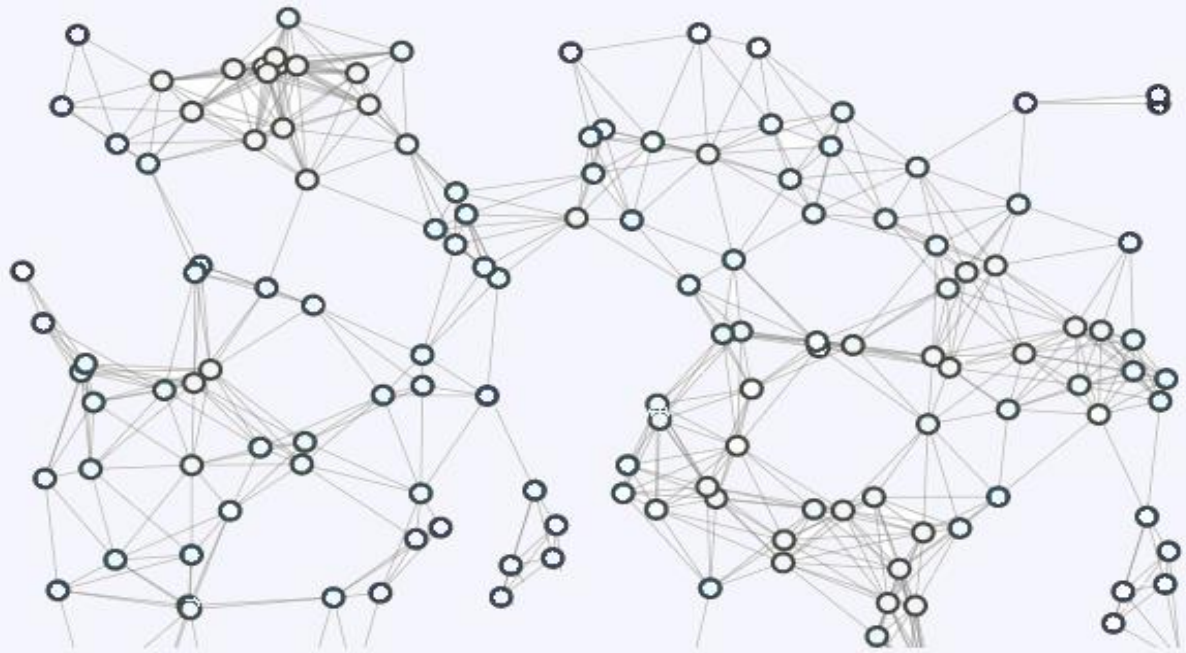
Learning Models using Tensorflow (Regression)



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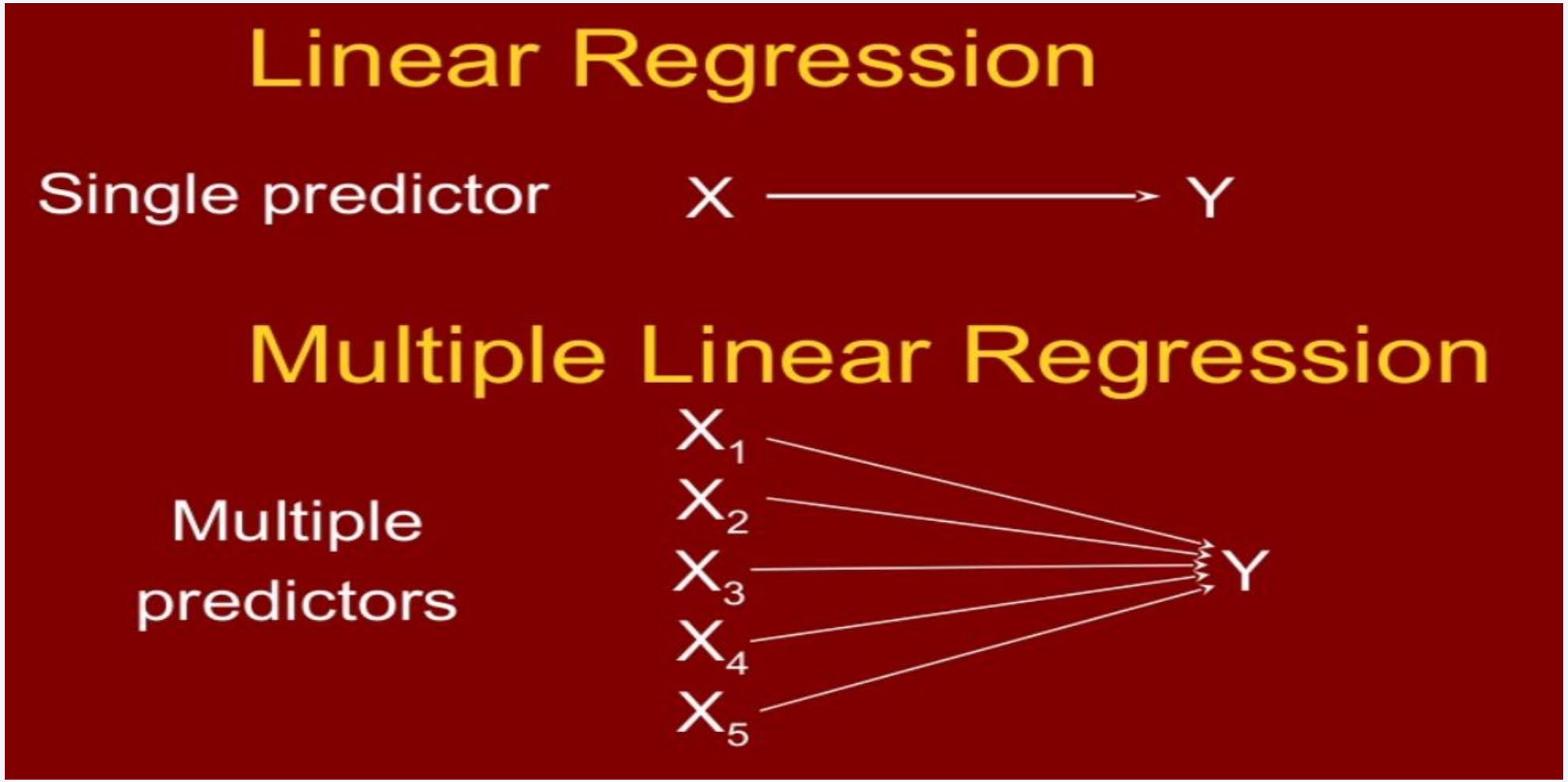
Topic Outline

Day 1	Day 2
1) Intro to Machine Learning and Tensorflow 2) Data Preprocessing 3) Learning Models (Regression) 3.1. NN Simple Linear **3.2. NN Multiple Linear** 4) Model Training	1) Learning Models (Classification) 1.1. NN Logistic Regression 1.2. CNN Deep Learning 2) Model Testing 3) Model Evaluation / Validation Performance 4) Data Visualization

Introduction to Multiple Linear Regression

- In reality, more accurate prediction relies on multiple features, so we need to advance from single-feature to multiple-feature linear regression.
- In this case, there will still be a single dependent variable but there will be 2 or more independent variables.
- Function: a mathematical relationship enabling us consider the influence of multiple independent variables (**$X_1 \ldots X_n$**) in predicting the value of one dependent variable (**Y**).
    1. **Y**: is referred to as the **dependent variable**, the **response variable** or the **predicted variable**.
    2. **X1, X2, … Xn**: is referred to as the **independent variables**, the **explanatory variable** or the **predictor variable**.

Simple vs Multiple Linear Regression



Problems for Multiple Linear Regression

With increasing fuel prices and picky consumers, automotive manufacturers are constantly optimizing the design of vehicles to increase fuel efficiency. The question is, can the various features of a vehicle be used to produce a reliable estimator of its fuel efficiency? Such as: cylinders, displacement, horsepower, weight, acceleration, model, and even country of origin.

In this case, the statement can be read as; is ***Y a function of $X_1 \ldots X_n$***. (i.e., Is the fuel efficiency a function of the various automotive features?

Question needing answer...

- What is the *association* between Y and $X_1 \ldots X_n$?
- How can changes in Y be explained by changes in $X_1 \ldots X_n$?
- What are the *functional relationships* between Y and $X_1 \ldots X_n$?

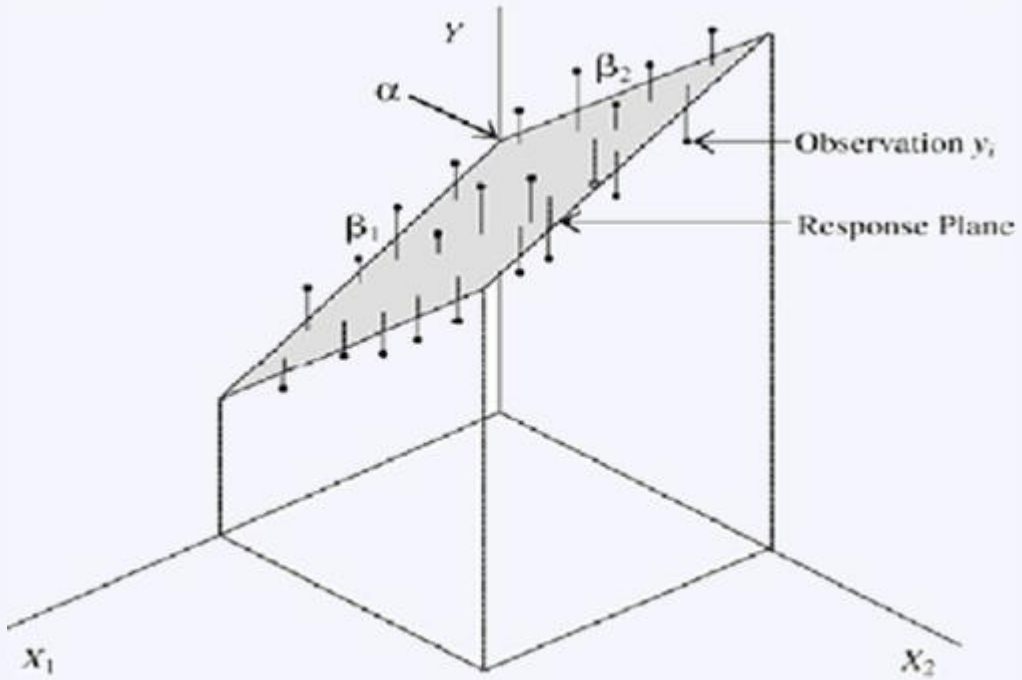
A functional relationship is symbolically written as:

Eq: 1 $$Y = f(X_1 \ldots X_n)$$

Example: A proportional relationship of the dependent and independent variables

$$y = b_1x_1 + b_2x_2 \ldots + b_nx_n$$

$b_1 \ldots b_n$ is the **slope** for each axis line.



The complete equation...

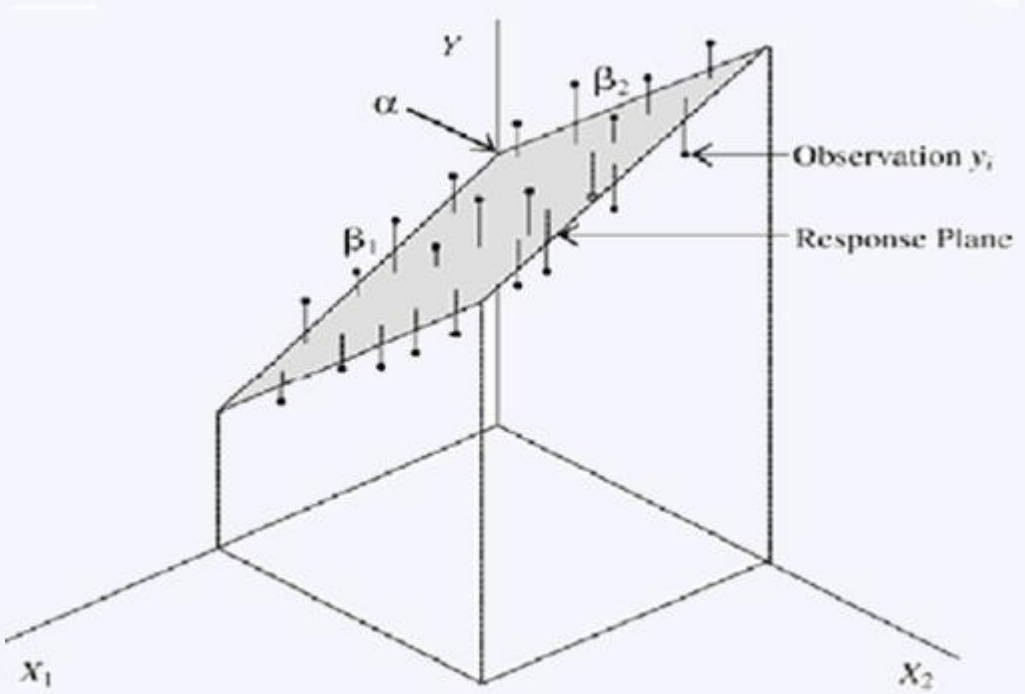
Example: Linear relationship (e.g. Y= mpg, X= automotive_features)

Here ***Y*** is the dependent variable and *X* is the independent variable. Hence, the change in variable ***X*** produces a change in variable ***Y***.

So, in a linear regression task our job is to find the appropriate values of the slope b_1 and the intercept value b_0 so that we can get an accurate estimated value of ***Y*** for any given ***X***.

$$y = b_0 + b_1 x_1 + b_2 x_2 \ldots + b_n x_n$$

b_0 is the intercept, b_1.. b_n is the slope.



Multiple Regression Model

- A multiple regression model with *k* >2 independent variables fits a regression plane in (k + 1) dimensional space
- This level of dimension can no longer be visualized

Categorical Variables in Regression Models

- Categorical independent variables can also be incorporated into a regression model through the use of dummy coding.
- Dummy coding converts categorical variables into representative 0/1 (“dummy”) variables
- Example, for binary variables, code dummies “0” for “no” and 1 for “yes”

Dummy Variables, More than two levels

For categorical variables with *k* categories, use *k*–1 dummy variables

If a variable SMOKE2 has three levels, initially coded as

0 = non-smoker

1 = former smoker

2 = current smoker

Use *k* – 1 = 3 – 1 = 2 dummy variables to code this information like this:

SMOKE2	DUMMY1	DUMMY2
0	0	0
1	1	0
2	0	1

Neural Network for Multiple Regression

Demo Time !!!

Activity 2:

Experiment on adjusting any of the following hyperparameters of the Neural Network and observe how it affects the performance of the prediction model:

1. Epochs
2. Batch size
3. Learning rate
4. Number of layers
5. Number of neurons/layer