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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

GOVT. POLYTECHNIC

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SPECIALIZATION PATHWAY

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING

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Table Content

SPECIALIZATION PATHWAY

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING

Problem Statement :

Stock market prediction is an important challenge in finance and data science. The goal of this project is to predict stock prices using two approaches:

Machine Learning (ML): Random Forest Regressor

Deep Learning (DL): Neural Network

- Stock market prices fluctuate daily, making accurate prediction challenging.
- Investors and analysts need reliable tools to estimate future price trends.
- Traditional methods (moving averages, statistical models) often fail on noisy data.
- Machine Learning (ML) can capture non-linear patterns in historical stock data.
- Deep Learning (DL) provides advanced capabilities to learn from complex features.
- This project aims to compare ML and DL models on a regression problem.
- Dataset consists of 100 days of synthetic stock prices with noise added.
- Independent variable: Day, Dependent variable: Price.
- ML approach: Random Forest Regressor.
- DL approach: Neural Network (Dense layers with dropout).

Project Plan :

A Project Plan is a structured roadmap that describes how a project will be executed, monitored, and completed.

- Define the objective: Predict stock price using regression.
- Collect/create dataset (synthetic data for demonstration).
- Preprocess data: scaling using StandardScaler.
- Split dataset into training and testing sets (80%-20%).
- Build ML model using Random Forest Regressor.
- Build DL model using a Neural Network with dense layer.
- Train both models on training data.
- Evaluate models using metrics (MSE, MAE, R^2).
- Visualize predictions and learning history.
- Compare ML vs DL results to analyze performance.
- Train DL model with 100 epochs and validation.
- Compare ML and DL predictions on test set.
- Visualize RF vs DL results with line plots.
- Analyze results using metrics (MSE, R^2, MAE).
- Document observations and finalize report.

Product Backlog:

A project backlog is a list of tasks, features, or work items that need to be completed in a project.

- Define Problem Statement – Clearly describe the task of predicting stock prices using regression models (ML + DL).
- Collect / Generate Dataset – Use a sample dataset (days vs price) or fetch real stock market data.
- Explore Dataset – View first rows, check summary statistics, and understand data structure.
- Preprocess Data – Select features (day) and target (price), handle missing values (if any).
- Feature Scaling – Apply StandardScaler to normalize feature values.
- Split Dataset – Divide into training and testing sets (e.g., 80%-20%).
- Build ML Model – Implement Random Forest Regressor as baseline machine learning model.
- Train ML Model – Fit Random Forest model using training dataset.
- Evaluate ML Model – Calculate metrics like MSE and R^2 for Random Forest.
- Build DL Model – Create Neural Network with dense layers and dropout for regression.

Implementation:

- Dataset: Generated synthetic stock prices (days vs price with noise).
- Preprocessing: StandardScaler applied to normalize features.
- Train-Test Split: 80% training, 20% testing data.
- ML Model: Random Forest Regressor with 100 trees.
- DL Model: Neural Network with 64-32 hidden layers + Dropout.
- Training: DL trained for 100 epochs, batch size = 8.
- Evaluation Metrics: MSE, MAE (DL) and R^2 (ML).
- Visualization: Scatter plots (RF), Training loss curves (DL).
- Comparison: Overplayed actual vs predicted (RF vs DL).
- Result: Random Forest performed well on small dataset,
- DL showed potential for larger datasets.

Program to demonstrate stack price prediction using regression model with ML

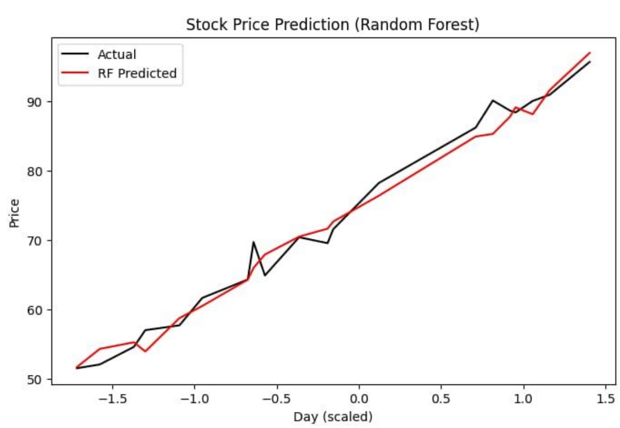
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.ensemble import RandomForestRegressor
from sklearn.metrics import mean_squared_error, r2_score
np.random.seed(42)
days = np.arange(1, 101)
price = 50 + 0.5 * days + np.random.normal(0, 2, size=100)
df = pd.DataFrame({"day": days, "price": price})
print("First 5 rows of dataset:\n", df.head())
X = df[['day']]
y = df['price']
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, random_state=42
)
rf_model = RandomForestRegressor(n_estimators=100, random_state=42)
rf_model.fit(X_train, y_train)
y_pred_rf = rf_model.predict(X_test)
print("\n Random Forest Results:")
print("MSE:", mean_squared_error(y_test, y_pred_rf))
print("R2 Score:", r2_score(y_test, y_pred_rf))
```

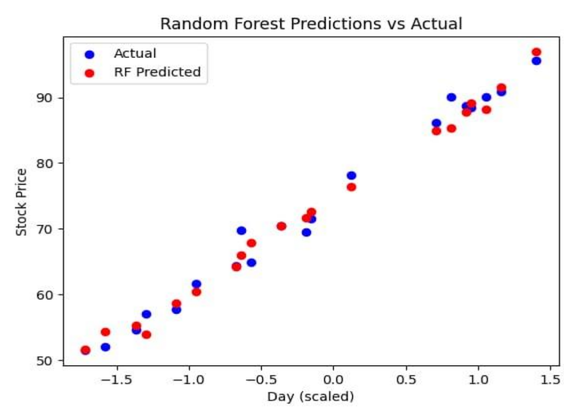
```
plt.scatter(X_test, y_test, color='blue', label="Actual")
plt.scatter(X_test, y_pred_rf, color='red', label="RF Predicted")
plt.title("Random Forest Predictions vs Actual")
plt.xlabel("Day (scaled)")
plt.ylabel("Stock Price")
plt.legend()
plt.show()
y_test_array = np.array(y_test)
sorted_idx = np.argsort(X_test.flatten())
plt.figure(figsize=(8,5))
plt.plot(X_test.flatten()[sorted_idx], y_test_array[sorted_idx], label="Actual", color="black")
plt.plot(X_test.flatten()[sorted_idx], y_pred_rf[sorted_idx], label="RF Predicted", color="red")
plt.title("Stock Price Prediction (Random Forest)")
plt.xlabel("Day (scaled)")
plt.ylabel("Price")
plt.legend()
plt.show()
```

OUTPUT :

Random Forest Results:

MSE: 4.0807103809295615 R2 Score: 0.9802872047844202





Program to demonstrate stack price prediction using regression model with DL

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import tensorflow as tf
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense, Dropout
np.random.seed(42)
days = np.arange(1, 101)
price = 50 + 0.5 * days + np.random.normal(0, 2, size=100)
df = pd.DataFrame({"day": days, "price": price})
print("First 5 rows of dataset:\n", df.head())
X = df[['day']]
y = df['price']
from sklearn.preprocessing import StandardScaler
scaler = StandardScaler()
X_scaled = scaler.fit_transform(X)
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(
    X_scaled, y, test_size=0.2, random_state=42
)
dl_model = Sequential([
    Dense(64, activation='relu', input_shape=(X_train.shape[1],)),
    Dropout(0.2),
```

```
    Dense(32, activation='relu'),
    Dense(1)  # Regression output (no activation)
])
dl_model.compile(optimizer='adam', loss='mse', metrics=['mae'])
history = dl_model.fit(X_train, y_train, validation_data=(X_test, y_test),
                       epochs=100, batch_size=8, verbose=0)
dl_mse, dl_mae = dl_model.evaluate(X_test, y_test, verbose=0)
print("\n Deep Learning Results:")
print("MSE:", dl_mse)
print("MAE:", dl_mae)
plt.plot(history.history['loss'], label='Train Loss')
plt.plot(history.history['val_loss'], label='Val Loss')
plt.title("DL Model Training Loss (MSE)")
plt.xlabel("Epochs")
plt.ylabel("Loss")
plt.legend()
plt.show()
y_pred_dl = dl_model.predict(X_test).flatten()
y_test_array = np.array(y_test)
sorted_idx = np.argsort(X_test.flatten())
plt.figure(figsize=(8,5))
plt.plot(X_test.flatten()[sorted_idx], y_test_array[sorted_idx], label="Actual", color="black")
plt.plot(X_test.flatten()[sorted_idx], y_pred_dl[sorted_idx], label="DL Predicted", color="green")
plt.title("Stock Price Prediction with Deep Learning")
plt.xlabel("Day (scaled)")
```

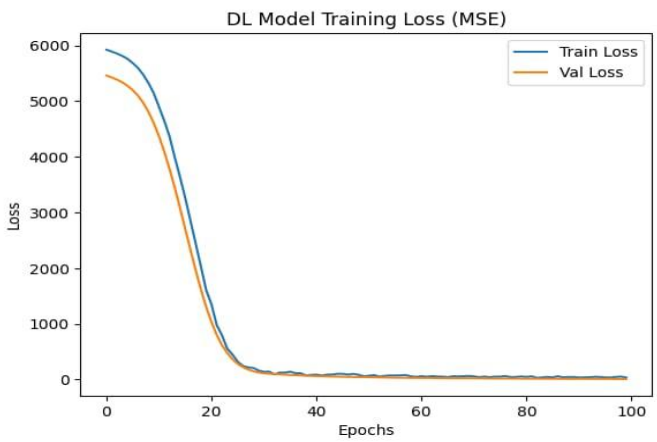
```
plt.ylabel("Price")

plt.legend()

plt.show()
```

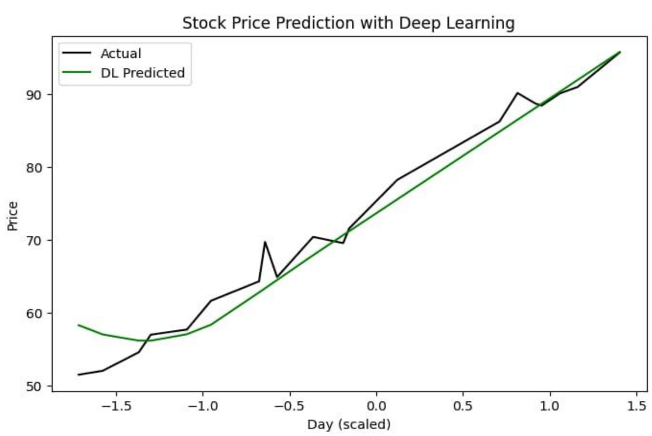
OUTPUT :

Deep Learning Results:

MSE: 7.991880893707275

MAE: 2.009674072265625





GIT REPOSITORY

Problem Statement :

- The project focuses on predicting student performance as Pass/Fail.
- It uses machine learning (Random Forest) and deep learning (Neural Network) for classification.
- Input features include study hours, attendance, parent support, and previous scores.
- Target variable is binary: pass or fail.
- The project compares ML vs DL approaches.
- Dataset is a small synthetic dataset with 15 student record
- The study aims to help in early identification of at-risk students.
- It uses supervised learning techniques.
- The ML part is implemented with scikit-learn RandomForestClassifier.
- The DL part is implemented with TensorFlow Keras Sequential API.
- Evaluation metrics include accuracy, confusion matrix, classification report.
- Feature scaling ensures fair comparison between models.

Project Plan:

- Define the problem statement clearly.
- Collect or simulate student dataset.
- Perform data preprocessing (encoding + scaling).
- Split dataset into training and testing sets.
- Implement Random Forest classifier.
- Train the RF model and evaluate accuracy.
- Visualize feature importance for ML.
- Build a Neural Network model using Keras.
- Train the DL model with proper validation.
- Monitor training vs validation accuracy.
- Compare ML vs DL model performance.
- Document challenges in data preprocessing.
- Prepare visualizations for clarity.
- Analyze which model works best with the dataset.
- Summarize findings in a final report.

Product Backlog:

- Dataset preparation (manual or real-world).
- Handle categorical encoding.
- Feature scaling implementation.
- ML model (Random Forest).
- Train-test split design.
- Evaluate ML with metrics.
- Visualize ML feature importance.
- DL model architecture design.
- Compile and train DL model.
- Plot training history (accuracy curves).
- Evaluate DL model accuracy.
- Compare ML and DL results.
- Documentation of results.
- Add visualization for better interpretability.
- Create final project report.

Implementation:

- Used pandas and matplotlib for dataset handling and visualization.
- Encoded categorical data (parental support, pass/fail labels).
- Applied StandardScaler for normalization of numeric features.
- Splitted dataset into 80% train, 20% test.
- ML Model: RandomForestClassifier with 100 trees.
- DL Model: Sequential Neural Network with ReLU layers and dropout for regularization.
- Output layer used sigmoid activation for binary classification.
- Trained DL model for 50 epochs with validation monitoring.
- Evaluated models with accuracy, confusion matrix, and classification report.
- Plotted feature importance (ML) and training accuracy (DL).

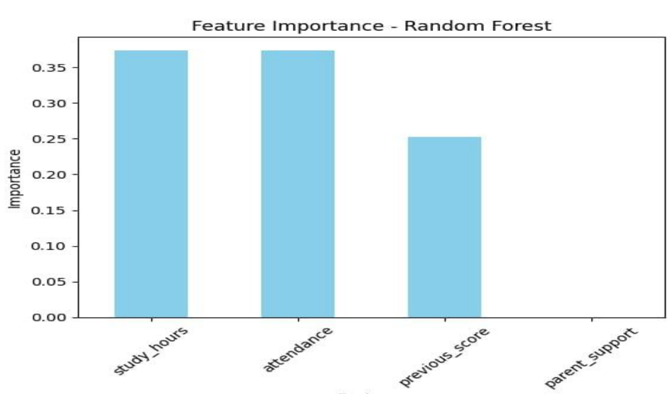
Program to demonstrate stack price prediction using Classification model with ML

```
import pandas as pd

from sklearn.model_selection import train_test_split

from sklearn.preprocessing import LabelEncoder, StandardScaler

from sklearn.ensemble import RandomForestClassifier

from sklearn.metrics import accuracy_score, confusion_matrix, classification_report

import matplotlib.pyplot as plt

data = {

    'study_hours': [2, 5, 7, 1, 3, 8, 4, 6, 9, 2, 5, 7, 3, 8, 6],

    'attendance': [70, 90, 85, 60, 75, 95, 80, 88, 96, 65, 85, 92, 78, 94, 89],

    'parent_support': ['low', 'medium', 'high', 'low', 'medium',

                       'high', 'medium', 'high', 'high', 'low',

                       'medium', 'high', 'medium', 'high', 'medium'],

    'previous_score': [40, 65, 78, 30, 55, 85, 60, 70, 90, 35, 68, 80, 58, 87, 72],

    'pass_fail': ['fail', 'pass', 'pass', 'fail', 'fail',

                  'pass', 'fail', 'pass', 'pass', 'fail',

                  'pass', 'pass', 'fail', 'pass', 'pass']

}

df = pd.DataFrame(data)

le = LabelEncoder()

df['parent_support'] = le.fit_transform(df['parent_support'])

y = LabelEncoder().fit_transform(df['pass_fail'])

X = df.drop('pass_fail', axis=1)

X = StandardScaler().fit_transform(X)
```

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

rf_model = RandomForestClassifier(n_estimators=100, random_state=42)

rf_model.fit(X_train, y_train)

y_pred = rf_model.predict(X_test)

print("\nRandom Forest Results:")

print("Accuracy:", accuracy_score(y_test, y_pred))

print("\nConfusion Matrix:\n", confusion_matrix(y_test, y_pred))

print("\nClassification Report:\n", classification_report(y_test, y_pred))

feat_importances = pd.Series(rf_model.feature_importances_, index=df.drop('pass_fail',
axis=1).columns)

feat_importances.nlargest(4).plot(kind='barh', color="skyblue")

plt.title("Feature Importance - Random Forest")

plt.show()
```

OUTPUT :

	precision	recall	f1-score	support
0	1.00	1.00	1.00	2
1	1.00	1.00	1.00	1
accuracy			1.00	3
macro avg	1.00	1.00	1.00	3
weighted avg	1.00	1.00	1.00	3



Program to demonstrate stack price prediction using Classification model with DL

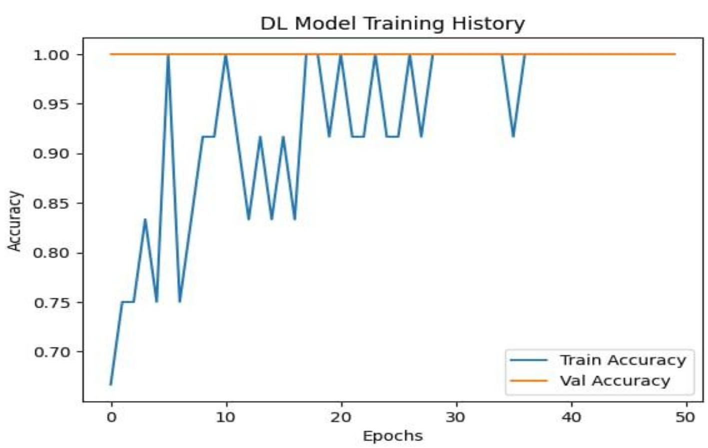
```
import pandas as pd

import numpy as np

import matplotlib.pyplot as plt

import seaborn as sns

import tensorflow as tf

from tensorflow.keras.models import Sequential

from tensorflow.keras.layers import Dense, Dropout

data = {

    'study_hours': [2, 5, 7, 1, 3, 8, 4, 6, 9, 2, 5, 7, 3, 8, 6],

    'attendance': [70, 90, 85, 60, 75, 95, 80, 88, 96, 65, 85, 92, 78, 94, 89],

    'parent_support': ['low', 'medium', 'high', 'low', 'medium',

                       'high', 'medium', 'high', 'high', 'low',

                       'medium', 'high', 'medium', 'high', 'medium'],

    'previous_score': [40, 65, 78, 30, 55, 85, 60, 70, 90, 35, 68, 80, 58, 87, 72],

    'pass_fail': ['fail', 'pass', 'pass', 'fail', 'fail',

                  'pass', 'fail', 'pass', 'pass', 'fail',

                  'pass', 'pass', 'fail', 'pass', 'pass']

}

df = pd.DataFrame(data)

print("First 5 rows of dataset:\n", df.head())

from sklearn.model_selection import train_test_split
```

```
from sklearn.preprocessing import LabelEncoder, StandardScaler
le = LabelEncoder()
df['parent_support'] = le.fit_transform(df['parent_support'])
X = df.drop('pass_fail', axis=1)
y = df['pass_fail']
y = LabelEncoder().fit_transform(y)
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, random_state=42
)
dl_model = Sequential([
    Dense(32, activation='relu', input_shape=(X_train.shape[1],)),
    Dropout(0.2),
    Dense(16, activation='relu'),
    Dropout(0.2),
    Dense(1, activation='sigmoid')  # Binary classification
])
dl_model.compile(optimizer='adam', loss='binary_crossentropy', metrics=['accuracy'])
history = dl_model.fit(X_train, y_train, validation_data=(X_test, y_test),
                       epochs=50, batch_size=4, verbose=0)
dl_loss, dl_acc = dl_model.evaluate(X_test, y_test, verbose=0)
print("\n Deep Learning Results:")
print("Accuracy:", dl_acc)
plt.plot(history.history['accuracy'], label='Train Accuracy')
```

```
plt.plot(history.history['val_accuracy'], label='Val Accuracy')
plt.title("DL Model Training History")
plt.xlabel("Epochs")
plt.ylabel("Accuracy")
plt.legend()
plt.show()
```

OUTPUT :

study_	hours	attendance	parent_support	previous_score	pass_fail
0	2	70	low	40	fail
1	5	90	medium	65	pass
2	7	85	high	78	pass
3	1	60	low	30	fail
4	3	75	medium	55	fail



Git Repository :