Sri Sivasubramaniya Nadar College of Engineering, Kalavakkam – 603 110
(An Autonomous Institution, Affiliated to Anna University, Chennai)

UCS2612 Machine Learning Laboratory

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Faculty In-charges: Y.V. Lokeswari VI Semester A

Assignment 7 : Predicting Diabetes using decision tree

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- **Aim:-**

To Develop a python program to predict diabetics using Decision Tree Model. Visualize the features from the dataset and interpret the results obtained by the model using Matplotlib library.

- **Code:-**

```
from sklearn.preprocessing import LabelEncoder
from sklearn.preprocessing import MinMaxScaler
import pandas as pd
from sklearn.metrics import accuracy_score
import seaborn as sns
import matplotlib.pyplot as plt
from sklearn.tree import DecisionTreeClassifier
from sklearn.model_selection import train_test_split
```

- Loading dataset

```
df = pd.read_csv('diabetes_prediction_dataset.csv')
df.head(10)
```

[3]:

	gender	age	hypertension	heart_disease	smoking_history	bmi	HbA1c_level	blood_glucose_level	diabetes
0	Female	80.0	0	1	never	25.19	6.6	140	0
1	Female	54.0	0	0	No Info	27.32	6.6	80	0
2	Male	28.0	0	0	never	27.32	5.7	158	0
3	Female	36.0	0	0	current	23.45	5.0	155	0
4	Male	76.0	1	1	current	20.14	4.8	155	0
5	Female	20.0	0	0	never	27.32	6.6	85	0
6	Female	44.0	0	0	never	19.31	6.5	200	1
7	Female	79.0	0	0	No Info	23.86	5.7	85	0
8	Male	42.0	0	0	never	33.64	4.8	145	0
9	Female	32.0	0	0	never	27.32	5.0	100	0

- Preprocessing

```
#Checking Null
any_null = df.isnull().any()
print(any_null)
```

```
gender                 False
age                    False
hypertension           False
heart_disease          False
smoking_history        False
bmi                    False
HbA1c_level            False
blood_glucose_level    False
diabetes               False
dtype: bool
```

```
#Encoding
label_encoder = LabelEncoder()
df['smoking_history'] = label_encoder.fit_transform(df['smoking_history'])
df['gender'] = label_encoder.fit_transform(df['gender'])
df.head(10)
```

	gender	age	hypertension	heart_disease	smoking_history	bmi	HbA1c_level	blood_glucose_level	diabetes
0	0	80.0	0	1	4	0.177171	0.563636	0.272727	0
1	0	54.0	0	0	0	0.202031	0.563636	0.000000	0
2	1	28.0	0	0	4	0.202031	0.400000	0.354545	0
3	0	36.0	0	0	1	0.156863	0.272727	0.340909	0
4	1	76.0	1	1	1	0.118231	0.236364	0.340909	0
5	0	20.0	0	0	4	0.202031	0.563636	0.022727	0
6	0	44.0	0	0	4	0.108543	0.545455	0.545455	1
7	0	79.0	0	0	0	0.161648	0.400000	0.022727	0
8	1	42.0	0	0	4	0.275794	0.236364	0.295455	0
9	0	32.0	0	0	4	0.202031	0.272727	0.090909	0

```
#Scaling
scaler = MinMaxScaler()
# Specify columns to scale
columns_to_scale = ['bmi','HbA1c_level', 'blood_glucose_level']
df[columns_to_scale] = scaler.fit_transform(df[columns_to_scale])
# Display the scaled DataFrame
print(df)
```

```
       gender   age  hypertension  heart_disease  smoking_history       bmi  \
0           0  80.0             0              1                4  0.177171
1           0  54.0             0              0                0  0.202031
2           1  28.0             0              0                4  0.202031
3           0  36.0             0              0                1  0.156863
4           1  76.0             1              1                1  0.118231
...       ...   ...           ...            ...              ...       ...
99995       0  80.0             0              0                0  0.202031
99996       0   2.0             0              0                0  0.085901
99997       1  66.0             0              0                3  0.207983
99998       0  24.0             0              0                4  0.296569
99999       0  57.0             0              0                1  0.144958

       HbA1c_level  blood_glucose_level  diabetes
0         0.563636             0.272727         0
1         0.563636             0.000000         0
2         0.400000             0.354545         0
3         0.272727             0.340909         0
4         0.236364             0.340909         0
...            ...                  ...       ...
99995     0.490909             0.045455         0
99996     0.545455             0.090909         0
99997     0.400000             0.340909         0
99998     0.090909             0.090909         0
99999     0.563636             0.045455         0

[100000 rows x 9 columns]
```

- Exploratory Data Analysis

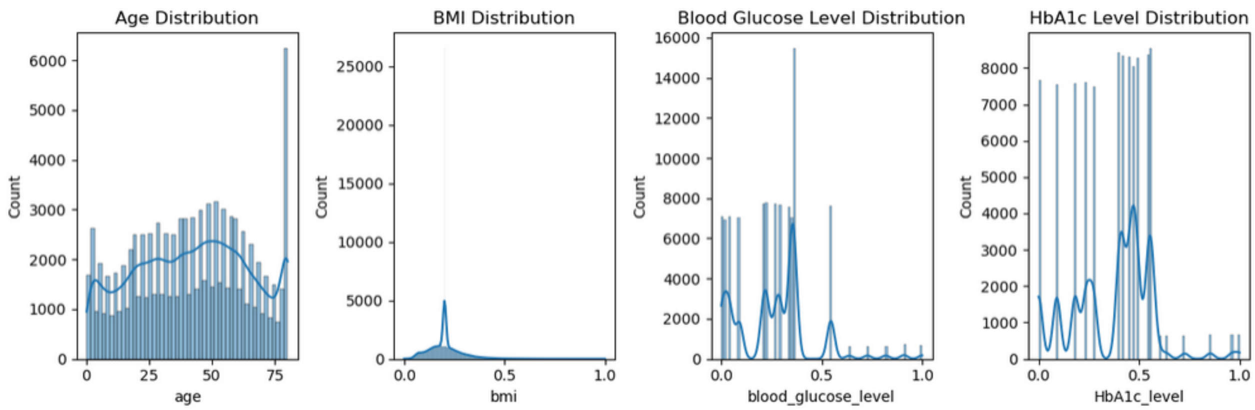
```
# Distribution plots
plt.figure(figsize=(12, 4))
plt.subplot(1, 4, 1)
sns.histplot(df['age'], kde=True)
plt.title('Age Distribution')

plt.subplot(1, 4, 2)
sns.histplot(df['bmi'], kde=True)
plt.title('BMI Distribution')

plt.subplot(1, 4, 3)
sns.histplot(df['blood_glucose_level'], kde=True)
plt.title('Blood Glucose Level Distribution')


plt.subplot(1, 4, 4)
sns.histplot(df['HbA1c_level'], kde=True)
plt.title('HbA1c Level Distribution')


plt.tight_layout()
plt.show()
```



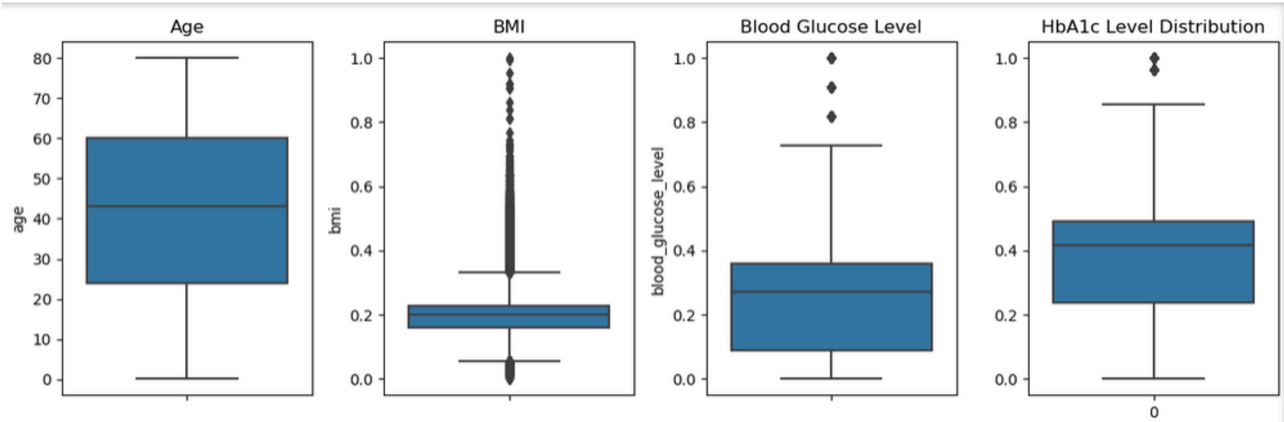

```
# Box plots
plt.figure(figsize=(12, 4))
plt.subplot(1, 4, 1)
sns.boxplot(y=df['age'])
plt.title('Age')

plt.subplot(1, 4, 2)
sns.boxplot(y=df['bmi'])
plt.title('BMI')

plt.subplot(1, 4, 3)
sns.boxplot(y=df['blood_glucose_level'])
plt.title('Blood Glucose Level')

plt.subplot(1, 4, 4)
sns.boxplot(df['HbA1c_level'])
plt.title('HbA1c Level Distribution')

plt.tight_layout()
plt.show()
```



- Decision Tree Algorithm before feature selection

```
X = df.drop(columns=['diabetes'])
y = df['diabetes']
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3, random_state=42)

dt_model_entropy = DecisionTreeClassifier(criterion='entropy', random_state=42)
dt_model_entropy.fit(X_train, y_train)

# Evaluate Decision Tree model using Entropy
y_pred_entropy = dt_model_entropy.predict(X_test)
accuracy_entropy = accuracy_score(y_test, y_pred_entropy)
print("Accuracy using Entropy:", accuracy_entropy)

# Train Decision Tree model using Gini-index
dt_model_gini = DecisionTreeClassifier(criterion='gini', random_state=42)
dt_model_gini.fit(X_train, y_train)

# Evaluate Decision Tree model using Gini-index
y_pred_gini = dt_model_gini.predict(X_test)
accuracy_gini = accuracy_score(y_test, y_pred_gini)
print("Accuracy using Gini-index:", accuracy_gini)
```

```
Accuracy using Entropy: 0.9542333333333334
Accuracy using Gini-index: 0.9530666666666666
```

- Feature selection

```
top_k = 3
top_features_indices = feature_importances.argsort()[-top_k:][::-1]
```

# Get names of top features
top_features_names = X.columns[top_features_indices]

print("Top", top_k, "features:", top_features_names)

# Rebuild model with selected features
X_train_selected = X_train.iloc[:, top_features_indices]
X_test_selected = X_test.iloc[:, top_features_indices]

# Retrain the model using selected features
dt_model_selected = DecisionTreeClassifier(random_state=42)
dt_model_selected.fit(X_train_selected, y_train)

```
Top 3 features: Index(['HbA1c_level', 'blood_glucose_level', 'bmi'], dtype='object')
```

dt_model_entropy_sel = DecisionTreeClassifier(criterion='entropy', random_state=42)
dt_model_entropy_sel.fit(X_train_selected, y_train)

# Evaluate Decision Tree model using Entropy
y_pred_entropy = dt_model_entropy_sel.predict(X_test_selected)
accuracy_entropy = accuracy_score(y_test, y_pred_entropy)
print("Accuracy using Entropy:", accuracy_entropy)

- Decision Tree Algorithm after feature selection

# Train Decision Tree model using Gini-index
dt_model_gini_sel = DecisionTreeClassifier(criterion='gini', random_state=42)
dt_model_gini_sel.fit(X_train_selected, y_train)

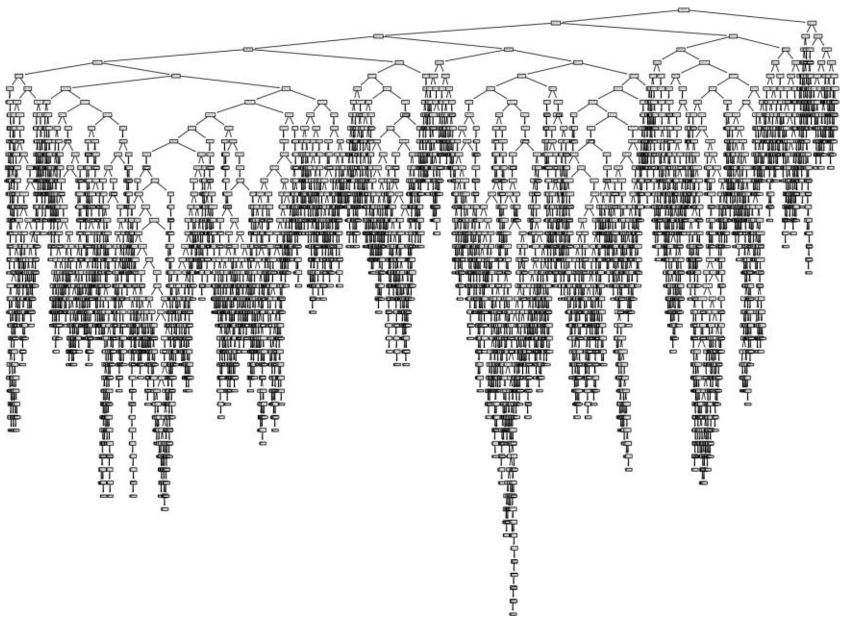
```
Accuracy using Entropy: 0.9555666666666667
```

#
Evaluate Decision Tree model using Gini-index
y_pred_gini = dt_model_gini_sel.predict(X_test_selected)
accuracy_gini = accuracy_score(y_test, y_pred_gini)
print("Accuracy using Gini-index:", accuracy_gini)

```
Accuracy using Gini-index: 0.9551666666666667
```

- Decision Tree

fig = plt.figure(figsize=(20,15))
tree.plot_tree(dt_model_entropy);



- **Inference:**

1. Accuracy using Entropy impurity measure without Feature Selction: 0.9542333333333334

   Accuracy using Gini-index impurity measure without Feature Selection: 0.9530666666666666

2. Accuracy using Entropy impurity measure with Feature Selction(n=3): 0.9555666666666667

   Accuracy using Gini-index impurity measure with Feature Selction(n=3): 0.9551666666666667

3. Accuracy using Entropy and gini-index impurity measure with Feature (n>3) goes below 0.93 as n increases

Therefore, we can obseve that the accuracy of the decision tree classifier using Gini-index and Entropy using feature selection gives higher accuracy if we choose the number of features correctly. But, we can also see that without applying feature selection, itself we can obtain better entropy and gini-index measures.

- **Github Link:**

  https://github.com/gk3204/ML-Assignment7

- **Learning Outcomes:**

  1. Applying standardization, normalization and other pre-processing techniques.
  2. Understanding Decision Tree classifier Algorithm.
  3. Implementing decision tree classifier model.
  4. Implementing the decision tree model with & without using feature selection.