Exploratory Data Analysis on Video Games Sales Dataset

- This is a personal project for the online course Data Analysis with Python: Zero to Pandas by **Jovian**.
- In this project, I used Python open-source libraries `NumPy`, `Pandas`, `Matplotlib`, `seaborn`, `opendatasets` and `os`.
- As a learner of data analysis/data science and also a video game player, I choose the video games sales dataset to perform exploratory data analysis. Besides I need a close-to-business-world dataset to practice my Python skills, I thought this topic would be interesting and I was also excited to find some insights into video games and related businesses.
- I would like to take this project as a showcase of my Python analysis skills. And at the same time, I would love to hear questions, comments, ideas, or feedback from readers.

By reading this notebook, you will know (I hope):

- Some usages and examples of some common-use Python libraries and functions.
- The basic process of exploratory data analysis.
- Some ideas of how to handle and visualize different categories of data.
- Some insights into the global video games and related businesses.
- Some interesting facts of video games.

Dataset Infomation

Before we actually started, the very first thing I should do (I hope you can do also) is to understand the dataset we will use.

The description of the source dataset, these 16 columns/variables are defined as follow:

> - `Name` - The game's title
> - `Platform` - Platform of the games release (i.e. PC, PS2, Wii, Xbox360 etc.)
> - `Year_of_Release` - Year of the game's release
> - `Genre` - Genre of the game
> - `Publisher` - Publisher of the game
> - `NA_Sales` - Cumulative Units sold in North America since the game was released (in millions)
> - `EU_Sales` - Cumulative Units sold in Europe since the game was released (in millions)
> - `JP_Sales` - Cumulative Units sold in Japan since the game was released (in millions)
> - `Other_Sales` - Cumulative Units sold in the rest of the world since the game was released (in millions)
> - `Global_Sales` - Cumulative Units sold worldwide since the game was released (in millions)
> - `Critic_Score` - Weighted average score by **Metacritic** base on all published critic reviews (0-100 scale)
> - `Critic_Count` - The number of published critic reviews used in the `Critic_Score`
> - `User_Score` - Average score by users reviews on **Metacritic** (0-10 scale)
> - `User_Count` - The number of scores used in the `User_Score` - `Developer` - Developer of the game
> - `Rating` - The ESRB rating of the game. (Ratings Guide)

Note: All data are as of December 22nd, 2016.

Source:\ Video Games Sales Dataset\ Metascore

Downloading the Dataset

- Because the source dataset is contributed by the user from Kaggle, I will download it to my local directory first.

Let me import the `os` library and create a new directory called `data` where later I can store the dataset.

In [1]:
```
import os
os.makedirs('./data', exist_ok = True)
```

Then download the `Video Games Sales Dataset`, which was contributed by `SID_TWR` from `Kaggle`, using the `download` function from `opendatasets` library.

Source:\ **Video Games Sales Dataset**

In [2]:
```
import opendatasets as od
```

In [3]:
```
url = 'https://www.kaggle.com/sidtwr/videogames-sales-dataset?select=Video_Games_Sales_as_at_22_Dec_2016.csv'
od.download(url, './data', force = True)
```

```
100%|██████████| 507k/507k [00:00<00:00, 3.39MB/s]
Downloading videogames-sales-dataset.zip to ./data/videogames-sales-dataset
```

Let's check what has been downloaded and extracted using the `listdir` function.

In [4]:
```
os.listdir('./data/videogames-sales-dataset')
```

Out[4]:
```
['PS4_GamesSales.csv',
 'Video_Games_Sales_as_at_22_Dec_2016.csv',
 'XboxOne_GameSales.csv']
```

There are three csv files and I will maily focus on the `Video_Games_Sales_as_at_22_Dec_2016.csv` since it included not only the sales data but also the score data by critics and users on **Metacritic**.

Data Preparation and Cleaning

- The first thing I would like to do before the data analysis is to read and load the dataset into Pandas `DataFrame`, then try to know and understand the dataset by getting some basic information about it.
- Then do some data cleaning and handle the invalid values as well.

Before load and read the dataset into a dataframe, we should install the `NumPy` and `Pandas` library.

In [5]:
```
!pip install numpy --upgrade --quiet
```

In [6]:
```
!pip install pandas --upgrade --quiet
```

Then import both `NumPy` and `Pandas` library and alias them as `np` and `pd` respectively.

In [7]:
```
import numpy as np, pandas as pd
```

Then read the csv file using `read_csv` function from `Pandas` library.\ The file will be read and stored as a Pandas `DataFrame` object and I name it `vgs_df`.

In [8]:
```
vgs_df = pd.read_csv('./data/videogames-sales-dataset/Video_Games_Sales_as_at_22_Dec_2016.csv')
```

We can check the `vgs_df` dataframe with some functions for more basic information.

In [9]:
```
# check the number of rows and columns
vgs_df.shape
```

Out[9]:
```
(16719, 16)
```

`vgs_df` has 16,719 rows and 16 columns which means there are 16,719 observations and 16 variables in the dataframe.

In [10]:
```
# check the top 10 rows
vgs_df.head(10)
```

Out[10]:

	Name	Platform	Year_of_Release	Genre	Publisher	NA_Sales	EU_Sales	JP_Sales	Other_Sales	Global_Sales	Critic_Score
0	Wii Sports	Wii	2006.0	Sports	Nintendo	41.36	28.96	3.77	8.45	82.53	76.0
1	Super Mario Bros.	NES	1985.0	Platform	Nintendo	29.08	3.58	6.81	0.77	40.24	NaN
2	Mario Kart Wii	Wii	2008.0	Racing	Nintendo	15.68	12.76	3.79	3.29	35.52	82.0
3	Wii Sports Resort	Wii	2009.0	Sports	Nintendo	15.61	10.93	3.28	2.95	32.77	80.0
4	Pokemon Red/Pokemon Blue	GB	1996.0	Role-Playing	Nintendo	11.27	8.89	10.22	1.00	31.37	NaN
5	Tetris	GB	1989.0	Puzzle	Nintendo	23.20	2.26	4.22	0.58	30.26	NaN
6	New Super Mario Bros.	DS	2006.0	Platform	Nintendo	11.28	9.14	6.50	2.88	29.80	89.0
7	Wii Play	Wii	2006.0	Misc	Nintendo	13.96	9.18	2.93	2.84	28.92	58.0
8	New Super Mario Bros. Wii	Wii	2009.0	Platform	Nintendo	14.44	6.94	4.70	2.24	28.32	87.0
9	Duck Hunt	NES	1984.0	Shooter	Nintendo	26.93	0.63	0.28	0.47	28.31	NaN

In [11]:
```
# # check the last 10 rows
vgs_df.tail(10)
```

Out[11]:

	Name	Platform	Year_of_Release	Genre	Publisher	NA_Sales	EU_Sales	JP_Sales	Other_Sales	Global_Sales	Cri
16709	15 Days	PC	2009.0	Adventure	DTP Entertainment	0.00	0.01	0.00	0.0	0.01	
16710	Men in Black II: Alien Escape	GC	2003.0	Shooter	Infogrames	0.01	0.00	0.00	0.0	0.01	
16711	Aiyoku no Eustia	PSV	2014.0	Misc	dramatic create	0.00	0.00	0.01	0.0	0.01	
16712	Woody Woodpecker in Crazy Castle 5	GBA	2002.0	Platform	Kemco	0.01	0.00	0.00	0.0	0.01	
16713	SCORE International Baja 1000: The Official Game	PS2	2008.0	Racing	Activision	0.00	0.00	0.00	0.0	0.01	
16714	Samurai Warriors: Sanada Maru	PS3	2016.0	Action	Tecmo Koei	0.00	0.00	0.01	0.0	0.01	
16715	LMA Manager 2007	X360	2006.0	Sports	Codemasters	0.00	0.01	0.00	0.0	0.01	
16716	Haitaka no Psychedelica	PSV	2016.0	Adventure	Idea Factory	0.00	0.00	0.01	0.0	0.01	
16717	Spirits & Spells	GBA	2003.0	Platform	Wanadoo	0.01	0.00	0.00	0.0	0.01	
16718	Winning Post 8 2016	PSV	2016.0	Simulation	Tecmo Koei	0.00	0.00	0.01	0.0	0.01	

In [12]:
```
# take a sample look
vgs_df.sample(10)
```

Out[12]:

	Name	Platform	Year_of_Release	Genre	Publisher	NA_Sales	EU_Sales	JP_Sales	Other_Sales	Global_Sales	Cr
7916	Tom Clancy's Splinter Cell: Blacklist	PC	2013.0	Action	Ubisoft	0.04	0.13	0.00	0.01	0.19	
7117	3rd Super Robot Wars Z Jigoku Hen	PS3	2014.0	Role-Playing	Namco Bandai Games	0.00	0.00	0.23	0.00	0.23	
5193	Mobile Suit Z-Gundam	PS	1997.0	Action	Namco Bandai Games	0.00	0.00	0.34	0.02	0.36	
8498	Guilty Gear Judgment	PSP	2006.0	Fighting	Majesco Entertainment	0.13	0.00	0.02	0.01	0.16	
5957	Kurohyou: Ryu ga Gotoku Shinshou	PSP	2010.0	Adventure	Sega	0.00	0.00	0.29	0.00	0.29	
12154	Army Men: RTS	GC	2004.0	Strategy	Global Star	0.05	0.01	0.00	0.00	0.07	
9970	Yattaman DS: BikkuriDokkiri Daisakusen da Koron	DS	2008.0	Action	Takara Tomy	0.00	0.00	0.12	0.00	0.12	
15466	Kawaii Koinu DS 3	DS	2010.0	Simulation	MTO	0.00	0.00	0.02	0.00	0.02	
14668	Metal Dungeon	XB	2002.0	Role-Playing	Xicat Interactive	0.02	0.01	0.00	0.00	0.03	
7288	The Crew	X360	2014.0	Racing	Ubisoft	0.06	0.14	0.00	0.02	0.22	

In [13]:
```
# check the columns name
vgs_df.columns
```

Out[13]:
```
Index(['Name', 'Platform', 'Year_of_Release', 'Genre', 'Publisher', 'NA_Sales',
       'EU_Sales', 'JP_Sales', 'Other_Sales', 'Global_Sales', 'Critic_Score',
       'Critic_Count', 'User_Score', 'User_Count', 'Developer', 'Rating'],
      dtype='object')
```

Then let's check if there is any `NaN` (Not a Number) value which is missing value in each columns.

In [14]:
```
vgs_df.isna().any()
```

Out[14]:
```
Name               True
Platform          False
Year_of_Release    True
Genre              True
Publisher          True
NA_Sales          False
EU_Sales          False
JP_Sales          False
Other_Sales       False
Global_Sales      False
Critic_Score       True
Critic_Count       True
User_Score         True
User_Count         True
Developer          True
Rating             True
dtype: bool
```

We can know that all the columns have `NaN` values except `Platform`, `NA_Sales`, `EU_Sales`, `JP_Sales`, `Other_Sales`, `Global_Sales`.

In [15]:
```
vgs_df.isna().sum()
```

Out[15]:
```
Name                  2
Platform              0
Year_of_Release     269
Genre                 2
Publisher            54
NA_Sales              0
EU_Sales              0
JP_Sales              0
Other_Sales           0
Global_Sales          0
Critic_Score       8582
Critic_Count       8582
User_Score         9129
User_Count         9129
Developer          6623
Rating             6769
dtype: int64
```

- There are 2 observations have missing values in `Name`.
- 269 observations have missing values in `Year_of_Release`.
- 2 observations have missing values in `Genre`.
- 54 observations have missing values in `Publisher`.
- 8582 observations have missing values in `Critic_Score` and `Critic_Count`.
- 9129 observations have missing values in `User_Score` and `User_Count`.
- 6623 observations have missing values in `Developer`.
- 6769 observations have missing values in `Rating`.

It is time to do some data cleaning, but I would save a copy of the dataframe before doing that in case something goes wrong.

In [16]:
```
vgs_copy = vgs_df
```

In [17]:
```
# Let's check the two which has NaN in Name
vgs_df[vgs_df['Name'].isna()]
```

Out[17]:

	Name	Platform	Year_of_Release	Genre	Publisher	NA_Sales	EU_Sales	JP_Sales	Other_Sales	Global_Sales	Critic_Score
659	NaN	GEN	1993.0	NaN	Acclaim Entertainment	1.78	0.53	0.00	0.08	2.39	NaN
14246	NaN	GEN	1993.0	NaN	Acclaim Entertainment	0.00	0.00	0.03	0.00	0.03	NaN

In [18]:
```
# also check the two which has NaN in Genre.
vgs_df[vgs_df['Genre'].isna()]
# They are the same two rows.
```

Out[18]:

	Name	Platform	Year_of_Release	Genre	Publisher	NA_Sales	EU_Sales	JP_Sales	Other_Sales	Global_Sales	Critic_Score
659	NaN	GEN	1993.0	NaN	Acclaim Entertainment	1.78	0.53	0.00	0.08	2.39	NaN
14246	NaN	GEN	1993.0	NaN	Acclaim Entertainment	0.00	0.00	0.03	0.00	0.03	NaN

In [19]:
```
# I will drop these two rows which with index of 659 and 14246 and store back to the dataframe
# since they are missing names and many others values.

vgs_df.drop([659,14246], inplace = True)
```

In [20]:
```
# check after data cleaning
vgs_df[['Name', 'Genre']].isna().any()
```

Out[20]:
```
Name     False
Genre    False
dtype: bool
```

Also drop the 269 observations which have `NaN` in `Year_of_Release`.

In [21]:
```
vgs_df.dropna(axis = 0, subset = ['Year_of_Release'], inplace = True)
```

In [22]:
```
#check the result
vgs_df['Year_of_Release'].isna().sum()
```

Out[22]:
```
0
```

In [23]:
```
# Since the dataset was only as of December 22th, 2016
# let me check the games released after 2016.

vgs_df[vgs_df.Year_of_Release > 2016]
```

Out[23]:

	Name	Platform	Year_of_Release	Genre	Publisher	NA_Sales	EU_Sales	JP_Sales	Other_Sales	Global_Sales	Critic_Sco
5936	Imagine: Makeup Artist	DS	2020.0	Simulation	Ubisoft	0.27	0.0	0.00	0.02	0.29	Na
14086	Phantasy Star Online 2 Episode 4: Deluxe Package	PS4	2017.0	Role-Playing	Sega	0.00	0.0	0.04	0.00	0.04	Na
16222	Phantasy Star Online 2 Episode 4: Deluxe Package	PSV	2017.0	Role-Playing	Sega	0.00	0.0	0.01	0.00	0.01	Na
16385	Brothers Conflict: Precious Baby	PSV	2017.0	Action	Idea Factory	0.00	0.0	0.01	0.00	0.01	Na

Seems these four video games have invalid values in `Year_of_Release`, I will drop them directly as these four observations will not much affect our dataframe.

In [24]:
```
vgs_df.drop(vgs_df[vgs_df.Year_of_Release > 2016].index, inplace = True)
```

In [25]:
```
vgs_df['Year_of_Release'].agg(['min','max'])
```

Out[25]:
```
min    1980.0
max    2016.0
Name: Year_of_Release, dtype: float64
```

Now the dataframe is only for the games that were released from 1980 to 2016.

For the `NA_Sales`, `EU_Sales`, `JP_Sales`, `Other_Sales` and `Global_Sales` five columns, based on the description of the priginal dataset,\ their values should follow this equation: `NA_Sales` + `EU_Sales` + `JP_Sales` + `Other_Sales` = `Global_Sales`

In [26]:
```
# Let me check
vgs_df[(vgs_df.NA_Sales + vgs_df.EU_Sales + vgs_df.JP_Sales + vgs_df.Other_Sales) != vgs_df.Global_Sales]
```

Out[26]:

	Name	Platform	Year_of_Release	Genre	Publisher	NA_Sales	EU_Sales	JP_Sales	Other_Sales	Global_Sales	Critic_
0	Wii Sports	Wii	2006.0	Sports	Nintendo	41.36	28.96	3.77	8.45	82.53	
2	Mario Kart Wii	Wii	2008.0	Racing	Nintendo	15.68	12.76	3.79	3.29	35.52	
4	Pokemon Red/Pokemon Blue	GB	1996.0	Role-Playing	Nintendo	11.27	8.89	10.22	1.00	31.37	
5	Tetris	GB	1989.0	Puzzle	Nintendo	23.20	2.26	4.22	0.58	30.26	
7	Wii Play	Wii	2006.0	Misc	Nintendo	13.96	9.18	2.93	2.84	28.92	
...	...	...	...	...	...	...	...	...	...	...	
16238	Vanark	PS	1999.0	Shooter	Jaleco	0.01	0.01	0.00	0.00	0.01	
16256	Bratz: Forever Diamondz	PS2	2006.0	Adventure	THQ	0.01	0.01	0.00	0.00	0.01	
16292	K-1 Grand Prix	PS	1999.0	Fighting	Jaleco	0.01	0.01	0.00	0.00	0.01	
16680	G1 Jockey 4 2008	PS3	2008.0	Sports	Tecmo Koei	0.00	0.00	0.00	0.00	0.01	
16713	SCORE International Baja 1000: The Official Game	PS2	2008.0	Racing	Activision	0.00	0.00	0.00	0.00	0.01	

6686 rows × 16 columns

Seems these 6,686 rows are not correct in `Global_Sales`, maybe there are typos when rounding. I will fix them using the same equation above.

In [27]:
```
# subset these rows
sub = vgs_df[(vgs_df.NA_Sales + vgs_df.EU_Sales + vgs_df.JP_Sales + vgs_df.Other_Sales) != vgs_df.Global_Sales]
```

In [28]:
```
# calculate their Global_Sales using the equation
total = sub.NA_Sales + sub.EU_Sales + sub.JP_Sales + sub.Other_Sales
```

In [29]:
```
# replace the wrongs values with corret values according to wrong rows index in vgs_df
vgs_df.loc[sub.index, 'Global_Sales'] = total
```

In [30]:
```
# check whether all values are fixed
((vgs_df.NA_Sales + vgs_df.EU_Sales + vgs_df.JP_Sales + vgs_df.Other_Sales) == vgs_df.Global_Sales).all()
```

Out[30]:
```
True
```

Since the value of `Year_of_Release` is in numeric format, we can conver it into `datetime` format and only use the year value.

In [31]:
```
vgs_df['Year_of_Release'] = pd.to_datetime(vgs_df['Year_of_Release'], format = '%Y').dt.year
```

In [32]:
```
vgs_df.shape # After cleaning, there are 16,444 obsevations
```

Out[32]:
```
(16444, 16)
```

In [33]:
```
vgs_df['Name'].nunique() # there are 11,426 unique obsevations
```

Out[33]:
```
11426
```

I will work on these 16,444 observations and 16 variables, note that only 11,426 among of them are unique, because some video games may release different platform versions. Which means there are around 5,000 observations in our dataframe are the same game title but in different platform.

We can start the next part for explorary analysis and visulization.\ I am not going to handle the missing values in `Publisher`, `Critic_Score`, `Critic_Count`, `User_Score`, `User_Count`, `Developer` and `Rating` right now, maybe we will do that later.

Exploratory Analysis and Visualization

Then we can actually start the exploratory data analysis and visualization by data manipulation and others more.

For more statistics information of each numeric column, call the `describe` function to check, it will ignore the `NaN` values which is missing values in each column.

In [34]:
```
vgs_df.describe()
```

Out[34]:

	Year_of_Release	NA_Sales	EU_Sales	JP_Sales	Other_Sales	Global_Sales	Critic_Score	Critic_Count	User_S
count	16444.000000	16444.000000	16444.000000	16444.000000	16444.000000	16444.000000	7983.000000	7983.000000	7463.00
mean	2006.486256	0.264012	0.145930	0.078487	0.047594	0.536023	68.994363	26.441313	7.12
std	5.875525	0.818378	0.506716	0.311100	0.188005	1.558786	13.920060	19.008136	1.49
min	1980.000000	0.000000	0.000000	0.000000	0.000000	0.000000	13.000000	3.000000	0.00
25%	2003.000000	0.000000	0.000000	0.000000	0.000000	0.060000	60.000000	12.000000	6.40
50%	2007.000000	0.080000	0.020000	0.000000	0.010000	0.170000	71.000000	22.000000	7.50
75%	2010.000000	0.240000	0.110000	0.040000	0.030000	0.470000	79.000000	36.000000	8.20
max	2016.000000	41.360000	28.960000	10.220000	10.570000	82.540000	98.000000	113.000000	9.70

In [35]:
```
# install the matplotlib and seaborn libraries.
!pip install matplotlib seaborn --upgrade --quiet
```

In [36]:
```
# import and alias them
import matplotlib
import matplotlib.pyplot as plt, seaborn as sns
```

In [37]:
```
# set plot basic styles
%matplotlib inline
sns.set_style('darkgrid')
matplotlib.rcParams['font.size'] = 14
matplotlib.rcParams['figure.figsize'] = (10, 6)
matplotlib.rcParams['figure.facecolor'] = '#00000000'
```

Histogram for the Number of Video Games Released Per 5-year

We can compare the number of video games released per 5-year from 1980 to 2016 by generating a histogram.

In [38]:
```
plt.hist(vgs_df.Year_of_Release,
         bins = [1980,1985,1990,1995,2000,2005,2010,2016],
         color = 'orange',
         alpha = 0.8)

# add axis labels
plt.xlabel('Year of Release')
plt.ylabel('Number of Video Games Released')

# add title
plt.title('Number of Video Games Released per 5-year from 1980 to 2016',
          pad = 20);
```

Number of Video Games Released per 5-year from 1980 to 2016

Known from the plot, there are about 6,000 video games released between 2005 and 2010 which is the highest 5 years in our dataset, following by 2010 to 2016, this 6-year has about 5,200 games released.

Pie Chart of Global Sales by Region

We can compare cumulative units sold since the games were released till December 22th, 2016 in `NA_Sales`, `EU_Sales`, `JP_Sales`, `Other_Sales` four regions by a pie plot.

In [39]:
```
# create a subset of sales data for these four regions
region_df = vgs_df[['NA_Sales','EU_Sales','JP_Sales','Other_Sales']]
```

In [40]:
```
# generate and style a pie plot with the above regional subset data
subtotal = region_df.sum() # calculate the sales for each region
label = ['North America','Europe','Japan','Rest of the World']

# to inverse the autopct for the actual values
def make_autopct(subtotal):
        def inverse_autopct(pct):
            return '{p:.2f}% ({v:.2f} m)'.format(p = pct, v = pct*sum(subtotal)/100)
        return inverse_autopct

# plot and style
pie = plt.pie(subtotal, # values
              labels = label, # label for each section
              autopct = make_autopct(subtotal), # show data in percentage and values with two decimal places
              explode = [0.06, 0.05, 0, 0], # to slice the particular sections
              textprops = {"fontsize" : 12}, # set the fontsize of the plot
              shadow = True, # set to show shadow
              startangle = 90) # set the angle for the first section

# add title
plt.title('Cumulative Units Sold by Region of Video Games that Released from 1980 to 2016 (in % and number)');
```

Cumulative Units Sold by Region of Video Games that Released from 1980 to 2016 (in % and number)

We can see that for the games released from 1980 to 2016, almost half of them have sold in North America, followed by Europe with a percentage of 27, which is more than half of the portion left by North America.

- That is, over three-fourths of the video games have sold in North America and Europe. These two regions are two important markets for video games and related businesses.

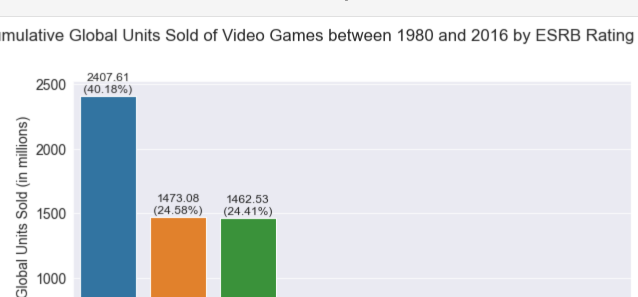
Bar Plot for Global Sales by ESRB Rating

I will generate a bar plot to show the cumulative global units sold for each ESRB rating.

In [41]:
```
sales_by_rating = vgs_df.groupby('Rating')['Global_Sales'].sum().sort_values(ascending = False).to_frame()
sales_by_rating['Perc'] = round(sales_by_rating['Global_Sales'] / sales_by_rating['Global_Sales'].sum() * 100,
sales_by_rating = sales_by_rating.reset_index()
```

In [42]:
```
# genreate the bar plot using sns
bar_sales_by_rating = sns.barplot(y = 'Global_Sales', x = 'Rating', data = sales_by_rating)

# set title and axis labels
bar_sales_by_rating.set_title('Cumulative Global Units Sold of Video Games between 1980 and 2016 by ESRB Rating
    pad = 40)
bar_sales_by_rating.set_ylabel('Cumulative Global Units Sold (in millions)')
bar_sales_by_rating.set_xlabel('ESRB Rating')

# add pecentage for each rating bar using sns.annotate function
for i in range(sales_by_rating.shape[0]):
    bar_sales_by_rating.annotate(str(round(sales_by_rating['Global_Sales'][i],2)) + '\n ('+ str(sales_by_rating
                                 xy = (i, sales_by_rating['Global_Sales'][i] + 30),
                                 fontsize = 12,
                                 horizontalalignment = 'center');
```

Cumulative Global Units Sold of Video Games between 1980 and 2016 by ESRB Rating (in millions)



- Seems about 90% of the games are rated as E, T, and M based on the ESRB rating.

Bar Plot for Global Sales by Genre

Now I am interested in what are the popular genres of video games. I will generate a bar plot to show the cumulative global units sold for each genre.

In [43]:
```
# check what are the genres of games
vgs_df['Genre'].unique()
```

Out[43]:
```
array(['Sports', 'Platform', 'Racing', 'Role-Playing', 'Puzzle', 'Misc',
       'Shooter', 'Simulation', 'Action', 'Fighting', 'Adventure',
       'Strategy'], dtype=object)
```

In [44]:
```
# check how many of them
vgs_df['Genre'].nunique()
```

Out[44]:
```
12
```

In [45]:
```
# create a subset and calculate the subtotal global sales and percentage by genre
sales_by_genre = vgs_df.groupby('Genre')['Global_Sales'].sum().sort_values(ascending = False).to_frame()
sales_by_genre['Perc'] = round(sales_by_genre['Global_Sales'] / sales_by_genre['Global_Sales'].sum() * 100, 2)
sales_by_genre = sales_by_genre.reset_index()
```

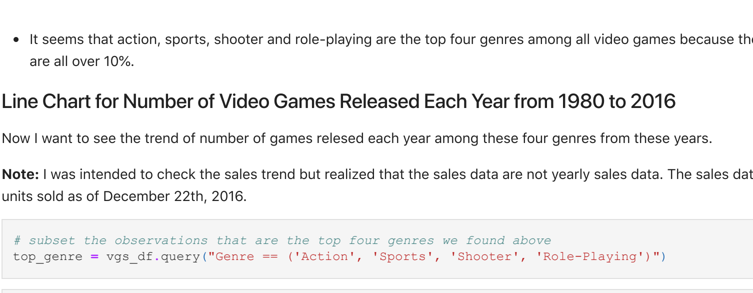
In [46]:
```
sales_by_genre
```

Out[46]:

	Genre	Global_Sales	Perc
0	Action	1716.52	19.47
1	Sports	1309.67	14.86
2	Shooter	1041.36	11.81
3	Role-Playing	931.08	10.56
4	Platform	825.55	9.37
5	Misc	790.29	8.97
6	Racing	723.49	8.21
7	Fighting	442.66	5.02
8	Simulation	387.96	4.40
9	Puzzle	239.89	2.72
10	Adventure	233.33	2.65
11	Strategy	172.57	1.96

In [47]:
```
# genreate the bar plot using sns
bar_sales_by_genre = sns.barplot(x = 'Global_Sales',
                                 y = 'Genre',
                                 data = sales_by_genre,
                                 ci = None)

# set title and axis labels
bar_sales_by_genre.set_title('Cumulative Global Units Sold of Video Games between 1980 and 2016 by Genre (in mi
        pad = 20)
bar_sales_by_genre.set_xlabel('Cumulative Global Units Sold (in millions)')
bar_sales_by_genre.set_ylabel('Genre')

# add pecentage for each genre bar using sns.annotate function
for i in range(sales_by_genre.shape[0]):
    bar_sales_by_genre.annotate(str(round(sales_by_genre['Global_Sales'][i],2)) + ' (' + str(sales_by_genre['Pe
                                xy = (sales_by_genre['Global_Sales'][i]+10, i),
                                fontsize = 12,
                                verticalalignment = 'center');
```

Cumulative Global Units Sold of Video Games between 1980 and 2016 by Genre (in millions)



- It seems that action, sports, shooter and role-playing are the top four genres among all video games because their percentages are all over 10%.

Line Chart for Number of Video Games Released Each Year from 1980 to 2016

Now I want to see the trend of number of games relesed each year among these four genres from these years.

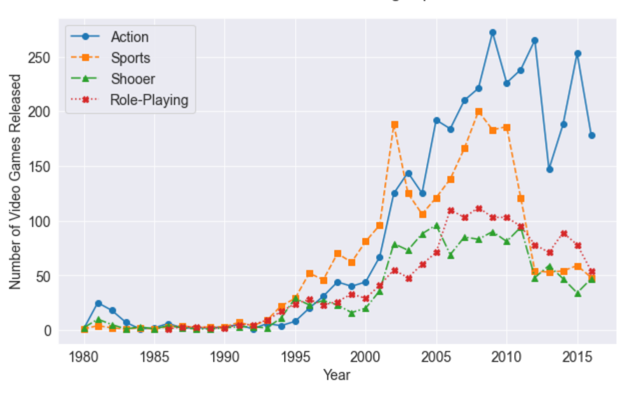
Note: I was intended to check the sales trend but realized that the sales data are not yearly sales data. The sales data are cumulative units sold as of December 22th, 2016.

In [48]:
```
# subset the observations that are the top four genres we found above
top_genre = vgs_df.query("Genre == ('Action', 'Sports', 'Shooter', 'Role-Playing')")
```

In [49]:
```
# calculate the number of games released each year for each genre
action = top_genre[top_genre.Genre == 'Action'].groupby('Year_of_Release')['Name'].count()
sports = top_genre[top_genre.Genre == 'Sports'].groupby('Year_of_Release')['Name'].count()
shoot = top_genre[top_genre.Genre == 'Shooter'].groupby('Year_of_Release')['Name'].count()
role = top_genre[top_genre.Genre == 'Role-Playing'].groupby('Year_of_Release')['Name'].count()
```

In [50]:
```
# plot and style lines for each genre using above pandas.series
plt.plot(action.index, action.values,'-o')
plt.plot(sports.index, sports.values, '--s')
plt.plot(shoot.index, shoot.values, '-.^')
plt.plot(role.index, role.values, ':X')

# add legend
plt.legend(['Action','Sports','Shooer','Role-Playing'])

# add labels for axis
plt.xlabel('Year')
plt.ylabel('Number of Video Games Released')

# add title
plt.title('Number of Video Games Released Each Year among Top Four Genres from 1980 to 2016',
          pad = 20);
```

Number of Video Games Released Each Year among Top Four Genres from 1980 to 2016



- We can see there is a big increase at the beginning of the 21st century for action, sports and shooter three genres.
- The sports genre (in orange dashed line) jumped from 60 to around 180 from 1999 to 2002. Then has a huge decline in 2011 and 2012, which is around 180 in 2010 to 50 in 2012.
- Similarly, the action genre (in blue solid line) jumped from 75 to about 280 in 5 years. Then dropped from 270 to 150 in only one year in 2013.

Stacked Bar Chart of Cumulative Global Sales for Games by Top Games Developers Released in the 21st Century

Next, I am interested in what are the cumulative global sales of video games that were released after 1999 by the famous video games developers.\ As an experienced and below-average skilled video game player, I already have a target list of companies to checked.\ But let's check who are the top 10 developers on number of games released and the top 10 on total global sales between 1980 and 2016 for some ideas.

In [51]:
```
# top 10 developers on number of games released from 1980 to 2016.
vgs_df.groupby('Developer')['Name'].count().sort_values(ascending = False).head(10)
```

Out[51]:
```
Developer
Ubisoft              200
EA Sports            169
EA Canada            164
Konami               158
Capcom               137
EA Tiburon           104
Electronic Arts      101
Ubisoft Montreal     100
Visual Concepts       98
Omega Force           80
Name: Name, dtype: int64
```

In [52]:
```
# top 10 developers global sales from 1980 to 2016.
vgs_df.groupby('Developer')['Global_Sales'].sum().sort_values(ascending = False).head(10)
```

Out[52]:
```
Developer
Nintendo             531.78
EA Sports            173.10
EA Canada            138.14
Ubisoft              131.99
Rockstar North       119.48
Capcom               115.19
Ubisoft Montreal     107.46
Treyarch             101.50
EA Tiburon            88.83
Infinity Ward         77.64
Name: Global_Sales, dtype: float64
```

OK, now we have targets, they are as follow:

- `Ubisoft` : the top one with 200 games released these years whose headquartered in France. More Info
- `Nintendo` : the top one with the highest global sales from 1980 to 2016 whose headquartered in Japan. More Info
- `EA Sports` : the one with second-best on both the number of released and global sales. Mostly develop sports games according to its name (correct me if I am wrong). Headquartered in the U.S. More Info
- `Rockstar North` : famous for the GTA series, the parent company is Take-Two Interactive whose headquarters are located in NYC. (Please let me know when GTA 6 is released.) More Info
- `Capcom` : famous for Street Fighter series, Resident Evil series and Monster Hunter series. Headquartered in Japan. More Info

In [53]:
```
# create a subset of games by these five developers and released in the 21st century
top_dev_2000 = vgs_df.query("Developer == ('Ubisoft', 'Nintendo', 'EA Sports', 'Rockstar North', 'Capcom') & Ye
```

In [54]:
```
# select the columns needed
sales_top_dev_2000 = top_dev_2000[['Developer', 'Year_of_Release', 'Global_Sales']]
```

In [55]:
```
# calculate global sales on each year for these developers
ubi = sales_top_dev_2000[sales_top_dev_2000.Developer == 'Ubisoft'].groupby('Year_of_Release')['Global_Sales'].
nin = sales_top_dev_2000[sales_top_dev_2000.Developer == 'Nintendo'].groupby('Year_of_Release')['Global_Sales']
eas = sales_top_dev_2000[sales_top_dev_2000.Developer == 'EA Sports'].groupby('Year_of_Release')['Global_Sales'
rs = sales_top_dev_2000[sales_top_dev_2000.Developer == 'Rockstar North'].groupby('Year_of_Release')['Global_Sa
cap = sales_top_dev_2000[sales_top_dev_2000.Developer == 'Capcom'].groupby('Year_of_Release')['Global_Sales'].s
```

In [56]:
```
# check their length, should be 17
print('{} has {} rows.'.format('ubi', len(ubi)))
print('{} has {} rows.'.format('nin', len(nin)))
print('{} has {} rows.'.format('eas', len(eas)))
print('{} has {} rows.'.format('rs', len(rs)))
print('{} has {} rows.'.format('cap', len(cap)))
```

```
ubi has 17 rows.
nin has 14 rows.
eas has 17 rows.
rs has 8 rows.
cap has 17 rows.
```

We need to find the 3 missing values in `nin` and 9 missing values in `rs`.

In [57]:
```
nin.index # missing 2000, 2003 and 2016
```

Out[57]:
```
Int64Index([2001, 2002, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012,
            2013, 2014, 2015],
           dtype='int64', name='Year_of_Release')
```

I need to create new indices of 2000, 2003 and 2006 in the `nin` series and then fill them with 0.\ Again, the `Global_Sales` values are the cumulative units sold since the games were released till December 22th, 2016. Not the units sold that year. The `Year_of_Release` is the year when the game was released.\ So in our case here, I fill the years with 0 means the developer didn't release games that year.

In [58]:
```
# fill them with 0
nin[2000] = 0
nin[2003] = 0
nin[2016] = 0
nin = nin.sort_index()
```

In [59]:
```
rs.index # missing 2000, 2001, 2006, 2007, 2009, 2010, 2011, 2012 and 2016
```

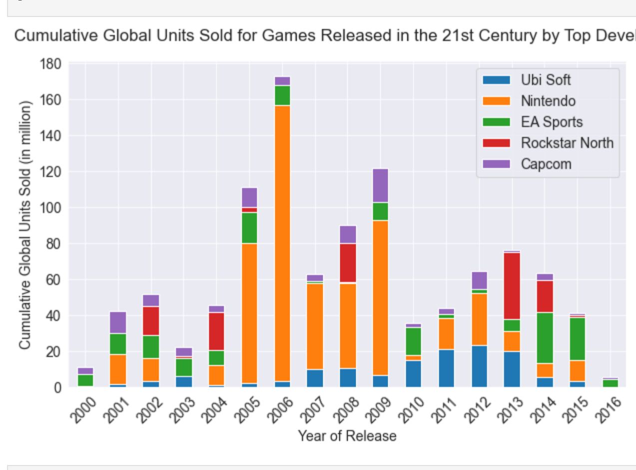
Out[59]:
```
Int64Index([2002, 2003, 2004, 2005, 2008, 2013, 2014, 2015], dtype='int64', name='Year_of_Release')
```

In [60]:
```
# fill them with 0
rs[2000] = 0
rs[2001] = 0
rs[2006] = 0
rs[2007] = 0
rs[2009] = 0
rs[2010] = 0
rs[2011] = 0
rs[2012] = 0
rs[2016] = 0
rs = rs.sort_index()
```

In [61]:
```
# create a DataFrame for our chart
stacked_bar_df = pd.DataFrame({'Year': ubi.index,
                               'Ubi Soft' : ubi.values,
                               'Nintendo' : nin.values,
                               'EA Sports': eas.values,
                               'Rockstar North': rs.values,
                               'Capcom': cap.values})
```

In [62]:
```
# generate and style a stacked bar chart
stacked_bar_df.set_index('Year').plot(kind = 'bar', stacked = True)

# add axis labels
plt.xlabel('Year of Release')
plt.ylabel('Cumulative Global Units Sold (in million)')

# add title
plt.title('Cumulative Global Units Sold for Games Released in the 21st Century by Top Developers',
          pad = 20)

#set y-axis range and interval
plt.yticks(range(0,200,20))

# rotate the xlabels
plt.xticks(rotation = 45);
```

Cumulative Global Units Sold for Games Released in the 21st Century by Top Developers



In [63]:
```
# calculate the cumulative units sold for all games that
# were developed by Nintendo from 1980 to 2016
vgs_df[vgs_df['Developer'] == 'Nintendo']['Global_Sales'].sum()
```

Out[63]: 531.78

- We can see Nintendo (in orange) has three huge columns in the chart in 2005, 2006 and 2009. Especially the column in 2006, which indicates that the games were released in 2006 and developed by Nintendo have a cumulative global units sold of around 150 million till December 22th 2016. That is, those games released in 2006 by Nintendo sold around 150 million units in 10 years.
- Compare to the cumulative global units sold for all games from 1980 to 2016 by Nintendo, which is around 531.78 million; the games that were released in 2006 have taken more than 28% of it. That is a great hit in the video games market. I will take a close look to find out what games are they.

In [64]:
```
# find out the games that were released in 2006 and developed by Nintendo
# select their names, global sales, platforms and genres
vgs_df.query("Developer == 'Nintendo' & Year_of_Release == 2006")[['Name','Platform','Genre','Global_Sales']]
```

Out[64]:

	Name	Platform	Genre	Global_Sales
0	Wii Sports	Wii	Sports	82.54
6	New Super Mario Bros.	DS	Platform	29.80
7	Wii Play	Wii	Misc	28.91
107	The Legend of Zelda: Twilight Princess	Wii	Action	7.16
787	Tetris DS	DS	Puzzle	2.11
1162	The Legend of Zelda: Twilight Princess	GC	Action	1.59
2686	Metroid Prime Hunters	DS	Shooter	0.78

- Seems that in 2006, the Wii video game console was very popular in the console market. It makes sense that Wii was first released in November 2006 with its novel gameplay by their innovated wireless controller.
- As we can see from the above table, the game Will Sports and Wii Play add up with more than 110 million in cumulative global units sold till Dec 2016. Only for my guessing, that is because by combining the novel gameplay mode on Wii which enables players to interact with each other; and the sports and music genres, these games are popular among all-ages game players, which is suitable for parties or other social situations.

Asking and Answering Questions

Let me ask some interesting questions and try my best to answer them.

Q1: What are the top one games based on the cumulative global units sold, Metacritic's critic scores, and user scores?

In [65]:
```
top_gs = vgs_df[['Name','Year_of_Release','Platform','Global_Sales']].sort_values('Global_Sales', ascending = F
print('The number one game in cumulative global unit sold is {} {} version released in {} with a record of {:.2
```

```
The number one game in cumulative global unit sold is Wii Sports Wii version released in 2006 with a record of
82.54 million.
```

In [66]:
```
top_cs = vgs_df[['Name','Year_of_Release','Platform','Critic_Score']].sort_values('Critic_Score', ascending = F
print('The number one game with the highest Critic Score is {} {} version released in {} with a score of {} in
```

```
The number one game with the highest Critic Score is Grand Theft Auto IV X360 version released in 2008 with a s
core of 98.0 in Metacritic.
```

In [67]:
```
top_us = vgs_df[['Name','Year_of_Release','Platform','User_Score']].sort_values('User_Score', ascending = False
print('The number one game with the highest User Score is {} {} version released in {} with a score of {} in Me
```

```
The number one game with the highest User Score is Breath of Fire III PSP version released in 2005 with a score
of 9.7 in Metacritic.
```

Q2: What are the top one game for each genre base on the cumulative global units sold?

In [68]:
```
# Let me write a small function for this question

def topN_by_genre(n):
    act = vgs_df[vgs_df['Genre'] == 'Action'].sort_values('Global_Sales', ascending = False).head(n)
    spo = vgs_df[vgs_df['Genre'] == 'Sports'].sort_values('Global_Sales', ascending = False).head(n)
    sho = vgs_df[vgs_df['Genre'] == 'Shooter'].sort_values('Global_Sales', ascending = False).head(n)
    plat = vgs_df[vgs_df['Genre'] == 'Platform'].sort_values('Global_Sales', ascending = False).head(n)
    rac = vgs_df[vgs_df['Genre'] == 'Racing'].sort_values('Global_Sales', ascending = False).head(n)
    misc = vgs_df[vgs_df['Genre'] == 'Misc'].sort_values('Global_Sales', ascending = False).head(n)
    puz = vgs_df[vgs_df['Genre'] == 'Puzzle'].sort_values('Global_Sales', ascending = False).head(n)
    sim = vgs_df[vgs_df['Genre'] == 'Simulation'].sort_values('Global_Sales', ascending = False).head(n)
    rp = vgs_df[vgs_df['Genre'] == 'Role-Playing'].sort_values('Global_Sales', ascending = False).head(n)
    adv = vgs_df[vgs_df['Genre'] == 'Adventure'].sort_values('Global_Sales', ascending = False).head(n)
    stra = vgs_df[vgs_df['Genre'] == 'Strategy'].sort_values('Global_Sales', ascending = False).head(n)
    fig = vgs_df[vgs_df['Genre'] == 'Fighting'].sort_values('Global_Sales', ascending = False).head(n)

    df = act.append([spo, sho, rp, plat, fig, rac, adv, misc, puz, sim, stra])[['Name','Genre','Platform','Year

    return df
```

In [69]:
```
# input 1 for top one game for each genre
# if you want top three game, try to input 3
topN_by_genre(1)
```

Out[69]:

	Name	Genre	Platform	Year_of_Release	Global_Sales
16	Grand Theft Auto V	Action	PS3	2013	21.05
0	Wii Sports	Sports	Wii	2006	82.54
9	Duck Hunt	Shooter	NES	1984	28.31
4	Pokemon Red/Pokemon Blue	Role-Playing	GB	1996	31.38
1	Super Mario Bros.	Platform	NES	1985	40.24
39	Super Smash Bros. Brawl	Fighting	Wii	2008	12.84
2	Mario Kart Wii	Racing	Wii	2008	35.52
50	Super Mario Land 2: 6 Golden Coins	Adventure	GB	1992	11.18
7	Wii Play	Misc	Wii	2006	28.91
5	Tetris	Puzzle	GB	1989	30.26
10	Nintendogs	Simulation	DS	2005	24.67
168	Pokemon Stadium	Strategy	N64	1999	5.45

- I am so surprised to know that the most popular shooter game is *Duck Hunt* released in 1984 ! ! Which has a cumulative units sold of 28.31 million, poor ducks.

Q3: What is the most popular genre and the most popular developer by region accoding to the cumulative units sold.

In [70]:
```
# most popular genre by region
vgs_df.groupby('Genre')[['NA_Sales','EU_Sales','JP_Sales','Other_Sales']].sum()
```

Out[70]:

	NA_Sales	EU_Sales	JP_Sales	Other_Sales
Genre				
Action	863.17	510.99	160.14	182.22
Adventure	101.52	63.20	52.24	16.37
Fighting	220.51	99.00	87.28	35.87
Misc	399.57	210.60	107.02	73.10
Platform	444.44	199.39	130.71	51.01
Puzzle	121.13	49.78	56.68	12.30
Racing	356.86	234.49	56.63	75.51
Role-Playing	330.04	188.24	353.39	59.41
Shooter	584.83	314.52	38.68	103.33
Simulation	180.40	113.35	63.64	30.57
Sports	671.20	371.33	134.93	132.21
Strategy	67.75	44.79	49.30	10.73

- The most popular genre in North America, Europe, Japan, and the rest of the world is action, action, role-playing, and action respectively.

In [71]:
```
# most popular developer by region
dev_na = vgs_df.groupby('Developer')['NA_Sales'].sum().sort_values(ascending = False).head(1).reset_index().iat
dev_eu = vgs_df.groupby('Developer')['EU_Sales'].sum().sort_values(ascending = False).head(1).reset_index().iat
dev_jp = vgs_df.groupby('Developer')['JP_Sales'].sum().sort_values(ascending = False).head(1).reset_index().iat
dev_oth = vgs_df.groupby('Developer')['Other_Sales'].sum().sort_values(ascending = False).head(1).reset_index()

print('The most popular developer in North America is {}.'.format(dev_na))
print('The most popular developer in Europe is {}.'.format(dev_eu))
print('The most popular developer in Japan is {}.'.format(dev_jp))
print('The most popular developer in rest of the world is {}.'.format(dev_oth))
```

```
The most popular developer in North America is Nintendo.
The most popular developer in Europe is Nintendo.
The most popular developer in Japan is Nintendo.
The most popular developer in rest of the world is Nintendo.
```

- Well, seems **Nintendo** is favored by game players all over the world.

I want to show Nintendo's logo here by using `PIL` to display an image.

In [72]:
```
# import urlretrieve to download the image
from urllib.request import urlretrieve
urlretrieve('https://upload.wikimedia.org/wikipedia/commons/9/95/Nintendo_Logo_2017.png',
            'nin_logo.png');
```

In [73]:
```
# also import PIL library to read the image
from PIL import Image
nin_logo = Image.open('nin_logo.png')
```

In [74]:
```
# display the image using imshow function then turn off the axis and grids
plt.imshow(nin_logo)
plt.axis('off')
plt.grid(False)
# add a title
plt.title('Nintendo LOGO (2016 - precent)');
```

Nintendo LOGO (2016 - precent)

Q4: What are the max, min, median and average critic score and user score for all games on *Metacritic* by genre.

In [75]:
```
vgs_df.groupby('Genre')[['Critic_Score','User_Score']].agg([np.min, np.max, np.median, np.mean,])
```

Out[75]:

	Critic_Score				User_Score			
	amin	amax	median	mean	amin	amax	median	mean
Genre								
Action	19.0	98.0	68.0	66.676931	0.3	9.5	7.4	7.058129
Adventure	17.0	93.0	66.0	65.268750	0.0	9.4	7.6	7.139597
Fighting	23.0	98.0	72.0	69.155556	0.9	9.2	7.6	7.295949
Misc	19.0	93.0	69.0	66.648330	0.5	9.2	7.1	6.805828
Platform	19.0	97.0	69.5	68.124490	0.2	9.4	7.7	7.305896
Puzzle	25.0	90.0	70.0	67.231818	1.1	9.3	7.5	7.138400
Racing	13.0	96.0	69.0	68.006897	0.3	9.5	7.4	7.040859
Role-Playing	35.0	96.0	74.0	72.655267	1.4	9.7	7.8	7.624423
Shooter	27.0	97.0	73.0	70.260022	1.2	9.3	7.4	7.053260
Simulation	31.0	92.0	70.0	68.609195	2.1	9.6	7.5	7.132153
Sports	19.0	98.0	75.0	71.993133	0.2	9.5	7.4	6.951434
Strategy	35.0	94.0	73.0	72.158784	0.6	9.4	7.8	7.294426

Note that `Critic_Score` is in 0-100 scale, `User_Score` is in 0-10 scale.

Q5: Given the name of a game, evaluate it by the scores on *Metacritic*.

I don't want to evaluate a game simply with its critic score and user score on *Metacritic*. I think it will be a good idea to make a **benchmark** for each genre then compare the game with it.

In [76]:
```
# Let me check the critic count and user count on Metacritic by genre first.
vgs_df.groupby('Genre')[['Critic_Count', 'User_Count']].agg([np.min,np.max,np.median,np.mean])
```

Out[76]:

	Critic_Count				User_Count			
	amin	amax	median	mean	amin	amax	median	mean
Genre								
Action	4.0	106.0	23.0	27.891950	4.0	8003.0	28.0	188.763920
Adventure	4.0	107.0	17.0	22.246875	4.0	2759.0	17.0	103.953020
Fighting	4.0	81.0	25.0	27.960494	4.0	1662.0	27.0	64.597468
Misc	4.0	76.0	17.0	21.683694	4.0	471.0	13.0	30.799534
Platform	4.0	87.0	17.0	23.767347	4.0	5311.0	22.0	109.674528
Puzzle	4.0	78.0	14.0	20.454545	4.0	607.0	11.0	33.120000
Racing	4.0	90.0	17.0	23.121379	4.0	1599.0	17.0	69.228935
Role-Playing	4.0	98.0	30.0	32.514364	4.0	10665.0	50.0	321.928087
Shooter	4.0	113.0	32.0	35.679307	4.0	9851.0	61.0	378.280663
Simulation	4.0	75.0	17.0	21.419540	4.0	4572.0	20.0	83.421829
Sports	4.0	75.0	18.0	21.050644	4.0	1290.0	16.0	41.875116
Strategy	3.0	104.0	25.0	28.331081	4.0	6157.0	34.0	198.413115

I will only take the scores for those games with more than 20 in `Critic_Count` and more than 50 in `User_Count` to make the benchmark for each genre.

In [77]:
```
# defind a small function for the question
def eva_game():
    name = str(input('Please enter the full official name of the game you want to evaluate.'))
    game = vgs_df[vgs_df.Name == name][['Name','Genre','Platform','Year_of_Release','Critic_Score','Critic_Cour
    bench = vgs_df.query("Critic_Count >= 20 & User_Count >= 50").groupby('Genre')[['Critic_Score','User_Score'

    cri_avg = "{:.1f}".format(bench[bench.Genre == game.iat[0,1]].iat[0,1])
    usr_avg = "{:.1f}".format(bench[bench.Genre == game.iat[0,1]].iat[0,2])
    game['Critic_Score_Benchmark'] = game['Name'].str.len()
    game['User_Score_Benchmark'] = game['Name'].str.len()
    game['Critic_Score_Benchmark'] = cri_avg
    game['User_Score_Benchmark'] = usr_avg

    return game
```

In [ ]:
```
# find a random game and extract its name to check
vgs_df.sample(1).iat[0,0]
```

In [78]:
```
eva_game()
```

```
Please enter the full official name of the game you want to evaluate.LEGO Harry Potter: Years 1-4
```

Out[78]:

	Name	Genre	Platform	Year_of_Release	Critic_Score	Critic_Count	User_Score	User_Count	Critic_Score_Benchmark	User_Sc
638	LEGO Harry Potter: Years 1-4	Action	Wii	2010	79.0	13.0	8.0	34.0	77.1	
700	LEGO Harry Potter: Years 1-4	Action	DS	2010	72.0	7.0	7.2	6.0	77.1	
1203	LEGO Harry Potter: Years 1-4	Action	X360	2010	79.0	58.0	8.0	62.0	77.1	
1497	LEGO Harry Potter: Years 1-4	Action	PS3	2010	79.0	42.0	8.0	52.0	77.1	
2993	LEGO Harry Potter: Years 1-4	Action	PSP	2010	71.0	4.0	NaN	NaN	77.1	
14759	LEGO Harry Potter: Years 1-4	Action	PC	2010	79.0	15.0	7.9	55.0	77.1	

In my random sample, I got *LEGO Harry Potter: Years 1-4* which is a action game released in 2010 and have 6 different platform versions.

- Its `Critic_Score` is around 79 for Wii, Xbox 360, PS3, and PC, but only has 72 and 71 in DS and PSP, seems the game does not perform well in the handheld game consoles.
- Compared to its `Critic_Score_Benchmark` is 77.1, which is the average critic score for all action games with more than 20 critic count and 50 user count. It overall higher than the benchmark score.
- The game's `Critic_Score` is overall higher than the benchmark score, so it seems this game is not bad. Well, if you are a fan of action games and a fan of Harry Potter, just give it a try.

Q6: Can you create a function to generate a pie chart to show the regional cumulative sales in percentage by giving the name of a developer or publisher?

Sounds interesting, let me do it.

In [79]:
```
def get_pie_RegionSales():
    intput = input("Please type 'dev' for developer or type 'pub' for publisher, then press enter.")
    name = input("Thanks, next please type the full name of the developer/publisher you want to check, then pre

    # check the input is dev or pub then calculate the regional sales for the input name
    if str(intput) == "dev":
        sales = vgs_df[vgs_df.Developer == str(name)][['NA_Sales','EU_Sales','JP_Sales','Other_Sales']].sum()

        # create a function to inverse autopct
        def make_autopct(sales):
            def inverse_autopct(pct):
                return '{p:.2f}% ({v:.2f} m)'.format(p = pct, v = pct*sum(sales)/100)
            return inverse_autopct

        # start to plot
        label = ['North America','Europe','Japan','Rest of the World']
        plt.pie(sales,
                labels = label,
                autopct = make_autopct(sales),
                explode = [0.03, 0.03, 0.03, 0.03],
                shadow = True,
                startangle = 80)
        plt.legend(loc = 4)
        plt.title('Cumulative Regional Units Sold of Video Games that Developed by {}'.format(name),
                  pad = 10)

    # if input is pub then check name for publisher
    elif str(intput) == 'pub':
        sales = vgs_df[vgs_df.Publisher == str(name)][['NA_Sales','EU_Sales','JP_Sales','Other_Sales']].sum()

    # create a function to inverse autopct
        def make_autopct(sales):
            def inverse_autopct(pct):
                return '{p:.2f}% ({v:.2f} m)'.format(p = pct, v = pct*sum(sales)/100)
            return inverse_autopct

    # start to plot
        label = ['North America','Europe','Japan','Rest of the World']
        plt.pie(sales,
                labels = label,
                autopct = make_autopct(sales),
                explode = [0.03, 0.03, 0.03, 0.03],
                shadow = True,
                startangle = 80)
        plt.legend(loc = 4)
        plt.title('Cumulative Regional Units Sold of Video Games that Published by {}'.format(name),
                  pad = 10)

    return plt.show()
```

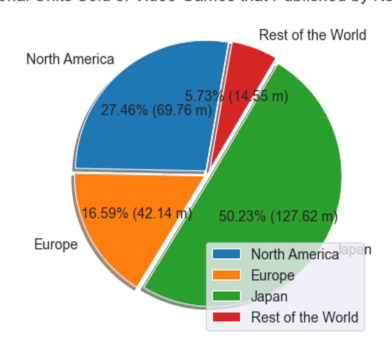
In [ ]:
```
# to random select a publisher and extract the name
vgs_df.sample(1).iat[0,4]
```

In [ ]:
```
# to random select a developer and extract the name
vgs_df.sample(1).iat[0,-2]
```

In [80]:
```
get_pie_RegionSales()
```

```
Please type 'dev' for developer or type 'pub' for publisher, then press enter.pub
Thanks, next please type the full name of the developer/publisher you want to check, then press enter.Namco Ban
dai Games
```

Cumulative Regional Units Sold of Video Games that Published by Namco Bandai Games



- In my case here, I randomly select a publisher called *Namco Bandai Games*, which is a Japanese multinational video game publisher headquartered in Tokyo, Japan. We can see that half of the cumulative units sold are in Japan, and the other around 45% are in North America and Europe. Seems they did a good job in the local region and not bad in the western world region.

Inferences and Conclusion

- More than 75% of the video games were sold in North America and Europe since they were released. These two regions are two important markets for video games and related businesses.
- There are about 6,000 games that were released between 2005 and 2010, that is about 3 games were released every day.
- About 90% of the games sold are rated as E, T, and M based on the ESRB rating.
- Action, sports, shooter, and role-playing are the top four genres among all video games.
- The number one game in cumulative global unit sold is Wii Sports Wii version released in 2006 with a record of 82.54 million.
- The number one game with the highest Critic Score is Grand Theft Auto IV X360 version released in 2008 with a score of 98.0 in Metacritic.
- The number one game with the highest User Score is Breath of Fire III PSP version released in 2005 with a score of 9.7 in Metacritic.
- The most popular genre in North America, Europe, Japan, and the rest of the world is action, action, role-playing, and action respectively.
- Nintendo is the number one developer, with a cumulative global unit sold of 531.78 million for all their games that were released from 1980 to 2016. Compared to the total population worldwide in 2016 is about 7.4 billion, which means every one of fourteen people in the world has bought Nintendo's game.
- The most popular shooter game is Duck Hunt released in 1984, with a global unit sold of 28.31 million.

Future Work

- In the future, for a better and updated analysis, I would like to scrape and update for latest released games, latest sales data, and Metacritic scores.
- For the data visualization, I will try to plot other types of charts and plot multiple charts in one grid.
- Further, I am planning to learn about modeling using libraries `SciPy`, `SciKit-Learn` and others.

Thank you for reading!

I want to say thank you to Instructor Aakash N S and also Jovian for providing this great online course for free!

To Python learners, enjoy coding!\ To game players, happy gaming!

In [1]:
```
# install notebook-as-pdf extension to convert ipynb file
# into pdf format for a better reading experience
!pip install -U -q notebook-as-pdf
!pip install pyppeteer -U -q
```

In [ ]:
```
# save and upload the notebook to jovian.ml using jovian.commit
!pip install jovian --upgrade -q
import jovian
jovian.commit(project = 'eda_video_games_cumulative_sales_1980_2016')
```