

RAJALAKSHMI ENGINEERING COLLEGE

RAJALAKSHMI NAGAR, THANDALAM - 602 105.



RAJALAKSHMI
ENGINEERING COLLEGE

AI192412 - Fundamentals of
Machine Learning

Laboratory Record Note Book

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BRANCH Artificial Intelligence & Data Science

UNIVERSITY REGISTER No 2116221801044

COLLEGE ROLL No 221801044

SEMESTER VI

ACADEMIC YEAR 2024 - 2025



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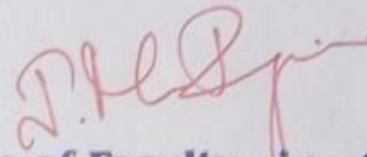
BONAFIDE CERTIFICATE

NAME Sandhya J

ACADEMIC YEAR 2024 - 2025 SEMESTER VI BRANCH AI&DS

UNIVERSITY REGISTER No. 2116221801044

Certified that this is the bonafide record of work done by the above student in the
AI19442 -
Fundamentals of Laboratory during the year **2024 - 2025**
machine learning


Signature of Faculty - in - Charge



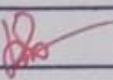


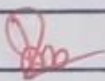





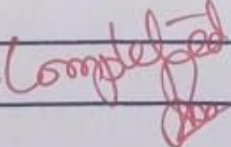
Submitted for the Practical Examination held on.....

External Examiner

Internal Examiner

INDEX

Name: Sandhya . J Branch: AI&DS Sec: - Roll No: 2218010144

S.No.	Date	Title	Page No.	Teacher's Sign/Remarks
1.	24/1/25	Univariate, Bivariate, Multivariate regression implementation	1	
2.	31/1/25	Simple linear regression using Least Square method	5	
3.	7/2/25	Logistic model implementation	9	
4.	14/2/25	Single layer perceptron implementation	13	
5.	21/2/25	Multilayer perceptron with back propagation implementation	15	
6.	28/2/25	Face recognition using SVM Classifier	18	
7.	7/3/25	Decision Tree Implementation	21	
8.	28/3/25	Boosting Implementation	23	
9.	4/4/25	KNN and K-means implementation	27	
10.	11/4/25	Dimensionality reduction using PCA	31	
11.	11/4/25	Simple Application Using TensorFlow / Keras	33	
Completed 				

EXP NO: 1	A PYTHON PROGRAM TO IMPLEMENT UNIVARIATE, BIVARIATE AND MULTIVARIATE REGRESION
DATE: 24/1/25	

AIM:

To implement a python program using univariate, bivariate and multivariate regression features for a given Housing dataset.

ALGORITHM:

- Step 1:** Load and preview the dataset
- Step 2:** Handle missing values
- Step 3:** Univariate regression (1 feature → price)
- Step 4:** Plot for univariate regression
- Step 5:** Bivariate regression (2 features → price)
- Step 6:** Plot for bivariate regression
- Step 7:** Multivariate regression (multiple features → price)
- Step 8:** Train the model
- Step 9:** Make predictions
- Step 10:** Evaluate performance (R^2 score)

SOURCE CODE:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.preprocessing import LabelEncoder
from mpl_toolkits.mplot3d import Axes3D
from sklearn.metrics import mean_squared_error, r2_score

# Step 1: Load dataset
file_path = "/content/Housing.csv"
```

```

df = pd.read_csv(file_path)

# Step 2: Preprocess data (convert categorical variables)
le = LabelEncoder()
df['mainroad'] = le.fit_transform(df['mainroad'])
df['guestroom'] = le.fit_transform(df['guestroom'])
df['basement'] = le.fit_transform(df['basement'])
df['hotwaterheating'] = le.fit_transform(df['hotwaterheating'])
df['airconditioning'] = le.fit_transform(df['airconditioning'])
df['prefarea'] = le.fit_transform(df['prefarea'])
df['furnishingstatus'] = le.fit_transform(df['furnishingstatus'])

# Step 3: Univariate Regression (Price vs Area)
X_uni = df[['area']]
y = df['price']
X_train, X_test, y_train, y_test = train_test_split(X_uni, y, test_size=0.2, random_state=42)
model_uni = LinearRegression()
model_uni.fit(X_train, y_train)
y_pred_uni = model_uni.predict(X_test)

# Plot Univariate Regression
plt.figure(figsize=(8,6))
plt.scatter(X_test, y_test, color='blue', label='Actual Data')
plt.plot(X_test, y_pred_uni, color='red', linewidth=2, label='Regression Line')
plt.xlabel('Area')
plt.ylabel('Price')
plt.title('Univariate Regression (Area vs Price)')
plt.legend()
plt.show()

# Step 4: Bivariate Regression (Price vs Area & Bedrooms)
X_bi = df[['area', 'bedrooms']]
X_train, X_test, y_train, y_test = train_test_split(X_bi, y, test_size=0.2, random_state=42)
model_bi = LinearRegression()
model_bi.fit(X_train, y_train)
y_pred_bi = model_bi.predict(X_test)

# Plot Bivariate Regression in 3D
fig = plt.figure(figsize=(10,7))
ax = fig.add_subplot(111, projection='3d')
ax.scatter(X_test['area'], X_test['bedrooms'], y_test, color='blue', label='Actual Data')
ax.set_xlabel('Area')
ax.set_ylabel('Bedrooms')
ax.set_zlabel('Price')
ax.set_title('Bivariate Regression (Area & Bedrooms vs Price)')
plt.show()

```



```

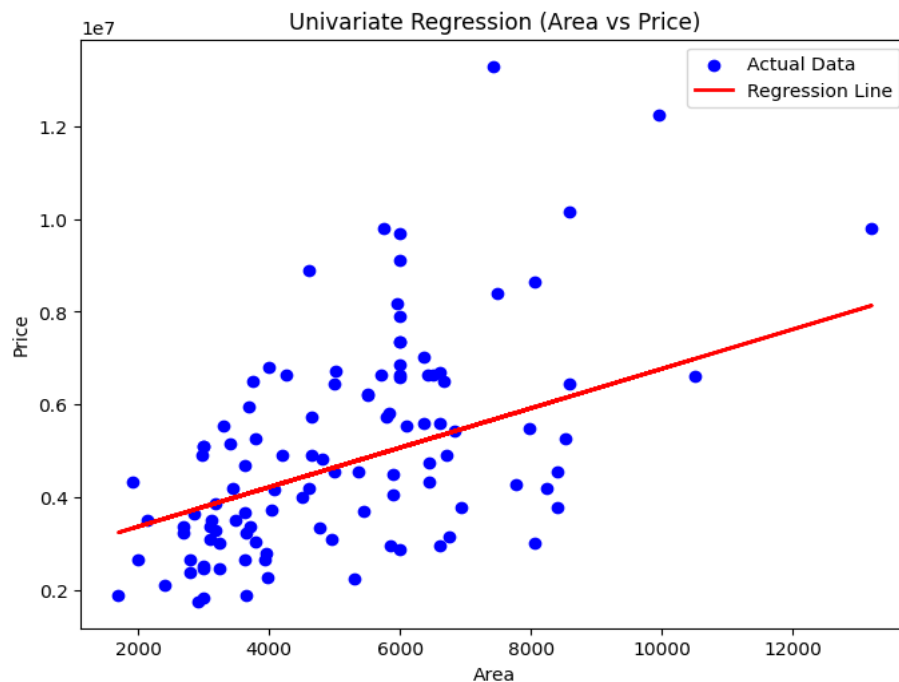
# Step 5: Multivariate Regression (Using all features)
X_multi = df.drop(columns=['price'])
X_train, X_test, y_train, y_test = train_test_split(X_multi, y, test_size=0.2, random_state=42)
model_multi = LinearRegression()
model_multi.fit(X_train, y_train)
y_pred_multi = model_multi.predict(X_test)

# Model Evaluation
mse = mean_squared_error(y_test, y_pred_multi)
r2 = r2_score(y_test, y_pred_multi)
print(f'Multivariate Regression R2 Score: {r2:.4f}')
print(f'Multivariate Regression MSE: {mse:.2f}')

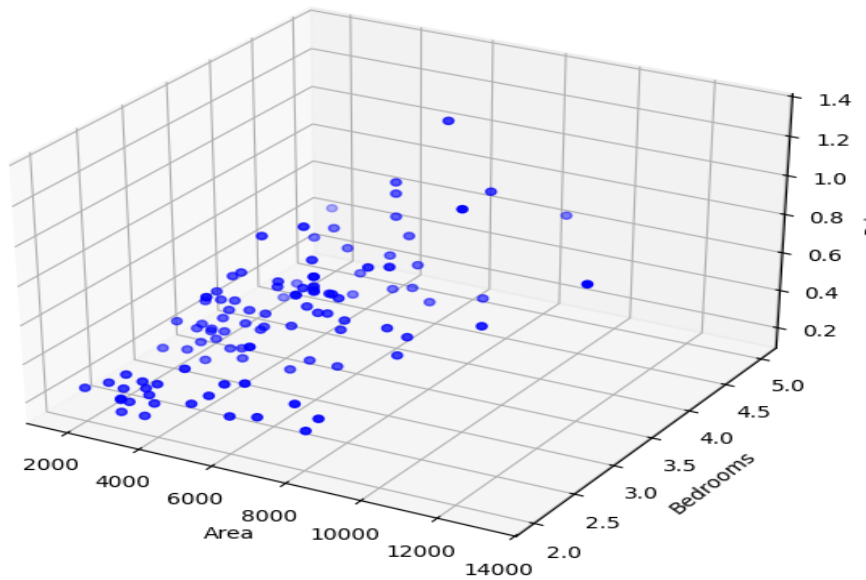
# Residual Plot
residuals = y_test - y_pred_multi
plt.figure(figsize=(8,6))
sns.histplot(residuals, kde=True, color='purple')
plt.xlabel('Residuals')
plt.ylabel('Frequency')
plt.title('Residual Distribution - Multivariate Regression')
plt.show()

```

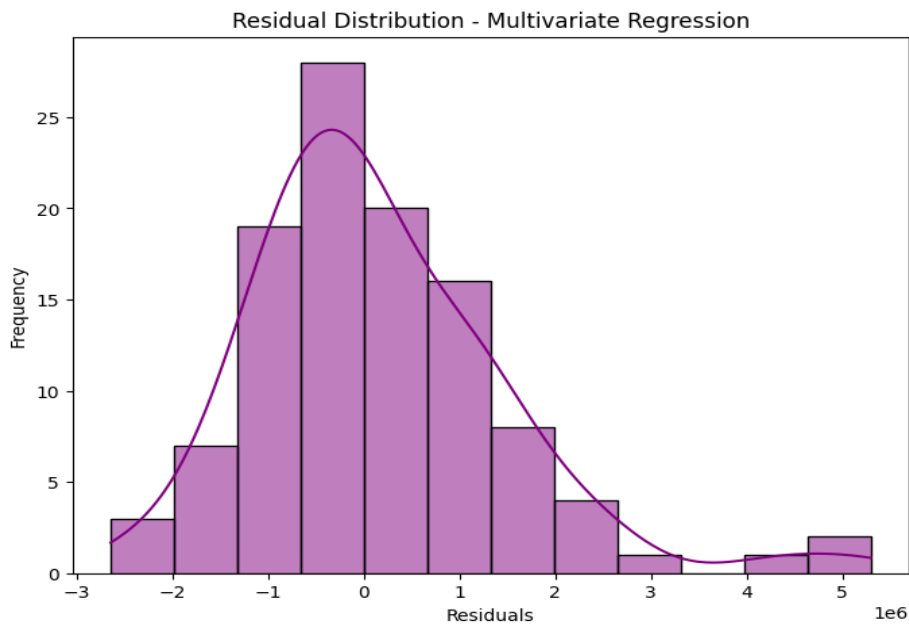
OUTPUT:



Bivariate Regression (Area & Bedrooms vs Price)



Multivariate Regression R^2 Score: 0.6495
Multivariate Regression MSE: 1771751116594.04



RESULT:

Thus, the python program to implement univariate, bivariate and multivariate regression features for the given housing dataset is analyzed and the features are plotted using scatter plot.

EXP NO: 2	A PYTHON PROGRAM TO IMPLEMENT SIMPLE LINEAR REGRESSION USING LEAST SQUARE METHOD
DATE: 31/1/25	

AIM:

To implement a python program for constructing a simple linear regression using least square method.

ALGORITHM:

Step 1: Import necessary libraries (numpy, matplotlib, pandas).

Step 2: Read the dataset (headbrain.csv) and explore data using `.head()`, `.info()`, and `.describe()`.

Step 3: Extract Head Size as X (independent variable) and Brain Weight as y (dependent variable).

Step 4: Compute the mean of X and y to prepare for coefficient calculations.

Step 5: Calculate slope (b1) and intercept (b0) using the Least Squares formula.

Step 6: Generate predictions (y_pred) using the linear equation $y_{pred} = b0 + b1 * x$.

Step 7: Plot the regression line over the actual data points (X, y).

Step 8: Plot residuals (differences between actual and predicted values) to analyze model fit.

Step 9: Compute the R-squared value, which indicates the proportion of variance explained by the model.

Step 10: Display results (Intercept, Slope, and R² Score) to evaluate model performance.

SOURCE CODE:

```
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd

# Step 1: Import necessary libraries

# Step 2: Read the dataset
file_path = "/content/headbrain.csv"
data = pd.read_csv(file_path)

data.head()
data.info()
data.describe()

# Step 3: Prepare the data
X = data['Head Size(cm^3)'].values
y = data['Brain Weight(grams)'].values

# Step 4: Calculate the mean
mean_x, mean_y = np.mean(X), np.mean(y)

# Step 5: Calculate the coefficients
b1 = np.sum((X - mean_x) * (y - mean_y)) / np.sum((X - mean_x) ** 2)
b0 = mean_y - b1 * mean_x

# Step 6: Make predictions
y_pred = b0 + b1 * X

# Step 7: Plot the regression line
plt.figure(figsize=(8, 6))
plt.scatter(X, y, color='blue', label='Actual data', alpha=0.6)
plt.plot(X, y_pred, color='red', label='Regression line', linewidth=2)
plt.xlabel('Head Size (cm³)')
plt.ylabel('Brain Weight (grams)')
plt.legend()
plt.title('Linear Regression using Least Squares')
plt.show()

# Step 8: Plot the residuals
residuals = y - y_pred
plt.figure(figsize=(8, 6))
plt.scatter(X, residuals, color='purple', alpha=0.6)
```

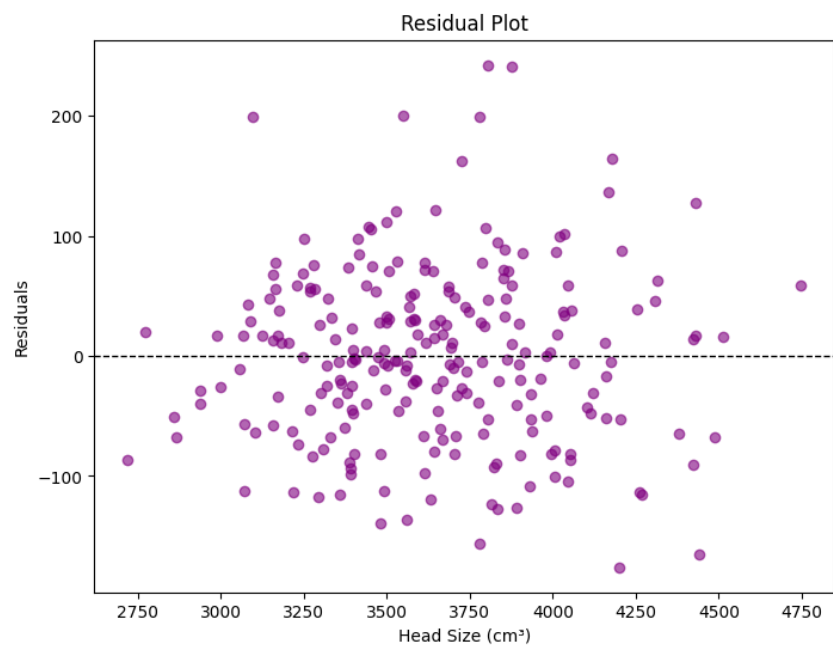
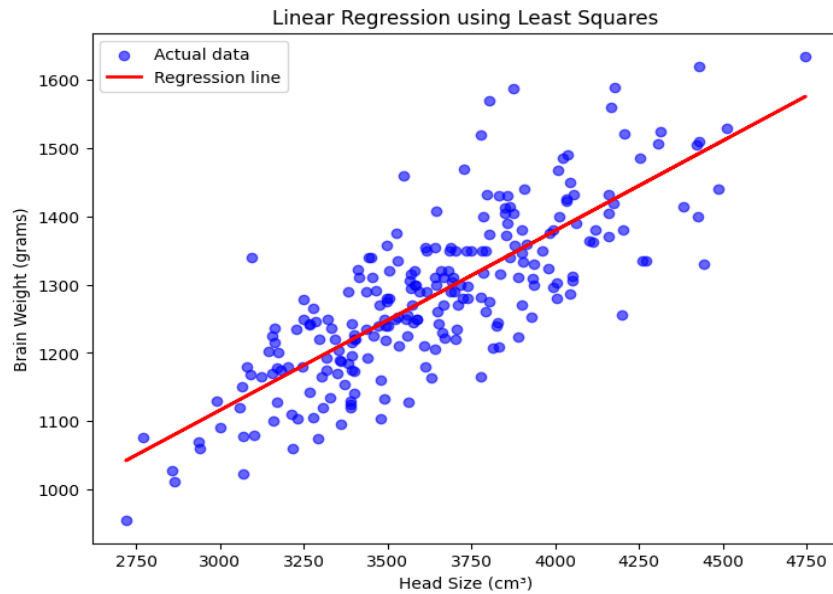
```
plt.axhline(y=0, color='black', linestyle='--', linewidth=1)
plt.xlabel('Head Size (cm³)')
plt.ylabel('Residuals')
plt.title('Residual Plot')
plt.show()
```

```
# Step 9: Calculate the R-squared value
TSS = np.sum((y - mean_y) ** 2)
RSS = np.sum((y - y_pred) ** 2)
R2 = 1 - (RSS / TSS)
```

```
# Step 10: Display the results
print(f"Intercept: {b0:.2f}")
print(f"Slope: {b1:.2f}")
print(f"R-squared Value: {R2:.4f}")
```

OUTPUT:

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 237 entries, 0 to 236
Data columns (total 4 columns):
 #   Column                Non-Null Count  Dtype
---  -
 0   Gender                237 non-null   int64
 1   Age Range             237 non-null   int64
 2   Head Size (cm^3)      237 non-null   int64
 3   Brain Weight (grams)  237 non-null   int64
dtypes: int64(4)
```



Intercept: 325.57

Slope: 0.26

R-squared Value: 0.6393

RESULT:

Thus, the python program to implement simple linear regression using least square method for the given head brain dataset is analyzed and the linear regression line is constructed successfully.

EXP NO: 3	A PYTHON PROGRAM TO IMPLEMENT LOGISTIC MODEL
DATE: 07/2/25	

AIM:

To implement python program for the logistic model using suv car dataset.

ALGORITHM:

- Step 1:** Import required libraries (numpy, matplotlib, pandas, sklearn).
- Step 2:** Load the dataset (suv_data.csv) into a pandas DataFrame.
- Step 3:** Extract Age and Estimated Salary as X (features) and Purchased as y (target variable).
- Step 4:** Split the data into training (80%) and testing (20%) sets using `train_test_split()`.
- Step 5:** Apply feature scaling (StandardScaler) to normalize `X_train` and `X_test` for better performance.
- Step 6:** Train the Logistic Regression model using `LogisticRegression().fit(X_train, y_train)`.
- Step 7:** Make predictions (`y_pred`) on `X_test` using `model.predict()`.
- Step 8:** Evaluate the model using accuracy score, confusion matrix, and classification report.
- Step 9:** Plot actual data using a scatter plot (Age vs. Estimated Salary, colored by `y_test`).
- Step 10:** Plot predicted data using a scatter plot (Age vs. Estimated Salary, colored by `y_pred`).

SOURCE CODE:

```
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import accuracy_score, confusion_matrix, classification_report

# Step 2: Read the dataset
file_path = "/content/suv_data.csv"
data = pd.read_csv(file_path)
```

```

# Step 3: Prepare the data
X = data[['Age', 'EstimatedSalary']].values # Independent variables
y = data['Purchased'].values # Dependent variable

# Step 4: Split the dataset into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=0)

# Step 5: Feature scaling
scaler = StandardScaler()
X_train = scaler.fit_transform(X_train)
X_test = scaler.transform(X_test)

# Step 6: Train the logistic regression model
model = LogisticRegression()
model.fit(X_train, y_train)

# Step 7: Make predictions
y_pred = model.predict(X_test)

# Step 8: Evaluate the model
accuracy = accuracy_score(y_test, y_pred)
conf_matrix = confusion_matrix(y_test, y_pred)
report = classification_report(y_test, y_pred)

print(f"Accuracy: {accuracy:.4f}")
print("Confusion Matrix:")
print(conf_matrix)
print("Classification Report:")
print(report)

# Step 9: Simple plots
# Scatter plot of actual data
plt.figure(figsize=(8, 6))
plt.scatter(X_test[:, 0], X_test[:, 1], c=y_test, cmap='coolwarm', edgecolors='k')
plt.xlabel('Age')
plt.ylabel('Estimated Salary')
plt.title('Actual Data Distribution')
plt.show()
# Scatter plot of predictions
plt.figure(figsize=(8, 6))
plt.scatter(X_test[:, 0], X_test[:, 1], c=y_pred, cmap='coolwarm', edgecolors='k')
plt.xlabel('Age')
plt.ylabel('Estimated Salary')
plt.title('Predicted Data Distribution')
plt.show()

```

OUTPUT:

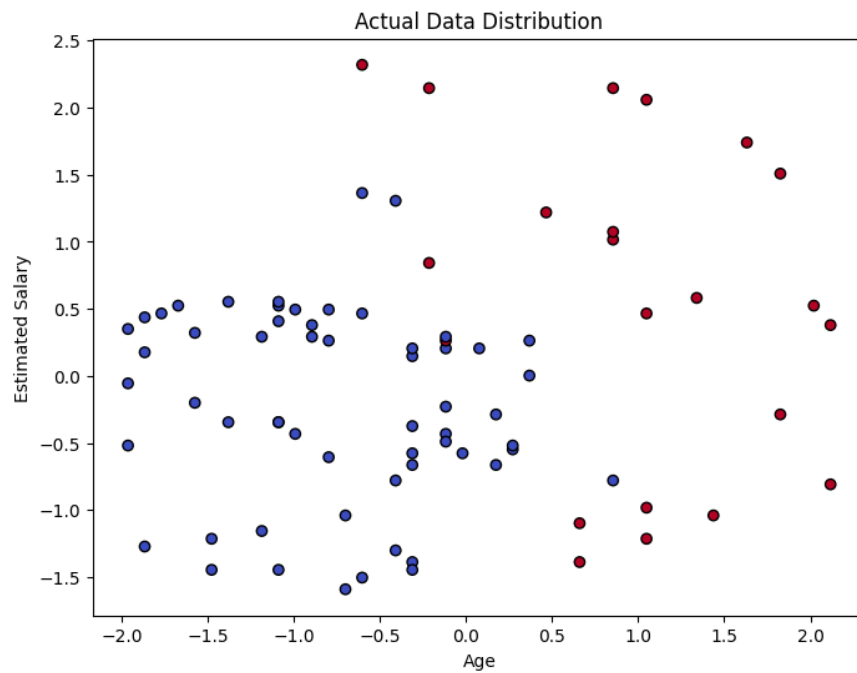
Accuracy: 0.9250

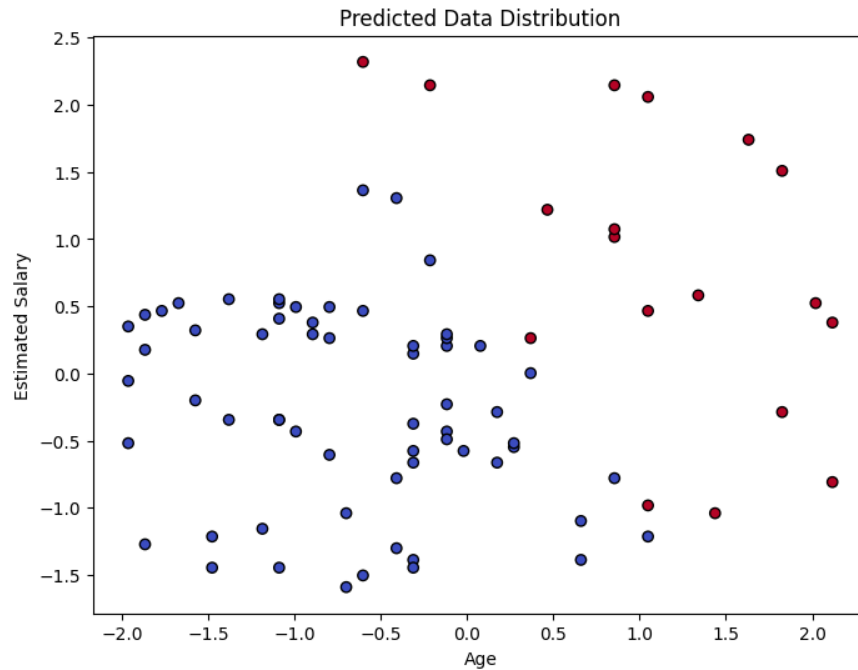
Confusion Matrix:

```
[[57  1]
 [ 5 17]]
```

Classification Report:

	precision	recall	f1-score	support
0	0.92	0.98	0.95	58
1	0.94	0.77	0.85	22
accuracy			0.93	80
macro avg	0.93	0.88	0.90	80
weighted avg	0.93	0.93	0.92	80





RESULT:

Thus, the python program to implement logistic regression for the given suv_cars dataset is analyzed and the logistic regression model is classifies successfully. The performance of the developed model is measured using F1-score and Accuracy.

EXP NO: 4	A PYTHON PROGRAM TO IMPLEMENT SINGLE LAYER PERCEPTRON
DATE: 14/2/25	

AIM:

To implement python program for the single layer perceptron.

ALGORITHM:

Step 1: Initialize the input data (X) and corresponding labels (y).

Step 2: Initialize weights and bias randomly.

Step 3: Define an activation function (e.g., step function).

Step 4: Set the learning rate (e.g., 0.1).

Step 5: Compute the weighted sum of inputs (X) and weights (W).

Step 6: Apply the activation function to get the output.

Step 7: Calculate the error (difference between expected and predicted output).

Step 8: Update weights and bias using the Perceptron Learning Rule.

Step 9: Repeat steps 5–8 for multiple epochs to train the model.

Step 10: Test the perceptron on new inputs and print predictions.

SOURCE CODE:

```
import numpy as np

# Step 1: Initialize input features (X) and target labels (y)
X = np.array([[0, 0], [0, 1], [1, 0], [1, 1]]) # Inputs
y = np.array([0, 0, 0, 1]) # AND logic gate output

# Step 2: Initialize weights and bias
weights = np.random.rand(2)
bias = np.random.rand(1)
learning_rate = 0.1

# Step 3: Define activation function (step function)
def step_function(x):
    return 1 if x >= 0 else 0
```

```

# Step 4: Train the perceptron using the Perceptron Learning Algorithm
epochs = 10
for epoch in range(epochs):
    for i in range(len(X)):
        # Step 5: Compute weighted sum
        weighted_sum = np.dot(X[i], weights) + bias

        # Step 6: Apply activation function
        y_pred = step_function(weighted_sum)

        # Step 7: Compute error
        error = y[i] - y_pred

        # Step 8: Update weights and bias
        weights += learning_rate * error * X[i]
        bias += learning_rate * error

# Step 9: Make predictions
for i in range(len(X)):
    output = step_function(np.dot(X[i], weights) + bias)
    print(f'Input: {X[i]}, Predicted Output: {output}')

# Step 10: Final weights and bias
print("Final Weights:", weights)
print("Final Bias:", bias)

```

OUTPUT:

```

Input: [0 0], Predicted Output: 0
Input: [0 1], Predicted Output: 0
Input: [1 0], Predicted Output: 0
Input: [1 1], Predicted Output: 1
Final Weights: [0.23942754 0.09998966]
Final Bias: [-0.33008925]

```

RESULT:

Thus, the python program to implement Single Layer Perceptron has been executed successfully.

EXP NO: 5	A PYTHON PROGRAM TO IMPLEMENT MULTI LAYER PERCEPTRON WITH BACK PROPOGATION
DATE: 21/2/25	

AIM:

To implement multilayer perceptron with back propagation using python.

ALGORITHM:

- Step 1:** Load the dataset from file (CSV or other formats).
- Step 2:** Preprocess the dataset (Handle missing values if any).
- Step 3:** Split the dataset into training and testing sets.
- Step 4:** Normalize the features using `StandardScaler()`.
- Step 5:** Define and train the MLP model with one hidden layer.
- Step 6:** Make predictions on the test set.
- Step 7:** Evaluate the model using accuracy and confusion matrix.
- Step 8:** Test the model with a new sample.
- Step 9:** Retrieve final weights and biases of the model.
- Step 10:** Visualize the classification results.

SOURCE CODE:

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.neural_network import MLPClassifier
from sklearn.metrics import accuracy_score, confusion_matrix, classification_report

# Step 1: Load the dataset from file
file_path = "/content/BankNote_Authentication.csv" # Replace with your file path
data = pd.read_csv(file_path)
```

```

# Step 2: Preprocess the dataset (Check for missing values)
print(data.info())
print(data.describe())

# Step 3: Prepare the data (Assuming last column is 'Class' and rest are features)
X = data.iloc[:, :-1].values # Features (all columns except last)
y = data.iloc[:, -1].values # Target (last column)

# Step 4: Split dataset into training (80%) and testing (20%)
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

# Step 5: Normalize the dataset
scaler = StandardScaler()
X_train = scaler.fit_transform(X_train)
X_test = scaler.transform(X_test)

# Step 6: Define the MLP model (1 hidden layer with 10 neurons)
mlp = MLPClassifier(hidden_layer_sizes=(10,), activation='relu', solver='adam', max_iter=1000,
random_state=42)

# Step 7: Train the model
mlp.fit(X_train, y_train)

# Step 8: Make predictions
y_pred = mlp.predict(X_test)

# Step 9: Evaluate the model
accuracy = accuracy_score(y_test, y_pred)
conf_matrix = confusion_matrix(y_test, y_pred)
report = classification_report(y_test, y_pred)

print(f"Model Accuracy: {accuracy:.2%}")
print("Confusion Matrix:")
print(conf_matrix)
print("Classification Report:")
print(report)

# Step 10: Test the model with a new sample
new_sample = [[2.5, -1.2, 3.1, -0.8]] # Replace with actual feature values
new_sample_scaled = scaler.transform(new_sample)
prediction = mlp.predict(new_sample_scaled)
print(f"Predicted Class: {'Forged' if prediction[0] == 1 else 'Genuine'}")

```

OUTPUT:

```
<class 'pandas.core.frame.DataFrame'>
```

```
RangeIndex: 1372 entries, 0 to 1371
```

```
Data columns (total 5 columns):
```

#	Column	Non-Null	Count	Dtype
0	variance	1372	non-null	float64
1	skewness	1372	non-null	float64
2	curtosis	1372	non-null	float64
3	entropy	1372	non-null	float64
4	class	1372	non-null	int64

```
dtypes: float64(4), int64(1)
```

```
memory usage: 53.7 KB
```

```
None
```

	variance	skewness	curtosis	entropy	class
count	1372.000000	1372.000000	1372.000000	1372.000000	1372.000000
mean	0.433735	1.922353	1.397627	-1.191657	0.444606
std	2.842763	5.869047	4.310030	2.101013	0.497103
min	-7.042100	-13.773100	-5.286100	-8.548200	0.000000
25%	-1.773000	-1.708200	-1.574975	-2.413450	0.000000
50%	0.496180	2.319650	0.616630	-0.586650	0.000000
75%	2.821475	6.814625	3.179250	0.394810	1.000000
max	6.824800	12.951600	17.927400	2.449500	1.000000

```
Model Accuracy: 99.64%
```

```
Confusion Matrix:
```

```
[[147  1]
 [ 0 127]]
```

```
Classification Report:
```

	precision	recall	f1-score	support
0	1.00	0.99	1.00	148
1	0.99	1.00	1.00	127
accuracy			1.00	275
macro avg	1.00	1.00	1.00	275
weighted avg	1.00	1.00	1.00	275

```
Predicted Class: Genuine
```

RESULT:

The MLP with backpropagation was successfully implemented on *banknotes.csv*, and results were analyzed using various activation functions (relu, logistic, tanh, identity) with training-testing splits of 0.2 and 0.3.

EXP NO: 6	A PYTHON PROGRAM TO IMPLEMENT FACE RECOGNITION USING SVM CLASSIFIER MODEL
DATE: 28/2/25	

AIM:

To implement a face recognition using SVM classifier model using python and determine its accuracy.

ALGORITHM:

- Step 1:** Load the Labeled Faces in the Wild (LFW) dataset.
- Step 2:** Extract face images (grayscale) and corresponding labels (person names).
- Step 3:** Flatten 2D face images into 1D feature vectors for processing.
- Step 4:** Normalize the feature vectors using `StandardScaler` to improve model performance.
- Step 5:** Split the dataset into training (80%) and testing (20%) sets.
- Step 6:** Apply PCA (Principal Component Analysis) to reduce dimensionality to 150 components.
- Step 7:** Train an SVM (Support Vector Machine) classifier with a linear kernel on the PCA-transformed data.
- Step 8:** Predict labels for the test set using the trained SVM model.
- Step 9:** Evaluate model performance using accuracy score and confusion matrix.
- Step 10:** Display sample predictions with actual vs. predicted labels using `matplotlib`.

SOURCE CODE:

```
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.datasets import fetch_lfw_people
from sklearn.model_selection import train_test_split
from sklearn.svm import SVC
from sklearn.decomposition import PCA
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import accuracy_score, confusion_matrix
```

```
# Load the Labeled Faces in the Wild (LFW) dataset
```

```

lfw_people = fetch_lfw_people(min_faces_per_person=70, resize=0.4)
X = lfw_people.images # Face images (Gray-scale)
y = lfw_people.target # Person labels
target_names = lfw_people.target_names # Names of people
# Flatten images for SVM input (Convert 2D images to 1D feature vectors)
n_samples, h, w = X.shape
X = X.reshape(n_samples, h * w)
# Normalize data
scaler = StandardScaler()
X = scaler.fit_transform(X)
# Split data (80% training, 20% testing)
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

# Apply PCA (Principal Component Analysis) for dimensionality reduction
n_components = 150 # Reduce features to 150 dimensions
pca = PCA(n_components=n_components, whiten=True)
X_train_pca = pca.fit_transform(X_train)
X_test_pca = pca.transform(X_test)
# Train SVM classifier
svm_classifier = SVC(kernel="linear", class_weight="balanced", probability=True)
svm_classifier.fit(X_train_pca, y_train)
# Test the model
y_pred = svm_classifier.predict(X_test_pca)
# Calculate accuracy
accuracy = accuracy_score(y_test, y_pred)
print(f"Face Recognition Model Accuracy: {accuracy * 100:.2f}%")

# Display Confusion Matrix
conf_matrix = confusion_matrix(y_test, y_pred)
plt.figure(figsize=(6, 5))
sns.heatmap(conf_matrix, annot=True, fmt="d", cmap="Blues", xticklabels=target_names,
yticklabels=target_names)
plt.xlabel("Predicted Label")
plt.ylabel("True Label")
plt.title("Confusion Matrix - Face Recognition")
plt.show()

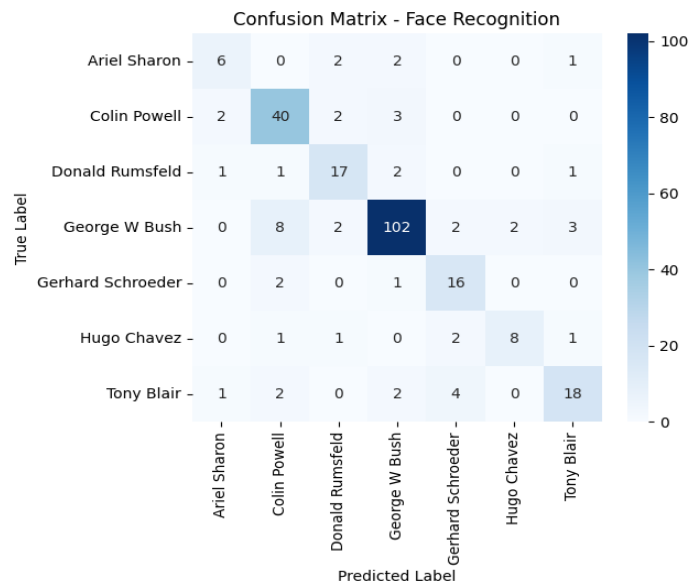
# Test with a sample image
sample_idx = 5 # Choose any index from test set
plt.imshow(lfw_people.images[sample_idx], cmap="gray")

plt.title(f"Actual: {target_names[y_test[sample_idx]]} \nPredicted:
{target_names[y_pred[sample_idx]]}")
plt.axis("off")
plt.show()

```

OUTPUT:

Face Recognition Model Accuracy: 80.23%



Actual: George W Bush
Predicted: George W Bush



RESULT:

Thus the python program to implement face recognition using SVM classifier model has been executed successfully and the classified output has been analyzed for the given dataset(fetch_lfw_people).

EXP NO: 7	A PYTHON PROGRAM TO IMPLEMENT DECISION TREE
DATE: 07/3/25	

AIM:

To implement a decision tree using a python program for the given dataset and plot the trained decision tree.

ALGORITHM:

Step 1: Import necessary libraries (numpy, matplotlib, sklearn).

Step 2: Load the Iris dataset using `load_iris()` function.

Step 3: Extract features (X) and labels (y) from the dataset.

Step 4: Split the dataset into training (80%) and testing (20%) sets using `train_test_split()`.

Step 5: Initialize the Decision Tree Classifier with a `gini` criterion and a maximum depth of 3.

Step 6: Train the Decision Tree model on the training dataset using `clf.fit(X_train, y_train)`.

Step 7: Predict the class labels for the test dataset using `clf.predict(X_test)`.

Step 8: Evaluate the model's accuracy using `accuracy_score()`.

Step 9: Print the model's accuracy as a percentage (`accuracy * 100`).

Step 10: Visualize the trained Decision Tree using `plot_tree()`.

SOURCE CODE:

```
import numpy as np
import matplotlib.pyplot as plt
from sklearn.datasets import load_iris
from sklearn.tree import DecisionTreeClassifier, plot_tree
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score

# Load dataset
iris = load_iris()
X, y = iris.data, iris.target # Features & Labels

# Split dataset (80% training, 20% testing)
```

```

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

# Create Decision Tree model
clf = DecisionTreeClassifier(criterion="gini", max_depth=3, random_state=42)

# Train the model
clf.fit(X_train, y_train)

# Predict on test data
y_pred = clf.predict(X_test)

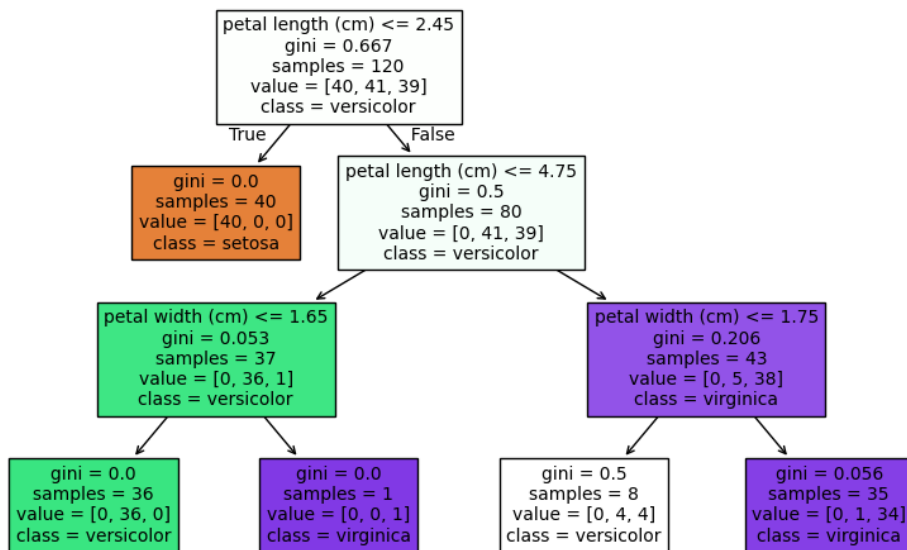
# Evaluate model accuracy
accuracy = accuracy_score(y_test, y_pred)
print(f"Model Accuracy: {accuracy * 100:.2f}%")

# Visualize the Decision Tree
plt.figure(figsize=(10, 6))
plot_tree(clf, feature_names=iris.feature_names, class_names=iris.target_names, filled=True)
plt.show()

```

OUTPUT:

Model Accuracy: 100.00%



RESULT:

Thus the python program to implement Decision Tree for the given dataset has been successfully implemented and the results have been verified and analysed.

EXP NO: 8	A PYTHON PROGRAM TO IMPLEMENT BOOSTING
DATE: 28/3/25	

AIM:

To implement a python program using the ada boosting model and gradient boosting model.

(1) ADA BOOSTING

ALGORITHM:

Step 1: Import necessary libraries (numpy, matplotlib, sklearn).

Step 2: Load the Iris dataset and extract features (X) and labels (y).

Step 3: Split the dataset into training (80%) and testing (20%) sets using `train_test_split()`.

Step 4: Initialize the AdaBoost Classifier with a Decision Tree (`max_depth=1`) as the base estimator.

Step 5: Train the AdaBoost model on the training dataset and make predictions on the test dataset.

Step 6: Evaluate the model's accuracy and plot feature importance using a bar chart.

SOURCE CODE:

```
import numpy as np
import matplotlib.pyplot as plt
from sklearn.datasets import load_iris
from sklearn.model_selection import train_test_split
from sklearn.ensemble import AdaBoostClassifier
from sklearn.tree import DecisionTreeClassifier
from sklearn.metrics import accuracy_score

# Load dataset
iris = load_iris()
X, y = iris.data, iris.target

# Split dataset
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)
```



```

# Create AdaBoost model with Decision Tree as base estimator

boosting_model = AdaBoostClassifier(
    estimator=DecisionTreeClassifier(max_depth=1),
    n_estimators=50,
    learning_rate=1.0,
    random_state=42
)

# Train the model
boosting_model.fit(X_train, y_train)

# Predict on test data
y_pred = boosting_model.predict(X_test)

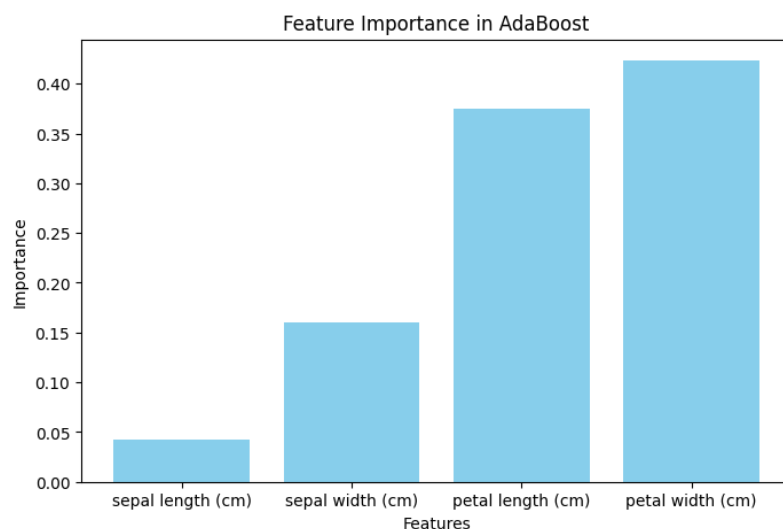
# Evaluate model accuracy
accuracy = accuracy_score(y_test, y_pred)
print(f"Model Accuracy: {accuracy * 100 :.2f}%")

# Plot feature importance
plt.figure(figsize=(8, 5))
plt.bar(iris.feature_names, boosting_model.feature_importances_, color='skyblue')
plt.xlabel("Features")
plt.ylabel("Importance")
plt.title("Feature Importance in AdaBoost")
plt.show()

```

OUTPUT:

Model Accuracy: 93.33%



II) GRADIENT BOOSTING

ALGORITHM:

Step 1: Import required libraries (`sklearn`, `numpy`, `matplotlib`).

Step 2: Load the Iris dataset and extract features (X) and labels (y).

Step 3: Split the dataset into training (80%) and testing (20%) sets using `train_test_split()`.

Step 4: Initialize the Gradient Boosting Classifier with 100 estimators, a learning rate of 0.1, and a max depth of 3.

Step 5: Train the Gradient Boosting model on the training dataset and predict labels for the test dataset.

Step 6: Evaluate the model's accuracy and plot the training loss curve to visualize model performance.

SOURCE CODE:

```
from sklearn.ensemble import GradientBoostingClassifier
from sklearn.model_selection import train_test_split
from sklearn.datasets import load_iris
from sklearn.metrics import accuracy_score

# Load dataset
data = load_iris()
X, y = data.data, data.target

# Split into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

# Create Gradient Boosting model
gb_clf = GradientBoostingClassifier(n_estimators=100, learning_rate=0.1, max_depth=3,
random_state=42)

# Train the model
gb_clf.fit(X_train, y_train)

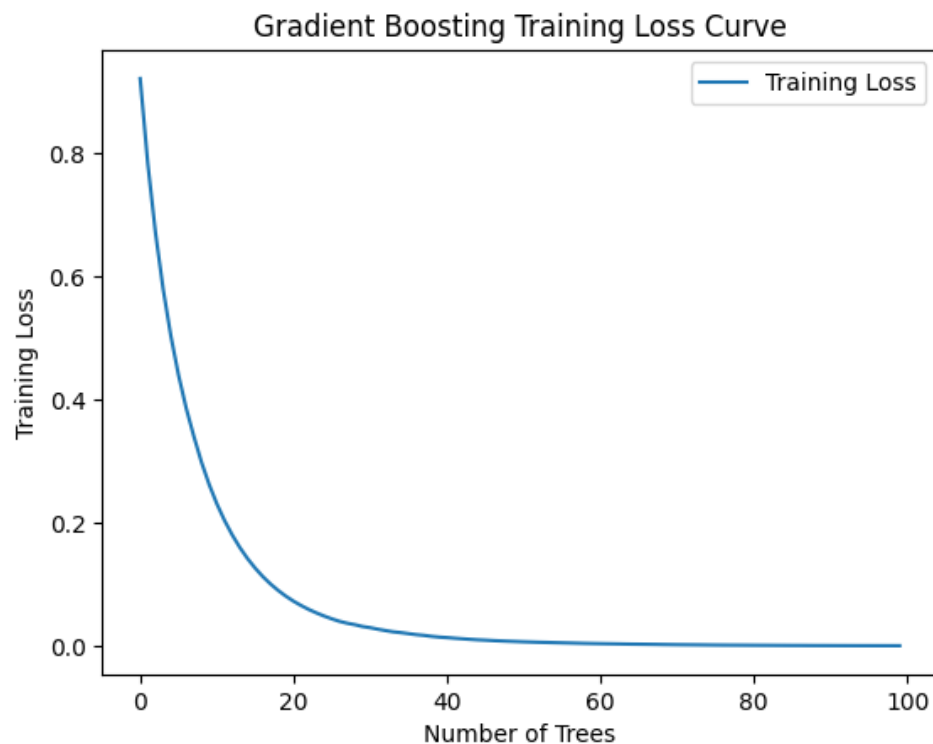
# Predict on test data
y_pred = gb_clf.predict(X_test)

# Calculate accuracy
accuracy = accuracy_score(y_test, y_pred)
print(f'Model Accuracy: {accuracy * 100:.2f}%')
# Plot the training loss curve
```

```
plt.plot(np.arange(len.gb_clf.train_score_), gb_clf.train_score_, label="Training Loss")
plt.xlabel("Number of Trees")
plt.ylabel("Training Loss")
plt.title("Gradient Boosting Training Loss Curve")
plt.legend()
plt.show()
```

OUTPUT:

Model Accuracy: 100.00%



RESULT:

Thus, the python program to implement ada boosting and gradient boosting for the standard uniform distribution has been successfully implemented and the results have been verified and analyzed.

EXP NO: 9	A PYTHON PROGRAM TO IMPLEMENT KNN AND KMEANS MODEL
DATE: 4/4/25	

AIM:

To implement a python program using a KNN and KMEANS Algorithm in a model.

(I) KNN MODEL

ALGORITHM:

Step 1: Import necessary libraries (numpy, matplotlib, sklearn).

Step 2: Load the Breast Cancer dataset and extract features (X) and labels (y).

Step 3: Split the dataset into training (80%) and testing (20%) sets using `train_test_split()`.

Step 4: Initialize the K-Nearest Neighbors (KNN) classifier with `k=5` and train it using the training dataset.

Step 5: Predict the labels for the test dataset and compute the model's accuracy score.

Step 6: Plot the accuracy vs. k-values to visualize model performance for different k.

SOURCE CODE:

```
# Import necessary libraries
import numpy as np
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
from sklearn.neighbors import KNeighborsClassifier
from sklearn.datasets import load_breast_cancer
from sklearn.metrics import accuracy_score

# Load the Breast Cancer dataset
cancer = load_breast_cancer()
X, y = cancer.data, cancer.target # Features and labels

# Split the data into training (80%) and testing (20%) sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

# Create and train the KNN model with k=5
knn = KNeighborsClassifier(n_neighbors=5)
```

```

knn.fit(X_train, y_train)

# Predict on the test set
y_pred = knn.predict(X_test)

# Calculate accuracy
accuracy = accuracy_score(y_test, y_pred)
print(f'Model Accuracy: {accuracy:.2%}') # Accuracy in percentage format

# Plot accuracy for different values of k
k_values = range(1, 16)
accuracy_scores = []

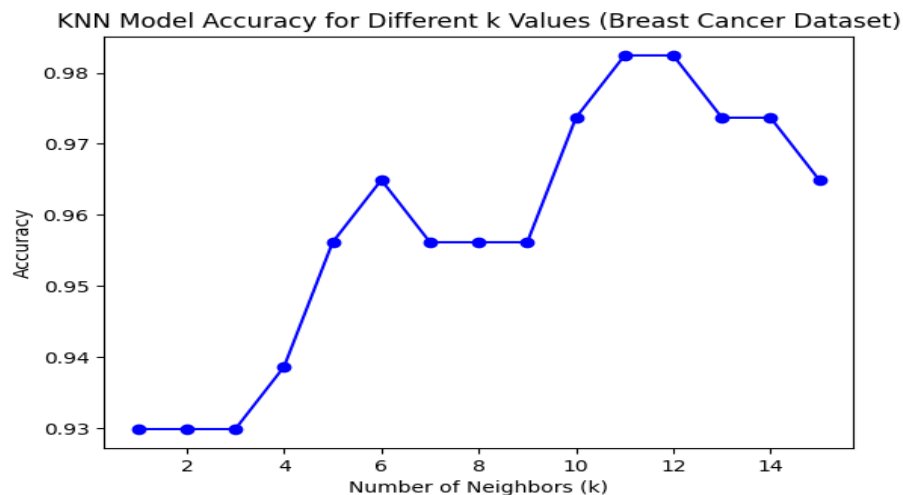
for k in k_values:
    knn = KNeighborsClassifier(n_neighbors=k)
    knn.fit(X_train, y_train)
    y_pred = knn.predict(X_test)
    accuracy_scores.append(accuracy_score(y_test, y_pred))

plt.plot(k_values, accuracy_scores, marker='o', linestyle='-', color='b')
plt.xlabel('Number of Neighbors (k)')
plt.ylabel('Accuracy')
plt.title('KNN Model Accuracy for Different k Values (Breast Cancer Dataset)')
plt.show()

```

OUTPUT:

Model Accuracy: 95.61%



(I) KMEANS MODEL

ALGORITHM:

Step 1: Import necessary libraries (numpy, matplotlib, sklearn).

Step 2: Load the Iris dataset and extract features (X).

Step 3: Apply K-Means clustering with `n_clusters=3` and fit the model.

Step 4: Predict cluster labels and compute the Silhouette Score to evaluate clustering performance.

Step 5: Plot the clusters using the first two features and mark cluster centroids.

Step 6: Display the clustering results and analyze the Silhouette Score for quality assessment.

SOURCE CODE:

```
import numpy as np
import matplotlib.pyplot as plt
from sklearn import datasets
from sklearn.cluster import KMeans
from sklearn.metrics import silhouette_score

# Load the Iris dataset
iris = datasets.load_iris()
X = iris.data # Features (4D)
y_true = iris.target # True labels (for reference)

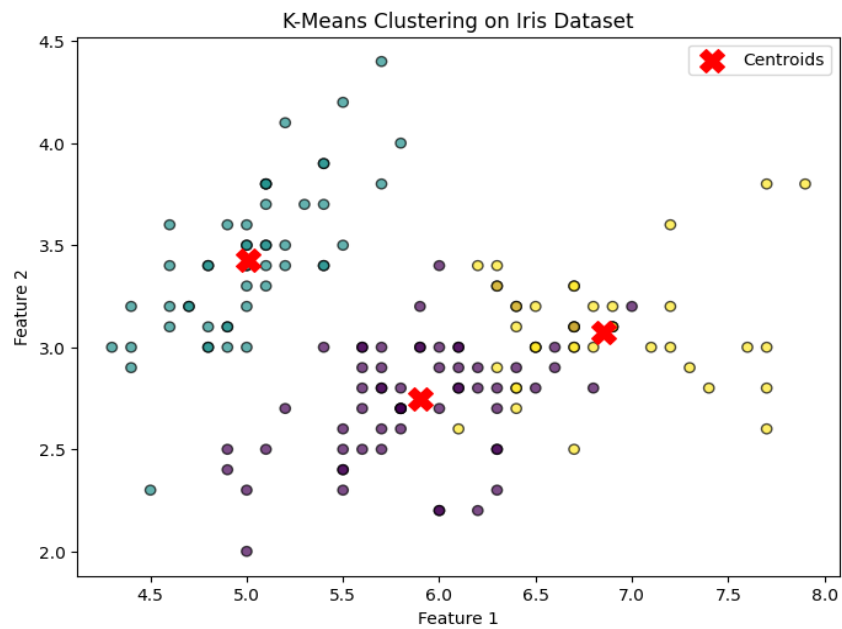
# Apply K-Means Clustering
kmeans = KMeans(n_clusters=3, random_state=42, n_init=10)
y_kmeans = kmeans.fit_predict(X)

# Calculate Silhouette Score (higher is better)
sil_score = silhouette_score(X, y_kmeans)
print(f'Silhouette Score: {sil_score:.4f}')

# Plot clusters
plt.figure(figsize=(8,6))
plt.scatter(X[:, 0], X[:, 1], c=y_kmeans, cmap='viridis', edgecolors='k', alpha=0.7)
plt.scatter(kmeans.cluster_centers_[0], kmeans.cluster_centers_[1],
            s=200, c='red', marker='X', label="Centroids")
plt.xlabel("Feature 1")
plt.ylabel("Feature 2")
plt.title("K-Means Clustering on Iris Dataset")
plt.legend()
plt.show()
```


OUTPUT:

Silhouette Score: 0.5528



RESULT:

Thus the python program to implement KNN and KMEANS model has been successfully implemented and the results have been verified and analyzed.

EXP NO: 10	PYTHON PROGRAM FOR SIMPLE LINEAR REGRESSION
DATE: 11/4/25	

AIM:

To implement Dimensionality Reduction using PCA in a python program.

ALGORITHM:

- Step 1:** Import required libraries (numpy, matplotlib, sklearn).
- Step 2:** Load the Iris dataset and extract features (X) and labels (y).
- Step 3:** Apply PCA to reduce 4D features to 2D (n_components=2).
- Step 4:** Compute and print the explained variance ratio for both principal components.
- Step 5:** Plot the transformed 2D data, color-coded by target class (y).
- Step 6:** Display the scatter plot with labeled axes and a color bar for class identification.

SOURCE CODE:

```
import numpy as np
import matplotlib.pyplot as plt
from sklearn import datasets
from sklearn.decomposition import PCA

# Load the Iris dataset
iris = datasets.load_iris()
X = iris.data # Features (4D)
y = iris.target # Labels (0,1,2)

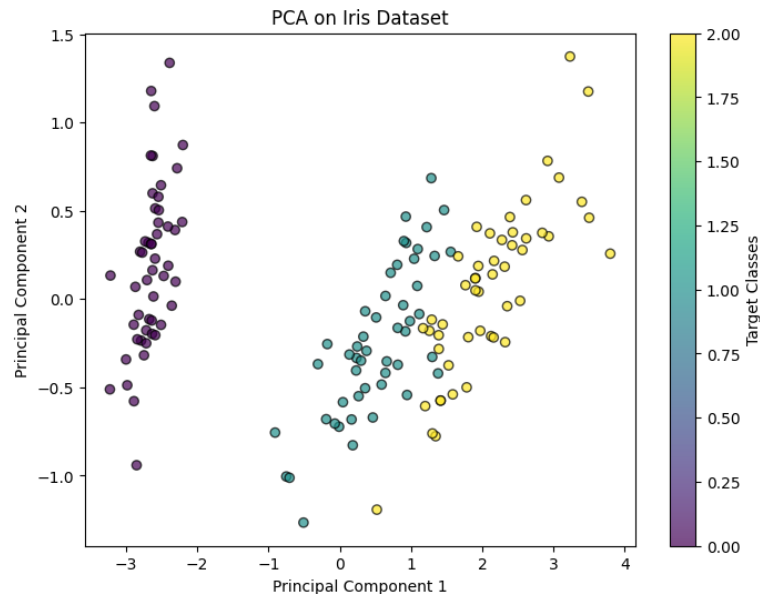
# Apply PCA to reduce from 4D to 2D
pca = PCA(n_components=2) # Reduce to 2 dimensions
X_pca = pca.fit_transform(X)

# Print explained variance ratio
explained_variance = pca.explained_variance_ratio_
print(f"Explained Variance by Component 1: {explained_variance[0]*100:.2f}%")
print(f"Explained Variance by Component 2: {explained_variance[1]*100:.2f}%")
print(f"Total Variance Retained: {sum(explained_variance)*100:.2f}%")
```

```
# Plot the reduced 2D data
plt.figure(figsize=(8,6))
plt.scatter(X_pca[:, 0], X_pca[:, 1], c=y, cmap='viridis', edgecolors='k', alpha=0.7)
plt.xlabel("Principal Component 1")
plt.ylabel("Principal Component 2")
plt.title("PCA on Iris Dataset")
plt.colorbar(label="Target Classes")
plt.show()
```

OUTPUT:

Explained Variance by Component 1: 92.46%
Explained Variance by Component 2: 5.31%
Total Variance Retained: 97.77%



RESULT:

Thus Dimensionality Reduction has been implemented using PCA in a python program successfully and the results have been analyzed

EXP NO: 11	DEVELOP A SIMPLE APPLICATION USING TENSORFLOW/KERAS
DATE: 11/4/25	

AIM:

To develop a simple application using tensorflow/keras.

ALGORITHM:

- Step 1:** Import necessary libraries (`tensorflow`, `matplotlib`, `numpy`).
- Step 2:** Load the MNIST dataset using `tf.keras.datasets.mnist.load_data()`.
- Step 3:** Normalize the image data by dividing pixel values by 255.0.
- Step 4:** Build a Sequential neural network model with:
- A Flatten layer to convert 28x28 images into 1D vectors,
 - A Dense hidden layer with 128 neurons and ReLU activation,
 - A Dense output layer with 10 units (for 10 digit classes).
- Step 5:** Compile the model using the Adam optimizer and sparse categorical crossentropy loss.
- Step 6:** Train the model on the training data for 5 epochs using `model.fit()`.
- Step 7:** Evaluate the model on the test data using `model.evaluate()`.
- Step 8:** Generate predictions for the test data using `model(x_test)`.
- Step 9:** Visualize the first 5 test images along with predicted and true labels using `matplotlib`.

SOURCE CODE:

```
import tensorflow as tf
import matplotlib.pyplot as plt
import numpy as np

# Load data
(x_train, y_train), (x_test, y_test) = tf.keras.datasets.mnist.load_data()
x_train, x_test = x_train/255.0, x_test/255.0 # Normalize

# Build model
model = tf.keras.Sequential([
    tf.keras.layers.Flatten(input_shape=(28, 28)),
    tf.keras.layers.Dense(128, activation='relu'),
    tf.keras.layers.Dense(10)
])

# Compile and train
model.compile(optimizer='adam',
              loss=tf.keras.losses.SparseCategoricalCrossentropy(from_logits=True),
```

```

        metrics=['accuracy'])
model.fit(x_train, y_train, epochs=5)

# Evaluate
model.evaluate(x_test, y_test)
predictions = model(x_test)

# Visualize the first 5 test images and their predicted labels
for i in range(5):
    plt.imshow(x_test[i], cmap=plt.cm.binary)
    plt.title(f"Predicted: {np.argmax(predictions[i])} | True: {y_test[i]}")
    plt.show()

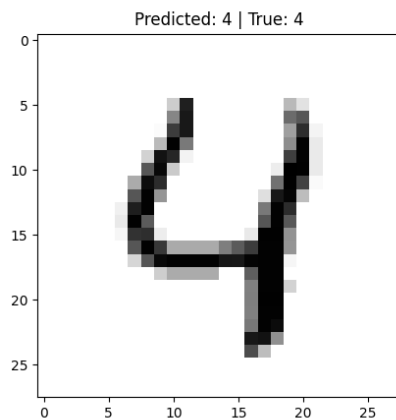
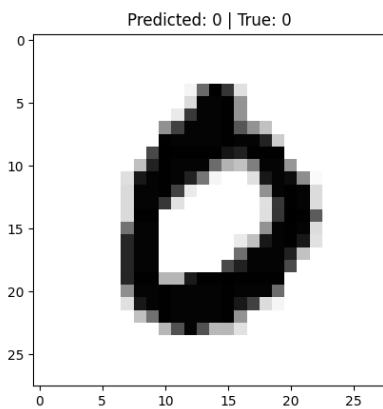
```

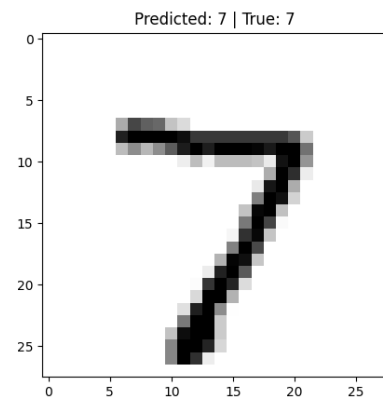
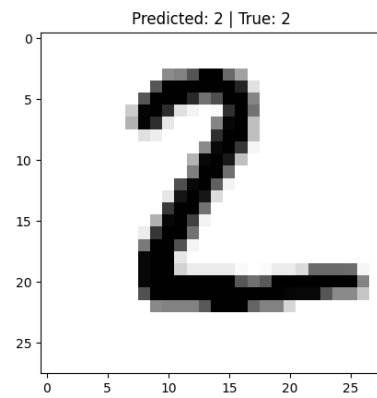
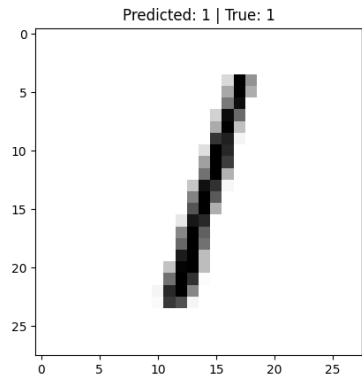
OUTPUT:

```

Explained Variance by Component 1: 92.46%
Explained Variance by Component 2: 5.31%
Total Variance Retained: 97.77%

```





RESULT:

Thus a simple application using tensorflow/keras is developed.