Analyzing Popular App Categories on Google Play Project

In this project, our Goal is to figure out what types of apps tend to be popular on the google play store.We work for a company that makes free apps and earn money through ads. By understanding which app Categories are in high demand. We can help our developers create apps that attract more users and generate more revenue. We will Analyze date from Google play store to identify patterns and preferences among users. This way,we can make smarter decisions about the kind of apps we develops.

In [1]:
```
import pandas as pd
import matplotlib.pyplot as plt
```

In [2]:
```
#read the database in pandas dataframe object
android_df=pd.read_csv("googleplaystore.csv")
```

In [3]:
```
#Explore the data using pandas method
android_df.head()
```

Out[3]:

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	Curr
0	Photo Editor & Candy Camera & Grid & ScrapBook	ART_AND_DESIGN	4.1	159	19M	10,000+	Free	0	Everyone	Art & Design	January 7, 2018	1
1	Coloring book moana	ART_AND_DESIGN	3.9	967	14M	500,000+	Free	0	Everyone	Art & Design;Pretend Play	January 15, 2018	2
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	August 1, 2018	1
3	Sketch - Draw & Paint	ART_AND_DESIGN	4.5	215644	25M	50,000,000+	Free	0	Teen	Art & Design	June 8, 2018	Va de
4	Pixel Draw - Number Art Coloring Book	ART_AND_DESIGN	4.3	967	2.8M	100,000+	Free	0	Everyone	Art & Design;Creativity	June 20, 2018	

In [4]:
```
android_df["Category"].value_counts()
```

Out[4]:
```
FAMILY                 1972
GAME                   1144
TOOLS                   843
MEDICAL                 463
BUSINESS                460
PRODUCTIVITY            424
PERSONALIZATION         392
COMMUNICATION           387
SPORTS                  384
LIFESTYLE               382
FINANCE                 366
HEALTH_AND_FITNESS      341
PHOTOGRAPHY             335
SOCIAL                  295
NEWS_AND_MAGAZINES      283
SHOPPING                260
TRAVEL_AND_LOCAL        258
DATING                  234
BOOKS_AND_REFERENCE     231
VIDEO_PLAYERS           175
EDUCATION               156
ENTERTAINMENT           149
MAPS_AND_NAVIGATION     137
FOOD_AND_DRINK          127
HOUSE_AND_HOME           88
LIBRARIES_AND_DEMO       85
AUTO_AND_VEHICLES        85
WEATHER                  82
ART_AND_DESIGN           65
EVENTS                   64
PARENTING                60
COMICS                   60
BEAUTY                   53
1.9                       1
Name: Category, dtype: int64
```

In [5]:
```
android_df[android_df["Category"]=="1.9"]
```

Out[5]:

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	Current Ver	Andro V
10472	Life Made WI-Fi Touchscreen Photo Frame	1.9	19.0	3.0M	1,000+	Free	0	Everyone	NaN	February 11, 2018	1.0.19	4.0 and up	N

In [6]:
```
android_df[android_df["Category"]=="1.9"].values
```

Out[6]:
```
array([['Life Made WI-Fi Touchscreen Photo Frame', '1.9', 19.0, '3.0M',
        '1,000+', 'Free', '0', 'Everyone', nan, 'February 11, 2018',
        '1.0.19', '4.0 and up', nan]], dtype=object)
```

In [7]:
```
clean_1st=['Life Made WI-Fi Touchscreen Photo Frame','LIFESTYLE','1.9', 19.0, '3.0M',
        '1,000+', 'Free', '0', 'Everyone','LIFESTYLE' , 'February 11, 2018',
        '1.0.19', '4.0 and up']
clean_1st
```

Out[7]:
```
['Life Made WI-Fi Touchscreen Photo Frame',
 'LIFESTYLE',
 '1.9',
 19.0,
 '3.0M',
 '1,000+',
 'Free',
 '0',
 'Everyone',
 'LIFESTYLE',
 'February 11, 2018',
 '1.0.19',
 '4.0 and up']
```

In [8]:
```
android_df[android_df["Category"]=="1.9"]=clean_1st
```

In [9]:
```
android_category=android_df["Category"].value_counts()
android_category
```

Out[9]:
```
FAMILY                 1972
GAME                   1144
TOOLS                   843
MEDICAL                 463
BUSINESS                460
PRODUCTIVITY            424
PERSONALIZATION         392
COMMUNICATION           387
SPORTS                  384
LIFESTYLE               383
FINANCE                 366
HEALTH_AND_FITNESS      341
PHOTOGRAPHY             335
SOCIAL                  295
NEWS_AND_MAGAZINES      283
SHOPPING                260
TRAVEL_AND_LOCAL        258
DATING                  234
BOOKS_AND_REFERENCE     231
VIDEO_PLAYERS           175
EDUCATION               156
ENTERTAINMENT           149
MAPS_AND_NAVIGATION     137
FOOD_AND_DRINK          127
HOUSE_AND_HOME           88
AUTO_AND_VEHICLES        85
LIBRARIES_AND_DEMO       85
WEATHER                  82
ART_AND_DESIGN           65
EVENTS                   64
PARENTING                60
COMICS                   60
BEAUTY                   53
Name: Category, dtype: int64
```

In [10]:
```
app_count=android_df["App"].value_counts()
app_count
```

Out[10]:
```
ROBLOX                                                9
CBS Sports App - Scores, News, Stats & Watch Live     8
ESPN                                                  7
Duolingo: Learn Languages Free                        7
Candy Crush Saga                                      7
                                                     ..
Meet U - Get Friends for Snapchat, Kik & Instagram    1
U-Report                                              1
U of I Community Credit Union                         1
Waiting For U Launcher Theme                          1
iHoroscope - 2018 Daily Horoscope & Astrology         1
Name: App, Length: 9660, dtype: int64
```

In [11]:
```
app_count[app_count >1]
```

Out[11]:
```
ROBLOX                                               9
CBS Sports App - Scores, News, Stats & Watch Live    8
ESPN                                                 7
Duolingo: Learn Languages Free                       7
Candy Crush Saga                                     7
                                                    ..
Transenger – Ts Dating and Chat for Free             2
Random Video Chat                                    2
Clover Dating App                                    2
Docs To Go™ Free Office Suite                        2
English Dictionary - Offline                         2
Name: App, Length: 798, dtype: int64
```

In [12]:
```
"Instagram" in app_count[app_count >1].index
```

Out[12]:
```
True
```

In [13]:
```
android_df[android_df["App"]== "Instagram"]
```

Out[13]:

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	Current Ver	Andro V
2545	Instagram	SOCIAL	4.5	66577313	Varies with device	1,000,000,000+	Free	0	Teen	Social	July 31, 2018	Varies with device	Vari wi devi
2604	Instagram	SOCIAL	4.5	66577446	Varies with device	1,000,000,000+	Free	0	Teen	Social	July 31, 2018	Varies with device	Vari wi devi
2611	Instagram	SOCIAL	4.5	66577313	Varies with device	1,000,000,000+	Free	0	Teen	Social	July 31, 2018	Varies with device	Vari wi devi
3909	Instagram	SOCIAL	4.5	66509917	Varies with device	1,000,000,000+	Free	0	Teen	Social	July 31, 2018	Varies with device	Vari wi devi

In [14]:
```
# check for duplicate rows based on "App" column marking all duplicates as True
duplicate_apps_df=android_df[android_df.duplicated(subset=["App"],keep=False)]
#keep=false means show all duplicates
duplicate_apps_df[duplicate_apps_df["App"]=="Instagram"]
```

Out[14]:

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	Current Ver	Andro V
2545	Instagram	SOCIAL	4.5	66577313	Varies with device	1,000,000,000+	Free	0	Teen	Social	July 31, 2018	Varies with device	Vari wi devi
2604	Instagram	SOCIAL	4.5	66577446	Varies with device	1,000,000,000+	Free	0	Teen	Social	July 31, 2018	Varies with device	Vari wi devi
2611	Instagram	SOCIAL	4.5	66577313	Varies with device	1,000,000,000+	Free	0	Teen	Social	July 31, 2018	Varies with device	Vari wi devi
3909	Instagram	SOCIAL	4.5	66509917	Varies with device	1,000,000,000+	Free	0	Teen	Social	July 31, 2018	Varies with device	Vari wi devi

In [15]:
```
#number of duplicate app
num_duplicate_apps=duplicate_apps_df["App"].nunique()
num_duplicate_apps
```

Out[15]:
```
798
```

In [16]:
```
duplicate_apps_df.shape
```

Out[16]:
```
(1979, 13)
```

In [17]:
```
android_df.shape
```

Out[17]:
```
(10841, 13)
```

In [18]:
```
10841-1181
```

Out[18]:
```
9660
```

Part two

In [19]:
```
#Group by "App" and get the maximum number of reviews for each app
reviews_max=android_df.groupby("App")["Reviews"].max()
reviews_max["Instagram"]
```

Out[19]:
```
'66577446'
```

In [20]:
```
reviews_max
```

Out[20]:
```
App
"i DT" Fútbol. Todos Somos Técnicos.                   27
+Download 4 Instagram Twitter                       40467
- Free Comics - Comic Apps                            115
.R                                                    259
/u/app                                                573
                                                    ...
뽕티비 - 개인방송, 인터넷방송, BJ방송                            414
💎 I'm rich                                            718
💘 WhatsLov: Smileys of love, stickers and GIF       22098
📏 Smart Ruler ↔ cm/inch measuring for homework!        19
🔥 Football Wallpapers 4K | Full HD Backgrounds 😍    11661
Name: Reviews, Length: 9660, dtype: object
```

In [21]:
```
#create an empty list to store clean data
android_clean = []
#create an empty list to keep track of  already added app
already_added = []
#iterate through each row in the dataframe
for index, row in android_df.iterrows():
    name = row['App']
    n_reviews = row['Reviews']

    #check if the current app has the maximum number of reviews and has not been added before
    if (reviews_max[name] == n_reviews) and (name not in already_added):
        android_clean.append(row) #add the app tothe clean list
        already_added.append(name) #add the app name to the list of already added apps
```

In [22]:
```
android_clean = pd.DataFrame(android_clean)
```

In [23]:
```
android_clean.shape
```

Out[23]:
```
(9660, 13)
```

Removing Non-Engliish Apps

Part one

If you explore the data sets enough,you will notice the names of some of the apps suggest they are not directed towards an English-Speaking audience.Below we see a couple of examples from both data sets.

In [24]:
```
ord("A")
```

Out[24]:
```
65
```

In [25]:
```
ord("a")
```

Out[25]:
```
97
```

In [26]:
```
chr(125)
```

Out[26]:
```
'}'
```

In [27]:
```
def is_english(app_name):
    lst = []
    for i in app_name:
        if ord(i) > 127:
            lst.append(False)
        else:
            lst.append(True)
    check = set(lst)
    if False in check:
        return False
    else:
        return True
```

In [28]:
```
for i in "sania":
    print(i)
```

```
s
a
n
i
a
```

In [29]:
```
is_english("Instagram😍")
```

Out[29]:
```
False
```

```
In [30]: is_english("Instagram")

Out[30]: True
```

Part Two

```
In [31]: def is_english(app_name):
             lst = []
             for i in app_name:
                 if ord(i) > 127:
                     lst.append(False)
                 else:
                     lst.append(True)
             non_ascii = 0
             for j in lst:
                 if j == False:
                     non_ascii += 1
             if non_ascii > 3:
                 return False
             else:
                 return True
```

```
In [32]: is_english("english jokes 😊😊 😊😊 ")

Out[32]: False

In [33]: is_english("insta")

Out[33]: True

In [34]: android_clean["App"].apply(is_english)

Out[34]: 0        True
         2        True
         3        True
         4        True
         5        True
                  ...
         10836    True
         10837    True
         10838    True
         10839    True
         10840    True
         Name: App, Length: 9660, dtype: bool

In [35]: android_english = android_clean[android_clean["App"].apply(is_english)]

In [36]: android_english.shape

Out[36]: (9615, 13)
```

In [37]:
```
android_english.head()
```

Out[37]:

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	Cur
0	Photo Editor & Candy Camera & Grid & ScrapBook	ART_AND_DESIGN	4.1	159	19M	10,000+	Free	0	Everyone	Art & Design	January 7, 2018	1
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	August 1, 2018	1
3	Sketch - Draw & Paint	ART_AND_DESIGN	4.5	215644	25M	50,000,000+	Free	0	Teen	Art & Design	June 8, 2018	Va de
4	Pixel Draw - Number Art Coloring Book	ART_AND_DESIGN	4.3	967	2.8M	100,000+	Free	0	Everyone	Art & Design;Creativity	June 20, 2018	
5	Paper flowers instructions	ART_AND_DESIGN	4.4	167	5.6M	50,000+	Free	0	Everyone	Art & Design	March 26, 2017	

Isolating the Free Apps

As we mentioned in the introduction,we only build apps that are free to downloaded and install, and our main source of revenue consist of in_app ads.Our data set contains both free and non_free apps and we will neeed to isolate only the free apps for our analysis. Below,we isolate for both our data sets.

In [38]:
```
android_english["Price"].unique()
```

Out[38]:
```
array(['0', '$4.99', '$3.99', '$6.99', '$1.49', '$2.99', '$7.99', '$5.99',
       '$3.49', '$1.99', '$9.99', '$7.49', '$0.99', '$9.00', '$5.49',
       '$10.00', '$11.99', '$79.99', '$16.99', '$14.99', '$1.00',
       '$29.99', '$12.99', '$2.49', '$24.99', '$10.99', '$1.50', '$19.99',
       '$15.99', '$33.99', '$74.99', '$39.99', '$3.95', '$4.49', '$1.70',
       '$8.99', '$2.00', '$3.88', '$25.99', '$399.99', '$17.99',
       '$400.00', '$3.02', '$1.76', '$4.84', '$4.77', '$1.61', '$2.50',
       '$1.59', '$6.49', '$1.29', '$5.00', '$13.99', '$299.99', '$379.99',
       '$37.99', '$18.99', '$389.99', '$19.90', '$8.49', '$1.75',
       '$14.00', '$4.85', '$46.99', '$109.99', '$154.99', '$3.08',
       '$2.59', '$4.80', '$1.96', '$19.40', '$3.90', '$4.59', '$15.46',
       '$3.04', '$4.29', '$2.60', '$3.28', '$4.60', '$28.99', '$2.95',
       '$2.90', '$1.97', '$200.00', '$89.99', '$2.56', '$30.99', '$3.61',
       '$394.99', '$1.26', '$1.20', '$1.04'], dtype=object)
```

In [39]:
```
android_final = android_english[android_english["Price"]=="0"]
```

In [40]:
```
android_final.shape
```

Out[40]:
```
(8863, 13)
```

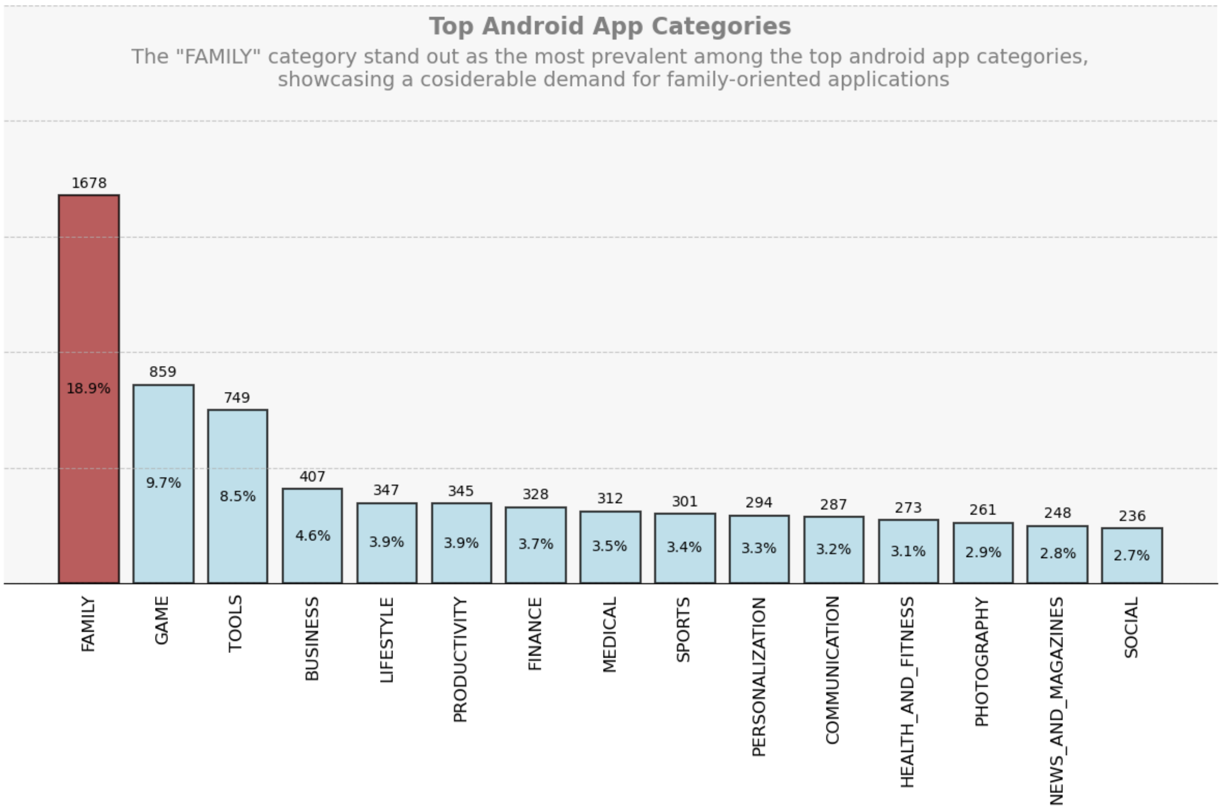
Most Common Apps by Genre

In [41]:
```
#Analysis
```

In [42]:
```
android_final["Category"].value_counts(normalize=True)*True
```

Out[42]:
```
FAMILY                 0.189326
GAME                   0.096920
TOOLS                  0.084509
BUSINESS               0.045921
LIFESTYLE              0.039152
PRODUCTIVITY           0.038926
FINANCE                0.037008
MEDICAL                0.035203
SPORTS                 0.033961
PERSONALIZATION        0.033172
COMMUNICATION          0.032382
HEALTH_AND_FITNESS     0.030802
PHOTOGRAPHY            0.029448
NEWS_AND_MAGAZINES     0.027981
SOCIAL                 0.026628
TRAVEL_AND_LOCAL       0.023356
SHOPPING               0.022453
BOOKS_AND_REFERENCE    0.021437
DATING                 0.018617
VIDEO_PLAYERS          0.017940
MAPS_AND_NAVIGATION    0.013991
FOOD_AND_DRINK         0.012411
EDUCATION              0.011734
ENTERTAINMENT          0.009590
LIBRARIES_AND_DEMO     0.009365
AUTO_AND_VEHICLES      0.009252
HOUSE_AND_HOME         0.008236
WEATHER                0.008011
EVENTS                 0.007108
PARENTING              0.006544
ART_AND_DESIGN         0.006431
COMICS                 0.006206
BEAUTY                 0.005980
Name: Category, dtype: float64
```

In [43]:
```
#Data
categories = android_final["Category"].value_counts().index[:15]
counts = android_final["Category"].value_counts().values[:15]
percentage = round(android_final["Category"].value_counts(normalize = True)*100,1)[:15]

#create stylish bar chart
plt.figure(figsize=(12, 8))
bars = plt.bar(categories,counts,color="lightblue", alpha=0.75, edgecolor="black", linewidth=1.5)
plt.xticks(rotation=90, fontsize=12)
plt.yticks(fontsize=12)
plt.grid(axis="y", linestyle= '--', alpha=0.7)
plt.grid(axis="x", linestyle= '')
plt.xticks(fontsize=12) #customized tick tables
plt.yticks(range(0,3000,500),[],fontsize=12) # customized tick table and customized y_tick table
plt.tick_params(bottom=0, left=0)

#find the category with the highest count
max_count_category = categories[counts.argmax()]

#highlight the bar for the category with the highest count
max_count_index = list(categories).index(max_count_category)
bars[max_count_index].set_color('brown')
bars[max_count_index].set_edgecolor('black')

#adding data labels and percentage inside each bar
for bar, perc in zip(bars,percentage):
    height = bar.get_height()
    plt.text(bar.get_x() + bar.get_width()/2, height + 20, '%d' % int(height), ha= 'center', va='bot
    plt.text(bar.get_x() + bar.get_width()/2, height/2, f'{perc}%', ha= 'center', va='center',fontsi

#adding a background color
ax = plt.gca()
ax.set_facecolor('#f7f7f7')

#adding chart title inside the chart
plt.text(0.5,0.95,'Top Android App Categories',horizontalalignment='center',fontsize=16,transform=pl
         color='gray',fontweight='bold')

#adding conclusion inside the chart
plt.text(0.5,0.86,'The "FAMILY" category stand out as the most prevalent among the top android app ca
         color='gray')

#remove spines
for i in ["top","right","left",]:
    plt.gca().spines[i].set_visible(False)

plt.tight_layout() #adjust layout to prevent clipping
plt.show()
```



In [44]:
```
android_final[android_final["Category"]=="FAMILY"]
```

Out[44]:

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	Cur
2017	Jewels Crush- Match 3 Puzzle	FAMILY	4.4	14774	19M	1,000,000+	Free	0	Everyone	Casual;Brain Games	July 23, 2018	1.9.3
2018	Coloring & Learn	FAMILY	4.4	12753	51M	5,000,000+	Free	0	Everyone	Educational;Creativity	July 17, 2018	
2019	Mahjong	FAMILY	4.5	33983	22M	5,000,000+	Free	0	Everyone	Puzzle;Brain Games	August 2, 2018	1.24.3
2020	Super ABC! Learning games for kids! Preschool ...	FAMILY	4.6	20267	46M	1,000,000+	Free	0	Everyone	Educational;Education	July 16, 2018	1.1
2021	Toy Pop Cubes	FAMILY	4.5	5761	21M	1,000,000+	Free	0	Everyone	Casual;Brain Games	July 4, 2018	1.8.3
...	...	...	...	...	...	...	...	...	...	...	...	
10821	Poop FR	FAMILY	NaN	6	2.5M	50+	Free	0	Everyone	Entertainment	May 29, 2018	
10827	Fr Agnel Ambarnath	FAMILY	4.2	117	13M	5,000+	Free	0	Everyone	Education	June 13, 2018	2.(
10834	FR Calculator	FAMILY	4.0	7	2.6M	500+	Free	0	Everyone	Education	June 18, 2017	1
10836	Sya9a Maroc - FR	FAMILY	4.5	38	53M	5,000+	Free	0	Everyone	Education	July 25, 2017	
10837	Fr. Mike Schmitz Audio Teachings	FAMILY	5.0	4	3.6M	100+	Free	0	Everyone	Education	July 6, 2018	

1678 rows × 13 columns

Most Popular App by genre on Google Play Store

For the google play market, we actually have data baout the number of install, so we should be able to get a clearer picture genre popularity. However the install number don't seem precise enough--we can see the most values are open ended (100,+1000,+5000 etc).

In [45]:
```
android_final["Installs"].value_counts(normalize = True)*100
```

Out[45]:
```
1,000,000+        15.739592
100,000+          11.553650
10,000,000+       10.515627
10,000+           10.199707
1,000+             8.405732
100+               6.916394
5,000,000+         6.837414
500,000+           5.573733
50,000+            4.772650
5,000+             4.513145
10+                3.542818
500+               3.249464
50,000,000+        2.290421
100,000,000+       2.121178
50+                1.918086
5+                 0.789800
1+                 0.507729
500,000,000+       0.270789
1,000,000,000+     0.225657
0+                 0.045131
0                  0.011283
Name: Installs, dtype: float64
```

In [46]:
```
android_final["Installs_int"] = android_final["Installs"].str.replace(",","").str.replace("+","").as
```

```
C:\Users\hassa\AppData\Local\Temp\ipykernel_17908\3840374705.py:1: FutureWarning: The default value
of regex will change from True to False in a future version. In addition, single character regular
expressions will *not* be treated as literal strings when regex=True.
  android_final["Installs_int"] = android_final["Installs"].str.replace(",","").str.replace
("+","").astype(int)
C:\Users\hassa\AppData\Local\Temp\ipykernel_17908\3840374705.py:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/index
ing.html#returning-a-view-versus-a-copy (https://pandas.pydata.org/pandas-docs/stable/user_guide/in
dexing.html#returning-a-view-versus-a-copy)
  android_final["Installs_int"] = android_final["Installs"].str.replace(",","").str.replace
("+","").astype(int)
```

In [47]:
```
install_frq = android_final["Installs_int"].value_counts().sort_index()
install_frq = install_frq[install_frq.index > 500]
install_frq
```

Out[47]:
```
1000           745
5000           400
10000          904
50000          423
100000        1024
500000         494
1000000       1395
5000000        606
10000000       932
50000000       203
100000000      188
500000000       24
1000000000      20
Name: Installs_int, dtype: int64
```

In [48]:
```
install_frq_per = round(android_final["Installs_int"].value_counts(normalize = True)*100,2).sort_ind
install_frq_per = install_frq_per[install_frq_per.index > 500]
install_frq_per
```

Out[48]:
```
1000           8.41
5000           4.51
10000         10.20
50000          4.77
100000        11.55
500000         5.57
1000000       15.74
5000000        6.84
10000000      10.52
50000000       2.29
100000000      2.12
500000000      0.27
1000000000     0.23
Name: Installs_int, dtype: float64
```

In [49]:
```
#alphanumeric_units
def alphanumeric_units(value):
    if value >= 1e9:
        return f'{value / 1e9:.0f}B'
    elif value >= 1e6:
        return f'{value / 1e6:.0f}M'
    elif value >= 1e3:
        return f'{value / 1e3:.0f}K'
    else:
        return f'{value:.0f}'
```

In [50]:
```
alphanumeric_units(1000000000)
```

Out[50]:
```
'1B'
```

In [51]:
```
install_frq.index
```

Out[51]:
```
Int64Index([      1000,       5000,      10000,      50000,     100000,
                500000,    1000000,    5000000,   10000000,   50000000,
             100000000,  500000000, 1000000000],
           dtype='int64')
```

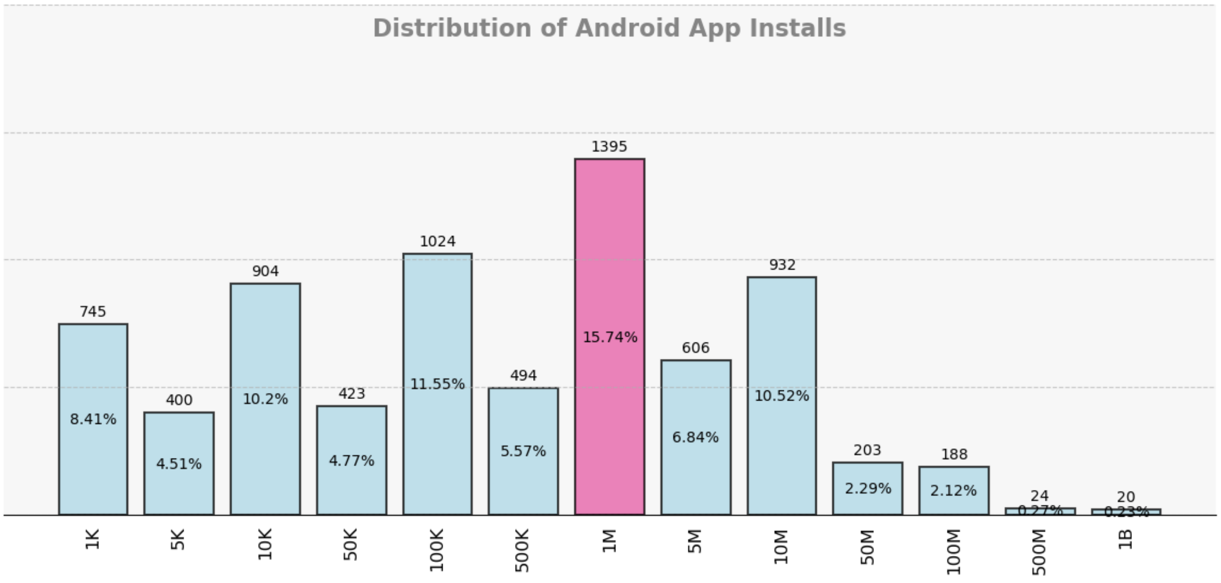
In [52]:
```
install_frq.index = install_frq.index.map(alphanumeric_units)
install_frq.index
```

Out[52]:
```
Index(['1K', '5K', '10K', '50K', '100K', '500K', '1M', '5M', '10M', '50M',
       '100M', '500M', '1B'],
      dtype='object')
```

In [53]:
```
install_frq
```

Out[53]:
```
1K       745
5K       400
10K      904
50K      423
100K    1024
500K     494
1M      1395
5M       606
10M      932
50M      203
100M     188
500M      24
1B        20
Name: Installs_int, dtype: int64
```

In [54]:
```
# Data
categories = install_frq.index
counts = install_frq.values
percentage = install_frq_per.values

#create stylish bar chart
plt.figure(figsize=(12,7))
bars = plt.bar(categories,counts,color='lightblue',alpha=0.75, edgecolor='black', linewidth=1.5)
plt.xticks(rotation=90,fontsize=12)
plt.yticks(fontsize=12)
plt.grid(axis='y',linestyle='--',alpha=0.7)
plt.grid(axis='x',linestyle='')
plt.xticks(fontsize=12) #customized tick table
plt.yticks(range(0,2500,500),[],fontsize=12) #customized tick label and customized y tick range
plt.tick_params(bottom=0,left=0)

#find the category with the highest count
max_count_category = categories[counts.argmax()]

#highlight the bar for the category with the highest count
max_count_index = list( categories).index(max_count_category)
bars[max_count_index].set_color('#E65BA5')
bars[max_count_index].set_edgecolor('black')

#adding data labels and percentage inside each bar
for bar,perc in zip(bars,percentage):
    height = bar.get_height()
    plt.text(bar.get_x() + bar.get_width()/2, height + 20, '%d' % int(height), ha='center',va='bottor
    plt.text(bar.get_x() + bar.get_width()/2, height/2, f'{perc}%' ,ha='center',va='center',fontsize

#adding a background color
ax = plt.gca()
ax.set_facecolor('#f7f7f7')

#adding chart title inside the chart
plt.text(0.5,0.94,'Distribution of Android App Installs',horizontalalignment='center', fontsize=16,tı
        color='#858585',fontweight='bold')

#adding conclusion inside the chart
plt.text(0.5,-0.35,'From the data provided it is evident that the majority of Android App installs fa
        horizontalalignment='center',fontsize=11,transform=plt.gca().transAxes, color = "#858585",foı

# remove spines
for i in ["top","right","left"]:
    plt.gca().spines[i].set_visible(False)

plt.tight_layout() #adjust layout to prevent clipping
plt.show()
```



**From the data provided it is evident that the majority of Android App installs fall within the lower range,
with th highest number of installs being in the 1k to 10M range.
Specifically,1M install range stand out with 1395 app, indicating a significant of apps falling into this category
As the number of install increases,the count of app decreases,
with only a few app reaching install counts of 500M and 1B**

In [55]:
```
categories_android = android_final["Category"].unique()
categories_android
```

Out[55]:
```
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'],
      dtype=object)
```

In [56]:
```
pd.pivot_table(android_final, values="Installs_int",index="Category",aggfunc="mean")
```

Out[56]:

	Installs_int
Category	
ART_AND_DESIGN	1.986335e+06
AUTO_AND_VEHICLES	6.473178e+05
BEAUTY	5.131519e+05
BOOKS_AND_REFERENCE	8.767812e+06
BUSINESS	1.712290e+06
COMICS	8.176573e+05
COMMUNICATION	3.845612e+07
DATING	8.540288e+05
EDUCATION	1.820673e+06
ENTERTAINMENT	1.164071e+07
EVENTS	2.535422e+05
FAMILY	3.694276e+06
FINANCE	1.387692e+06
FOOD_AND_DRINK	1.924898e+06
GAME	1.556097e+07
HEALTH_AND_FITNESS	4.188822e+06
HOUSE_AND_HOME	1.331541e+06
LIBRARIES_AND_DEMO	6.385037e+05
LIFESTYLE	1.433676e+06
MAPS_AND_NAVIGATION	4.056942e+06
MEDICAL	1.206165e+05
NEWS_AND_MAGAZINES	9.549178e+06
PARENTING	5.426036e+05
PERSONALIZATION	5.201483e+06
PHOTOGRAPHY	1.780563e+07
PRODUCTIVITY	1.678733e+07
SHOPPING	7.036877e+06
SOCIAL	2.325365e+07
SPORTS	3.638640e+06
TOOLS	1.068230e+07
TRAVEL_AND_LOCAL	1.398408e+07
VIDEO_PLAYERS	2.472787e+07
WEATHER	5.074486e+06

In [57]:
```
#display DataFrame without scientific notation
pd.options.display.float_format = '{:.0f}'.format
```

In [58]:
```
categories_installs = pd.pivot_table(android_final, values="Installs_int",index="Category",aggfunc="
categories_installs = categories_installs.sort_values(by="Installs_int", ascending=False)
categories_installs = categories_installs["Installs_int"]
categories_installs
```

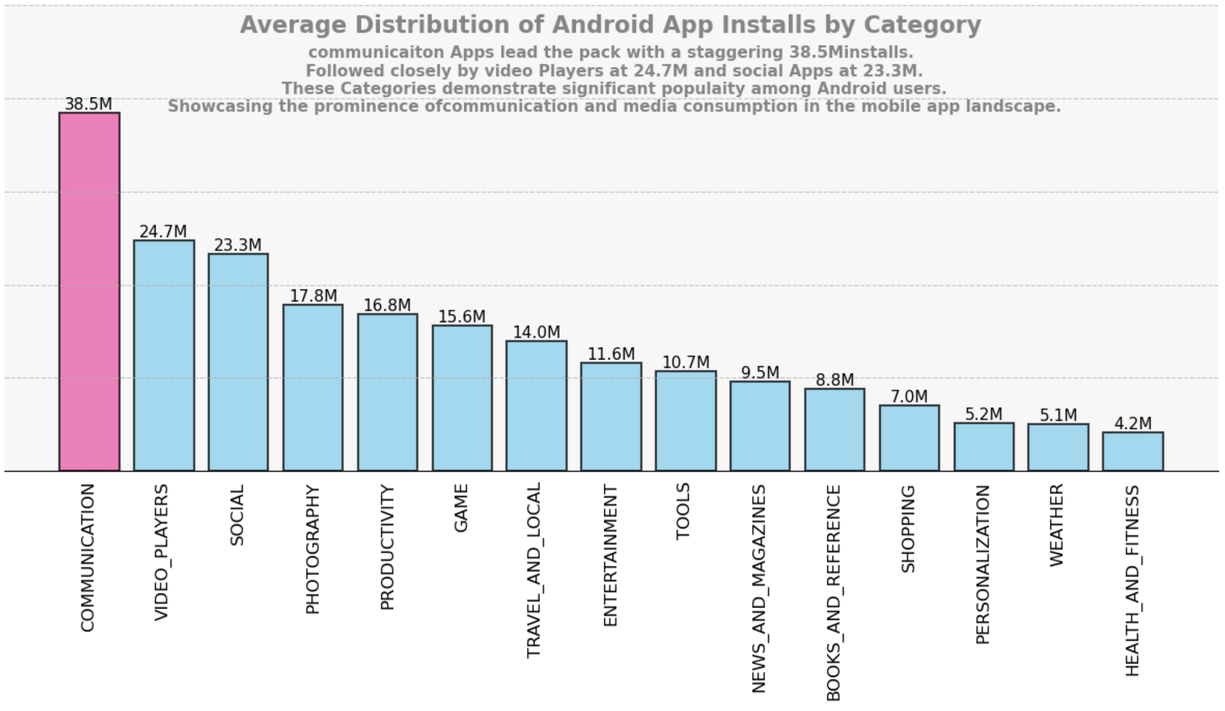
Out[58]:
```
Category
COMMUNICATION          38456119
VIDEO_PLAYERS          24727872
SOCIAL                 23253652
PHOTOGRAPHY            17805628
PRODUCTIVITY           16787331
GAME                   15560966
TRAVEL_AND_LOCAL       13984078
ENTERTAINMENT          11640706
TOOLS                  10682301
NEWS_AND_MAGAZINES      9549178
BOOKS_AND_REFERENCE     8767812
SHOPPING                7036877
PERSONALIZATION         5201483
WEATHER                 5074486
HEALTH_AND_FITNESS      4188822
MAPS_AND_NAVIGATION     4056942
FAMILY                  3694276
SPORTS                  3638640
ART_AND_DESIGN          1986335
FOOD_AND_DRINK          1924898
EDUCATION               1820673
BUSINESS                1712290
LIFESTYLE               1433676
FINANCE                 1387692
HOUSE_AND_HOME          1331541
DATING                   854029
COMICS                   817657
AUTO_AND_VEHICLES        647318
LIBRARIES_AND_DEMO       638504
PARENTING                542604
BEAUTY                   513152
EVENTS                   253542
MEDICAL                  120616
Name: Installs_int, dtype: float64
```

In [59]:
```
#alphanumeric_units
def alphanumeric_units(value):
    if value >= 1e9:
        return f'{value / 1e9:.1f}B'
    elif value >= 1e6:
        return f'{value / 1e6:.1f}M'
    elif value >= 1e3:
        return f'{value / 1e3:.1f}K'
    else:
        return f'{value:.1f}'
```

In [60]:
```
categories_installs_units = categories_installs.map(alphanumeric_units)
categories_installs_units
```

Out[60]:
```
Category
COMMUNICATION          38.5M
VIDEO_PLAYERS          24.7M
SOCIAL                 23.3M
PHOTOGRAPHY            17.8M
PRODUCTIVITY           16.8M
GAME                   15.6M
TRAVEL_AND_LOCAL       14.0M
ENTERTAINMENT          11.6M
TOOLS                  10.7M
NEWS_AND_MAGAZINES      9.5M
BOOKS_AND_REFERENCE     8.8M
SHOPPING                7.0M
PERSONALIZATION         5.2M
WEATHER                 5.1M
HEALTH_AND_FITNESS      4.2M
MAPS_AND_NAVIGATION     4.1M
FAMILY                  3.7M
SPORTS                  3.6M
ART_AND_DESIGN          2.0M
FOOD_AND_DRINK          1.9M
EDUCATION               1.8M
BUSINESS                1.7M
LIFESTYLE               1.4M
FINANCE                 1.4M
HOUSE_AND_HOME          1.3M
DATING                854.0K
COMICS                817.7K
AUTO_AND_VEHICLES     647.3K
LIBRARIES_AND_DEMO    638.5K
PARENTING             542.6K
BEAUTY                513.2K
EVENTS                253.5K
MEDICAL               120.6K
Name: Installs_int, dtype: object
```

```
In [61]: # Data
         categories = categories_installs.index[:15]
         counts = categories_installs.values[:15]

         # create stylish bar
         plt.figure(figsize=(12,7))
         bars = plt.bar(categories,counts,color="skyblue",alpha=0.75,edgecolor="black",linewidth=1.5)
         plt.xticks(rotation=90,fontsize=12)
         plt.yticks(fontsize=12)
         plt.grid(axis='y',linestyle='--',alpha=0.7)
         plt.grid(axis='x',linestyle='')
         plt.xticks(fontsize=12) #customized tick table
         plt.yticks(range(0,60000000,10000000),[],fontsize=12) #customized tick label and customized y tick ra
         plt.tick_params(bottom=0,left=0)

         #find the category with the highest count
         max_count_category = categories[counts.argmax()]

         #highlight the bar for the category with the highest count
         max_count_index = list( categories).index(max_count_category)
         bars[max_count_index].set_color('#E65BA5')
         bars[max_count_index].set_edgecolor('black')

         #adding data labels and percentage inside each bar
         for bar,units in zip(bars,categories_installs_units.values):
             height = bar.get_height()
             plt.text(bar.get_x() + bar.get_width()/2, height + 25, units , ha='center',va='bottom',fontsize=

         #adding a background color
         ax = plt.gca()
         ax.set_facecolor('#f7f7f7')

         #adding chart title inside the chart
         plt.text(0.5,0.94,'Average Distribution of Android App Installs by Category',horizontalalignment='cen
                 color='#858585',fontweight='bold')

         #adding conclusion inside the chart
         plt.text(0.5,0.77,'communicaiton Apps lead the pack with a staggering 38.5Minstalls.\n Followed close
                 horizontalalignment='center',fontsize=11,transform=plt.gca().transAxes, color = "#858585",fon

         # remove spines
         for i in ["top","right","left"]:
             plt.gca().spines[i].set_visible(False)

         plt.tight_layout() #adjust layout to prevent clipping
         plt.show()
```



Average Distribution of Android App Installs by Category

communicaiton Apps lead the pack with a staggering 38.5Minstalls.
Followed closely by video Players at 24.7M and social Apps at 23.3M.
These Categories demonstrate significant populaity among Android users.
Showcasing the prominence ofcommunication and media consumption in the mobile app landscape.

In [62]:
```
category_group = android_final.groupby("Category")
```

In [63]:
```
communication = category_group.get_group('COMMUNICATION').sort_values(by="Installs_int",ascending=Fal
communication.head()
```

Out[63]:

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated
336	WhatsApp Messenger	COMMUNICATION	4	69119316	Varies with device	1,000,000,000+	Free	0	Everyone	Communication	August 3, 2018
382	Messenger – Text and Video Chat for Free	COMMUNICATION	4	56646578	Varies with device	1,000,000,000+	Free	0	Everyone	Communication	August 1, 2018
464	Hangouts	COMMUNICATION	4	3419513	Varies with device	1,000,000,000+	Free	0	Everyone	Communication	July 21, 2018
411	Google Chrome: Fast & Secure	COMMUNICATION	4	9643041	Varies with device	1,000,000,000+	Free	0	Everyone	Communication	August 1, 2018
391	Skype - free IM & video calls	COMMUNICATION	4	10484169	Varies with device	1,000,000,000+	Free	0	Everyone	Communication	August 3, 2018

In [64]:
```
#alphanumeric_units
def alphanumeric_units(value):
    if value >= 1e9:
        return f'{value / 1e9:.0f}B'
    elif value >= 1e6:
        return f'{value / 1e6:.0f}M'
    elif value >= 1e3:
        return f'{value / 1e3:.0f}K'
    else:
        return f'{value:.1f}'
```

In [65]:
```
categories_installs.index[:15]
```

Out[65]:
```
Index(['COMMUNICATION', 'VIDEO_PLAYERS', 'SOCIAL', 'PHOTOGRAPHY',
       'PRODUCTIVITY', 'GAME', 'TRAVEL_AND_LOCAL', 'ENTERTAINMENT', 'TOOLS',
       'NEWS_AND_MAGAZINES', 'BOOKS_AND_REFERENCE', 'SHOPPING',
       'PERSONALIZATION', 'WEATHER', 'HEALTH_AND_FITNESS'],
      dtype='object', name='Category')
```

In [66]:
```
df=communication[['App','Installs_int']].head(15)
df['App','Installs_int_unit']= df['Installs_int'].map(alphanumeric_units)
df
```

Out[66]:

	App	Installs_int	(App, Installs_int_unit)
336	WhatsApp Messenger	1000000000	1B
382	Messenger – Text and Video Chat for Free	1000000000	1B
464	Hangouts	1000000000	1B
411	Google Chrome: Fast & Secure	1000000000	1B
391	Skype - free IM & video calls	1000000000	1B
451	Gmail	1000000000	1B
403	LINE: Free Calls & Messages	500000000	500M
4676	Viber Messenger	500000000	500M
420	UC Browser - Fast Download Private & Secure	500000000	500M
371	Google Duo - High Quality Video Calls	500000000	500M
383	imo free video calls and chat	500000000	500M
393	Who	100000000	100M
4633	UC Browser Mini -Tiny Fast Private & Secure	100000000	100M
4602	Truecaller: Caller ID, SMS spam blocking & Dialer	100000000	100M
4592	Telegram	100000000	100M

In [67]:
```
df = category_group.get_group('VIDEO_PLAYERS').sort_values(by="Installs_int",ascending=False)
df = df[['App','Installs_int']].head(15)
df['App','Installs_int_unit']= df['Installs_int'].map(alphanumeric_units)
df
```

Out[67]:

	App	Installs_int	(App, Installs_int_unit)
3665	YouTube	1000000000	1B
3687	Google Play Movies & TV	1000000000	1B
3711	MX Player	500000000	500M
3675	VLC for Android	100000000	100M
4688	VivaVideo - Video Editor & Photo Movie	100000000	100M
4032	Dubsmash	100000000	100M
10647	Motorola FM Radio	100000000	100M
4696	VideoShow-Video Editor, Video Maker, Beauty Ca...	100000000	100M
3672	Motorola Gallery	100000000	100M
3691	Samsung Video Library	50000000	50M
4038	DU Recorder – Screen Recorder, Video Editor, Live	50000000	50M
3693	LIKE – Magic Video Maker & Community	50000000	50M
3686	Vigo Video	50000000	50M
4049	KineMaster – Pro Video Editor	50000000	50M
5612	Ringdroid	50000000	50M

In [68]:
```
df = category_group.get_group('SOCIAL').sort_values(by="Installs_int",ascending=False)
df = df[['App','Installs_int']].head(15)
df['App','Installs_int_unit']= df['Installs_int'].map(alphanumeric_units)
df
```

Out[68]:

	App	Installs_int	(App, Installs_int_unit)
2544	Facebook	1000000000	1B
2554	Google+	1000000000	1B
2604	Instagram	1000000000	1B
2610	Snapchat	500000000	500M
2546	Facebook Lite	500000000	500M
3945	Tik Tok - including musical.ly	100000000	100M
2592	Tango - Live Video Broadcast	100000000	100M
6373	VK	100000000	100M
2552	Pinterest	100000000	100M
3951	BIGO LIVE - Live Stream	100000000	100M
2621	LinkedIn	100000000	100M
2548	Tumblr	100000000	100M
2588	Badoo - Free Chat & Dating App	100000000	100M
2636	Zello PTT Walkie Talkie	50000000	50M
2595	ooVoo Video Calls, Messaging & Stories	50000000	50M

In [69]:
```
df = category_group.get_group('PHOTOGRAPHY').sort_values(by="Installs_int",ascending=False)
df = df[['App','Installs_int']].head(15)
df['App','Installs_int_unit']= df['Installs_int'].map(alphanumeric_units)
df
```

Out[69]:

	App	Installs_int	(App, Installs_int_unit)
2884	Google Photos	1000000000	1B
4574	S Photo Editor - Collage Maker , Photo Collage	100000000	100M
2949	Camera360: Selfie Photo Editor with Funny Sticker	100000000	100M
2908	Retrica	100000000	100M
8307	LINE Camera - Photo editor	100000000	100M
2921	Photo Editor Pro	100000000	100M
2847	Sweet Selfie - selfie camera, beauty cam, phot...	100000000	100M
2937	BeautyPlus - Easy Photo Editor & Selfie Camera	100000000	100M
2938	PicsArt Photo Studio: Collage Maker & Pic Editor	100000000	100M
5057	AR effect	100000000	100M
2833	YouCam Makeup - Magic Selfie Makeovers	100000000	100M
2942	Z Camera - Photo Editor, Beauty Selfie, Collage	100000000	100M
2943	PhotoGrid: Video & Pic Collage Maker, Photo Ed...	100000000	100M
2944	Candy Camera - selfie, beauty camera, photo ed...	100000000	100M
2945	YouCam Perfect - Selfie Photo Editor	100000000	100M

In [70]:
```
df = category_group.get_group('TOOLS').sort_values(by="Installs_int",ascending=False)
df = df[['App','Installs_int']].head(15)
df['App','Installs_int_unit']= df['Installs_int'].map(alphanumeric_units)
df
```

Out[70]:

	App	Installs_int	(App, Installs_int_unit)
3234	Google	1000000000	1B
3265	Gboard - the Google Keyboard	500000000	500M
3255	SHAREit - Transfer & Share	500000000	500M
4005	Clean Master- Space Cleaner & Antivirus	500000000	500M
3235	Google Translate	500000000	500M
7536	Security Master - Antivirus, VPN, AppLock, Boo...	500000000	500M
8452	Automatic Call Recorder	100000000	100M
3266	Google Korean Input	100000000	100M
7550	Battery Doctor-Battery Life Saver & Battery Co...	100000000	100M
3272	Share Music & Transfer Files - Xender	100000000	100M
4578	Samsung Smart Switch Mobile	100000000	100M
4568	360 Security - Free Antivirus, Booster, Cleaner	100000000	100M
3289	Tiny Flashlight + LED	100000000	100M
4151	Google Now Launcher	100000000	100M
8758	Anti-virus Dr.Web Light	100000000	100M

Analysis of Photography Category and Potential for Photo Generation in 2024

Conclusion

The analysis of the photography sector reveals a notable trend towards the popularity of photo editing and collage-making applications. These apps have garnered significant attention, with several platforms amassing over 100 million installations. This trend indicates a robust demand for photo-related functionalities among users.

Given this observation, there appears to be significant potential for the development of a photo generation application in 2024. Such an app, offering prompt and free generation of pictures and photos, could capitalize on the existing user interest in photography apps, stand out in the competitive market, and attract a large user base.

Considering the success of existing photography apps and the evolving preferences of users, investing in the development of a photography app seems promising for tapping into this lucrative market segment in 2024.

In [ ]: