

Final Year Project:

Anticipating Menstrual Migraine using Deep Learning.

Importing Libraries

```
In [ ]: # For data manipulation
import numpy as np
import pandas as pd

# For data visualization
import seaborn as sns
import matplotlib.pyplot as plt

# For upsampling
from sklearn.utils import resample

# For encoding
from sklearn.preprocessing import LabelEncoder, LabelBinarizer
```

Importing Dataset

```
In [ ]: df = pd.read_csv('ExperimentalMigraneData.csv')

x = df[['Age', 'Duration', 'Frequency', 'Location', 'Character', 'Intensity', 'Nausea']
y = df['Types'] #select target

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

Out[]:

	Age	Duration	Frequency	Location	Character	Intensity	Nausea	Vomit	Phonophobia	PI
0	30	1	5	1	1	2	1	0		1
1	50	3	5	1	1	3	1	1		1
2	53	2	1	1	1	2	1	1		1
3	45	3	5	1	1	3	1	0		1
4	53	1	1	1	1	2	1	0		1

5 rows × 26 columns

___Exploratory Data Analysis___

Relation between Categorical Variable and Target Variable

```
In [ ]: cat_col = []
con_col = []

for col in df.columns:
    if df[col].nunique() < 15:
        cat_col.append(col)
    else:
        con_col.append(col)
```

```
In [ ]: def count_percentage_plot(df, x, target, subtitle):
    fig, (ax1, ax2) = plt.subplots(1, 2, figsize=(20, 10))
    plt.suptitle(subtitle, fontsize=16)

    # Plot the count plot
    ax1.set_title(f"Number of {x.capitalize()} across Migraine Type")
    sns.countplot(data=df, x=target, hue=x, ax=ax1, palette="Set1")
    ax1.set_xlabel("")
    ax1.set_xticklabels(ax1.get_xticklabels(), rotation=90)

    # Plot the percent plot
    ax2.set_title(f"Percentage of {x.capitalize()} across Migraine Type")
    sns.histplot(df, x=target, hue=x, stat="probability", multiple="fill", shrink=0.8)
    ax2.set_xlabel("")
    ax2.set_ylabel("Percentage")
    ax2.set_xticklabels(ax1.get_xticklabels(), rotation=90)
```

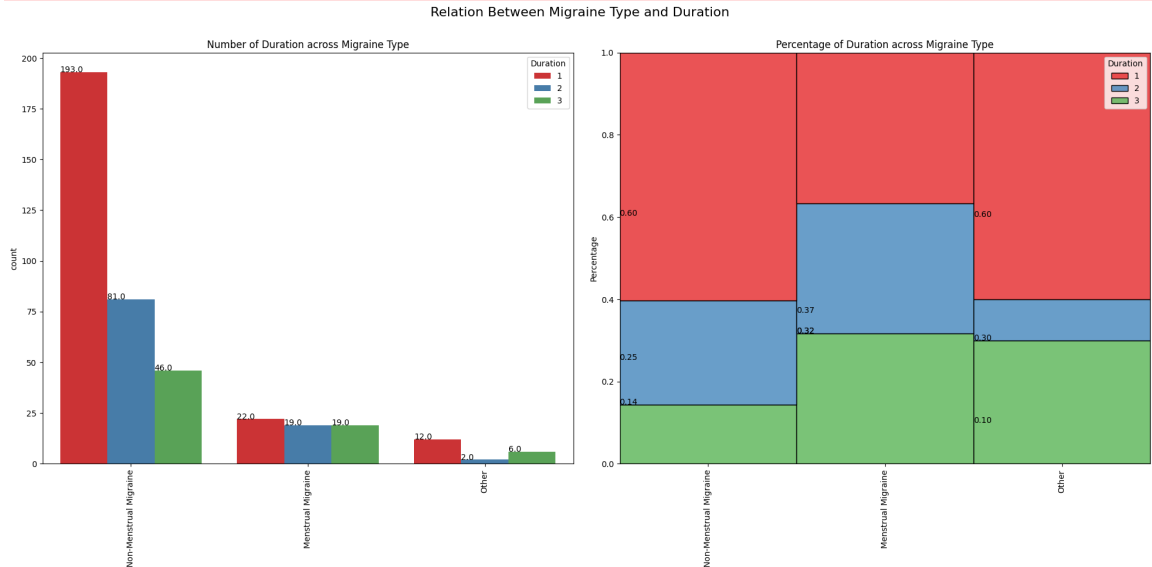
```
# Annotating the plots
for p1,p2 in zip(ax1.patches,ax2.patches):
    ax1.annotate("{:.1f}".format(p1.get_height()), (p1.get_x(),p1.get_height())
    ax2.annotate("{:.2f}".format(p2.get_height()), (p2.get_x(),p2.get_height())

plt.tight_layout(pad=2)
plt.show()
```

Duration and Type

```
In [ ]: count_percentage_plot(df, 'Duration', 'Type', "Relation Between Migraine Type and
```

```
C:\Users\bokad\AppData\Local\Temp\ipykernel_43416\1632486721.py:16: UserWarning: FixedFormatter should only be used together with FixedLocator
ax2.set_xticklabels(ax1.get_xticklabels(), rotation=90)
```

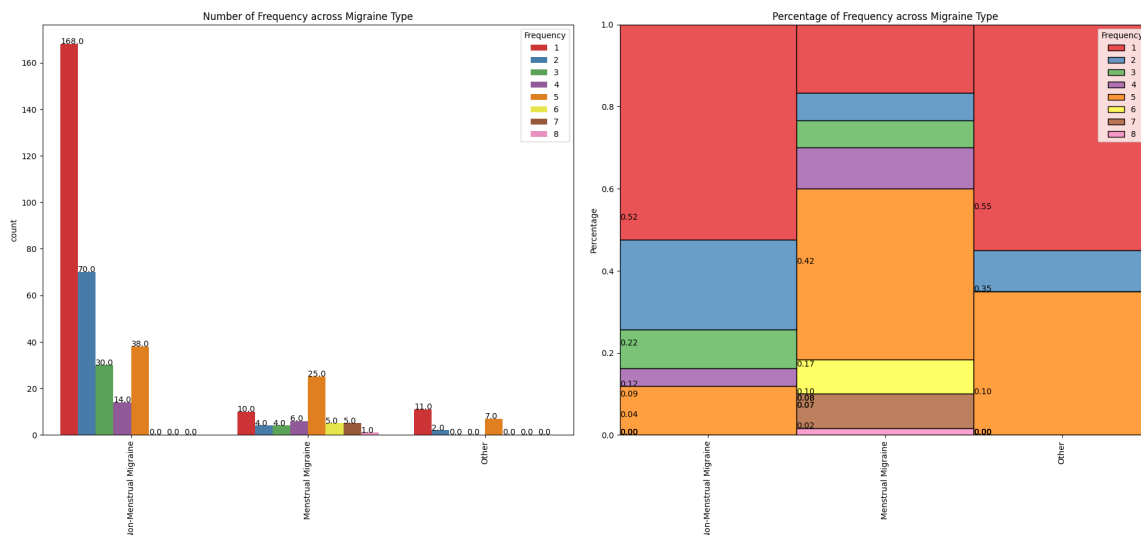


Frequency and Type

```
In [ ]: count_percentage_plot(df, 'Frequency', 'Type', "Relation Between Frequency & Mig
```

```
C:\Users\bokad\AppData\Local\Temp\ipykernel_43416\1632486721.py:16: UserWarning: FixedFormatter should only be used together with FixedLocator
ax2.set_xticklabels(ax1.get_xticklabels(), rotation=90)
```

Relation Between Frequency & Migraine Type

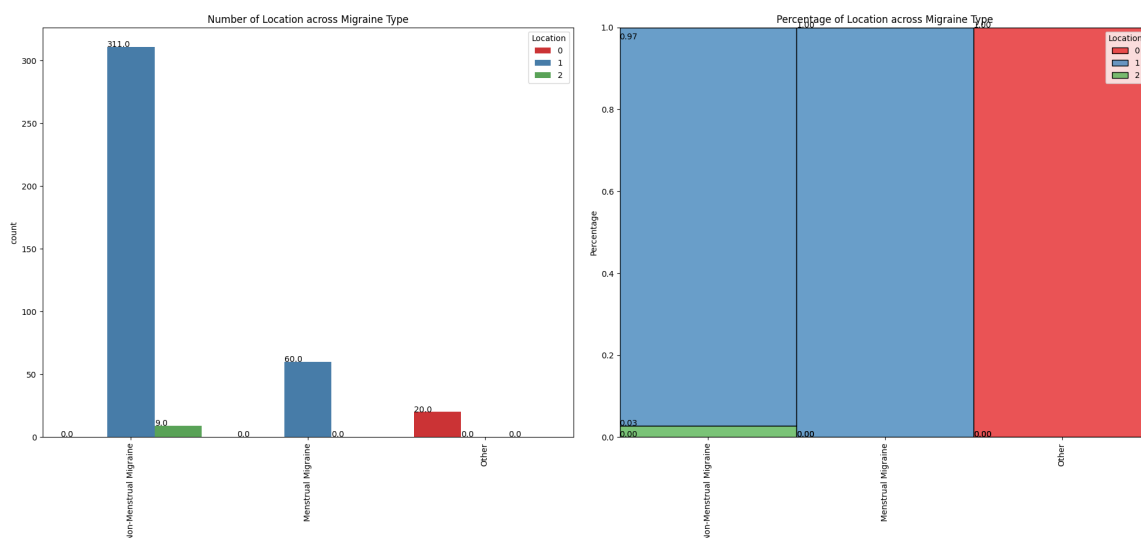


Location and Type

```
In [ ]: count_percentage_plot(df, 'Location', 'Type', "Relation Between Location & Migraine Type")
```

C:\Users\bokad\AppData\Local\Temp\ipykernel_43416\1632486721.py:16: UserWarning: FixedFormatter should only be used together with FixedLocator
ax2.set_xticklabels(ax1.get_xticklabels(), rotation=90)

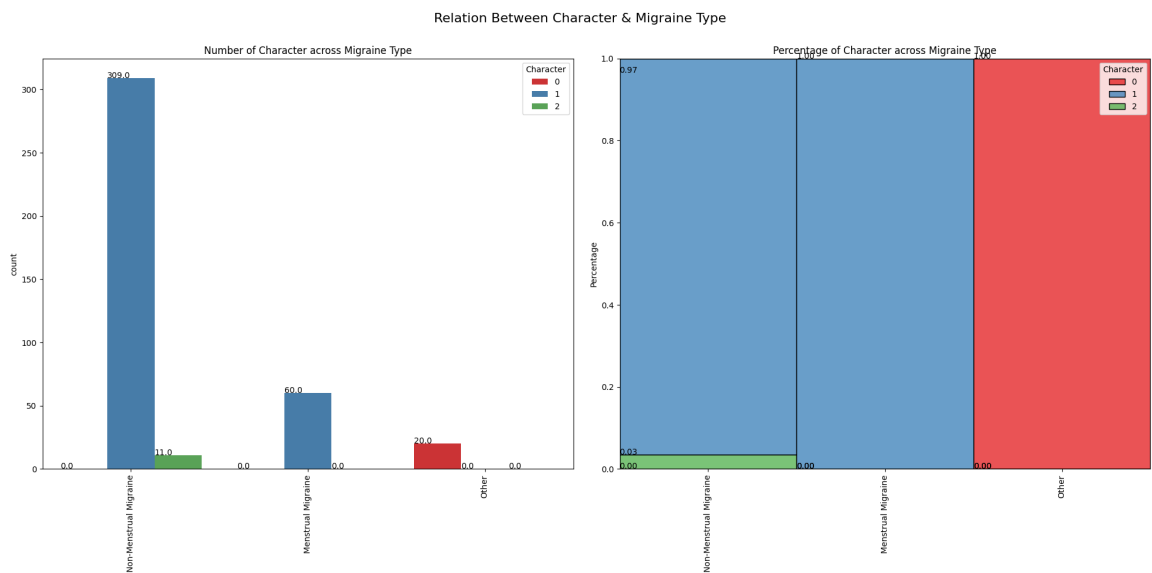
Relation Between Location & Migraine Type



Character and Type

```
In [ ]: count_percentage_plot(df, 'Character', 'Type', "Relation Between Character & Migraine Type")
```

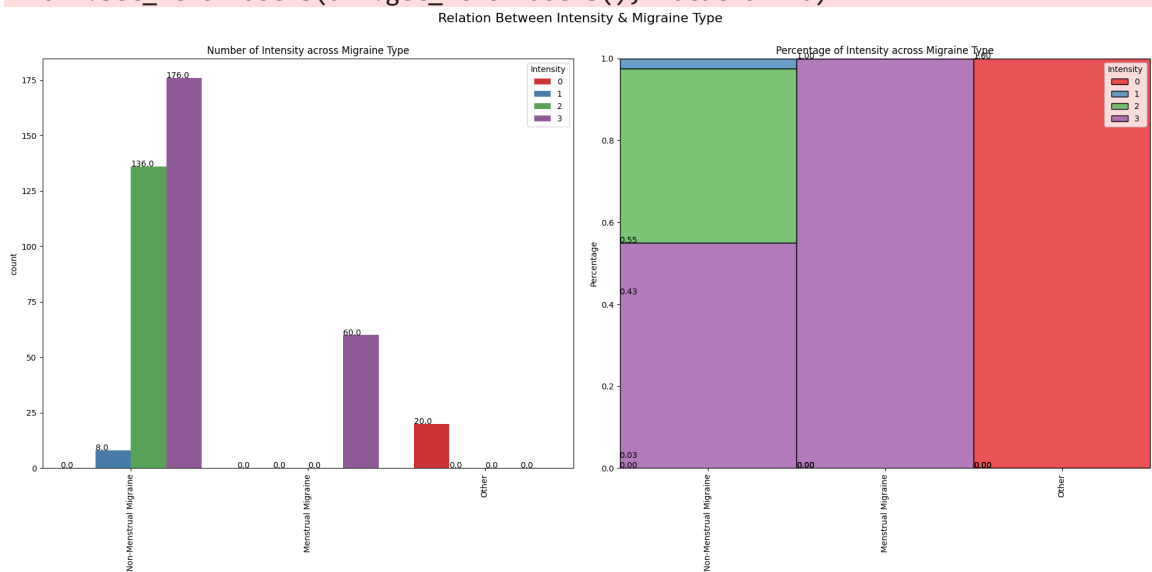
C:\Users\bokad\AppData\Local\Temp\ipykernel_43416\1632486721.py:16: UserWarning: FixedFormatter should only be used together with FixedLocator
ax2.set_xticklabels(ax1.get_xticklabels(), rotation=90)



Intensity and Type

```
In [ ]: count_percentage_plot(df, 'Intensity', 'Type', "Relation Between Intensity & Mig
```

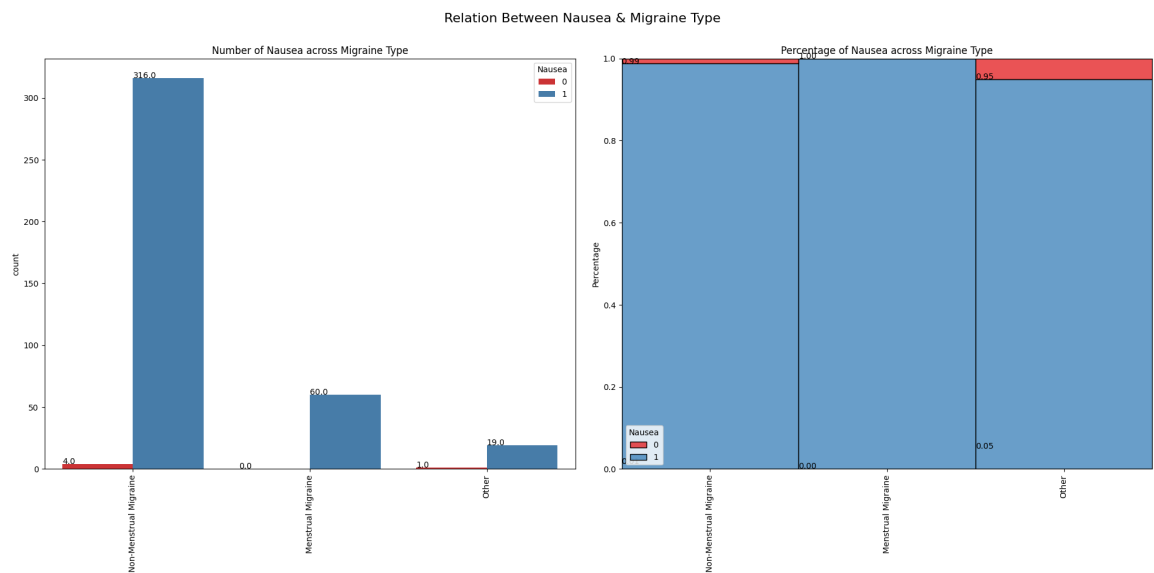
C:\Users\bokad\AppData\Local\Temp\ipykernel_43416\1632486721.py:16: UserWarning: FixedFormatter should only be used together with FixedLocator
 ax2.set_xticklabels(ax1.get_xticklabels(), rotation=90)



Nausea and Type

```
In [ ]: count_percentage_plot(df, 'Nausea', 'Type', "Relation Between Nausea & Migraine
```

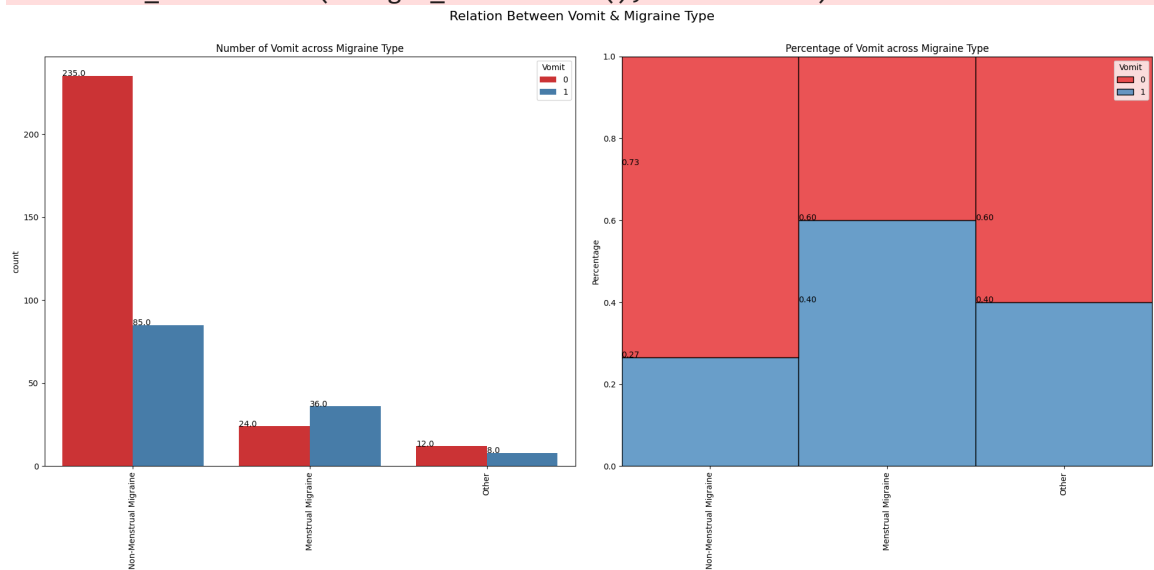
C:\Users\bokad\AppData\Local\Temp\ipykernel_43416\1632486721.py:16: UserWarning: FixedFormatter should only be used together with FixedLocator
 ax2.set_xticklabels(ax1.get_xticklabels(), rotation=90)



Vomit and Type

```
In [ ]: count_percentage_plot(df, 'Vomit', 'Type', "Relation Between Vomit & Migraine Ty
```

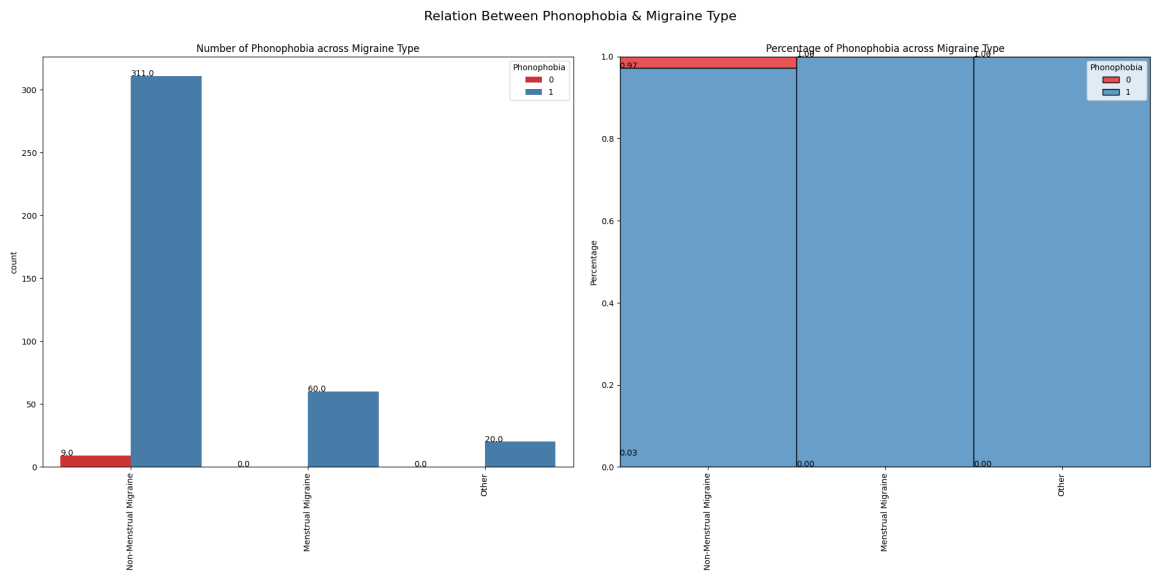
C:\Users\bokad\AppData\Local\Temp\ipykernel_43416\1632486721.py:16: UserWarning: FixedFormatter should only be used together with FixedLocator
 ax2.set_xticklabels(ax1.get_xticklabels(), rotation=90)



Phonophobia and Type

```
In [ ]: count_percentage_plot(df, 'Phonophobia', 'Type', "Relation Between Phonophobia &
```

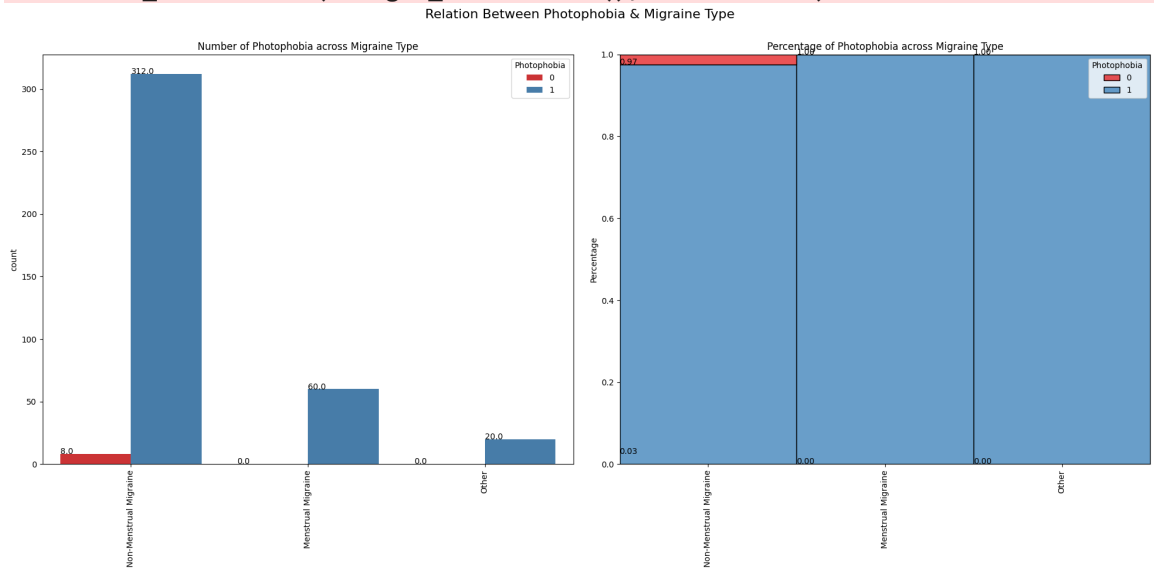
C:\Users\bokad\AppData\Local\Temp\ipykernel_43416\1632486721.py:16: UserWarning: FixedFormatter should only be used together with FixedLocator
 ax2.set_xticklabels(ax1.get_xticklabels(), rotation=90)



Photophobia and Type

```
In [ ]: count_percentage_plot(df, 'Photophobia', 'Type', "Relation Between Photophobia & Migraine Type")
```

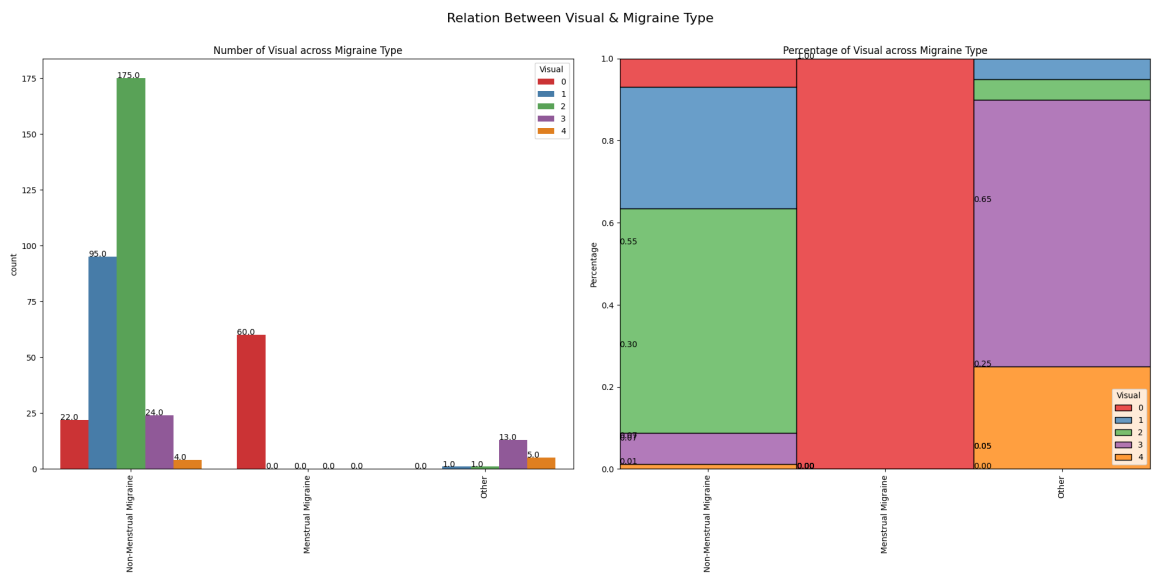
C:\Users\bokad\AppData\Local\Temp\ipykernel_43416\1632486721.py:16: UserWarning: FixedFormatter should only be used together with FixedLocator
ax2.set_xticklabels(ax1.get_xticklabels(), rotation=90)



Visual and Type

```
In [ ]: count_percentage_plot(df, 'Visual', 'Type', "Relation Between Visual & Migraine Type")
```

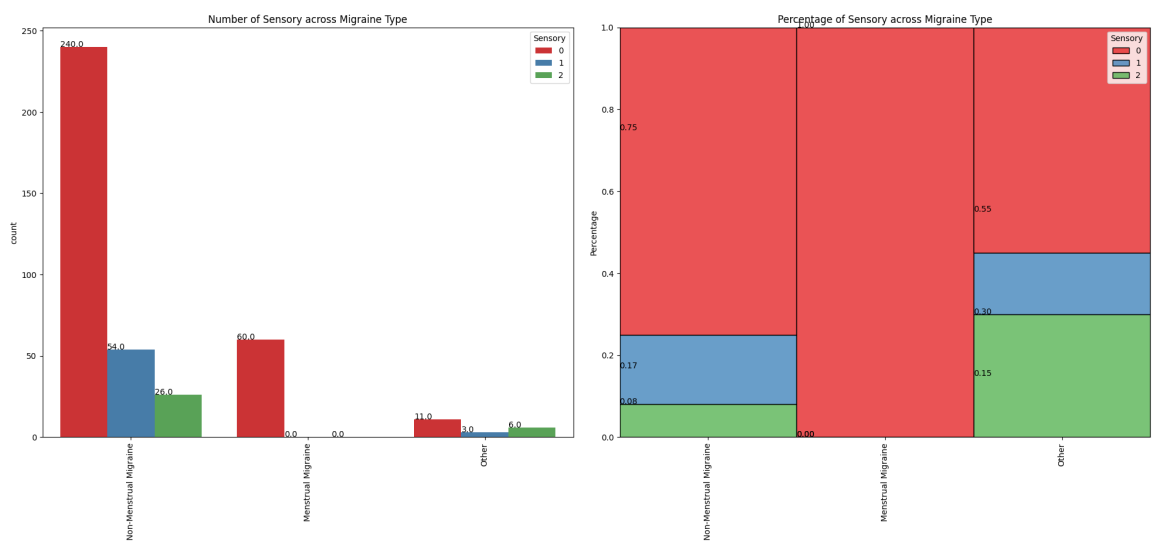
C:\Users\bokad\AppData\Local\Temp\ipykernel_43416\1632486721.py:16: UserWarning: FixedFormatter should only be used together with FixedLocator
ax2.set_xticklabels(ax1.get_xticklabels(), rotation=90)



Sensory and Type

```
In [ ]: count_percentage_plot(df, 'Sensory', 'Type', "Relation Between Sensory & Migraine Type")
```

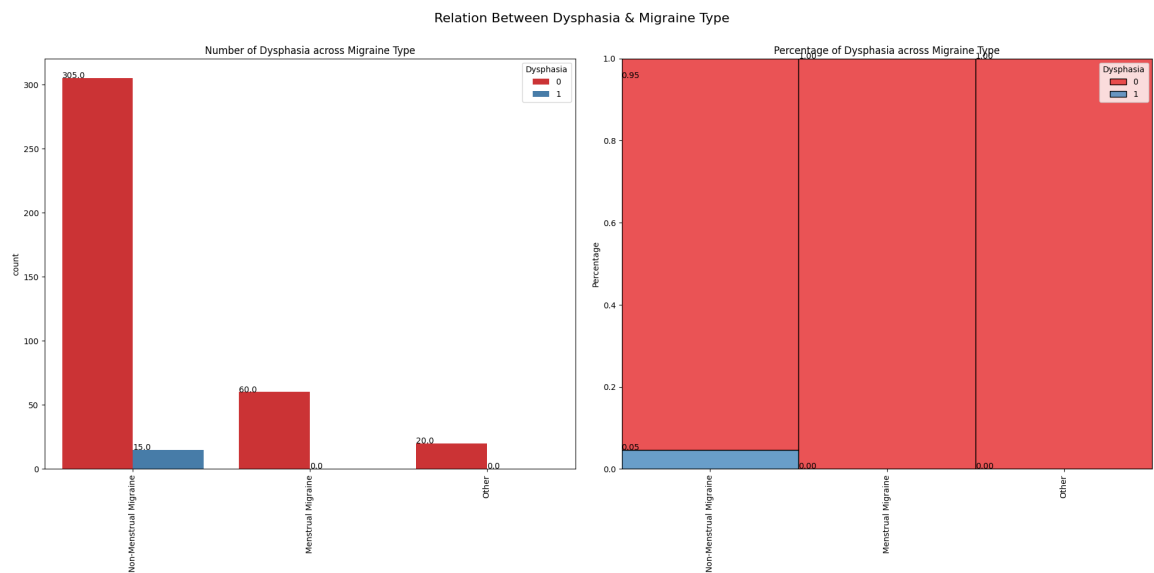
C:\Users\bokad\AppData\Local\Temp\ipykernel_43416\1632486721.py:16: UserWarning: FixedFormatter should only be used together with FixedLocator
 ax2.set_xticklabels(ax1.get_xticklabels(), rotation=90)



Dysphasia and Type

```
In [ ]: count_percentage_plot(df, 'Dysphasia', 'Type', "Relation Between Dysphasia & Migraine Type")
```

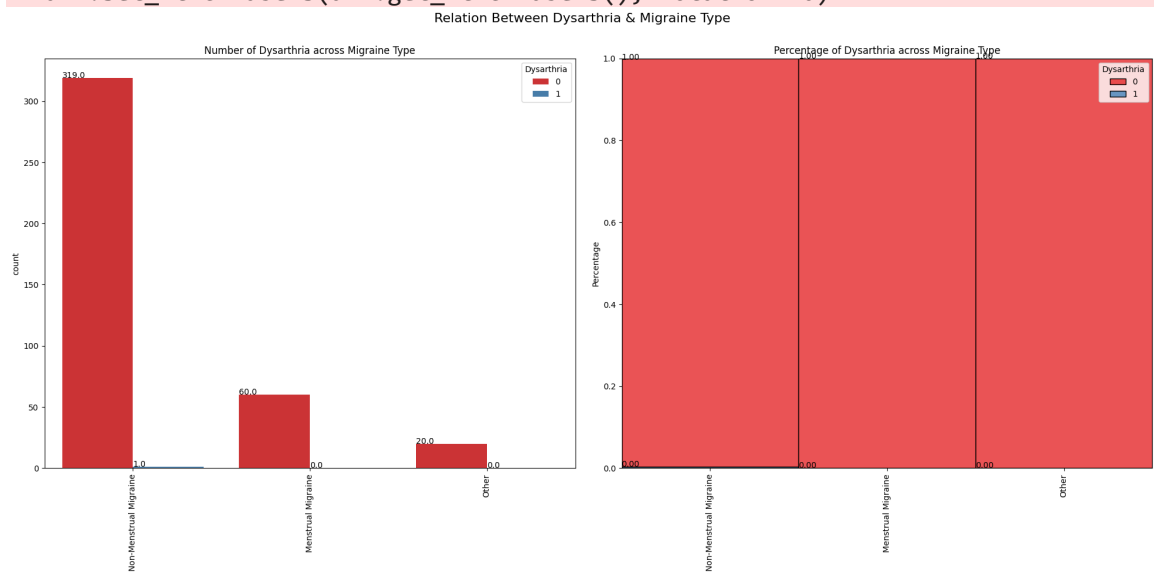
C:\Users\bokad\AppData\Local\Temp\ipykernel_43416\1632486721.py:16: UserWarning: FixedFormatter should only be used together with FixedLocator
 ax2.set_xticklabels(ax1.get_xticklabels(), rotation=90)



Dysarthria and Type

```
In [ ]: count_percentage_plot(df, 'Dysarthria', 'Type', "Relation Between Dysarthria & Migraine Type")
```

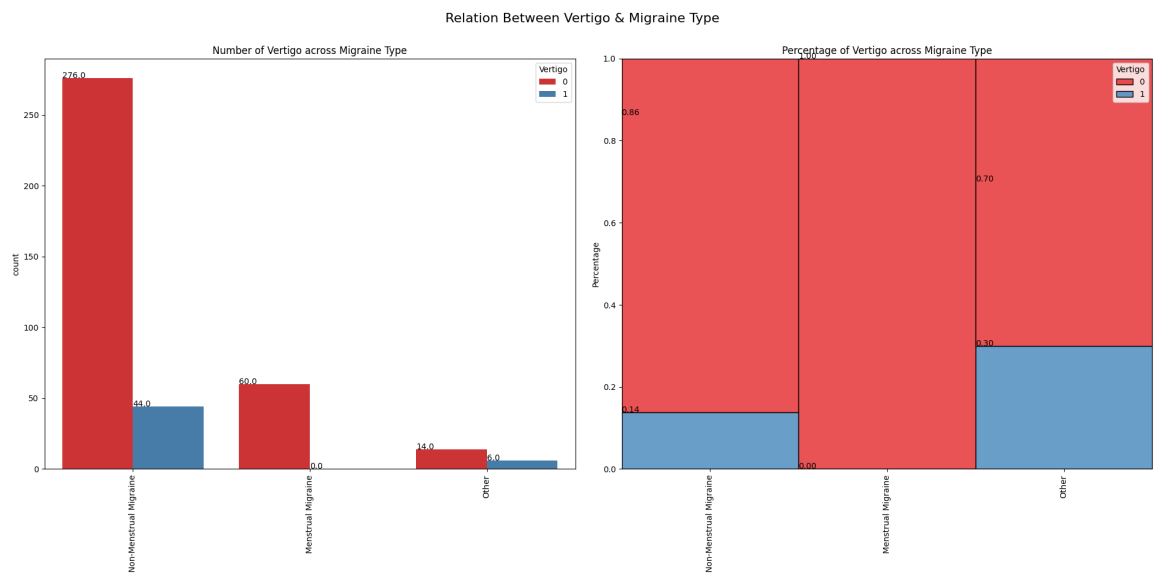
C:\Users\bokad\AppData\Local\Temp\ipykernel_43416\1632486721.py:16: UserWarning: FixedFormatter should only be used together with FixedLocator
ax2.set_xticklabels(ax1.get_xticklabels(), rotation=90)



Vertigo and Type

```
In [ ]: count_percentage_plot(df, 'Vertigo', 'Type', "Relation Between Vertigo & Migraine Type")
```

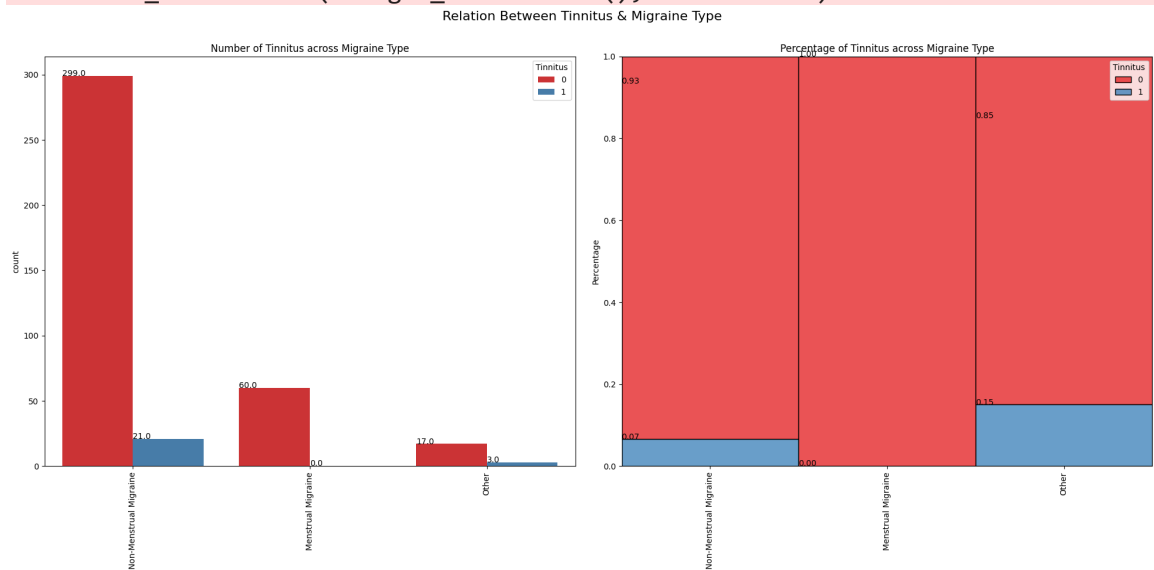
C:\Users\bokad\AppData\Local\Temp\ipykernel_43416\1632486721.py:16: UserWarning: FixedFormatter should only be used together with FixedLocator
ax2.set_xticklabels(ax1.get_xticklabels(), rotation=90)



Tinnitus and Type

```
In [ ]: count_percentage_plot(df, 'Tinnitus', 'Type', "Relation Between Tinnitus & Migraine Type")
```

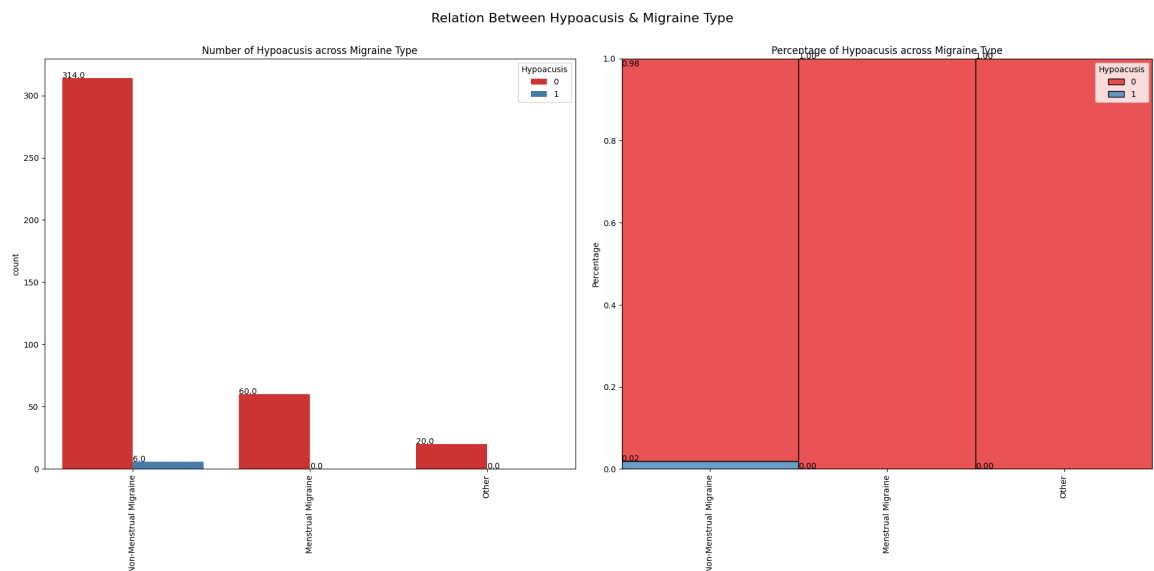
C:\Users\bokad\AppData\Local\Temp\ipykernel_43416\1632486721.py:16: UserWarning: FixedFormatter should only be used together with FixedLocator
ax2.set_xticklabels(ax1.get_xticklabels(), rotation=90)



Hypoacusis and Type

```
In [ ]: count_percentage_plot(df, 'Hypoacusis', 'Type', "Relation Between Hypoacusis & Migraine Type")
```

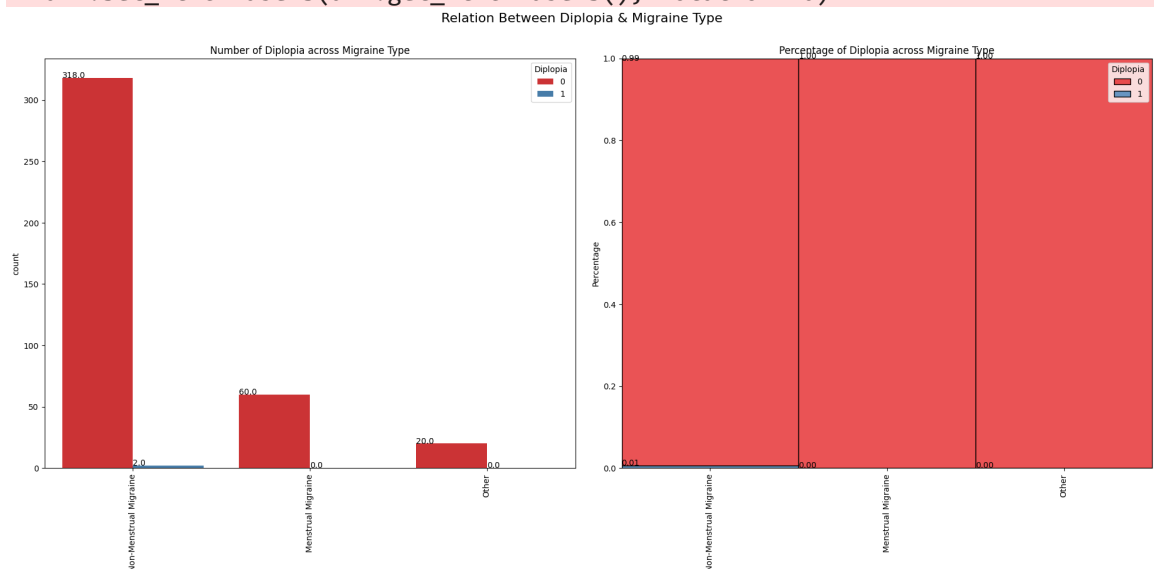
C:\Users\bokad\AppData\Local\Temp\ipykernel_43416\1632486721.py:16: UserWarning: FixedFormatter should only be used together with FixedLocator
ax2.set_xticklabels(ax1.get_xticklabels(), rotation=90)



Diplopia and Type

```
In [ ]: count_percentage_plot(df, 'Diplopia', 'Type', "Relation Between Diplopia & Migraine Type")
```

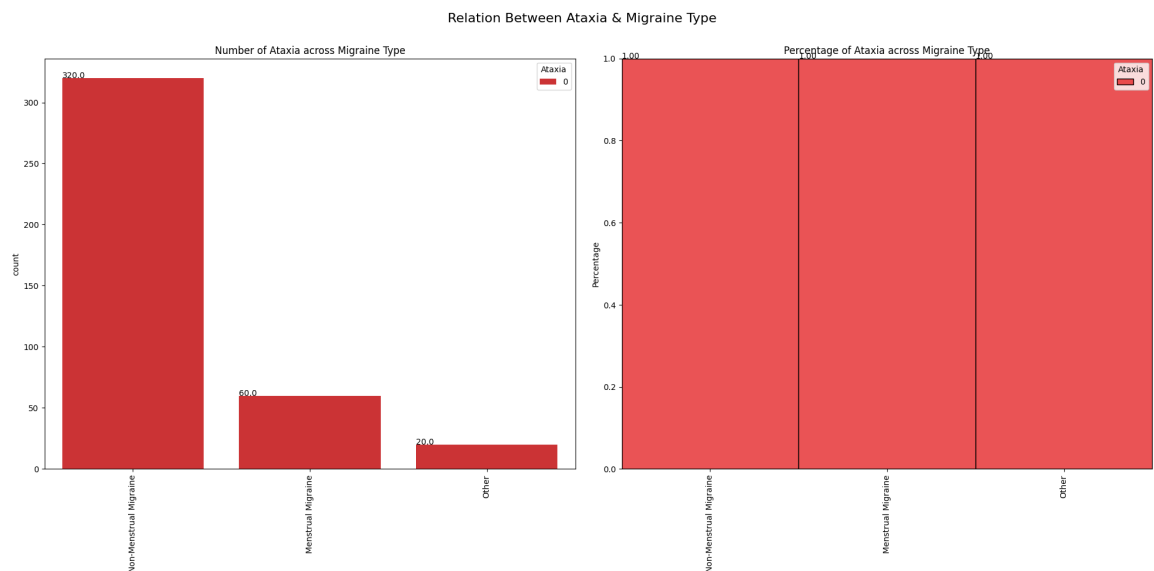
C:\Users\bokad\AppData\Local\Temp\ipykernel_43416\1632486721.py:16: UserWarning: FixedFormatter should only be used together with FixedLocator
ax2.set_xticklabels(ax1.get_xticklabels(), rotation=90)



Ataxia and Type

```
In [ ]: count_percentage_plot(df, 'Ataxia', 'Type', "Relation Between Ataxia & Migraine Type")
```

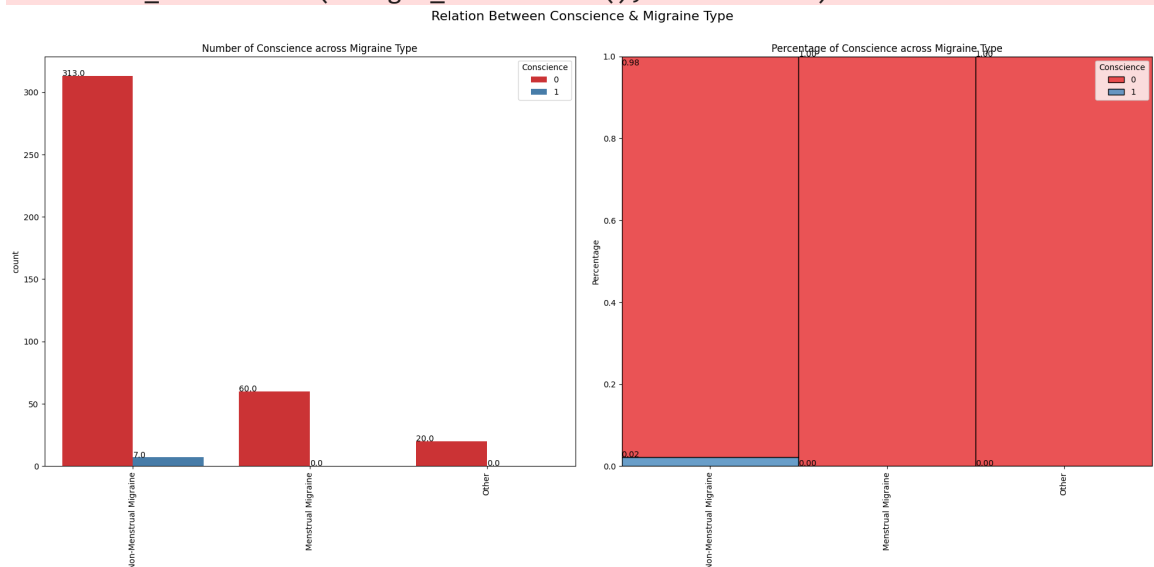
C:\Users\bokad\AppData\Local\Temp\ipykernel_43416\1632486721.py:16: UserWarning: FixedFormatter should only be used together with FixedLocator
ax2.set_xticklabels(ax1.get_xticklabels(), rotation=90)



Conscience and Type

```
In [ ]: count_percentage_plot(df, 'Conscience', 'Type', "Relation Between Conscience & Migraine Type")
```

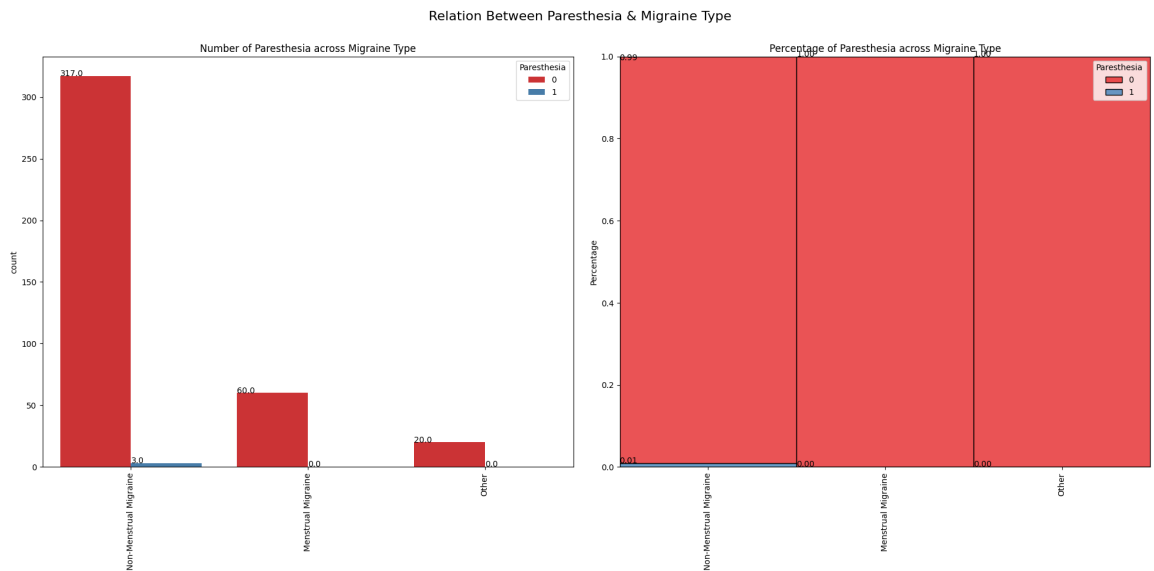
C:\Users\bokad\AppData\Local\Temp\ipykernel_43416\1632486721.py:16: UserWarning: FixedFormatter should only be used together with FixedLocator
 ax2.set_xticklabels(ax1.get_xticklabels(), rotation=90)



Paresthesia and Type

```
In [ ]: count_percentage_plot(df, 'Paresthesia', 'Type', "Relation Between Paresthesia & Migraine Type")
```

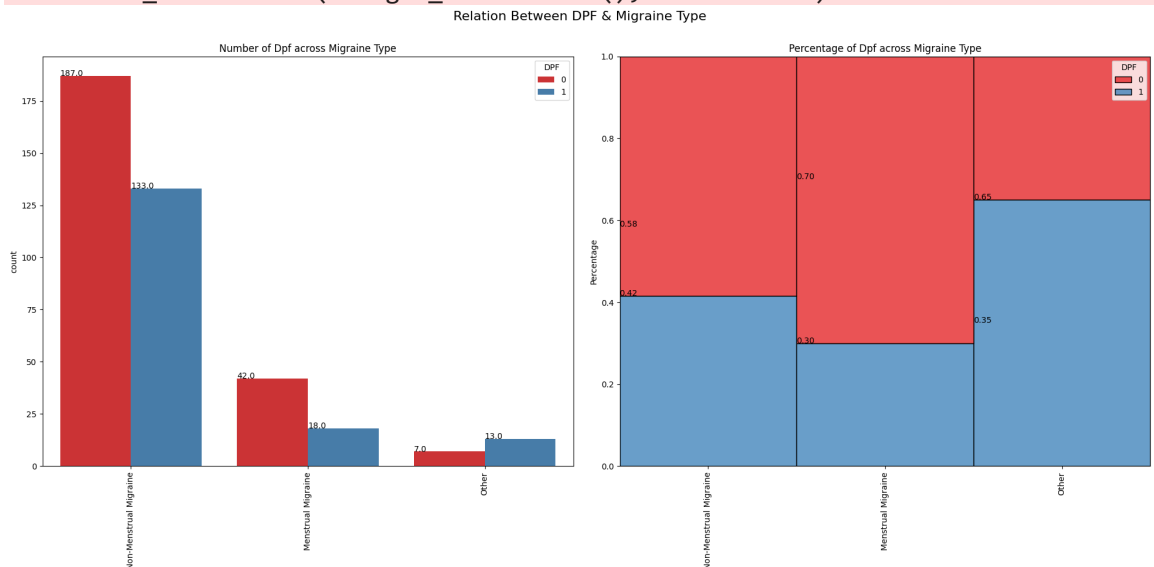
C:\Users\bokad\AppData\Local\Temp\ipykernel_43416\1632486721.py:16: UserWarning: FixedFormatter should only be used together with FixedLocator
 ax2.set_xticklabels(ax1.get_xticklabels(), rotation=90)



DPF and Type

```
In [ ]: count_percentage_plot(df, 'DPF', 'Type', "Relation Between DPF & Migraine Type")
```

C:\Users\bokad\AppData\Local\Temp\ipykernel_43416\1632486721.py:16: UserWarning: FixedFormatter should only be used together with FixedLocator
 ax2.set_xticklabels(ax1.get_xticklabels(), rotation=90)



___Relation Between Continous Variable and Target___

Distribution of Age

```
In [ ]: from matplotlib.pyplot import colorbar

def dist_summary(df,col,title,color="purple"):
    fig,ax = plt.subplots(3,1, figsize=(15,8),sharex=True)
    # Histogram plot
    sns.histplot(df[col], kde=True, ax=ax[0], color=color)
```

```

ax[0].set(xlabel=None)
ax[0].set_title("KDE Plot")

# Box Plot
sns.boxplot(df[col], ax=ax[1], color=color)
ax[1].set(xlabel=None)
ax[1].set_title("Box Plot")

# Violon Plot
sns.violinplot(df[col],ax=ax[2], color=color)
ax[2].set(xlabel=None)
ax[2].set_title("Violin Plot")

plt.suptitle(title, fontsize=18)
plt.tight_layout(pad=3)
plt.show()

```

```

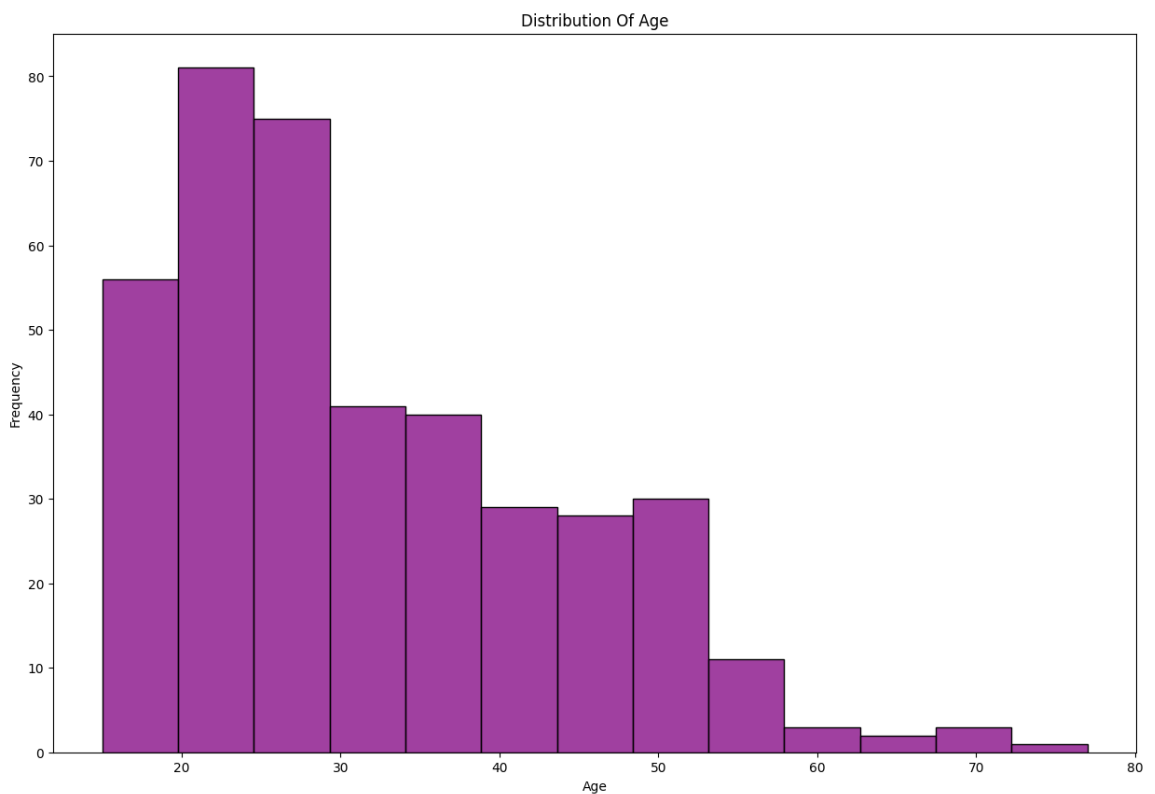
In [ ]: def hist(df,col):
        plt.figure(figsize=(15,10))
        plt.title("Distribution Of Age")
        plt.xlabel("Age")
        plt.ylabel("Frequency")
        sns.histplot(df[col], color='purple')
        plt.show()

```

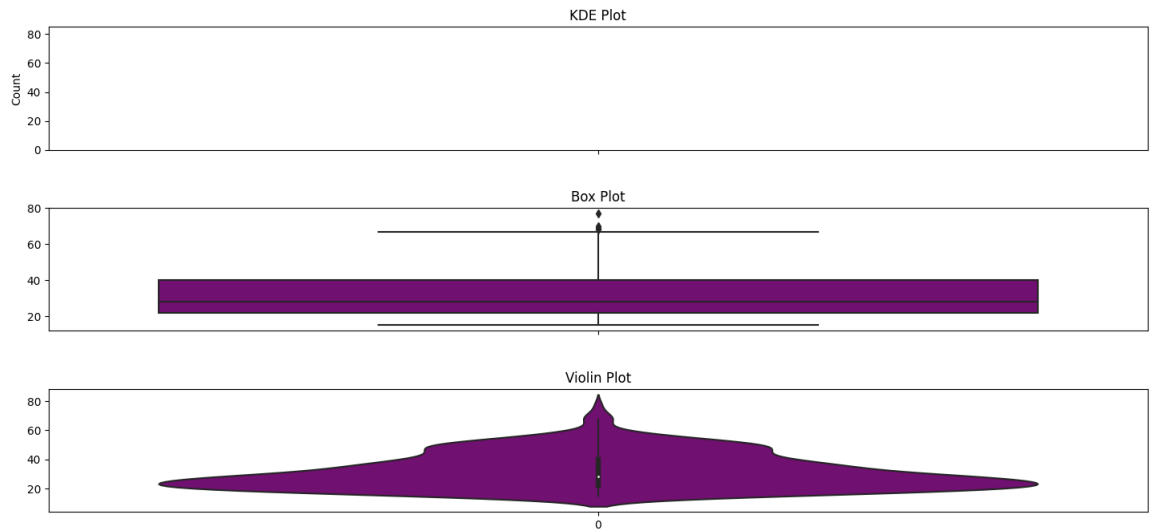
```

In [ ]: hist(df,"Age")
dist_summary(df,"Age", "Distribution Of Feature Age")

```



Distribution Of Feature Age



Label Encoding the Target Variable

```
In [ ]: # Initilize LabelEncoder object
le = LabelEncoder()

# Fit transform from the Type feature
df['Type'] = le.fit_transform(df["Type"])

# Print the head of data
df.head()
```

```
Out[ ]:
```

	Age	Duration	Frequency	Location	Character	Intensity	Nausea	Vomit	Phonophobia	PI
0	30	1	5	1	1	2	1	0	1	
1	50	3	5	1	1	3	1	1	1	
2	53	2	1	1	1	2	1	1	1	
3	45	3	5	1	1	3	1	0	1	
4	53	1	1	1	1	2	1	0	1	

5 rows × 26 columns

Train-Test Split

```
In [ ]: import pandas as pd
import numpy as np
from sklearn import metrics
```

```
In [ ]: import pandas as pd
import numpy as np
from sklearn import metrics
%pip install tensorflow
import tensorflow as tf
```

```
import numpy as np
import pandas as pd
from keras.models import Sequential
from keras.layers import Dense
from keras.wrappers.scikit_learn import KerasClassifier
from sklearn.model_selection import cross_val_score
from sklearn.model_selection import KFold
from sklearn.preprocessing import MinMaxScaler
import matplotlib.pyplot as plt
from sklearn.ensemble import RandomForestClassifier

seed = 10
np.random.seed(seed)
```


Requirement already satisfied: tensorflow in c:\users\bokad\appdata\local\packages\pythonsoftwarefoundation.python.3.10_qbz5n2kfra8p0\localcache\local-packages\python310\site-packages (2.11.0)

Requirement already satisfied: tensorflow-intel==2.11.0 in c:\users\bokad\appdata\local\packages\pythonsoftwarefoundation.python.3.10_qbz5n2kfra8p0\localcache\local-packages\python310\site-packages (from tensorflow) (2.11.0)

Requirement already satisfied: grpcio<2.0,>=1.24.3 in c:\users\bokad\appdata\local\packages\pythonsoftwarefoundation.python.3.10_qbz5n2kfra8p0\localcache\local-packages\python310\site-packages (from tensorflow-intel==2.11.0->tensorflow) (1.51.1)

Requirement already satisfied: tensorflow-io-gcs-filesystem>=0.23.1 in c:\users\bokad\appdata\local\packages\pythonsoftwarefoundation.python.3.10_qbz5n2kfra8p0\localcache\local-packages\python310\site-packages (from tensorflow-intel==2.11.0->tensorflow) (0.28.0)

Requirement already satisfied: numpy>=1.20 in c:\users\bokad\appdata\local\packages\pythonsoftwarefoundation.python.3.10_qbz5n2kfra8p0\localcache\local-packages\python310\site-packages (from tensorflow-intel==2.11.0->tensorflow) (1.23.4)

Requirement already satisfied: flatbuffers>=2.0 in c:\users\bokad\appdata\local\packages\pythonsoftwarefoundation.python.3.10_qbz5n2kfra8p0\localcache\local-packages\python310\site-packages (from tensorflow-intel==2.11.0->tensorflow) (2.11.23)

Requirement already satisfied: google-pasta>=0.1.1 in c:\users\bokad\appdata\local\packages\pythonsoftwarefoundation.python.3.10_qbz5n2kfra8p0\localcache\local-packages\python310\site-packages (from tensorflow-intel==2.11.0->tensorflow) (0.2.0)

Requirement already satisfied: typing-extensions>=3.6.6 in c:\users\bokad\appdata\local\packages\pythonsoftwarefoundation.python.3.10_qbz5n2kfra8p0\localcache\local-packages\python310\site-packages (from tensorflow-intel==2.11.0->tensorflow) (4.4.0)

Requirement already satisfied: h5py>=2.9.0 in c:\users\bokad\appdata\local\packages\pythonsoftwarefoundation.python.3.10_qbz5n2kfra8p0\localcache\local-packages\python310\site-packages (from tensorflow-intel==2.11.0->tensorflow) (3.7.0)

Requirement already satisfied: libclang>=13.0.0 in c:\users\bokad\appdata\local\packages\pythonsoftwarefoundation.python.3.10_qbz5n2kfra8p0\localcache\local-packages\python310\site-packages (from tensorflow-intel==2.11.0->tensorflow) (14.0.6)

Requirement already satisfied: setuptools in c:\program files\windowsapps\pythonsoftwarefoundation.python.3.10_3.10.2544.0_x64__qbz5n2kfra8p0\lib\site-packages (from tensorflow-intel==2.11.0->tensorflow) (65.5.0)

Requirement already satisfied: astunparse>=1.6.0 in c:\users\bokad\appdata\local\packages\pythonsoftwarefoundation.python.3.10_qbz5n2kfra8p0\localcache\local-packages\python310\site-packages (from tensorflow-intel==2.11.0->tensorflow) (1.6.3)

Requirement already satisfied: six>=1.12.0 in c:\users\bokad\appdata\local\packages\pythonsoftwarefoundation.python.3.10_qbz5n2kfra8p0\localcache\local-packages\python310\site-packages (from tensorflow-intel==2.11.0->tensorflow) (1.16.0)

Requirement already satisfied: protobuf<3.20,>=3.9.2 in c:\users\bokad\appdata\local\packages\pythonsoftwarefoundation.python.3.10_qbz5n2kfra8p0\localcache\local-packages\python310\site-packages (from tensorflow-intel==2.11.0->tensorflow) (3.19.6)

Requirement already satisfied: tensorboard<2.12,>=2.11 in c:\users\bokad\appdata\local\packages\pythonsoftwarefoundation.python.3.10_qbz5n2kfra8p0\localcache\local-packages\python310\site-packages (from tensorflow-intel==2.11.0->tensorflow) (2.11.0)

Requirement already satisfied: opt-einsum>=2.3.2 in c:\users\bokad\appdata\local\packages\pythonsoftwarefoundation.python.3.10_qbz5n2kfra8p0\localcache\local-packages\python310\site-packages (from tensorflow-intel==2.11.0->tensorflow) (3.3.0)

Requirement already satisfied: packaging in c:\users\bokad\appdata\local\packages\pythonsoftwarefoundation.python.3.10_qbz5n2kfra8p0\localcache\local-packages

\python310\site-packages (from tensorflow-intel==2.11.0->tensorflow) (21.3)
Requirement already satisfied: tensorflow-estimator<2.12,>=2.11.0 in c:\users\bokad\appdata\local\packages\pythonsoftwarefoundation.python.3.10_qbz5n2kfra8p0\localcache\local-packages\python310\site-packages (from tensorflow-intel==2.11.0->tensorflow) (2.11.0)
Requirement already satisfied: wrapt>=1.11.0 in c:\users\bokad\appdata\local\packages\pythonsoftwarefoundation.python.3.10_qbz5n2kfra8p0\localcache\local-packages\python310\site-packages (from tensorflow-intel==2.11.0->tensorflow) (1.14.1)
Requirement already satisfied: keras<2.12,>=2.11.0 in c:\users\bokad\appdata\local\packages\pythonsoftwarefoundation.python.3.10_qbz5n2kfra8p0\localcache\local-packages\python310\site-packages (from tensorflow-intel==2.11.0->tensorflow) (2.11.0)
Requirement already satisfied: termcolor>=1.1.0 in c:\users\bokad\appdata\local\packages\pythonsoftwarefoundation.python.3.10_qbz5n2kfra8p0\localcache\local-packages\python310\site-packages (from tensorflow-intel==2.11.0->tensorflow) (2.1.1)
Requirement already satisfied: absl-py>=1.0.0 in c:\users\bokad\appdata\local\packages\pythonsoftwarefoundation.python.3.10_qbz5n2kfra8p0\localcache\local-packages\python310\site-packages (from tensorflow-intel==2.11.0->tensorflow) (1.3.0)
Requirement already satisfied: gast<=0.4.0,>=0.2.1 in c:\users\bokad\appdata\local\packages\pythonsoftwarefoundation.python.3.10_qbz5n2kfra8p0\localcache\local-packages\python310\site-packages (from tensorflow-intel==2.11.0->tensorflow) (0.4.0)
Requirement already satisfied: wheel<1.0,>=0.23.0 in c:\users\bokad\appdata\local\packages\pythonsoftwarefoundation.python.3.10_qbz5n2kfra8p0\localcache\local-packages\python310\site-packages (from astunparse>=1.6.0->tensorflow-intel==2.11.0->tensorflow) (0.38.4)
Requirement already satisfied: google-auth<3,>=1.6.3 in c:\users\bokad\appdata\local\packages\pythonsoftwarefoundation.python.3.10_qbz5n2kfra8p0\localcache\local-packages\python310\site-packages (from tensorboard<2.12,>=2.11->tensorflow-intel==2.11.0->tensorflow) (2.15.0)
Requirement already satisfied: tensorboard-data-server<0.7.0,>=0.6.0 in c:\users\bokad\appdata\local\packages\pythonsoftwarefoundation.python.3.10_qbz5n2kfra8p0\localcache\local-packages\python310\site-packages (from tensorboard<2.12,>=2.11->tensorflow-intel==2.11.0->tensorflow) (0.6.1)
Requirement already satisfied: markdown>=2.6.8 in c:\users\bokad\appdata\local\packages\pythonsoftwarefoundation.python.3.10_qbz5n2kfra8p0\localcache\local-packages\python310\site-packages (from tensorboard<2.12,>=2.11->tensorflow-intel==2.11.0->tensorflow) (3.4.1)
Requirement already satisfied: requests<3,>=2.21.0 in c:\users\bokad\appdata\local\packages\pythonsoftwarefoundation.python.3.10_qbz5n2kfra8p0\localcache\local-packages\python310\site-packages (from tensorboard<2.12,>=2.11->tensorflow-intel==2.11.0->tensorflow) (2.28.1)
Requirement already satisfied: tensorboard-plugin-wit>=1.6.0 in c:\users\bokad\appdata\local\packages\pythonsoftwarefoundation.python.3.10_qbz5n2kfra8p0\localcache\local-packages\python310\site-packages (from tensorboard<2.12,>=2.11->tensorflow-intel==2.11.0->tensorflow) (1.8.1)
Requirement already satisfied: werkzeug>=1.0.1 in c:\users\bokad\appdata\local\packages\pythonsoftwarefoundation.python.3.10_qbz5n2kfra8p0\localcache\local-packages\python310\site-packages (from tensorboard<2.12,>=2.11->tensorflow-intel==2.11.0->tensorflow) (2.2.2)
Requirement already satisfied: google-auth-oauthlib<0.5,>=0.4.1 in c:\users\bokad\appdata\local\packages\pythonsoftwarefoundation.python.3.10_qbz5n2kfra8p0\localcache\local-packages\python310\site-packages (from tensorboard<2.12,>=2.11->tensorflow-intel==2.11.0->tensorflow) (0.4.6)
Requirement already satisfied: pyparsing!=3.0.5,>=2.0.2 in c:\users\bokad\appdata\local\packages\pythonsoftwarefoundation.python.3.10_qbz5n2kfra8p0\localcache\local-packages\python310\site-packages (from packaging->tensorflow-intel==2.1

```

1.0->tensorflow) (3.0.9)
Requirement already satisfied: pyasn1-modules>=0.2.1 in c:\users\bokad\appdata\local\packages\pythonsoftwarefoundation.python.3.10_qbz5n2kfra8p0\localcache\local-packages\python310\site-packages (from google-auth<3,>=1.6.3->tensorboard<2.12,>=2.11->tensorflow-intel==2.11.0->tensorflow) (0.2.8)
Requirement already satisfied: cachetools<6.0,>=2.0.0 in c:\users\bokad\appdata\local\packages\pythonsoftwarefoundation.python.3.10_qbz5n2kfra8p0\localcache\local-packages\python310\site-packages (from google-auth<3,>=1.6.3->tensorboard<2.12,>=2.11->tensorflow-intel==2.11.0->tensorflow) (5.2.0)
Requirement already satisfied: rsa<5,>=3.1.4 in c:\users\bokad\appdata\local\packages\pythonsoftwarefoundation.python.3.10_qbz5n2kfra8p0\localcache\local-packages\python310\site-packages (from google-auth<3,>=1.6.3->tensorboard<2.12,>=2.11->tensorflow-intel==2.11.0->tensorflow) (4.9)
Requirement already satisfied: requests-oauthlib>=0.7.0 in c:\users\bokad\appdata\local\packages\pythonsoftwarefoundation.python.3.10_qbz5n2kfra8p0\localcache\local-packages\python310\site-packages (from google-auth-oauthlib<0.5,>=0.4.1->tensorboard<2.12,>=2.11->tensorflow-intel==2.11.0->tensorflow) (1.3.1)
Requirement already satisfied: certifi>=2017.4.17 in c:\users\bokad\appdata\local\packages\pythonsoftwarefoundation.python.3.10_qbz5n2kfra8p0\localcache\local-packages\python310\site-packages (from requests<3,>=2.21.0->tensorboard<2.12,>=2.11->tensorflow-intel==2.11.0->tensorflow) (2022.9.24)
Requirement already satisfied: urllib3<1.27,>=1.21.1 in c:\users\bokad\appdata\local\packages\pythonsoftwarefoundation.python.3.10_qbz5n2kfra8p0\localcache\local-packages\python310\site-packages (from requests<3,>=2.21.0->tensorboard<2.12,>=2.11->tensorflow-intel==2.11.0->tensorflow) (1.26.13)
Requirement already satisfied: charset-normalizer<3,>=2 in c:\users\bokad\appdata\local\packages\pythonsoftwarefoundation.python.3.10_qbz5n2kfra8p0\localcache\local-packages\python310\site-packages (from requests<3,>=2.21.0->tensorboard<2.12,>=2.11->tensorflow-intel==2.11.0->tensorflow) (2.1.1)
Requirement already satisfied: idna<4,>=2.5 in c:\users\bokad\appdata\local\packages\pythonsoftwarefoundation.python.3.10_qbz5n2kfra8p0\localcache\local-packages\python310\site-packages (from requests<3,>=2.21.0->tensorboard<2.12,>=2.11->tensorflow-intel==2.11.0->tensorflow) (3.4)
Requirement already satisfied: MarkupSafe>=2.1.1 in c:\users\bokad\appdata\local\packages\pythonsoftwarefoundation.python.3.10_qbz5n2kfra8p0\localcache\local-packages\python310\site-packages (from werkzeug>=1.0.1->tensorboard<2.12,>=2.11->tensorflow-intel==2.11.0->tensorflow) (2.1.1)
Requirement already satisfied: pyasn1<0.5.0,>=0.4.6 in c:\users\bokad\appdata\local\packages\pythonsoftwarefoundation.python.3.10_qbz5n2kfra8p0\localcache\local-packages\python310\site-packages (from pyasn1-modules>=0.2.1->google-auth<3,>=1.6.3->tensorboard<2.12,>=2.11->tensorflow-intel==2.11.0->tensorflow) (0.4.8)
Requirement already satisfied: oauthlib>=3.0.0 in c:\users\bokad\appdata\local\packages\pythonsoftwarefoundation.python.3.10_qbz5n2kfra8p0\localcache\local-packages\python310\site-packages (from requests-oauthlib>=0.7.0->google-auth-oauthlib<0.5,>=0.4.1->tensorboard<2.12,>=2.11->tensorflow-intel==2.11.0->tensorflow) (3.2.2)
Note: you may need to restart the kernel to use updated packages.

```

```
In [ ]: import keras
```

```
In [ ]: # importing libraries and modules...
from keras.models import Sequential
from keras.layers import Dense
```

```
In [ ]: #Defining our Base Model
def baseline_model():
    # Create model here
    model = Sequential()
    model.add(Dense(14, input_dim = 24, activation = 'relu')) # Rectified Linear
```

```

model.add(Dense(14, activation = 'relu'))
model.add(Dense(3, activation = 'softmax')) # Softmax for multi-class classi
# Compile model here
model.compile(loss = 'categorical_crossentropy', optimizer = 'adam', metrics
return model

```

```

In [ ]: #Create Keras Classifier to use predefined base model
estimator = KerasClassifier(build_fn = baseline_model, epochs = 100, batch_size

```

C:\Users\bokad\AppData\Local\Temp\ipykernel_43416\1017261305.py:2: DeprecationWarning: KerasClassifier is deprecated, use Sci-Keras (<https://github.com/adrian-gb/scikeras>) instead. See <https://www.adriangb.com/scikeras/stable/migration.html> for help migrating.

```

estimator = KerasClassifier(build_fn = baseline_model, epochs = 100, batch_size = 10, verbose = 0)

```

```

In [ ]: estimator.fit(x, y, batch_size=32, epochs=50)

```

```

Out[ ]: <keras.callbacks.History at 0x2ad9564b6d0>

```

```

In [ ]: # KFold Cross Validation
kfold = KFold(n_splits = 5, shuffle = True, random_state = seed)

```

```

In [ ]: # Object to describe the result
results = cross_val_score(estimator, x, y, cv = kfold)
# Result
print("Result: %.2f%% (%.2f%%)" % (results.mean()*100, results.std()*100))

Result: 99.50% (0.61%)

```

```

In [ ]: #Testing with a Random Input
a = np.array([[53,1,3,1,1,2,1,1,1,0,0,0,0,0,0,1,0,1,0,0,0,0,1,0]])
b = pd.Series(['Migraine without aura'])
#a.reshape(1, -1)

```

```

In [ ]: y_pred = estimator.predict(a) #prediction

1/1 [=====] - 0s 32ms/step

```

```

In [ ]: print(y_pred)

[0]

```

```

In [ ]: #Testing with a Random Input
c = np.array([[46,1,5,1,1,3,1,1,1,1,0,0,0,0,0,0,0,0,0,0,0,0,1,1]])
d = pd.Series(['Migraine without aura'])

```

```

In [ ]: y_pred = estimator.predict(c)
print(y_pred)

1/1 [=====] - 0s 48ms/step
[1]

```