EEG collection for epileptic seizure detection and classification using ML models

evaluating and comparing baseline model(Logistic Regression) and advanced model (Neural network)

importing CSV file dataset as a dataframe.

```
import pandas as pd
df = pd.read_csv("BEED_Data[1].csv")
print(df.head())
```

```
     X1   X2   X3   X4   X5   X6  X7  X8  X9  X10  X11  X12  X13  X14  X15  \
0    4    7   18   25   28   27  20  10 -10  -18  -20  -16   13   32   12
1   87  114  120  106   76   54  28   5 -19  -49  -85 -102 -100  -89  -61
2 -131 -133 -140 -131 -123 -108 -58 -51 -70  -77  -76  -76  -73  -57  -40
3   68  104   73   34  -12  -26 -38 -36 -67  -88  -25   31   18   -4    6
4  -67  -90  -97  -94  -86  -71 -43 -11  23   46   58   50   39   19   -9

   X16  y
0   10  0
1  -21  0
2  -14  0
3  -29  0
4  -41  0
```

dividing the dataset into features and label

```
from sklearn.model_selection import train_test_split
x = df.drop(columns = "y")
y = df["y"]
```

further dividing the features and label into training and test dataset

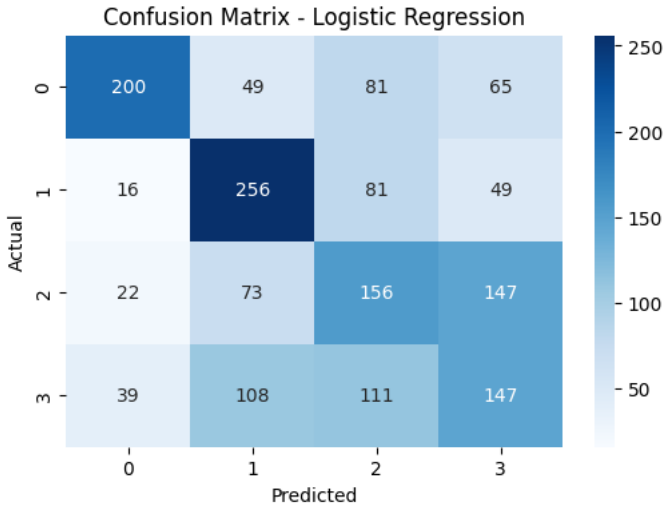
```
from sklearn.preprocessing import StandardScaler
scaler = StandardScaler()
x_scaled = scaler.fit_transform(x)
x_train, x_test, y_train, y_test = train_test_split(x_scaled, y, test_size=0.2)
```

base-line model: **Logistic Regression**

```
from sklearn.metrics import classification_report
from sklearn.linear_model import LogisticRegression
lgr_model = LogisticRegression()
lgr_model.fit(x_train, y_train)
y_pred_lgr = lgr_model.predict(x_test)
print(classification_report(y_test, y_pred_lgr))
```

```
              precision    recall  f1-score   support

           0       0.72      0.51      0.60       395
           1       0.53      0.64      0.58       402
           2       0.36      0.39      0.38       398
           3       0.36      0.36      0.36       405

    accuracy                           0.47      1600
   macro avg       0.49      0.47      0.48      1600
weighted avg       0.49      0.47      0.48      1600
```

```
from sklearn.metrics import confusion_matrix
import seaborn as sns
import matplotlib.pyplot as plt

cm = confusion_matrix(y_test, y_pred_lgr)
plt.figure(figsize=(6,4))
sns.heatmap(cm, annot=True, fmt='d', cmap='Blues')
plt.xlabel("Predicted")
plt.ylabel("Actual")
plt.title("Confusion Matrix - Logistic Regression")
plt.show()
```




```
from sklearn.metrics import accuracy_score
acc = accuracy_score(y_test, y_pred_lgr)
print("Logistic Regression Accuracy:", acc)
```

```
Logistic Regression Accuracy: 0.474375
```

best performing model: **Neural Network**

```
import tensorflow as tf
```

```
early_stop = tf.keras.callbacks.EarlyStopping(monitor='val_loss', patience=10, restore_best_weights=True, mode='min')
```

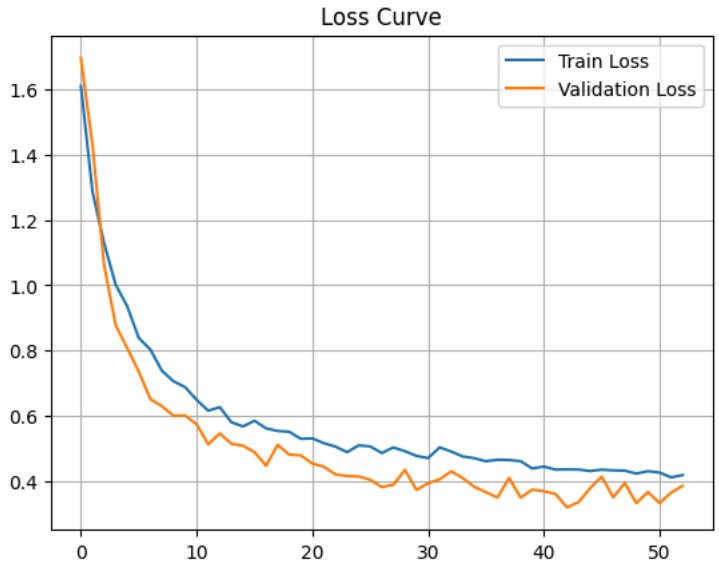
```
nn_model = tf.keras.Sequential([
    tf.keras.layers.Dense(512, kernel_regularizer=tf.keras.regularizers.l2(0.001)),
    tf.keras.layers.BatchNormalization(),
    tf.keras.layers.LeakyReLU(negative_slope=0.01),
    tf.keras.layers.Dense(256, kernel_regularizer=tf.keras.regularizers.l2(0.001)),
    tf.keras.layers.BatchNormalization(),
    tf.keras.layers.LeakyReLU(negative_slope=0.01),
    tf.keras.layers.Dense(128, kernel_regularizer=tf.keras.regularizers.l2(0.001)),
    tf.keras.layers.BatchNormalization(),
    tf.keras.layers.LeakyReLU(negative_slope=0.01),
    tf.keras.layers.Dense(64, kernel_regularizer=tf.keras.regularizers.l2(0.001)),
    tf.keras.layers.BatchNormalization(),
    tf.keras.layers.LeakyReLU(negative_slope=0.01),
    # tf.keras.layers.Activation('relu'),
    tf.keras.layers.Dropout(0.2),
    tf.keras.layers.Dense(32, kernel_regularizer=tf.keras.regularizers.l2(0.001)),
    tf.keras.layers.BatchNormalization(),
    # tf.keras.layers.LeakyReLU(negative_slope=0.01),
    tf.keras.layers.Activation('relu'),
    tf.keras.layers.Dropout(0.2),
    tf.keras.layers.Dense(16, kernel_regularizer=tf.keras.regularizers.l2(0.001)),
    tf.keras.layers.BatchNormalization(),
    tf.keras.layers.Activation('relu'),
    tf.keras.layers.Dropout(0.2),
    tf.keras.layers.Dense(4, activation='softmax'),
])
nn_model.compile(optimizer = tf.keras.optimizers.Adam(learning_rate=0.001), loss='sparse_categorical_crossentropy', metrics=['accuracy'])
history = nn_model.fit(x_train, y_train, epochs=100, batch_size=32, validation_split=0.2, verbose=0, callbacks=[early_stop])
```

```
import numpy as np
y_pred_probab = nn_model.predict(x_test)
y_pred_nn = np.argmax(y_pred_probab, axis=1)
print(classification_report(y_pred_nn, y_test))
```

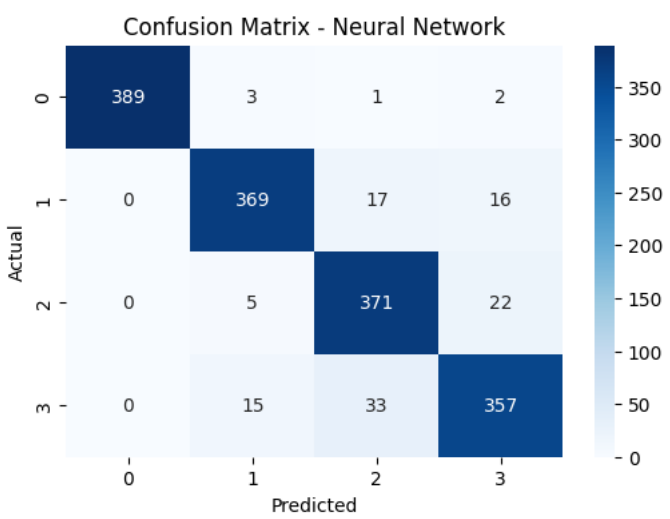
```
50/50 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step
              precision    recall  f1-score   support

           0       0.98      1.00      0.99       389
           1       0.92      0.94      0.93       392
           2       0.93      0.88      0.90       422
           3       0.88      0.90      0.89       397

    accuracy                           0.93      1600
   macro avg       0.93      0.93      0.93      1600
weighted avg       0.93      0.93      0.93      1600
```

```
import matplotlib.pyplot as plt

plt.plot(history.history['loss'], label='Train Loss')
plt.plot(history.history['val_loss'], label='Validation Loss')
plt.legend(); plt.grid(); plt.title('Loss Curve')
```

```
Text(0.5, 1.0, 'Loss Curve')
```




```
c = confusion_matrix(y_test, y_pred_nn)
plt.figure(figsize=(6,4))
sns.heatmap(c, annot=True, fmt='d', cmap='Blues')
plt.xlabel("Predicted")
plt.ylabel("Actual")
plt.title("Confusion Matrix - Neural Network")
plt.show()
```




```
acc = accuracy_score(y_test, y_pred_nn)
print("Neural Network Accuracy:", acc)
```

```
Neural Network Accuracy: 0.92875
```