VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI 590018

Report on

“Google Play Store App Data Analytics ”

By

Riyanchhi Agrawal (1BM17CS076)
Shehyaaz Khan Nayazi (1BM17CS094)

Under the Guidance of

Mrs. PALLAVI G B
(Assistant Professor)
Department of CSE
BMS College of Engineering

Work carried out at

Department of Computer Science and Engineering
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(Autonomous college under VTU)
P.O. Box No.: 1908, Bull Temple Road, Bangalore-560 019
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BMS COLLEGE OF ENGINEERING

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CERTIFICATE

This is to certify that the BIG DATA and ANALYTICS mini Project titled **“Google Play Store App Data Analytics”** has been carried out by Riyanchhi Agrawal (1BM17CS076), Shehyaaz Khan Nayazi (1BM17CS094) during the academic year 2020-2021.

Signature of the guide
Mrs. PALLAVI G B
Assistant Professor,
Department of Computer Science and Engineering
BMS College of Engineering, Bangalore

BMS COLLEGE OF ENGINEERING

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

DECLARATION

We, Riyanchhi Agrawal (1BM17CS076) , Shehyaaz Khan Nayazi (1BM17CS094), students of 7th Semester, B.E, Department of Computer Science and Engineering,BMS College of Engineering, Bangalore, hereby declare that, this assignment work entitled "Google Play Store App Data Analytics" has been carried out by us under the guidance of **Mrs. PALLAVI G B (**Assistant Professor), Department of CSE, BMS College of Engineering,Bangalore during the academic semester Aug- Dec 2020. We also declare that to the best of our knowledge and belief, the assignment reported here is not from part of any other report by any other students.

Signature of the Candidates

RIYANCHHI AGRAWAL (1BM17CS076)

SHEHYAAZ KHAN NAYAZI (1BM17CS094)

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1. OBJECTIVE

Big data analytics is the use of advanced analytic techniques against very large, diverse data sets that include structured, semi-structured and unstructured data, from different sources, and in different sizes.

Big data analytics applications allow data analysts, data scientists, predictive modelers, statisticians and other analytics professionals to analyze growing volumes of structured transaction data, plus other forms of data that are often left untapped by conventional BI and analytics programs.

This includes a mix of semi-structured and unstructured data. For example, internet clickstream data, web server logs, social media content, text from customer emails and survey responses, mobile phone records, and machine data captured by sensors connected to the internet of things (IoT).

Kaggle, a subsidiary of Google , is an online community of data scientists and machine learning practitioners.

Kaggle allows users to find and publish data sets, explore and build models in a web-based data-science environment, work with other data scientists and machine learning engineers, and enter competitions to solve data science challenges.

Apart from a huge number of public datasets (on Kaggle) , there are not many counterpart datasets available for Google Play Store apps anywhere on the web. Google Play Store uses sophisticated modern-day techniques (like dynamic page load) using JQuery making scraping more challenging.

The Play Store apps data has enormous potential to drive app-making businesses to success. Actionable insights can be drawn for developers to work on and capture the Android market.

The dataset is the web scraped data of Play Store apps for analyzing the Android market. It consists of a total of 4470 records with 13 columns.

2. INTRODUCTION

Analysis of data examines large and different types of data and study their growth and development.

It involves three major stages-

- Pre-processing the data
- Performing Analytics over data
- Visualizing the data.

Data Pre-processing - It involves methods and techniques used to discover knowledge from the data. As data is most likely to be imperfect, inconsistent and sometimes redundant it cannot be directly used in the next step i.e. Data Mining process. Data preprocessing stage enables us to process data by adapting it to the requirements presented by each data mining algorithm.

General steps in pre-processing-

- **Noise Identification:** The veracity of data depends on identifying and removing additional meaningless information present in data. The noise can also be random fluctuations in data values that harm analytic predictions.
- **Data Cleaning:** Detecting and correcting or removing corrupt or inaccurate records in raw data by removing typographical errors and validating values against a known list of entities. Noisy data is also smoothened out or removed in this stage.
- **Data Normalization:** Where skew in data is removed by transforming all variables in data to specific range for better analytics processing.
- **Data Transformation:** Converting data from one format or structure to another format suitable for integration, warehousing and wrangling.
- **Data Integration:** Combining data from multiple sources into an integrated view. As volume of data increases and more machine learning algorithms are applied, data integration becomes more critical.

The **Data Analysis** stage is dedicated to carrying out the actual analysis task, which typically involves one or more types of analytics. This stage can be iterative in nature, especially if the data analysis is exploratory, in which case analysis is repeated until the appropriate pattern or correlation is uncovered. The exploratory analysis approach will be explained shortly, along with confirmatory analysis.

Depending on the type of analytic result required, this stage can be as simple as querying a dataset to compute an aggregation for comparison. On the other hand, it can be as challenging as combining data mining and complex statistical analysis techniques to discover patterns and anomalies or to generate a statistical or mathematical model to depict relationships between variables.

Data analysis can be classified as

- Confirmatory analysis
- Exploratory analysis.

Confirmatory data analysis is a deductive approach where the cause of the phenomenon being investigated is proposed beforehand. The proposed cause or assumption is called a hypothesis. The data is then analyzed to prove or disprove the hypothesis and provide definitive answers to specific questions. Data sampling techniques are typically used. Unexpected findings or anomalies are usually ignored since a predetermined cause was assumed.

Exploratory data analysis is an inductive approach that is closely associated with data mining. No hypothesis or predetermined assumptions are generated. Instead, the data is explored through analysis to develop an understanding of the cause of the phenomenon. Although it may not provide definitive answers, this method provides a general direction that can facilitate the discovery of patterns or anomalies.

Data Visualization- The ability to analyze massive amounts of data and find useful insights carries little value if the only ones that can interpret the results are the analysts.The Data Visualization stage is dedicated to using data visualization techniques and tools to graphically communicate the analysis results for effective interpretation by business users.

Business users need to be able to understand the results in order to obtain value from the analysis and subsequently have the ability to provide feedback.The results of completing the Data Visualization stage provide users with the ability to perform visual analysis, allowing for the discovery of answers to questions that users have not yet even formulated. Visual analysis techniques are covered later in this book.The same results may be presented in a number of different ways, which can influence the interpretation of the results. Consequently, it is important to use the most suitable visualization technique by keeping the business domain in context.

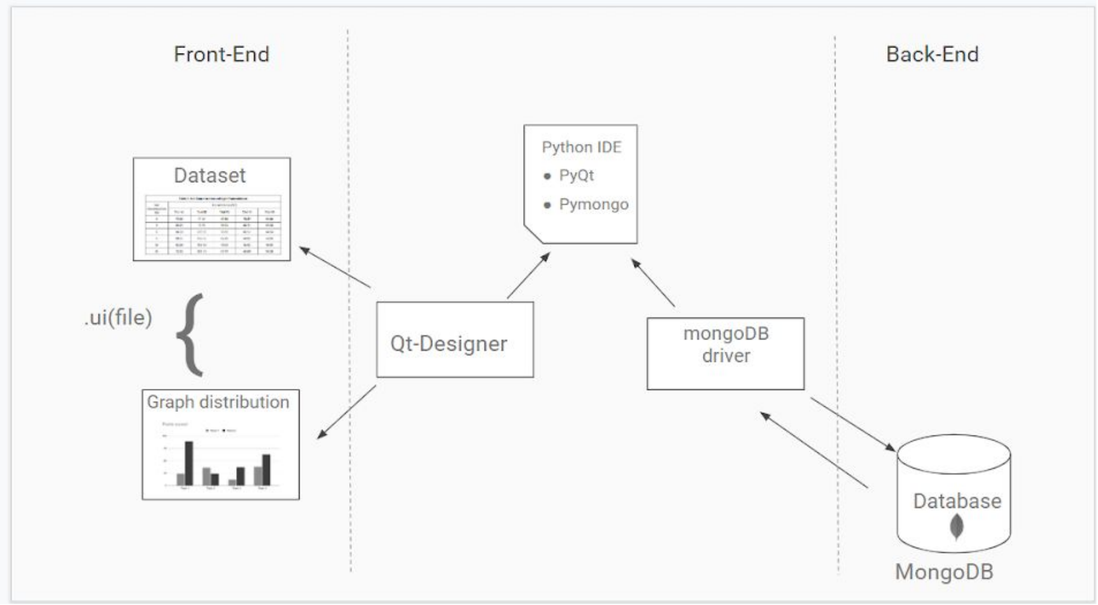
Another aspect to keep in mind is that providing a method of drilling down to comparatively simple statistics is crucial, in order for users to understand how the rolled up or aggregated results were generated.

Here we analyze the data on apps present in Google playstore and based on certain logic we process the data from above mentioned stages. The Play Store apps data has enormous potential to drive app-making businesses to success. Actionable insights can be drawn for developers to work on and capture the Android market. The dataset is the web scraped data of Play Store apps for analyzing the Android market. It consists of a total of 4470 rows with 13 columns.

The dataset contains following columns -

1. App - Application name on Google Playstore
2. Category - General category to which the app belongs.
3. Rating - App rating ranges between 0 to 5.
4. Reviews - No. of user reviews.
5. Size - Size of the app in MB.
6. Installs - No.of Installs.
7. Type - App is capitalized or not.
8. Price - Based on Type charging amount of the particular app. (in $)
9. Content Rating - Based on user age period access given by developer.
10. Genres - A more detailed category to which the application belongs.
11. Last Updated - Date on which the app was last updated.
12. Current Ver - Current version of the app.
13. Android Ver - Android version supported by the app.

3. DESIGN MODULES



Front-End- It is all about the visual aspects of the application that a user can see and experience. Here User can view data set and graphical representation of data set. The files known UI files are named with .ui extensions.

Python driver- Connects front-end and back-end.

Back-End-It is a 'database-side' programming, happens on the database. It's the machinery that works behind the scenes to power those features which users interact with on the client-side.

4. REQUIREMENTS AND FUNCTIONALITY

➢ Functional Requirements-

- ■ The system must be able to import and export the dataset.
- ■ The system must allow the users to insert, update, delete and search the dataset.
- ■ The system must analyse the information contained in the dataset and display the relevant results.

➢ System Requirements-

- ○ System Specifications-
  - ■ Windows(version 7 or above)/Linux OS
  - ■ 500Gb-1Tb HDD/SSD
  - ■ 4GB RAM or above

- Tools Required-
    - VS Code/Pycharm (or any required library supporting IDE)
    - MongoDB
    - Qt Designer

Google Play Store App Data Analytics provides the following productive accessibility on data manipulation -

- **Import / Export Dataset-** MongoDB supports import and export for both JSON and CSV files by exporting MongoDB information we can acquire a human readable text file with your data. By default, information is exported in json format but you can also export to csv (comma separated value).
- **Insert Document-** Any new details of an app can be inserted in the dataset with the help of inserting a document in the dataset. Here with the help of application form, users can perform the functionality.
- **Delete Document(s)-** Similar to insertion any new details of an app can be deleted in the dataset with the help of deleting a document in the dataset. Here with the help of application form, users can perform the deletion with the help of App name.
- **Update Document(s)-** Any details of an app can be updated in the dataset with the help of updating a document in the dataset.
- **Delete Collection-** Whole collection can be dropped at once by accessing the button.
- **Perform Analysis (using graphs)-** With the help of the dropdown menu any graph distribution can be loaded and analyzed . Following seven graphs can be analyzed and represents the dataset in a best way-

    1. Bar graph of distribution of apps across Category.
    2. Pie chart of free and paid apps.
    3. Pie chart of Content rating in each category.
    4. Bar graph of android version.
    5. Histogram of Rating.
    6. Boxplot of Installs.
    7. Ratings vs Size.

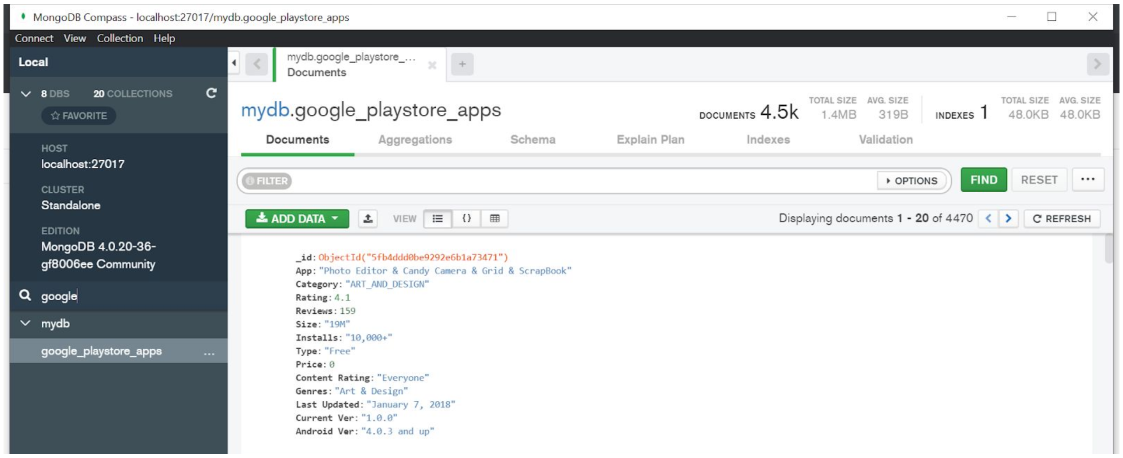
- **Recommendations (using Demographic Filtering)**-Demographic filtering is used to generate top 20 recommended Apps. Based on Rating and Reviews, a score is generated and using the score we can rank the records.

To perform the above mentioned functionalities following python libraries are used-

- **Pymongo** (MongoDB driver for Python)- PyMongo is a Python distribution containing tools for working with MongoDB, and is the recommended way to work with MongoDB from Python. This documentation attempts to explain everything you need to know to use PyMongo.
- **PyQt5-** PyQt is a Python binding of the cross-platform GUI toolkit Qt, implemented as a Python plug-in.
- **Pandas-** Pandas is a software library written for the Python programming language for data manipulation and analysis.
- **Numpy-**NumPy is a Python library used for working with arrays. It also has functions for working in domain of linear algebra, fourier transform, and matrices.
- **Matplotlib-** Matplotlib is a plotting library for the Python programming language and its numerical mathematics extension NumPy. It provides an object-oriented API for embedding plots into applications using general-purpose GUI toolkits.
- **MongoDB** (Backend NoSQL Database)-MongoDB is a cross-platform document-oriented database program. Classified as a NoSQL database program, MongoDB uses JSON-like documents with optional schemas.

5. SCREENSHOTS

Database-



HOST localhost:27017

CLUSTER Standalone

EDITION MongoDB 4.0.20-36-gf8006ee Community

google

mydb

google_playstore_apps

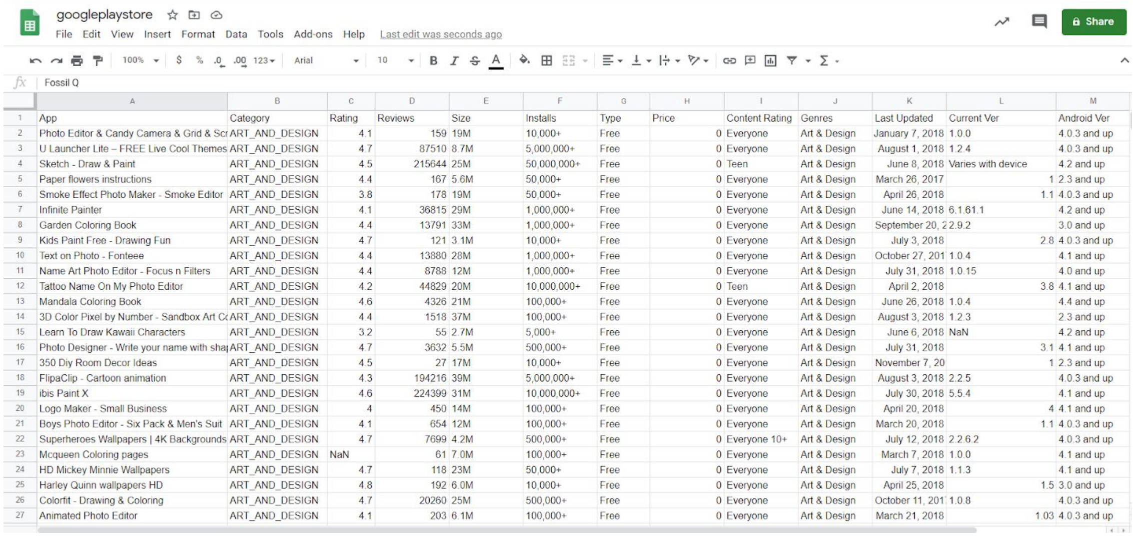
mydb.google_playstore_apps

DOCUMENTS 4.5k TOTAL SIZE 1.4MB AVG. SIZE 319B INDEXES 1 TOTAL SIZE 48.0KB AVG. SIZE 48.0KB

Displaying documents 1 - 20 of 4470

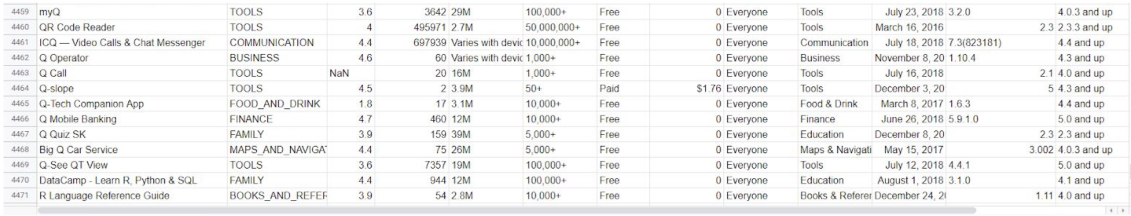
```
_id: ObjectId("5fb4ddd0be9292e6b1a73471")
App: "Photo Editor & Candy Camera & Grid & ScrapBook"
Category: "ART_AND_DESIGN"
Rating: 4.1
Reviews: 159
Size: "19M"
Installs: "10,000+"
Type: "Free"
Price: 0
Content Rating: "Everyone"
Genres: "Art & Design"
Last Updated: "January 7, 2018"
Current Ver: "1.0.0"
Android Ver: "4.0.3 and up"
```

Dataset-


googleplaystore
File Edit View Insert Format Data Tools Add-ons Help
Last edit was seconds ago
Share
100%
$ % .0 .00 123
Arial
10
B I S A
fx

Fossil Q

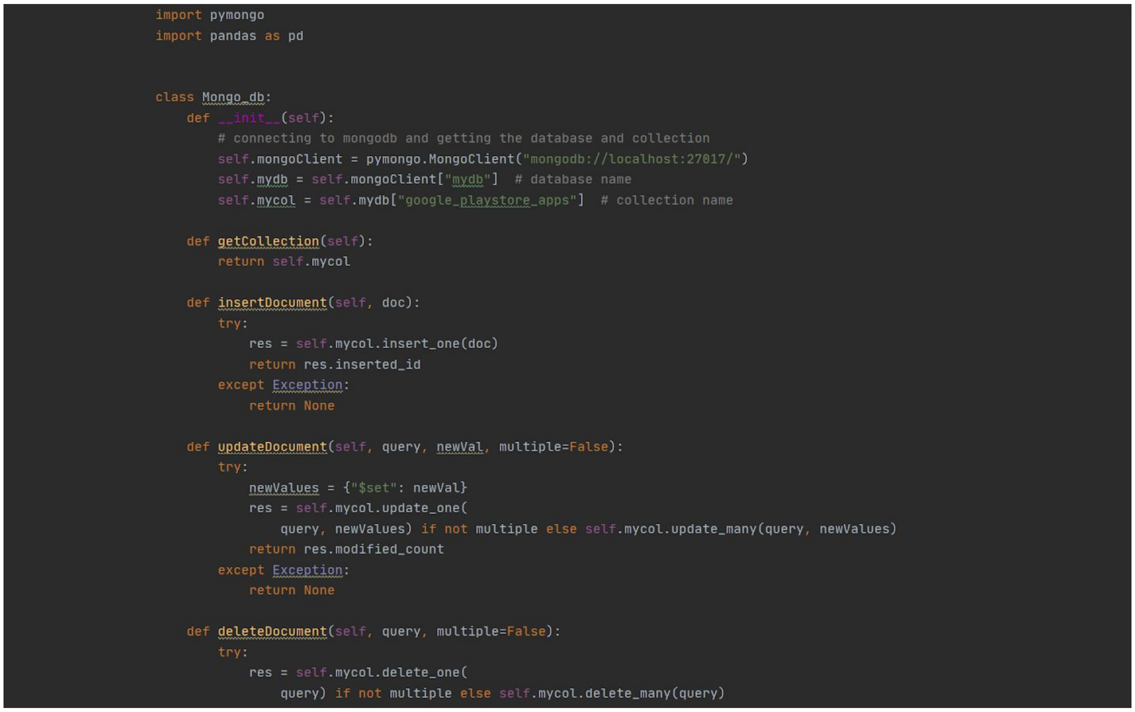
	A	B	C	D	E	F	G	H	I	J	K	L	M
1	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	Current Ver	Android Ver
2	Photo Editor & Candy Camera & Grid & Scr	ART_AND_DESIGN	4.1	159	19M	10,000+	Free	0	Everyone	Art & Design	January 7, 2018	1.0.0	4.0.3 and up
3	U Launcher Lite – FREE Live Cool Themes	ART_AND_DESIGN	4.7	87510	8.7M	5,000,000+	Free	0	Everyone	Art & Design	August 1, 2018	1.2.4	4.0.3 and up
4	Sketch - Draw & Paint	ART_AND_DESIGN	4.5	215644	25M	50,000,000+	Free	0	Teen	Art & Design	June 8, 2018	Varies with device	4.2 and up
5	Paper flowers instructions	ART_AND_DESIGN	4.4	167	5.6M	50,000+	Free	0	Everyone	Art & Design	March 26, 2017	1	2.3 and up
6	Smoke Effect Photo Maker - Smoke Editor	ART_AND_DESIGN	3.8	178	19M	50,000+	Free	0	Everyone	Art & Design	April 26, 2018	1.1	4.0.3 and up
7	Infinite Painter	ART_AND_DESIGN	4.1	36815	29M	1,000,000+	Free	0	Everyone	Art & Design	June 14, 2018	6.1.61.1	4.2 and up
8	Garden Coloring Book	ART_AND_DESIGN	4.4	13791	33M	1,000,000+	Free	0	Everyone	Art & Design	September 20, 2	2.9.2	3.0 and up
9	Kids Paint Free - Drawing Fun	ART_AND_DESIGN	4.7	121	3.1M	10,000+	Free	0	Everyone	Art & Design	July 3, 2018	2.8	4.0.3 and up
10	Text on Photo - Fonteee	ART_AND_DESIGN	4.4	13880	28M	1,000,000+	Free	0	Everyone	Art & Design	October 27, 201	1.0.4	4.1 and up
11	Name Art Photo Editor - Focus n Filters	ART_AND_DESIGN	4.4	8788	12M	1,000,000+	Free	0	Everyone	Art & Design	July 31, 2018	1.0.15	4.0 and up
12	Tattoo Name On My Photo Editor	ART_AND_DESIGN	4.2	44829	20M	10,000,000+	Free	0	Teen	Art & Design	April 2, 2018	3.8	4.1 and up
13	Mandala Coloring Book	ART_AND_DESIGN	4.6	4326	21M	100,000+	Free	0	Everyone	Art & Design	June 26, 2018	1.0.4	4.4 and up
14	3D Color Pixel by Number - Sandbox Art Co	ART_AND_DESIGN	4.4	1518	37M	100,000+	Free	0	Everyone	Art & Design	August 3, 2018	1.2.3	2.3 and up
15	Learn To Draw Kawaii Characters	ART_AND_DESIGN	3.2	55	2.7M	5,000+	Free	0	Everyone	Art & Design	June 6, 2018	NaN	4.2 and up
16	Photo Designer - Write your name with sha	ART_AND_DESIGN	4.7	3632	5.5M	500,000+	Free	0	Everyone	Art & Design	July 31, 2018	3.1	4.1 and up
17	350 Diy Room Decor Ideas	ART_AND_DESIGN	4.5	27	17M	10,000+	Free	0	Everyone	Art & Design	November 7, 20	1	2.3 and up
18	FlipaClip - Cartoon animation	ART_AND_DESIGN	4.3	194216	39M	5,000,000+	Free	0	Everyone	Art & Design	August 3, 2018	2.2.5	4.0.3 and up
19	ibis Paint X	ART_AND_DESIGN	4.6	224399	31M	10,000,000+	Free	0	Everyone	Art & Design	July 30, 2018	5.5.4	4.1 and up
20	Logo Maker - Small Business	ART_AND_DESIGN	4	450	14M	100,000+	Free	0	Everyone	Art & Design	April 20, 2018	4	4.1 and up
21	Boys Photo Editor - Six Pack & Men's Suit	ART_AND_DESIGN	4.1	654	12M	100,000+	Free	0	Everyone	Art & Design	March 20, 2018	1.1	4.0.3 and up
22	Superheroes Wallpapers | 4K Backgrounds	ART_AND_DESIGN	4.7	7699	4.2M	500,000+	Free	0	Everyone 10+	Art & Design	July 12, 2018	2.2.6.2	4.0.3 and up
23	Mcqueen Coloring pages	ART_AND_DESIGN	NaN	61	7.0M	100,000+	Free	0	Everyone	Art & Design	March 7, 2018	1.0.0	4.1 and up
24	HD Mickey Minnie Wallpapers	ART_AND_DESIGN	4.7	118	23M	50,000+	Free	0	Everyone	Art & Design	July 7, 2018	1.1.3	4.1 and up
25	Harley Quinn wallpapers HD	ART_AND_DESIGN	4.8	192	6.0M	10,000+	Free	0	Everyone	Art & Design	April 25, 2018	1.5	3.0 and up
26	Colorfit - Drawing & Coloring	ART_AND_DESIGN	4.7	20260	25M	500,000+	Free	0	Everyone	Art & Design	October 11, 201	1.0.8	4.0.3 and up
27	Animated Photo Editor	ART_AND_DESIGN	4.1	203	6.1M	100,000+	Free	0	Everyone	Art & Design	March 21, 2018	1.03	4.0.3 and up



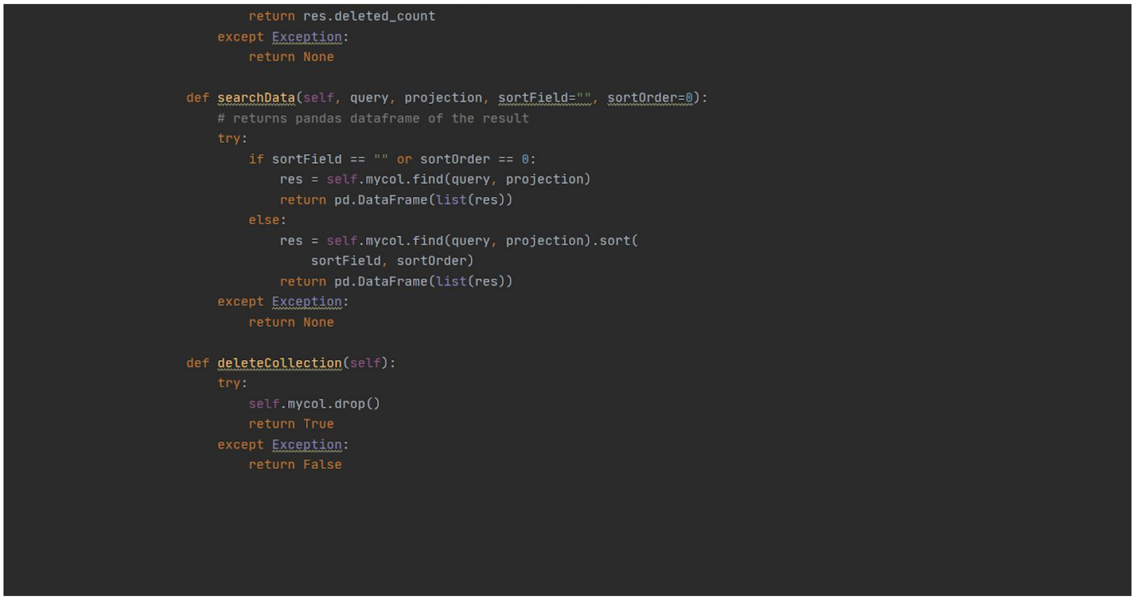
4459	myQ	TOOLS	3.6	3642	29M	100,000+	Free	0	Everyone	Tools	July 23, 2018	3.2.0	4.0.3 and up
4460	QR Code Reader	TOOLS	4	495971	2.7M	50,000,000+	Free	0	Everyone	Tools	March 16, 2016	2.3	2.3.3 and up
4461	ICQ — Video Calls & Chat Messenger	COMMUNICATION	4.4	697939	Varies with devic	10,000,000+	Free	0	Everyone	Communication	July 18, 2018	7.3(823181)	4.4 and up
4462	Q Operator	BUSINESS	4.6	60	Varies with devic	1,000+	Free	0	Everyone	Business	November 8, 20	1.10.4	4.3 and up
4463	Q Call	TOOLS	NaN	20	16M	1,000+	Free	0	Everyone	Tools	July 16, 2018	2.1	4.0 and up
4464	Q-slope	TOOLS	4.5	2	3.9M	50+	Paid	$1.76	Everyone	Tools	December 3, 20	5	4.3 and up
4465	Q-Tech Companion App	FOOD_AND_DRINK	1.8	17	3.1M	10,000+	Free	0	Everyone	Food & Drink	March 8, 2017	1.6.3	4.4 and up
4466	Q Mobile Banking	FINANCE	4.7	460	12M	10,000+	Free	0	Everyone	Finance	June 26, 2018	5.9.1.0	5.0 and up
4467	Q Quiz SK	FAMILY	3.9	159	39M	5,000+	Free	0	Everyone	Education	December 8, 20	2.3	2.3 and up
4468	Big Q Car Service	MAPS_AND_NAVIGAT	4.4	75	26M	5,000+	Free	0	Everyone	Maps & Navigati	May 15, 2017	3.002	4.0.3 and up
4469	Q-See QT View	TOOLS	3.6	7357	19M	100,000+	Free	0	Everyone	Tools	July 12, 2018	4.4.1	5.0 and up
4470	DataCamp - Learn R, Python & SQL	FAMILY	4.4	944	12M	100,000+	Free	0	Everyone	Education	August 1, 2018	3.1.0	4.1 and up
4471	R Language Reference Guide	BOOKS_AND_REFEF	3.9	54	2.8M	10,000+	Free	0	Everyone	Books & Referer	December 24, 2(	1.11	4.0 and up

Code-

mongo_db.py

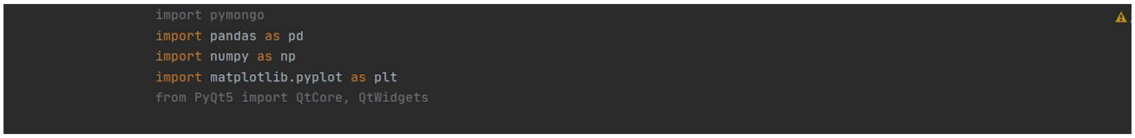


```
import pymongo
import pandas as pd


class Mongo_db:
    def __init__(self):
        # connecting to mongodb and getting the database and collection
        self.mongoClient = pymongo.MongoClient("mongodb://localhost:27017/")
        self.mydb = self.mongoClient["mydb"]  # database name
        self.mycol = self.mydb["google_playstore_apps"]  # collection name

    def getCollection(self):
        return self.mycol

    def insertDocument(self, doc):
        try:
            res = self.mycol.insert_one(doc)
            return res.inserted_id
        except Exception:
            return None

    def updateDocument(self, query, newVal, multiple=False):
        try:
            newValues = {"$set": newVal}
            res = self.mycol.update_one(
                query, newValues) if not multiple else self.mycol.update_many(query, newValues)
            return res.modified_count
        except Exception:
            return None

    def deleteDocument(self, query, multiple=False):
        try:
            res = self.mycol.delete_one(
                query) if not multiple else self.mycol.delete_many(query)
```

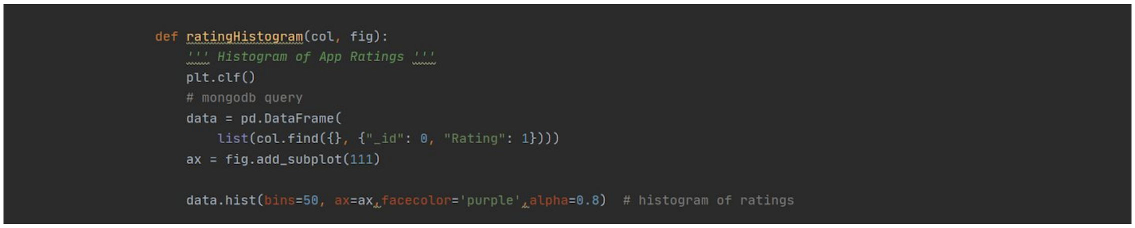


```
            return res.deleted_count
        except Exception:
            return None

    def searchData(self, query, projection, sortField="", sortOrder=0):
        # returns pandas dataframe of the result
        try:
            if sortField == "" or sortOrder == 0:
                res = self.mycol.find(query, projection)
                return pd.DataFrame(list(res))
            else:
                res = self.mycol.find(query, projection).sort(
                    sortField, sortOrder)
                return pd.DataFrame(list(res))
        except Exception:
            return None

    def deleteCollection(self):
        try:
            self.mycol.drop()
            return True
        except Exception:
            return False
```

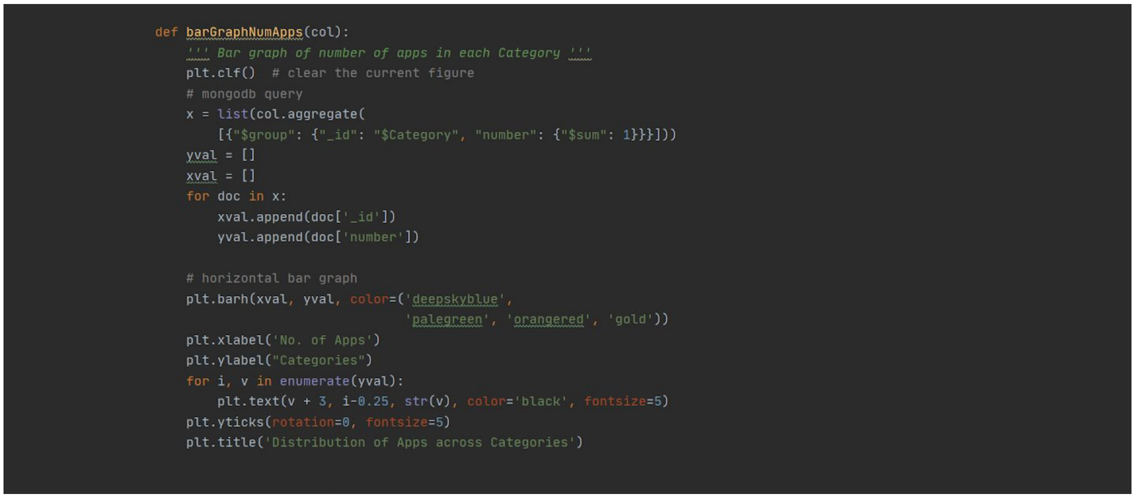
graph.py



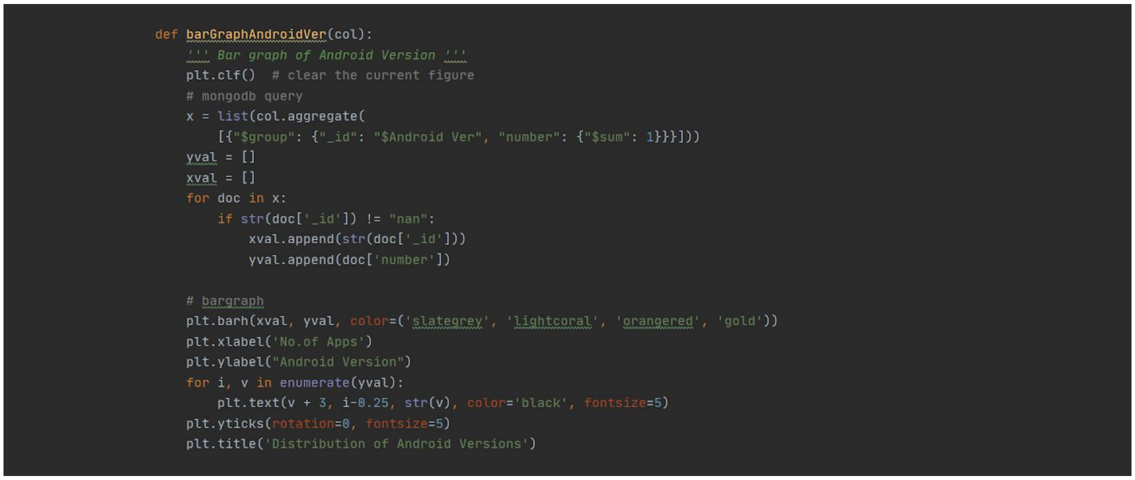
```python
import pymongo
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from PyQt5 import QtCore, QtWidgets
```



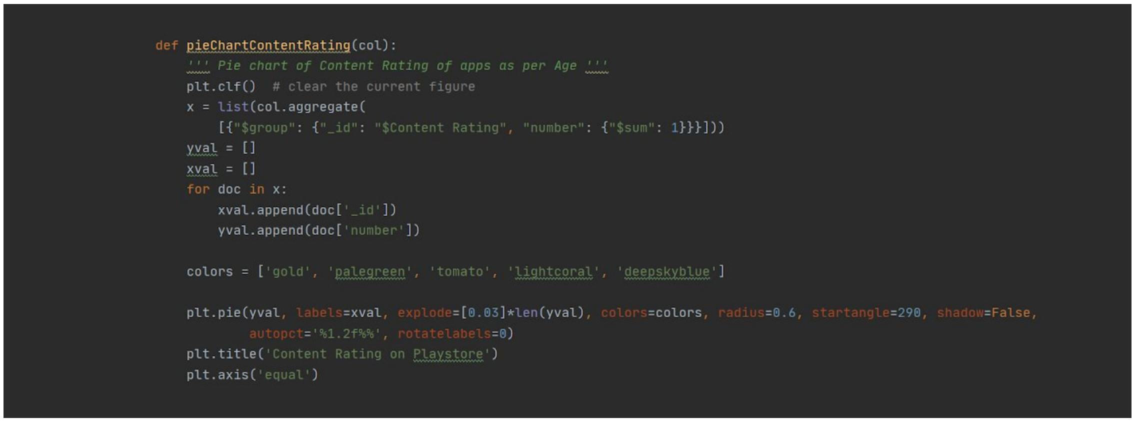
```python
def ratingHistogram(col, fig):
    ''' Histogram of App Ratings '''
    plt.clf()
    # mongodb query
    data = pd.DataFrame(
        list(col.find({}, {"_id": 0, "Rating": 1})))
    ax = fig.add_subplot(111)

    data.hist(bins=50, ax=ax,facecolor='purple',alpha=0.8)  # histogram of ratings
```



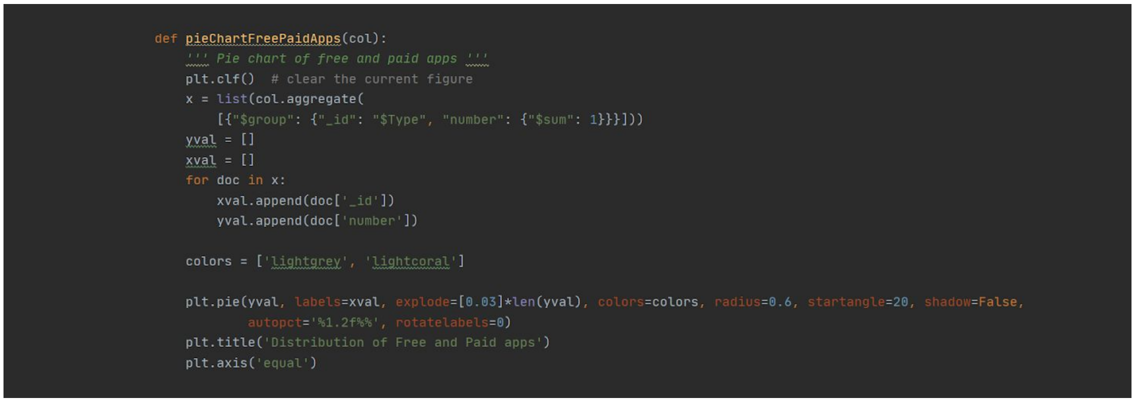
```python
def barGraphNumApps(col):
    ''' Bar graph of number of apps in each Category '''
    plt.clf()  # clear the current figure
    # mongodb query
    x = list(col.aggregate(
        [{"$group": {"_id": "$Category", "number": {"$sum": 1}}}]))
    yval = []
    xval = []
    for doc in x:
        xval.append(doc['_id'])
        yval.append(doc['number'])

    # horizontal bar graph
    plt.barh(xval, yval, color=('deepskyblue',
                                'palegreen', 'orangered', 'gold'))
    plt.xlabel('No. of Apps')
    plt.ylabel("Categories")
    for i, v in enumerate(yval):
        plt.text(v + 3, i-0.25, str(v), color='black', fontsize=5)
    plt.yticks(rotation=0, fontsize=5)
    plt.title('Distribution of Apps across Categories')
```



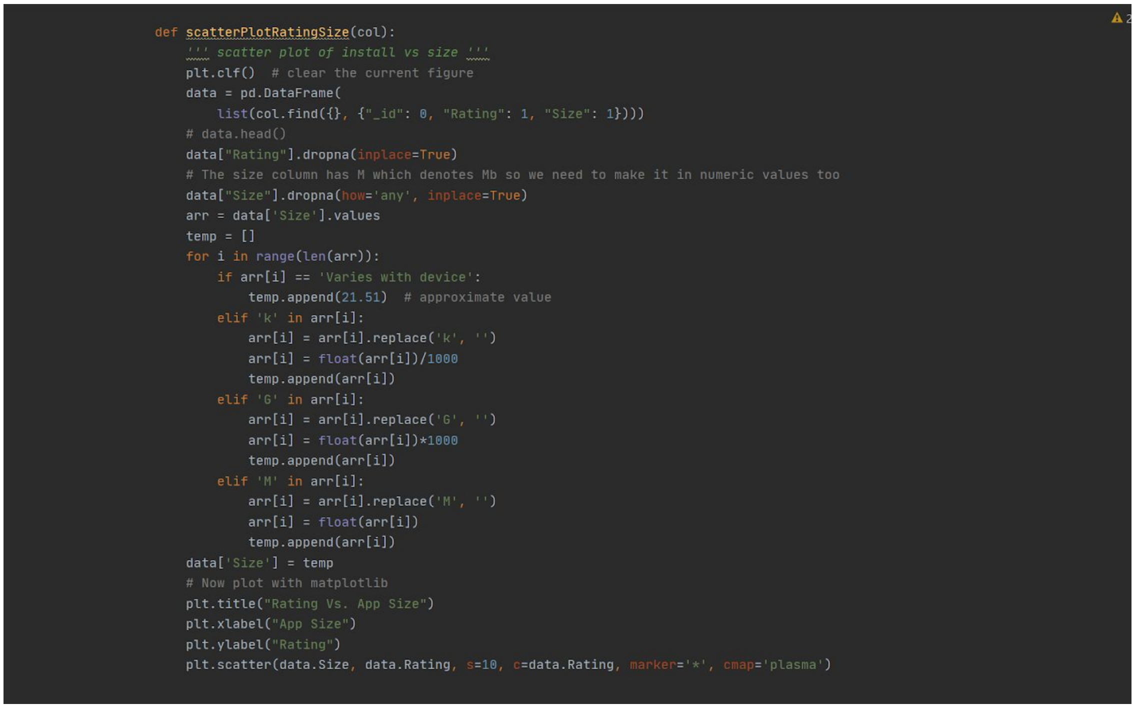
```python
def barGraphAndroidVer(col):
    ''' Bar graph of Android Version '''
    plt.clf()  # clear the current figure
    # mongodb query
    x = list(col.aggregate(
        [{"$group": {"_id": "$Android Ver", "number": {"$sum": 1}}}]))
    yval = []
    xval = []
    for doc in x:
        if str(doc['_id']) != "nan":
            xval.append(str(doc['_id']))
            yval.append(doc['number'])

    # bargraph
    plt.barh(xval, yval, color=('slategrey', 'lightcoral', 'orangered', 'gold'))
    plt.xlabel('No.of Apps')
    plt.ylabel("Android Version")
    for i, v in enumerate(yval):
        plt.text(v + 3, i-0.25, str(v), color='black', fontsize=5)
    plt.yticks(rotation=0, fontsize=5)
    plt.title('Distribution of Android Versions')
```



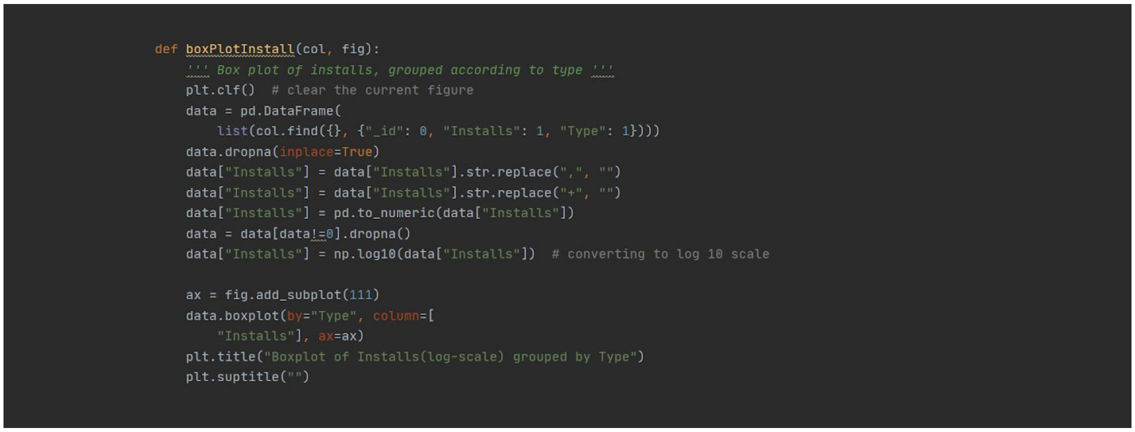
```python
def pieChartContentRating(col):
    ''' Pie chart of Content Rating of apps as per Age '''
    plt.clf()  # clear the current figure
    x = list(col.aggregate(
        [{"$group": {"_id": "$Content Rating", "number": {"$sum": 1}}}]))
    yval = []
    xval = []
    for doc in x:
        xval.append(doc['_id'])
        yval.append(doc['number'])

    colors = ['gold', 'palegreen', 'tomato', 'lightcoral', 'deepskyblue']

    plt.pie(yval, labels=xval, explode=[0.03]*len(yval), colors=colors, radius=0.6, startangle=290, shadow=False,
            autopct='%1.2f%%', rotatelabels=0)
    plt.title('Content Rating on Playstore')
    plt.axis('equal')
```



```python
def pieChartFreePaidApps(col):
    ''' Pie chart of free and paid apps '''
    plt.clf()  # clear the current figure
    x = list(col.aggregate(
        [{"$group": {"_id": "$Type", "number": {"$sum": 1}}}]))
    yval = []
    xval = []
    for doc in x:
        xval.append(doc['_id'])
        yval.append(doc['number'])

    colors = ['lightgrey', 'lightcoral']

    plt.pie(yval, labels=xval, explode=[0.03]*len(yval), colors=colors, radius=0.6, startangle=20, shadow=False,
            autopct='%1.2f%%', rotatelabels=0)
    plt.title('Distribution of Free and Paid apps')
    plt.axis('equal')
```

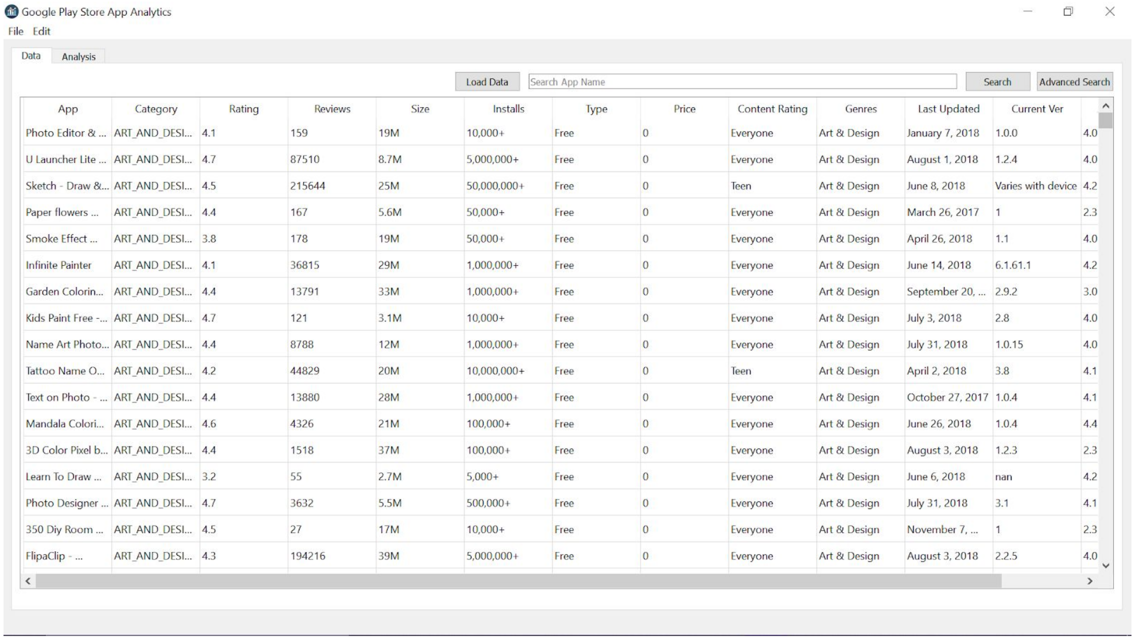


```python
def scatterPlotRatingSize(col):
    ''' scatter plot of install vs size '''
    plt.clf()  # clear the current figure
    data = pd.DataFrame(
        list(col.find({}, {"_id": 0, "Rating": 1, "Size": 1})))
    # data.head()
    data["Rating"].dropna(inplace=True)
    # The size column has M which denotes Mb so we need to make it in numeric values too
    data["Size"].dropna(how='any', inplace=True)
    arr = data['Size'].values
    temp = []
    for i in range(len(arr)):
        if arr[i] == 'Varies with device':
            temp.append(21.51)  # approximate value
        elif 'k' in arr[i]:
            arr[i] = arr[i].replace('k', '')
            arr[i] = float(arr[i])/1000
            temp.append(arr[i])
        elif 'G' in arr[i]:
            arr[i] = arr[i].replace('G', '')
            arr[i] = float(arr[i])*1000
            temp.append(arr[i])
        elif 'M' in arr[i]:
            arr[i] = arr[i].replace('M', '')
            arr[i] = float(arr[i])
            temp.append(arr[i])
    data['Size'] = temp
    # Now plot with matplotlib
    plt.title("Rating Vs. App Size")
    plt.xlabel("App Size")
    plt.ylabel("Rating")
    plt.scatter(data.Size, data.Rating, s=10, c=data.Rating, marker='*', cmap='plasma')
```



```
def boxPlotInstall(col, fig):
    ''' Box plot of installs, grouped according to type '''
    plt.clf()  # clear the current figure
    data = pd.DataFrame(
        list(col.find({}, {"_id": 0, "Installs": 1, "Type": 1})))
    data.dropna(inplace=True)
    data["Installs"] = data["Installs"].str.replace(",", "")
    data["Installs"] = data["Installs"].str.replace("+", "")
    data["Installs"] = pd.to_numeric(data["Installs"])
    data = data[data!=0].dropna()
    data["Installs"] = np.log10(data["Installs"])  # converting to log 10 scale

    ax = fig.add_subplot(111)
    data.boxplot(by="Type", column=[
        "Installs"], ax=ax)
    plt.title("Boxplot of Installs(log-scale) grouped by Type")
    plt.suptitle("")
```

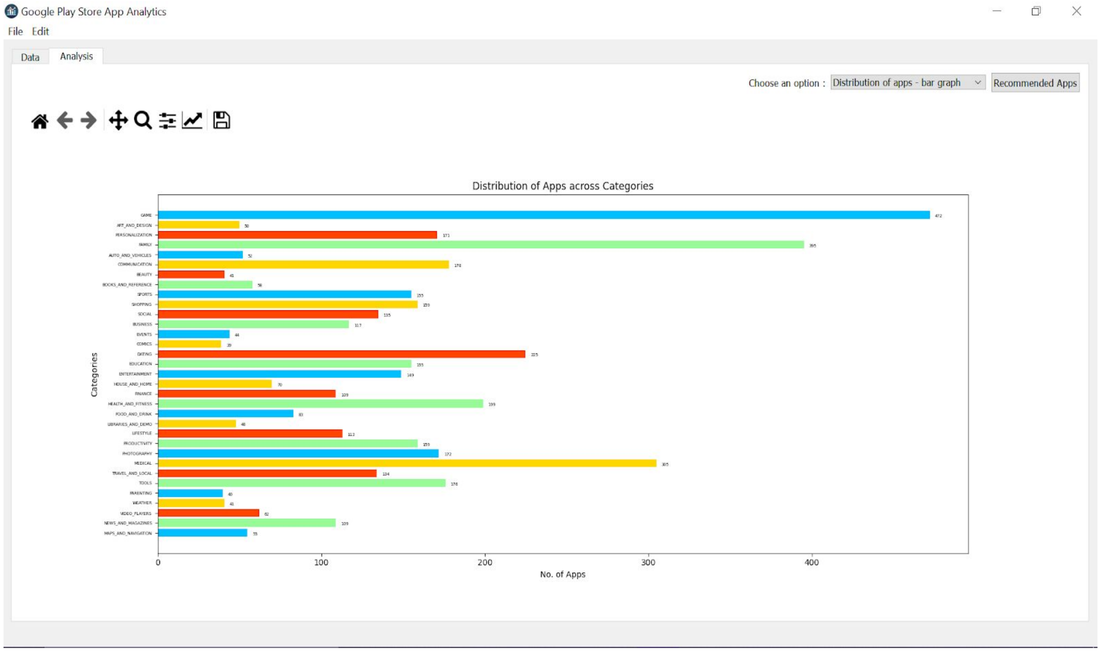
Output-



App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	Current Ver	
Photo Editor & ...	ART_AND_DESI...	4.1	159	19M	10,000+	Free	0	Everyone	Art & Design	January 7, 2018	1.0.0	4.0
U Launcher Lite ...	ART_AND_DESI...	4.7	87510	8.7M	5,000,000+	Free	0	Everyone	Art & Design	August 1, 2018	1.2.4	4.0
Sketch - Draw &...	ART_AND_DESI...	4.5	215644	25M	50,000,000+	Free	0	Teen	Art & Design	June 8, 2018	Varies with device	4.2
Paper flowers ...	ART_AND_DESI...	4.4	167	5.6M	50,000+	Free	0	Everyone	Art & Design	March 26, 2017	1	2.3
Smoke Effect ...	ART_AND_DESI...	3.8	178	19M	50,000+	Free	0	Everyone	Art & Design	April 26, 2018	1.1	4.0
Infinite Painter	ART_AND_DESI...	4.1	36815	29M	1,000,000+	Free	0	Everyone	Art & Design	June 14, 2018	6.1.61.1	4.2
Garden Colorin...	ART_AND_DESI...	4.4	13791	33M	1,000,000+	Free	0	Everyone	Art & Design	September 20, ...	2.9.2	3.0
Kids Paint Free -...	ART_AND_DESI...	4.7	121	3.1M	10,000+	Free	0	Everyone	Art & Design	July 3, 2018	2.8	4.0
Name Art Photo...	ART_AND_DESI...	4.4	8788	12M	1,000,000+	Free	0	Everyone	Art & Design	July 31, 2018	1.0.15	4.0
Tattoo Name O...	ART_AND_DESI...	4.2	44829	20M	10,000,000+	Free	0	Teen	Art & Design	April 2, 2018	3.8	4.1
Text on Photo - ...	ART_AND_DESI...	4.4	13880	28M	1,000,000+	Free	0	Everyone	Art & Design	October 27, 2017	1.0.4	4.1
Mandala Colori...	ART_AND_DESI...	4.6	4326	21M	100,000+	Free	0	Everyone	Art & Design	June 26, 2018	1.0.4	4.4
3D Color Pixel b...	ART_AND_DESI...	4.4	1518	37M	100,000+	Free	0	Everyone	Art & Design	August 3, 2018	1.2.3	2.3
Learn To Draw ...	ART_AND_DESI...	3.2	55	2.7M	5,000+	Free	0	Everyone	Art & Design	June 6, 2018	nan	4.2
Photo Designer ...	ART_AND_DESI...	4.7	3632	5.5M	500,000+	Free	0	Everyone	Art & Design	July 31, 2018	3.1	4.1
350 Diy Room ...	ART_AND_DESI...	4.5	27	17M	10,000+	Free	0	Everyone	Art & Design	November 7, ...	1	2.3
FlipaClip - ...	ART_AND_DESI...	4.3	194216	39M	5,000,000+	Free	0	Everyone	Art & Design	August 3, 2018	2.2.5	4.0

Graph Analysis -

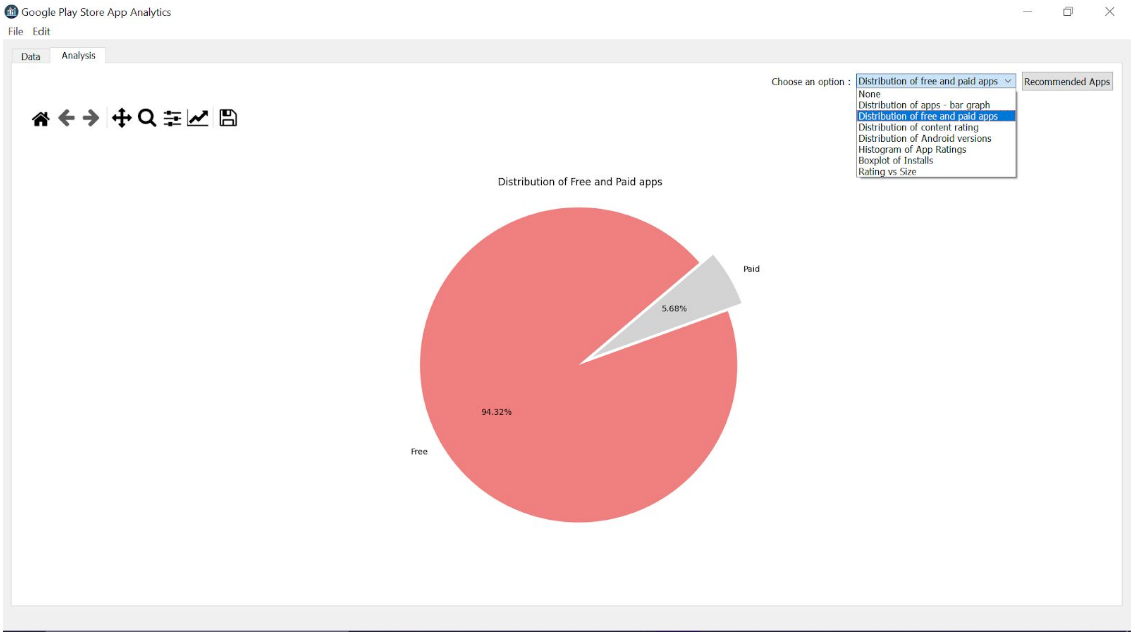
a. Distribution of Apps across Categories



Choose an option : Distribution of apps - bar graph

This graph shows that the categories with the maximum number of apps are Gaming, Family and Medical. This indicates that Gaming, Family and Medical are popular categories.

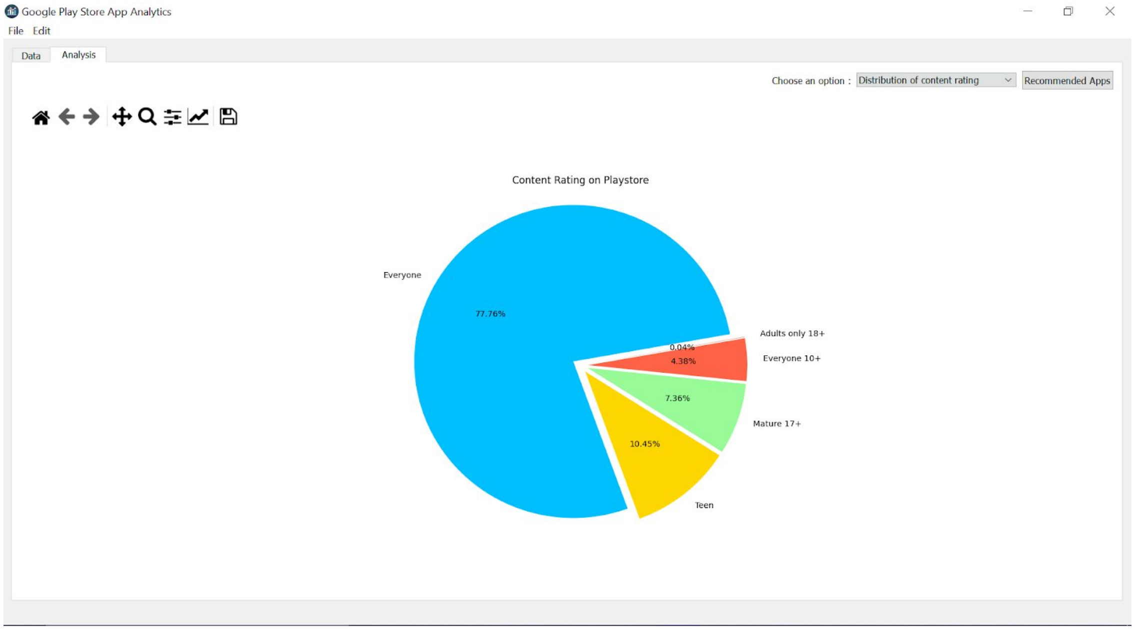
b. Distribution of Free and Paid apps


Google Play Store App Analytics
File
Edit
Data
Analysis
None
Distribution of apps - bar graph
Distribution of free and paid apps
Distribution of content rating
Distribution of Android versions
Histogram of App Ratings
Boxplot of Installs
Rating vs Size
Recommended Apps
Distribution of Free and Paid apps
Paid
5.68%
94.32%
Free

Choose an option : Distribution of free and paid apps

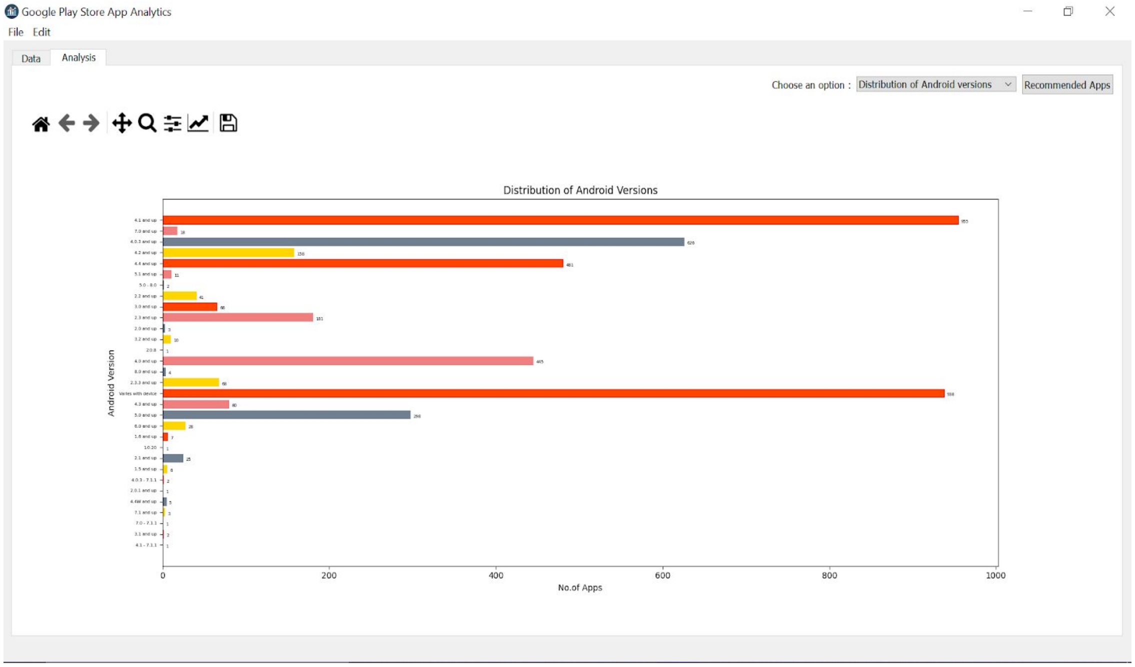
This graph shows that the distribution of Free apps is much more than the distribution of Paid apps, which is an indicator of the higher popularity of free apps compared to paid apps.

c. Distribution of Content Rating



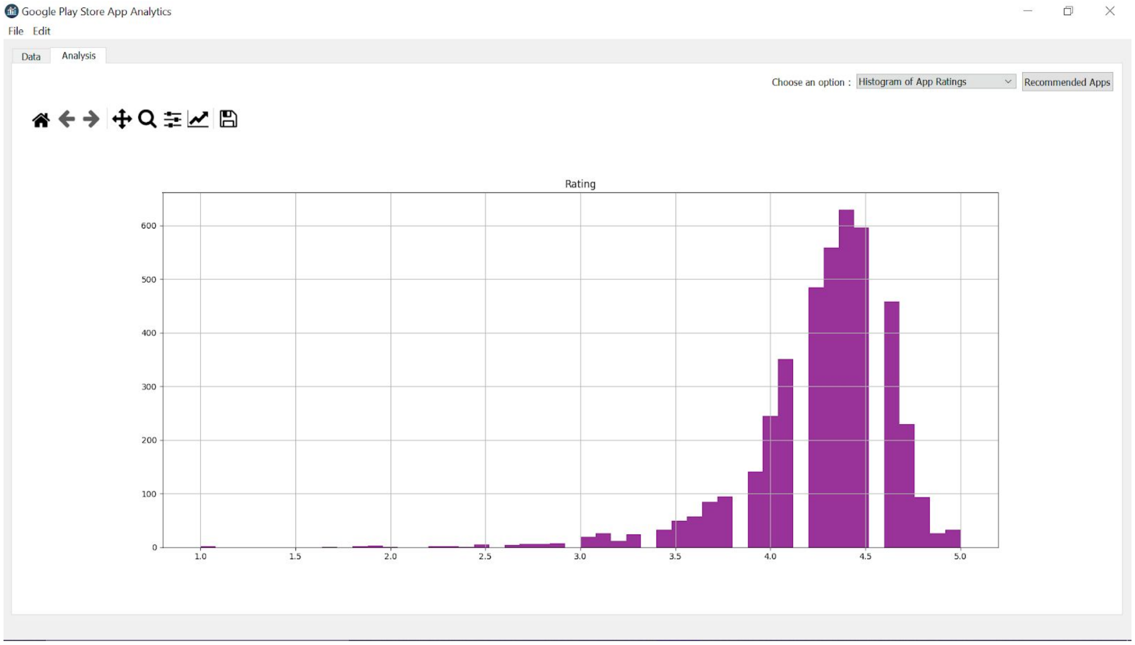
This pie chart shows that the majority of the apps provide content that is suitable for everyone, appealing to the majority of the audience. Also, very few apps provide content that is suitable only for adults.

d. Distribution of Android Versions



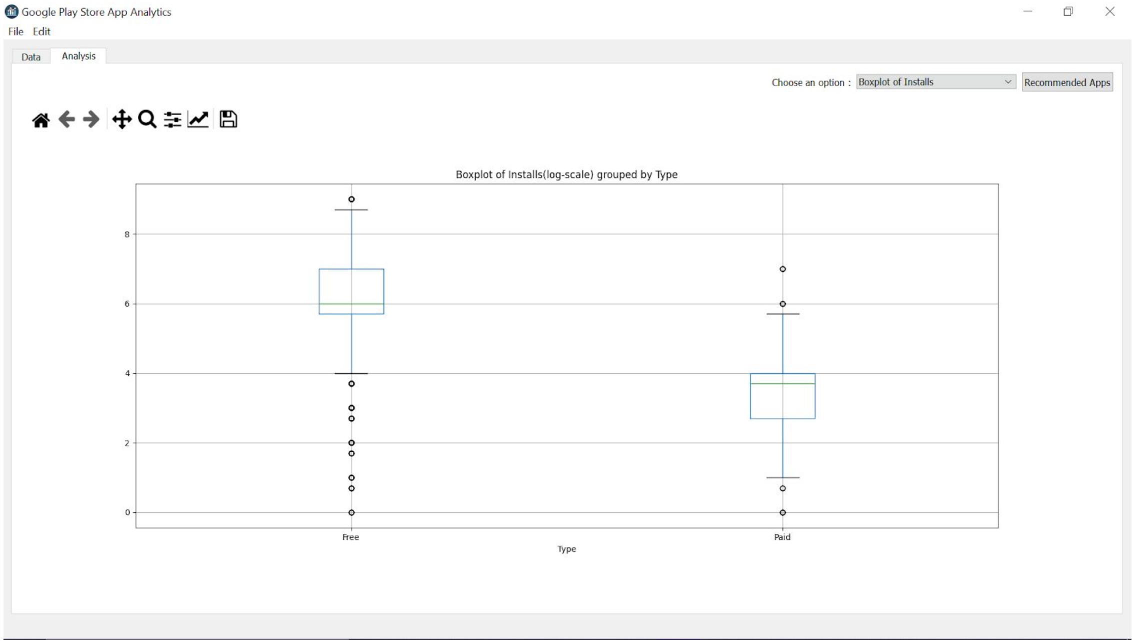
This bar graph shows that the majority of the apps support Android 4.1 and above. Also, the Android version varies for a significant number of apps.

e. Histogram of App Ratings



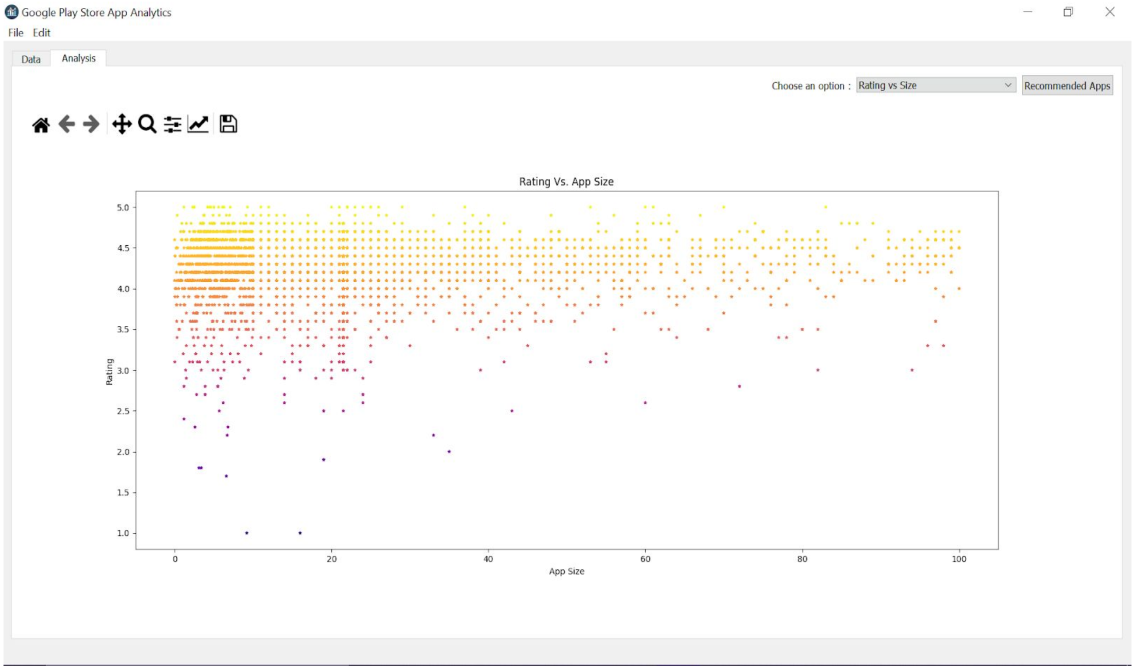
This histogram indicates that the majority of the apps have a rating above 4.0, showing that most of the apps provide quality content to the users.

f. Boxplots of Installs



The boxplot of App installs for free and paid apps shows that the number of installs of Free apps is higher than that of Paid apps. This means that users tend to download free apps more than paid apps.

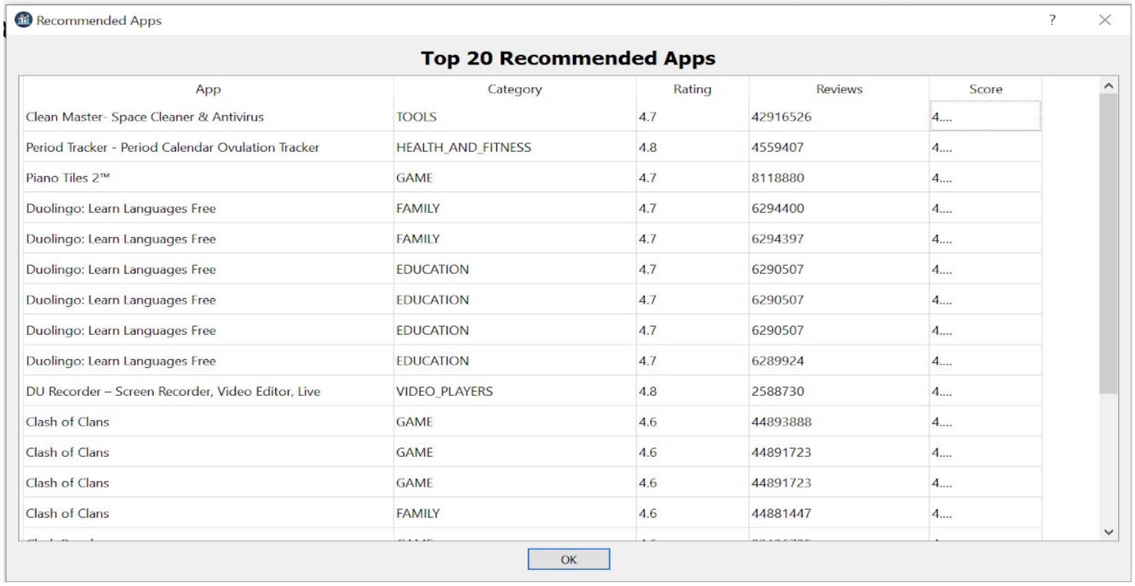
g. Scatterplot of Rating vs Size



The scatterplot of App Rating vs App size shows that most of the high rated apps do not consume a lot of space, i.e., are light-weighted apps.

Though bulky apps are also highly rated, the frequency is very less compared to light-weighted apps (size<40MB).

App Recommendations -



Top 20 Recommended Apps

App	Category	Rating	Reviews	Score
Clean Master- Space Cleaner & Antivirus	TOOLS	4.7	42916526	4....
Period Tracker - Period Calendar Ovulation Tracker	HEALTH_AND_FITNESS	4.8	4559407	4....
Piano Tiles 2™	GAME	4.7	8118880	4....
Duolingo: Learn Languages Free	FAMILY	4.7	6294400	4....
Duolingo: Learn Languages Free	FAMILY	4.7	6294397	4....
Duolingo: Learn Languages Free	EDUCATION	4.7	6290507	4....
Duolingo: Learn Languages Free	EDUCATION	4.7	6290507	4....
Duolingo: Learn Languages Free	EDUCATION	4.7	6290507	4....
Duolingo: Learn Languages Free	EDUCATION	4.7	6289924	4....
DU Recorder – Screen Recorder, Video Editor, Live	VIDEO_PLAYERS	4.8	2588730	4....
Clash of Clans	GAME	4.6	44893888	4....
Clash of Clans	GAME	4.6	44891723	4....
Clash of Clans	GAME	4.6	44891723	4....
Clash of Clans	FAMILY	4.6	44881447	4....

Using Demographic Filtering, the top 20 best apps are recommended. The recommendation is based on a score calculated as follows :

$$Score \;=\; \left(\frac{v}{v+m}\right)R + \left(\frac{m}{v+m}\right)C$$

Here,

- v is the number of votes for the app;
- m is the minimum votes required to be listed in the chart;
- R is the average rating of the app; And
- C is the mean vote across the whole report

6. NEW LEARNINGS FROM THE PROGRAMMING ASSIGNMENT

Data extraction and manipulation on huge amounts of data has added to the experience of the learning journey. The application of big data analysis, treats the ways to analyze, systematically extract information from, or otherwise deal with data sets that are too large or complex to be dealt with by traditional data-processing application software.

Analysis of big data allows analysts, researchers and business users to make better and faster decisions using data that was previously inaccessible or unusable. Businesses can use advanced analytics techniques such as text analytics, machine learning, predictive analytics, data mining, statistics and natural language processing to gain new insights from previously untapped data sources independently or together with existing enterprise data.

7. FUTURE ENHANCEMENTS

a. If volume of data increases then migrating the data set to the cloud can bring an improvement in Quantity analysis.

b. More prediction increases more competition in best methods and can result in better forecasting.

c. Introducing the method to more new technologies and better functional dependent libraries can be an advancement.