INTRO TO DATA SCIENCE - Final Project

Game's Genre Classification Model Using NLP

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Introduction

This project utilizes the power of Natural Language Processing (NLP) to tackle this challenge. By employing language models and machine learning techniques, we aim to develop a genre classification system that can effectively analyze game descriptions or summaries and assign them to the appropriate genres. In addition, by scraping and crawling we got a lot of data to present in plots and get some information about our data.

Import Necessary Libraries

In [400…

```
import requests
from bs4 import BeautifulSoup
import pandas as pd
import time
import ast
import numpy as np
import matplotlib as mpl
import matplotlib.pyplot as plt
from matplotlib.colors import ListedColormap
import seaborn as sns
from collections import Counter
import collections
from pandas.api.types import CategoricalDtype
pd.plotting.register_matplotlib_converters()
import matplotlib.pyplot as plt
from wordcloud import WordCloud
import seaborn as sns
import plotly.express as px
import nltk
import re
from nltk import FreqDist
from nltk.corpus import stopwords
from sklearn.preprocessing import MultiLabelBinarizer
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.feature_extraction.text import TfidfTransformer
from sklearn.model_selection import train_test_split
from sklearn.naive_bayes import MultinomialNB
from sklearn.linear_model import LogisticRegression
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.metrics import f1_score
from sklearn import metrics
from sklearn.pipeline import Pipeline
from sklearn.metrics import accuracy_score
from sklearn.preprocessing import LabelEncoder
from sklearn.metrics import classification_report
from sklearn.linear_model import LogisticRegression, SGDClassifier
from sklearn import preprocessing
from sklearn.ensemble import VotingClassifier
%matplotlib inline
```

Scraping the data

In this section, scraping the data based 'backloggd' website and save all the data we collected in dataframe.

- Backloggd - https://www.backloggd.com

Data we looking for:

- Title
- Release Year
- Genres
- Platforms
- Publisher
- Description
- Average Rating
- Times Listed
- Number Of Reviews
- Plays
- Playing
- Backlogs
- Wishlists

In [187…

```
def game_to_crawling(df,url):
    response = requests.get(url)
    soup = BeautifulSoup(response.content , 'html.parser')
    try:
            # extract the Avg. rating (1-5 Stars rating).
        temp = soup.find("div", {"id": "score"})
        temp = temp.find('h1', class_='text-center').text
        avg_rating = temp

            # extract plays, playing, backlogs, wishlist.
        temp = soup.find_all(class_="col-auto ml-auto pl-0")
        plays = temp[0].find('p', class_='mb-0').text
        playing = temp[1].find('p', class_='mb-0').text
        backlogs = temp[2].find('p', class_='mb-0').text
        wishlist = temp[3].find('p', class_='mb-0').text

            # extract game title.
        temp = soup.find("div", class_='col-12 pr-0')
        game_title = temp.find('h1', class_='mb-0').text

            # extract release date.
        temp = soup.find("div", class_='col-auto mt-auto pr-0')
        release_date = temp.find('a').text

            # extract publisher.
        temp = soup.find("div", class_='col-auto pl-lg-1 sub-title')
        temp = temp.find_all('a')
        publishers = []
        for a in temp:
            publishers.append(a.text)
```

```
            # extract the amount of Lists and Reviews.
        temp = soup.find_all('p', class_='game-page-sidecard')
        lists = temp[0].text
        reviews = temp[1].text
        try:
            if (not(lists.isdigit())):
                lists = lists.replace("Lists","")
            if (not(reviews.isdigit())):
                reviews = reviews.replace("Reviews","")
        except: None

            # extract all platforms supported.
        temp = soup.find_all('a', class_='game-page-platform')
        platforms = []
        for i in temp:
            platforms.append(i.text)

            # extract the genres.
        temp = soup.find_all('p', class_='genre-tag')
        genres = []
        for i in temp:
            genres.append(i.text)

            # extract game description
        temp = soup.find("div", {'id':'collapseSummary'})
        description = temp.find('p').text


            # lets union all the data we collected for the current game and
        data_union = [game_title,release_date,genres,platforms,publishers,de
                      lists,reviews,plays,playing,backlogs,wishlist]
        df.loc[len(df)] = data_union
    except: None
    return df
```

In [ ]:

```
# Initialize params
url = 'https://www.backloggd.com/games/lib/popular/'
n_page = 1
df = pd.DataFrame(columns=["Title","Release Year","Genres","Platforms","Publ
                           "Description","Average Rating","Times Lis
                           "Number Of Reviews","Plays","Playing","Ba

# loop for each page in the website.
# in every page we need to request 36 different pages for each game in the p
# we got the list of the 36 current game and then send every link to 'game_t
# to crawl the data for the current game.

while (n_page < 1500):
    response = requests.get(url)
    html = BeautifulSoup(response.content , 'html.parser')
    for game in html.find_all(class_='col-2 my-2 px-1 px-md-2'):
        game_url = 'https://www.backloggd.com/'+game.find('a')['href']
        df = game_to_crawling(df,game_url)
    n_page += 1
    url = 'https://www.backloggd.com/'+html.find('a', {'rel':'next'})['href'
```

In [197…
```
# Export the df to csv file as backup.
df.to_csv('Games.csv')
```

Initial & Cleaning data

Read dataset (csv file) and present dataframe.

In [421…
```
games_df = pd.read_csv('Games.csv')
games_df
```

Out[421]:

	Title	Release Year	Genres	Platforms	Publisher	Description
0	Elden Ring	Feb 25, 2022	['Adventure', 'RPG']	[' Windows PC', ' PlayStation 4', ' Xbox One',...	['Bandai Namco Entertainment', 'FromSoftware']	Elden Ring is a fantasy, action and open world...
1	The Legend of Zelda: Breath of the Wild	Mar 03, 2017	['Adventure', 'RPG']	[' Wii U', ' Nintendo Switch']	['Nintendo', 'Nintendo EPD Production Group No...	The Legend of Zelda: Breath of the Wild is the...
2	Hades	Dec 10, 2019	['Adventure', 'Brawler', 'Indie', 'RPG']	[' Windows PC', ' Mac', ' PlayStation 4', ' Xb...	['Supergiant Games']	A rogue-lite hack and slash dungeon crawler in...
3	Undertale	Sep 15, 2015	['Adventure', 'Indie', 'RPG', 'Turn Based Stra...	[' Windows PC', ' Mac', ' Linux', ' PlayStatio...	['tobyfox', '8-4']	A small child falls into the Underground, wher...
4	Hollow Knight	Feb 24, 2017	['Adventure', 'Indie', 'Platform']	[' Windows PC', ' Mac', ' Linux', ' Nintendo S...	['Team Cherry']	A 2D metroidvania with an emphasis on close co...
...	...	...	...	...	...	...
8998	Mario Goes to Brazil	Nov 17, 2022	['Platform']	[' SNES']	['Marcos Moutta']	After years of people asking him to come to Br...
8999	The Tarnishing of Juxtia	Jul 26, 2022	['Adventure', 'Indie', 'Platform', 'RPG']	[' Windows PC']	['Actual Nerds', 'Mastiff']	As the final creation of the Goddess, Juxtia, ...
9000	YuYu Hakusho 2: Kakutou no Sho	Jun 10, 1994	['Fighting']	[' Super Famicom']	['Namco']	YuYu Hakusho 2: Kakutou no Sho is an Action ga...
9001	BloodRayne 2: Terminal Cut	Nov 20, 2020	['Adventure', 'Brawler', 'Fighting', 'RPG', 'S...	[' Windows PC']	['Terminal Reality', 'Ziggurat']	Enhanced and updated for modern systems, this ...

	Title	Release Year	Genres	Platforms	Publisher	Description
9002	GeGeGe no Kitaro: Yokai Daimakyou	Apr 17, 1986	['Platform']	[' Family Computer (FAMICOM)']	['Tose', 'Bandai']	GeGeGe no Kitaro: Yokai Daimakyou, known as Ni...

9003 rows × 13 columns

In [422…
```
games_df.shape
```

Out[422]: (9003, 13)

As you can see, the type of some features is string. I'll covert the string to numeric for the next steps so we could use this features to present our data.

In [423…
```
games_df['Times Listed'] = games_df['Times Listed'].str.replace('K','').asty
games_df['Number Of Reviews'] = games_df['Number Of Reviews'].str.replace('K
games_df['Plays'] = games_df['Plays'].str.replace('K','').astype(float)*1000
games_df['Playing'] = games_df['Playing'].str.replace('K','').astype(float)*
games_df['Backlogs'] = games_df['Backlogs'].str.replace('K','').astype(float
games_df['Wishlists'] = games_df['Wishlists'].str.replace('K','').astype(flo
games_df['Release Year'].replace('TBD', np.nan, inplace=True)
games_df.head()
```

Out[423]:

	Title	Release Year	Genres	Platforms	Publisher	Description	Averag Ratin
0	Elden Ring	Feb 25, 2022	['Adventure', 'RPG']	[' Windows PC', ' PlayStation 4', ' Xbox One',...	['Bandai Namco Entertainment', 'FromSoftware']	Elden Ring is a fantasy, action and open world...	4.
1	The Legend of Zelda: Breath of the Wild	Mar 03, 2017	['Adventure', 'RPG']	[' Wii U', ' Nintendo Switch']	['Nintendo', 'Nintendo EPD Production Group No...	The Legend of Zelda: Breath of the Wild is the...	4.
2	Hades	Dec 10, 2019	['Adventure', 'Brawler', 'Indie', 'RPG']	[' Windows PC', ' Mac', ' PlayStation 4', ' Xb...	['Supergiant Games']	A rogue-lite hack and slash dungeon crawler in...	4.
3	Undertale	Sep 15, 2015	['Adventure', 'Indie', 'RPG', 'Turn Based Stra...	[' Windows PC', ' Mac', ' Linux', ' PlayStatio...	['tobyfox', '8-4']	A small child falls into the Underground, wher...	4.
4	Hollow Knight	Feb 24, 2017	['Adventure', 'Indie', 'Platform']	[' Windows PC', ' Mac', ' Linux', ' Nintendo S...	['Team Cherry']	A 2D metroidvania with an emphasis on close co...	4.

In [424…
```
games_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 9003 entries, 0 to 9002
Data columns (total 13 columns):
 #   Column             Non-Null Count  Dtype  
---  ------             --------------  -----  
 0   Title              9003 non-null   object 
 1   Release Year       8913 non-null   object 
 2   Genres             9003 non-null   object 
 3   Platforms          9003 non-null   object 
 4   Publisher          9003 non-null   object 
 5   Description        8924 non-null   object 
 6   Average Rating     8445 non-null   float64
 7   Times Listed       9003 non-null   float64
 8   Number Of Reviews  9003 non-null   float64
 9   Plays              9003 non-null   float64
 10  Playing            9003 non-null   float64
 11  Backlogs           9003 non-null   float64
 12  Wishlists          9003 non-null   float64
dtypes: float64(7), object(6)
memory usage: 914.5+ KB
```

In [425…
```
games_df.describe()
```

Out[425]:

	Average Rating	Times Listed	Number Of Reviews	Plays	Playing
count	8445.000000	9003.000000	9003.000000	9003.000000	9003.000000
mean	3.255903	115005.675886	56518.282795	191647.284239	29574.352993
std	0.624380	167769.470527	113650.279356	247489.990336	85016.112126
min	0.500000	0.000000	0.000000	0.000000	-1000.000000
25%	2.900000	16000.000000	4000.000000	5400.000000	1000.000000
50%	3.300000	50000.000000	16000.000000	70000.000000	4000.000000
75%	3.700000	134000.000000	50000.000000	305000.000000	18000.000000
max	5.000000	998000.000000	980000.000000	999000.000000	972000.000000

Dataframe's shape = 9003 rows × 13 columns (117,039 Data-Points).

Missing data treatment

In [426…

```
def missing_data_df_function(games_df):
    null_count = games_df.isnull().sum().sort_values(ascending=False)
    precents = ((games_df.isnull().sum() / games_df.count())*100).sort_value
    return pd.concat([null_count, precents.round(2)], axis=1, keys=["Total M
```

In [427…

```
missing_data_df = missing_data_df_function(games_df)
missing_data_df
```

Out[427]:

	Total Missing Data	Precents
Average Rating	558	6.61
Release Year	90	1.01
Description	79	0.89
Title	0	0.00
Genres	0	0.00
Platforms	0	0.00
Publisher	0	0.00
Times Listed	0	0.00
Number Of Reviews	0	0.00
Plays	0	0.00
Playing	0	0.00
Backlogs	0	0.00
Wishlists	0	0.00

As we see, there are 3 features with missing data (Average Rating, Release Year and Description).

Lets find the rows with the missing and clean them from the dataframe.

In [428…
```
games_df[["Average Rating", "Description",'Release Year']].info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 9003 entries, 0 to 9002
Data columns (total 3 columns):
 #   Column          Non-Null Count  Dtype  
---  ------          --------------  -----  
 0   Average Rating  8445 non-null   float64
 1   Description     8924 non-null   object 
 2   Release Year    8913 non-null   object 
dtypes: float64(1), object(2)
memory usage: 211.1+ KB
```

In [429…
```
ave_rating_mean = round(games_df['Average Rating'].mean(),1)
games_df['Average Rating'].fillna(ave_rating_mean, inplace=True)
games_df.dropna(subset=['Description'], inplace=True)
games_df.dropna(subset=['Release Year'], inplace=True)
missing_data_df = missing_data_df_function(games_df)
missing_data_df
```

Out[429]:

	Total Missing Data	Precents
Title	0	0.0
Release Year	0	0.0
Genres	0	0.0
Platforms	0	0.0
Publisher	0	0.0
Description	0	0.0
Average Rating	0	0.0
Times Listed	0	0.0
Number Of Reviews	0	0.0
Plays	0	0.0
Playing	0	0.0
Backlogs	0	0.0
Wishlists	0	0.0

There no more missing data!

In [430…
```
games_df = games_df.sort_values(by='Average Rating', ascending=False)
games_df
```

Out[430]:

	Title	Release Year	Genres	Platforms	Publisher	Description	A
1029	Marvel's Spider-Man 2	Dec 31, 2023	['Adventure', 'Brawler']	[' PlayStation 5']	['Insomniac Games', 'Sony Interactive Entertai...	Marvel's Spider-Man 2 is the next game in the ...	
6513	Resident Evil 4: Deluxe Edition	Mar 24, 2023	['Adventure', 'Puzzle', 'Shooter']	[' Windows PC', ' PlayStation 4', ' PlayStatio...	['Capcom Development Division 1', 'Capcom']	Comes with the base game, as well as bonus cos...	
3319	Sonic the Hedgehog 3	Dec 31, 1994	['Arcade']	[' Handheld Electronic LCD']	['Tiger Electronics']	Sonic the Hedgehog 3 is an LCD game created by...	
4893	Double Edged	Jun 22, 2009	['Arcade', 'Brawler', 'Fighting']	[' Android', ' iOS', ' Web browser']	['Nitrome']	Play as Spartan soldiers that are invading ene...	
7449	Ketsui Deathtiny: Kizuna Jigoku Tachi	Nov 29, 2018	['Shooter']	[' PlayStation 4']	['M2 Co.,LTD', 'M2']	Overcome despair with ketsui—determination.	
...	...	...	...	...	...	...	
5050	Dr. Jekyll and Mr. Hyde	Apr 08, 1988	['Platform']	[' NES']	['Toho', 'Advance Communication Company']	Dr. Jekyll and Mr. Hyde is a 1988 side-scrolli...	
8852	Fat 2 Fit!	May 21, 2021	[]	[' Android']	['Voodoo']	Get fit to win! Avoid those tasty but BAD burg...	
2189	Superman: The New Superman Adventures	May 31, 1999	['Adventure', 'Shooter']	[' Nintendo 64']	['Titus Software', 'WB Games']	Superman: The New Adventures, often referred t...	
7805	Raid 2020	Dec 31, 1989	['Arcade', 'Brawler']	[' NES']	['Color Dreams', 'HES Interactive']	The year is 2020 A.D. The evil drug kingpin Pi...	
8059	Raid 2020	Dec 31, 1989	['Arcade', 'Brawler']	[' NES']	['Color Dreams', 'HES Interactive']	The year is 2020 A.D. The evil drug kingpin Pi...	

8846 rows × 13 columns

Wait, wait... we cannot forget that duplicate data can hide from us ->

Duplicated data treatment by drop

In [431…
```
games_df['Title'].duplicated().sum()
```

Out[431]: 1307

1307 duplicated rows founded. Lets take a look on the duplicated:

In [432…
```
games_df[games_df['Title'].duplicated()]
```

Out[432]:

	Title	Release Year	Genres	Platforms	Publisher	Description	Aver Ra
2095	Papa's Freezeria Deluxe	Mar 31, 2023	['Indie', 'Simulator', 'Strategy']	[' Windows PC']	['Flipline Studios']	After starting a relaxing job at the oceanfron...	
7554	Dokyusei: Bangin' Summer	Feb 16, 2021	['Adventure', 'Simulator', 'Visual Novel']	[' Windows PC']	['ELF', 'Shiravune']	Dōkyūsei is a seminal classic of the dating si...	
76	Chrono Trigger	Mar 11, 1995	['Adventure', 'RPG']	[' PlayStation 3', ' Super Famicom', ' SNES', ...	['Square']	In this turn-based Japanese RPG, young Crono m...	
5029	Planescape: Torment - Enhanced Edition	Apr 11, 2017	['Adventure', 'RPG', 'Strategy']	[' Windows PC', ' Android', ' Mac', ' Linux', ...	['Beamdog']	"Discover an incredibly rich story and a uniqu...	
3355	Chrono Trigger	Feb 27, 2018	['Adventure', 'RPG']	[' Windows PC']	['Square Enix']	The timeless RPG classic returns loaded with u...	
...	...	...	...	...	...	...	
5278	Sonic Boom: Rise of Lyric	Nov 11, 2014	['Adventure', 'Platform']	[' Wii U']	['Big Red Button', 'Sega']	Sonic Boom: Rise of Lyric delivers a completel...	
6482	Dragon Ball Z: Taiketsu	Nov 24, 2003	['Fighting']	[' Game Boy Advance']	['Webfoot Technologies', 'Atari']	Heroes and villains collide in the latest Drag...	
8023	The Forgotten Ones	Jun 04, 2014	['Adventure', 'Indie']	[' Windows PC', ' Mac', ' Linux']	['Bernt Andreas Eide']	Losing his parents during the holocaust to a m...	

	Title	Release Year	Genres	Platforms	Publisher	Description	Aver Ra
7735	Clown House	Jul 15, 2015	['Indie']	[' Windows PC', ' Mac', ' Linux']	['gord10', 'Aslan Game Studio']	A horror game you've never experienced before!...	
8059	Raid 2020	Dec 31, 1989	['Arcade', 'Brawler']	[' NES']	['Color Dreams', 'HES Interactive']	The year is 2020 A.D. The evil drug kingpin Pi...	

1307 rows × 13 columns

In [433…

```
games_df.drop_duplicates(subset=['Title'], keep='first', inplace=True)
games_df = games_df.reset_index(drop=True)
games_df
```

Out[433]:

	Title	Release Year	Genres	Platforms	Publisher	Description	A
0	Marvel's Spider-Man 2	Dec 31, 2023	['Adventure', 'Brawler']	[' PlayStation 5']	['Insomniac Games', 'Sony Interactive Entertai...	Marvel's Spider-Man 2 is the next game in the ...	
1	Resident Evil 4: Deluxe Edition	Mar 24, 2023	['Adventure', 'Puzzle', 'Shooter']	[' Windows PC', ' PlayStation 4', ' PlayStatio...	['Capcom Development Division 1', 'Capcom']	Comes with the base game, as well as bonus cos...	
2	Sonic the Hedgehog 3	Dec 31, 1994	['Arcade']	[' Handheld Electronic LCD']	['Tiger Electronics']	Sonic the Hedgehog 3 is an LCD game created by...	
3	Double Edged	Jun 22, 2009	['Arcade', 'Brawler', 'Fighting']	[' Android', ' iOS', ' Web browser']	['Nitrome']	Play as Spartan soldiers that are invading ene...	
4	Ketsui Deathtiny: Kizuna Jigoku Tachi	Nov 29, 2018	['Shooter']	[' PlayStation 4']	['M2 Co.,LTD', 'M2']	Overcome despair with ketsui—determination.	
...	...	...	...	...	...	...	
7534	Action 52	Sep 01, 1991	['Adventure', 'Arcade', 'Platform', 'Racing', ...	[' NES']	['FarSight Studios', 'Active Enterprises']	Get 52 "New and Original" exciting games for p...	
7535	Dr. Jekyll and Mr. Hyde	Apr 08, 1988	['Platform']	[' NES']	['Toho', 'Advance Communication Company']	Dr. Jekyll and Mr. Hyde is a 1988 side-scrolli...	
7536	Fat 2 Fit!	May 21, 2021	[]	[' Android']	['Voodoo']	Get fit to win! Avoid those tasty but BAD burg...	
7537	Superman: The New Superman Adventures	May 31, 1999	['Adventure', 'Shooter']	[' Nintendo 64']	['Titus Software', 'WB Games']	Superman: The New Adventures, often referred t...	
7538	Raid 2020	Dec 31, 1989	['Arcade', 'Brawler']	[' NES']	['Color Dreams', 'HES Interactive']	The year is 2020 A.D. The evil drug kingpin Pi...	

7539 rows × 13 columns

In [434…
```
games_df.duplicated().any()
```

Out[434]: False

We got rid of all the duplicates!!!

Let's move on to the next part ->

Data visualization

Univariate Analysis

Let's split all the Genres list for each game by explode. This is necessary for the delete of the sub-genres and later for the model too.

In [435…
```
games_df['Genres'] = games_df['Genres'].apply(lambda x: ast.literal_eval(x))
df_genres = pd.DataFrame({
    'Title': games_df['Title'].tolist(),
    'Genres': games_df['Genres'].tolist()
})
df_genres = df_genres.explode('Genres')
df_genres.head(15)
```

Out[435]:

	Title	Genres
0	Marvel's Spider-Man 2	Adventure
0	Marvel's Spider-Man 2	Brawler
1	Resident Evil 4: Deluxe Edition	Adventure
1	Resident Evil 4: Deluxe Edition	Puzzle
1	Resident Evil 4: Deluxe Edition	Shooter
2	Sonic the Hedgehog 3	Arcade
3	Double Edged	Arcade
3	Double Edged	Brawler
3	Double Edged	Fighting
4	Ketsui Deathtiny: Kizuna Jigoku Tachi	Shooter
5	Street Fighter III: 3rd Strike	Arcade
5	Street Fighter III: 3rd Strike	Fighting
6	Metal Gear Solid 3: Subsistence	Adventure
6	Metal Gear Solid 3: Subsistence	Shooter
6	Metal Gear Solid 3: Subsistence	Tactical

Now, we can see the games in split and lets leave only Most-Popular genres (Main). Present the Quality in data-frame for each Genre we had.

In [436…
```
top_10_main_genres = ['Adventure', 'RPG', 'Indie', 'Shooter',\
                      'Puzzle', 'Simulator', 'Fighting', 'Racing', 'Sport']

df_genres = df_genres.groupby('Genres')['Title'].count().reset_index()
df_genres.columns = ['Genres', 'Quality']
df_genres = df_genres.sort_values(by = 'Quality', ascending=False)
df_genres = df_genres.loc[df_genres['Genres'].isin(top_10_main_genres)]

df_genres
```

Out[436]:

	Genres	Quality
0	Adventure	3574
13	RPG	1887
5	Indie	1734
16	Shooter	1462
11	Puzzle	995
17	Simulator	941
4	Fighting	581
18	Sport	413
14	Racing	392

Also, in percents

In [437…
```
amount = df_genres['Quality'].sum()
df_genres['Percents'] = df_genres['Quality'].apply(lambda x : ((x / amount)*
df_genres = df_genres.reset_index(drop=True)
df_genres = df_genres[:16]
df_genres
```

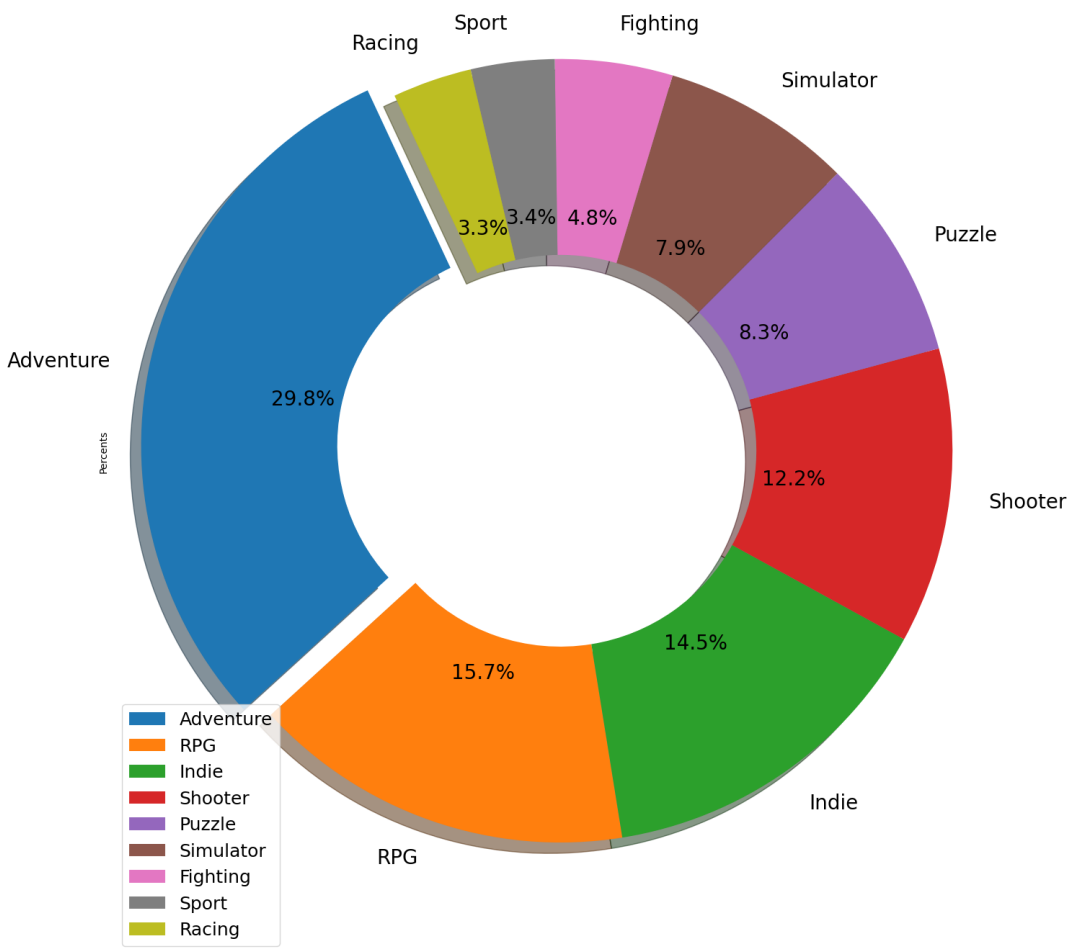
Out[437]:

	Genres	Quality	Percents
0	Adventure	3574	29.84
1	RPG	1887	15.75
2	Indie	1734	14.48
3	Shooter	1462	12.20
4	Puzzle	995	8.31
5	Simulator	941	7.86
6	Fighting	581	4.85
7	Sport	413	3.45
8	Racing	392	3.27

Let's take our data and make pie-plot to present it visually.

In [439…

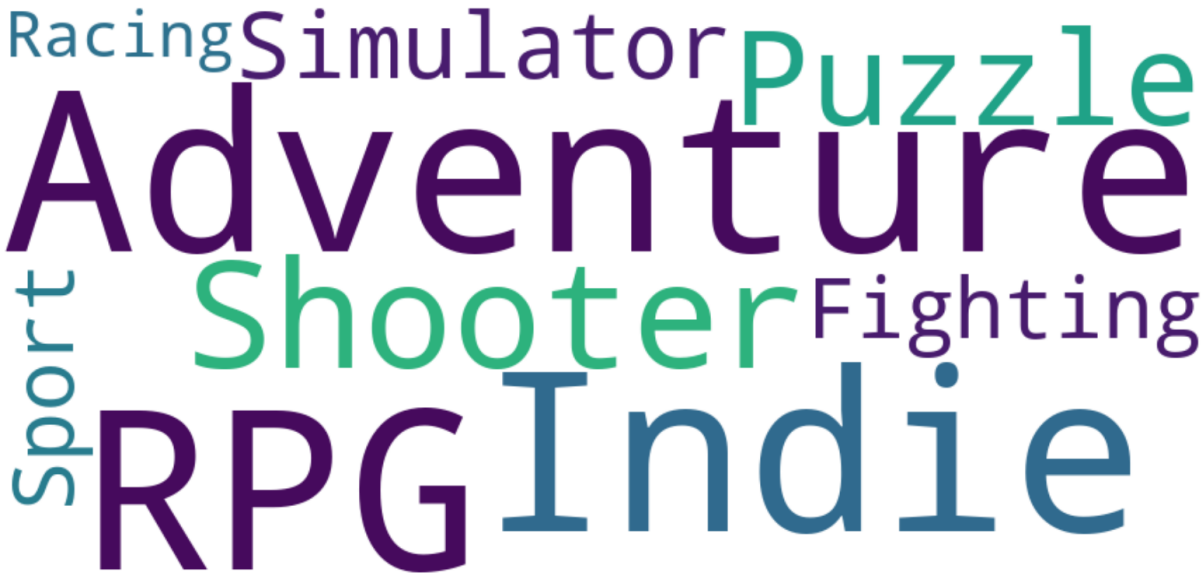
```
fig, ax = plt.subplots(figsize=(15,15))
explode = [0.07,0,0,0,0,0,0,0,0]
ax = df_genres['Percents'].plot.pie(labels=df_genres['Genres'], ax=ax,\
                                    autopct='%1.1f%%',startangle=115,shadow=Tr
                                     wedgeprops=dict(width=0.5),explode=explod
ax.set_title('DISTRIBUTION OF VALUES BY GENRES (Including subgenres)',pad=20
mpl.rcParams['font.family'] = 'sans-serif'
ax.axis('equal')
ax.legend(loc='lower left',labels=df_genres['Genres'],fontsize=18)
plt.tight_layout()
plt.show()
```



In addition, WordCloud is another option to present our data.

In [440…

```
text_to_cloud = str(list(df_genres['Genres'])).replace(',','').replace('[','
plt.rcParams['figure.figsize'] = (20,20)
wordcloud = WordCloud(background_color = 'white', mode="RGB", width = 850, h
plt.imshow(wordcloud,interpolation='bilinear')
plt.axis('off')
plt.show()
```



Now, lets take the features 'Plays' and 'Playing' to evaluate a sample of popularity and amount of player for the genres.

In [441…
```
df_players_genre = pd.DataFrame({
    'Title' : games_df['Title'].tolist(),
    'Genres' : games_df['Genres'].tolist(),
    'Plays' : games_df['Plays'].tolist(),
    'Playing' : games_df['Playing'].tolist()})

df_players_genre = df_players_genre.explode('Genres')
df_players_genre = df_players_genre.groupby('Genres')[['Plays','Playing']].s
df_players_genre = df_players_genre.loc[df_players_genre['Genres'].isin(top_
df_players_genre
```

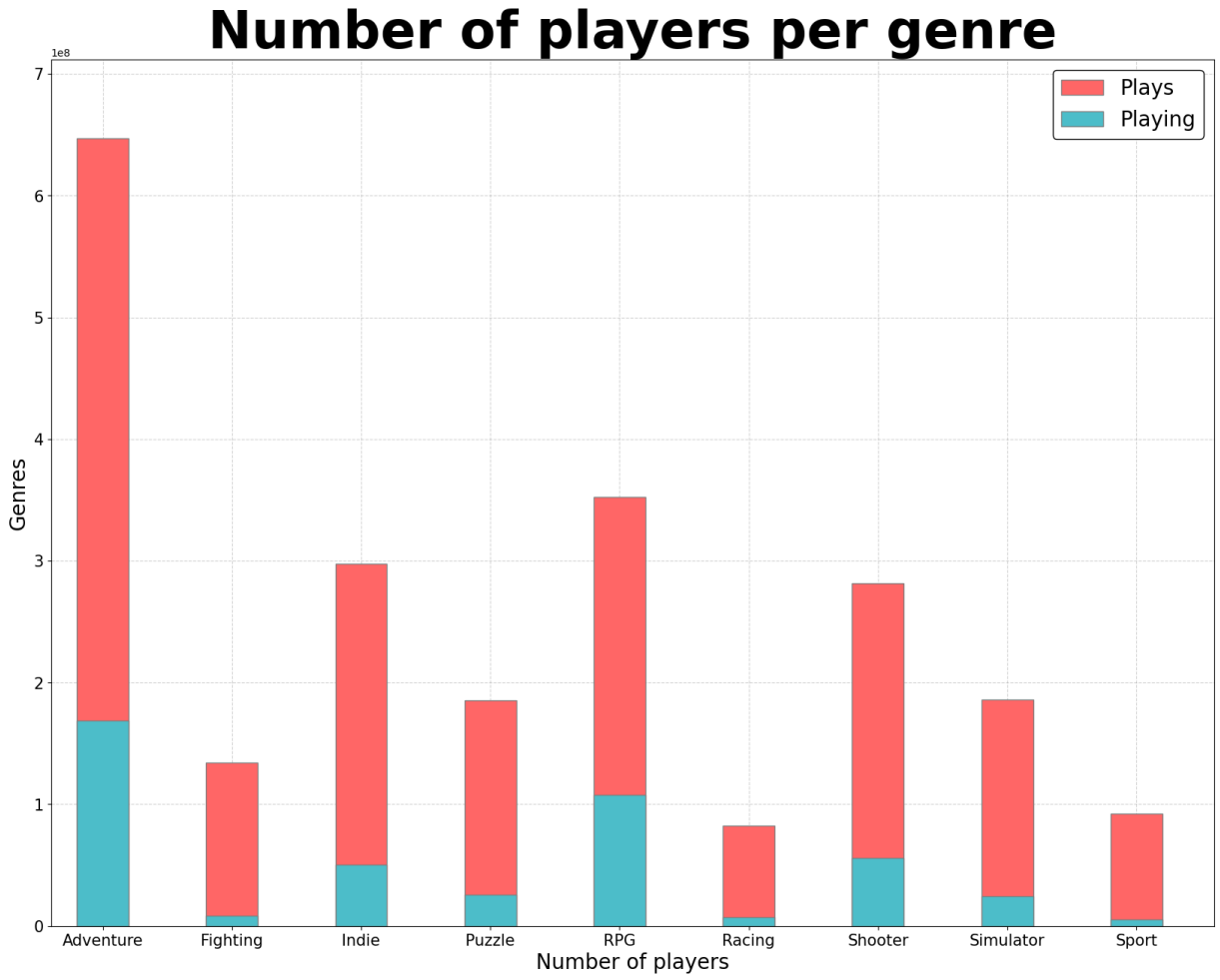
Out[441]:

	Genres	Plays	Playing
0	Adventure	647202500.0	168688400.0
4	Fighting	134334600.0	8324200.0
5	Indie	297512800.0	50315700.0
11	Puzzle	185131600.0	25571000.0
13	RPG	352365900.0	107536200.0
14	Racing	82543800.0	6937000.0
16	Shooter	281775800.0	55746800.0
17	Simulator	185789600.0	24782600.0
18	Sport	92293000.0	5116000.0

All this numbers could be hard to understand. Lets put this numbers in Bar-Plot to make it easy to understand.

In [442…
```
index = df_players_genre['Genres'].tolist()
val1 = df_players_genre['Plays'].tolist()
```

```
val2 = df_players_genre['Playing'].tolist()

fig, ax = plt.subplots(figsize=(20, 15))
plt.xticks(fontsize=15)
plt.yticks(fontsize=15)
width = 0.4
bar1 = ax.bar(index, val1, width, label='Plays', edgecolor='gray',facecolor=
ax.bar(index, val2, width, label='Playing', edgecolor='gray',facecolor='#4cb
ax.set_xlim([-width, len(index)-width])
ax.set_ylim([0, max(max(val1),max(val2))*1.1])
ax.set_axisbelow(True)
ax.grid(True, color='gray',which='major',linestyle='--',alpha=0.35,zorder=-1
ax.set_xlabel('Number of players', fontsize=20)
ax.set_ylabel('Genres', fontsize=20)
ax.set_title('Number of players per genre', fontweight='bold',fontsize = 50)
ax.legend(loc='upper right', facecolor='white', edgecolor='black', framealph
plt.show()
```



<!> The amount in the bar-plot present 1e8 -> the amount of the genres playing and play need to be X*(10^8).

Machine learning preperation

Text Analysis

In [443…
```
df = pd.DataFrame({'Title': games_df['Title'].tolist(),\
                   'Description': games_df['Description'].tolist(),'Genres':
df = df.explode('Genres')
df = df[df['Genres'].isin(['Sport','Simulator','Shooter','RPG','Racing','Fig
df = df.sort_values(by='Genres', ascending=False)
df = df.drop_duplicates(subset='Title', keep='first')
df
```

Out[443]:

	Title	Description	Genres
2959	Motorsport Manager	Have you got what it takes to become the manag...	Sport
4274	FIFA 2000	Game Boy Color port of FIFA 2000.	Sport
6422	Surf's Up	When the Surf's Up, Cody Maverick comes runnin...	Sport
6421	Mario & Sonic at the Rio 2016 Olympic Games	Mario & Sonic at the Rio 2016 Olympic Games is...	Sport
741	Inazuma Eleven 2: Blizzard	Endou Mamoru (Mark Evans in the European versi...	Sport
...	...	...	...
6825	Art of Fighting	This fighting game began the story of the Saka...	Fighting
4721	Dragon Ball Z: Supersonic Warriors 2	Supersonic Warriors 2 is the DS sequel to the ...	Fighting
3959	Kang Fu (1996)	A side-scrolling game for Amiga CD32	Fighting
989	Akatsuki Blitzkampf	Akatsuki Blitzkampf is a Japanese dōjin 2D fig...	Fighting
1235	JoJo's Bizarre Adventure: Heritage for the Future	JoJo's Bizarre Adventure: Heritage for the Fut...	Fighting

4677 rows × 3 columns

By using nltk library - the text in each description split by the space between the words. Then we print the most common words (40) we found in the texts. But this is just our first step to prepare our text for the classification model.

In [444…
```
tokens = nltk.word_tokenize(' '.join(df.Description.values))
text = nltk.Text(tokens)
fdist = FreqDist(text)
print(fdist)
fdist.most_common(40)
```

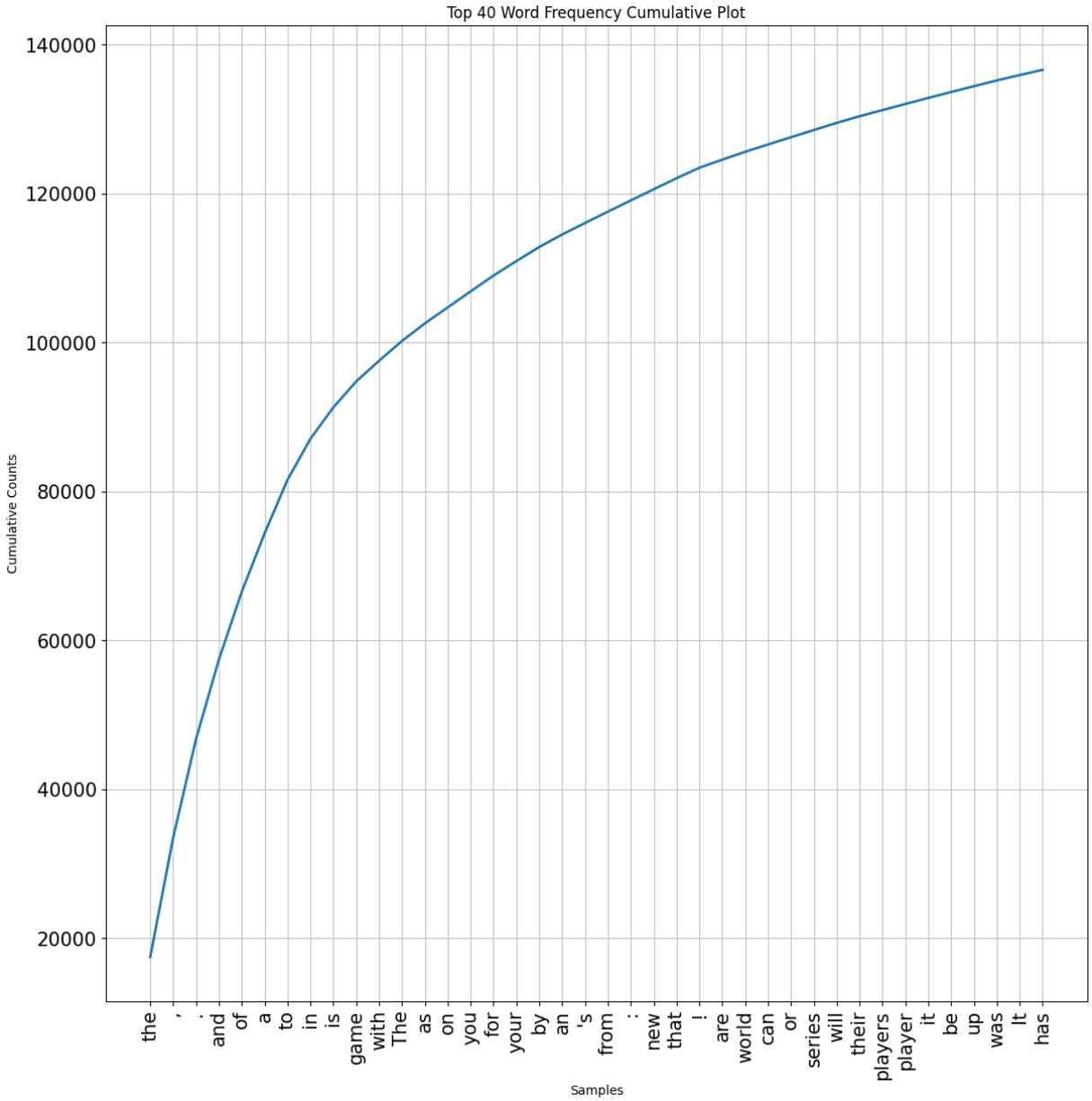
```
<FreqDist with 26108 samples and 335873 outcomes>
```

Out[444]:
```
[('the', 17472),
 (',', 16027),
 ('.', 13248),
 ('and', 10698),
 ('of', 9102),
 ('a', 7854),
 ('to', 7174),
 ('in', 5498),
 ('is', 4212),
 ('game', 3490),
 ('with', 2776),
 ('The', 2658),
 ('as', 2351),
 ('on', 2157),
 ('you', 2146),
 ('for', 2121),
 ('your', 1950),
 ('by', 1888),
 ('an', 1684),
 ("'s", 1546),
 ('from', 1523),
 (':', 1501),
 ('new', 1500),
 ('that', 1483),
 ('!', 1414),
 ('are', 1079),
 ('world', 1058),
 ('can', 982),
 ('or', 971),
 ('series', 969),
 ('will', 957),
 ('their', 897),
 ('players', 828),
 ('player', 819),
 ('it', 809),
 ('be', 798),
 ('up', 782),
 ('was', 777),
 ('It', 715),
 ('has', 704)]
```

We found 26108 unique words in 335873 outcomes. There are also several stop words that will be removed.

Lets present the frequency of the most common words. The below plot shows the top 40 most frequent words and the cumulative distribution.

In [445…
```
fig, ax = plt.subplots(figsize=(14,14))
plt.xticks(fontsize=15)
plt.yticks(fontsize=15)
fdist.plot(40, cumulative=True, title='Top 40 Word Frequency Cumulative Plot
ax.set_title('Top 40 Word Frequency Cumulative Plot', fontsize=30)
plt.show()
```



Collocations

*Collocations present the commonly occuring biagrams or words that tend to follow one*another.

In [446…
```
text.collocations()
```

```
video game; Mega Man; Final Fantasy; Resident Evil; North America;
Street Fighter; Kingdom Hearts; takes place; Dragon Ball; Star Wars;
Xbox 360; Fire Emblem; game developed; Game Boy; fighting game; FINAL
FANTASY; Mortal Kombat; first-person shooter; open world; Theft Auto
```

Lexical Diversity

The lexical diversity can suggest how varied in word choice the names are within their respective genres. RPG have the lowest lexical diversity ratios while Racing have the highest.

In [447…
```
genres = list(df['Genres'].unique())
dictionary = {}
for genre in genres:
    descs = list(df[df['Genres'] == genre].Description.values)
    tokens = nltk.word_tokenize(' '.join(descs))
    types = set(tokens)
    lexical_diversity = round(len(types) / len(tokens),3)
    dictionary[genre] = (len(tokens), len(types), lexical_diversity)

table = pd.DataFrame.from_dict(dictionary, orient='index', columns=['Tokens'
display(table.sort_values('Lexical Diversity'))
```

	Tokens	Type	Lexical Diversity
RPG	106322	12425	0.117
Shooter	96969	12321	0.127
Simulator	54247	9349	0.172
Fighting	30820	5368	0.174
Sport	31074	5745	0.185
Racing	16441	3733	0.227

Data Cleaning and Auditing

Now, lets clean the text and make sure we will only be working with text, non-alphabetic, stopwords and roman numerals will be removed from the titles.

In [448…
```
def text_cleaner(text):
    text = text.lower()
    tokens = nltk.word_tokenize(text)
    tokens = [t for t in tokens if t.isalpha()]
    tokens = [t for t in tokens if t not in stopwords.words('english')]
    roman_re = r'\bM{0,4}(CM|CD|D?C{0,3})(XC|XL|L?X{0,3})(IX|IV|V?I{0,3})\b'
    tokens = [t for t in tokens if not re.match (roman_re, t, flags=re.IGNOR
    text = ' '.join(tokens).strip()
    return text
```

In [449…
```
df['Description'] = df['Description'].apply(lambda n: text_cleaner(n))
df.sample(20)
```

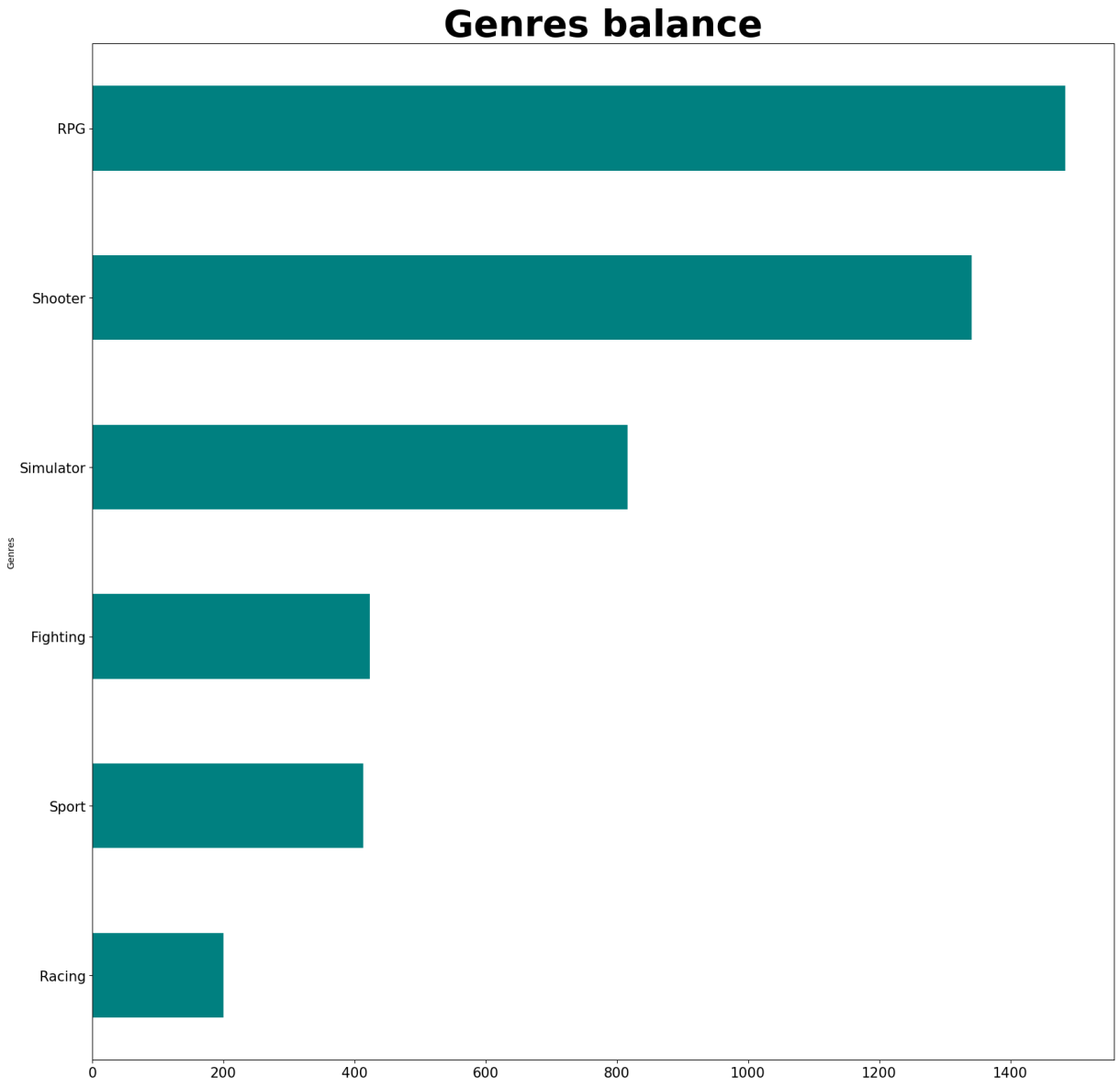
Out[449]:

	Title	Description	Genres
426	Rune Factory 4	rune factory marks return popular harvest moon...	Simulator
5643	Eternal Ring	young magician sent king investigate strange h...	RPG
2928	Sol Cresta	dock split form pilot three ships free solar s...	Shooter
4044	Trinity Trigger	trinity trigger action video game developed th...	RPG
1984	Half-Life: Opposing Force	opposing force returns setting instead portray...	Shooter
1074	Xenoblade Chronicles 2	next adventure nintendo switch console set bac...	RPG
2313	Unpacking	unpacking zen puzzle game familiar experience ...	Simulator
6	Metal Gear Solid 3: Subsistence	metal gear solid subsistence continues metal g...	Shooter
6140	The Adventures of Tintin: The Game	interactive adaptation tintin debut game true ...	Fighting
5484	Cool Boarders 2	cool boarders features four stock riders six s...	Sport
4996	Mega Man & Bass	mega man bass entry classic mega man series op...	Shooter
1352	SimCity 4: Deluxe Edition	simcity deluxe edition includes bestselling si...	Simulator
7077	Mega Man Battle Chip Challenge	installment mega man rockman franchise bring r...	RPG
2006	Advance Wars	battle fits palm hand mean stakes small contra...	Simulator
2398	The Simpsons: Hit & Run	strange spy cameras shady black vans lingering...	Racing
2418	Melty Blood: Type Lumina	melty blood series fighting games based visual...	Fighting
5378	World of Dragon Warrior: Torneko - The Last Hope	torneko last hope single player rpg title revo...	RPG
2866	NBA Live 2004	nba live installment nba live video games seri...	Sport
357	Ridge Racer Type 4	ridge racer type ridge racer type europe racin...	Racing
3341	Baldur's Gate: Dark Alliance II	using edition dungeons dragons rules set baldu...	RPG

Genres balance analyze

The next plot, will present the amount of games of each genre.

In [450…
```
plt.xticks(fontsize=15)
plt.yticks(fontsize=15)
fig.set_size_inches(6,6)
plt.title('Genres balance', fontsize = 40, fontweight='bold')
df['Genres'].value_counts(ascending=True).plot(kind='barh', color='#008080')
plt.show()
```



Post-cleaning analysis

In [451…
```
def stemm_cleaner(text):
    text = ' '.join(stemmer.stem(word) for word in text.split(' '))
    return text
```

In [452…
```
genres = list(df['Genres'].unique())
```

```
stemmer = nltk.SnowballStemmer("english")
df['Description'] = df['Description'].apply(stemm_cleaner)
dictionary = {}
for genre in genres:
    descs = list(df[df['Genres'] == genre].Description.values)
    tokens = nltk.word_tokenize(' '.join(descs))
    types = set(tokens)
    lexical_diversity = round(len(types) / len(tokens),3)
    dictionary[genre] = (len(tokens), len(types), lexical_diversity)

table = pd.DataFrame.from_dict(dictionary, orient='index', columns=['Tokens'
display(table.sort_values('Lexical Diversity'))
```

	Tokens	Type	Lexical Diversity
RPG	52757	6821	0.129
Shooter	48074	6624	0.138
Simulator	26740	5259	0.197
Fighting	15661	3151	0.201
Sport	15640	3275	0.209
Racing	8166	2281	0.279

In [453…

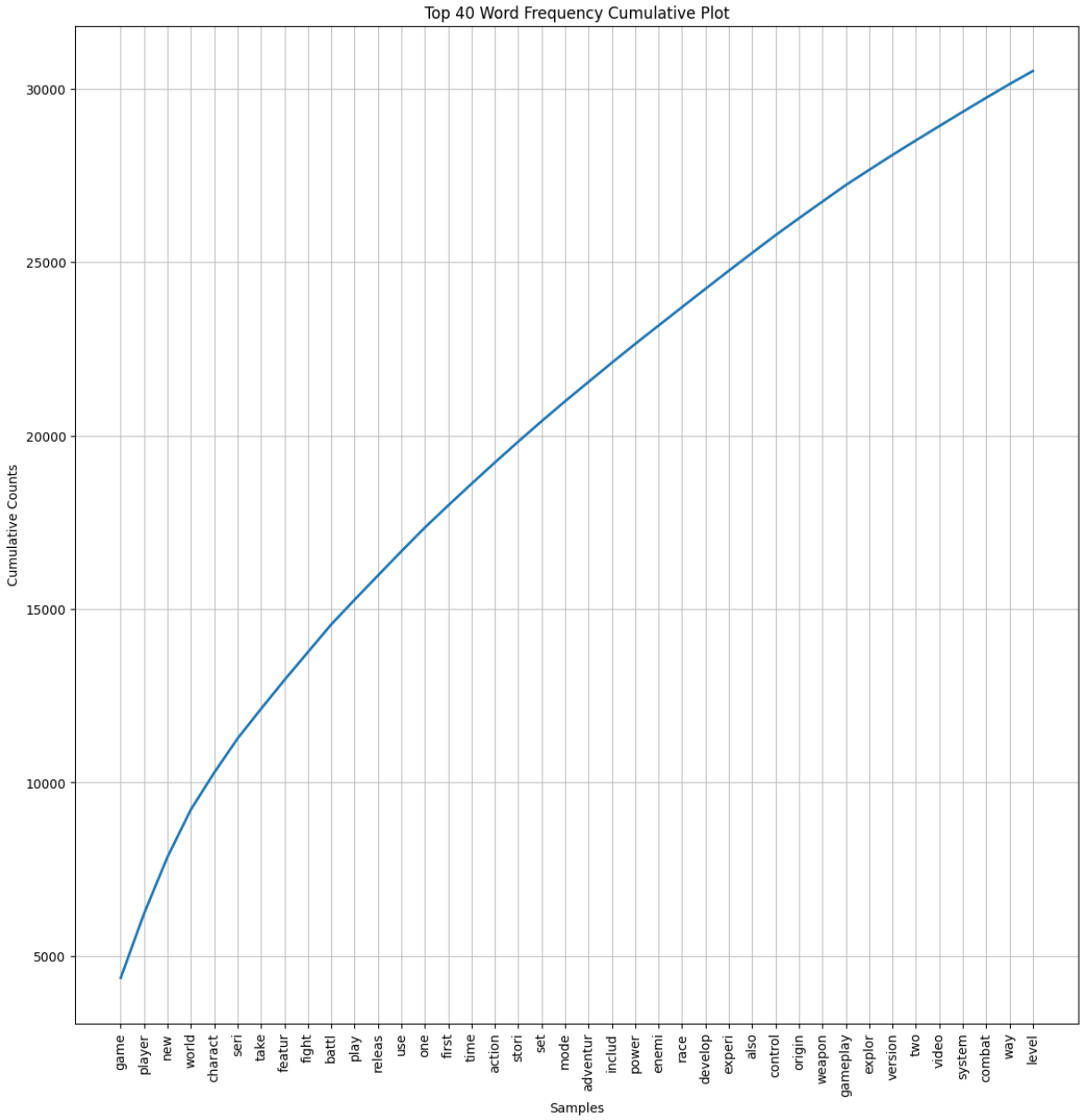
```
tokens = nltk.word_tokenize(' '.join(df['Description'].values))
text = nltk.Text(tokens)
fdist = FreqDist(text)
print(fdist)
fdist.most_common(40)
```

```
<FreqDist with 12974 samples and 167038 outcomes>
```

Out[453]:
```
[('game', 4365),
 ('player', 1859),
 ('new', 1629),
 ('world', 1366),
 ('charact', 1067),
 ('seri', 985),
 ('take', 852),
 ('featur', 831),
 ('fight', 801),
 ('battl', 800),
 ('play', 714),
 ('releas', 700),
 ('use', 697),
 ('one', 681),
 ('first', 639),
 ('time', 626),
 ('action', 615),
 ('stori', 603),
 ('set', 588),
 ('mode', 573),
 ('adventur', 557),
 ('includ', 554),
 ('power', 544),
 ('enemi', 530),
 ('race', 529),
 ('develop', 527),
 ('experi', 523),
 ('also', 514),
 ('control', 512),
 ('origin', 487),
 ('weapon', 479),
 ('gameplay', 477),
 ('explor', 438),
 ('version', 432),
 ('two', 419),
 ('video', 412),
 ('system', 410),
 ('combat', 404),
 ('way', 396),
 ('level', 378)]
```

After cleaning the data from all the non-alphabetic, stop words and roman numerals - there 12974 unique word in 167038 outcomes!

In [454…
```
fig, ax = plt.subplots(figsize=(14,14))
fdist.plot(40, cumulative=True, title='Top 40 Word Frequency Cumulative Plot
ax.set_title('Top 40 Word Frequency Cumulative Plot', fontsize=30)
plt.show()
```



Common words per genre

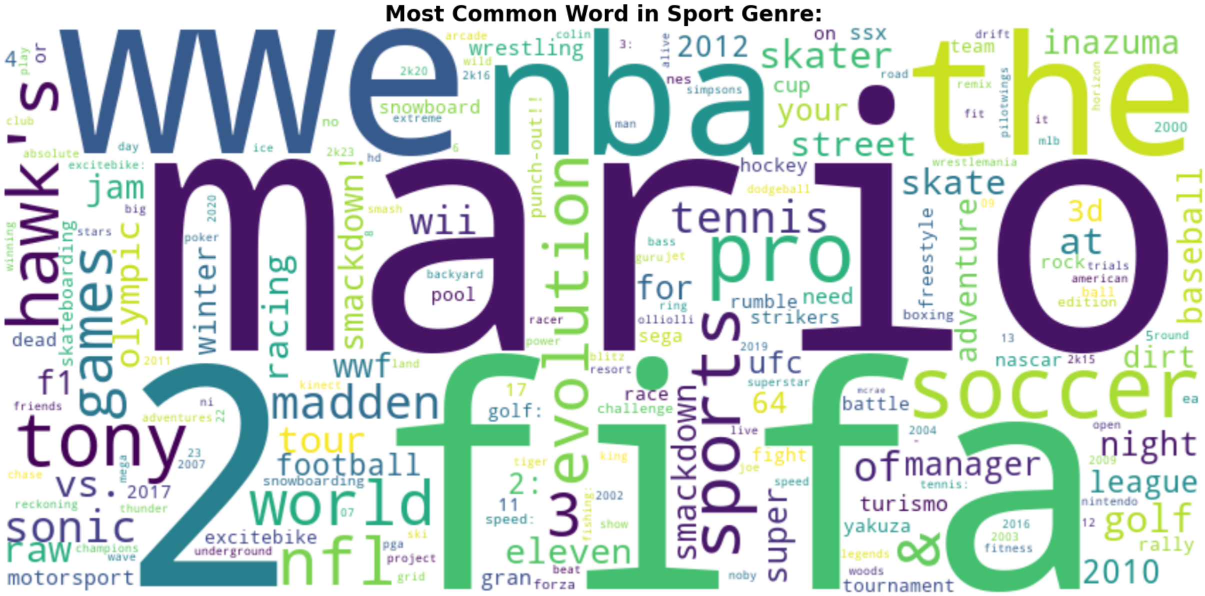
Now, let's take a look on the most common word BUT per genre.

In [378…

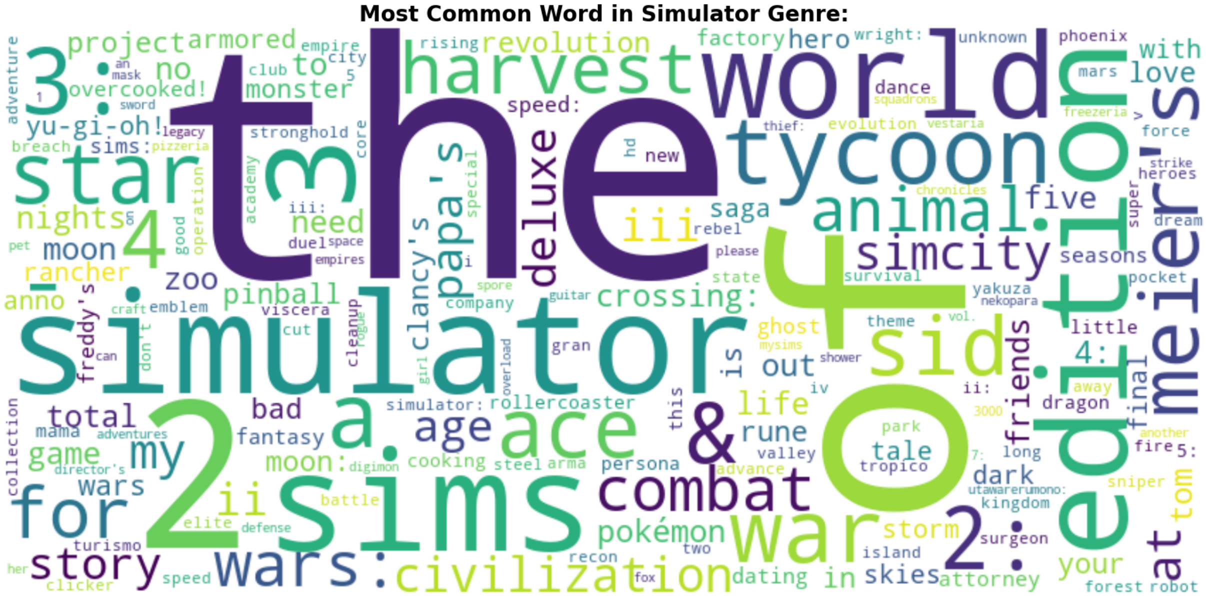
```
genres = ['Sport','Simulator','Shooter','RPG','Racing','Fighting']

game_titles = {genre: [] for genre in genres}

for index, row in df.iterrows():
    genre = row['Genres']
    title = row['Title']
    if genre in game_titles:
        game_titles[genre].append(title)

word_counts = {genre: collections.Counter(' '.join(game_titles[genre]).lower
```

```python
for genre in genres:
    counts = word_counts[genre]
    wordcloud = WordCloud(background_color='white', mode="RGB", width = 850,
    plt.figure()
    plt.imshow(wordcloud, interpolation='bilinear')
    plt.title(f"Most Common Word in {genre} Genre:", fontsize=20, fontweight
    plt.axis('off')
    plt.show()
    print("\n\n\n")
```

Most Common Word in Sport Genre:



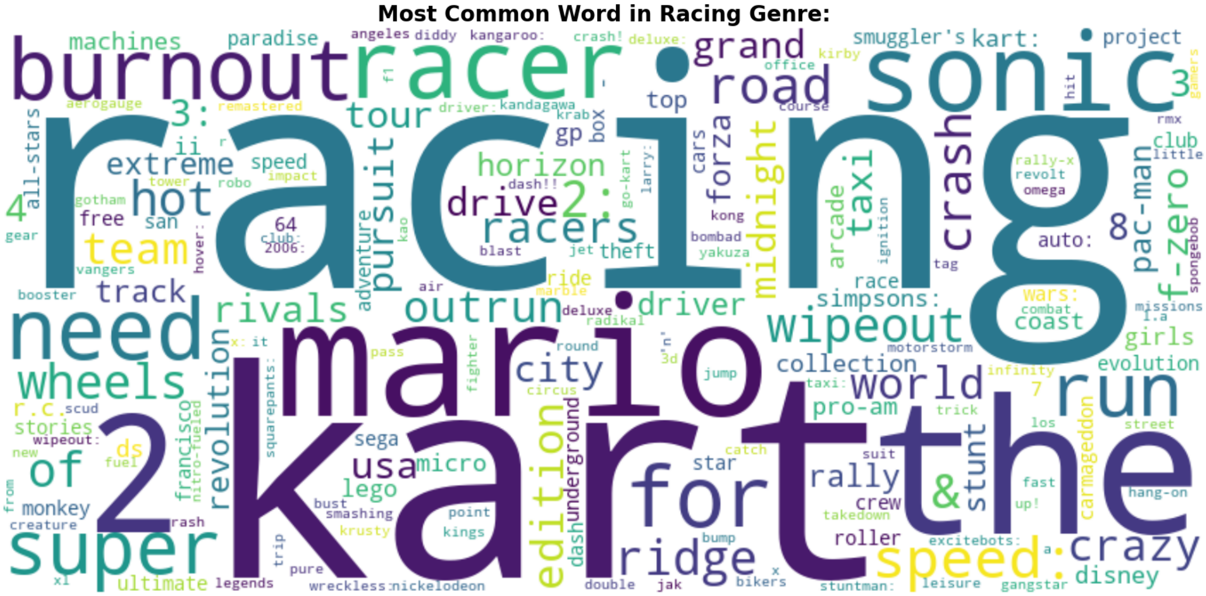
Most Common Word in Simulator Genre:



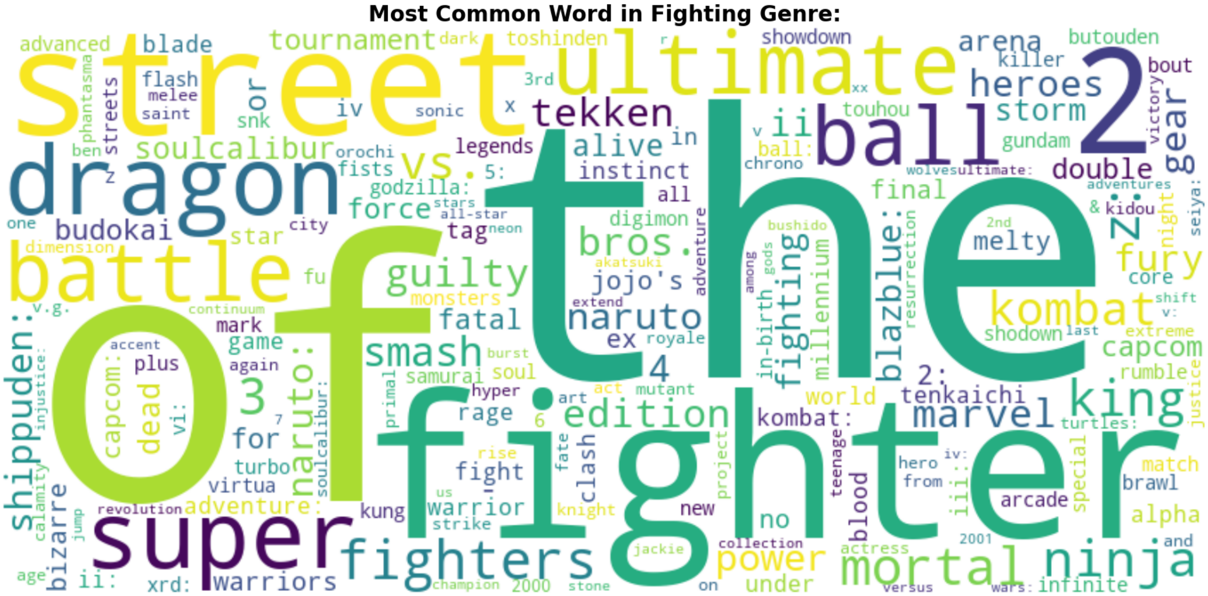
Most Common Word in Shooter Genre:

Most Common Word in RPG Genre:

Most Common Word in Racing Genre:



Most Common Word in Fighting Genre:



Genre Classification Model :)

In this section we will use the Pipeline with CountVectorizer, TFIDF, MultinomialNB algorithms (Based on internet explore for the project).

In [347…

```
TFIDF_vectorizer = TfidfVectorizer(analyzer='word')
df = df.sample(frac = 1)
X = df['Description']
y = df['Genres']
Xtrain, Xtest, ytrain, ytest = train_test_split(X, y, test_size=0.2, random_
```

```
xtrain_TFIDF = TFIDF_vectorizer.fit_transform(Xtrain)
xtest_TFIDF = TFIDF_vectorizer.transform(Xtest)
lr = LogisticRegression(max_iter=10000)
lr.fit(xtrain_TFIDF, ytrain)
lr_pred = lr.predict(xtest_TFIDF)
lr_acc = metrics.accuracy_score(ytest, lr_pred)
lr_acc = round(lr_acc, 2)
```

In [348…

```
print(f'~~~Accuracy Scores~~~')
print(f'Logistic Regression: {lr_acc}')
```

```
~~~Accuracy Scores~~~
Logistic Regression: 0.71
```

In [349…

```
pred_df = pd.DataFrame(Xtest)
pred_df['Actual'] = ytest
pred_df['Prediction'] = lr_pred
pred_df.sample(10)
```

Out[349]:

	Description	Actual	Prediction
2150	alien land futurist los angel duke bring pain ...	Shooter	Shooter
6367	master time becom ultim weapon aiden krone mad...	Shooter	Shooter
7035	omega quintet hybrid idol simul game japanes g...	RPG	Simulator
1602	shadow heart first offici game shadow heart se...	RPG	RPG
6408	third game ar tonelico seri first playstat	RPG	RPG
4613	call duti modern warfar shooter video game dev...	Shooter	Shooter
148	come age stori set protagonist friend journey ...	Simulator	RPG
2964	raidou kuzunoha privat detect japan taishou pe...	RPG	RPG
3267	mario paint educ game allow anyon creat simpl ...	Simulator	Simulator
4619	inspir realiti counter terrorist oper across w...	Shooter	Shooter

In [350…

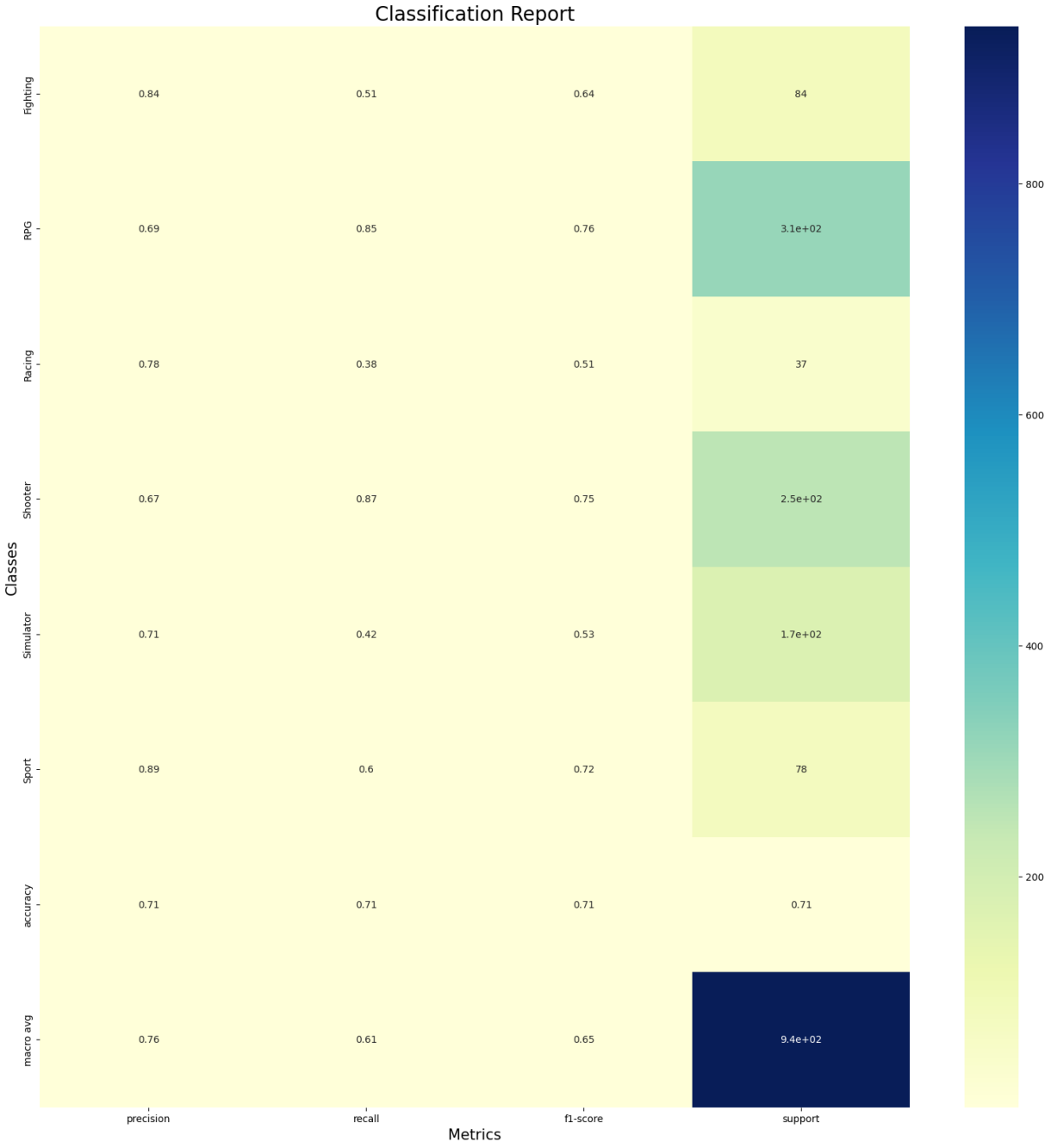
```
print(metrics.classification_report(ytest, lr_pred))
```

```
              precision    recall  f1-score   support

    Fighting       0.84      0.51      0.64        84
         RPG       0.69      0.85      0.76       312
      Racing       0.78      0.38      0.51        37
     Shooter       0.67      0.87      0.75       252
   Simulator       0.71      0.42      0.53       173
       Sport       0.89      0.60      0.72        78

    accuracy                           0.71       936
   macro avg       0.76      0.61      0.65       936
weighted avg       0.72      0.71      0.69       936
```

In [351…

```
report = classification_report(ytest, lr_pred, output_dict=True)
df_report = pd.DataFrame(report).transpose()
```

```
sns.heatmap(df_report.iloc[:-1, :].astype(float), annot=True, cmap="YlGnBu")
plt.title("Classification Report", fontsize=20)
plt.xlabel("Metrics", fontsize=15)
plt.ylabel("Classes", fontsize=15)
plt.show()
```



CountVectorizer & SGDClassifier - Pipeline

In [352…

```
df = df.sample(frac = 1)
X = df['Description']
y = df['Genres']
Xtrain, Xtest, ytrain, ytest = train_test_split(X, y, test_size=0.2, random_

text_clf_svm = Pipeline([
```

```
    ('vect', CountVectorizer(stop_words="english",max_features=10000)),
    ('norm', preprocessing.Normalizer(norm='l1')),
    ('clf', SGDClassifier(loss='hinge', penalty='l2',
                          alpha=1e-3, random_state=42,
                          max_iter=5, tol=None)),
])
text_clf_svm.fit(Xtrain, ytrain)
predicted = text_clf_svm.predict(Xtest)
print(f"Accuracy = {round(np.mean(predicted == ytest),2)}")
```

```
Accuracy = 0.67
```

In [353…
```
df_model = pd.DataFrame({"Desc":Xtest, "ACTUAL":ytest, "Predicted":predicted
df_model.sample(10)
```

Out[353]:

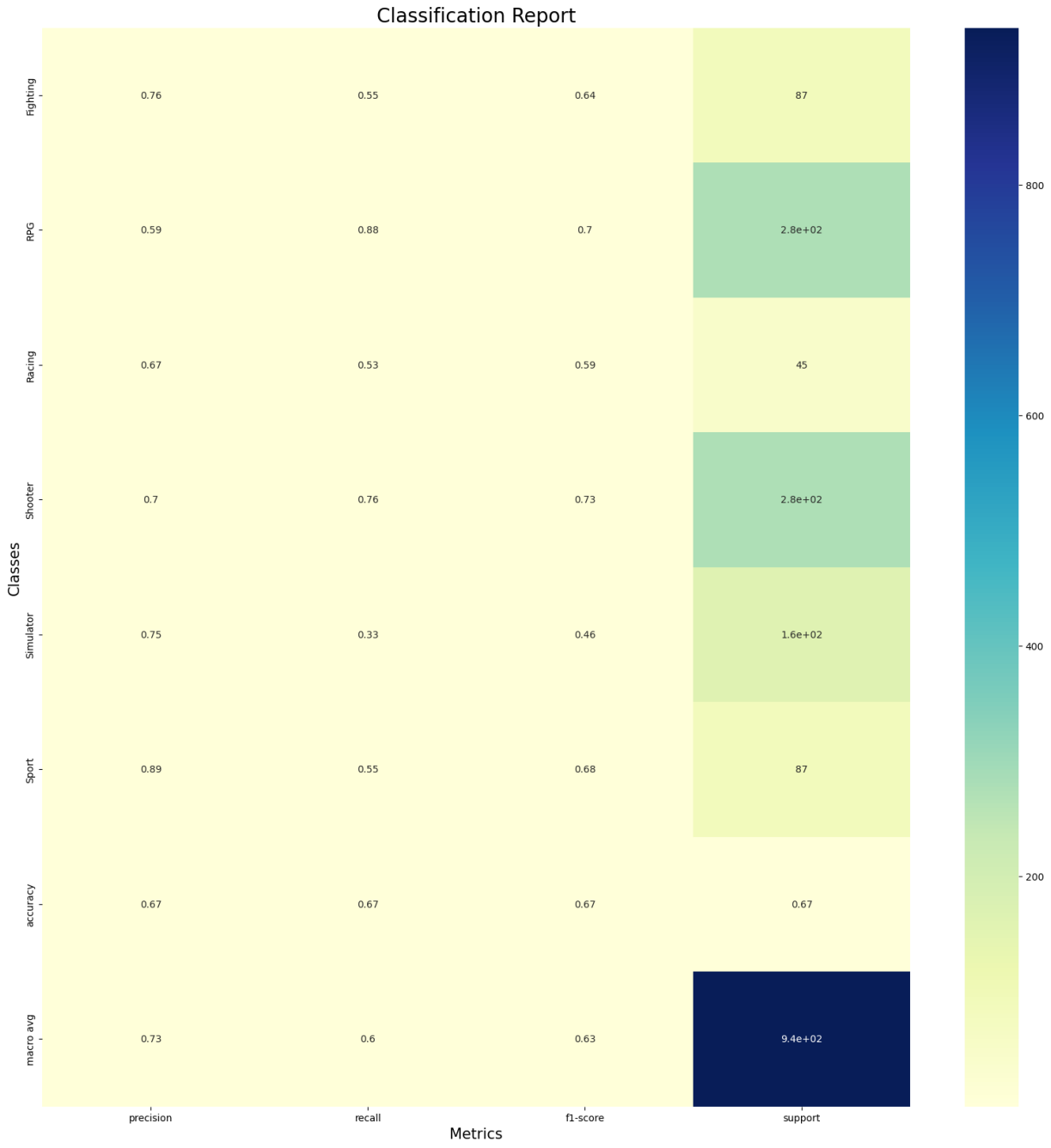
	Desc	ACTUAL	Predicted
2321	caesar part sierra citi build seri releas octo...	Simulator	Simulator
5758	elliot quest player explor mysteri urel island...	RPG	RPG
6244	one franchis time avail free jump one favorit ...	Simulator	Fighting
7022	final fantasi year direct sequel final fantasi...	RPG	RPG
4567	rpg dungeon crawler use team five charact five...	RPG	RPG
5991	adventur begin stage rpg revu starlight live d...	RPG	RPG
5726	huge air phat move sick trick race real bmx bi...	Sport	Sport
2282	mlb show deliv realist person basebal game exp...	Sport	Shooter
6870	chemic spill somewher rural england mutat armi...	Shooter	Shooter
2638	polish graphic enhanc gameplay updat featur wo...	Shooter	RPG

In [354…
```
print(metrics.classification_report(ytest, predicted))
```

```
              precision    recall  f1-score   support

    Fighting       0.76      0.55      0.64        87
         RPG       0.59      0.88      0.70       275
      Racing       0.67      0.53      0.59        45
     Shooter       0.70      0.76      0.73       278
   Simulator       0.75      0.33      0.46       164
       Sport       0.89      0.55      0.68        87

    accuracy                           0.67       936
   macro avg       0.73      0.60      0.63       936
weighted avg       0.70      0.67      0.65       936
```

In [355…
```
report = classification_report(ytest, predicted, output_dict=True)
df_report = pd.DataFrame(report).transpose()
sns.heatmap(df_report.iloc[:-1, :].astype(float), annot=True, cmap="YlGnBu")
plt.title("Classification Report", fontsize=20)
plt.xlabel("Metrics", fontsize=15)
```

```
plt.ylabel("Classes", fontsize=15)
plt.show()
```



CountVectorizer & TfidfTransformer & LogisticRegression - Pipeline

In [356…

```
Xtrain, Xtest, ytrain, ytest = train_test_split(X, y, test_size=0.2)

logreg = Pipeline([('vect', CountVectorizer()),
                   ('tfidf', TfidfTransformer()),
                   ('clf', LogisticRegression(n_jobs=1, C=1e5, max_iter=1000)),
                  ])
logreg.fit(Xtrain, ytrain)
```

```
ypred = logreg.predict(Xtest)

print('accuracy %s' % round(accuracy_score(ypred, ytest),2))
```

```
accuracy 0.7
```

In [357…
```
df_model = pd.DataFrame({"Desc":Xtest, "ACTUAL":ytest, "Predicted":ypred})
df_model.sample(10)
```

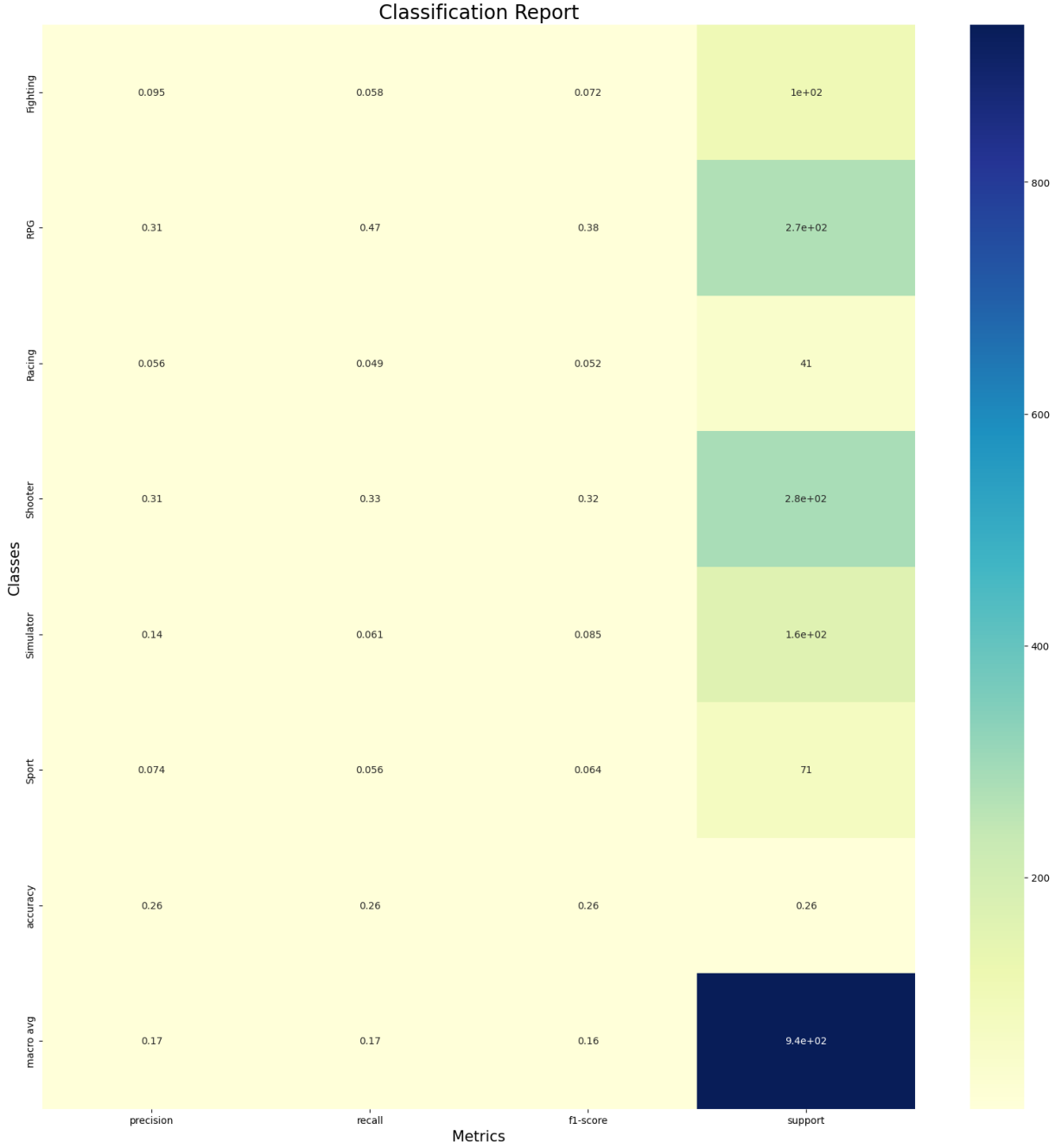
Out[357]:

	Desc	ACTUAL	Predicted
3947	overhead play jeep driver gunner rescu pow com...	Shooter	Shooter
2505	embark journey reclaim crown drangleic king ve...	RPG	RPG
3391	nintendog japanes ニンテンドッグス hepburn nintendoggu...	Simulator	Fighting
3797	chronicl riddick assault dark athena new actio...	Shooter	Shooter
3477	jim power mutant planet platform game design d...	Shooter	Shooter
5886	discov uniqu combin branch stori innov combat ...	RPG	RPG
2623	crypt necrodanc hardcor roguelik rhythm game s...	RPG	RPG
374	jrpg sequel earthbound begin ness young boy li...	RPG	RPG
1684	blazblu chrono phantasma extend former dub bla...	Fighting	Fighting
476	rockman minus infin fan made overhaul rockman ...	Shooter	Shooter

In [358…
```
report = metrics.classification_report(ytest, predicted)
print(report)
```

```
              precision    recall  f1-score   support

    Fighting       0.10      0.06      0.07       103
         RPG       0.31      0.47      0.38       274
      Racing       0.06      0.05      0.05        41
     Shooter       0.31      0.33      0.32       284
   Simulator       0.14      0.06      0.09       163
       Sport       0.07      0.06      0.06        71

    accuracy                           0.26       936
   macro avg       0.17      0.17      0.16       936
weighted avg       0.23      0.26      0.24       936
```

In [359…
```
report = classification_report(ytest, predicted, output_dict=True)
df_report = pd.DataFrame(report).transpose()
sns.heatmap(df_report.iloc[:-1, :].astype(float), annot=True, cmap="YlGnBu")
plt.title("Classification Report", fontsize=20)
plt.xlabel("Metrics", fontsize=15)
plt.ylabel("Classes", fontsize=15)
plt.show()
```



SVM

In [362…

```
df = df.sample(frac = 1)
X = df['Description']
y = df['Genres']
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, ran
svm_pipeline = Pipeline([
    ('vect', CountVectorizer(stop_words="english", max_features=10000)),
    ('norm', preprocessing.Normalizer(norm='l1')),
    ('clf', SGDClassifier(loss='hinge', penalty='l2',
                          random_state=42,
                          max_iter=10000))
])
```

```
svm_pipeline.fit(X_train, y_train)
svm_predictions = svm_pipeline.predict(X_test)
df_svm = pd.DataFrame({"Desc":X_test, "Actual":y_test, "Prediction":svm_pred
ensemble_clf = VotingClassifier(estimators=[
    ('svm', svm_pipeline)
], voting='hard')

print("SVM Report:")
print(classification_report(y_test, svm_predictions))
```

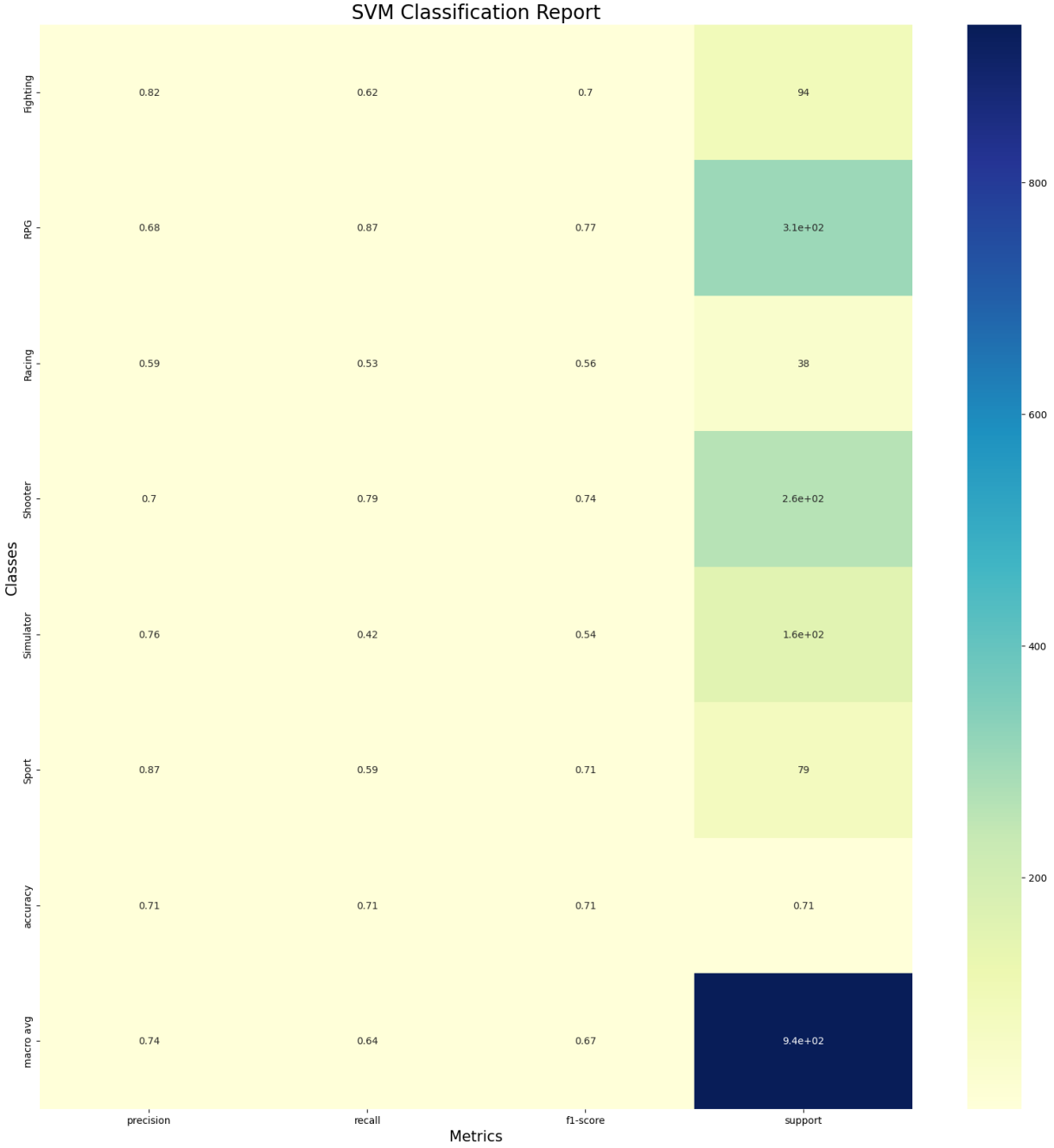
```
SVM Report:
              precision    recall  f1-score   support

    Fighting       0.82      0.62      0.70        94
         RPG       0.68      0.87      0.77       306
      Racing       0.59      0.53      0.56        38
     Shooter       0.70      0.79      0.74       263
   Simulator       0.76      0.42      0.54       156
       Sport       0.87      0.59      0.71        79

    accuracy                           0.71       936
   macro avg       0.74      0.64      0.67       936
weighted avg       0.73      0.71      0.70       936
```

In [365…
```
df_svm.sample(10)
```

Out[365]:

	Desc	Actual	Prediction
1138	dream battl last king fighter come favorit cha...	Fighting	Fighting
3054	object bosconian score mani point possibl dest...	Shooter	Shooter
7527	bless fantasi mmorpg dive beauti world bless b...	RPG	RPG
1841	attempt conquer world guardian encas castl bri...	RPG	RPG
5386	one year event final fantasi young protagonist...	RPG	RPG
5275	bungi emphas univers destini aliv event may ha...	Shooter	Shooter
2389	new era shoot loot begin play one four new vau...	Shooter	Shooter
4235	star war episod racer let particip famous pod ...	Racing	Racing
808	thief gold perspect stealth game first game us...	Simulator	Shooter
2353	stori unexpect encount mario irrever rabbid mu...	RPG	RPG

In [366…
```
report = classification_report(y_test, svm_predictions, output_dict=True)
df_report = pd.DataFrame(report).transpose()
sns.heatmap(df_report.iloc[:-1, :].astype(float), annot=True, cmap="YlGnBu")
plt.title("SVM Classification Report", fontsize=20)
plt.xlabel("Metrics", fontsize=15)
plt.ylabel("Classes", fontsize=15)
plt.show()
```



After trying 4 models -> the SVM PipeLine model has the best results.

Lets give new texts for testing the SVM model

In [375…

```
desc = ["this is an shooter game play with friends 6vs6. teams split to terr
the terrorist should bomb or kill everyone while the counter-terrorists must
svm_prediction = svm_pipeline.predict(desc)
print("Actual = Shooter")
print(f"SVM Predicted = {svm_prediction}")
```

```
Actual = Shooter
SVM Predicted = ['Shooter']
```

In [376…
```
desc = ["this football game about the champions league called fifa all you h
against other clubs be the champion"]
svm_prediction = svm_pipeline.predict(desc)
print("Actual = Sport")
print(f"SVM Predicted = {svm_prediction}")
```

```
Actual = Sport
SVM Predicted = ['Sport']
```

In [380…
```
desc = ["this is an fantasy role play game take your character to the next l
out to survive against the monsters with your sword"]
svm_prediction = svm_pipeline.predict(desc)
print("Actual = RPG")
print(f"SVM Predicted = {svm_prediction}")
```

```
Actual = RPG
SVM Predicted = ['RPG']
```

In [381…
```
desc = ["race against time outsmart the cops and take on weekly qualifiers t
reach the grand lakeshore ultimate street racing"]
svm_prediction = svm_pipeline.predict(desc)
print("Actual = Racing")
print(f"SVM Predicted = {svm_prediction}")
```

```
Actual = Racing
SVM Predicted = ['Racing']
```

With random texts that I gave to the model we can see that he predicted all of them right!

CREDITS

- YouTube & Kaggle - Tutorials for Classification using NLP
- matplotlib
- scikit-learn
- Backloggd