# Training Day 17 Report

**Date:** 15 July 2025
**Topic:** Supervised Learning – Linear Regression (Extended)

**Overview**

Today's session extended the discussion on **Supervised Learning** with a detailed focus on **Linear Regression**. Linear Regression is one of the simplest yet most widely used algorithms in Machine Learning. It helps in modeling the relationship between **independent variables (features)** and a **dependent variable (target)** by fitting a straight line (in case of simple regression) or a hyperplane (in multiple regression).

**Key Concepts**

**1. What is Linear Regression?**

- A **supervised learning algorithm** used for predicting a continuous value.
- Assumes a **linear relationship** between input variables (X) and output variable (Y).
- General formula:

Y=b0+b1X1+b2X2+⋯+bnXnY = b_0 + b_1X_1 + b_2X_2 + \dots + b_nX_n

Where:

- YY = Dependent variable (target).
- X1,X2,…,XnX_1, X_2, \dots, X_n = Independent variables (features).
- b0b_0 = Intercept.
- b1,b2,…,bnb_1, b_2, \dots, b_n = Coefficients (weights).

**2. Types of Linear Regression**

1. **Simple Linear Regression** – Single feature used to predict the target.
   Example: Predicting house price using only square footage.

2. **Multiple Linear Regression** – Multiple features used.
   Example: Predicting car prices using age, mileage, fuel type, etc.

**3. Steps in Linear Regression**

1. Data Collection
2. Data Preprocessing (handling missing values, encoding categorical data, scaling).
3. Splitting dataset into **Training** and **Testing** sets.
4. Training the model (fitting regression line).
5. Making predictions.
6. Evaluating model performance (using metrics like **Mean Absolute Error (MAE), Mean Squared Error (MSE), $R^2$ score**).

**Code Example: Simple Linear Regression**

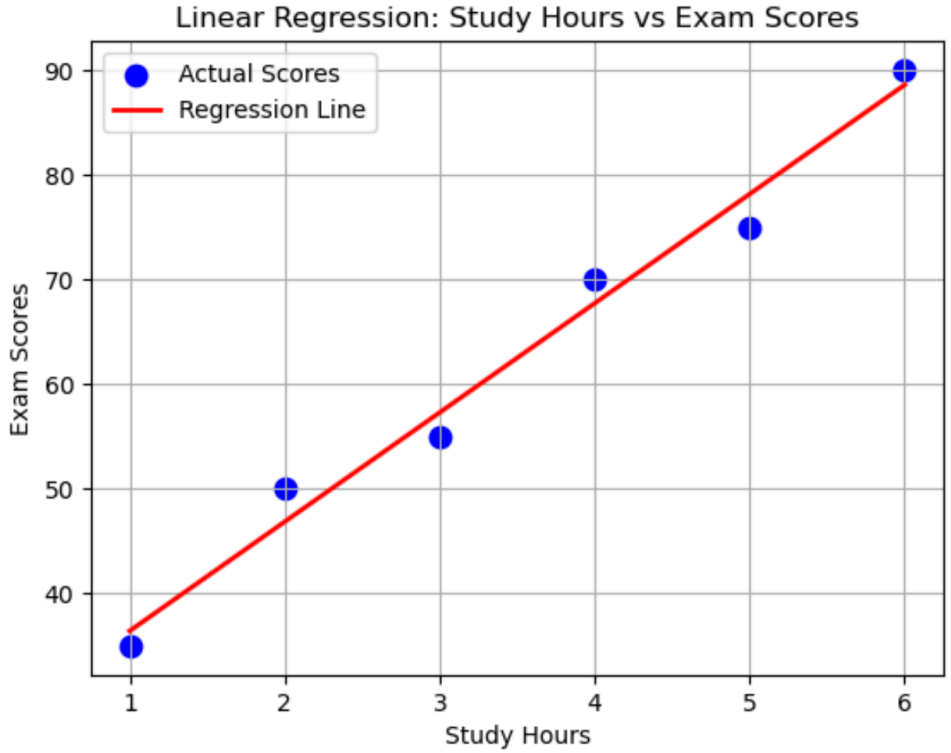
```
import numpy as np
import matplotlib.pyplot as plt
from sklearn.linear_model import LinearRegression

# Dataset: Study Hours vs Exam Scores
X = np.array([1, 2, 3, 4, 5, 6]).reshape(-1, 1)   # Features
y = np.array([35, 50, 55, 70, 75, 90])            # Target

# Train Model
model = LinearRegression()
model.fit(X, y)

# Predictions
y_pred = model.predict(X)

# Visualization
plt.scatter(X, y, color="blue", label="Actual Scores")
plt.plot(X, y_pred, color="red", linewidth=2, label="Regression Line")
plt.xlabel("Study Hours")
plt.ylabel("Exam Scores")
plt.title("Linear Regression Example")
plt.legend()
plt.show()
```




**Learning Outcome**

- Understood the **mathematical foundation** of Linear Regression.
- Learned the difference between **simple and multiple linear regression**.
- Practiced **model training and prediction** using a real dataset.
- Visualized how regression lines represent the relationship between input and output.
- Gained awareness of **evaluation metrics** for regression models.