Big Data Project

International Population & Health Metrics Analysis Using Hive & Spark

Team Members :

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Content :

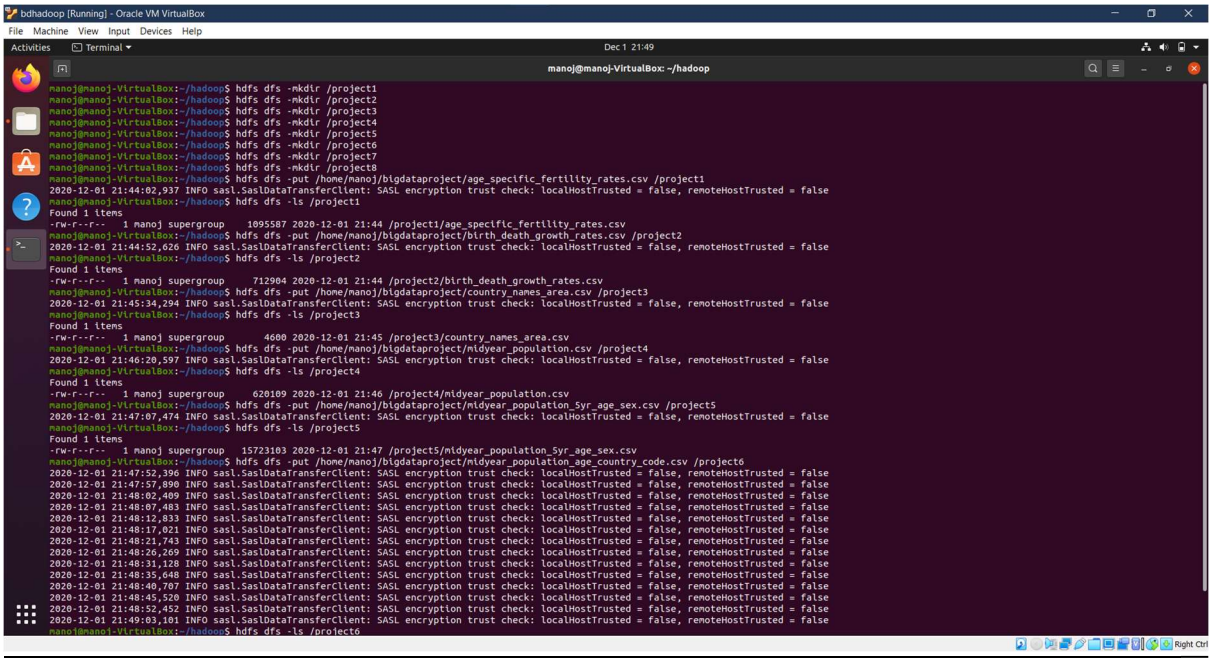
The International Dataset provides estimates of country populations since 1950 and projections through 2050 .Specifically , the data set includes midyear population figures broken down by age and gender assignment at birth.

The csv files are :

- Age_specific_fertility_rates.csv
- Birth_death_growth_rates.csv
- Country_names_area.csv

- Midyear_population
- Midyear_population_5yr_age_sex.csv
- Midyear_population_age_country_code.csv
- Midyear_population_age_sex.csv
- Mortality_life_expectancy.csv

First Step in our Project is, we upload or Dataset into HDFS :

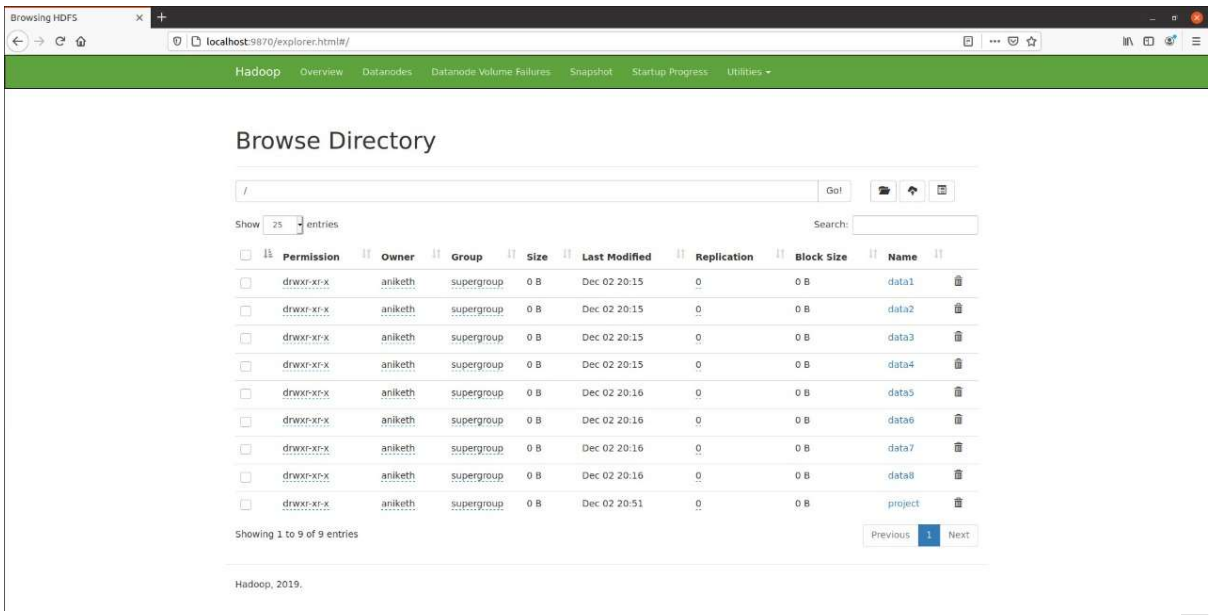


Code :

- hdfs dfs -mkdir /project1
- hdfs dfs -mkdir /project2
- hdfs dfs -mkdir /project3
- hdfs dfs -mkdir /project4
- hdfs dfs -mkdir /project5
- hdfs dfs -mkdir /project6
- hdfs dfs -mkdir /project7
- hdfs dfs -mkdir /project8
- hdfs dfs -put /home/manoj/bigdataproject/age_specific_fertility_rates.csv /project1

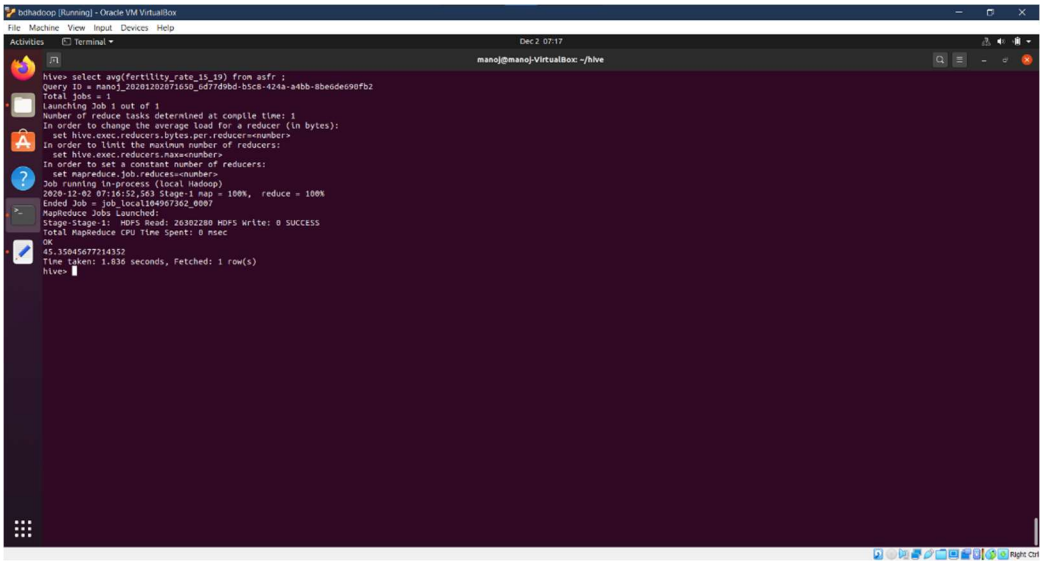
- hdfs dfs -put /home/manoj/bigdataproject/birth_death_growth_rate.csv /project2
- hdfs dfs -put /home/manoj/bigdataproject/country_name_area.csv /project3
- hdfs dfs -put /home/manoj/bigdataproject/midyear_population.csv /project4
- hdfs dfs -put /home/manoj/bigdataproject/midyear_population_5yr_age_sex.csv /project5
- hdfs dfs -put /home/manoj/bigdataproject/midyear_population_age_country_code.csv /project6
- hdfs dfs -put /home/manoj/bigdataproject/midyear_population_age_sex.csv /project7
- hdfs dfs -put /home/manoj/bigdataproject/mortality_life_expectancy.csv /project8

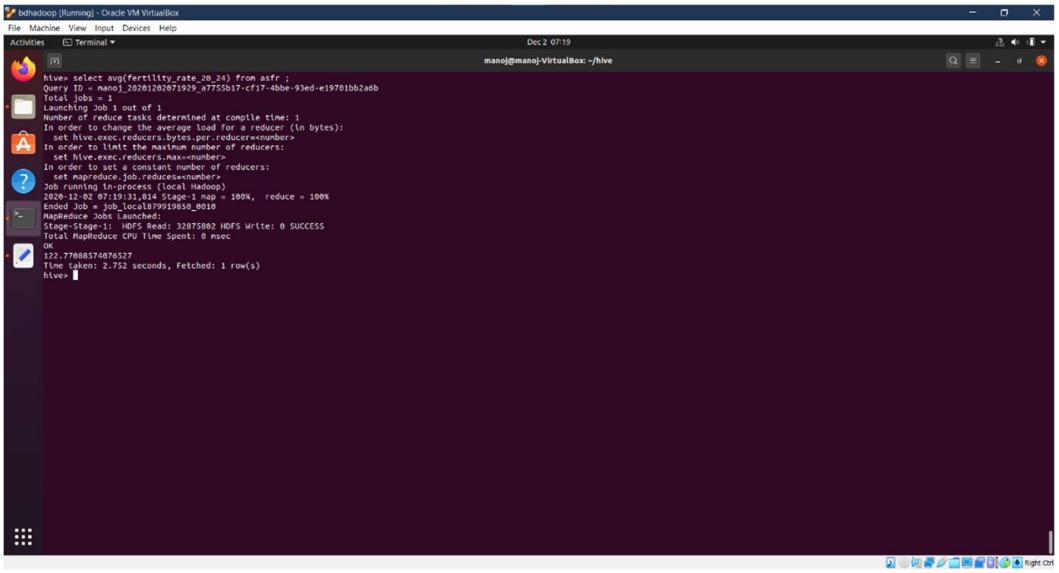
Screenshot of the csv files being uploaded into the HDFS system:

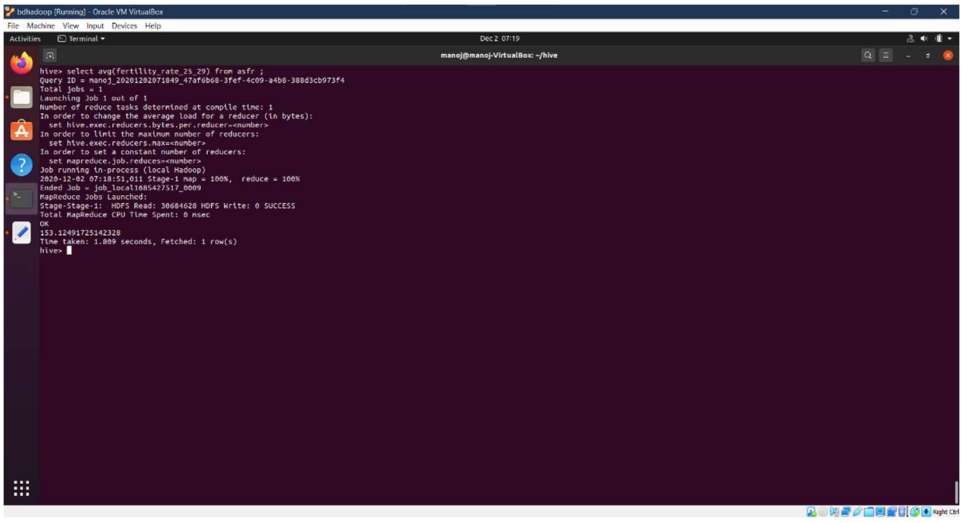


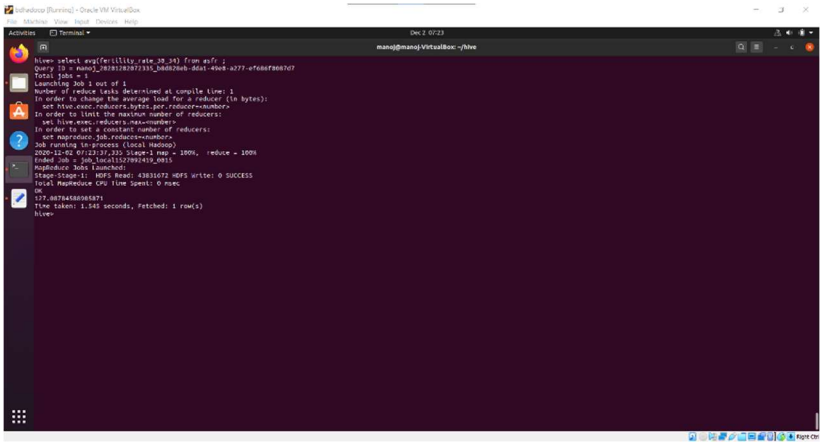
Analysis:

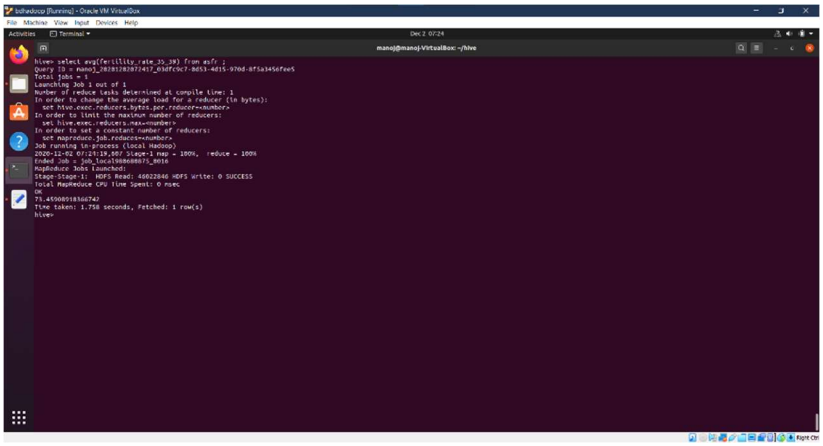
1] DATASET : age_specific_fertility_rates.csv :

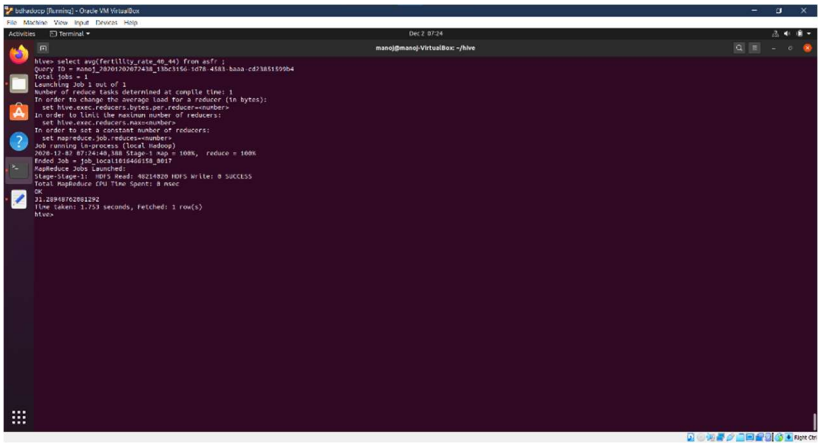


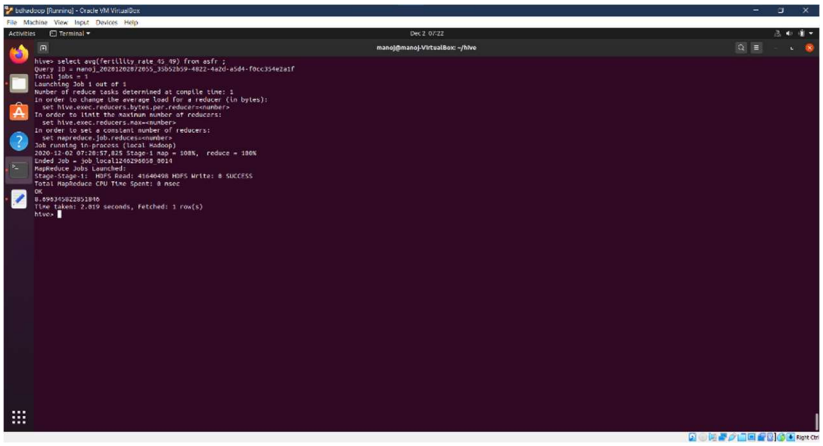





bdhadoop [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities
Terminal
Dec 2 07:23
manoj@manoj-VirtualBox: ~/hive
hive> select avg(fertility_rate_30_34) from asfr ;
Query ID = manoj_20201202072335_bdd820eb-ddd1-49e8-a277-ef686f8087d7
Total jobs = 1
Launching Job 1 out of 1
Number of reduce tasks determined at compile time: 1
In order to change the average load for a reducer (in bytes):
set hive.exec.reducers.bytes.per.reducer=<number>
In order to limit the maximum number of reducers:
set hive.exec.reducers.max=<number>
In order to set a constant number of reducers:
set mapreduce.job.reduces=<number>
Job running in-process (local Hadoop)
2020-12-02 07:23:37,335 Stage-1 map = 100%, reduce = 100%
Ended Job = job_local1527992459_0015
MapReduce Jobs Launched:
Stage-Stage-1: HDFS Read: 43831672 HDFS Write: 0 SUCCESS
Total MapReduce CPU Time Spent: 0 msec
OK
127.88784588985871
Time taken: 1.545 seconds, Fetched: 1 row(s)
hive>


bdhadoop [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities
Terminal
Dec 2 07:24
manoj@manoj-VirtualBox: ~/hive
hive> select avg(fertility_rate_35_39) from asfr ;
Query ID = manoj_20201202072417_03dfc9c7-8d53-4d15-970d-8f5a3456fee5
Total jobs = 1
Launching Job 1 out of 1
Number of reduce tasks determined at compile time: 1
In order to change the average load for a reducer (in bytes):
set hive.exec.reducers.bytes.per.reducer=<number>
In order to limit the maximum number of reducers:
set hive.exec.reducers.max=<number>
In order to set a constant number of reducers:
set mapreduce.job.reduces=<number>
Job running in-process (local Hadoop)
2020-12-02 07:24:19,807 Stage-1 map = 100%, reduce = 100%
Ended Job = job_local1980680871_0016
MapReduce Jobs Launched:
Stage-Stage-1: HDFS Read: 46022846 HDFS Write: 0 SUCCESS
Total MapReduce CPU Time Spent: 0 msec
OK
79.45908918366742
Time taken: 1.758 seconds, Fetched: 1 row(s)
hive>


bdhadoop [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities
Terminal
Dec 2 07:24
manoj@manoj-VirtualBox: ~/hive
hive> select avg(fertility_rate_40_44) from asfr ;
Query ID = manoj_20201202072438_11bc1166-1d78-4681-baaa-cd2385159964
Total jobs = 1
Launching Job 1 out of 1
Number of reduce tasks determined at compile time: 1
In order to change the average load for a reducer (in bytes):
set hive.exec.reducers.bytes.per.reducer=<number>
In order to limit the maximum number of reducers:
set hive.exec.reducers.max=<number>
In order to set a constant number of reducers:
set mapreduce.job.reduces=<number>
Job running in-process (local Hadoop)
2020-12-02 07:24:40,388 Stage-1 map = 100%, reduce = 100%
Ended Job = job_local1851660158_0017
MapReduce Jobs Launched:
Stage-Stage-1: HDFS Read: 48214920 HDFS Write: 0 SUCCESS
Total MapReduce CPU Time Spent: 0 msec
OK
21.28948702881292
Time taken: 1.753 seconds, Fetched: 1 row(s)
hive>


bdhadoop [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities
Terminal
Dec 2 07:22
manoj@manoj-VirtualBox: ~/hive
hive> select avg(fertility_rate_45_49) from asfr ;
Query ID = manoj_20201202072055_31b52b59-4822-4a2d-a5d4-f0cc354e2a1f
Total jobs = 1
Launching Job 1 out of 1
Number of reduce tasks determined at compile time: 1
In order to change the average load for a reducer (in bytes):
set hive.exec.reducers.bytes.per.reducer=<number>
In order to limit the maximum number of reducers:
set hive.exec.reducers.max=<number>
In order to set a constant number of reducers:
set mapreduce.job.reduces=<number>
Job running in-process (local Hadoop)
2020-12-02 07:20:57,825 Stage-1 map = 100%, reduce = 100%
Ended Job = job_local1250290058_0013
MapReduce Jobs Launched:
Stage-Stage-1: HDFS Read: 41640498 HDFS Write: 0 SUCCESS
Total MapReduce CPU Time Spent: 0 msec
OK
0.8983598228951046
Time taken: 2.819 seconds, Fetched: 1 row(s)
hive>

Code :

- select avg(fertility_rate_15_19) from asfr ;
- select avg(fertility_rate_20_24) from asfr ;
- select avg(fertility_rate_25_29) from asfr ;
- select avg(fertility_rate_30_34) from asfr ;
- select avg(fertility_rate_35_39) from asfr ;
- select avg(fertility_rate_40_44) from asfr ;
- select avg(fertility_rate_45_49) from asfr ;

The results come out to be :

fertility_rate_15_19 = 45.35

fertility_rate_20_24 = 122.77

fertility_rate_25_29 = 153.12

fertility_rate_30_34 = 127.087

fertility_rate_35_39 = 73.45

fertility_rate_40_44 = 31.28

fertility_rate_45_49 = 8.69

Conclusion : From the above results we can conclude that the women between **the age group 25-29** have the **highest fertility rate.**

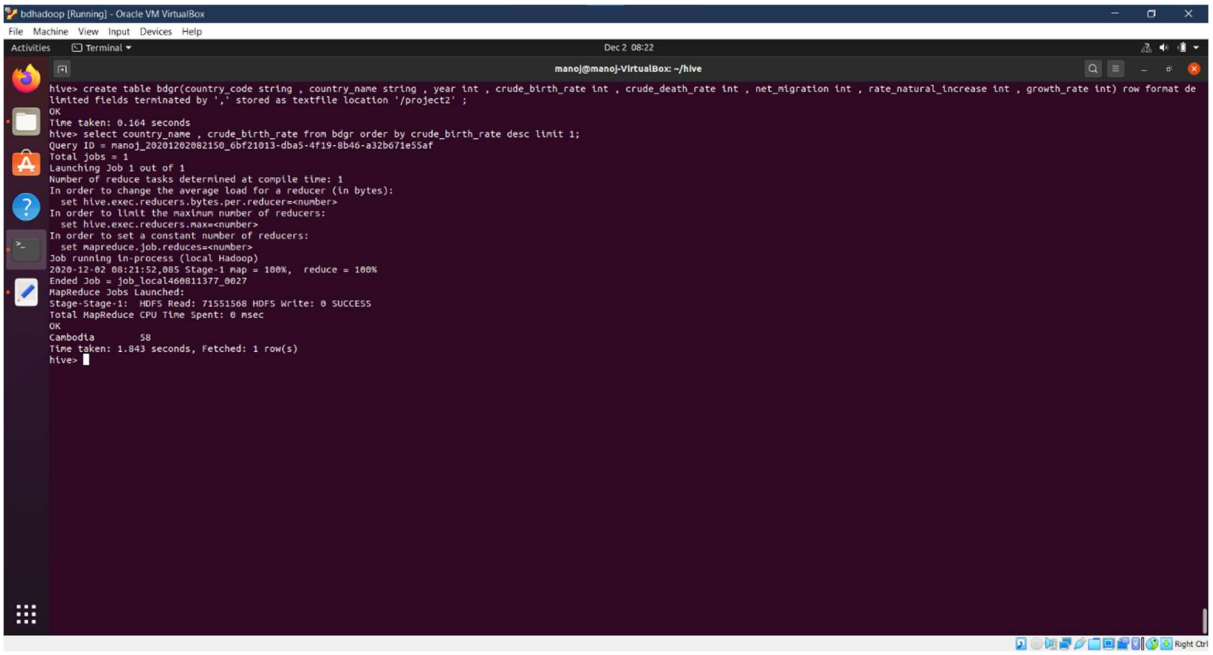
-x-

2] DATASET : birth_death_growth_rates.csv :

Crude Birth Rate : Is the number of births per 1000 divided by the length of the period in years.

Crude Death Rate : Is the number of deaths per 1000 divided by the length of the period in years.

Screenshot of execution :



Code :

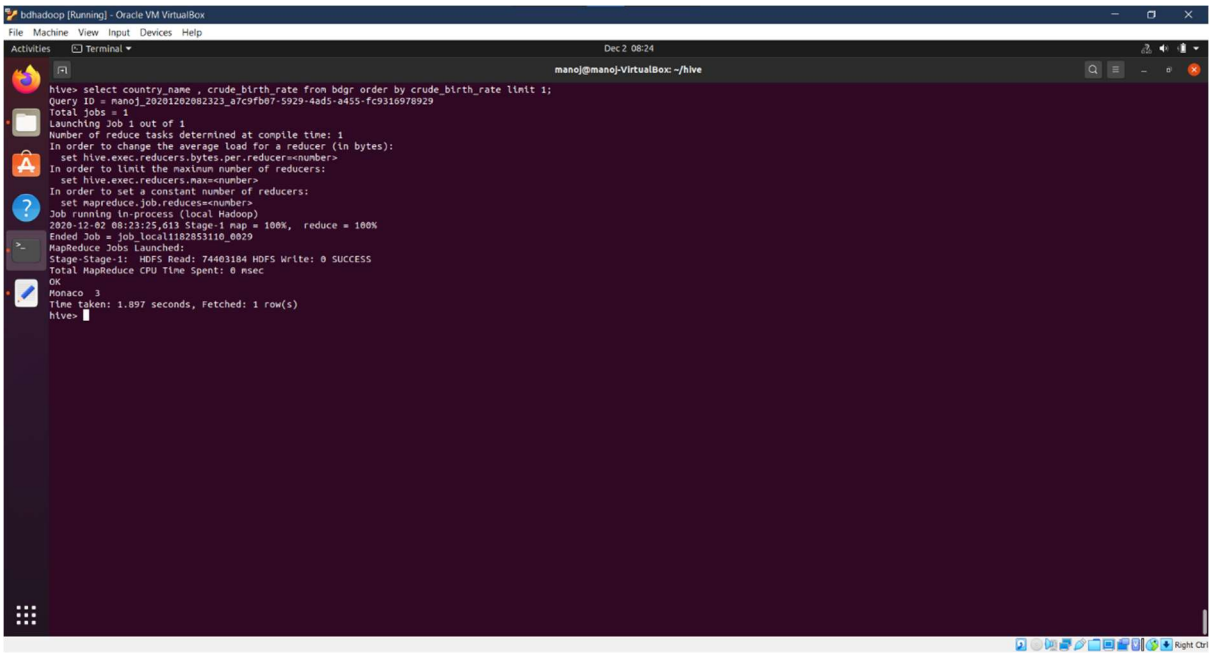
- Select country_name,crude_birth_rate from bdgr order by crude_birth_rate desc limit 1 ;

Results :

Cambodia 58

Conclusion : **Cambodia** has the highest **crude birth rate** .

-x-



Code :

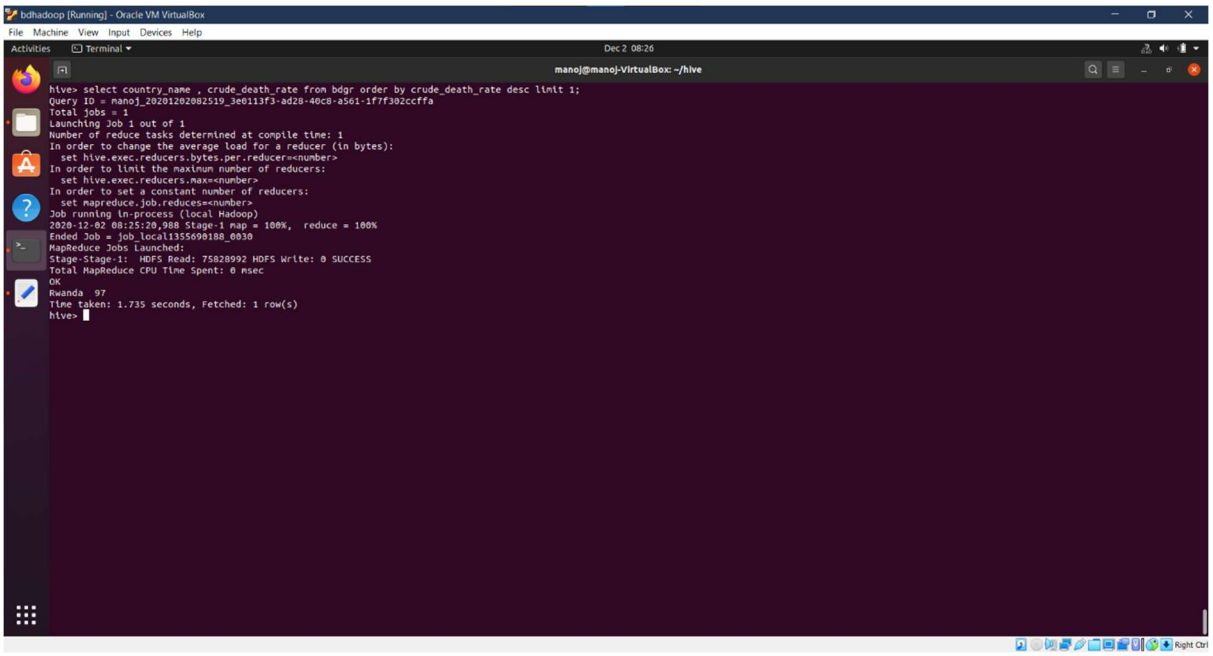
- Select country_name,crude_birth_rate from bdgr order by crude_birth_rate limit 1 ;

Results :

Monaco 3

Conclusion: Monaco has the lowest crude birth rate.

-X-



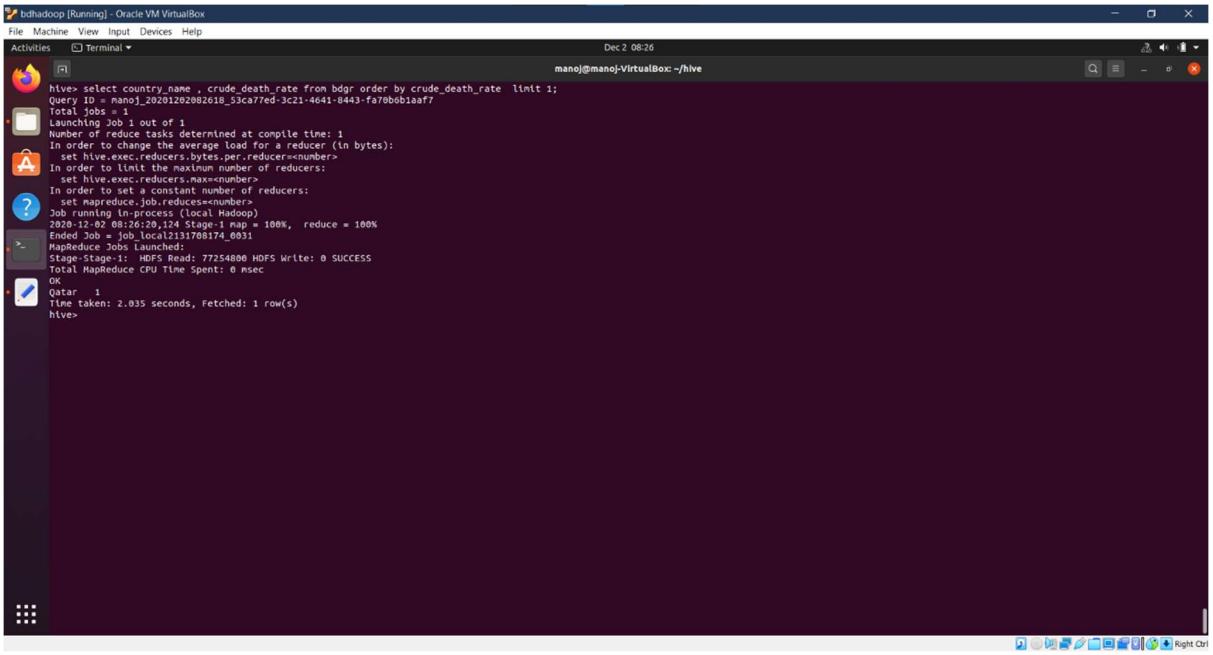
Code:

- Select country_name,crude_death_rate from bdgr order by crude_death_rate desc limit 1 ;

Results:

Rwanda 97

Conclusion: Rwanda has the highest crude death rate .



Code:

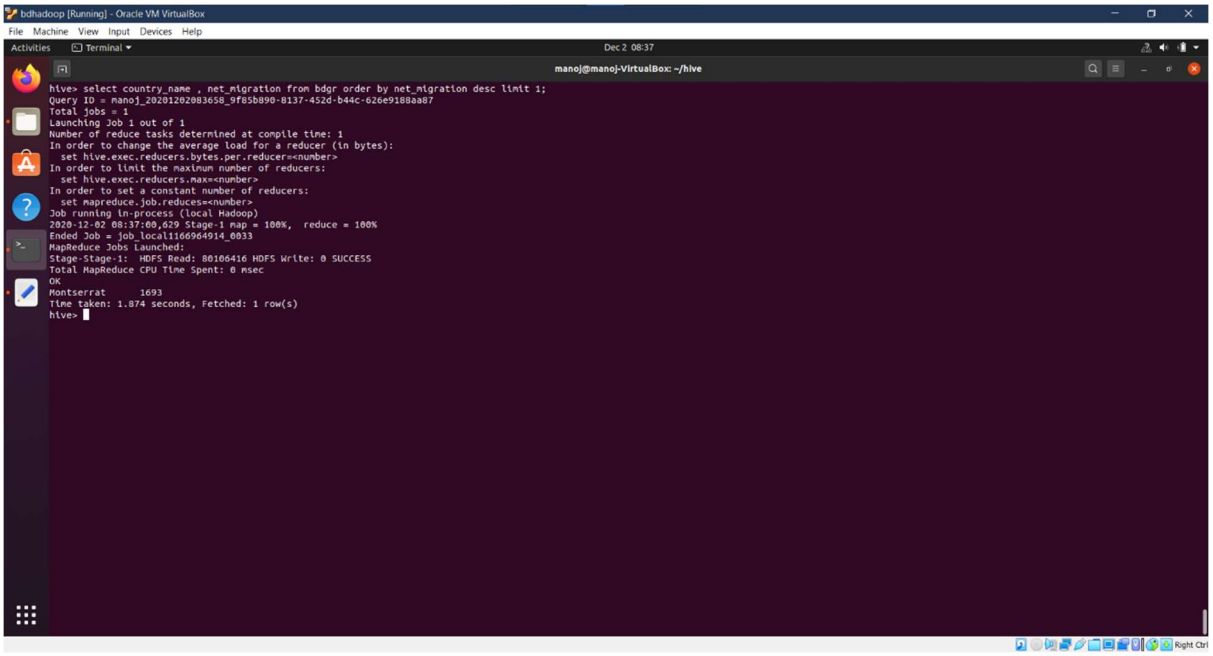
- Select country_name,crude_death_rate from bdgr order by crude_death_rate limit 1 ;

Results:

Qatar 1

Conclusion: Qatar has the highest crude death rate .

-X-



Code:

- Select country_name,net_migration from bdgr order by net_migration desc limit 1 ;

Results:

Montserrat 1693.

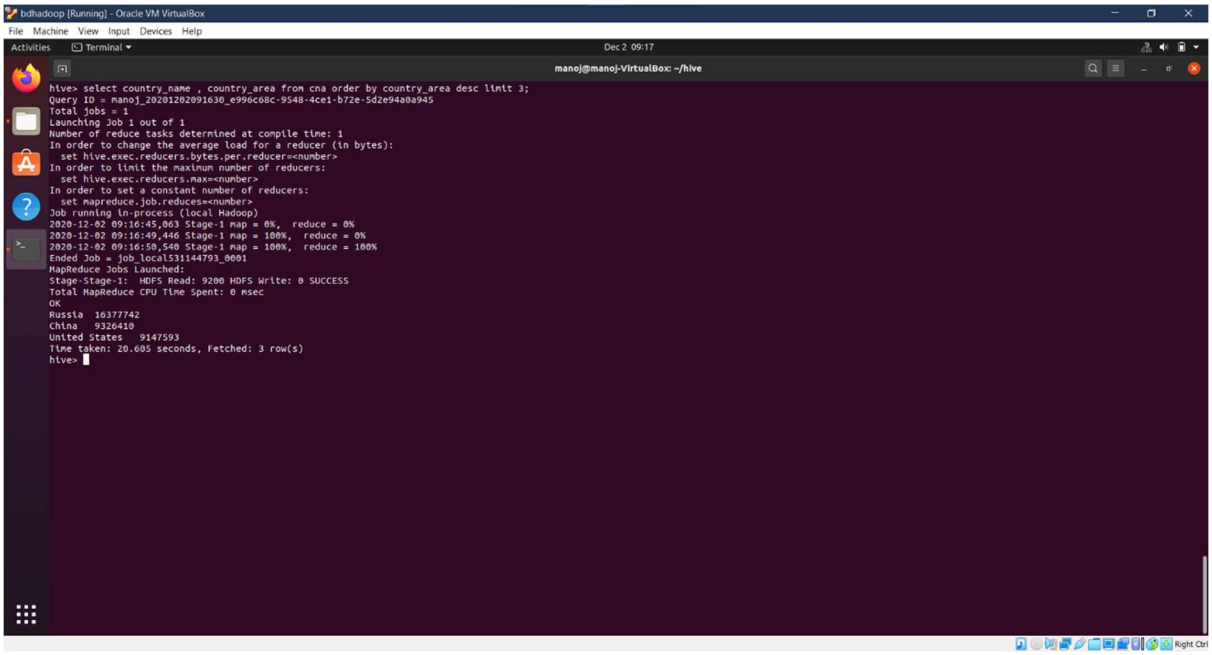
Conclusion: Net migration rate is the difference between the number of emigrants and the number of immigrants every year. The net migration rate is positive when the number of emigrants > number of immigrants .

In the country **Montserrat** , the **difference** between the number of people who leave the country and the number of people who come and settle in the country is **the highest (i.e1693).**

-X-

3] DATASET : country_names_area.csv

Let's find the top 3 countries with the highest area (in sq. kilometers).



Code:

- Select country_name, country_area from cna order by country_area desc limit 3 ;

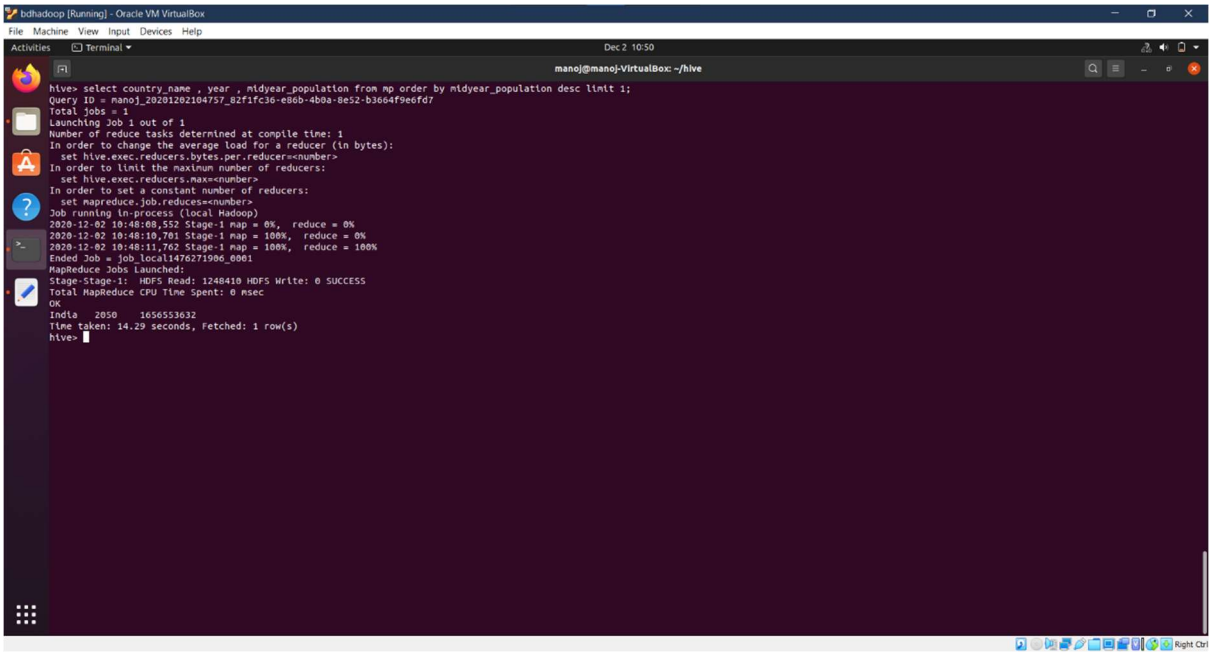
Results:

1. Russia – 16377742 sq.kms
2. China – 9326410 sq.kms
3. USA – 9147593 sq.kms

Conclusion: The top 3 countries with the highest area are **RUSSIA , CHINA , USA.**

-X-

4] DATASET : midyear_population.csv



Code:

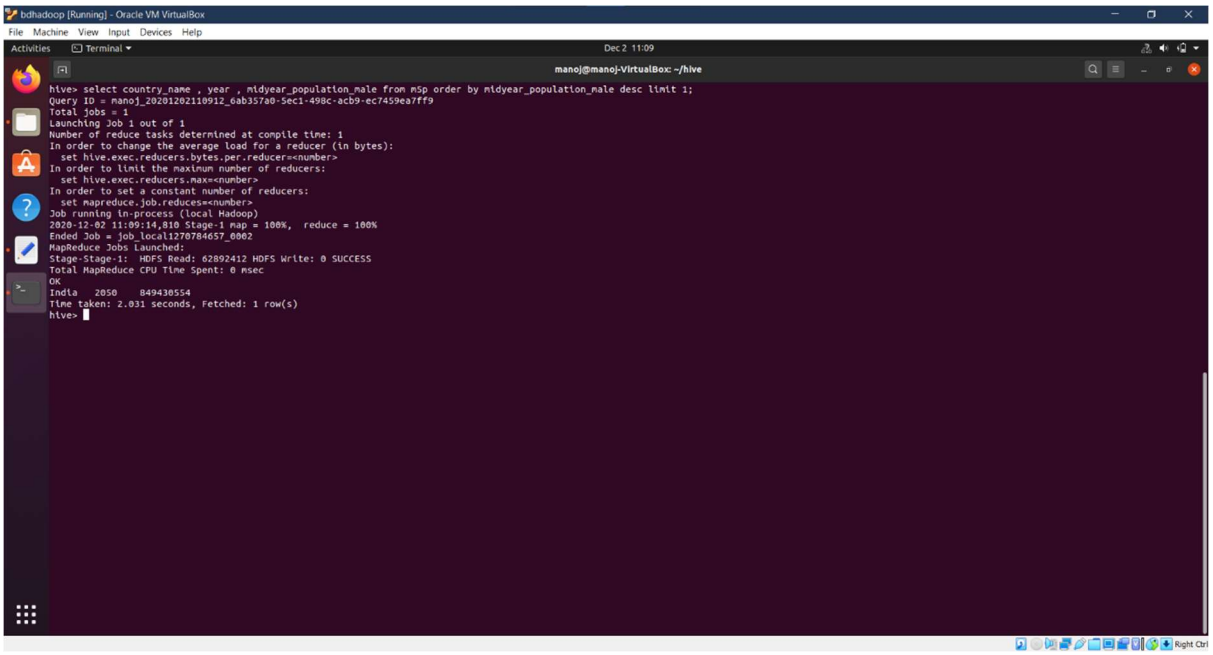
- Select country_name, year , midyear_population from mp order by midyear_population desc limit 1 ;

Results:

India – 2050 – 1656553632

Conclusion: According to the analysis , India will have the highest population in the world in the year 2050 with a population of 1.6Billion.

5] DATASET : midyear_population_5yr_age_sex



Code:

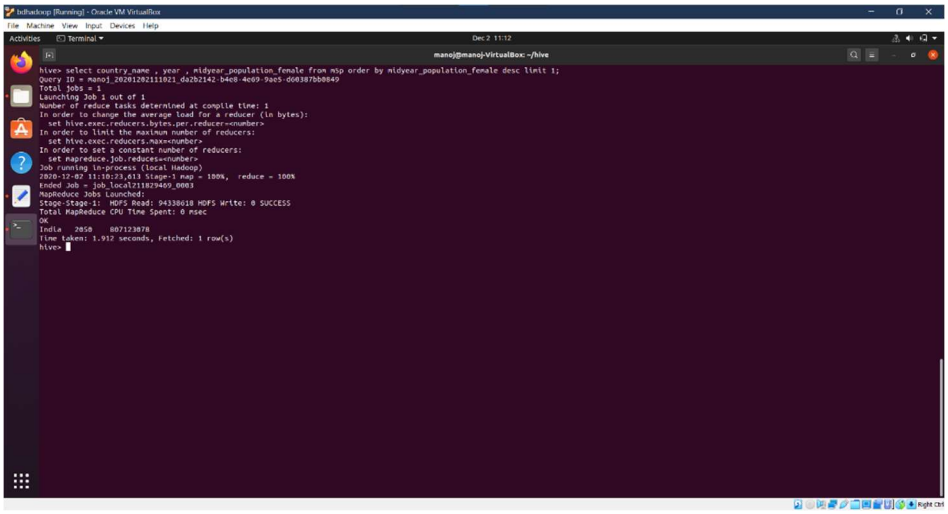
- Select country_name, year , midyear_population_male from m5p order by midyear_population_male desc limit 1 ;

Results:

India – 2050 – 849430554

Conclusion: According to the analysis , India will have the highest male population in the world in the year 2050 with a population of 0.84 Billion.

-X-



Code:

- Select country_name, year , midyear_population_female from m5p order by midyear_population_female desc limit 1 ;

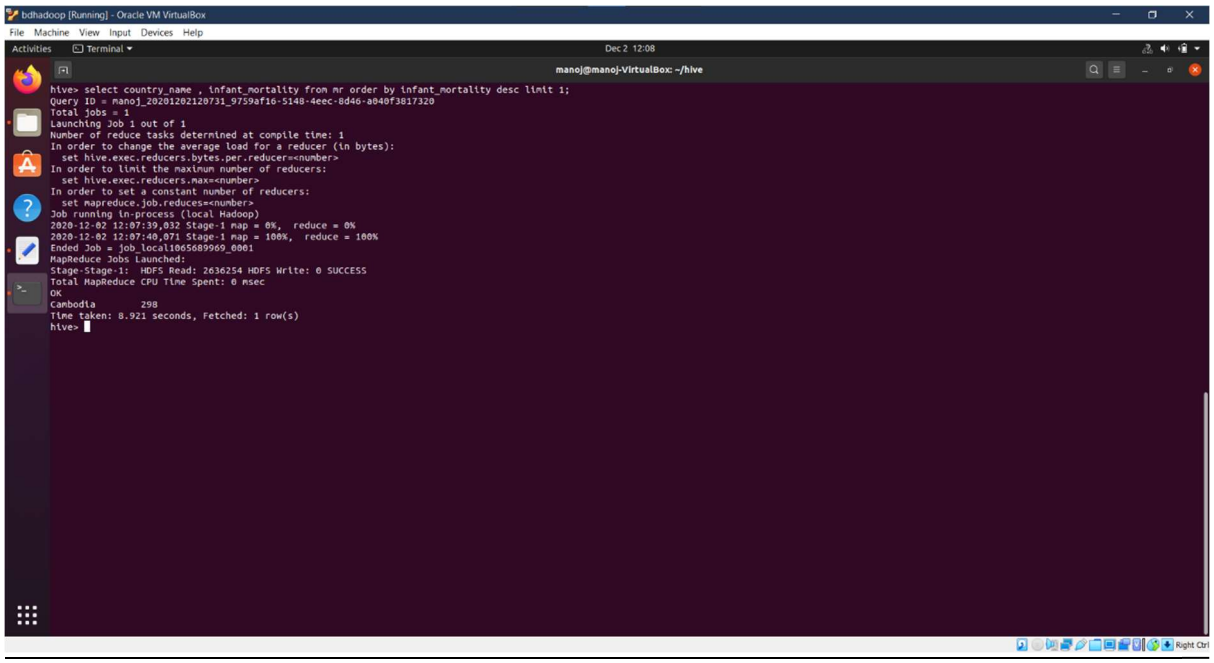
Results:

India – 2050 – 807923078

Conclusion: According to the analysis , India will have the highest female population in the world in the year 2050 with a population of 0.807Billion.

-X-

6] DATASET : mortality_life_expectancy.csv



Code:

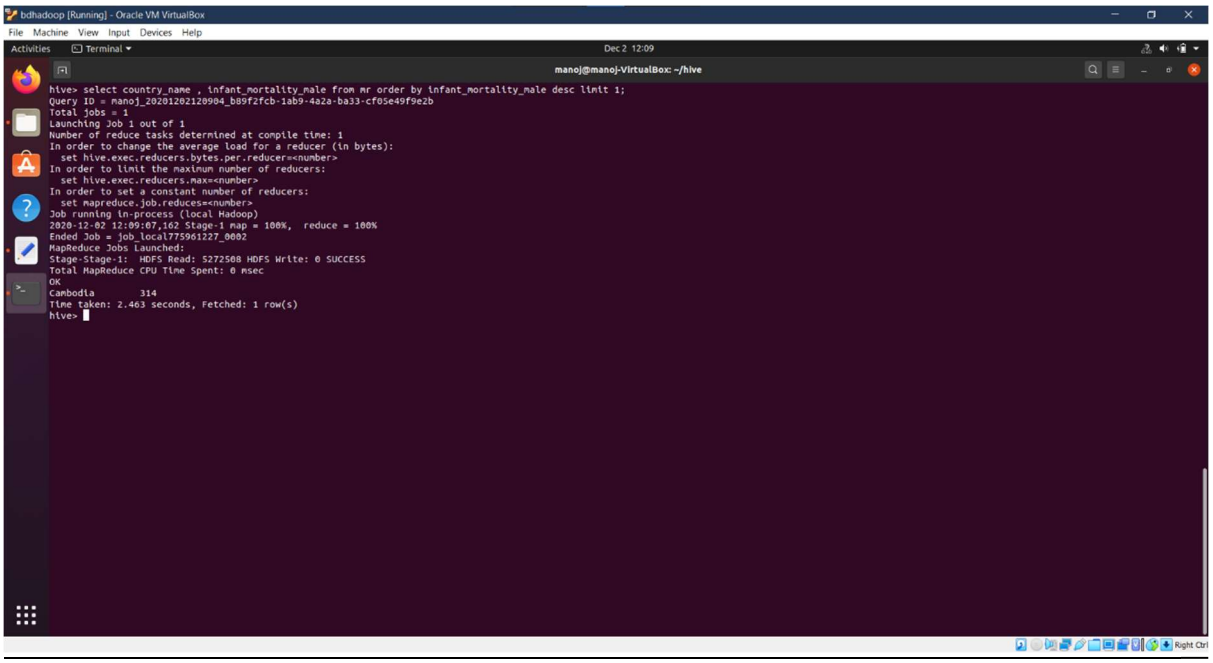
- Select country_name, year , infant_mortality from mr order by infant_mortality desc limit 1 ;

Results:

Cambodia - 298

Conclusion: Infant Mortality Rate means the number of deaths per 1000 that happen before the child is born. From our analysis,

In Cambodia , for every 1000 births , 298 babies die .



Code:

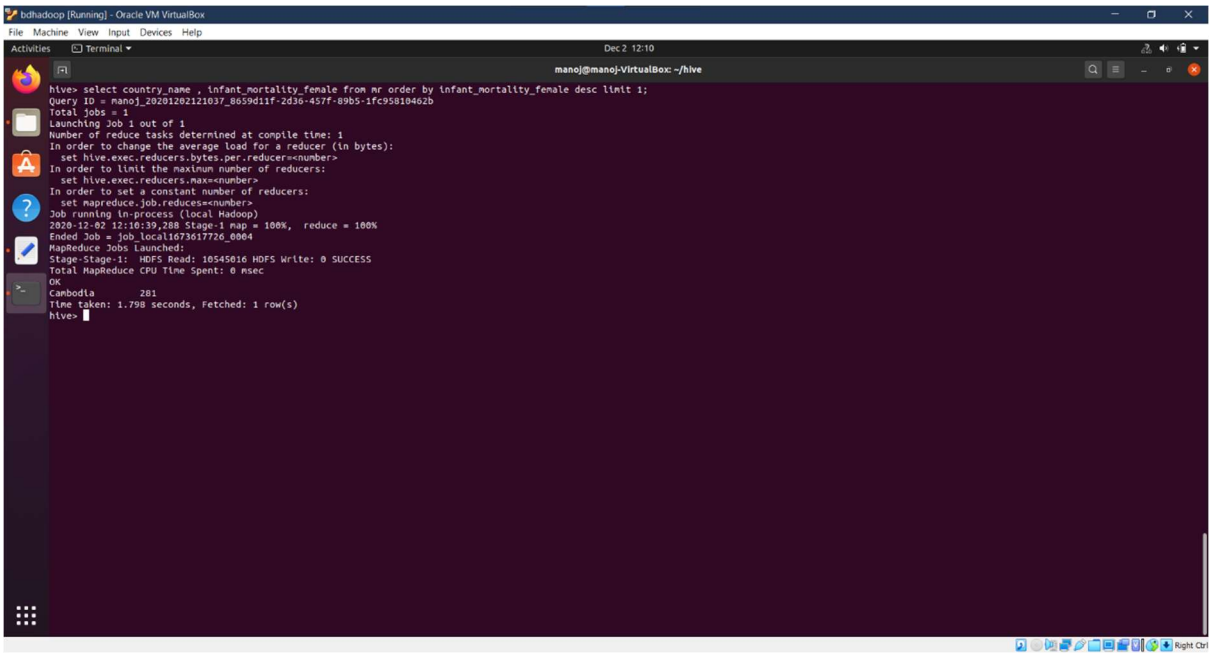
- Select country_name, year , infant_mortality_male from mr order by infant_mortality_male desc limit 1 ;

Results:

Cambodia - 314

Conclusion: In Cambodia , for every 1000 births , 314 male babies die

-X-



Code:

- Select country_name, year , infant_mortality_female from mr order by infant_mortality_female desc limit 1 ;

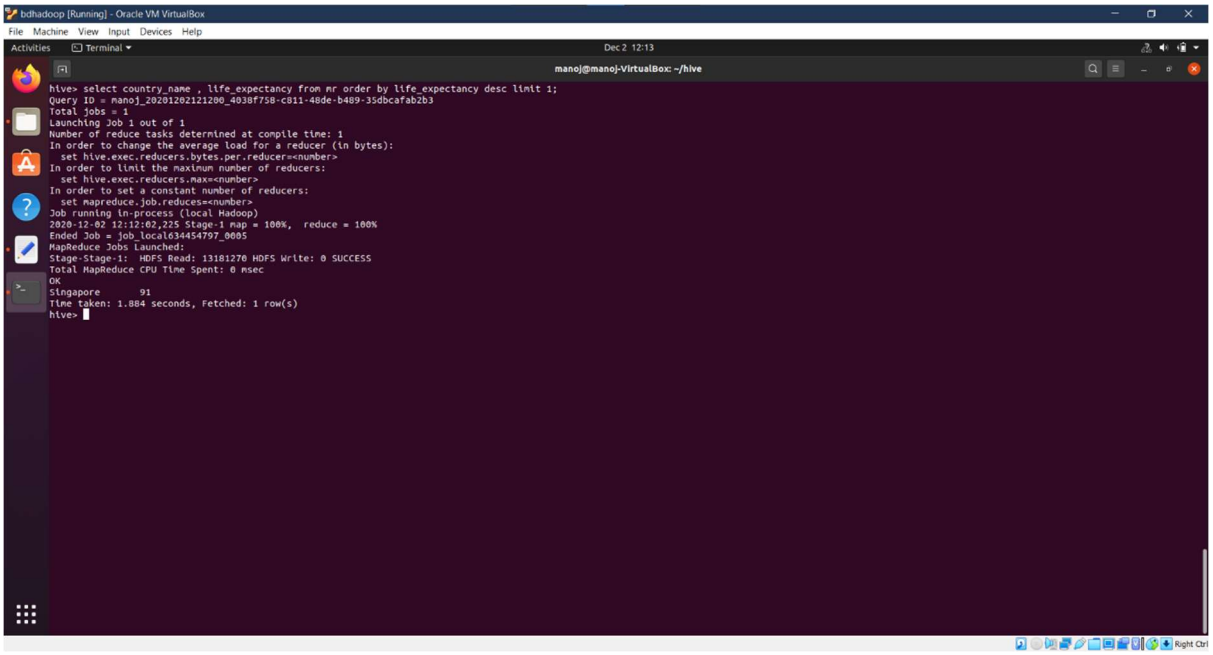
Results:

Cambodia - 281

Conclusion: From our analysis , we conclude that

In Cambodia , for every 1000 births , 281 female babies die .

-X-



Code:

- Select country_name, year , life_expectancy from mr order by life_expectancy desc limit 1 ;

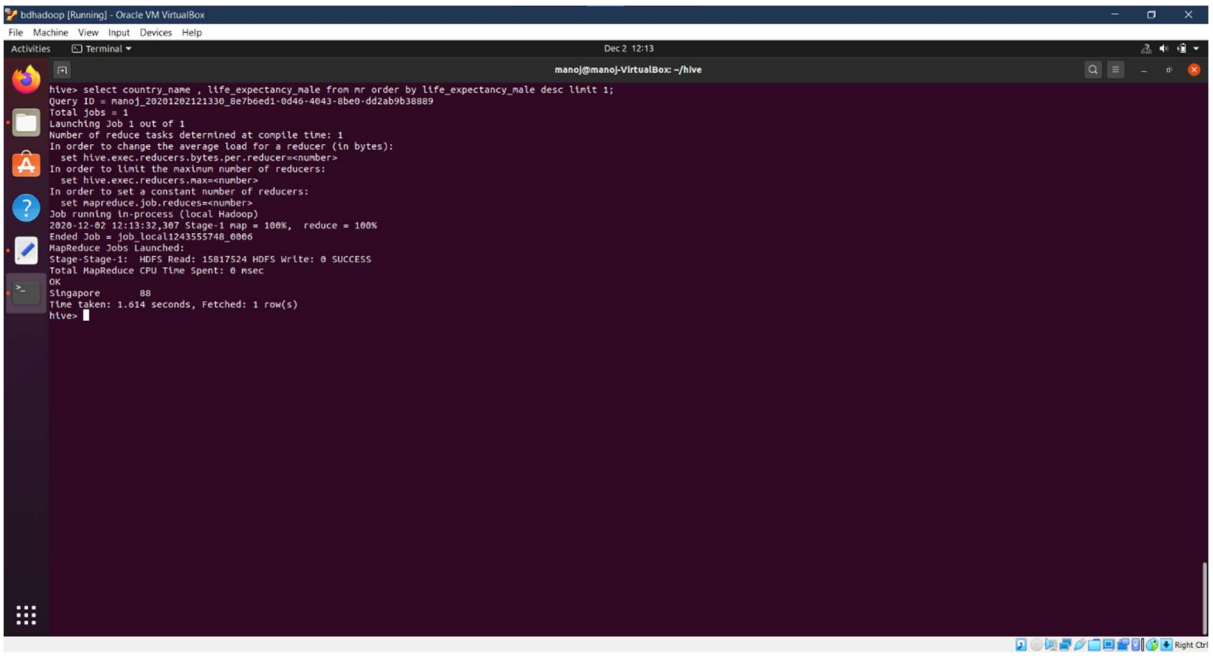
Results:

Singapore - 91

Conclusion: Life expectancy means the average number of years the person in a country can live.

From our Analysis , we conclude that

In Singapore , maximum number of people on average live upto the 91 years !



Code:

- Select country_name, year , life_expectancy_male from mr order by life_expectancy_male desc limit 1 ;

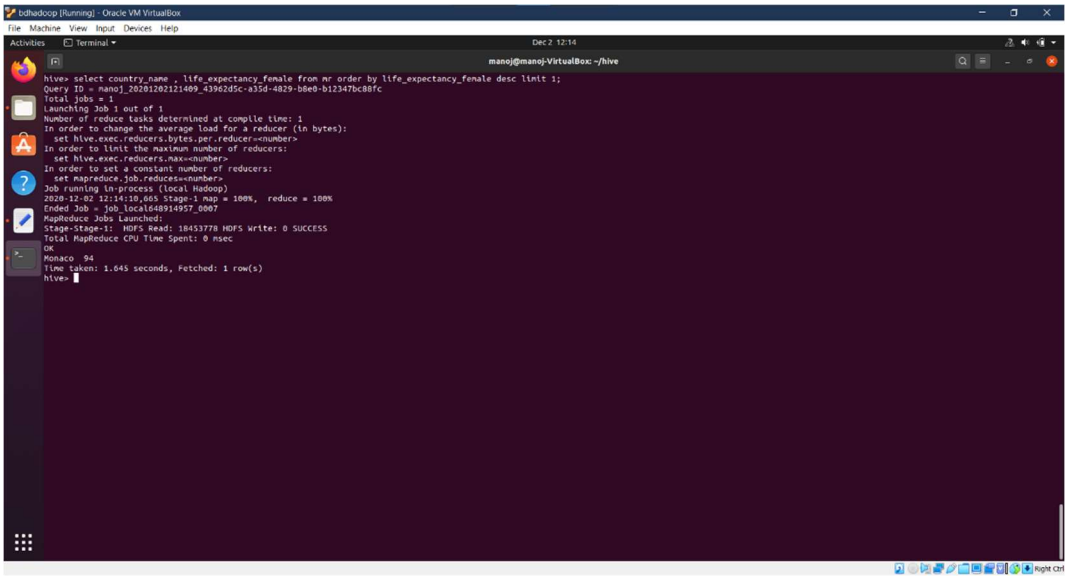
Results:

Singapore - 88

Conclusion: From our Analysis , we conclude that

In Singapore , maximum number of men on average upto the age of 88 years !

-X-



Code:

- Select country_name, year , life_expectancy_female from mr order by life_expectancy_female desc limit 1 ;

Results:

Monaco - 94

Conclusion: From our Analysis , we conclude that

In Monaco , maximum number of women on average upto the age of 94 years !

-X-

7] DATASET : midyear_population_age_country_code:

Let's see what the population of India will be in the year 2026.

Code:

```
hive> select distinct country_name, year, (population_age_0+population_age_1+population_age_2+population_age_3+population_age_4+population_age_5+population_age_6+population_age_7+population_age_8+populat
ion_age_9+population_age_10+population_age_11+population_age_12+population_age_13+population_age_14+population_age_15+population_age_16+population_age_17+population_age_18+population_age_19+population_ag
e_20) as sum, (population_age_21+population_age_22+population_age_23+population_age_24+population_age_25+population_age_26+population_age_27+population_age_28+population_age_29+population_age_30+populati
on_age_31+population_age_32+population_age_33+population_age_34+population_age_35+population_age_36+population_age_37+population_age_38+population_age_39+population_age_40) as sum1, (population_age_41+po
pulation_age_42+population_age_43+population_age_44+population_age_45+population_age_46+population_age_47+population_age_48+population_age_49+population_age_50+population_age_51+population_age_52+populat
ion_age_53+population_age_54+population_age_55+population_age_56+population_age_57+population_age_58+population_age_59+population_age_60) as sum3, (population_age_61+population_age_62+population_age_63+p
opulation_age_64+population_age_65+population_age_66+population_age_67+population_age_68+population_age_69+population_age_70+population_age_71+population_age_72+population_age_73+population_age_74+popula
tion_age_75+population_age_76+population_age_77+population_age_78+population_age_79+population_age_80) as sum4,(population_age_81+population_age_82+population_age_83+population_age_84+population_age_85+p
opulation_age_86+population_age_87+population_age_88+population_age_89+population_age_90+population_age_91+population_age_92+population_age_93+population_age_94+population_age_95+population_age_96+popula
tion_age_97+population_age_98+population_age_99+population_age_100) as sum5 from midyear_population_age_country_code where year=2036 and country_name='India' order by country_name desc limit 1;
Query ID = aniketh_20201204035002_19e18a23-cd26-4cab-956e-1ef8ded05254
Total jobs = 1
Launching Job 1 out of 1
Number of reduce tasks not specified. Estimated from input data size: 3
In order to change the average load for a reducer (in bytes):
  set hive.exec.reducers.bytes.per.reducer=<number>
In order to limit the maximum number of reducers:
  set hive.exec.reducers.max=<number>
In order to set a constant number of reducers:
  set mapreduce.job.reduces=<number>
Job running in-process (local Hadoop)
2020-12-04 03:50:03,702 Stage-1 map = 0%,  reduce = 0%
2020-12-04 03:50:05,704 Stage-1 map = 100%,  reduce = 0%
2020-12-04 03:50:08,709 Stage-1 map = 100%,  reduce = 100%
Ended Job = job_local695964774_0018
MapReduce Jobs Launched:
Stage-Stage-1:  HDFS Read: 58382030182 HDFS Write: 0 SUCCESS
Total MapReduce CPU Time Spent: 0 msec
OK
India   2036    227588702       214539462       182701858       101983940       13395251
Time taken: 6.532 seconds, Fetched: 1 row(s)
```

Result:

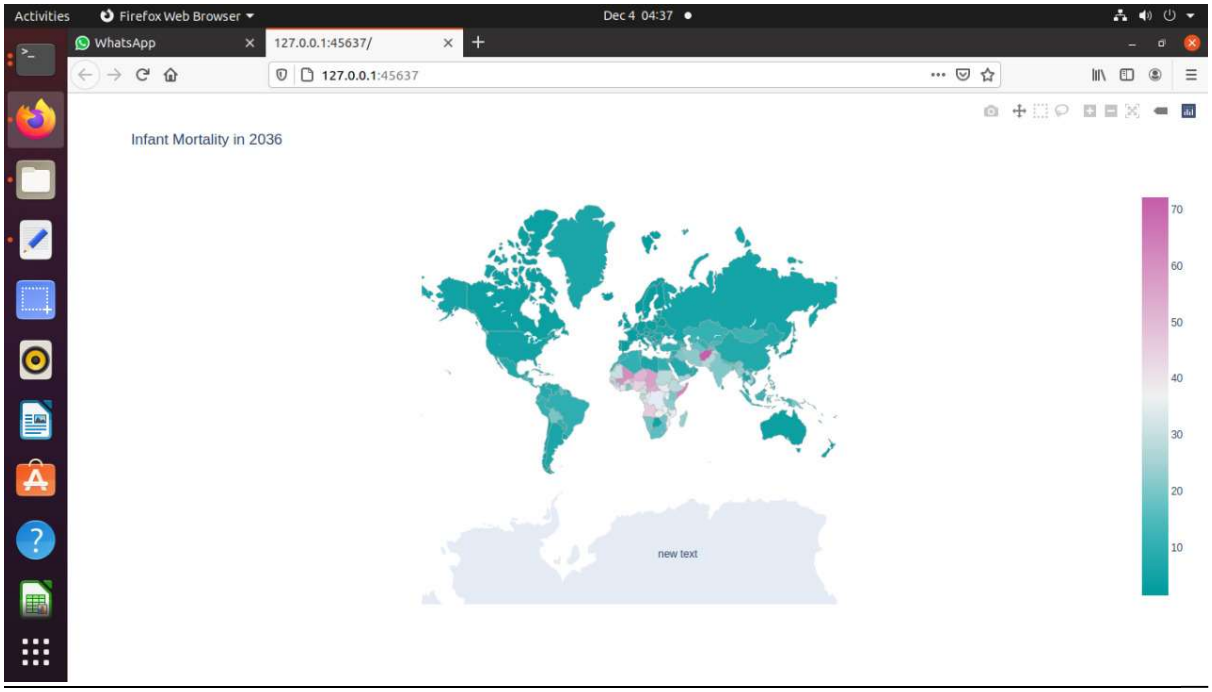
```
Total MapReduce CPU Time Spent: 0 msec
OK
Afghanistan     2036    12124289        7870651 3952910 1285414 91393
Afghanistan     2036    12535530        8050863 3981785 1144932 59629
Albania 2036    340090  347321  461342  324348  82800
Albania 2036    363254  380111  433749  267450  49946
Algeria 2036    7772104 6781490 6512027 3356350 550976
Algeria 2036    8160969 7111035 6631157 3206951 411262
American Samoa  2036    6499    5124    8217    4644    403
American Samoa  2036    6712    5720    7495    5458    798
Andorra 2036    6283    8211    9965    13313   3327
Andorra 2036    6687    8663    10207   13193   2826
Angola  2036    8513827 4862680 2364129 831339  78967
Angola  2036    8855527 4991014 2400433 740607  55302
Anguilla        2036    3075    2998    3430    2638    399
Anguilla        2036    3155    2805    2463    1931    317
Antigua and Barbuda     2036    15961   16217   15487   11291   2010
Antigua and Barbuda     2036    16393   15029   12620   8277    1145
Argentina       2036    7192005 6853090 6333842 4057578 1220248
Argentina       2036    7645642 7172201 6258038 3478540 653943
Armenia 2036    274936  297625  416983  334181  76322
Armenia 2036    287489  318673  445246  283989  41504
Aruba   2036    15805   16849   19694   16366   4546
Aruba   2036    15972   16473   17908   12763   2104
Australia       2036    3091938 3383234 3365701 2697514 990088
Australia       2036    3271899 3568367 3525515 2538752 660200
Austria 2036    874228  1000854 1206237 1190328 398575
Austria 2036    916399  1021951 1204990 1067316 244761
Azerbaijan      2036    1357308 1353427 1612259 1080665 153179
Azerbaijan      2036    1442545 1536432 1601982 798031  70681
Bahamas The     2036    48825   49118   46594   34633   7080
Bahamas The     2036    50231   50437   46938   28599   3264
Bahrain 2036    202013  247565  172025  74297   10411
Bahrain 2036    213012  421376  279029  84303   8119
Bangladesh      2036    28149337        26908621        24280862        13023884        2062542
Bangladesh      2036    29157333        26000677        21847502        11030444        1339113
Barbados        2036    32831   34146   37765   31897   5275
Barbados        2036    32974   35224   38742   37298   9753
Belarus 2036    847450  952712  1399927 1221128 349356
Belarus 2036    897317  1001291 1344781 796131  108872
Belgium 2036    1382988 1491618 1560060 1389461 510697
Belgium 2036    1448511 1529094 1568849 1273025 315330
Belize  2036    86196   73941   48735   22321   3239
Belize  2036    90090   77881   50932   19363   2044
Benin   2036    4037757 2660102 1333103 485859  54645
Benin   2036    4204758 2731878 1346838 433445  28044
Bermuda 2036    8178    8304    8142    9599    3699
Bermuda 2036    8345    8464    8183    8194    2087
Bhutan  2036    120970  129960  125052  48107   8719
```

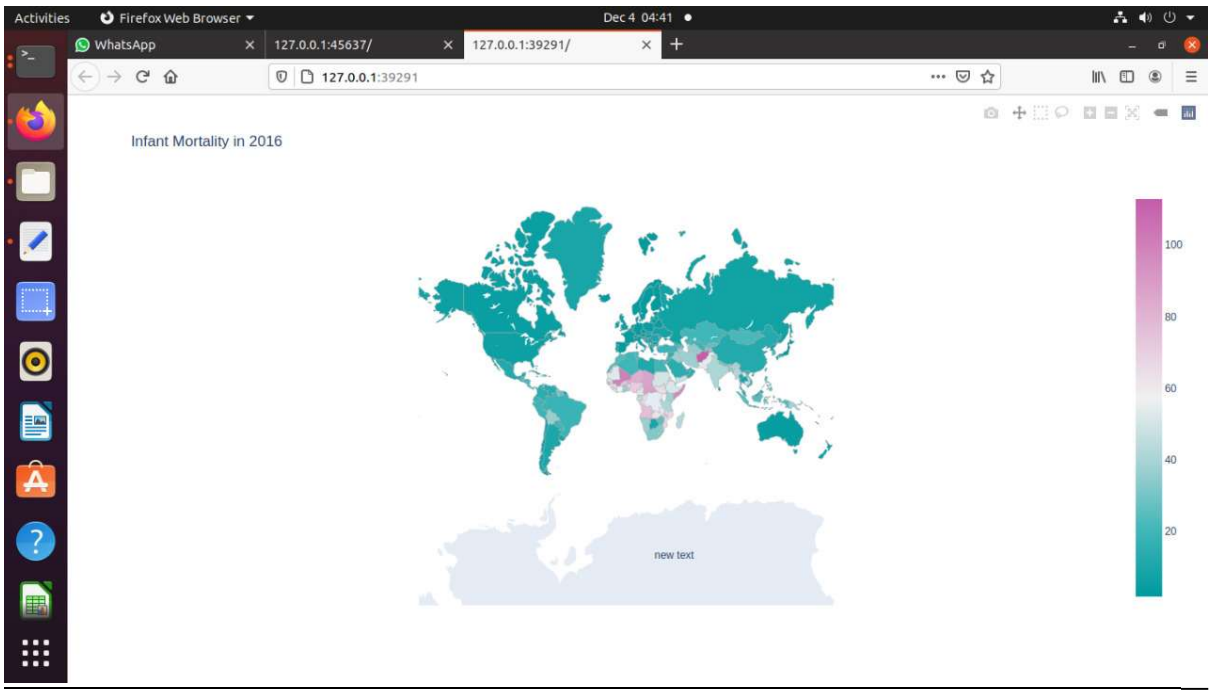
Conclusion:

The above screenshot show the population of different countries of different age groups (i.e 0-20 , 21-40 , 41-60 , 61-80 , 81-100).

SPARK ANALYSIS:

1] Infant Mortality Rate :





Code :

```
from pyspark import SparkContext, SparkConf

from pyspark.sql import SparkSession

sc=SparkContext('local')
```

```
spark=SparkSession(sc)


import pandas as pd

import pydoop.hdfs as hd

import plotly.graph_objects as go

from mpl_toolkits.mplot3d import Axes3D

from sklearn.preprocessing import StandardScaler

import matplotlib.pyplot as plt # plotting

import numpy as np # linear algebra



t3 = spark.read.option('header','true').csv("hdfs://localhost:9000/project/mortality_life_expectancy.csv")

with hd.open("/project/mortality_life_expectancy.csv") as b:

   df2 =  pd.read_csv(b)

   df2.dataframeName = 'mortality_life_expectancy.csv'

countries={'Afghanistan':'AFG',

'Aland Islands':'ALA','Albania':'ALB','Algeria':'DZA','American
Samoa':'ASM','Andorra':'AND','Angola':'AGO','Anguilla':'AIA','Antigua and Barbuda':'ATG',

'Antarctica':'ATA','Argentina':'ARG','Armenia':'ARM','Aruba':'ABW','Australia':'AUS','Austria':'AUT','Azerbaijan':'AZE','Azerbaidj
an':'AZE',

'Bahrain':'BHR','Bahamas The':'BHS','Bangladesh':'BGD','Barbados':'BRB','Belarus':'BLR',

'Belgium':'BEL','Belize':'BLZ','Benin':'BEN','Bermuda':'BMU','Bhutan':'BTN','Bolivia':'BOL','Bosnia and
Herzegovina':'BIH','Bosnia-Herzegovina':'BIH',

'Botswana':'BWA','Bouvet Island':'BVT','Brazil':'BRA','British Virgin Islands':'VGB','British Indian Ocean Territory':'IOT',

'Brunei':'BRN','Brunei Darussalam':'BRN','Bulgaria':'BGR','Burkina Faso':'BFA','Burma':'MMR',

'Burundi':'BDI','Cabo Verde':'CPV','Cape Verde':'CPV','Cambodia':'KHM','Cameroon':'CMR',

'Canada':'CAN','Cayman Islands':'CYM','Central African Republic':'CAF','Chad':'TCD','Chile':'CHL',

'Christmas Island':'CHR','China':'CHN','Colombia':'COL','Comoros':'COM','Congo (Kinshasa)':'COG','Cook Islands':'COK','Costa
Rica':'CRI','Cote d\'Ivoire':'CIV',

"Ivory Coast (Cote D'Ivoire)":'CIV','Croatia':'HRV','Cuba':'CUB','Curacao':'CUW','Cyprus':'CYP',

'Czech Republic':'CZE','Denmark':'DNK','Djibouti':'DJI','Dominica':'DMA','Dominican Republic':'DOM',

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'Fiji':'FJI','Finland':'FIN','France':'FRA','French Polynesia':'PYF','Gabon':'GAB',

'Gambia The':'GMB','Georgia':'GEO','Germany':'DEU','Ghana':'GHA','Gibraltar':'GIB',

'Greece':'GRC','Greenland':'GRL','Grenada':'GRD','Guam':'GUM','Guatemala':'GTM',

'Guernsey':'GGY','Guinea-Bissau':'GNB','Guinea':'GIN','Guyana':'GUY','French Guyana':'GUY','Haiti':'HTI',
```

'Honduras':'HND','Heard and McDonald Islands':'HMD','Hong Kong':'HKG','Hungary':'HUN','Iceland':'ISL',

'India':'IND','Indonesia':'IDN','Iran':'IRN','Iraq':'IRQ','Ireland':'IRL','Isle of Man':'IMN',

'Israel':'ISR','Italy':'ITA','Jamaica':'JAM','Japan':'JPN','Jersey':'JEY','Jordan':'JOR',

'Kazakhstan':'KAZ','Kenya':'KEN','Kiribati':'KIR','Korea North':'KOR','Korea South':'PRK',

'South Korea':'PRK','North Korea':'KOR','Kosovo':'KSV','Kuwait':'KWT','Kyrgyzstan':'KGZ',

'Laos':'LAO','Latvia':'LVA','Lebanon':'LBN','Lesotho':'LSO','Liberia':'LBR','Libya':'LBY','Liechtenstein':'LIE',

'Lithuania':'LTU','Luxembourg':'LUX','Macau':'MAC','Macedonia':'MKD','Madagascar':'MDG',

'Malawi':'MWI','Malaysia':'MYS','Maldives':'MDV','Mali':'MLI','Malta':'MLT','Marshall Islands':'MHL',

'Martinique (French)':'MTQ','Mauritania':'MRT','Mauritius':'MUS','Mexico':'MEX','Micronesia, Federated States of':'FSM',

'Moldova':'MDA','Moldavia':'MDA','Monaco':'MCO','Mongolia':'MNG','Montenegro':'MNE','Montserrat':'MSR',

'Morocco':'MAR','Mozambique':'MOZ','Myanmar':'MMR','Namibia':'NAM','Nepal':'NPL','Netherlands':'NLD',

'Netherlands Antilles':'ANT','New Caledonia':'NCL','New Caledonia (French)':'NCL','New Zealand':'NZL','Nicaragua':'NIC',

'Nigeria':'NGA','Niger':'NER','Niue':'NIU','Northern Mariana Islands':'MNP','Norway':'NOR','Oman':'OMN',

'Pakistan':'PAK','Palau':'PLW','Panama':'PAN','Papua New Guinea':'PNG','Paraguay':'PRY','Peru':'PER',

'Philippines':'PHL','Pitcairn Island':'PCN','Poland':'POL','Polynesia (French)':'PYF','Portugal':'PRT',

'Puerto Rico':'PRI','Qatar':'QAT','Reunion (French)':'REU','Romania':'ROU','Russia':'RUS','Russian Federation':'RUS',

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'Saint Vincent and the Grenadines':'VCT','Saint Vincent & Grenadines':'VCT','S. Georgia & S. Sandwich Isls.':'SGS','Samoa':'WSM',

'San Marino':'SMR','Saint Helena':'SHN','Sao Tome and Principe':'STP','Saudi Arabia':'SAU','Senegal':'SEN',

'Serbia':'SRB','Seychelles':'SYC','Sierra Leone':'SLE','Singapore':'SGP','Sint Maarten':'SXM',

'Slovakia':'SVK','Slovak Republic':'SVK','Slovenia':'SVN','Solomon Islands':'SLB','Somalia':'SOM','South Africa':'ZAF',

'South Sudan':'SSD','Spain':'ESP','Sri Lanka':'LKA','Sudan':'SDN','Suriname':'SUR',

'Swaziland':'SWZ','Sweden':'SWE','Switzerland':'CHE','Syria':'SYR','Taiwan':'TWN','Tajikistan':'TJK',

'Tadjikistan':'TJK','Tanzania':'TZA','Thailand':'THA','Timor-Leste':'TLS','Togo':'TGO','Tonga':'TON',

'Trinidad and Tobago':'TTO','Tunisia':'TUN','Turkey':'TUR','Turkmenistan':'TKM','Tuvalu':'TUV',

'Uganda':'UGA','Ukraine':'UKR','United Arab Emirates':'ARE','United Kingdom':'GBR','United States':'USA',

'U.S. Minor Outlying Islands':'UMI','Uruguay':'URY','Uzbekistan':'UZB','Vanuatu':'VUT',

'Vatican City State':'VAT','Venezuela':'VEN','Vietnam':'VNM','Virgin Islands':'VGB',

'Virgin Islands U.S.':'VIR','Virgin Islands British':'VGB','West Bank':'WBG','Yemen':'YEM',

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'Western Sahara':'ESH','Wallis and Futuna':'WLF','Gaza Strip':'GZA','Micronesia Federated States of':'FSM','Czechia':'CZE','Congo (Brazzaville)':'COG','Turks and Caicos Islands':'TCA'}

codes = [countries[country] if country != 'I prefer not to say' else None for country in df2['country_name']]

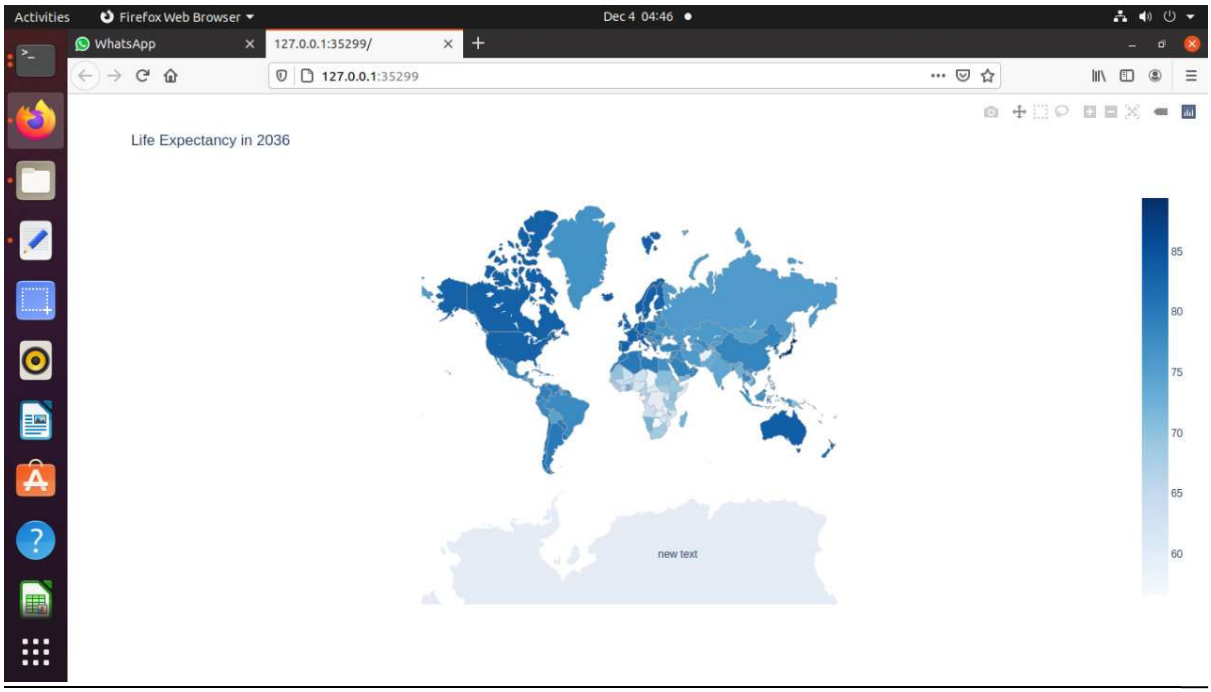
df2['code']=codes

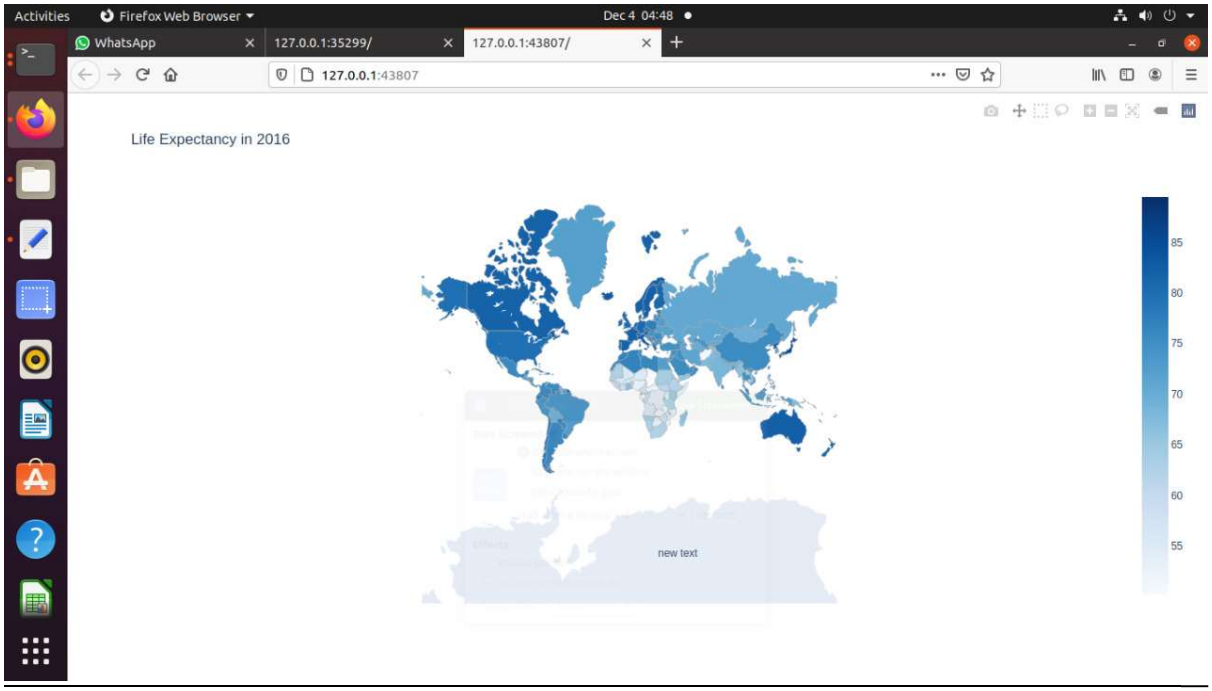
```
sbd = df2[['code','infant_mortality','year']]
sbdgroup36 = sbd[sbd['year']==2036].drop('year',axis=1).groupby('code').mean()
sbdgroup16 = sbd[sbd['year']==2016].drop('year',axis=1).groupby('code').mean()
fig = go.Figure(data=go.Choropleth(
    locations = sbdgroup16.index,
    z = sbdgroup16['infant_mortality'],
    text = sbdgroup16.index,
    colorscale = 'tropic',
    autocolorscale=False,
    reversescale=False,
    marker_line_color='darkgray',
    marker_line_width=0.5,
    colorbar_tickprefix = '',
    colorbar_title = '',
))

fig.update_layout(
    title_text='Infant Mortality in 2016',
    geo=dict(
        showframe=False,
        showcoastlines=False,
        projection_type='mercator'
    ),
    annotations = [dict(
        x=0.55,
        y=0.1,
        xref='paper',
        yref='paper',
        showarrow = False
    )]
)

fig.show()
```

2] Life Expectancy :





Code :

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from pyspark.sql import SparkSession

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spark=SparkSession(sc)
```

```
import pandas as pd

import pydoop.hdfs as hd

import plotly.graph_objects as go

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from sklearn.preprocessing import StandardScaler

import matplotlib.pyplot as plt # plotting

import numpy as np # linear algebra

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Samoa':'ASM','Andorra':'AND','Angola':'AGO','Anguilla':'AIA','Antigua and Barbuda':'ATG',

'Antarctica':'ATA','Argentina':'ARG','Armenia':'ARM','Aruba':'ABW','Australia':'AUS','Austria':'AUT','Azerbaijan':'AZE','Azerbaijdan':'AZE',

'Bahrain':'BHR','Bahamas The':'BHS','Bangladesh':'BGD','Barbados':'BRB','Belarus':'BLR',

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'Christmas Island':'CHR','China':'CHN','Colombia':'COL','Comoros':'COM','Congo (Kinshasa)':'COG','Cook Islands':'COK','Costa Rica':'CRI','Cote d\'Ivoire':'CIV',

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'Guernsey':'GGY','Guinea-Bissau':'GNB','Guinea':'GIN','Guyana':'GUY','French Guyana':'GUY','Haiti':'HTI',

'Honduras':'HND','Heard and McDonald Islands':'HMD','Hong Kong':'HKG','Hungary':'HUN','Iceland':'ISL',
```

'India':'IND','Indonesia':'IDN','Iran':'IRN','Iraq':'IRQ','Ireland':'IRL','Isle of Man':'IMN',

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'Kazakhstan':'KAZ','Kenya':'KEN','Kiribati':'KIR','Korea North':'KOR','Korea South':'PRK',

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'Laos':'LAO','Latvia':'LVA','Lebanon':'LBN','Lesotho':'LSO','Liberia':'LBR','Libya':'LBY','Liechtenstein':'LIE',

'Lithuania':'LTU','Luxembourg':'LUX','Macau':'MAC','Macedonia':'MKD','Madagascar':'MDG',

'Malawi':'MWI','Malaysia':'MYS','Maldives':'MDV','Mali':'MLI','Malta':'MLT','Marshall Islands':'MHL',

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'Morocco':'MAR','Mozambique':'MOZ','Myanmar':'MMR','Namibia':'NAM','Nepal':'NPL','Netherlands':'NLD',

'Netherlands Antilles':'ANT','New Caledonia':'NCL','New Caledonia (French)':'NCL','New Zealand':'NZL','Nicaragua':'NIC',

'Nigeria':'NGA','Niger':'NER','Niue':'NIU','Northern Mariana Islands':'MNP','Norway':'NOR','Oman':'OMN',

'Pakistan':'PAK','Palau':'PLW','Panama':'PAN','Papua New Guinea':'PNG','Paraguay':'PRY','Peru':'PER',

'Philippines':'PHL','Pitcairn Island':'PCN','Poland':'POL','Polynesia (French)':'PYF','Portugal':'PRT',

'Puerto Rico':'PRI','Qatar':'QAT','Reunion (French)':'REU','Romania':'ROU','Russia':'RUS','Russian Federation':'RUS',

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'Saint Vincent and the Grenadines':'VCT','Saint Vincent & Grenadines':'VCT','S. Georgia & S. Sandwich Isls.':'SGS','Samoa':'WSM',

'San Marino':'SMR','Saint Helena':'SHN','Sao Tome and Principe':'STP','Saudi Arabia':'SAU','Senegal':'SEN',

'Serbia':'SRB','Seychelles':'SYC','Sierra Leone':'SLE','Singapore':'SGP','Sint Maarten':'SXM',

'Slovakia':'SVK','Slovak Republic':'SVK','Slovenia':'SVN','Solomon Islands':'SLB','Somalia':'SOM','South Africa':'ZAF',

'South Sudan':'SSD','Spain':'ESP','Sri Lanka':'LKA','Sudan':'SDN','Suriname':'SUR',

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'Tadjikistan':'TJK','Tanzania':'TZA','Thailand':'THA','Timor-Leste':'TLS','Togo':'TGO','Tonga':'TON',

'Trinidad and Tobago':'TTO','Tunisia':'TUN','Turkey':'TUR','Turkmenistan':'TKM','Tuvalu':'TUV',

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'Vatican City State':'VAT','Venezuela':'VEN','Vietnam':'VNM','Virgin Islands':'VGB',

'Virgin Islands U.S.':'VIR','Virgin Islands British':'VGB','West Bank':'WBG','Yemen':'YEM',

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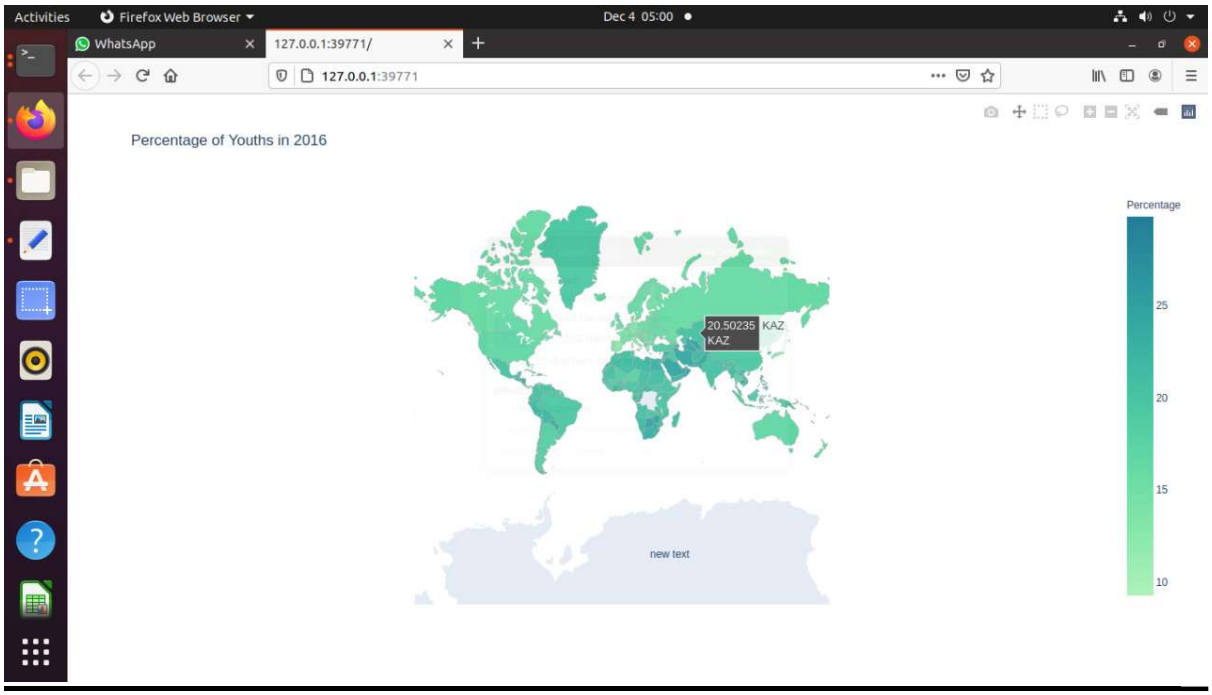
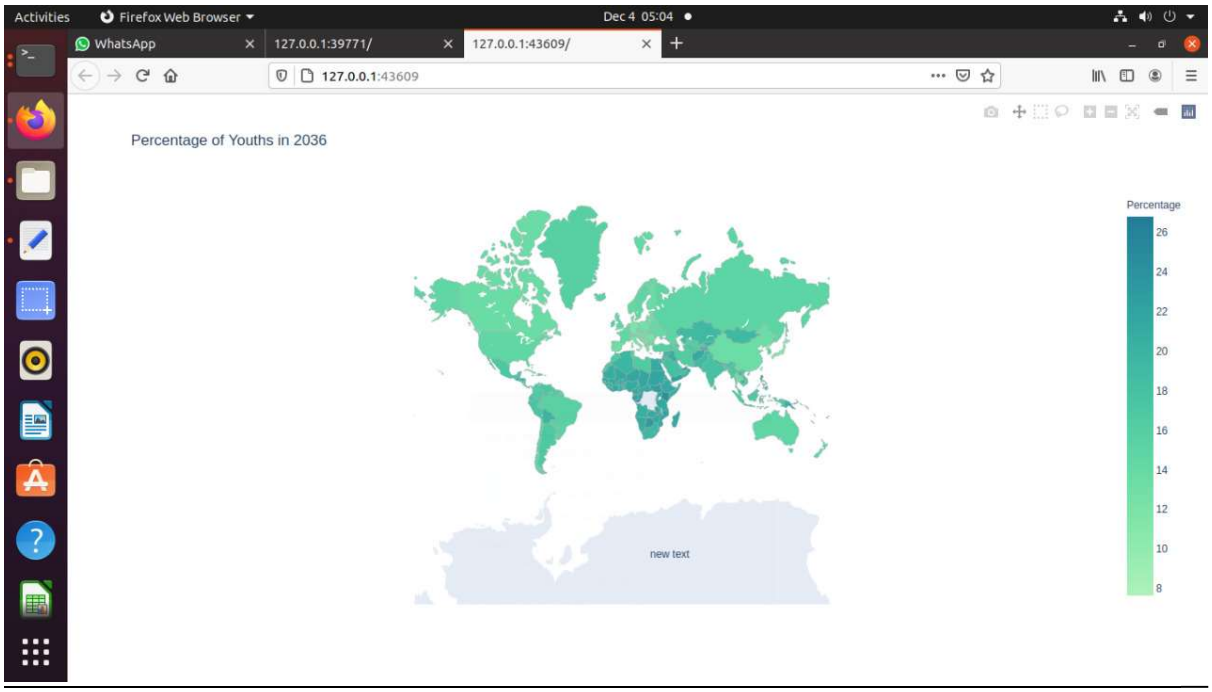
'Western Sahara':'ESH','Wallis and Futuna':'WLF','Gaza Strip':'GZA','Micronesia Federated States of':'FSM','Czechia':'CZE','Congo (Brazzaville)':'COG','Turks and Caicos Islands':'TCA'}

```
codes = [countries[country] if country != 'I prefer not to say' else None for country in df2['country_name']]
df2['code']=codes
sbd = df2[['code','life_expectancy','year']]
sbdgroup36 = sbd[sbd['year']==2036].drop('year',axis=1).groupby('code').mean()
sbdgroup16 = sbd[sbd['year']==2016].drop('year',axis=1).groupby('code').mean()


fig = go.Figure(data=go.Choropleth(
    locations = sbdgroup16.index,
    z = sbdgroup16['life_expectancy'],
    text = sbdgroup16.index,
    colorscale = 'Blues',
    autocolorscale=False,
    reversescale=False,
    marker_line_color='darkgray',
    marker_line_width=0.5,
    colorbar_tickprefix = '',
    colorbar_title = '',
))
fig.update_layout(
    title_text='Life Expectancy in 2016',
    geo=dict(
        showframe=False,
        showcoastlines=False,
        projection_type='mercator'
    ),
    annotations = [dict(
        x=0.55,
        y=0.1,
        xref='paper',
        yref='paper',
        showarrow = False
  )
fig.show()
```

3] Percentage of Youths in Countries:





CODE:

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from pyspark.sql import SparkSession

sc=SparkContext('local')

spark=SparkSession(sc)
```

```
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import pydoop.hdfs as hd
import plotly.graph_objects as go
from mpl_toolkits.mplot3d import Axes3D
from sklearn.preprocessing import StandardScaler
import matplotlib.pyplot as plt # plotting
import numpy as np # linear algebra

t3 = spark.read.option('header','true').csv("hdfs://localhost:9000/project/midyear_population_age_sex.csv")
with hd.open("/project/midyear_population_age_sex.csv") as b:
   df =  pd.read_csv(b)
df.dataframeName = 'midyear_population_age_sex.csv'

K=[]
Y=[]
M=[]
O=[]

for i in range(len(df)):
        kids=df.loc[i,'population_age_0':'population_age_18']
        K.append(sum(kids))
        youths=df.loc[i,'population_age_19':'population_age_30']
        Y.append(sum(youths))
        middle_age=df.loc[i,'population_age_31':'population_age_60']
        M.append(sum(middle_age))
        old=df.loc[i,'population_age_61':'population_age_100']
        O.append(sum(old))

df['kids']=K
df['youths']=Y
df['middle_aged']=M
df['old_aged']=O
```
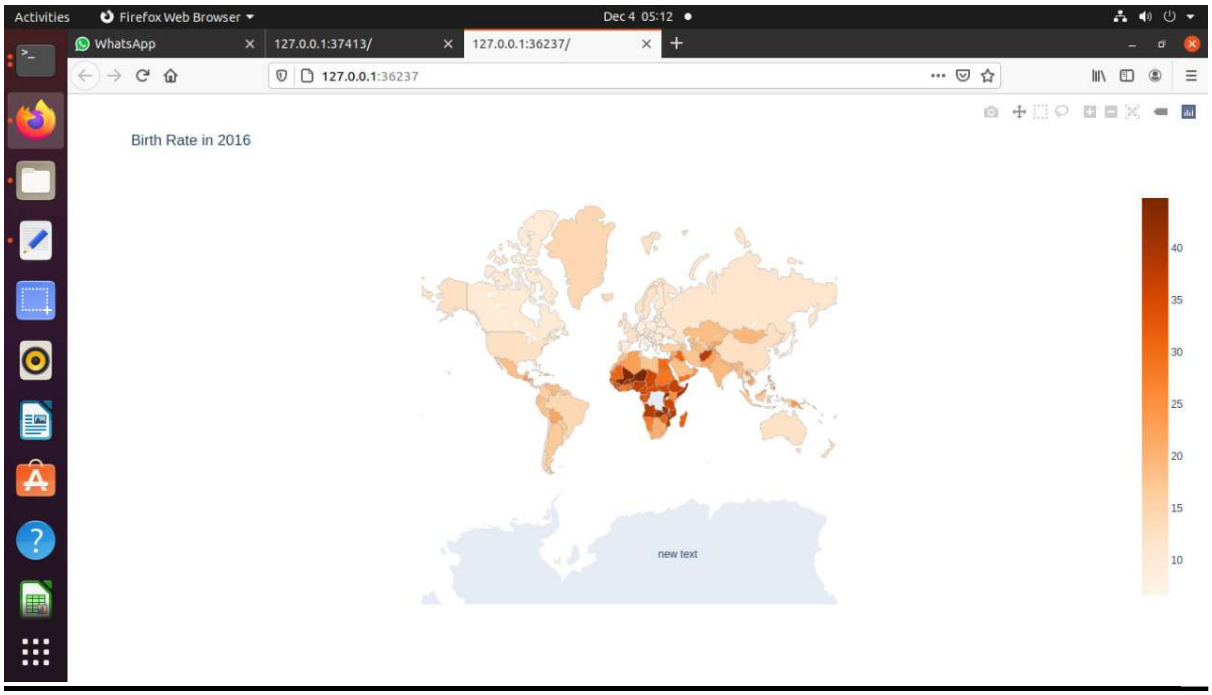
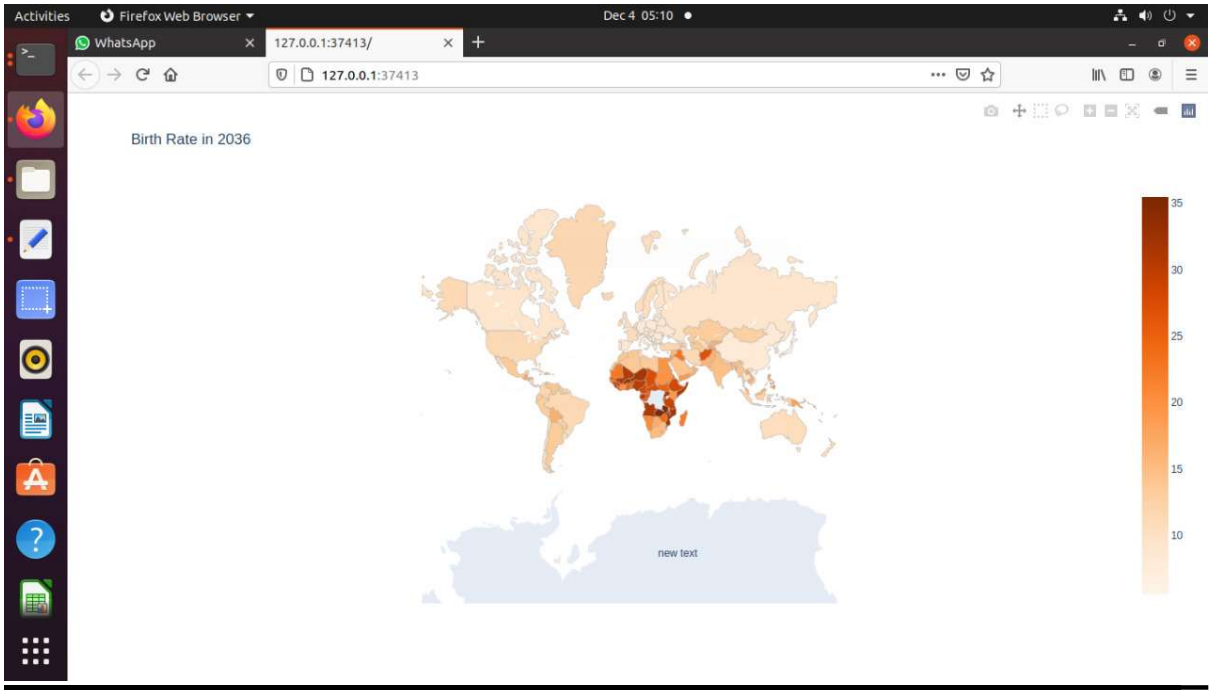

```
countries={'Afghanistan':'AFG',

'Aland Islands':'ALA','Albania':'ALB','Algeria':'DZA','American
Samoa':'ASM','Andorra':'AND','Angola':'AGO','Anguilla':'AIA','Antigua and Barbuda':'ATG',

'Antarctica':'ATA','Argentina':'ARG','Armenia':'ARM','Aruba':'ABW','Australia':'AUS','Austria':'AUT','Azerbaijan':'AZE','Azerba
idjan':'AZE',

'Bahrain':'BHR','Bahamas The':'BHS','Bangladesh':'BGD','Barbados':'BRB','Belarus':'BLR',

'Belgium':'BEL','Belize':'BLZ','Benin':'BEN','Bermuda':'BMU','Bhutan':'BTN','Bolivia':'BOL','Bosnia and
Herzegovina':'BIH','Bosnia-Herzegovina':'BIH',

'Botswana':'BWA','Bouvet Island':'BVT','Brazil':'BRA','British Virgin Islands':'VGB','British Indian Ocean Territory':'IOT',

'Brunei':'BRN','Brunei Darussalam':'BRN','Bulgaria':'BGR','Burkina Faso':'BFA','Burma':'MMR',

'Burundi':'BDI','Cabo Verde':'CPV','Cape Verde':'CPV','Cambodia':'KHM','Cameroon':'CMR',

'Canada':'CAN','Cayman Islands':'CYM','Central African Republic':'CAF','Chad':'TCD','Chile':'CHL',

'Christmas Island':'CHR','China':'CHN','Colombia':'COL','Comoros':'COM','Congo (Kinshasa)':'COG','Cook Islands':'COK','Costa
Rica':'CRI','Cote d\'Ivoire':'CIV',

"Ivory Coast (Cote D'Ivoire)":'CIV','Croatia':'HRV','Cuba':'CUB','Curacao':'CUW','Cyprus':'CYP',

'Czech Republic':'CZE','Denmark':'DNK','Djibouti':'DJI','Dominica':'DMA','Dominican Republic':'DOM',

'Ecuador':'ECU','Egypt':'EGY','El Salvador':'SLV','Equatorial Guinea':'GNQ','Eritrea':'ERI','Estonia':'EST',

'Ethiopia':'ETH','Falkland Islands (Islas Malvinas)':'FLK','Falkland Islands':'FLK','Faroe Islands':'FRO',

'Fiji':'FJI','Finland':'FIN','France':'FRA','French Polynesia':'PYF','Gabon':'GAB',

'Gambia The':'GMB','Georgia':'GEO','Germany':'DEU','Ghana':'GHA','Gibraltar':'GIB',

'Greece':'GRC','Greenland':'GRL','Grenada':'GRD','Guam':'GUM','Guatemala':'GTM',

'Guernsey':'GGY','Guinea-Bissau':'GNB','Guinea':'GIN','Guyana':'GUY','French Guyana':'GUY','Haiti':'HTI',

'Honduras':'HND','Heard and McDonald Islands':'HMD','Hong Kong':'HKG','Hungary':'HUN','Iceland':'ISL',

'India':'IND','Indonesia':'IDN','Iran':'IRN','Iraq':'IRQ','Ireland':'IRL','Isle of Man':'IMN',

'Israel':'ISR','Italy':'ITA','Jamaica':'JAM','Japan':'JPN','Jersey':'JEY','Jordan':'JOR',

'Kazakhstan':'KAZ','Kenya':'KEN','Kiribati':'KIR','Korea North':'KOR','Korea South':'PRK',

'South Korea':'PRK','North Korea':'KOR','Kosovo':'KSV','Kuwait':'KWT','Kyrgyzstan':'KGZ',

'Laos':'LAO','Latvia':'LVA','Lebanon':'LBN','Lesotho':'LSO','Liberia':'LBR','Libya':'LBY','Liechtenstein':'LIE',

'Lithuania':'LTU','Luxembourg':'LUX','Macau':'MAC','Macedonia':'MKD','Madagascar':'MDG',

'Malawi':'MWI','Malaysia':'MYS','Maldives':'MDV','Mali':'MLI','Malta':'MLT','Marshall Islands':'MHL',

'Martinique (French)':'MTQ','Mauritania':'MRT','Mauritius':'MUS','Mexico':'MEX','Micronesia, Federated States of':'FSM',

'Moldova':'MDA','Moldavia':'MDA','Monaco':'MCO','Mongolia':'MNG','Montenegro':'MNE','Montserrat':'MSR',

'Morocco':'MAR','Mozambique':'MOZ','Myanmar':'MMR','Namibia':'NAM','Nepal':'NPL','Netherlands':'NLD',

'Netherlands Antilles':'ANT','New Caledonia':'NCL','New Caledonia (French)':'NCL','New Zealand':'NZL','Nicaragua':'NIC',
```

```
'Nigeria':'NGA','Niger':'NER','Niue':'NIU','Northern Mariana Islands':'MNP','Norway':'NOR','Oman':'OMN',
'Pakistan':'PAK','Palau':'PLW','Panama':'PAN','Papua New Guinea':'PNG','Paraguay':'PRY','Peru':'PER',
'Philippines':'PHL','Pitcairn Island':'PCN','Poland':'POL','Polynesia (French)':'PYF','Portugal':'PRT',
'Puerto Rico':'PRI','Qatar':'QAT','Reunion (French)':'REU','Romania':'ROU','Russia':'RUS','Russian Federation':'RUS',
'Rwanda':'RWA','Saint Kitts and Nevis':'KNA','Saint Lucia':'LCA','Saint Martin':'MAF','Saint Pierre and Miquelon':'SPM',
'Saint Vincent and the Grenadines':'VCT','Saint Vincent & Grenadines':'VCT','S. Georgia & S. Sandwich
Isls.':'SGS','Samoa':'WSM',
'San Marino':'SMR','Saint Helena':'SHN','Sao Tome and Principe':'STP','Saudi Arabia':'SAU','Senegal':'SEN',
'Serbia':'SRB','Seychelles':'SYC','Sierra Leone':'SLE','Singapore':'SGP','Sint Maarten':'SXM',
'Slovakia':'SVK','Slovak Republic':'SVK','Slovenia':'SVN','Solomon Islands':'SLB','Somalia':'SOM','South Africa':'ZAF',
'South Sudan':'SSD','Spain':'ESP','Sri Lanka':'LKA','Sudan':'SDN','Suriname':'SUR',
'Swaziland':'SWZ','Sweden':'SWE','Switzerland':'CHE','Syria':'SYR','Taiwan':'TWN','Tajikistan':'TJK',
'Tadjikistan':'TJK','Tanzania':'TZA','Thailand':'THA','Timor-Leste':'TLS','Togo':'TGO','Tonga':'TON',
'Trinidad and Tobago':'TTO','Tunisia':'TUN','Turkey':'TUR','Turkmenistan':'TKM','Tuvalu':'TUV',
'Uganda':'UGA','Ukraine':'UKR','United Arab Emirates':'ARE','United Kingdom':'GBR','United States':'USA',
'U.S. Minor Outlying Islands':'UMI','Uruguay':'URY','Uzbekistan':'UZB','Vanuatu':'VUT',
'Vatican City State':'VAT','Venezuela':'VEN','Vietnam':'VNM','Virgin Islands':'VGB',
'Virgin Islands U.S.':'VIR','Virgin Islands British':'VGB','West Bank':'WBG','Yemen':'YEM',
'Zaire':'ZAR','Zambia':'ZMB','Zimbabwe':'ZWE','Saint Barthelemy':'BLM','Nauru':'NRU',
'Western Sahara':'ESH','Wallis and Futuna':'WLF','Gaza Strip':'GZA','Micronesia Federated States
of':'FSM','Czechia':'CZE','Congo (Brazzaville)':'COG','Turks and Caicos Islands':'TCA'}

codes = [countries[country] if country != 'I prefer not to say' else None for country in df['country_name']]
df['code']=codes
sbd = df[['code','kids','youths','middle_aged','old_aged','year']]
sbdgroup36 = sbd[sbd['year']==2036].drop('year',axis=1).groupby('code').mean()
sbdgroup16 = sbd[sbd['year']==2016].drop('year',axis=1).groupby('code').mean()
sbdgroup00 = sbd[sbd['year']==2000].drop('year',axis=1).groupby('code').mean()
sbdgroup90 = sbd[sbd['year']==1990].drop('year',axis=1).groupby('code').mean()

fig = go.Figure(data=go.Choropleth(
    locations = sbdgroup36.index,
```

```
 z =
(sbdgroup36['youths']/(sbdgroup36['kids']+sbdgroup36['youths']+sbdgroup36['middle_aged']+sbdgroup36['old_aged']))*1
00,
    text = sbdgroup36.index,
    colorscale = 'tealgrn',
    autocolorscale=False,
    reversescale=False,
    marker_line_color='darkgray',
    marker_line_width=0.5,
    colorbar_tickprefix = '',
    colorbar_title = 'Percentage',
))

fig.update_layout(
    title_text='Percentage of Youths in 2036',
    geo=dict(
        showframe=False,
        showcoastlines=False,
        projection_type='mercator'
    ),
    annotations = [dict(
        x=0.55,
        y=0.1,
        xref='paper',
        yref='paper',
        showarrow = False
    )]
)

fig.show()
```

4] Different Birth Rates in different Countries :





CODE:

```
from pyspark import SparkContext, SparkConf

from pyspark.sql import SparkSession


sc=SparkContext('local')

spark=SparkSession(sc)
```

```
import pandas as pd

import pydoop.hdfs as hd

import plotly.graph_objects as go

from mpl_toolkits.mplot3d import Axes3D

from sklearn.preprocessing import StandardScaler

import matplotlib.pyplot as plt # plotting

import numpy as np # linear algebra


t2 = spark.read.option('header','true').csv("hdfs://localhost:9000/project/birth_death_growth_rates.csv")

with hd.open("/project/birth_death_growth_rates.csv") as b:

   df1 =  pd.read_csv(b)


df1.dataframeName = 'birth_death_growth_rates.csv'

nRow, nCol = df1.shape

print(f'There are {nRow} rows and {nCol} columns')


print(df1.head(5))




countries={'Afghanistan':'AFG',

'Aland Islands':'ALA','Albania':'ALB','Algeria':'DZA','American
Samoa':'ASM','Andorra':'AND','Angola':'AGO','Anguilla':'AIA','Antigua and Barbuda':'ATG',

'Antarctica':'ATA','Argentina':'ARG','Armenia':'ARM','Aruba':'ABW','Australia':'AUS','Austria':'AUT','Azerbaijan':'AZE','Azerba
idjan':'AZE',

'Bahrain':'BHR','Bahamas The':'BHS','Bangladesh':'BGD','Barbados':'BRB','Belarus':'BLR',

'Belgium':'BEL','Belize':'BLZ','Benin':'BEN','Bermuda':'BMU','Bhutan':'BTN','Bolivia':'BOL','Bosnia and
Herzegovina':'BIH','Bosnia-Herzegovina':'BIH',

'Botswana':'BWA','Bouvet Island':'BVT','Brazil':'BRA','British Virgin Islands':'VGB','British Indian Ocean Territory':'IOT',

'Brunei':'BRN','Brunei Darussalam':'BRN','Bulgaria':'BGR','Burkina Faso':'BFA','Burma':'MMR',

'Burundi':'BDI','Cabo Verde':'CPV','Cape Verde':'CPV','Cambodia':'KHM','Cameroon':'CMR',

'Canada':'CAN','Cayman Islands':'CYM','Central African Republic':'CAF','Chad':'TCD','Chile':'CHL',
```

'Christmas Island':'CHR','China':'CHN','Colombia':'COL','Comoros':'COM','Congo (Kinshasa)':'COG','Cook Islands':'COK','Costa Rica':'CRI','Cote d\'Ivoire':'CIV',

"Ivory Coast (Cote D'Ivoire)":'CIV','Croatia':'HRV','Cuba':'CUB','Curacao':'CUW','Cyprus':'CYP',

'Czech Republic':'CZE','Denmark':'DNK','Djibouti':'DJI','Dominica':'DMA','Dominican Republic':'DOM',

'Ecuador':'ECU','Egypt':'EGY','El Salvador':'SLV','Equatorial Guinea':'GNQ','Eritrea':'ERI','Estonia':'EST',

'Ethiopia':'ETH','Falkland Islands (Islas Malvinas)':'FLK','Falkland Islands':'FLK','Faroe Islands':'FRO',

'Fiji':'FJI','Finland':'FIN','France':'FRA','French Polynesia':'PYF','Gabon':'GAB',

'Gambia The':'GMB','Georgia':'GEO','Germany':'DEU','Ghana':'GHA','Gibraltar':'GIB',

'Greece':'GRC','Greenland':'GRL','Grenada':'GRD','Guam':'GUM','Guatemala':'GTM',

'Guernsey':'GGY','Guinea-Bissau':'GNB','Guinea':'GIN','Guyana':'GUY','French Guyana':'GUY','Haiti':'HTI',

'Honduras':'HND','Heard and McDonald Islands':'HMD','Hong Kong':'HKG','Hungary':'HUN','Iceland':'ISL',

'India':'IND','Indonesia':'IDN','Iran':'IRN','Iraq':'IRQ','Ireland':'IRL','Isle of Man':'IMN',

'Israel':'ISR','Italy':'ITA','Jamaica':'JAM','Japan':'JPN','Jersey':'JEY','Jordan':'JOR',

'Kazakhstan':'KAZ','Kenya':'KEN','Kiribati':'KIR','Korea North':'KOR','Korea South':'PRK',

'South Korea':'PRK','North Korea':'KOR','Kosovo':'KSV','Kuwait':'KWT','Kyrgyzstan':'KGZ',

'Laos':'LAO','Latvia':'LVA','Lebanon':'LBN','Lesotho':'LSO','Liberia':'LBR','Libya':'LBY','Liechtenstein':'LIE',

'Lithuania':'LTU','Luxembourg':'LUX','Macau':'MAC','Macedonia':'MKD','Madagascar':'MDG',

'Malawi':'MWI','Malaysia':'MYS','Maldives':'MDV','Mali':'MLI','Malta':'MLT','Marshall Islands':'MHL',

'Martinique (French)':'MTQ','Mauritania':'MRT','Mauritius':'MUS','Mexico':'MEX','Micronesia, Federated States of':'FSM',

'Moldova':'MDA','Moldavia':'MDA','Monaco':'MCO','Mongolia':'MNG','Montenegro':'MNE','Montserrat':'MSR',

'Morocco':'MAR','Mozambique':'MOZ','Myanmar':'MMR','Namibia':'NAM','Nepal':'NPL','Netherlands':'NLD',

'Netherlands Antilles':'ANT','New Caledonia':'NCL','New Caledonia (French)':'NCL','New Zealand':'NZL','Nicaragua':'NIC',

'Nigeria':'NGA','Niger':'NER','Niue':'NIU','Northern Mariana Islands':'MNP','Norway':'NOR','Oman':'OMN',

'Pakistan':'PAK','Palau':'PLW','Panama':'PAN','Papua New Guinea':'PNG','Paraguay':'PRY','Peru':'PER',

'Philippines':'PHL','Pitcairn Island':'PCN','Poland':'POL','Polynesia (French)':'PYF','Portugal':'PRT',

'Puerto Rico':'PRI','Qatar':'QAT','Reunion (French)':'REU','Romania':'ROU','Russia':'RUS','Russian Federation':'RUS',

'Rwanda':'RWA','Saint Kitts and Nevis':'KNA','Saint Lucia':'LCA','Saint Martin':'MAF','Saint Pierre and Miquelon':'SPM',

'Saint Vincent and the Grenadines':'VCT','Saint Vincent & Grenadines':'VCT','S. Georgia & S. Sandwich Isls.':'SGS','Samoa':'WSM',

'San Marino':'SMR','Saint Helena':'SHN','Sao Tome and Principe':'STP','Saudi Arabia':'SAU','Senegal':'SEN',

'Serbia':'SRB','Seychelles':'SYC','Sierra Leone':'SLE','Singapore':'SGP','Sint Maarten':'SXM',

'Slovakia':'SVK','Slovak Republic':'SVK','Slovenia':'SVN','Solomon Islands':'SLB','Somalia':'SOM','South Africa':'ZAF',

'South Sudan':'SSD','Spain':'ESP','Sri Lanka':'LKA','Sudan':'SDN','Suriname':'SUR',

```
'Swaziland':'SWZ','Sweden':'SWE','Switzerland':'CHE','Syria':'SYR','Taiwan':'TWN','Tajikistan':'TJK',
'Tadjikistan':'TJK','Tanzania':'TZA','Thailand':'THA','Timor-Leste':'TLS','Togo':'TGO','Tonga':'TON',
'Trinidad and Tobago':'TTO','Tunisia':'TUN','Turkey':'TUR','Turkmenistan':'TKM','Tuvalu':'TUV',
'Uganda':'UGA','Ukraine':'UKR','United Arab Emirates':'ARE','United Kingdom':'GBR','United States':'USA',
'U.S. Minor Outlying Islands':'UMI','Uruguay':'URY','Uzbekistan':'UZB','Vanuatu':'VUT',
'Vatican City State':'VAT','Venezuela':'VEN','Vietnam':'VNM','Virgin Islands':'VGB',
'Virgin Islands U.S.':'VIR','Virgin Islands British':'VGB','West Bank':'WBG','Yemen':'YEM',
'Zaire':'ZAR','Zambia':'ZMB','Zimbabwe':'ZWE','Saint Barthelemy':'BLM','Nauru':'NRU',
'Western Sahara':'ESH','Wallis and Futuna':'WLF','Gaza Strip':'GZA','Micronesia Federated States
of':'FSM','Czechia':'CZE','Congo (Brazzaville)':'COG','Turks and Caicos Islands':'TCA'}



codes = [countries[country] if country != 'I prefer not to say' else None for country in df1['country_name']]


df1['code']=codes



sbd = df1[['code','crude_birth_rate','year']]
sbdgroup36 = sbd[sbd['year']==2036].drop('year',axis=1).groupby('code').mean()
sbdgroup16 = sbd[sbd['year']==2016].drop('year',axis=1).groupby('code').mean()
sbdgroup00 = sbd[sbd['year']==2000].drop('year',axis=1).groupby('code').mean()
sbdgroup90 = sbd[sbd['year']==1990].drop('year',axis=1).groupby('code').mean()



fig = go.Figure(data=go.Choropleth(
    locations = sbdgroup16.index,
    z = sbdgroup16['crude_birth_rate'],
    text = sbdgroup16.index,
    colorscale = 'oranges',
    autocolorscale=False,
```

```
    reversescale=False,
    marker_line_color='darkgray',
    marker_line_width=0.5,
    colorbar_tickprefix = '',
    colorbar_title = '',
))

fig.update_layout(
    title_text='Birth Rate in 2016',
    geo=dict(
        showframe=False,
        showcoastlines=False,
        projection_type='mercator'
    ),
    annotations = [dict(
        x=0.55,
        y=0.1,
        xref='paper',
        yref='paper',
        showarrow = False
    )]
)

fig.show()
```

-THANK YOU !