CS 156:Introduction to Artificial Intelligence

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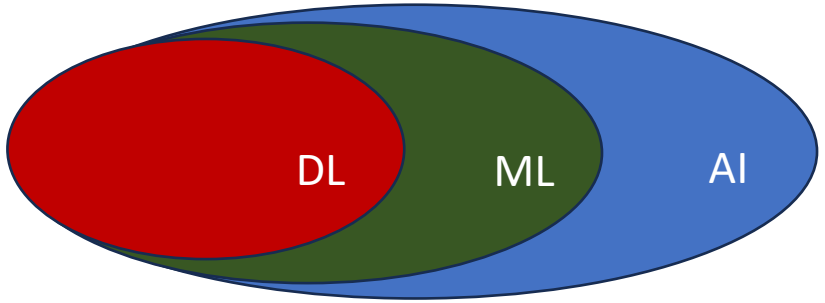
San José State University

AI vs ML vs DL



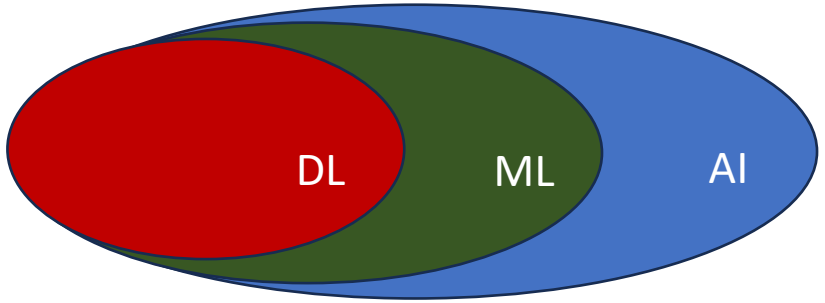
What is AI? (Artificial Intelligence)

- The science and engineering of creating intelligent machines, especially intelligent computer programs.
- Any technique that mimics human behavior

Objective: Mimic human intelligence – reasoning, learning, problem-solving, perception, language understanding, etc.

Examples: Robotics, Natural Language Processors, Expert Systems.

AI vs ML vs DL

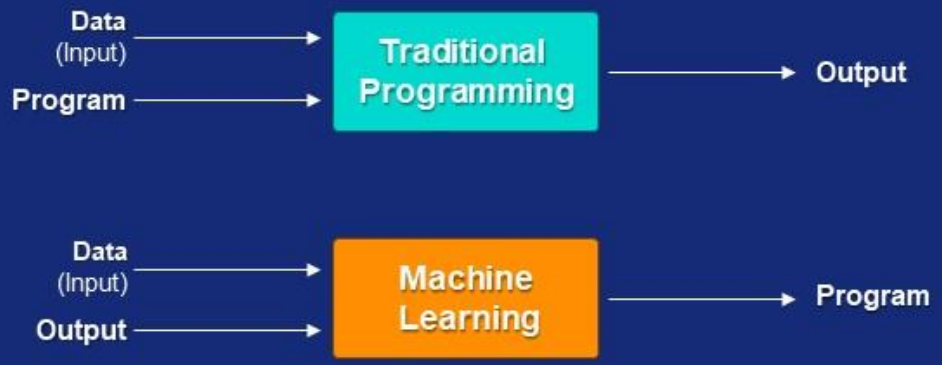


What is ML? (Machine Learning)

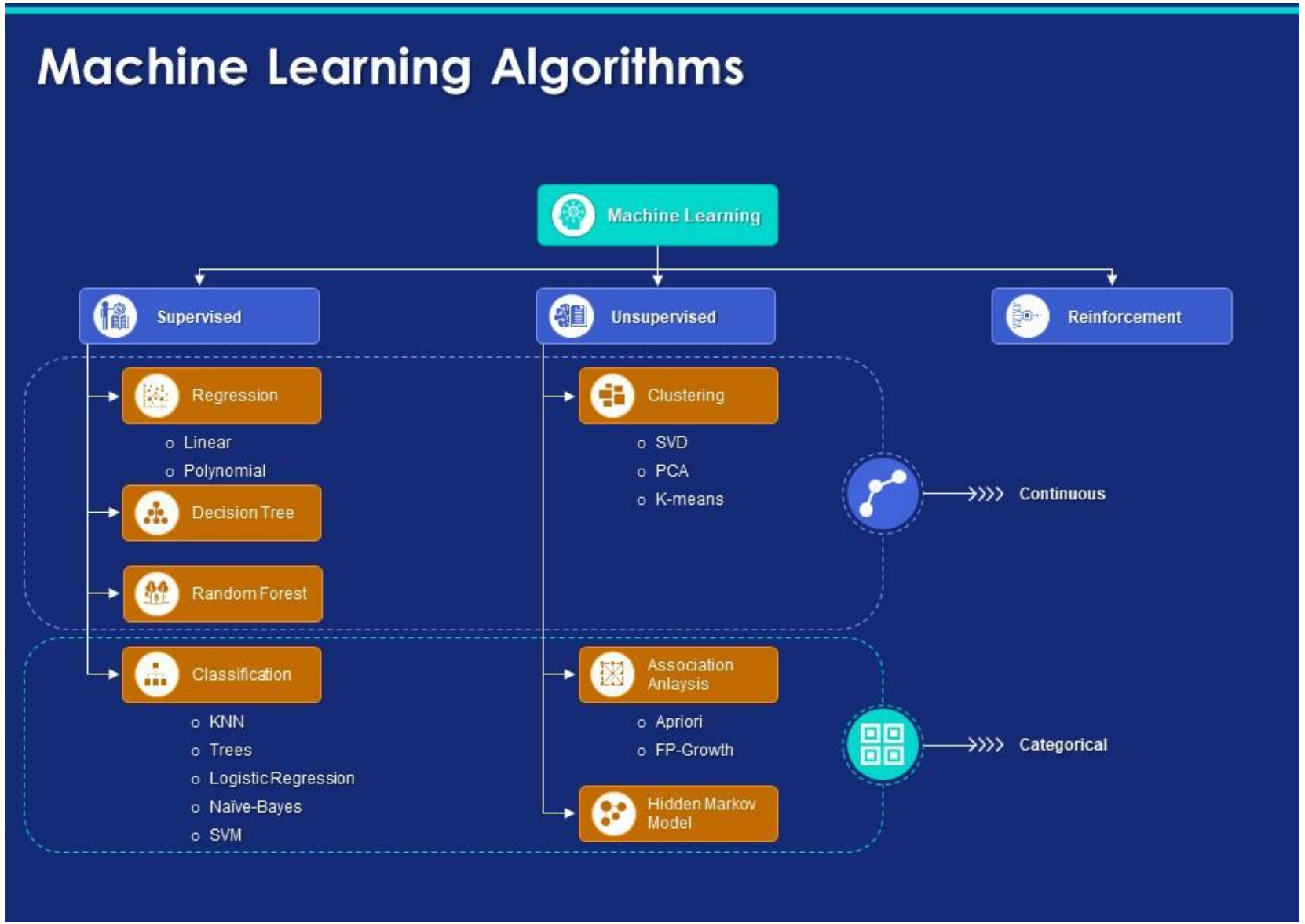
- A subset of AI that provides machines the ability to learn automatically & improve from experience without being explicitly programmed.
- Any technique that learns from experience
- **Objective**: Predict outcomes and adjust actions accordingly.
- **Examples**: Email filtering, Speech Recognition, Recommendation systems.

Machine Learning

Machine Learning is the result of General AI that involves developing machines that can deliver results better than humans



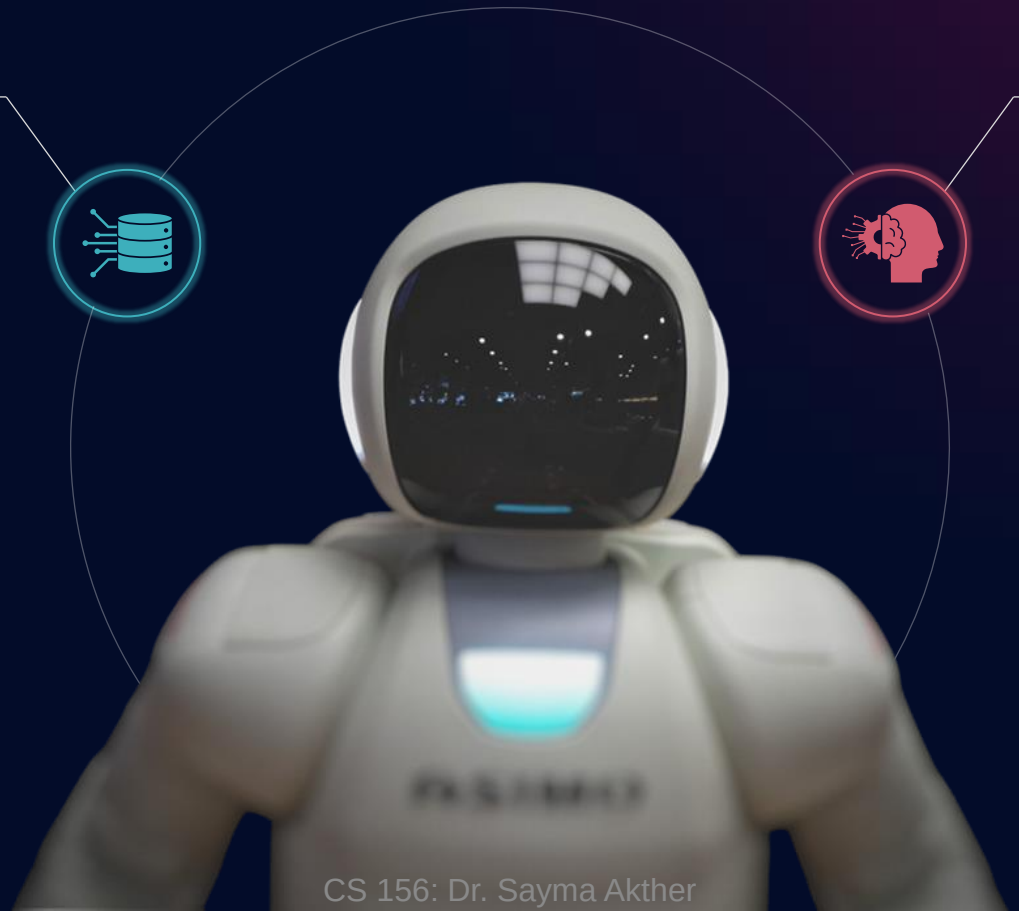

01
Gathering Data
02
Preparing that Data
03
Choosing a Model
04
Training
05
Evaluation
06
Hyperparameter Tuning
07
Prediction


Machine Learning Algorithms
Machine Learning
Supervised
Unsupervised
Reinforcement
Regression
Linear
Polynomial
Decision Tree
Random Forest
Classification
KNN
Trees
Logistic Regression
Naïve-Bayes
SVM
Clustering
SVD
PCA
K-means
Association Anlaysis
Apriori
FP-Growth
Hidden Markov Model
Continuous
Categorical

Machine Learning Type: Supervised Learning

It is one of the most basic types of Machine Learning. In this case, the Machine Learning algorithm is trained on labeled data

Even though the data must be appropriately marked for this method to work, supervised learning is powerful when used in the right situations



What is Regression Analysis ?

Regression analysis is a predictive modeling approach that examines the relationship between a dataset's goal or dependent variable and its independent variables

When the target and independent variables have a linear or non-linear connection and the target variable has continuous values, many regression analysis techniques are applied

Regression Models in Machine Learning

Linear and logistic regression are two regression analysis approaches used to address problems using Machine Learning, and they are the most popular regression approaches. However, there are several types of regression analysis approaches in Machine Learning, and their use varies depending on the nature of the data.

Machine Learning Regression Model: Simple Linear Regression

One of the most fundamental forms of regression in Machine Learning is linear regression

The linear regression model links a predictor variable and a dependent variable linearly

In case the data set carries more than one independent variable, then the linear regression in such case is done using multiple linear regression model

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$$\hat{y} = b_0 + b_1 X_1$$

- $\hat{y}$: Dependent variable
- b_0: y-intercept (constant)
- b_1: Slope coefficient
- X_1: Independent variable

Slide~Andrew Ng

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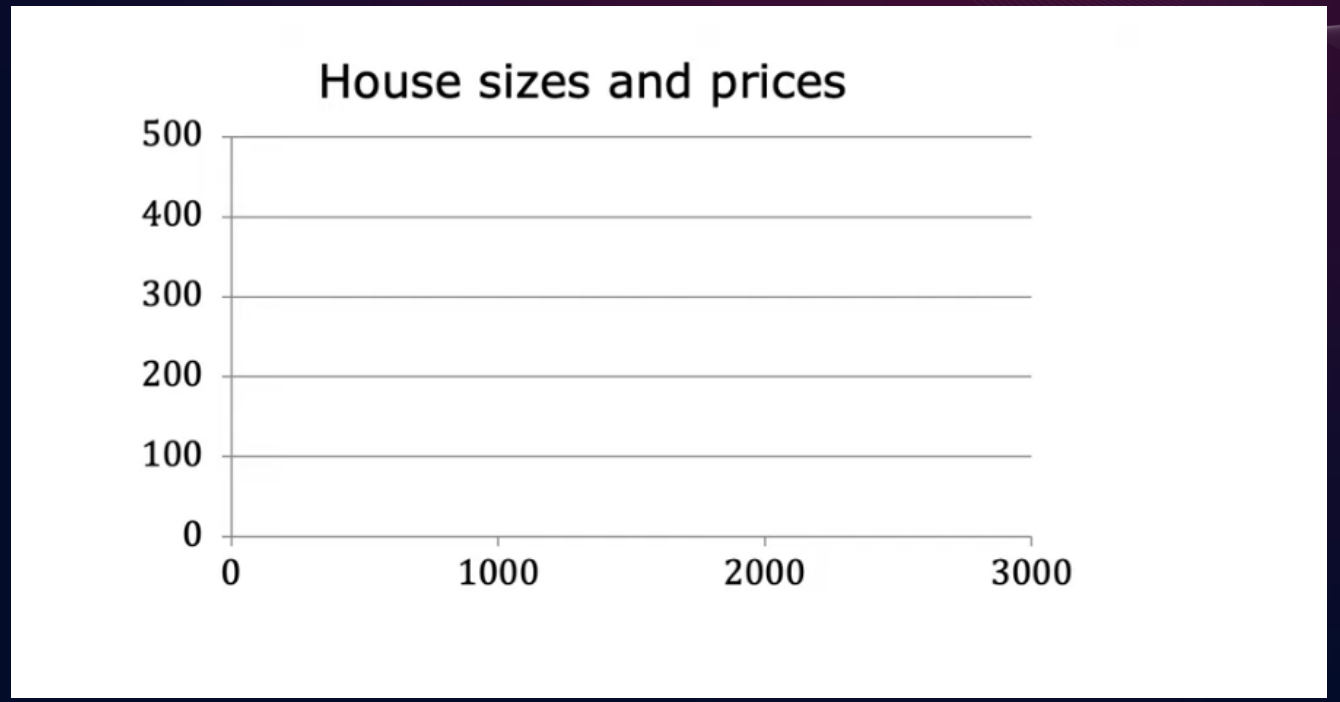

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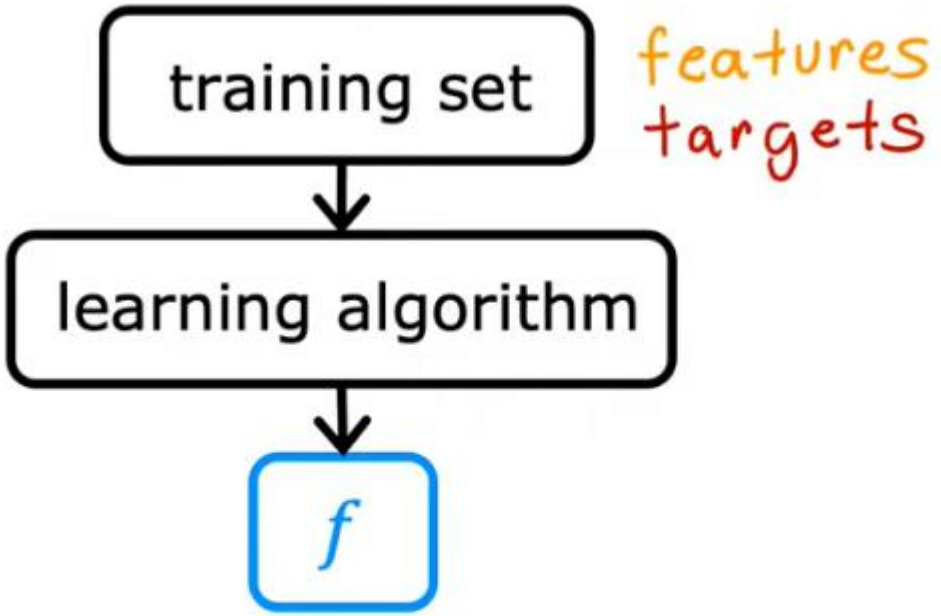
Machine Learning Regression Model: Simple Linear Regression

Data table

size in feet²	price in $1000's
2104	400
1416	232
1534	315
852	178
...	...
3210	870

Machine Learning Regression Model: Simple Linear Regression



Data table

size in feet²	price in $1000's
2104	400
1416	232
1534	315
852	178
...	...
3210	870

Machine Learning Regression Model: Cost Function

Training set

features | targets

size in feet² (x)	price \$1000's (y)
2104	460
1416	232
1534	315
852	178
...	...

Model: $f_{w,b}(x) = wx + b$

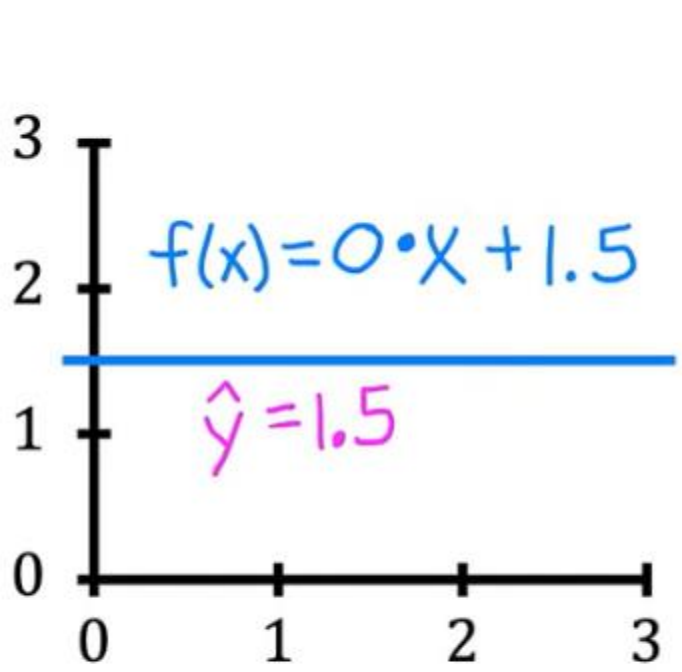
w, b: parameters

coefficients

weights

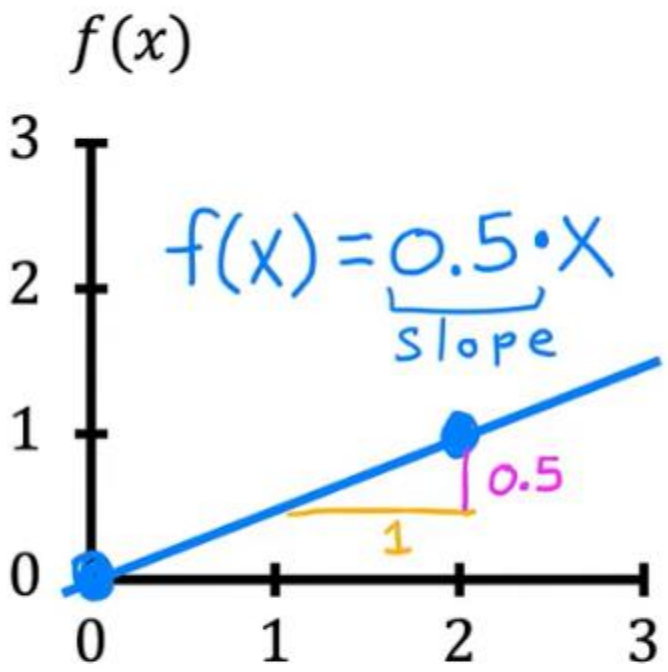
Machine Learning Regression Model: Cost Function

$$f_{w,b}(x) = wx + b$$



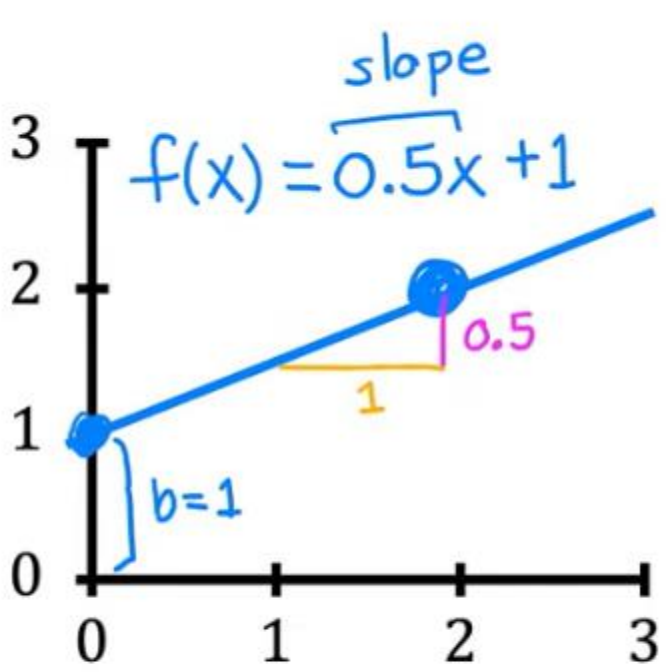
→ $w = 0$

→ $b = 1.5$ (y-intercept)



→ $w = 0.5$

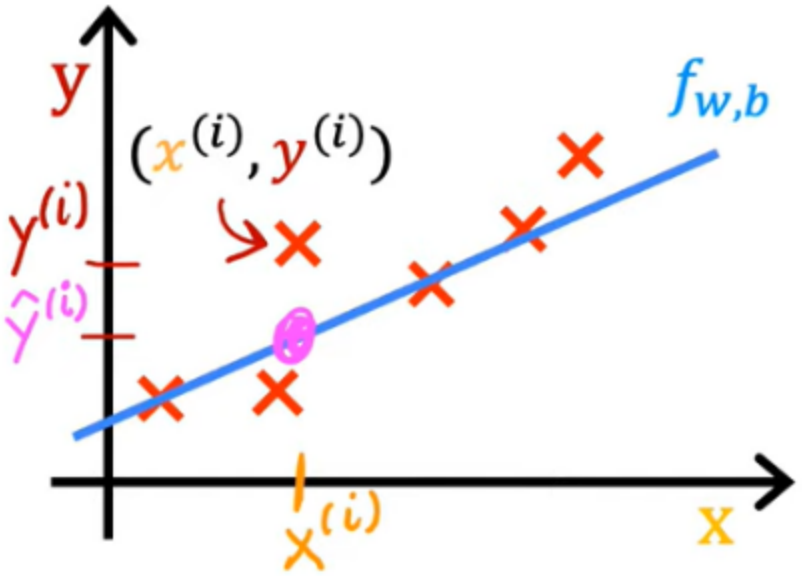
→ $b = 0$



→ $w = 0.5$

→ $b = 1$

Machine Learning Regression Model: Cost Function



Cost function

$$J(w,b) = \frac{1}{2m}\sum_{i=1}^{m}\left(\underbrace{\hat{y}^{(i)} - y^{(i)}}_{\text{error}}\right)^2$$

m = number of training examples

$$\hat{y}^{(i)} = f_{w,b}(x^{(i)})$$

$$f_{w,b}(x^{(i)}) = wx^{(i)} + b$$

Find w, b:
$\hat{y}^{(i)}$ is close to $y^{(i)}$ for all $(x^{(i)}, y^{(i)})$.

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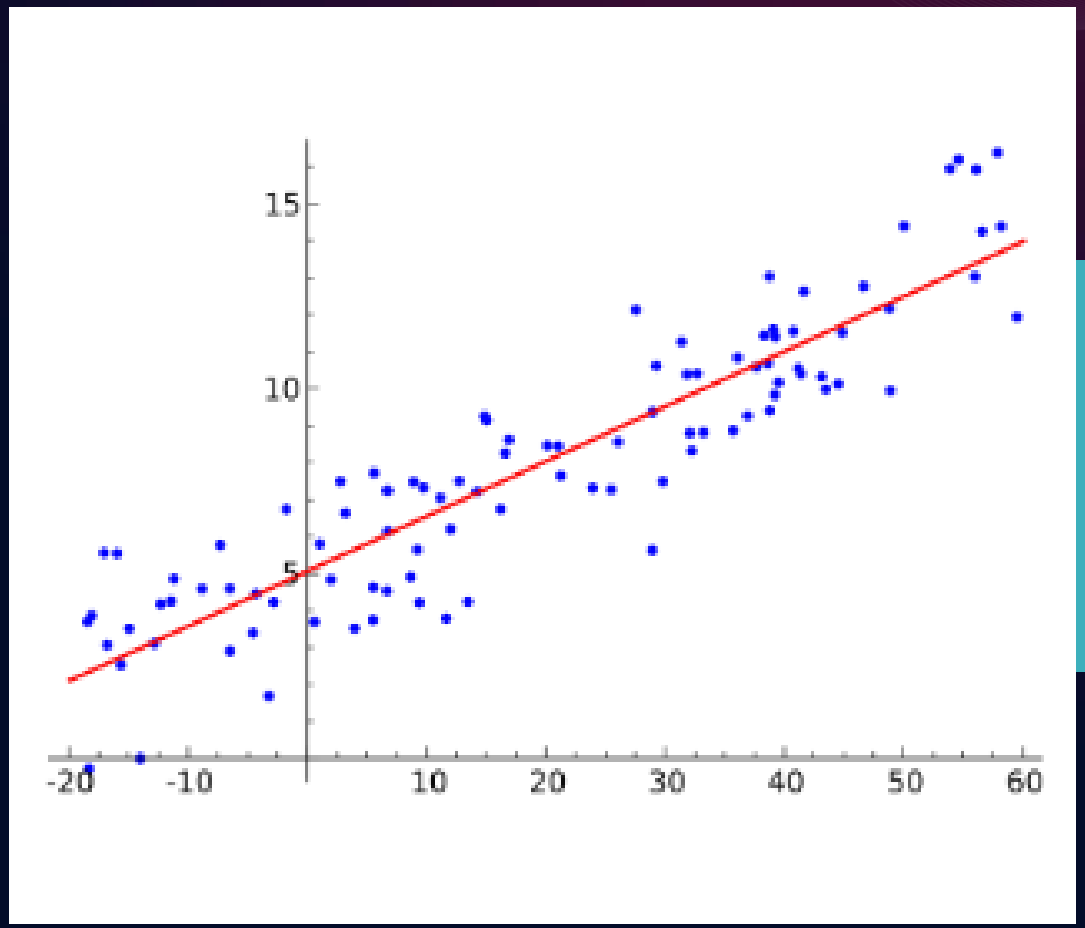

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Multiple features (variables)

Size in feet^2	Number of bedrooms	Number of floors	Age of home in years	Price ($) in $1000's
2104	5	1	45	460
1416	3	2	40	232
1534	3	2	30	315
852	2	1	36	178
...	...	...	...	...

Machine Learning Regression Model: Multiple Linear Regression

Multiple features (variables)

Size in feet^2	Number of bedrooms	Number of floors	Age of home in years	Price ($) in $1000's
2104	5	1	45	460
1416	3	2	40	232
1534	3	2	30	315
852	2	1	36	178
...	...	...	...	...

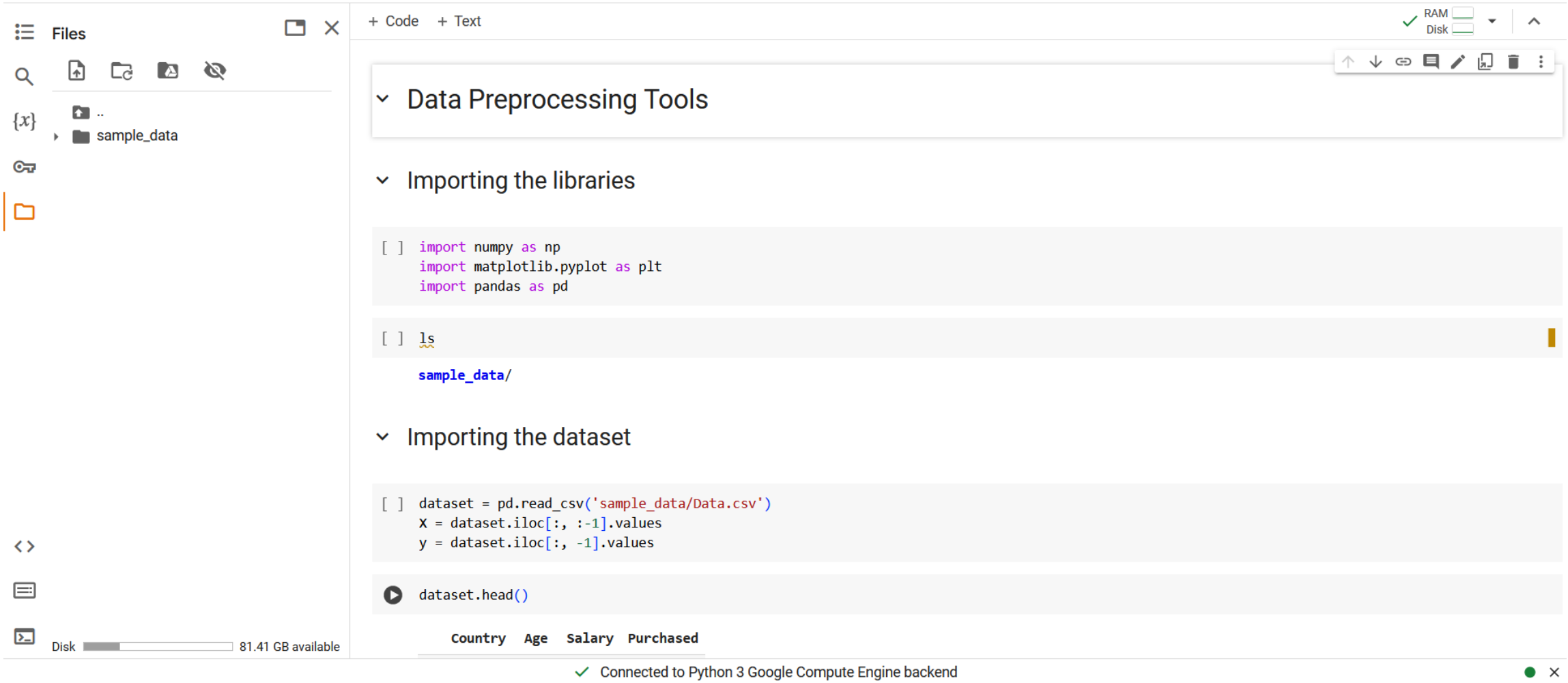
Model:

Previously: $f_{w,b}(x) = wx + b$

$$f_{w,b}(X) = w_1 X_1 + w_2 X_2 + w_3 X_3 + w_4 X_4 + b$$

Machine Learning

1. Data preprocessing
   - Input the data
   - Clean the data
   - Split into training and test sets
   - Feature scaling
2. Modeling
   - Build the model
   - Train the model
   - Make Prediction
3. Evaluation
   - Calculate the performance metrics
   - Make a verdict


Files
..
sample_data
Disk 81.41 GB available
+ Code + Text
RAM
Disk
Data Preprocessing Tools
Importing the libraries
[ ] import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
[ ] ls
sample_data/
Importing the dataset
[ ] dataset = pd.read_csv('sample_data/Data.csv')
X = dataset.iloc[:, :-1].values
y = dataset.iloc[:, -1].values
dataset.head()
Country Age Salary Purchased
Connected to Python 3 Google Compute Engine backend