SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
An Autonomous Institution

Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A++' Grade
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DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

23AMB201 - MACHINE LEARNING

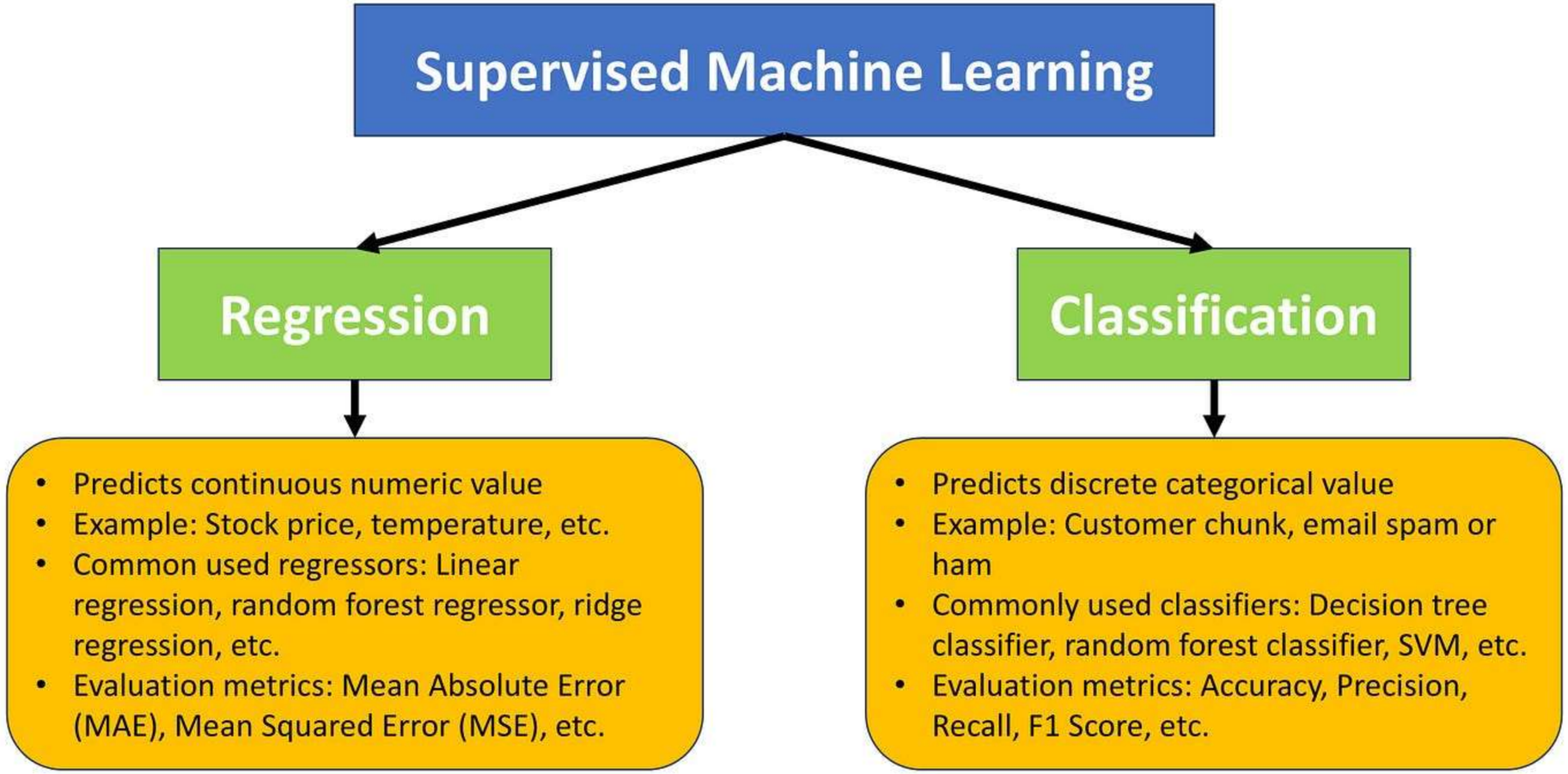
II YEAR IV SEM

UNIT II – SUPERVISED LEARNING ALGORITHMS

TOPIC 6 – Logistic Regression

Recall

1. Supervised Learning is a branch of Artificial Intelligence that focuses on training models to make predictions or decision based on labeled training data.

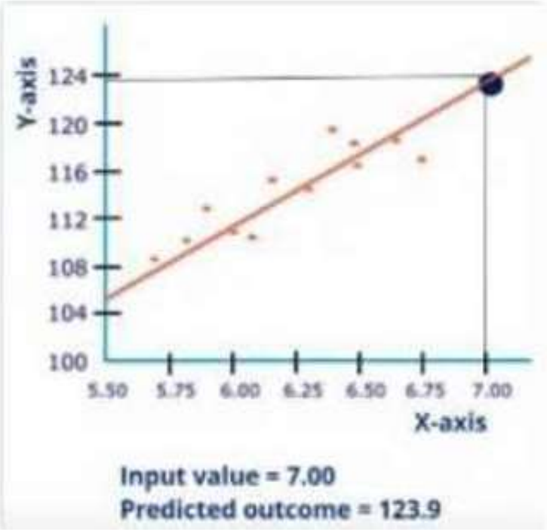


Step into

- What is Regression?
- Logistic regression: What and Why?
- Linear Vs Logistic Regression
- Use- Cases
- Demo

What is Regression?

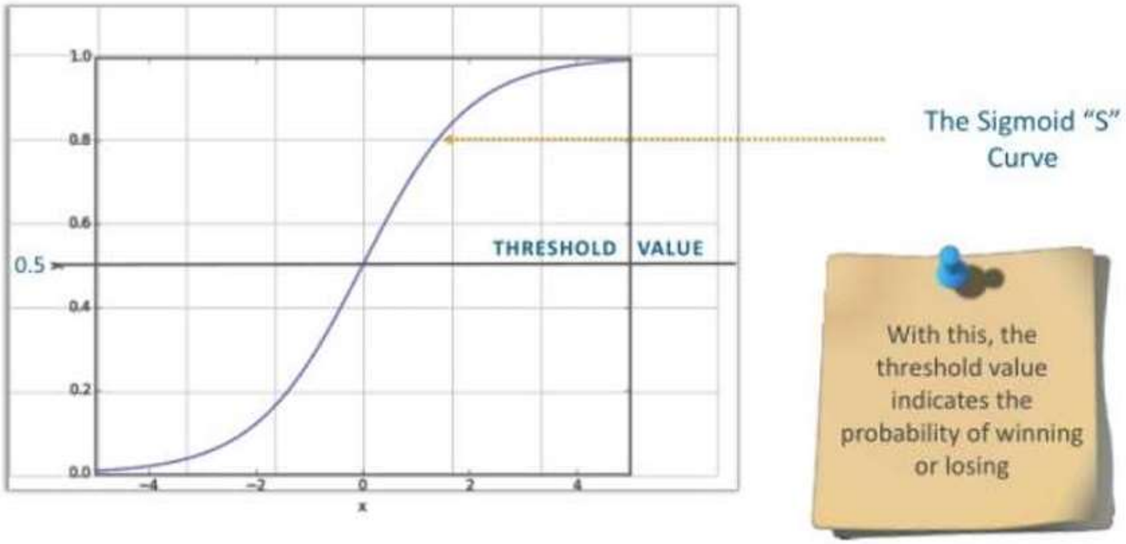
Regression Analysis is a predictive modelling technique



It estimates the relationship between a dependent (target) and an independent variable(predictor)

Logistic Regression: What and Why?

1. Logistic Regression produces results in a binary format which is used to predict the outcome of a categorical dependent variable. So the outcome should be discrete/categorial



Logistic Regression

Logistic regression: predict a categorical dependent variable from a number of independent variables.

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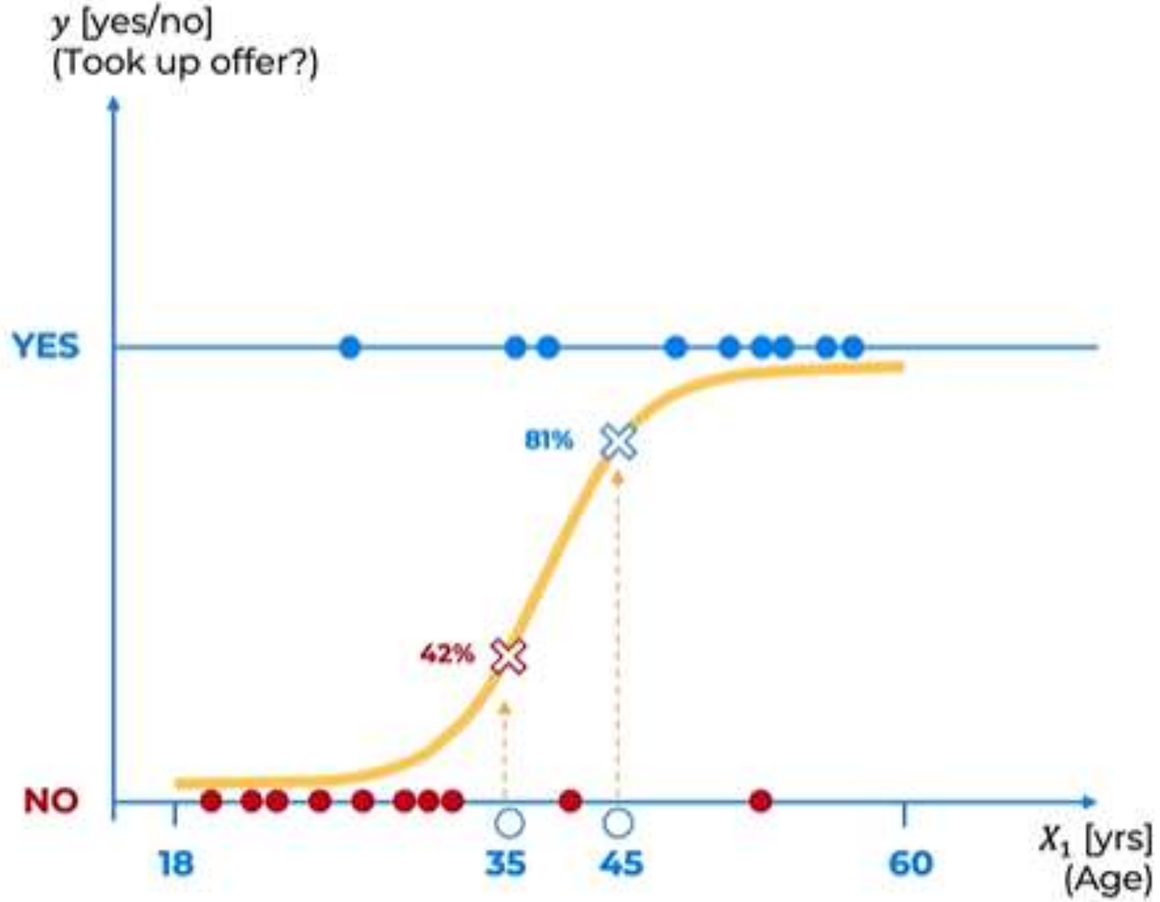
Will purchase health insurance: Yes / No

Age

$$\ln \frac{p}{1-p} = b_0 + b_1 X_1$$



Logistic Regression

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Will purchase health insurance: Yes / No

Age

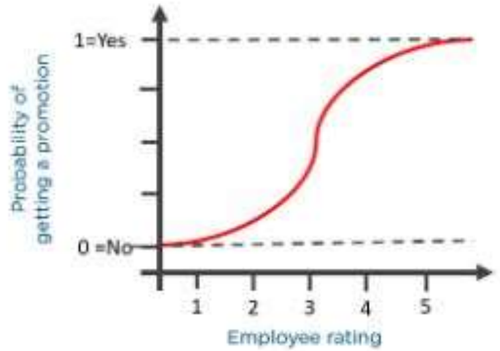
Income

Level of Education

Family or Single

$$\ln \frac{p}{1-p} = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4$$

Maximum Likelihood



$$\left(\frac{p(x)}{1-p(x)}\right) = e^{\beta_0+\beta_1 x}$$

$$p(x) = \frac{e^{\beta_0+\beta_1 x}}{1+e^{\beta_0+\beta_1 x}}$$

Let Y = e $\beta 0+\beta 1 * x$

Then p(x) / 1 - p(x) = Y

p(x) = Y(1 - p(x))

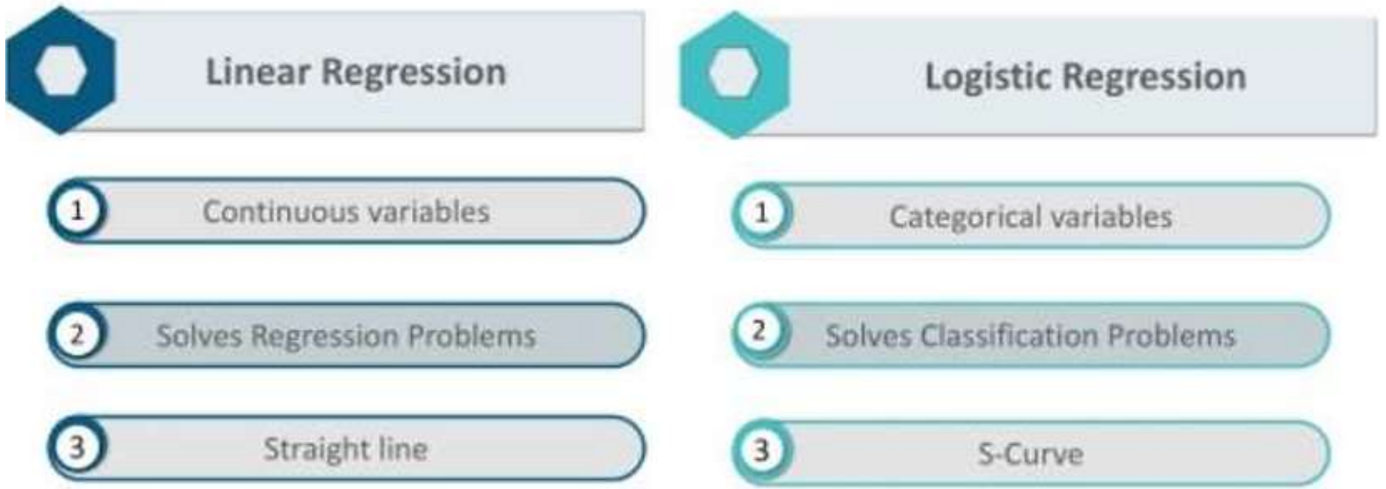
p(x) = Y - Y(p(x))

p(x) + Y(p(x)) = Y

p(x)(1+Y) = Y

p(x) = Y / 1+Y

Linear Vs Logistic

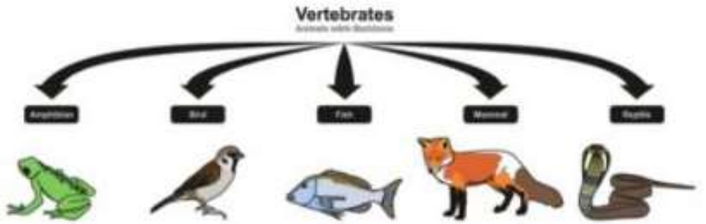


Use Case

Logistic Regression: Use - Cases

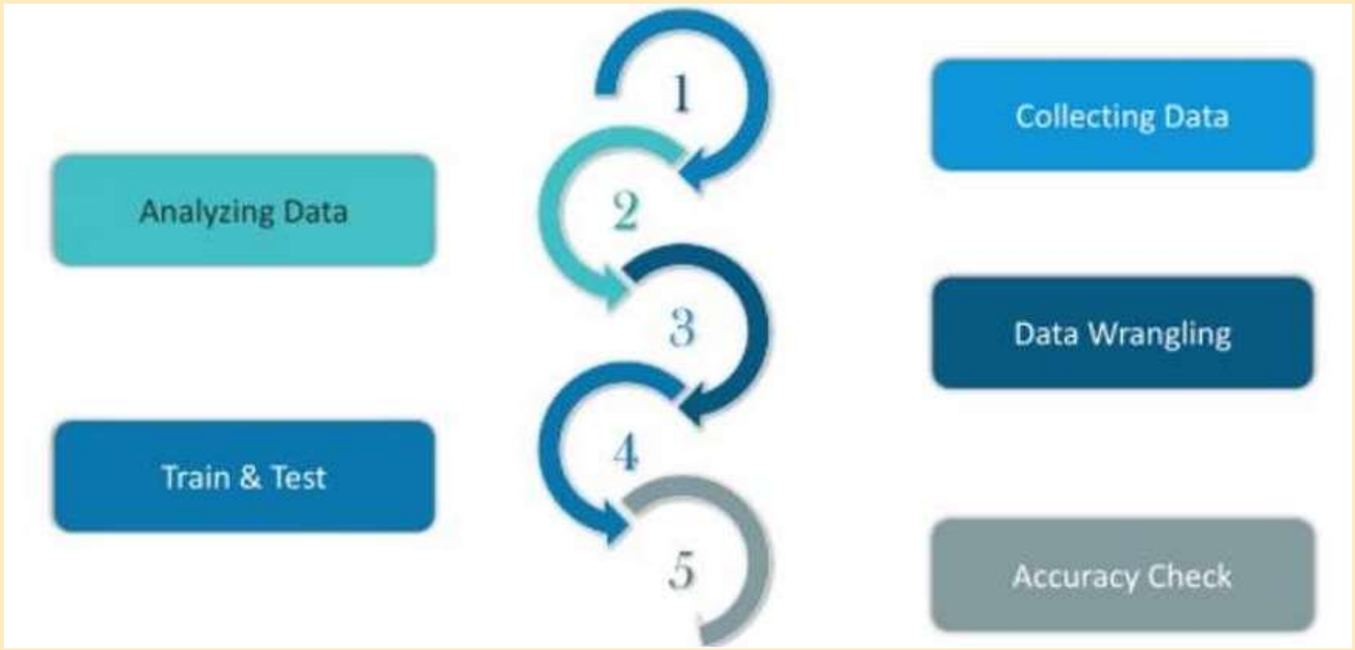
Weather Predictions

Classification Problems



Determines Illness

Implementation of Logistic Regression



Case Example: Disease prediction using Logistic Regression

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LogisticRegression
data = {
    "Age": [25, 32, 47, 50, 35, 60, 28, 55, 40, 45],
    "BloodPressure": [120, 130, 140, 135, 128, 145, 118, 150, 138, 132],
    "Glucose": [85, 90, 160, 150, 88, 170, 80, 180, 140, 110],
    "Diabetic": [0, 0, 1, 1, 0, 1, 0, 1, 1, 0]
}
df = pd.DataFrame(data)
df
```

	Age	BloodPressure	Glucose	Diabetic
0	25	120	85	0
1	32	130	90	0
2	47	140	160	1
3	50	135	150	1
4	35	128	88	0
5	60	145	170	1
6	28	118	80	0
7	55	150	180	1
8	40	138	140	1
9	45	132	110	0

Case Example: Disease prediction using Logistic Regression

```
X = df[["Age", "BloodPressure", "Glucose"]]  # Input Features
y = df["Diabetic"]  # Output Label
X
```

	Age	BloodPressure	Glucose
0	25	120	85
1	32	130	90
2	47	140	160
3	50	135	150
4	35	128	88
5	60	145	170
6	28	118	80
7	55	150	180
8	40	138	140
9	45	132	110

Case Example: Disease prediction using Logistic Regression

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

	Age	BloodPressure	Glucose
3	50	135	150
2	47	140	160

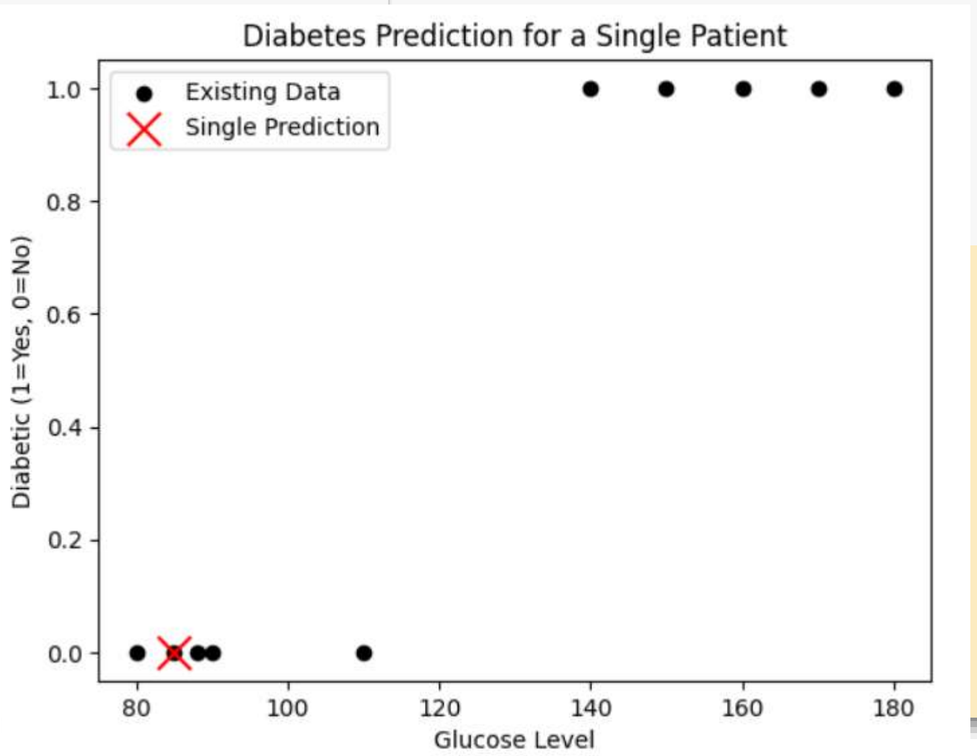
Case Example: Disease prediction using Logistic Regression

```
model = LogisticRegression()
model.fit(X_train, y_train)

single_patient = np.array([[25, 120, 85]])
single_prediction = model.predict(single_patient)

result = "Diabetic" if single_prediction == 1 else "Non-Diabetic"
print(f"📌 Prediction for Single Patient:")
print(f"Age: {single_patient[0][0]}, BP: {single_patient[0][1]}, Glucose: {single_patient[0][2]}")
print(f"Prediction: {result}")
```

```
📌 Prediction for Single Patient:
Age: 25, BP: 120, Glucose: 85
Prediction: Non-Diabetic
```

Case Example: Disease prediction using Logistic Regression

```
# Visualization: Showing the single patient prediction
plt.scatter(X["Glucose"], y, color="black", label="Existing Data")
plt.scatter(single_patient[:, 2], single_prediction, color="red", label="Single Prediction", marker="x", s=200)
plt.xlabel("Glucose Level")
plt.ylabel("Diabetic (1=Yes, 0=No)")
plt.legend()
plt.title("Diabetes Prediction for a Single Patient")
plt.show()
```



References

Y. S. Abu-Mostafa, M. Magdon-Ismail, and H.-T. Lin, ―Learning from Data, AML Book Publishers, 2012.

P. Flach, ―Machine Learning: The art and science of algorithms that make sense of data‖, Cambridge University Press, 2012.

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