prweewuly

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1 Google Play Store Apps

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Source: https://www.kaggle.com/datasets/lava18/google-play-store-apps

1.1 Complete EDA analysis for Practice

1.2 About DataSet

- `Description`
  The Data Set was downloaded from Kaggle, from the following link

- `Context` While many public datasets (on Kaggle and the like) provide Apple App Store data, there are not many counterpart datasets available for Google Play Store apps anywhere on the web. On digging deeper, I found out that iTunes App Store page deploys a nicely indexed appendix-like structure to allow for simple and easy web scraping. On the other hand, Google Play Store uses sophisticated modern-day techniques (like dynamic page load) using JQuery making scraping more challenging.
- `Content` Each app (row) has values for catergory, rating, size, and more.
- `Acknowledgements` This information is scraped from the Google Play Store. This app information would not be available without it.
- `Inspiration` 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!

2 1. Importing Libraries

[1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline
```

3 2. Data Loading and Exploration | Cleaning

- Load csv

[2]:
```
df=pd.read_csv("googleplaystore.csv")
```

- See top 5 rows of csv

[3]:
```
df.head()
```

[3]:

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	Current Ver	Android Ver
0	Photo Editor & Candy Camera & Grid & ScrapBook	ART_AND_DESIGN	4.1	159	19M	10,000+	Free	0	Everyone	Art & Design	7-Jan-18	1.0.0	4.0.3 and up
1	Coloring book moana	ART_AND_DESIGN	3.9	967	14M	500,000+	Free	0	Everyone	Art & Design;Pretend Play	15-Jan-18	2.0.0	4.0.3 and up
2	U Launcher Lite – FREE Live Cool Themes, Hide …	ART_AND_DESIGN	4.7	87510	8.7M	5,000,000+	Free	0	Everyone	Art & Design	1-Aug-18	1.2.4	4.0.3 and up
3	Sketch - Draw & Paint	ART_AND_DESIGN	4.5	215644	25M	50,000,000+	Free	0	Teen	Art & Design	8-Jun-18	Varies with device	4.2 and up
4	Pixel Draw - Number Art Coloring Book	ART_AND_DESIGN	4.3	967	2.8M	100,000+	Free	0	Everyone	Art & Design;Creativity	20-Jun-18	1.1	4.4 and up

- To view maximum columns and rows

[4]:
```
# set options to be maximum for rows and columns
pd.set_option('display.max_columns', None)
pd.set_option('display.max_rows', None)
# hide all warnings
import warnings
warnings.filterwarnings('ignore')
```

- View the names of columns of Google Play store

[5]:
```
print(" The columns of this dataset are",df.columns)
```

```
 The columns of this dataset are Index(['App', 'Category', 'Rating', 'Reviews',
'Size', 'Installs', 'Type',
       'Price', 'Content Rating', 'Genres', 'Last Updated', 'Current Ver',
       'Android Ver'],
      dtype='object')
```

- See total rows and columns of dataset

[6]:
```
# df.shape is tuple and it has indexed 0 and 1
print(f"The number of rows are {df.shape[0]} and the number of columns are {df.
↪shape[1]}.")
```

```
The number of rows are 10841 and the number of columns are 13.
```

- Get the info about the dataset

[7]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10841 entries, 0 to 10840
Data columns (total 13 columns):
 #   Column          Non-Null Count  Dtype
---  ------          --------------  -----
 0   App             10841 non-null  object
 1   Category        10840 non-null  object
 2   Rating          9367 non-null   float64
 3   Reviews         10841 non-null  int64
 4   Size            10841 non-null  object
 5   Installs        10841 non-null  object
 6   Type            10840 non-null  object
 7   Price           10841 non-null  object
 8   Content Rating  10841 non-null  object
 9   Genres          10840 non-null  object
 10  Last Updated    10841 non-null  object
 11  Current Ver     10833 non-null  object
 12  Android Ver     10839 non-null  object
dtypes: float64(1), int64(1), object(11)
memory usage: 1.1+ MB
```

- Check the statistics of dataset

[8]:
```
df.describe().T
```

[8]:

	count	mean	std	min	25%	50%	75%	max
Rating	9367.0	4.191513	5.157352e-01	1.0	4.0	4.3	4.5	5.0
Reviews	10841.0	444111.928051	2.927629e+06	0.0	38.0	2094.0	54768.0	78158306.0

4 make size a numeric column

[9]:
```
df['Size'].value_counts()
```

[9]:
```
Size
Varies with device    1695
11M                    198
12M                    196
14M                    194
13M                    191
                       …
430k                     1
429k                     1
200k                     1
460k                     1
619k                     1
Name: count, Length: 461, dtype: int64
```

[10]:
```
df['Size'].unique()
```

[10]:
```
array(['19M', '14M', '8.7M', '25M', '2.8M', '5.6M', '29M', '33M', '3.1M',
       '28M', '12M', '20M', '21M', '37M', '2.7M', '5.5M', '17M', '39M',
       '31M', '4.2M', '7.0M', '23M', '6.0M', '6.1M', '4.6M', '9.2M',
       '5.2M', '11M', '24M', 'Varies with device', '9.4M', '15M', '10M',
       '1.2M', '26M', '8.0M', '7.9M', '56M', '57M', '35M', '54M', '201k',
       '3.6M', '5.7M', '8.6M', '2.4M', '27M', '2.5M', '16M', '3.4M',
       '8.9M', '3.9M', '2.9M', '38M', '32M', '5.4M', '18M', '1.1M',
       '2.2M', '4.5M', '9.8M', '52M', '9.0M', '6.7M', '30M', '2.6M',
       '7.1M', '3.7M', '22M', '7.4M', '6.4M', '3.2M', '8.2M', '9.9M',
       '4.9M', '9.5M', '5.0M', '5.9M', '13M', '73M', '6.8M', '3.5M',
       '4.0M', '2.3M', '7.2M', '2.1M', '42M', '7.3M', '9.1M', '55M',
       '23k', '6.5M', '1.5M', '7.5M', '51M', '41M', '48M', '8.5M', '46M',
       '8.3M', '4.3M', '4.7M', '3.3M', '40M', '7.8M', '8.8M', '6.6M',
       '5.1M', '61M', '66M', '79k', '8.4M', '118k', '44M', '695k', '1.6M',
       '6.2M', '18k', '53M', '1.4M', '3.0M', '5.8M', '3.8M', '9.6M',
       '45M', '63M', '49M', '77M', '4.4M', '4.8M', '70M', '6.9M', '9.3M',
       '10.0M', '8.1M', '36M', '84M', '97M', '2.0M', '1.9M', '1.8M',
       '5.3M', '47M', '556k', '526k', '76M', '7.6M', '59M', '9.7M', '78M',
       '72M', '43M', '7.7M', '6.3M', '334k', '34M', '93M', '65M', '79M',
       '100M', '58M', '50M', '68M', '64M', '67M', '60M', '94M', '232k',
       '99M', '624k', '95M', '8.5k', '41k', '292k', '11k', '80M', '1.7M',
       '74M', '62M', '69M', '75M', '98M', '85M', '82M', '96M', '87M',
       '71M', '86M', '91M', '81M', '92M', '83M', '88M', '704k', '862k',
       '899k', '378k', '266k', '375k', '1.3M', '975k', '980k', '4.1M',
       '89M', '696k', '544k', '525k', '920k', '779k', '853k', '720k',
       '713k', '772k', '318k', '58k', '241k', '196k', '857k', '51k',
       '953k', '865k', '251k', '930k', '540k', '313k', '746k', '203k',
       '26k', '314k', '239k', '371k', '220k', '730k', '756k', '91k',
       '293k', '17k', '74k', '14k', '317k', '78k', '924k', '902k', '818k',
       '81k', '939k', '169k', '45k', '475k', '965k', '90M', '545k', '61k',
       '283k', '655k', '714k', '93k', '872k', '121k', '322k', '1.0M',
```

```
       '976k', '172k', '238k', '549k', '206k', '954k', '444k', '717k',
       '210k', '609k', '308k', '705k', '306k', '904k', '473k', '175k',
       '350k', '383k', '454k', '421k', '70k', '812k', '442k', '842k',
       '417k', '412k', '459k', '478k', '335k', '782k', '721k', '430k',
       '429k', '192k', '200k', '460k', '728k', '496k', '816k', '414k',
       '506k', '887k', '613k', '243k', '569k', '778k', '683k', '592k',
       '319k', '186k', '840k', '647k', '191k', '373k', '437k', '598k',
       '716k', '585k', '982k', '222k', '219k', '55k', '948k', '323k',
       '691k', '511k', '951k', '963k', '25k', '554k', '351k', '27k',
       '82k', '208k', '913k', '514k', '551k', '29k', '103k', '898k',
       '743k', '116k', '153k', '209k', '353k', '499k', '173k', '597k',
       '809k', '122k', '411k', '400k', '801k', '787k', '237k', '50k',
       '643k', '986k', '97k', '516k', '837k', '780k', '961k', '269k',
       '20k', '498k', '600k', '749k', '642k', '881k', '72k', '656k',
       '601k', '221k', '228k', '108k', '940k', '176k', '33k', '663k',
       '34k', '942k', '259k', '164k', '458k', '245k', '629k', '28k',
       '288k', '775k', '785k', '636k', '916k', '994k', '309k', '485k',
       '914k', '903k', '608k', '500k', '54k', '562k', '847k', '957k',
       '688k', '811k', '270k', '48k', '329k', '523k', '921k', '874k',
       '981k', '784k', '280k', '24k', '518k', '754k', '892k', '154k',
       '860k', '364k', '387k', '626k', '161k', '879k', '39k', '970k',
       '170k', '141k', '160k', '144k', '143k', '190k', '376k', '193k',
       '246k', '73k', '658k', '992k', '253k', '420k', '404k', '470k',
       '226k', '240k', '89k', '234k', '257k', '861k', '467k', '157k',
       '44k', '676k', '67k', '552k', '885k', '1020k', '582k', '619k'],
      dtype=object)
```

4.0.1 Observe

Size is not in same unit

1. Varies with device
2. M
3. k

- Check is any missing value

[11]:
```
df['Size'].isnull().sum()
```

[11]:
```
0
```

- Data has no null values

[12]:
```
#count the rows that have "varies with device"
df['Size'].loc[df['Size'].str.contains('Varies with device')].value_counts().
 ↪sum()
```

[12]:
```
1695
```

[13]:
```
# find the values having M in them
df['Size'].loc[df['Size'].str.contains('M')].value_counts().sum()
```

[13]: 8830

[14]:
```
# find the values having k in them
df['Size'].loc[df['Size'].str.contains('k')].value_counts().sum()
```

[14]: 316

[15]:
```
def convert_to_bytes(x):
    if isinstance(x, str): #check if x is a string
       if 'M' in x:
           x = x.replace('M', '')
           x = float(x)
           return x * 1024 * 1024
       elif 'k' in x:
              x = x.replace('k', '')
              x = float(x)
              return x * 1024
       elif 'Varies with device' in x:
            return np.nan
    return x    #If x is not a string or none of the conditions above match,␣
 ↪the function simply returns x without any conversion.

#do in 1 line
#if 'k' in size:
    #return float(size.replace('k', "")) * 1024
```

[16]:
```
# Apply the function to size column
df['Size']=df['Size'].apply(convert_to_bytes)
```

[17]:
```
df['Size']
```

[17]:
```
0        19922944.0
1        14680064.0
2         9122611.2
3        26214400.0
4         2936012.8
              …
10836    55574528.0
10837     3774873.6
10838     9961472.0
10839           NaN
10840    19922944.0
Name: Size, Length: 10841, dtype: float64
```

[18]:
```
# rename  the column
df.rename(columns={'Size':'size_in_bytes'}, inplace=True)
```

[19]:
```
df.head()
```

[19]:

	App	Category	Rating	Reviews	size_in_bytes	Installs	Type	Price	Content Rating	Genres	Last Updated	Current Ver	Android Ver
0	Photo Editor & Candy Camera & Grid & ScrapBook	ART_AND_DESIGN	4.1	159	19922944.0	10,000+	Free	0	Everyone	Art & Design	7-Jan-18	1.0.0	4.0.3 and up
1	Coloring book moana	ART_AND_DESIGN	3.9	967	14680064.0	500,000+	Free	0	Everyone	Art & Design;Pretend Play	15-Jan-18	2.0.0	4.0.3 and up
2	U Launcher Lite - FREE Live Cool Themes, Hide …	ART_AND_DESIGN	4.7	87510	9122611.2	5,000,000+	Free	0	Everyone	Art & Design	1-Aug-18	1.2.4	4.0.3 and up
3	Sketch - Draw & Paint	ART_AND_DESIGN	4.5	215644	26214400.0	50,000,000+	Free	0	Teen	Art & Design	8-Jun-18	Varies with device	4.2 and up
4	Pixel Draw - Number Art Coloring Book	ART_AND_DESIGN	4.3	967	2936012.8	100,000+	Free	0	Everyone	Art & Design;Creativity	20-Jun-18	1.1	4.4 and up

[20]:
```
# add new column and convert size_in_bytes to size in MB
df['Size_in_MB']=df['size_in_bytes'].apply(lambda x: x/(1024*1024))
```

[21]:
```
# add new column and convert size_in_bytes to size in KB
df['Size_in_KB']=df['size_in_bytes'].apply(lambda x: x/(1024))
```

[22]:
```
df.head()
```

[22]:

	App	Category	Rating	Reviews	size_in_bytes	Installs	Type	Price	Content Rating	Genres	Last Updated	Current Ver	Android Ver
0	Photo Editor & Candy Camera & Grid & ScrapBook	ART_AND_DESIGN	4.1	159	19922944.0	10,000+	Free	0	Everyone	Art & Design	7-Jan-18	1.0.0	4.0.3 and up
1	Coloring book moana	ART_AND_DESIGN	3.9	967	14680064.0	500,000+	Free	0	Everyone	Art & Design;Pretend Play	15-Jan-18	2.0.0	4.0.3 and up
2	U Launcher Lite - FREE Live Cool Themes, Hide …	ART_AND_DESIGN	4.7	87510	9122611.2	5,000,000+	Free	0	Everyone	Art & Design	1-Aug-18	1.2.4	4.0.3 and up
3	Sketch - Draw & Paint	ART_AND_DESIGN	4.5	215644	26214400.0	50,000,000+	Free	0	Teen	Art & Design	8-Jun-18	Varies with device	4.2 and up
4	Pixel Draw - Number Art Coloring Book	ART_AND_DESIGN	4.3	967	2936012.8	100,000+	Free	0	Everyone	Art & Design;Creativity	20-Jun-18	1.1	4.4 and up

```
                      Genres Last Updated         Current Ver   Android Ver  \
0               Art & Design     7-Jan-18               1.0.0  4.0.3 and up
1  Art & Design;Pretend Play    15-Jan-18               2.0.0  4.0.3 and up
2               Art & Design     1-Aug-18               1.2.4  4.0.3 and up
3               Art & Design     8-Jun-18  Varies with device    4.2 and up
4    Art & Design;Creativity    20-Jun-18                 1.1    4.4 and up

   Size_in_MB  Size_in_KB
0        19.0     19456.0
1        14.0     14336.0
2         8.7      8908.8
3        25.0     25600.0
4         2.8      2867.2
```

[23]:
```
# check %age of null values in size col
df['size_in_bytes'].isnull().sum()/len(df)*100
```

[23]: 15.635089013928605

- Since it has only 15% null values.I am immputing it by mean of value

[24]:
```
df['size_in_bytes'].fillna(df['size_in_bytes'].mean(), inplace=True)
```

[25]:
```
df['size_in_bytes'].isnull().sum()
```

[25]: 0

[26]:
```
# check %age of null values in size_in_KB col
df['Size_in_KB'].isnull().sum()/len(df)*100
```

[26]: 15.635089013928605

[27]:
```
df['Size_in_KB'].fillna(df['Size_in_KB'].mean(),inplace=True)
```

[28]:
```
df['Size_in_KB'].isnull().sum()
```

[28]: 0

[29]:
```
# check %age of null values in size_in_MB col
df['Size_in_MB'].isnull().sum()/len(df)*100
```

[29]: 15.635089013928605

[30]:
```
df['Size_in_MB'].fillna(df['Size_in_KB'].mean(),inplace=True)
```

[31]:
```
df['Size_in_MB'].isnull().sum()
```

[31]: 0

I'm done with Rating, reviews , size in bytes, in Kb, and in MB's

- Next step is to explore next columns

5 Explore Install Column

[32]:
```
df['Installs'].isnull().sum()
```

[32]: 0

[33]:
```
df['Installs'].unique()
```

[33]:
```
array(['10,000+', '500,000+', '5,000,000+', '50,000,000+', '100,000+',
       '50,000+', '1,000,000+', '10,000,000+', '5,000+', '100,000,000+',
       '1,000,000,000+', '1,000+', '500,000,000+', '50+', '100+', '500+',
       '10+', '1+', '5+', '0+', '0'], dtype=object)
```

6 Observe on Install Columns

1. Remove +sign
2. Convert it to integer
3. Remove ,

[34]:
```
df['Installs']=df['Installs'].apply(
    lambda x: x.replace('+','') if '+' in str(x) else x
)
```

[35]:
```
df['Installs']=df['Installs'].apply(
    lambda x: x.replace(',','') if ',' in str(x) else x
)
```

[36]:
```
df['Installs']=df['Installs'].astype(int)
```

[37]:
```
df['Installs'].info()
```

```
<class 'pandas.core.series.Series'>
RangeIndex: 10841 entries, 0 to 10840
Series name: Installs
Non-Null Count  Dtype
--------------  -----
10841 non-null  int32
dtypes: int32(1)
memory usage: 42.5 KB
```

[38]:
```
df.describe().T
```

[38]:
```
                  count          mean           std          min         25%  \
Rating           9367.0  4.191513e+00  5.157352e-01     1.000000         4.0
Reviews         10841.0  4.441119e+05  2.927629e+06     0.000000        38.0
size_in_bytes   10841.0  2.255921e+07  2.175544e+07  8704.000000  6186598.4
Installs        10841.0  1.546291e+07  8.502557e+07     0.000000     1000.0
Size_in_MB      10841.0  3.462636e+03  7.993781e+03     0.008301        5.9
Size_in_KB      10841.0  2.203048e+04  2.124555e+04     8.500000     6041.6

                       50%         75%           max
Rating                 4.3         4.5  5.000000e+00
Reviews             2094.0     54768.0  7.815831e+07
size_in_bytes   18874368.0  27262976.0  1.048576e+08
Installs          100000.0   5000000.0  1.000000e+09
Size_in_MB            18.0        52.0  2.203048e+04
Size_in_KB         18432.0     26624.0  1.024000e+05
```

7 Price Column

[39]:
```
df['Price'].value_counts()
```

[39]:
```
Price
0          10041
$0.99        148
$2.99        129
$1.99         73
$4.99         72
           ...
$19.90         1
$1.75          1
$14.00         1
$4.85          1
$1.04          1
Name: count, Length: 92, dtype: int64
```

7.1 Observe

1. Remove $
2. Convert float

[40]:
```
# Observe how many rows have $ sign
df['Price'].loc[df['Price'].str.contains('\$')].value_counts().sum()
```

[40]:
```
800
```

[41]:
```
# This code counts the number of values in the 'Price' column which contains 0␣
↪but does not contain $ sign
```

```
df['Price'].loc[df['Price'].str.contains('0')].value_counts().sum() &␣
 ↪df['Price'].loc[~df['Price'].str.contains('\$')].value_counts().sum()
```

[41]:
```
10032
```

[42]:
```
# Remove $ sign
df['Price']=df['Price'].apply(
    lambda x: x.replace('$','') if '$' in str(x) else x
)
```

[43]:
```
# Convert Price column to float
df['Price']=df['Price'].astype(float)
```

[44]:
```
df.describe()
```

[44]:

	Rating	Reviews	size_in_bytes	Installs	Price	\
count	9367.000000	1.084100e+04	1.084100e+04	1.084100e+04	10841.000000	
mean	4.191513	4.441119e+05	2.255921e+07	1.546291e+07	1.027273	
std	0.515735	2.927629e+06	2.175544e+07	8.502557e+07	15.948971	
min	1.000000	0.000000e+00	8.704000e+03	0.000000e+00	0.000000	
25%	4.000000	3.800000e+01	6.186598e+06	1.000000e+03	0.000000	
50%	4.300000	2.094000e+03	1.887437e+07	1.000000e+05	0.000000	
75%	4.500000	5.476800e+04	2.726298e+07	5.000000e+06	0.000000	
max	5.000000	7.815831e+07	1.048576e+08	1.000000e+09	400.000000	

	Size_in_MB	Size_in_KB
count	10841.000000	10841.000000
mean	3462.635592	22030.480308
std	7993.780928	21245.551287
min	0.008301	8.500000
25%	5.900000	6041.600000
50%	18.000000	18432.000000
75%	52.000000	26624.000000
max	22030.480308	102400.000000

[45]:
```
# using f string print min, max and average prices of the app
print(f"The minimum price is {df['Price'].min()}")
print(f"The maximum price is {df['Price'].max()}")
print(f"The averag price is {df['Price'].mean()}")
```

```
The minimum price is 0.0
The maximum price is 400.0
The averag price is 1.0272733142699015
```

8 Missing Values

[46]:
```
# find missing values
df.isnull().sum().sort_values(ascending=False)
```

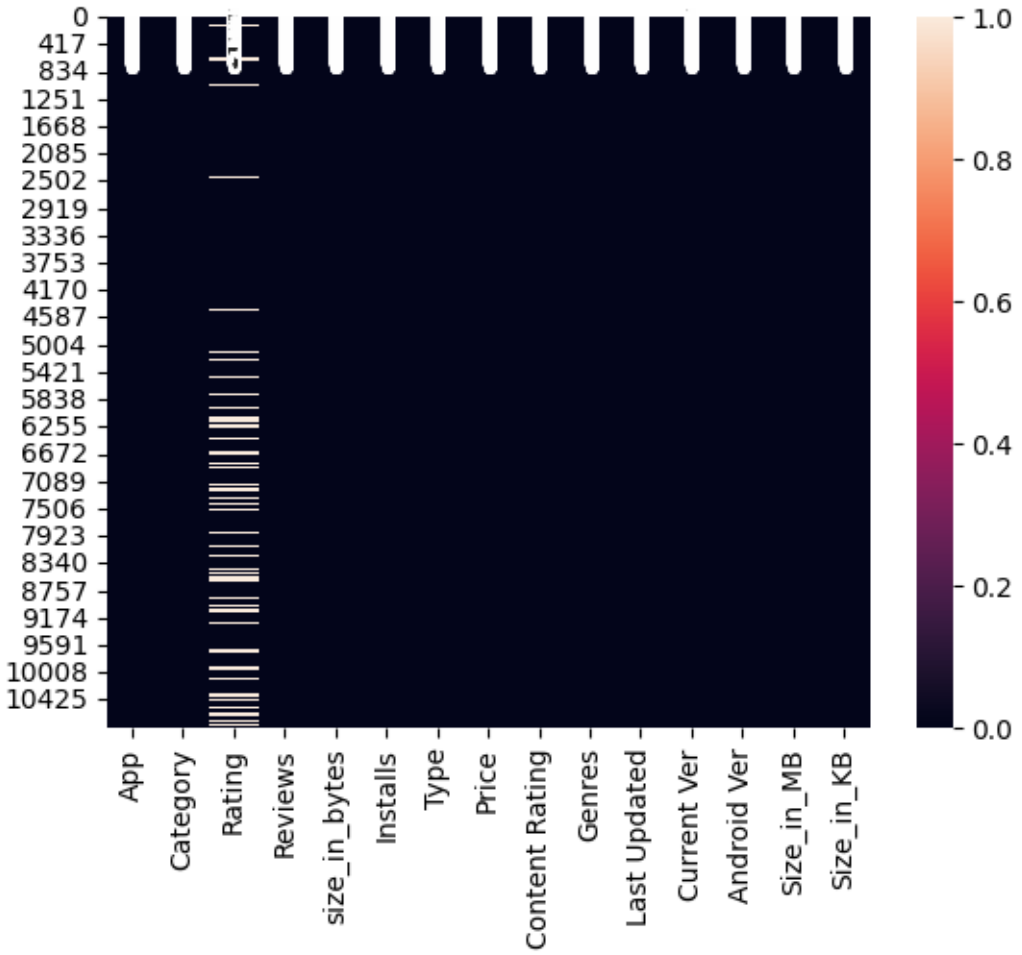
[46]:
```
Rating            1474
Current Ver          8
Android Ver          2
Category             1
Type                 1
Genres               1
App                  0
Reviews              0
size_in_bytes        0
Installs             0
Price                0
Content Rating       0
Last Updated         0
Size_in_MB           0
Size_in_KB           0
dtype: int64
```

[47]:
```
# find missing value percentage in th data
df.isnull().sum().sort_values(ascending=False)/len(df)*100
# round(df.isnull().sum()/len(df)*100, 2).sort_values(ascending=False) ->round␣
 ↪upto 2 decimal
```

[47]:
```
Rating            13.596532
Current Ver        0.073794
Android Ver        0.018448
Category           0.009224
Type               0.009224
Genres             0.009224
App                0.000000
Reviews            0.000000
size_in_bytes      0.000000
Installs           0.000000
Price              0.000000
Content Rating     0.000000
Last Updated       0.000000
Size_in_MB         0.000000
Size_in_KB         0.000000
dtype: float64
```

[48]:
```
# plot missing values
sns.heatmap(df.isnull(), annot=True)
```

[48]: <Axes: >



9 Impute Missing values

[49]:
```
df['Genres'].unique()
```

[49]:
```
array(['Art & Design', 'Art & Design;Pretend Play',
       'Art & Design;Creativity', 'Art & Design;Action & Adventure',
       'Auto & Vehicles', 'Beauty', 'Books & Reference', 'Business',
       'Comics', 'Comics;Creativity', 'Communication', 'Dating',
       'Education;Education', 'Education', 'Education;Creativity',
       'Education;Music & Video', 'Education;Action & Adventure',
       'Education;Pretend Play', 'Education;Brain Games', 'Entertainment',
       'Entertainment;Music & Video', 'Entertainment;Brain Games',
       'Entertainment;Creativity', 'Events', 'Finance', 'Food & Drink',
       'Health & Fitness', 'House & Home', 'Libraries & Demo',
```

```
       'Lifestyle', 'Lifestyle;Pretend Play',
       'Adventure;Action & Adventure', 'Arcade', 'Casual', 'Card',
       'Casual;Pretend Play', 'Action', 'Strategy', 'Puzzle', 'Sports',
       'Music', 'Word', 'Racing', 'Casual;Creativity',
       'Casual;Action & Adventure', 'Simulation', 'Adventure', 'Board',
       'Trivia', 'Role Playing', 'Simulation;Education',
       'Action;Action & Adventure', 'Casual;Brain Games',
       'Simulation;Action & Adventure', 'Educational;Creativity',
       'Puzzle;Brain Games', 'Educational;Education', 'Card;Brain Games',
       'Educational;Brain Games', 'Educational;Pretend Play',
       'Entertainment;Education', 'Casual;Education',
       'Music;Music & Video', 'Racing;Action & Adventure',
       'Arcade;Pretend Play', 'Role Playing;Action & Adventure',
       'Simulation;Pretend Play', 'Puzzle;Creativity',
       'Sports;Action & Adventure', 'Educational;Action & Adventure',
       'Arcade;Action & Adventure', 'Entertainment;Action & Adventure',
       'Puzzle;Action & Adventure', 'Strategy;Action & Adventure',
       'Music & Audio;Music & Video', 'Health & Fitness;Education',
       'Adventure;Education', 'Board;Brain Games',
       'Board;Action & Adventure', 'Board;Pretend Play',
       'Casual;Music & Video', 'Role Playing;Pretend Play',
       'Entertainment;Pretend Play', 'Video Players & Editors;Creativity',
       'Card;Action & Adventure', 'Medical', 'Social', 'Shopping',
       'Photography', 'Travel & Local',
       'Travel & Local;Action & Adventure', 'Tools', 'Tools;Education',
       'Personalization', 'Productivity', 'Parenting',
       'Parenting;Music & Video', 'Parenting;Education',
       'Parenting;Brain Games', 'Weather', 'Video Players & Editors',
       'Video Players & Editors;Music & Video', 'News & Magazines',
       'Maps & Navigation', 'Health & Fitness;Action & Adventure',
       'Educational', 'Casino', 'Adventure;Brain Games',
       'Trivia;Education', 'Lifestyle;Education',
       'Books & Reference;Creativity', 'Books & Reference;Education',
       'Puzzle;Education', 'Role Playing;Education',
       'Role Playing;Brain Games', 'Strategy;Education',
       'Racing;Pretend Play', 'Communication;Creativity', nan,
       'Strategy;Creativity'], dtype=object)
```

[50]:
```
df['Genres'] = df['Genres'].fillna(df['Genres'].mode()[0])  # Filling with the␣
↪first mode value
```

[51]:
```
df['Content Rating'].unique()
```

[51]:
```
array(['Everyone', 'Teen', 'Everyone 10+', 'Mature 17+',
       'Adults only 18+', 'Unrated'], dtype=object)
```

[52]:
```
def convert(x):
    if isinstance(x, str): #check if x is a string
       if '10+' in x:
           return x.replace('10+', '')
       elif '17+' in x:
              return x.replace('17+', '')
       elif '18+' in x:
              return x.replace('18+', '')
    return x
```

[53]:
```
df['Content Rating']=df['Content Rating'].apply(convert)
```

[54]:
```
df['Content Rating'].unique()
```

[54]:
```
array(['Everyone', 'Teen', 'Everyone ', 'Mature ', 'Adults only ',
       'Unrated'], dtype=object)
```

[55]:
```
df['Content Rating'].isnull().sum()
```

[55]:
```
0
```

[56]:
```
df['Android Ver'].unique()
```

[56]:
```
array(['4.0.3 and up', '4.2 and up', '4.4 and up', '2.3 and up',
       '3.0 and up', '4.1 and up', '4.0 and up', '2.3.3 and up',
       'Varies with device', '2.2 and up', '5.0 and up', '6.0 and up',
       '1.6 and up', '1.5 and up', '2.1 and up', '7.0 and up',
       '5.1 and up', '4.3 and up', '4.0.3 - 7.1.1', '2.0 and up',
       '3.2 and up', '4.4W and up', '7.1 and up', '7.0 - 7.1.1',
       '8.0 and up', '5.0 - 8.0', '3.1 and up', '2.0.1 and up',
       '4.1 - 7.1.1', nan, '5.0 - 6.0', '1.0 and up', '2.2 - 7.1.1',
       '5.0 - 7.1.1'], dtype=object)
```

[57]:
```
def convert_Android(x):
    if isinstance(x, str): #check if x is a string
       if 'W' in x:
           return x.replace('W', '')
       elif '- 7.1.1' in x:
              return x.replace('- 7.1.1', 'and up')
       elif '- 8.0' in x:
              return x.replace('- 8.0', 'and up')
       elif '- 6.0' in x:
              return x.replace('- 6.0', 'and up')
       elif 'Varies with device' in x:
              return np.nan
    return x
```

[58]:
```
df['Android Ver']=df['Android Ver'].apply(convert_Android)
```

[59]:
```
df['Android Ver'].unique()
```

[59]:
```
array(['4.0.3 and up', '4.2 and up', '4.4 and up', '2.3 and up',
       '3.0 and up', '4.1 and up', '4.0 and up', '2.3.3 and up', nan,
       '2.2 and up', '5.0 and up', '6.0 and up', '1.6 and up',
       '1.5 and up', '2.1 and up', '7.0 and up', '5.1 and up',
       '4.3 and up', '2.0 and up', '3.2 and up', '7.1 and up',
       '8.0 and up', '3.1 and up', '2.0.1 and up', '1.0 and up'],
      dtype=object)
```

[60]:
```
df['Android Ver'].isnull().sum()/len(df)*100
```

[60]:
```
12.581865141592106
```

[61]:
```
df['Android Ver']=df['Android Ver'].fillna(df['Android Ver'].mode()[0])
```

[62]:
```
df['Android Ver'].isnull().sum()
```

[62]:
```
0
```

[63]:
```
df.isnull().sum()
```

[63]:
```
App                0
Category           1
Rating          1474
Reviews            0
size_in_bytes      0
Installs           0
Type               1
Price              0
Content Rating     0
Genres             0
Last Updated       0
Current Ver        8
Android Ver        0
Size_in_MB         0
Size_in_KB         0
dtype: int64
```

[64]:
```
df.head()
```

[64]:
```
                                                 App        Category  Rating  \
0     Photo Editor & Candy Camera & Grid & ScrapBook  ART_AND_DESIGN     4.1
1                                 Coloring book moana  ART_AND_DESIGN     3.9
2  U Launcher Lite - FREE Live Cool Themes, Hide …  ART_AND_DESIGN     4.7
```

```
3                              Sketch - Draw & Paint  ART_AND_DESIGN     4.5
4              Pixel Draw - Number Art Coloring Book  ART_AND_DESIGN     4.3

   Reviews  size_in_bytes  Installs  Type  Price Content Rating  \
0      159     19922944.0     10000  Free    0.0       Everyone
1      967     14680064.0    500000  Free    0.0       Everyone
2    87510      9122611.2   5000000  Free    0.0       Everyone
3   215644     26214400.0  50000000  Free    0.0           Teen
4      967      2936012.8    100000  Free    0.0       Everyone

                      Genres Last Updated         Current Ver   Android Ver  \
0               Art & Design     7-Jan-18               1.0.0  4.0.3 and up
1  Art & Design;Pretend Play    15-Jan-18               2.0.0  4.0.3 and up
2               Art & Design     1-Aug-18               1.2.4  4.0.3 and up
3               Art & Design     8-Jun-18  Varies with device    4.2 and up
4    Art & Design;Creativity    20-Jun-18                 1.1    4.4 and up

   Size_in_MB  Size_in_KB
0        19.0     19456.0
1        14.0     14336.0
2         8.7      8908.8
3        25.0     25600.0
4         2.8      2867.2
```

[65]:
```
df['Type'].unique()
```

[65]:
```
array(['Free', 'Paid', nan], dtype=object)
```

[66]:
```
df['Type']=df['Type'].fillna(df['Type'].mode()[0])
```

[67]:
```
df['Category'].unique()
```

[67]:
```
array(['ART_AND_DESIGN', 'AUTO_AND_VEHICLES', 'BEAUTY',
       'BOOKS_AND_REFERENCE', 'BUSINESS', 'COMICS', 'COMMUNICATION',
       'DATING', 'EDUCATION', 'ENTERTAINMENT', 'EVENTS', 'FINANCE',
       'FOOD_AND_DRINK', 'HEALTH_AND_FITNESS', 'HOUSE_AND_HOME',
       'LIBRARIES_AND_DEMO', 'LIFESTYLE', 'GAME', 'FAMILY', 'MEDICAL',
       'SOCIAL', 'SHOPPING', 'PHOTOGRAPHY', 'SPORTS', 'TRAVEL_AND_LOCAL',
       'TOOLS', 'PERSONALIZATION', 'PRODUCTIVITY', 'PARENTING', 'WEATHER',
       'VIDEO_PLAYERS', 'NEWS_AND_MAGAZINES', 'MAPS_AND_NAVIGATION', nan],
      dtype=object)
```

[68]:
```
#Already check above only 1 1 value is missing in each column
df['Category']=df['Category'].fillna(df['Category'].mode()[0])
```

[69]:
```
# rating %age is already caclualted which is about 13% we can impute it
df['Rating']=df['Rating'].astype(float)
```

[70]:
```
df['Rating']=df['Rating'].fillna(df['Rating'].mean())
```

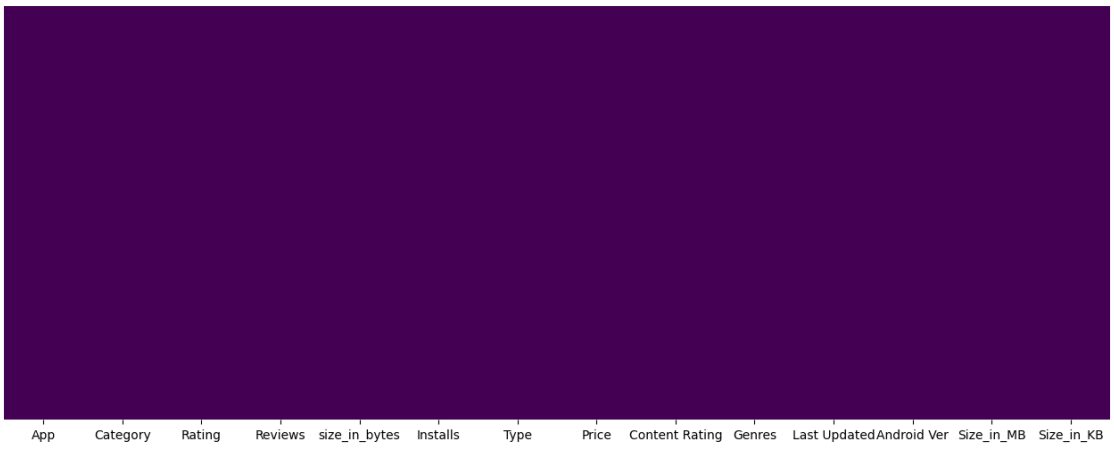
[71]:
```
df.isnull().sum()
```

[71]:
```
App               0
Category          0
Rating            0
Reviews           0
size_in_bytes     0
Installs          0
Type              0
Price             0
Content Rating    0
Genres            0
Last Updated      0
Current Ver       8
Android Ver       0
Size_in_MB        0
Size_in_KB        0
dtype: int64
```

[72]:
```
# Droping Current Ver Column, It has miscallenous data which will affect␣
  ↪predictions
df.drop('Current Ver', axis=1, inplace=True)
```

[73]:
```
# plot missing values
plt.figure(figsize=(16, 6))
sns.heatmap(df.isnull(), yticklabels=False, cbar=False, cmap='viridis')
```

[73]:
```
<Axes: >
```



[74]:
```
# Feature ENgineering
bins=[0,1.0,2.0,3.0,4.0,5.0]
labels=['Very Bad','Bad','Okay','Good','Excellent']
```

[75]:
```
df['Rating']=pd.cut(df['Rating'],bins=bins,labels=labels)
```

[76]:
```
# check who many rows have excellent rating
df[df['Rating']=='Excellent'].shape[0]
```

[76]: 8274

[77]:
```
# print  rows have excellent rating
df[df['Rating']=='Excellent']
```

[77]:

	App	Category	Rating	Reviews	size_in_bytes	Installs	Type	Price	Content Rating	Genres	Last Updated	Android Ver
0	Photo Editor & Candy Camera & Grid & ScrapBook	ART_AND_DESIGN	Excellent	159	1.992294e+07	10000	Free	0.0	Everyone	Art & Design	7-Jan-18	4.0.3 and up
2	U Launcher Lite - FREE Live Cool Themes, Hide …	ART_AND_DESIGN	Excellent	87510	9.122611e+06	5000000	Free	0.0	Everyone	Art & Design	1-Aug-18	4.0.3 and up
3	Sketch - Draw & Paint	ART_AND_DESIGN	Excellent	215644	2.621440e+07	50000000	Free	0.0	Teen	Art & Design	8-Jun-18	4.2 and up
4	Pixel Draw - Number Art Coloring Book	ART_AND_DESIGN	Excellent	967	2.936013e+06	100000	Free	0.0	Everyone	Art & Design;Creativity	20-Jun-18	4.4 and up
5	Paper flowers instructions	ART_AND_DESIGN	Excellent	167	5.872026e+06	50000	Free	0.0	Everyone	Art & Design	26-Mar-17	2.3 and up
…	…	…	…	…	…	…	…	…	…	…	…	…
10836	Sya9a Maroc - FR	FAMILY	Excellent	38	5.557453e+07	5000	Free	0.0	Everyone	Education	17-Jul-18	4.1 and up
10837	Fr. Mike Schmitz Audio Teachings	FAMILY	Excellent	4	3.774874e+06	100	Free	0.0	Everyone	Education	3-Jul-18	4.1 and up
10838	Parkinson Exercices FR	MEDICAL	Excellent	3	9.961472e+06	1000	Free	0.0	Everyone	Medical	6-Jul-18	4.1 and up
10839	The SCP Foundation DB fr nn5n	BOOKS_AND_REFERENCE	Excellent	114	2.255921e+07	1000	Free	0.0	Mature 17+	Books & Reference	1-Jan-15	2.2 and up
10840	iHoroscope - 2018 Daily Horoscope & Astrology	LIFESTYLE	Excellent	398307	1.992294e+07	10000000	Free	0.0	Everyone	Lifestyle	19-Jul-18	4.0.3 and up

```
10836       Everyone                Education    25-Jul-17    4.1 and up
10837       Everyone                Education     6-Jul-18    4.1 and up
10838       Everyone                  Medical    20-Jan-17    2.2 and up
10839         Mature          Books & Reference    19-Jan-15    4.1 and up
10840       Everyone                Lifestyle    25-Jul-18    4.1 and up

         Size_in_MB    Size_in_KB
0         19.000000  19456.000000
2          8.700000   8908.800000
3         25.000000  25600.000000
4          2.800000   2867.200000
5          5.600000   5734.400000
…               …           …
10836     53.000000  54272.000000
10837      3.600000   3686.400000
10838      9.500000   9728.000000
10839  22030.480308  22030.480308
10840     19.000000  19456.000000

[8274 rows x 14 columns]
```

[ ]: