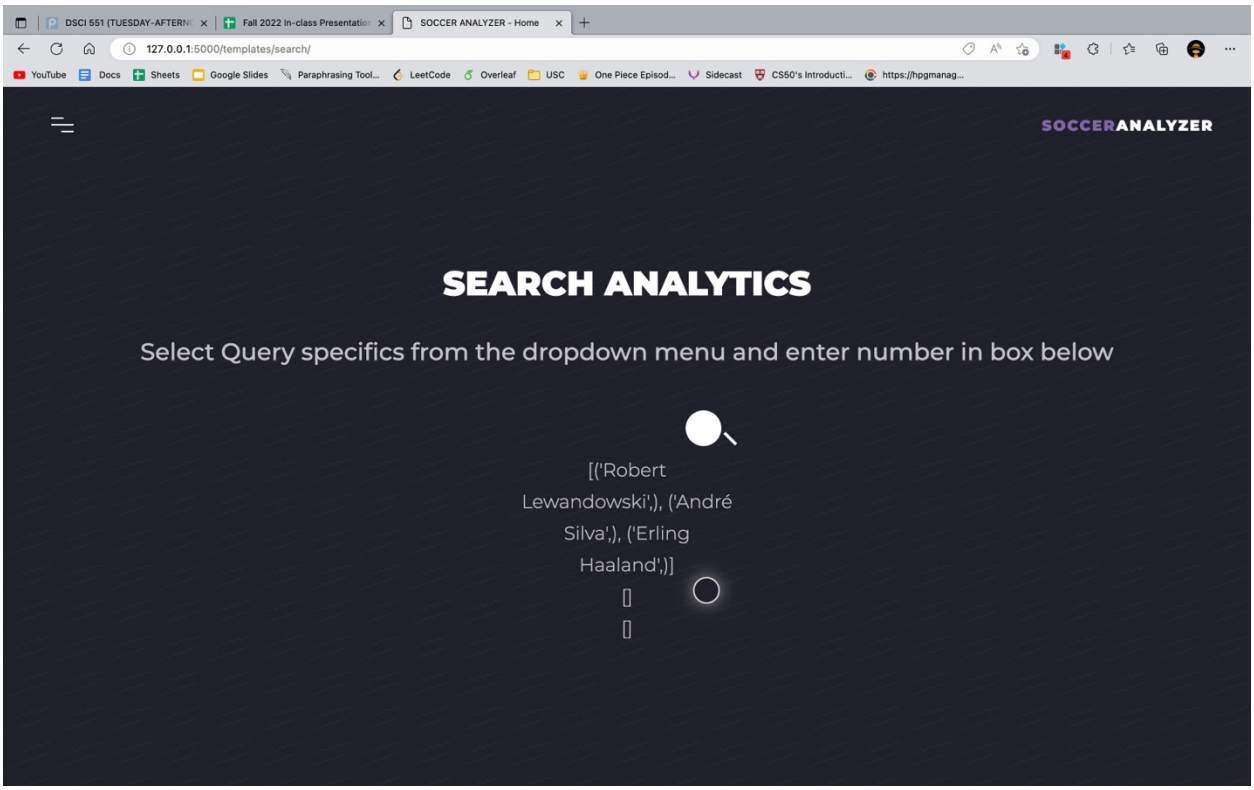


Fig 31. Search analytics

MongoDB and SQL Comparison:

- MongoDB works well with unstructured data while SQL can only handle structured data.
- MongoDB is more flexible and scalable as compared to SQL
- MongoDB is faster and works well when the amount of data is large compared to SQL
- SQL is developer friendly. MongodB cannot support traditional SQL queries the way SQL does.
- SQL is more suitable when the data is structure and when there is a need for traditional relational database.

In this case and then the data stored in name node is structured. As the data sets are CSV files, the data to be stored in the data node is also organized. The size of the dataset is not very large. Hence SQL offers a more convenient way of implementing emulated HDFS. The resources are well documented which makes the implementation easier.

Development experience:

Developing this project provided a deeper insight into the working of HDFS file system. It gave a better understanding of the role played by the name node and data node in the file system. We could also explore command execution and querying using MongodB and SQL databases through python scripts. The User interface was made as interpretable as possible while all the complex query execution happened in the back end. MongodB and SQL have plenty of resources and documentation online which made the implementation easier.

Link of the Code and Demo:

https://drive.google.com/drive/folders/1NRfcEKBHVSEvRTEbzmx9j95LeUsE7Tor?usp=share_link

Soccer Analytics(EDFS) - YouTube