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The WILLIAM STATES LEE COLLEGE *of* ENGINEERING

Introduction to ML
Lecture 1: Supervised Learning

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ML – types of training/learning

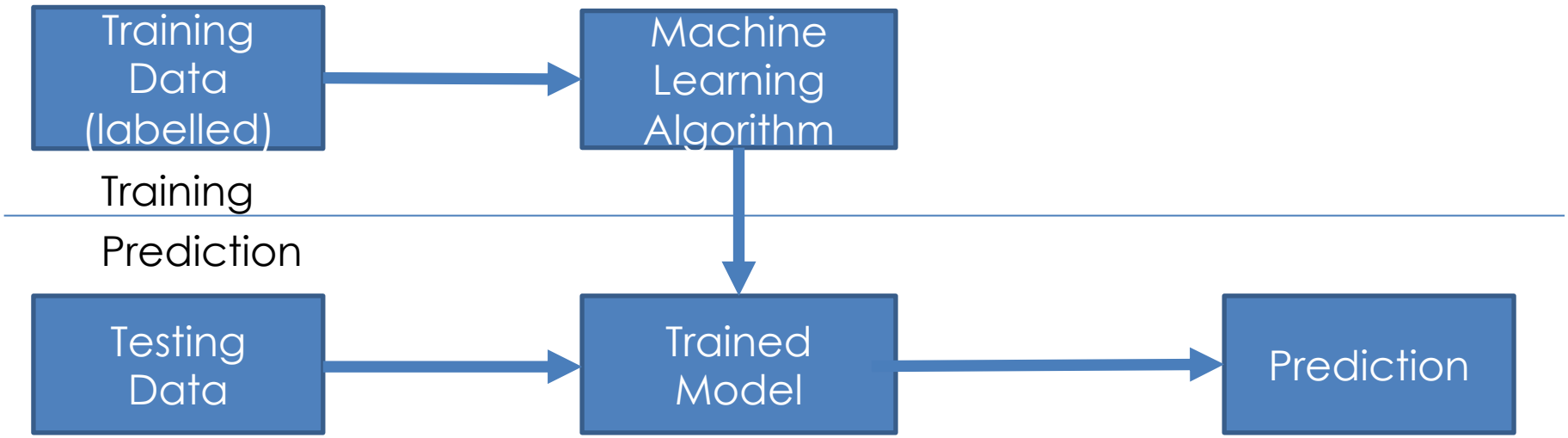
- Supervised learning: uses a series of labelled examples with direct feedback
- Unsupervised/clustering learning: no feedback
- Reinforcement learning: indirect feedback, after many examples
- Semi-supervised learning: partial labelled samples and possibly (a lot of) unlabeled samples

- Self-supervised learning
- Weakly-supervised learning

→ Popular in the deep learning era

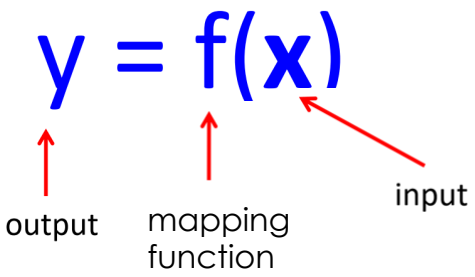
Supervised Learning

- Supervised learning: uses a series of labelled examples with direct feedback
- The most common learning approach



Supervised learning

- The basic supervised learning framework

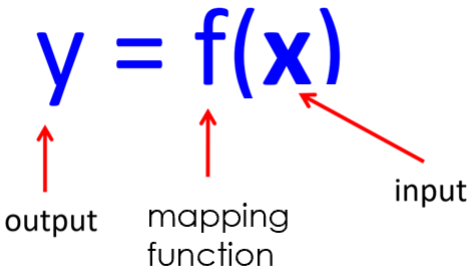


Function approximation

- **Learning:** given a *training set* of labeled examples $\{(\mathbf{x}_1,y_1), \ldots, (\mathbf{x}_N,y_N)\}$, estimate the parameters of the prediction function f
- **Inference:** apply f to a never before seen *test example* **x** and output the predicted value $y = f(\mathbf{x})$

Supervised learning

- Learning goal



- The goal is to approximate the mapping function so well that when you have new input data (x) that you can predict the output variables (Y) for that data accurately.

Supervised learning

- Supervised learning problems can be further grouped into **Regression** and **Classification** problems

- What is the difference?
  - Output or predictive value:
    - numerical for regression (real or continuous value)
    - categorical for classification

Supervised learning

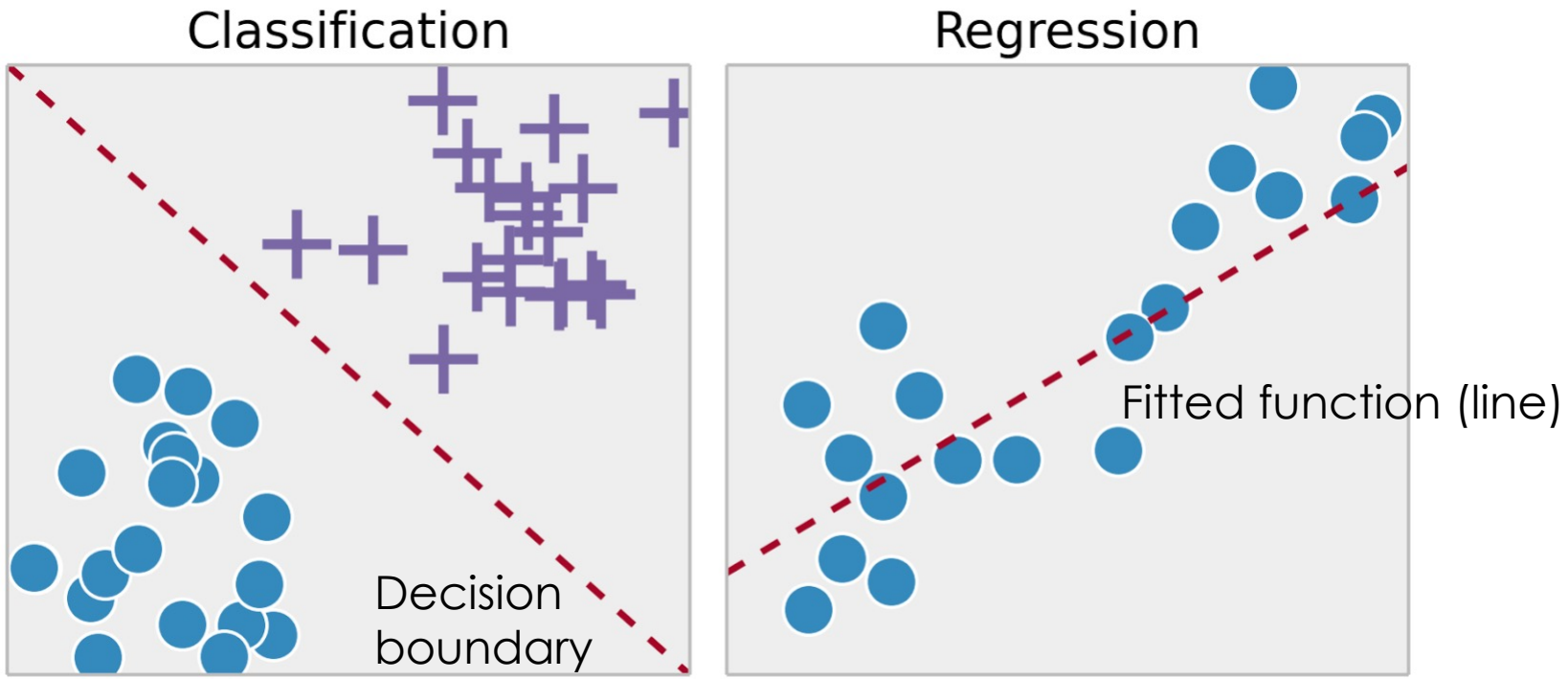
- A classification problem is when the output variable is a category (discrete class label), such as “red” or “blue” or “disease” and “no disease”.

- A classification algorithm may predict a continuous value, but the continuous value is in the form of a probability for a class label.

- A regression algorithm may predict a discrete value, but the discrete value in the form of an integer quantity.

Classification vs. regression

- A visual example of comparison



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Quiz

- Supervised learning

Classification (C) or Regression (R) ?

	Input	Output	C or R
1.	Credit history	Lend money?	
2.		High school, college, Graduate	
3.		Age	

Types of classification

- **Binary classification**—when there is only two classes to predict, usually 1 or 0 values.

- **Multi-Class classification**—When there are more than two class labels to predict
  - E.g. image classification problems where there are more than thousands classes(cat, dog, fish, car,…)

Regression Model

Regression model

- Explanatory variables are termed the **independent** variables and the variables to be explained are termed the **dependent** variables.

- Regression model estimates the nature of the relationship between the independent and dependent variables.

Examples

- Stock Market Forecast

$f($  $) =$ Dow Jones Industrial Average at tomorrow

- Self-driving Car

$f($  $) =$ Steering angle

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Types of Regression Models

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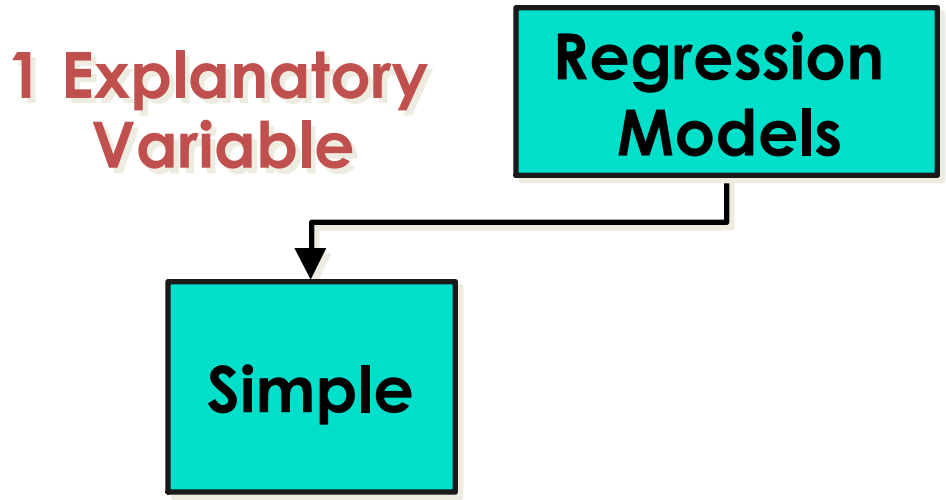
Types of Regression Models



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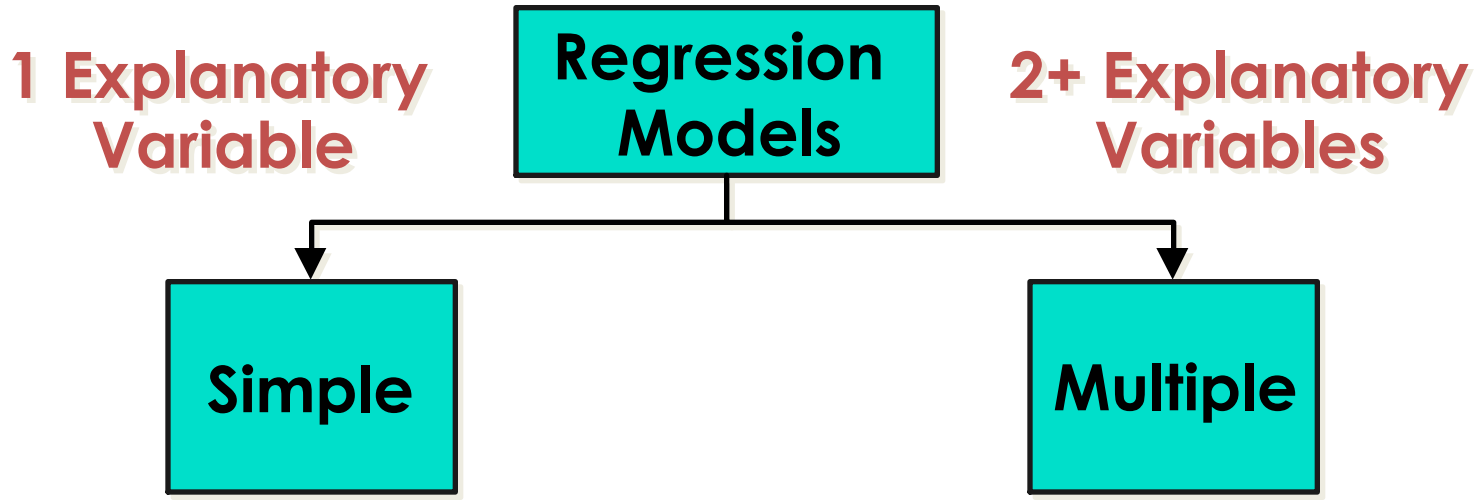
Types of Regression Models



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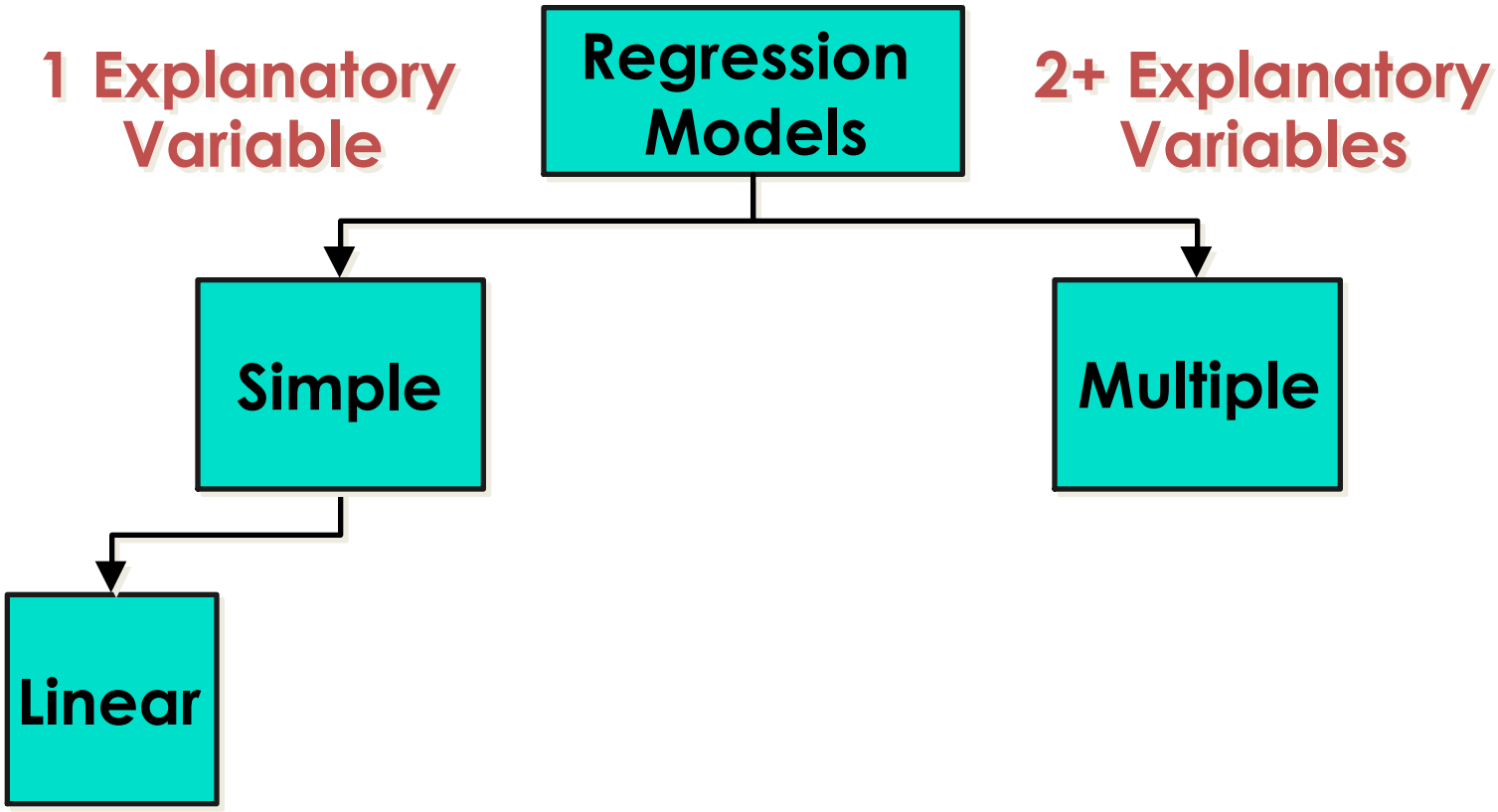

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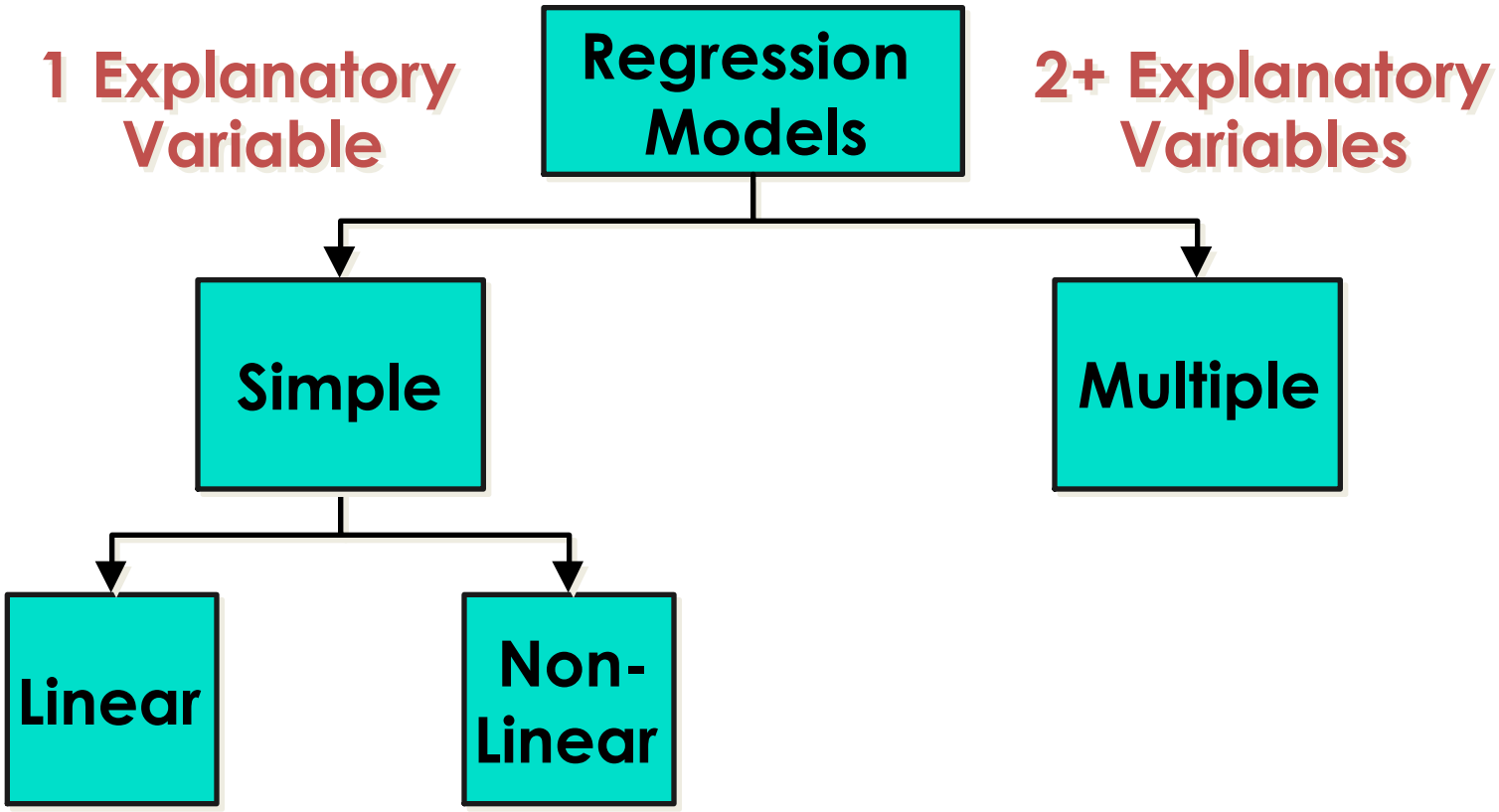

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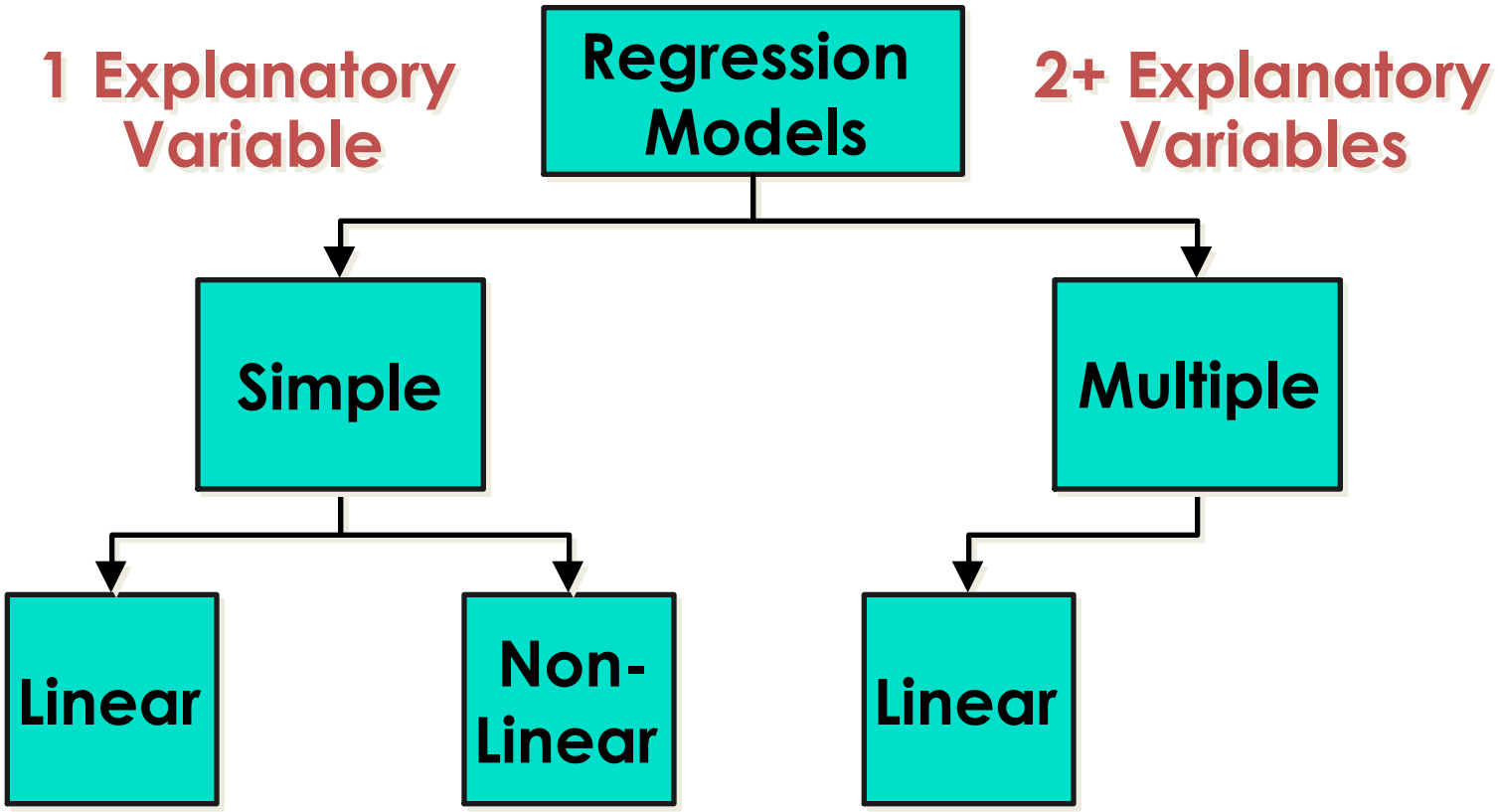

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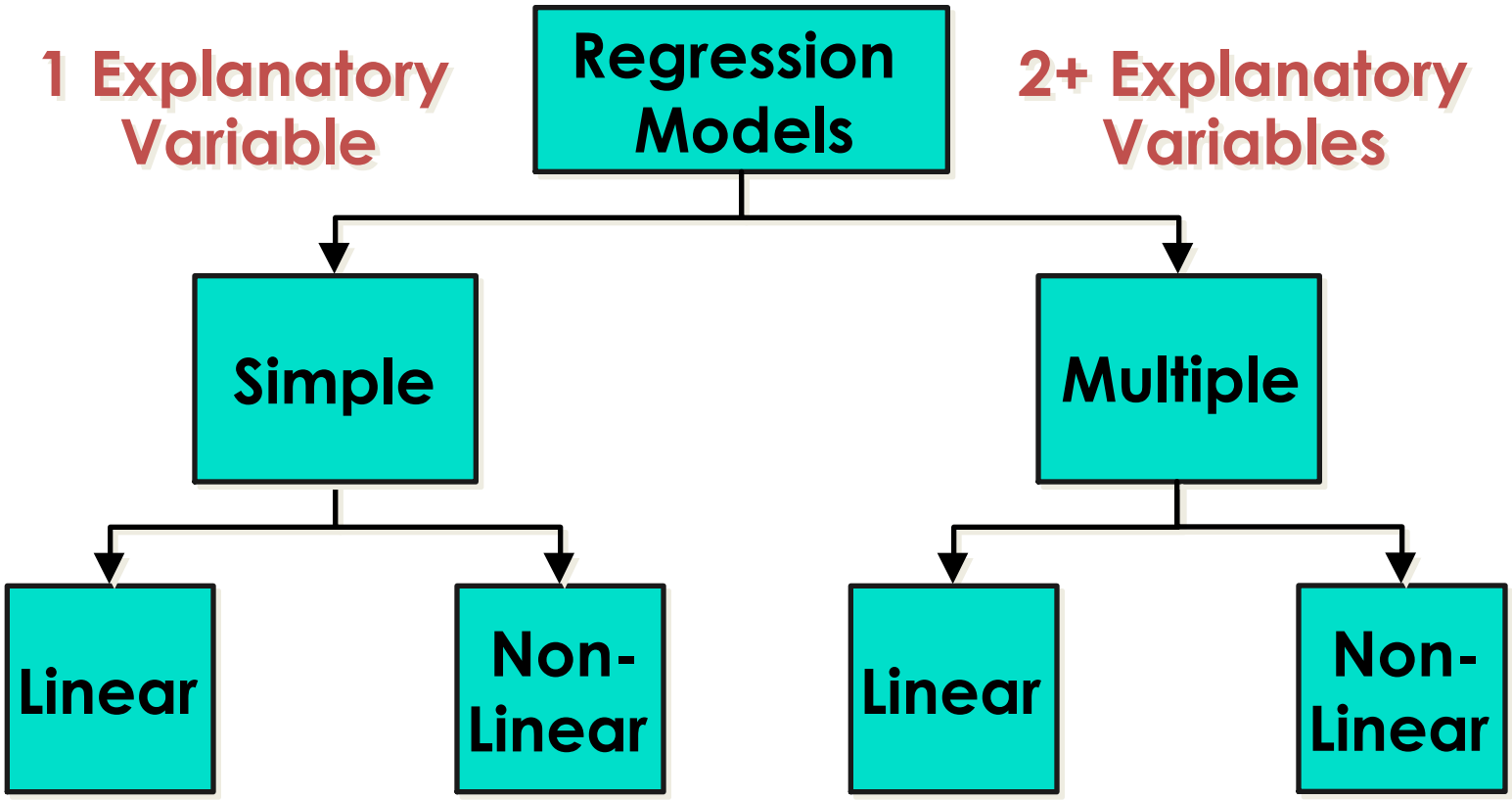

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