Logical Rhythm

Class 2

Overview of Today’s Class

- Linear Regression Example
- Classification and Logistic Regression
- Perceptron
- Support Vector Machines(SVMs)
- Python Implementation

Linear Regression in Action!

Classification Problem

Identifying to which category from a **set of known categories** a new observation belongs to.

Training data - contains observations whose category membership is known

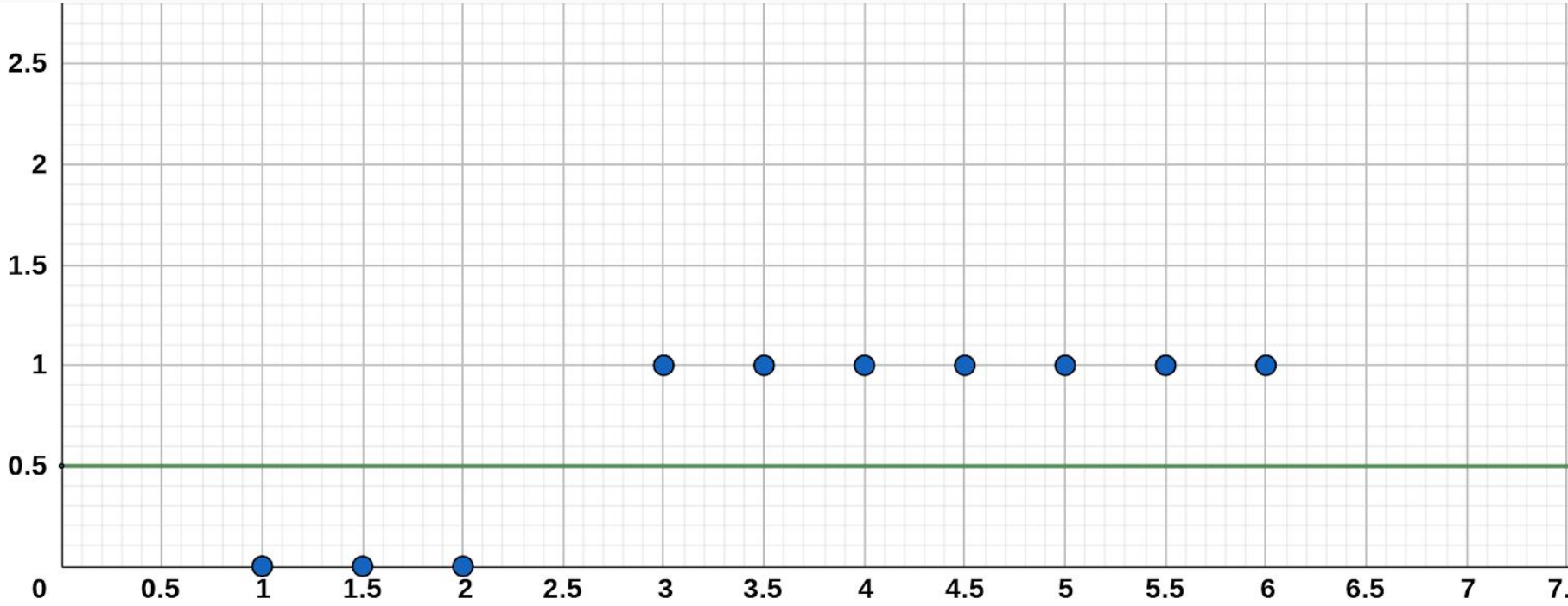
Example please!

Breast Cancer

X : Tumour size
Y : malignant or not

You are given a dataset which has the following attributes

X : Tumour Size
Y : 1 / 0 (Bad/Good)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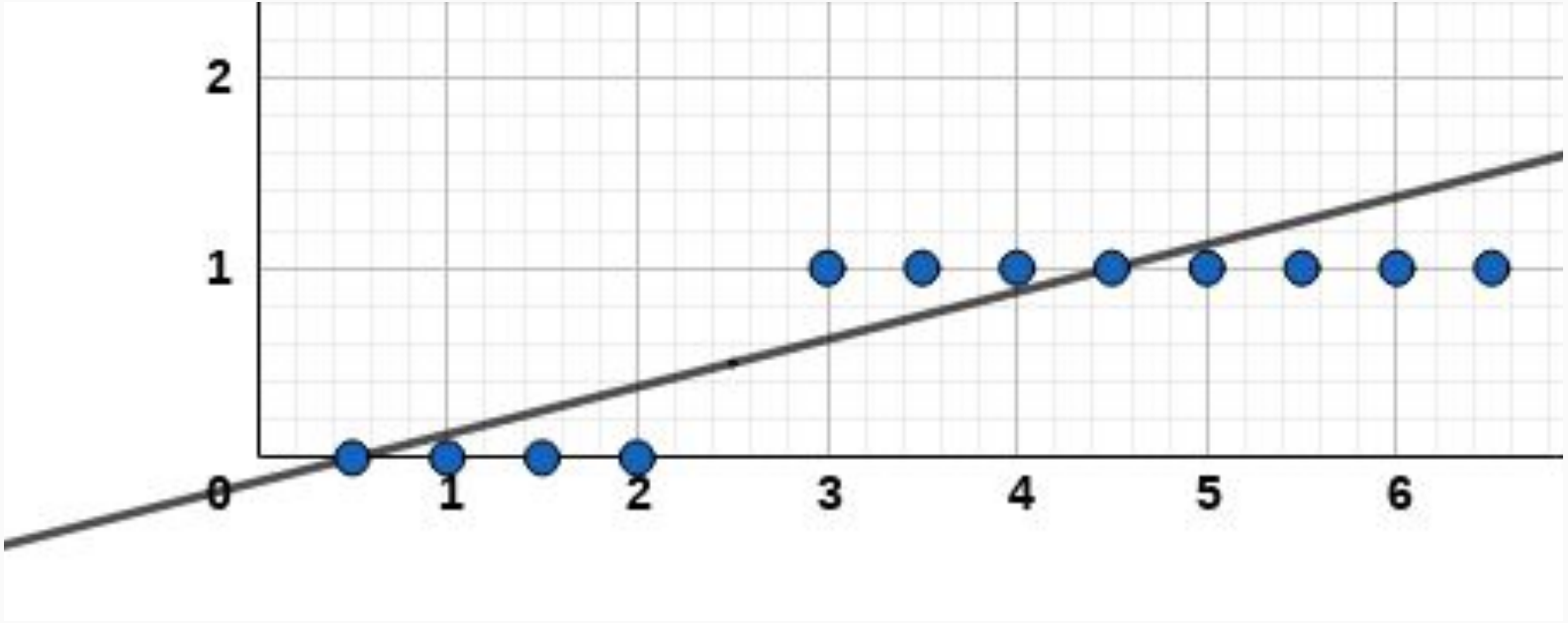
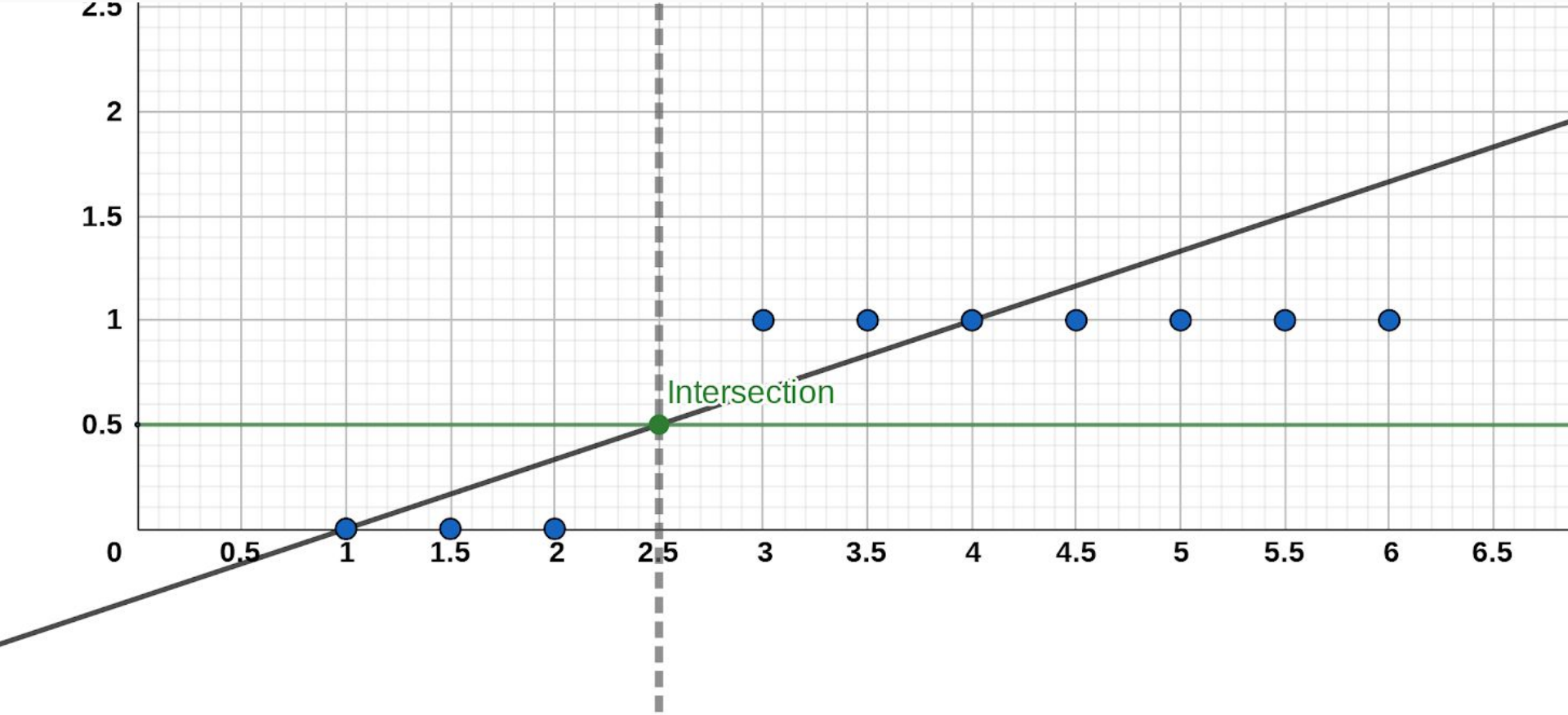
5.5
6
6.5
7

Any ideas?

On how to classify these data points correctly?

How about linear Regression?

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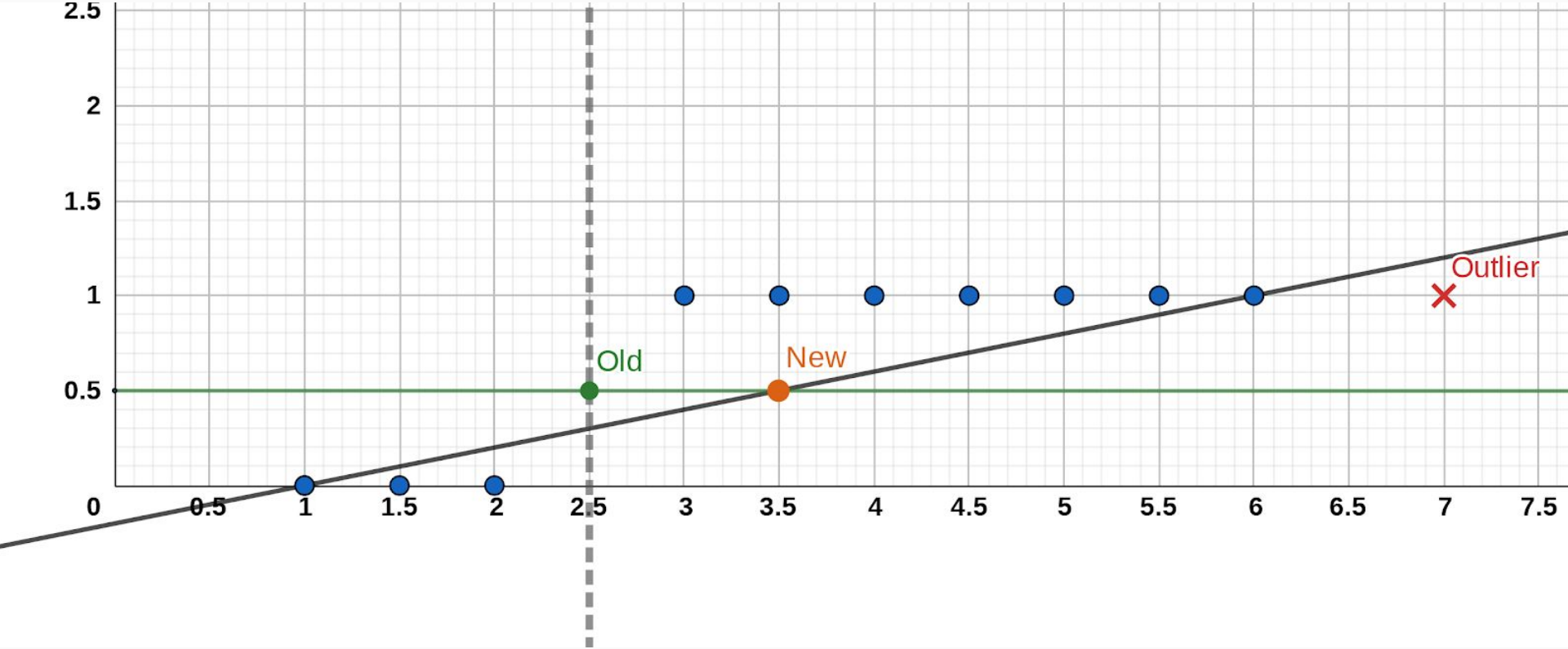
Intersection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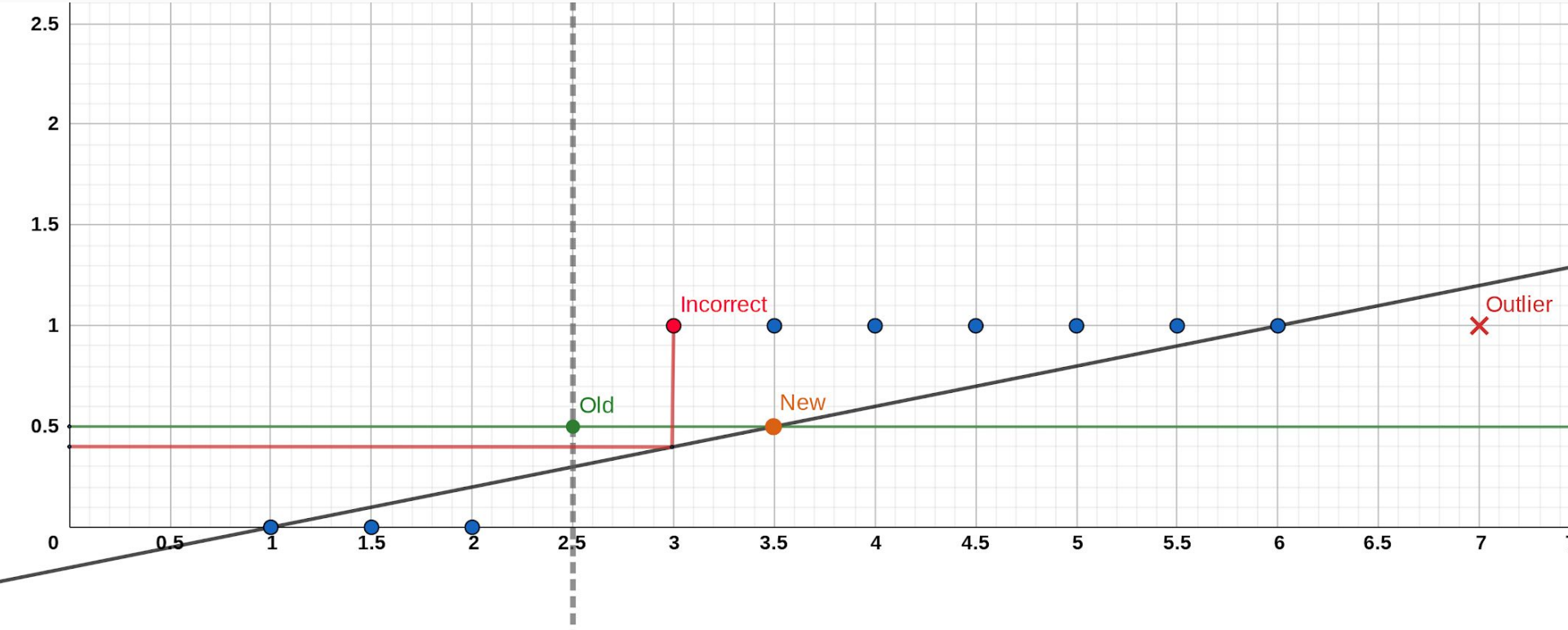
Outlier
Old
New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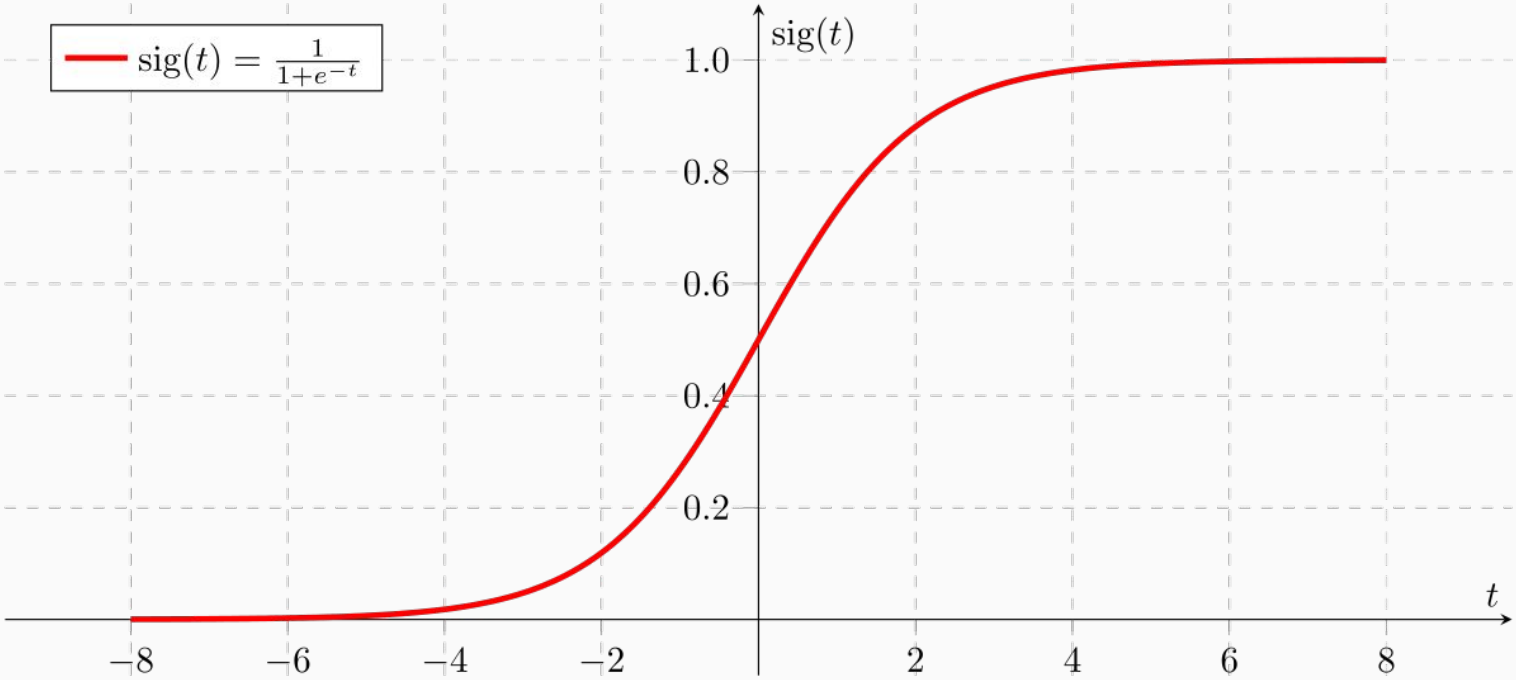
7
Incorrect
Outlier
Old
New

Sigmoid Function

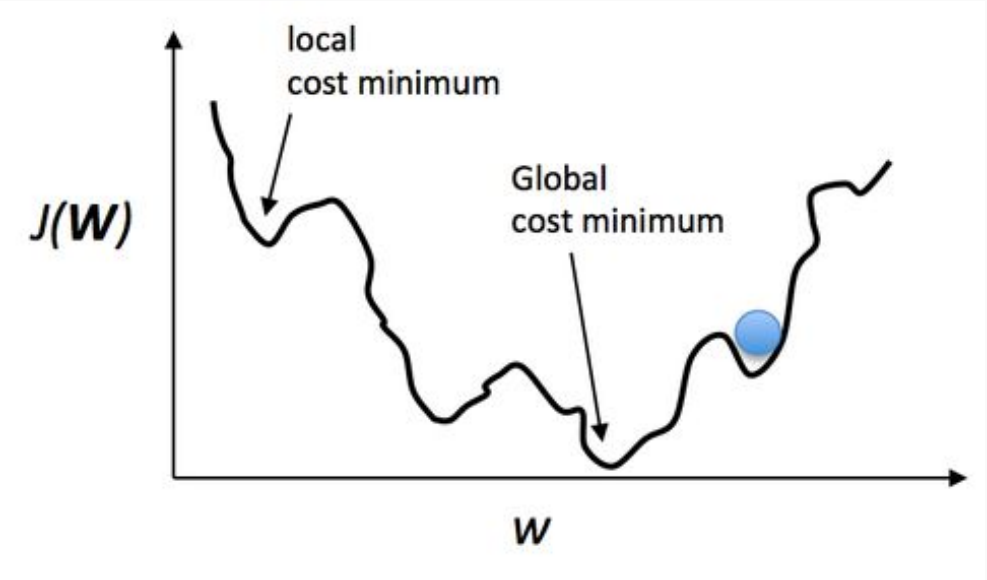


Cost Function For Logistic Regression

$$Cost(h_\theta(x), y) = \begin{cases} -\log(h_\theta(x)) & \text{if } y = 1 \\ -\log(1 - h_\theta(x)) & \text{if } y = 0 \end{cases}$$

Why not use MSE ?

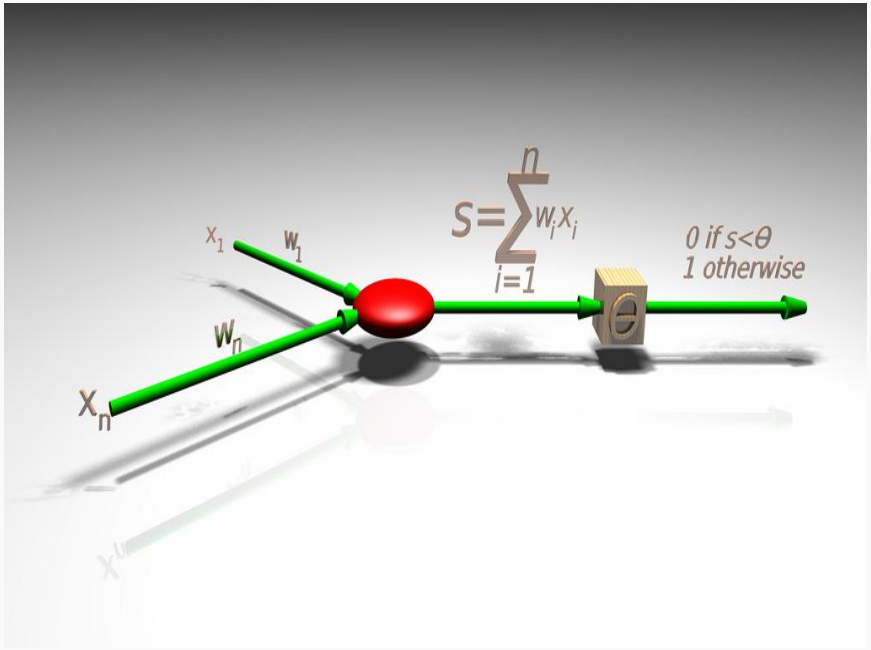
- MSE is non-convex on non-linear activation functions like sigmoid(x).

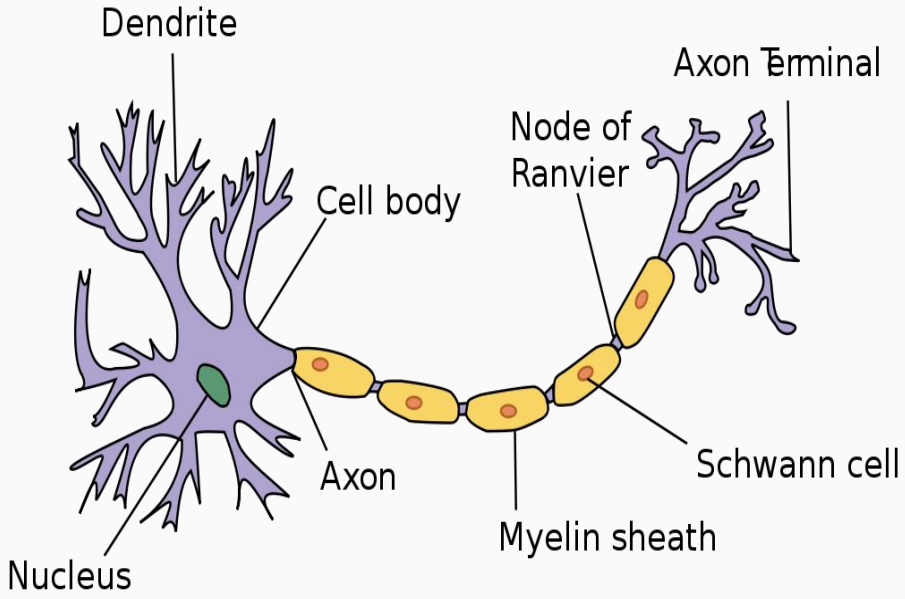


Perceptron

Fundamental Unit of a Neural Network

Perceptron

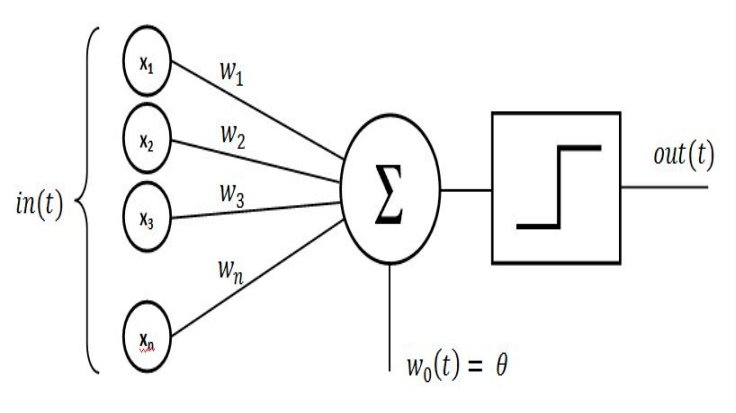

$S=\sum_{i=1}^{n} w_i x_i$
x_1
w_1
w_n
x_n
θ
0 if s<θ
1 otherwise


Dendrite
Axon Terminal
Node of Ranvier
Cell body
Axon
Schwann cell
Myelin sheath
Nucleus

Perceptron (contd.)

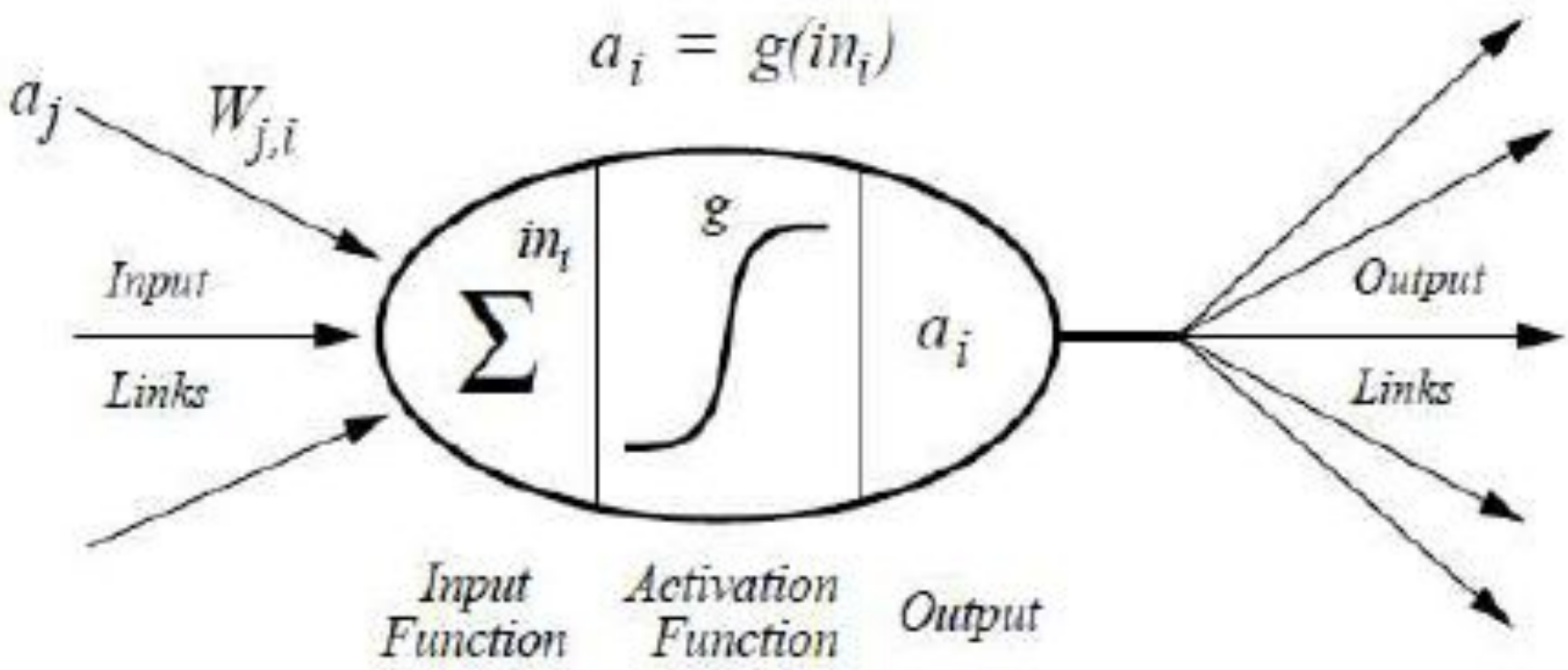
- Perceptrons are the basic building blocks of Neural Networks
- This is a model that mimics human neuron - the basic processing unit of brain.
- Like Neurons, Perceptrons have 3 parts:
    - Weighted Inputs = Dendrites
    - Processing Body = Cell body
    - Outputs = Axon

Perceptron (contd.)



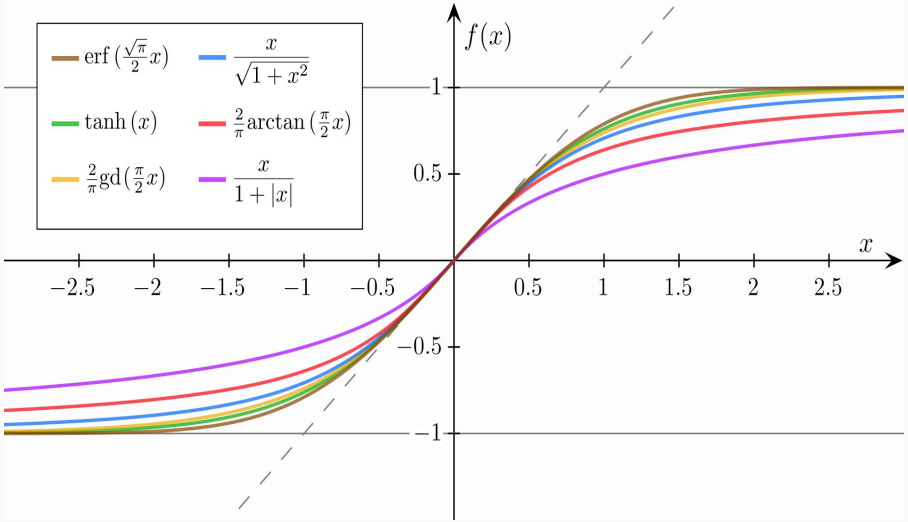
The Processing Body of a perceptron consists of:

- A way to combine the inputs, generally **an adder.**
- A way to decide whether to output a signal or not. This is achieved using the **activation function** (since it activates or makes the perceptron “fire” a signal), generally, **sigmoid activation**



ANATOMY OF A PERCEPTRON

Perceptron (contd.)



- At its heart, a perceptron is a simple logistic regression model.
- But unlike logistic regression which uses a sigmoid function for classification, perceptrons can use a variety of functions.

Time to get your hands dirty

SVMs(Support Vector Machines)

What do SVM do differently?

SVMs aim at solving classification problems **by finding good decision boundaries** between two sets of points belonging to two different categories.

What is a support vector ?

- Between two classes there exist infinite number of hyperplanes.
- For both the classes , we can draw one hyperplane parallel to the decision-boundary hyperplane **DBP**, such that it **touches** the datapoint which is **nearest** to the **DBP**.
- This hyperplane is called a support vector.
- SVM maximises the margin/perpendicular distance between two support vectors.

Common Kernels Used in SVMs

- Linear
- Nonlinear
- Polynomial
- Gaussian kernel
- Radial basis function (RBF)
- Sigmoid
- Hyperbolic tangent(tanh)

Advantages of SVMs

- Effective in cases where number of dimensions is greater than the number of samples.
- Uses a subset of training points in the decision function (called support vectors), so it is also memory efficient.
- Versatility provided by Kernels

In the next Class*

*tentative

- Hyperparameter Optimization
- Intro to D-Trees
- Intro to Neural Nets
- Some common Performance Metrics