San Francisco Crime Analysis

September 29, 2023

1 San Francisco Crime Analysis

1.1 Description:

Crime analysis and prediction in San Francisco is a complex and challenging task. Crime is a complex phenomenon with many contributing factors, including social, economic, and environmental factors. It is also difficult to predict crime because it is often random and unpredictable.

However, there are a number of ways to analyze and predict crime in San Francisco. One common approach is to use historical crime data to identify patterns and trends. This data can be used to identify high-crime areas and times of day, as well as the types of crimes that are most common in different neighborhoods.

Another approach to crime analysis is to use predictive analytics. Predictive analytics is a set of techniques that use historical data to predict future events. In the context of crime prediction, predictive analytics can be used to predict the likelihood of a crime occurring in a particular location at a particular time.

There are a number of different predictive analytics techniques that can be used to predict crime. Some of the most common techniques include:

- **Regression analysis:** Regression analysis is a statistical technique that can be used to identify the relationship between different variables. In the context of crime prediction, regression analysis can be used to identify the factors that are most associated with crime, such as poverty, unemployment, and the presence of gangs.
- **Decision trees:** Decision trees are a type of machine learning algorithm that can be used to classify data. In the context of crime prediction, decision trees can be used to classify neighborhoods as high-crime or low-crime based on their characteristics, such as poverty, unemployment, and the presence of gangs.
- **Random forests:** Random forests are a type of machine learning algorithm that is similar to decision trees, but instead of using a single decision tree, random forests use a large number of decision trees to make predictions. This makes random forests more accurate and less prone to overfitting than decision trees.

Predictive analytics models can be used to help the San Francisco Police Department (SFPD) allocate resources more effectively and prevent crime from happening in the first place. For example, the SFPD can use predictive analytics models to identify high-crime areas and times of day, and then deploy more officers to those areas during those times. The SFPD can also use predictive analytics models to identify individuals who are at high risk of committing crimes, and then intervene to prevent those crimes from happening.

It is important to note that crime prediction is not perfect. No predictive analytics model can accurately predict crime with 100% accuracy. However, predictive analytics models can be a valuable tool for helping the SFPD reduce crime in San Francisco.

Here are some examples of how crime analysis and prediction are being used in San Francisco:

- The SFPD is using predictive analytics models to identify high-crime areas and times of day. This information is being used to deploy more officers to those areas during those times.
- The SFPD is also using predictive analytics models to identify individuals who are at high risk of committing crimes. This information is being used to intervene to prevent those crimes from happening.
- The SFPD is working with researchers at the University of California, Berkeley to develop a new crime prediction model that uses social media data. This model is still under development, but it has the potential to be more accurate than existing crime prediction models.

Crime analysis and prediction is a complex and challenging field, but it has the potential to make a significant impact on reducing crime in San Francisco.

2 Importing Libraries

[ ]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import folium # To create interactive maps
import squarify # used to create treemaps
```

[ ]:
```
import warnings
warnings.filterwarnings('ignore')
```

3 Reading Datasets

[ ]:
```
data=pd.read_csv('crime.csv')
data.head()
```

[ ]:
```
   IncidntNum      Category                                         Descript  \
0   120058272   WEAPON LAWS                    POSS OF PROHIBITED WEAPON
1   120058272   WEAPON LAWS  FIREARM, LOADED, IN VEHICLE, POSSESSION OR USE
2   141059263      WARRANTS                                   WARRANT ARREST
3   160013662  NON-CRIMINAL                                    LOST PROPERTY
4   160002740  NON-CRIMINAL                                    LOST PROPERTY

  DayOfWeek                    Date   Time  PdDistrict      Resolution  \
0    Friday  01/29/2016 12:00:00 AM  11:00    SOUTHERN  ARREST, BOOKED
1    Friday  01/29/2016 12:00:00 AM  11:00    SOUTHERN  ARREST, BOOKED
2    Monday  04/25/2016 12:00:00 AM  14:59     BAYVIEW  ARREST, BOOKED
3   Tuesday  01/05/2016 12:00:00 AM  23:50  TENDERLOIN            NONE
```

```
4    Friday  01/01/2016 12:00:00 AM  00:30     MISSION            NONE

                  Address           X          Y  \
0  800 Block of BRYANT ST -122.403405  37.775421
1  800 Block of BRYANT ST -122.403405  37.775421
2   KEITH ST / SHAFTER AV -122.388856  37.729981
3  JONES ST / OFARRELL ST -122.412971  37.785788
4    16TH ST / MISSION ST -122.419672  37.765050

                                Location           PdId
0   (37.775420706711, -122.403404791479)  12005827212120
1   (37.775420706711, -122.403404791479)  12005827212168
2  (37.7299809672996, -122.388856204292)  14105926363010
3  (37.7857883766888, -122.412970537591)  16001366271000
4  (37.7650501214668, -122.419671780296)  16000274071000
```

3.0.1 The Datasets Information:

DataSets Link (Click Me)

The San Francisco crime dataset is a collection of crime reports from the San Francisco Police Department (SFPD). The dataset contains nearly 12 years of crime reports from all of San Francisco's neighborhoods.

The following are the features of the San Francisco crime dataset:

- **Dates:** The timestamp of the crime incident.
- **Category:** The category of the crime incident. This is the target variable for the dataset.
- **Descript:** A detailed description of the crime incident.
- **DayOfWeek:** The day of the week on which the crime occurred.
- **PdDistrict:** The name of the Police Department District in which the crime occurred.
- **Resolution:** The resolution of the crime incident.
- **Address:** The approximate street address of the crime incident.
- **X:** The longitude of the crime incident.
- **Y:** The latitude of the crime incident.

The categories of crime in the dataset are:

- Assault
- Battery
- Burglary
- Drug/Alcohol
- Fraud
- Larceny/Theft
- Miscellaneous
- Narcotics
- Robbery
- Sex Crimes
- Vehicle Theft

4 Data Exploration

- Let's check duplicate data

[ ]:
```
data.duplicated().sum()
```

[ ]:
```
0
```

[ ]:
```
data.shape
```

[ ]:
```
(150500, 13)
```

[ ]:
```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 150500 entries, 0 to 150499
Data columns (total 13 columns):
 #   Column      Non-Null Count   Dtype
---  ------      --------------   -----
 0   IncidntNum  150500 non-null  int64
 1   Category    150500 non-null  object
 2   Descript    150500 non-null  object
 3   DayOfWeek   150500 non-null  object
 4   Date        150500 non-null  object
 5   Time        150500 non-null  object
 6   PdDistrict  150499 non-null  object
 7   Resolution  150500 non-null  object
 8   Address     150500 non-null  object
 9   X           150500 non-null  float64
 10  Y           150500 non-null  float64
 11  Location    150500 non-null  object
 12  PdId        150500 non-null  int64
dtypes: float64(2), int64(2), object(9)
memory usage: 14.9+ MB
```

[ ]:
```
data.describe()
```

[ ]:

	IncidntNum	X	Y	PdId
count	1.505000e+05	150500.000000	150500.000000	1.505000e+05
mean	1.616440e+08	-122.423599	37.768921	1.616440e+13
std	5.535976e+06	0.026210	0.023637	5.535976e+11
min	1.135121e+07	-122.513642	37.707922	1.135121e+12
25%	1.603283e+08	-122.434036	37.756486	1.603283e+13
50%	1.606541e+08	-122.416903	37.775421	1.606541e+13
75%	1.609764e+08	-122.406605	37.785063	1.609764e+13
max	9.910090e+08	-122.365565	37.819975	9.910090e+13

- Checking if any null value presents

[ ]:
```
data.isnull()
```

[ ]:
```
        IncidntNum  Category  Descript  DayOfWeek   Date   Time  PdDistrict  \
0            False     False     False      False  False  False       False
1            False     False     False      False  False  False       False
2            False     False     False      False  False  False       False
3            False     False     False      False  False  False       False
4            False     False     False      False  False  False       False
…                …         …         …          …      …      …           …
150495       False     False     False      False  False  False       False
150496       False     False     False      False  False  False       False
150497       False     False     False      False  False  False       False
150498       False     False     False      False  False  False       False
150499       False     False     False      False  False  False       False

        Resolution  Address      X      Y  Location   PdId
0            False    False  False  False     False  False
1            False    False  False  False     False  False
2            False    False  False  False     False  False
3            False    False  False  False     False  False
4            False    False  False  False     False  False
…                …        …      …      …         …      …
150495       False    False  False  False     False  False
150496       False    False  False  False     False  False
150497       False    False  False  False     False  False
150498       False    False  False  False     False  False
150499       False    False  False  False     False  False

[150500 rows x 13 columns]
```

[ ]:
```
data.isnull().sum()
```

[ ]:
```
IncidntNum    0
Category      0
Descript      0
DayOfWeek     0
Date          0
Time          0
PdDistrict    1
Resolution    0
Address       0
X             0
Y             0
Location      0
PdId          0
dtype: int64
```

[ ]:
```
data.isnull().sum().sum()
```

[ ]: 1

- One null value present
- let's fill their mode value

[ ]:
```
data['PdDistrict'].fillna(data['PdDistrict'].mode()[0], inplace=True)
```

[ ]:
```
data.isnull().sum().sum()
```

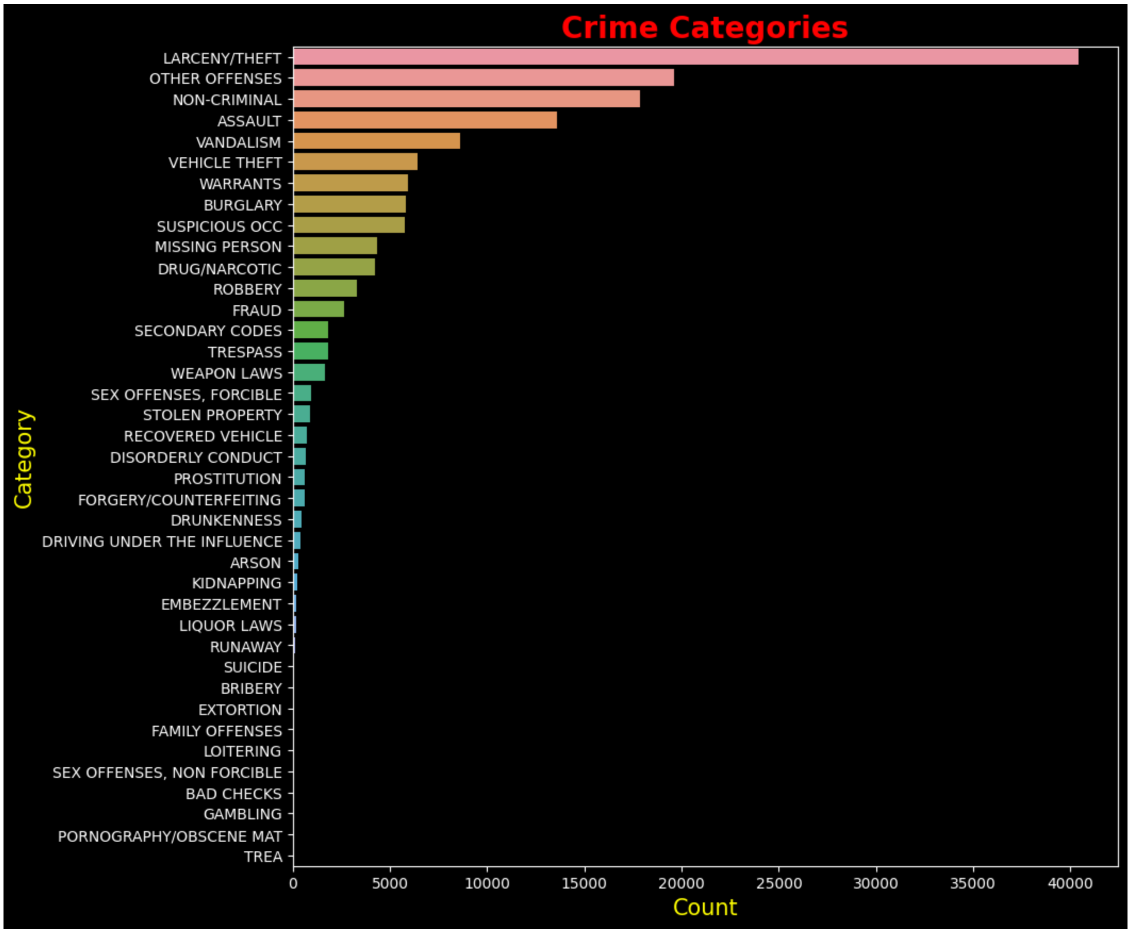
[ ]: 0

5 Data Visualization

[ ]:
```
plt.style.use('dark_background')
```

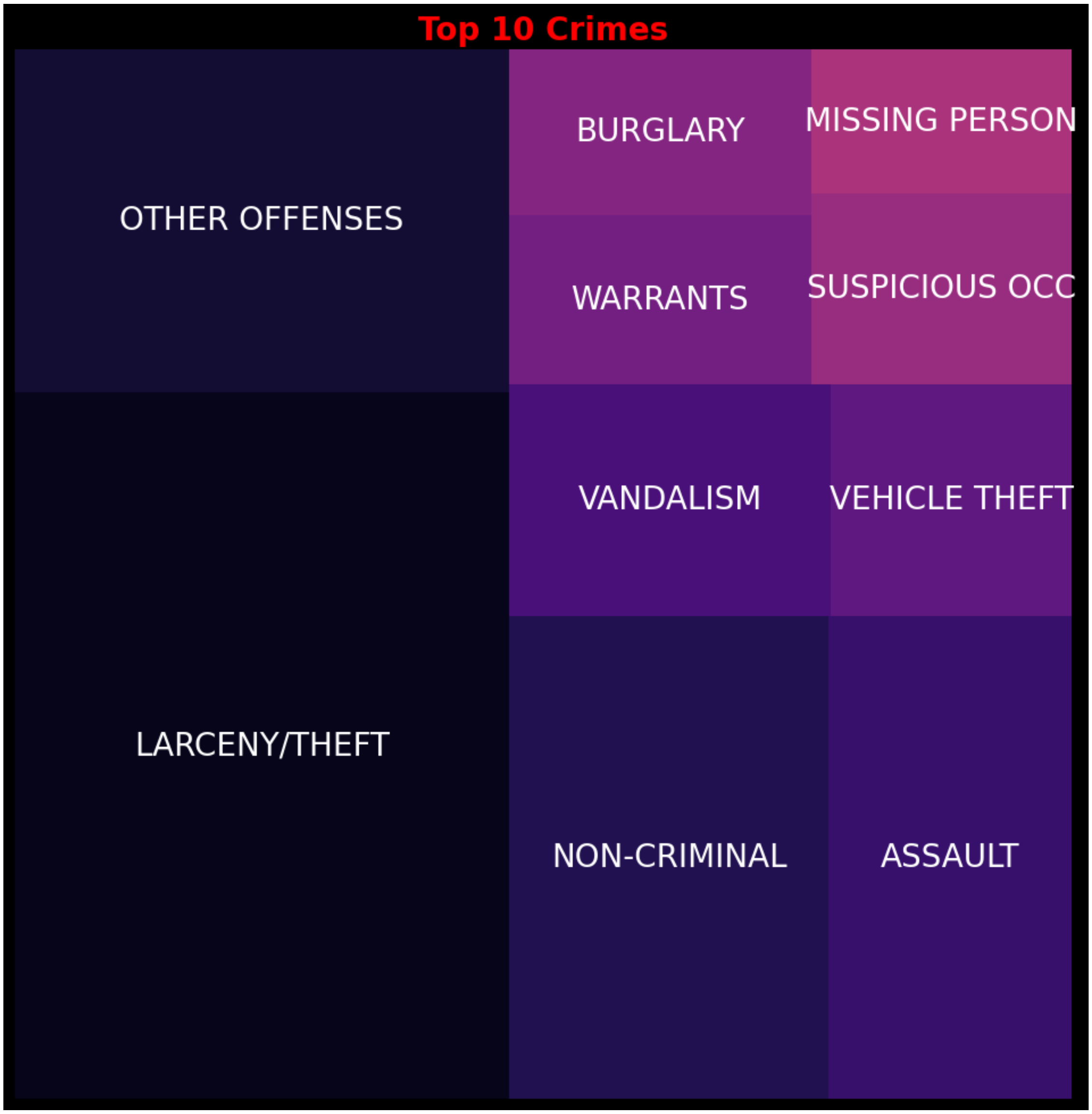
- First thing we are going to find category of crime

[ ]:
```
plt.figure(figsize=(10,10))
sns.countplot(y=data['Category'], order=data['Category'].value_counts().index)
plt.title('Crime Categories', fontweight='bold', fontsize=20,color='red')
plt.xlabel('Count', fontsize=15, color='yellow')
plt.ylabel('Category', fontsize=15, color='yellow')
plt.xticks(color='white')
plt.yticks(color='white')
plt.show()
```



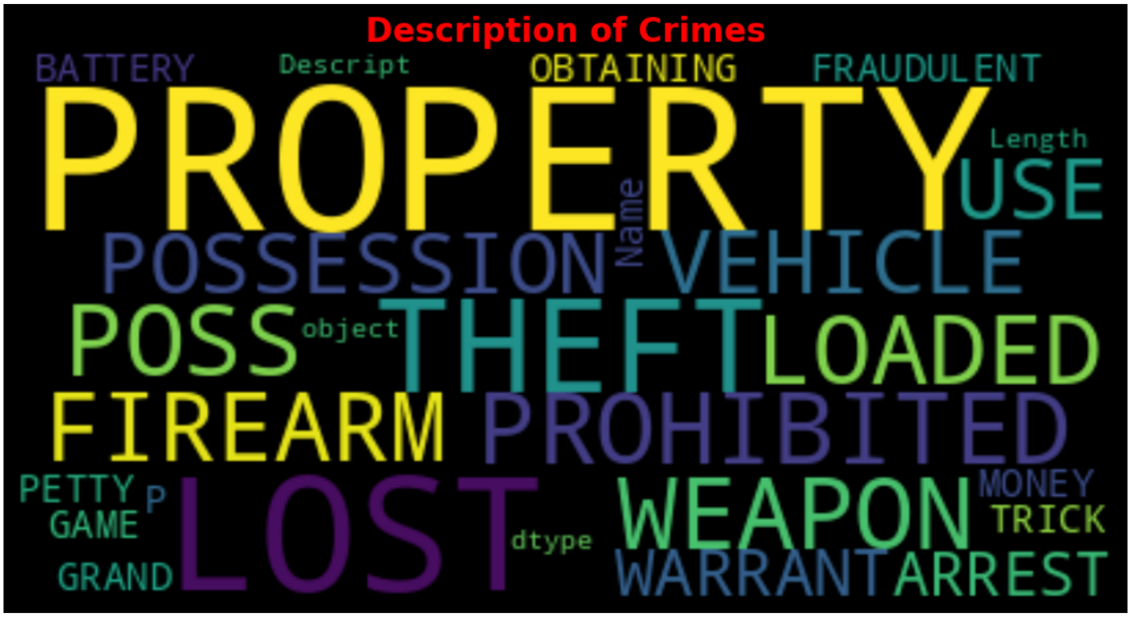
- Let's draw tree map of a crime category

[ ]:
```
y=data['Category'].value_counts().head(10)
plt.figure(figsize=(12,12))
squarify.plot(sizes=y.values,label=y.index,color=sns.color_palette('magma',20))
plt.rcParams.update({'font.size':20})
plt.axis('off')
plt.title('Top 10 Crimes', fontweight='bold', fontsize=20,color='red')
plt.show()
```



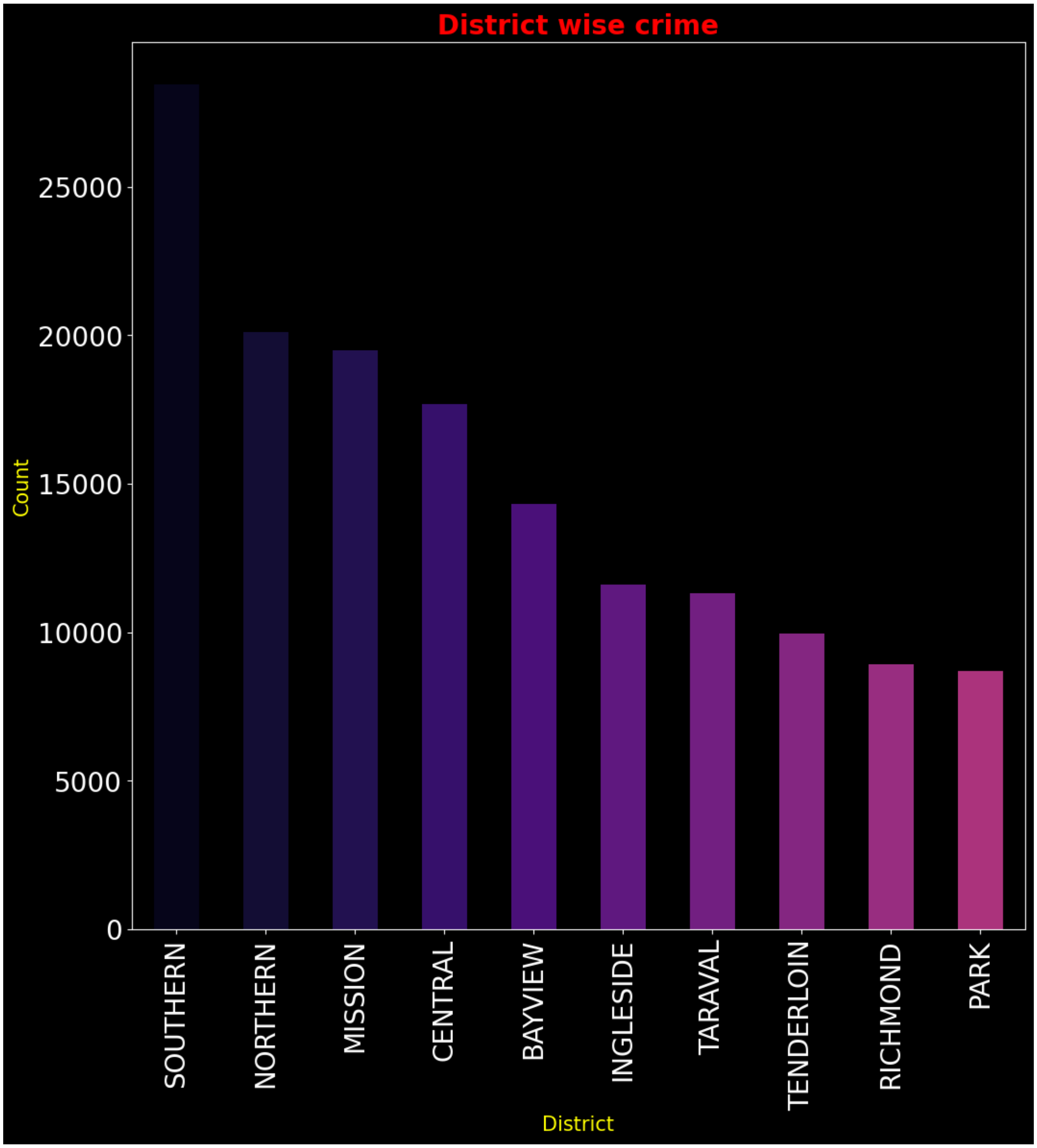
- We can observe description of crime using `WordCloud`

[ ]:
```
from wordcloud import WordCloud, STOPWORDS

plt.figure(figsize=(12,12))
wc=WordCloud(background_color='black',max_words=100)
wc.generate(str(data['Descript']))
plt.imshow(wc,interpolation='bilinear')
plt.axis('off')
plt.title('Description of Crimes',fontsize=20, fontweight='bold',color='red')
plt.show()
```



- Let's check in which District with most crime

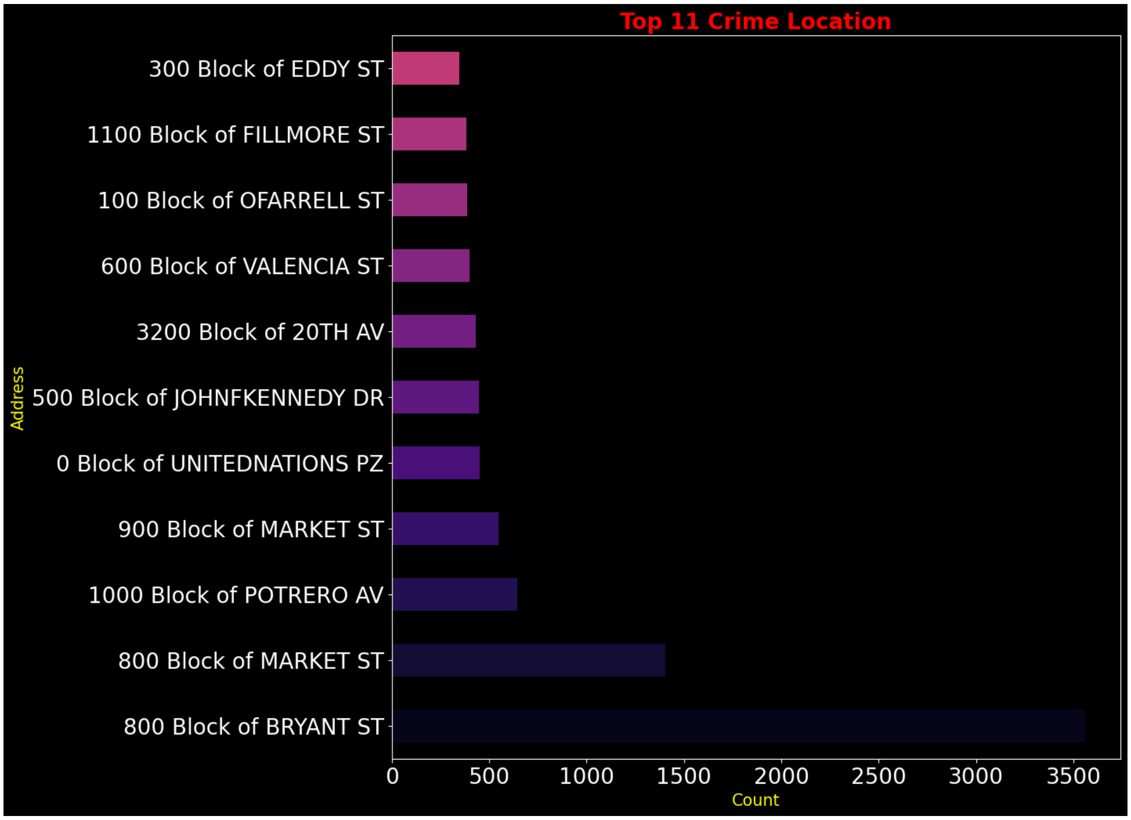
```
[ ]: plt.figure(figsize=(12,12))
data['PdDistrict'].value_counts().plot(kind='bar',color=sns.
 ↪color_palette('magma',20))
plt.xlabel('District', fontsize=15, color='yellow')
plt.ylabel('Count', fontsize=15, color='yellow')
plt.xticks(color='white')
plt.yticks(color='white')
plt.title('District wise crime', fontweight='bold', fontsize=20,color='red')
plt.show()
```



- I want to know in which area ('Addresses') crime occuring most

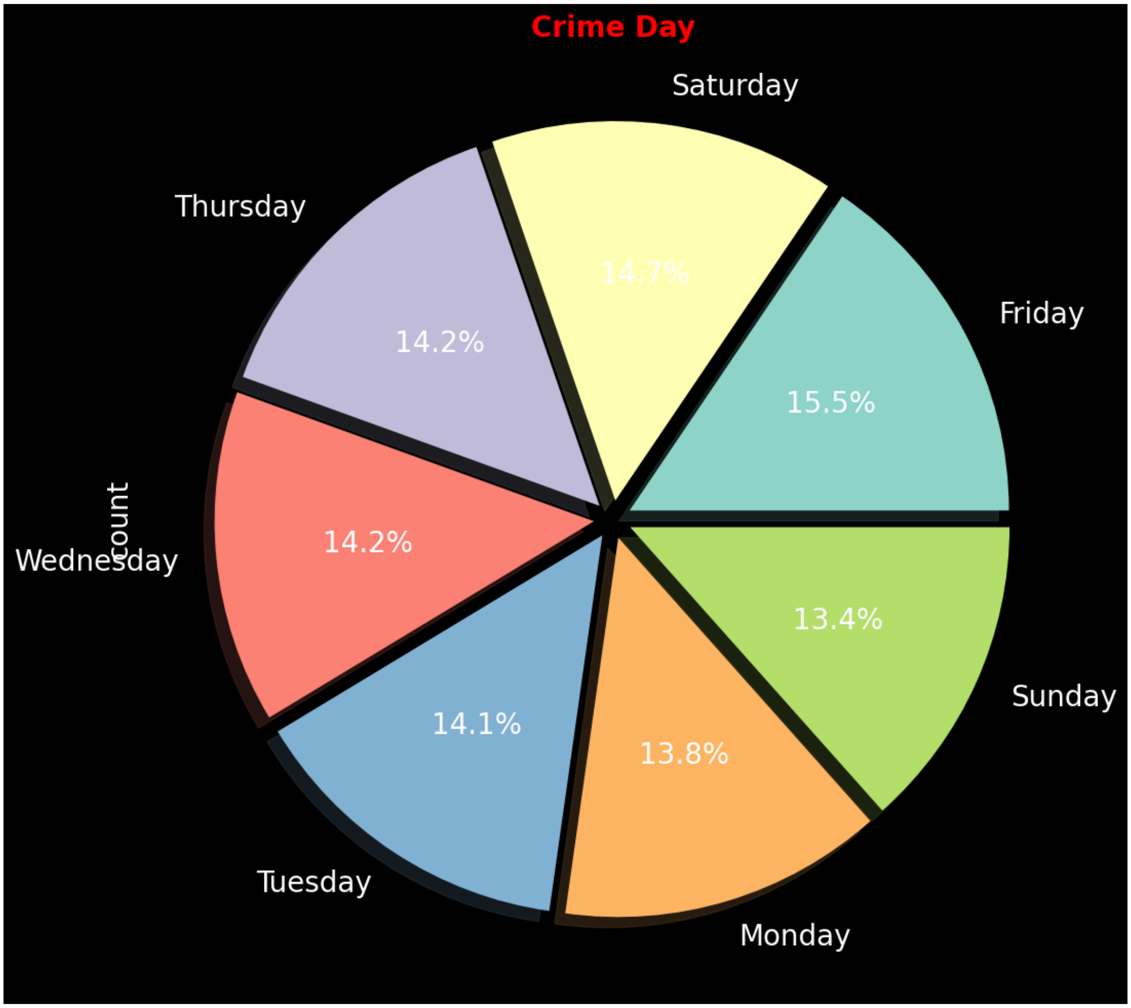
[ ]:
```
plt.figure(figsize=(12,12))
data['Address'].value_counts().head(11).plot(kind='barh',color=sns.
 ↪color_palette('magma',20))
plt.xlabel('Count', fontsize=15, color='yellow')
plt.ylabel('Address', fontsize=15, color='yellow')
plt.xticks(color='white')
plt.yticks(color='white')
plt.title('Top 11 Crime Location', fontweight='bold', fontsize=20,color='red')
```

```
plt.show()
```



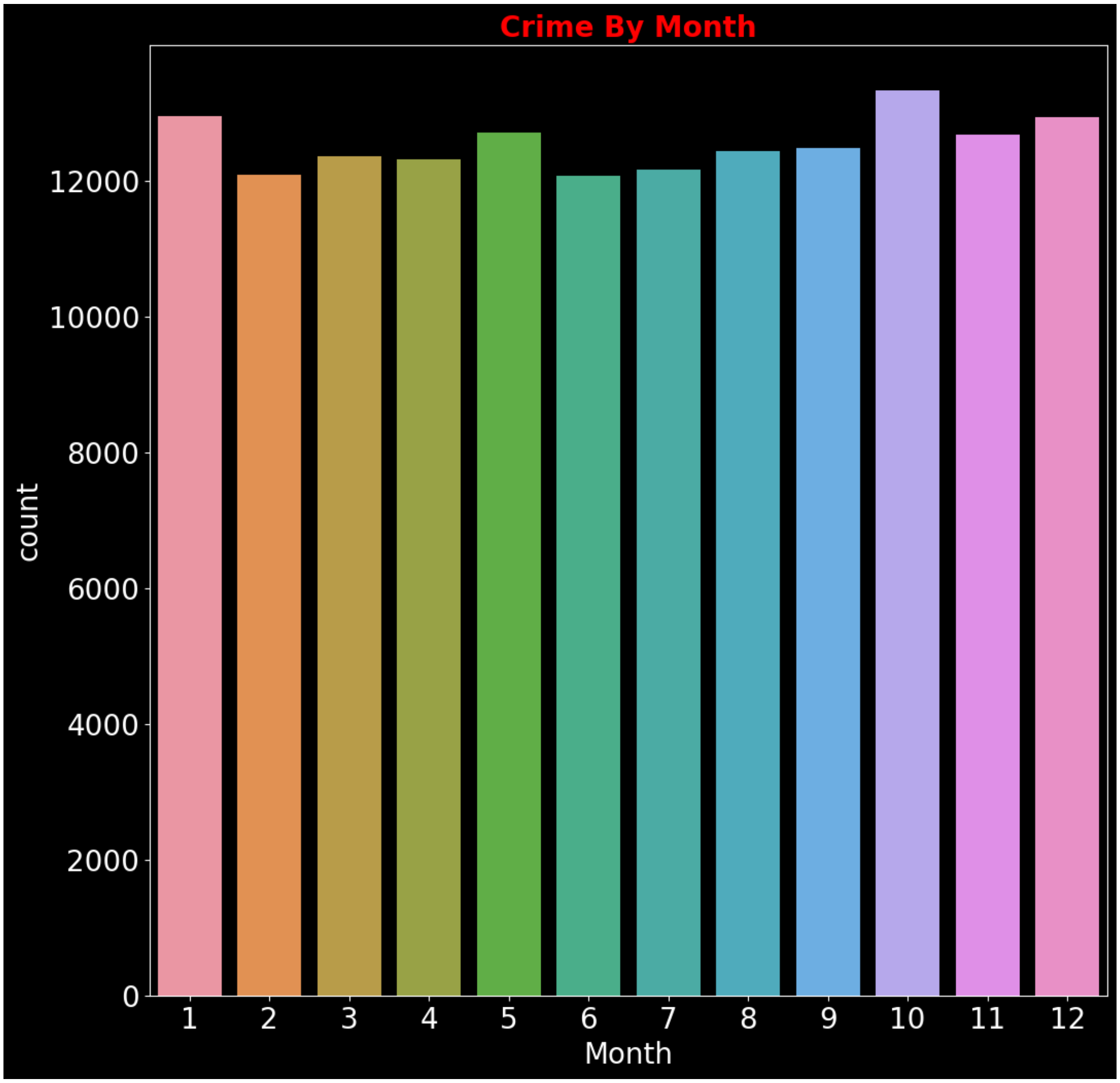
- Which day of weak crime occuring most?

```
[ ]: plt.figure(figsize=(12,12))
data['DayOfWeek'].value_counts().plot.pie(autopct='%1.
 ↪1f%%',shadow=True,explode=(0.05,0.05,0.05,0.05,0.05,0.05,0.05))
plt.title('Crime Day', fontweight='bold', fontsize=20,color='red')
plt.show()
```



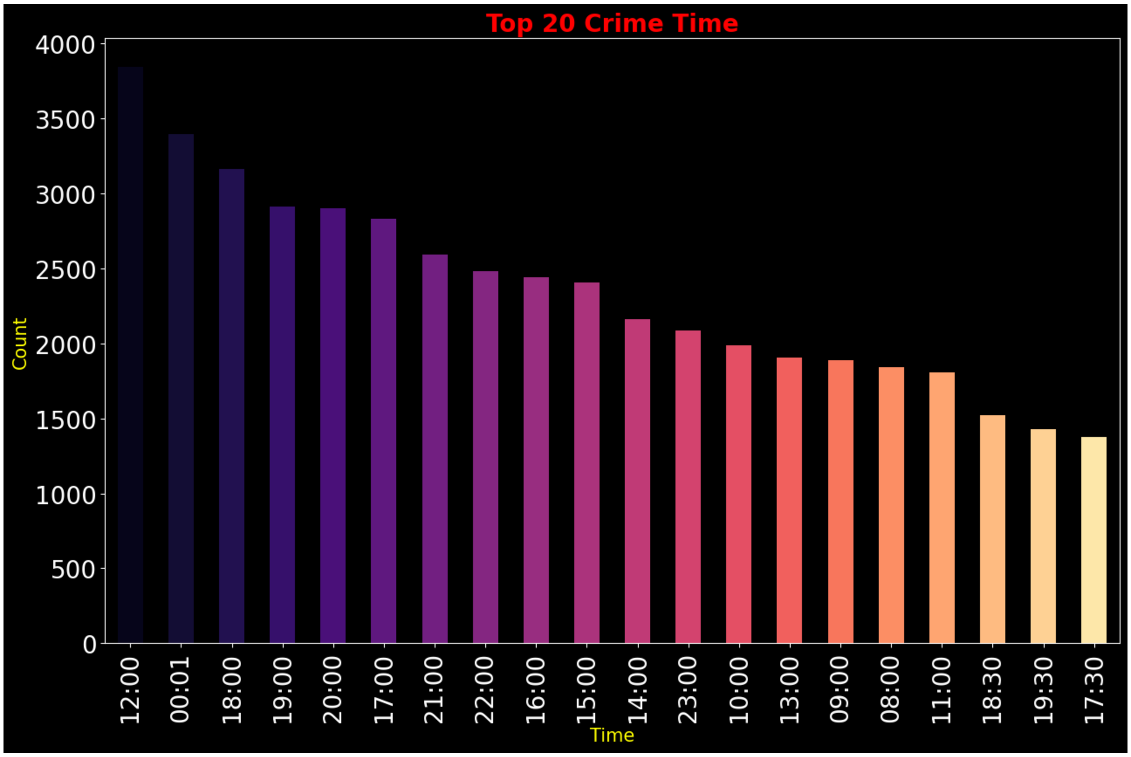
- **I think friday is wrost day for `San Francisco`**
- Yes! Now time for month after day

[ ]:
```
plt.figure(figsize=(12,12))
data['Date']=pd.to_datetime(data['Date'])
data['Month']=data['Date'].dt.month
sns.countplot(x='Month',data=data)
plt.title('Crime By Month', fontweight='bold', fontsize=20,color='red')
plt.show()
```



- Which time crime occurs mostly?

[ ]:
```
plt.figure(figsize=(15,9))
data['Time'].value_counts().head(20).plot(kind='bar',color=sns.
 ↪color_palette('magma',20))
plt.xlabel('Time', fontsize=15, color='yellow')
plt.ylabel('Count', fontsize=15, color='yellow')
plt.xticks(color='white')
plt.yticks(color='white')
plt.title('Top 20 Crime Time', fontweight='bold', fontsize=20,color='red')
plt.show()
```



- Time for cross showdown

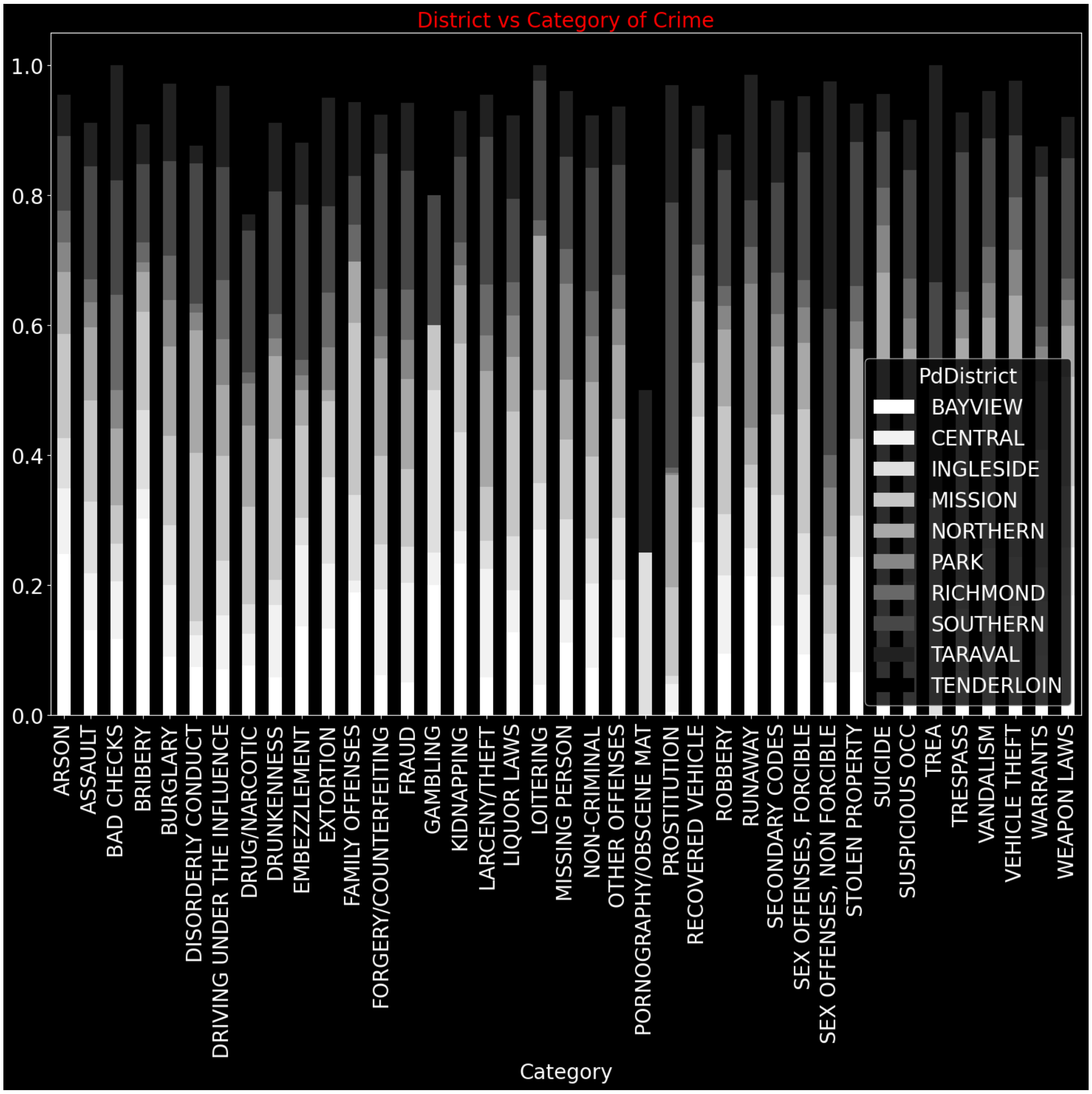
District vs Category of crime

[ ]:
```
df=data.groupby(['PdDistrict','Category']).size().reset_index(name='Count')
df=df.pivot(index='PdDistrict',columns='Category',values='Count')
df.reset_index(inplace=True)
df.fillna(0,inplace=True)
df.head()
```

[ ]:
```
Category PdDistrict   ARSON   ASSAULT  BAD CHECKS  BRIBERY  BURGLARY  \
0             BAYVIEW   71.0   1775.0         4.0     20.0     521.0
1             CENTRAL   29.0   1187.0         3.0      3.0     645.0
2           INGLESIDE   22.0   1506.0         2.0      8.0     534.0
3             MISSION   46.0   2110.0         2.0     10.0     793.0
4            NORTHERN   27.0   1536.0         4.0      4.0     803.0

Category  DISORDERLY CONDUCT  DRIVING UNDER THE INFLUENCE  DRUG/NARCOTIC  \
0                       49.0                         27.0          327.0
1                       32.0                         31.0          207.0
2                       14.0                         32.0          191.0
3                      171.0                         61.0          639.0
4                      124.0                         41.0          527.0
```

```
Category  DRUNKENNESS  …  SEX OFFENSES, NON FORCIBLE  STOLEN PROPERTY  \
0                27.0  …                         2.0             59.0
1                52.0  …                         0.0            156.0
2                18.0  …                         3.0             56.0
3               101.0  …                         3.0            104.0
4                59.0  …                         3.0            123.0

Category  SUICIDE  SUSPICIOUS OCC  TREA  TRESPASS  VANDALISM  VEHICLE THEFT  \
0             4.0           610.0   0.0     125.0     1059.0         1081.0
1            10.0           580.0   0.0     173.0     1148.0          481.0
2            16.0           527.0   1.0      74.0      761.0          915.0
3             3.0           945.0   0.0     412.0     1091.0          932.0
4            14.0           600.0   0.0     268.0     1199.0          739.0

Category  WARRANTS  WEAPON LAWS
0            548.0        306.0
1            489.0        122.0
2            307.0        157.0
3           1073.0        278.0
4            624.0        131.0

[5 rows x 40 columns]
```

[ ]:
```
df = pd.crosstab(data['Category'], data['PdDistrict'])
color = plt.cm.Greys(np.linspace(0, 1, 10))

df.div(df.sum(1).astype(float), axis = 0).plot.bar(stacked = True, color =
 ↪color, figsize = (18, 12))
plt.title('District vs Category of Crime', fontweight = 30, fontsize = 20,
 ↪color = 'red')

plt.xticks(rotation = 90)
plt.show()
```



5.0.1 Geographical Visulization

[ ]:
```
crimes=data['Category'].unique().tolist()
crimes.remove('TREA')
```

[ ]:
```
# Create a base map centered on San Francisco
sf_map = folium.Map(location=[37.77, -122.42], zoom_start=12)

# Add markers for each incident
for index, row in data.iterrows():
    folium.Marker([row['Y'], row['X']], tooltip=row['Category']).add_to(sf_map)
```

```python
# Display the map
sf_map.save('sf_crime_map.html')
```

[ ]:
```python
t = data.PdDistrict.value_counts()

table = pd.DataFrame(data=t.values, index=t.index, columns=['Count'])
table = table.reindex(["CENTRAL", "NORTHERN", "PARK", "SOUTHERN", "MISSION",␣
 ↪"TENDERLOIN", "RICHMOND", "TARAVAL", "INGLESIDE", "BAYVIEW"])

table = table.reset_index()
table.rename({'index': 'Neighborhood'}, axis='columns', inplace=True)

table
```

[ ]:

	PdDistrict	Count
0	CENTRAL	17666
1	NORTHERN	20100
2	PARK	8699
3	SOUTHERN	28446
4	MISSION	19503
5	TENDERLOIN	9942
6	RICHMOND	8922
7	TARAVAL	11325
8	INGLESIDE	11594
9	BAYVIEW	14303

[ ]:
```python
gjson = r'https://cocl.us/sanfran_geojson'
sf_map = folium.Map(location = [37.77, -122.42], zoom_start = 12)
```

5.0.2 Dessity of crime in San Francisco

[ ]:
```python
sf_map.choropleth(
    geo_data=gjson,
    data=table,
    columns=['PdDistrict', 'Count'],
    key_on='feature.properties.DISTRICT',
    fill_color='YlOrRd',
    fill_opacity=0.7,
    line_opacity=0.2,
    legend_name='Crime Rate in San Francisco'
)

sf_map
```

[ ]:
```
<folium.folium.Map at 0x7fa186789720>
```

6 Reference

Aman Kharwal

thecleverprogrammer.com

7 Thank You!