Welcome & Overview

Google Cloud Platform

Google Colab

Vertex AI

Welcome & Overview

Introduction

Google Colab

- A free, cloud-based platform that offers an interactive environment for writing and executing Python code.
- Provides a Jupyter Notebook-like interface.

Vertex AI

- A managed machine learning (ML) platform provided by Google Cloud Platform (GCP) for building, deploying, and serving ML models.
- Formerly known as AI Platform.

Welcome & Overview

Cost

Google Colab

- Offers free access to GPU and TPU.
- Limited to 12 hours of continuous runtime.

Vertex AI

- Costs vary based on resource usage (e.g., training hours, prediction requests, storage).
- Offers a more flexible and scalable environment for large-scale ML projects.

Runtime and Limitations

Google Colab

- Sessions can run for a maximum of 12 hours.
- Idle timeouts can occur.
- Limited resources compared to dedicated cloud instances.

Vertex AI

- No such limitations on runtime.
- Customizable and scalable resources based on project needs.

Welcome & Overview

Customization and Flexibility

Google Colab

- Limited in terms of customizing the underlying infrastructure.

Vertex AI

- Highly customizable, allowing users to choose specific machine types, accelerators, and configurations for their tasks.

Welcome & Overview

Collaboration

Google Colab

- Supports real-time collaboration similar to other Google Docs.

Vertex AI

- Designed for enterprise-level collaboration with role-based access control and other security features.

Welcome & Overview

Model Deployment

Google Colab

- Not designed for model deployment or serving.

Vertex AI

- Provides tools for easy model deployment, scaling, and serving with prediction capabilities.

Welcome & Overview

Security

Google Colab

- Standard Google Drive security.

Vertex AI

- Enterprise-grade security features, including encryption, IAM roles, and VPC Service Controls.

Welcome & Overview

User Base and Use Cases

Google Colab

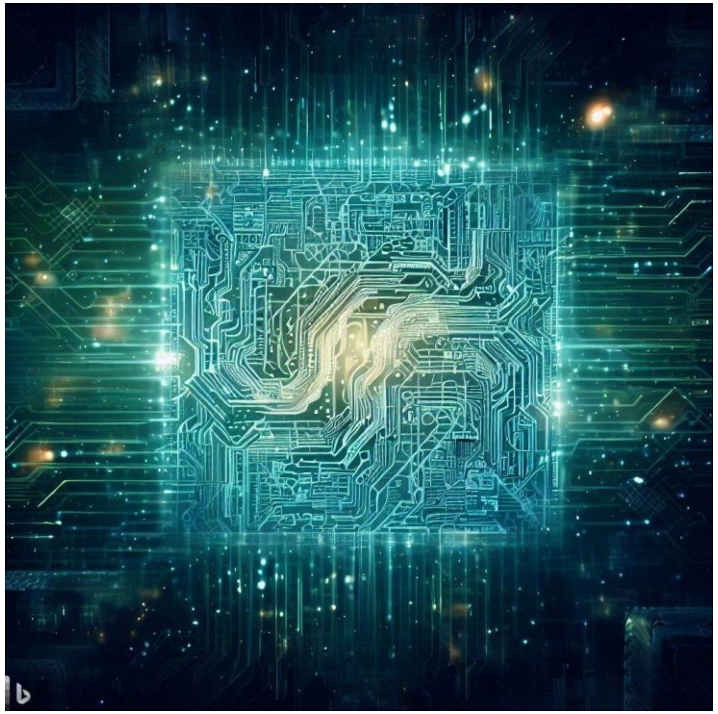
- Ideal for students, researchers, and individuals looking for a quick way to run Python code, especially for ML/DL experimentation.

Vertex AI

- Targeted towards businesses and ML professionals seeking an end-to-end platform for building, training, deploying, and serving ML models at scale.

Welcome & Overview

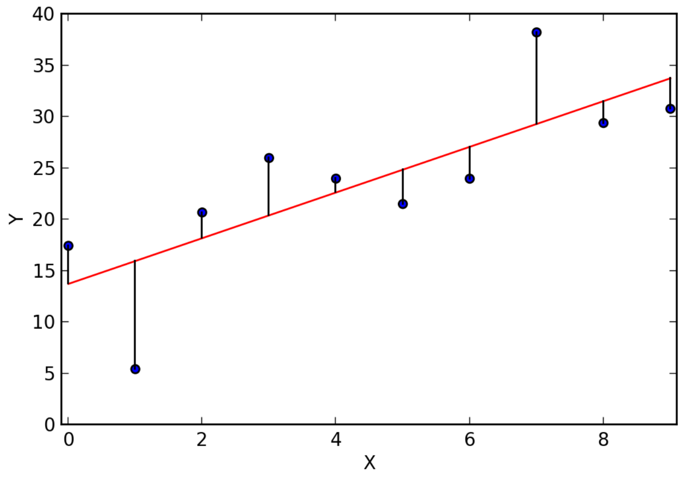
Exploring TensorFlow & Deep Learning



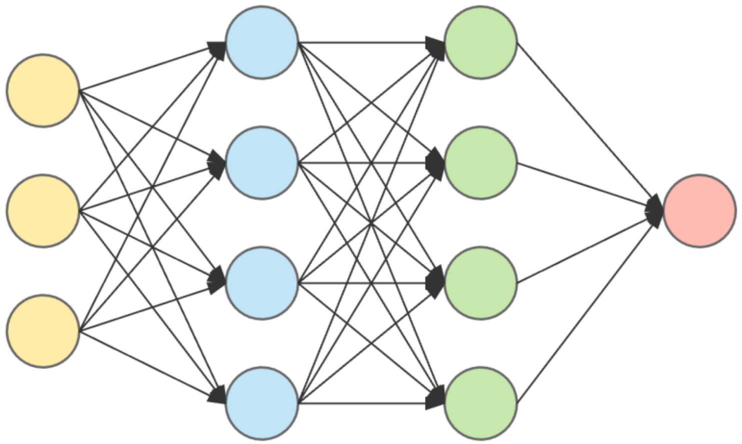
Journey into the world of deep learning with TensorFlow.

Machine Learning Landscape

The Broad Spectrum of Machine Learning



Foundational Models: Linear and Logistic Regression

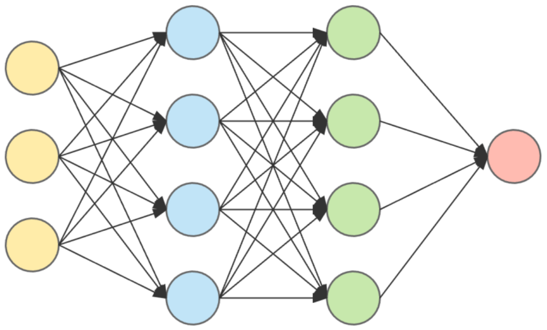


Advanced Structures: Neural Networks and Deep Learning

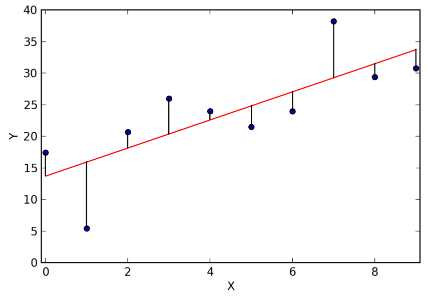
Why Not More Regression?

TensorFlow

- Designed for Deep Learning
- Handles Complex Calculations Efficiently



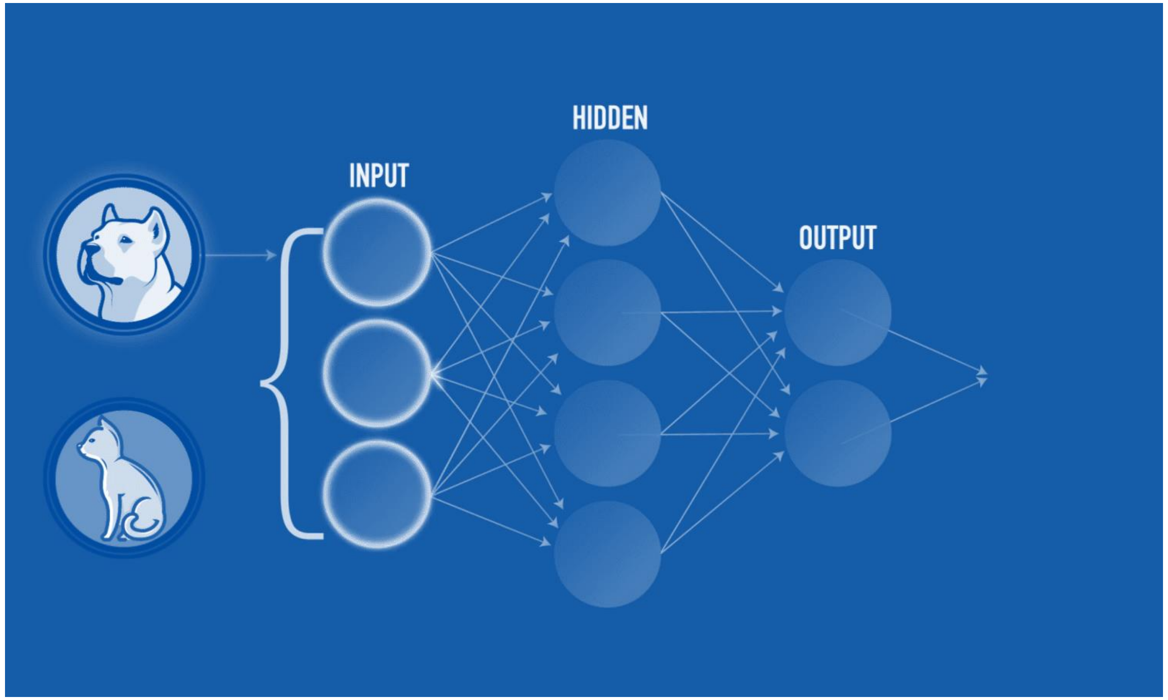
Advanced Structures: Neural Networks and Deep Learning



Foundational Models: Linear and Logistic Regression

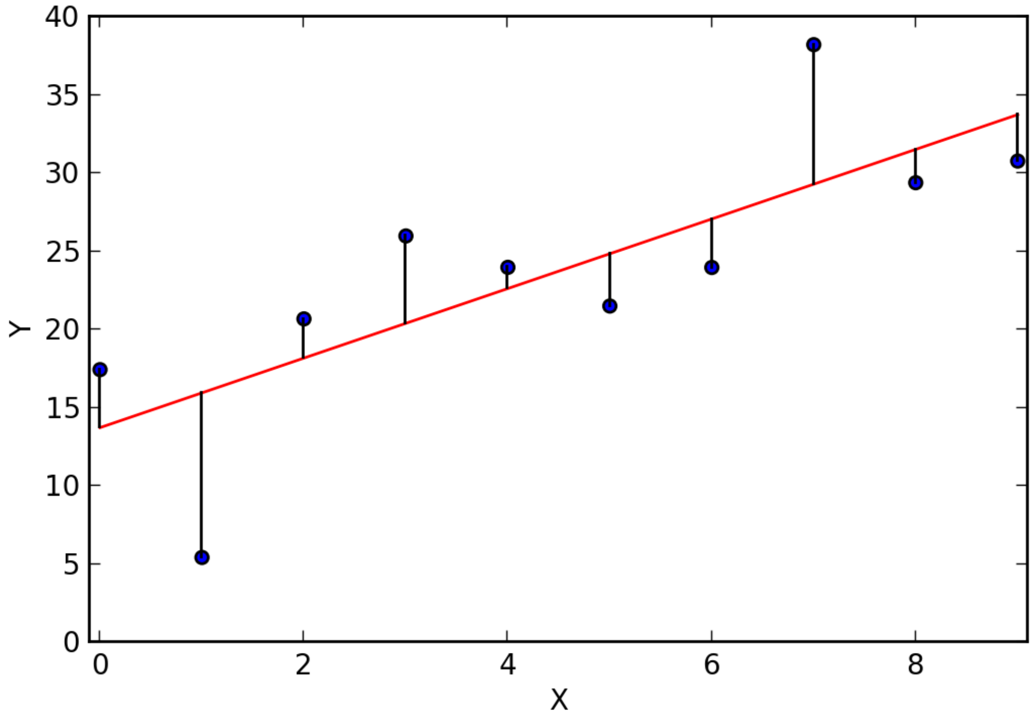
Why Not More Regression?

- Multi-layered Neural Networks
- GPU Acceleration
- Beyond Simple Models



Importance of Regression Foundations

- Regression as the bedrock of ML
- Essential for understanding advanced topics



Linear regression

What is it?

- Definition: A linear approach to modeling the relationship between a dependent variable and one or more independent variables.
- It's a line of best fit.
- Used for prediction and explaining variance.

Linear regression

Simple Linear Regression

- This is used when there's only one independent variable

$$y = b0 + b1 * X + \varepsilon$$

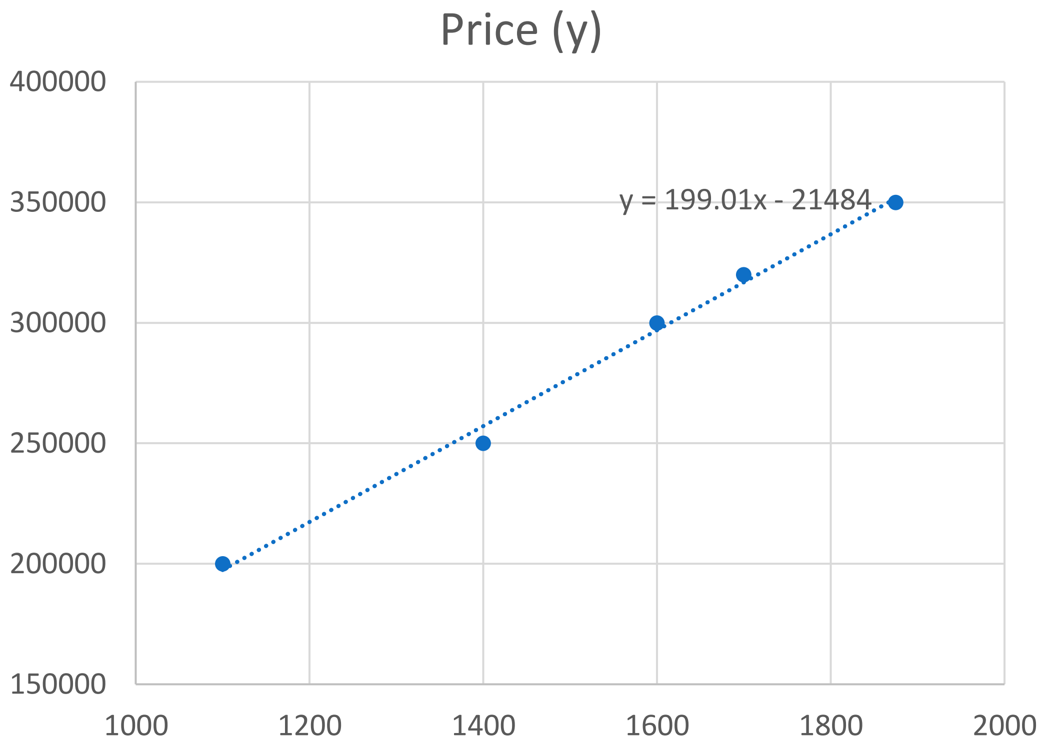
- y is the dependent variable.
- X is the independent variable.
- b0 is the y-intercept (constant term).
- b1 is the coefficient of the independent variable.
- ε is the error term, representing the variability in y that is not explained by the model.

Linear regression

$$y = b0 + b1 * X + \varepsilon$$

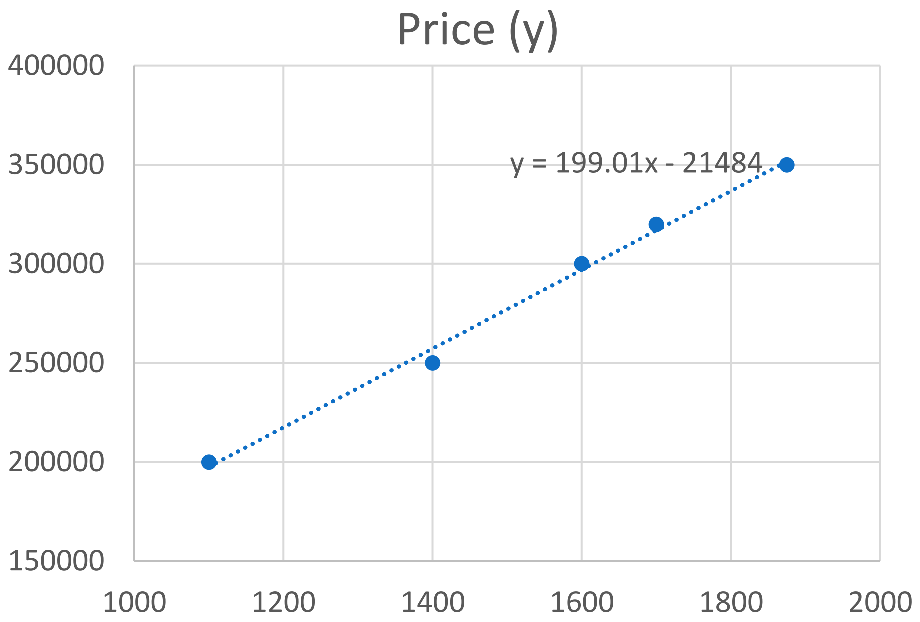
Example

House Size (X)	Price (y)
1400	250000
1600	300000
1700	320000
1875	350000
1100	200000



Linear regression

Cost function



- The cost function (also known as the loss function) quantifies the error between the predicted values and the actual values in the training dataset.
- The Mean Squared Error (MSE) is commonly used as the cost function. It calculates the average squared difference between predicted and actual values.
- Optimizers, such as Gradient Descent, are used to iteratively update the model's parameters (coefficients) to minimize the cost function.

Linear regression

Multiple Linear Regression

- This is used when there are mutiple independent variables

$$y = b0 + b1 * X1 + b2 * X2 + \ldots + bn * Xn + \varepsilon$$

- y is the dependent variable.
- X1, X2, ..., Xn are the independent variables.
- b0 is the y-intercept.
- b1, b2, ..., bn are the coefficients of the independent variables.
- ε is the error term, as in simple linear regression.

Linear regression

What is it?

- Dependent Variable: House Price
- Independent Variables: Number of Bedrooms, Size in Square Feet, Proximity to City Center.
- Price = β0 + β1(Number of Bedrooms) + β2(Size) + β3(Proximity to City Center) + ε

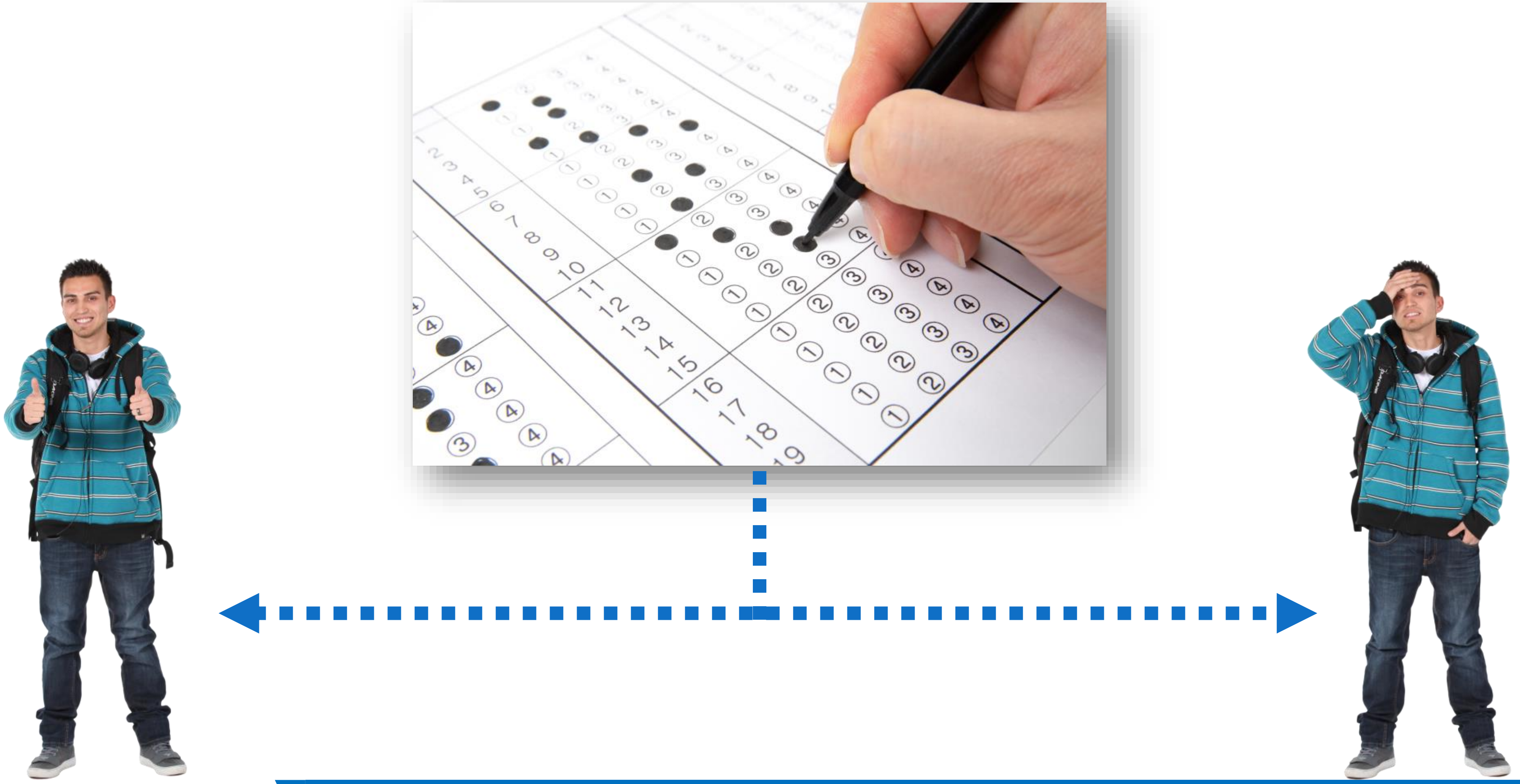
Bedrooms (X1)	Size (X2)	Distance (X3)	Salary (y)
2	1200	12	50000
5	1600	16	75000
6	1400	14	60000
4	1800	18	90000
3	1300	13	55000

Logistic regression

How much rain is expected?

Will it rain tomorrow?

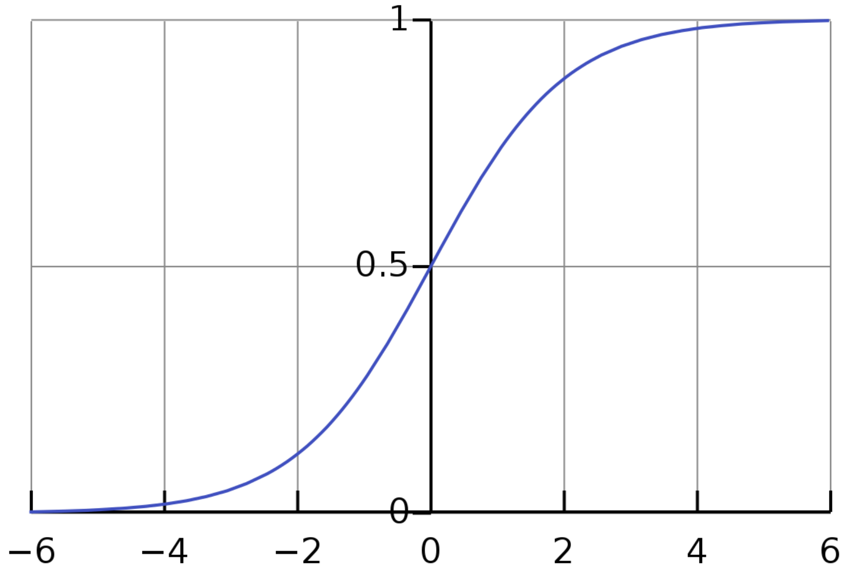
Logistic regression



Logistic regression

Logistic function

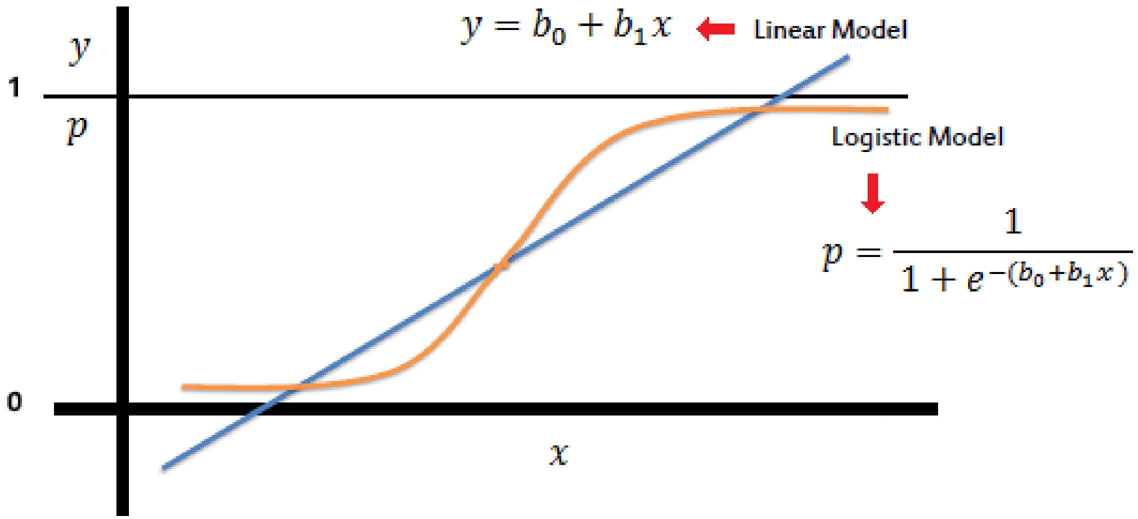
$$f(x) = 1 / (1 + e^{\wedge}(-x))$$



- Its output is always between 0 and 1, making it useful for modeling probabilities
- It is a non-linear function, which allows us to model more complex relationships between the dependent and independent variables.

Logistic regression

Logistic vs Linear



$$P(Y = 1) = \frac{1}{(1 + e^{-(\beta 0 + \beta 1 X)})}$$

- Y is either 0 or 1 (For e.g. student admitted or not, It will rain or not)
- P(Y=1) is the probability that the dependent variable Y is equal to 1.

Logistic regression

Odds and Log Odds

- **Odds Definition:** Odds represent the ratio of the probability that an event will occur to the probability that it will not occur.
- **Formula**: Odds = Probability of Success / Probability of Failure
- **Example**: If the probability of success is 0.8, the probability of failure is 0.2, leading to odds of 4 (0.8 / 0.2).
- **Log Odds (Logit Function):** Log odds, or the logit function, is the natural logarithm of the odds.

Logistic regression

Logistic vs Linear

$$P(Y=1) = \frac{1}{(1 + e^{-(\beta 0 + \beta 1 X)})}$$

$$\downarrow$$

$$Ln\left(\frac{P}{1-P}\right) = \beta 0 + \beta 1 X$$

- Y is either 0 or 1 (For e.g. student admitted or not, It will rain or not)
- P(Y=1) is the probability that the dependent variable Y is equal to 1.

Logistic regression

Maximum Likelihood Estimation

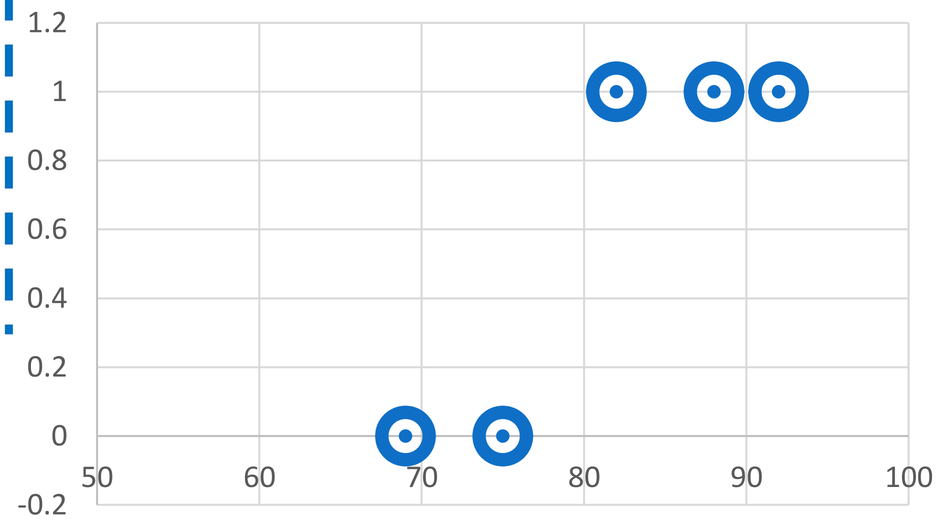
$$Ln\left(\frac{P}{1-P}\right) = \beta 0 \; + \; \beta 1X$$

- MLE finds the values for the model's parameters (coefficients) that make the predicted probabilities as close as possible to the actual outcomes (0 or 1) for the observed data.

Logistic regression

Example

Exam Score (X)	Admission Status (Y)
75	0
82	1
88	1
92	1
69	0



$$Ln\left(\frac{P}{1-P}\right) = \beta 0 + \beta 1X$$

Help John

John

Analytics Manager at STA Retailers

STA Retailers owns hundreds of grocery stores across the country. John's team invests a large amount of time and effort in analyzing different localities to find a location for new stores. John has recently completed a course in Analytics and Machine Learning, and he thinks that STA can use Machine Learning to use past data to create data-driven process for selecting new store locations.

Data Sample

Type of Location	City type	Marketing Sales Investment	Estimated Population in vicinity	Average Household Income	Sales
Commercial	Non-Metro	55,523.00	13134	11400	71,406.58
Residential	Metro	57,081.00	16716	10800	68,005.87
Residential	Metro	60,347.00	10348	16800	76,764.02
Residential	Metro	49,010.00	16119	19800	82,092.39
Residential	Metro	57,879.00	14726	19200	73,878.10
Residential	Non-Metro	54,340.00	14527	18600	59,950.89
Residential	Non-Metro	60,298.00	8358	27600	66,602.34
Residential	Non-Metro	49,944.00	11144	22200	57,768.44
Residential	Metro	53,124.00	7960	22200	70,083.30
Residential	Non-Metro	51,141.00	9353	36000	85,648.48
Residential	Metro	49,497.00	9950	15000	74,914.15
Commercial	Non-Metro	50,197.00	13134	37200	85,219.39

Help Tim

Tim

Analytics Manager at STA Telecom

STA Telecom provides 4G and 5G services all over India. STA currently offers services including fixed-line broadband, and voice services.

Tim has been tasked to reduce customer attrition. He thinks that STA can use Machine Learning to use past data to create data-driven process for reducing customer churn.

Data Sample

PhoneService	Contract	PaperlessBilling	PaymentMethod	Tenure	MonthlyCharges	TotalCharges	Churn
No	Month-to-month	Yes	Electronic check	1	29.85	29.85	No
Yes	One year	No	Mailed check	34	56.95	1889.5	No
Yes	Month-to-month	Yes	Mailed check	2	53.85	108.15	Yes
No	One year	No	Bank transfer (automatic)	45	42.3	1840.75	No
Yes	Month-to-month	Yes	Electronic check	2	70.7	151.65	Yes
Yes	Month-to-month	Yes	Electronic check	8	99.65	820.5	Yes
Yes	Month-to-month	Yes	Credit card (automatic)	22	89.1	1949.4	No
No	Month-to-month	No	Mailed check	10	29.75	301.9	No
Yes	Month-to-month	Yes	Electronic check	28	104.8	3046.05	Yes
Yes	One year	No	Bank transfer (automatic)	62	56.15	3487.95	No