Assignment SCOA-5

Title: Single layer perceptron

Problem Statement:

Write a program to find the Boolean function to implement following single layer perceptron. Assume all activation functions to be the threshold function which is 1for all input values greater than zero and 0 otherwise..

Objectives:

- Understand concept and basics of single layer perceptron
- Understand the idea of fuzzy logic in neural networks.

Outcomes

Students will be able to:

- Understand and implement single layer perceptron.
- Understand the use of fuzzy logic in neural networks.

Software and Hardware Requirements:

4GB RAM, Processor 13 and above, 500GB HDD. OS Fedora / Ubuntu, Text, Editor Jupyter Notebook, Python 2.7 or 3.6.

Theory

Perceptron

An algorithm for supervised learning of binary classifiers. It basically ascertains whether a given input vector belongs to the same class or not. Linear classifier that is function of the form

$\hat{y} = b + w_1 * x_1 + w_2 * x_2 \dots w_n * x_n$

$y \in \{0, 1\}$

$\hat{y} = A \cdot B$

$A = [b \; w_1 \; w_2 \dots w_n]$

$$B = \begin{bmatrix} 1 \\ x_1 \\ \vdots \\ x_n \end{bmatrix}$$

Mathematically, a perceptron is threshold function ie for a real valued vector X

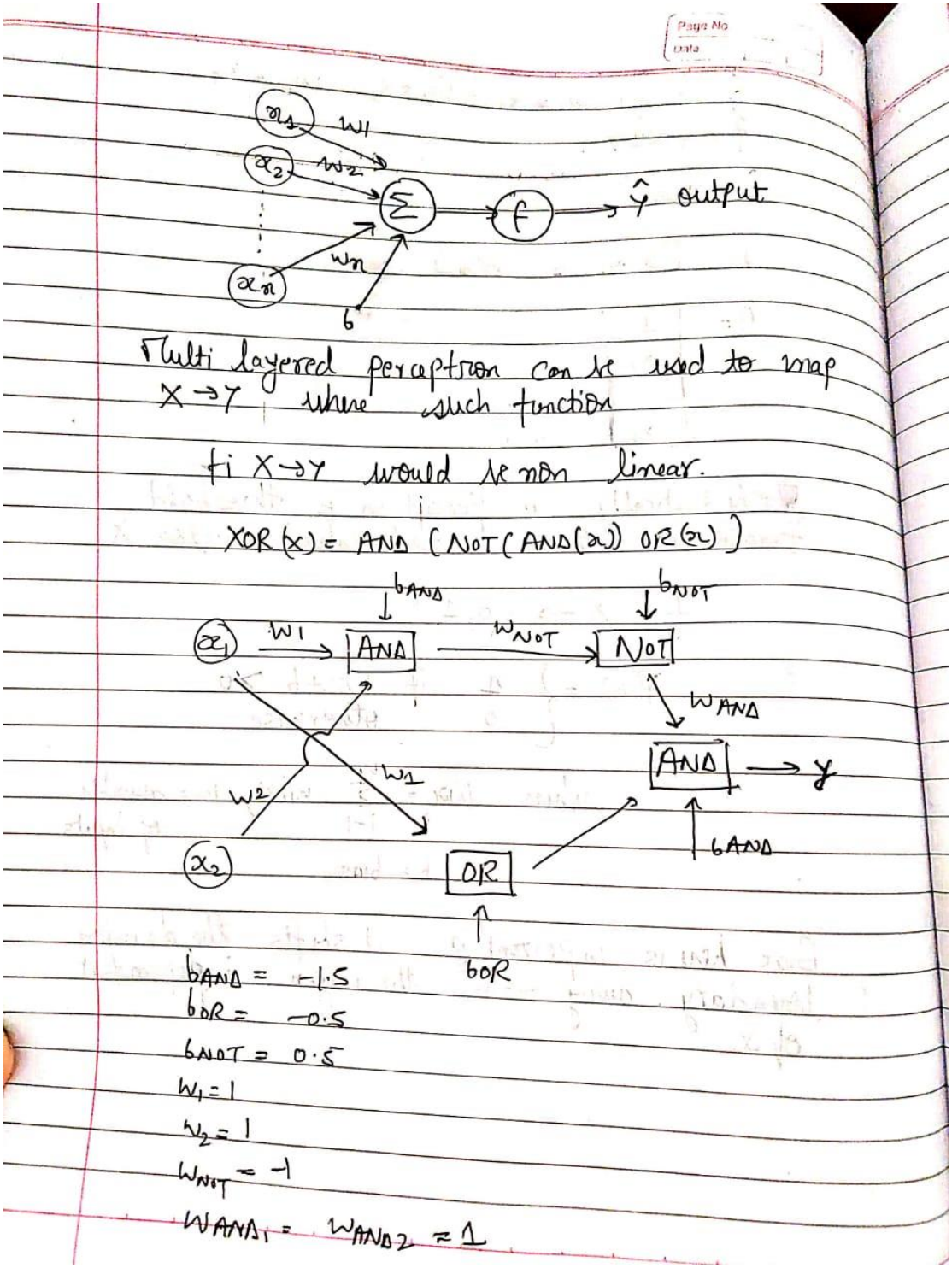
$$f = X \rightarrow \{0, 1\}$$

$$f(x) = \begin{cases} 1 & \text{if } wx + b > 0 \\ 0 & \text{otherwise} \end{cases}$$

where $wx = \sum_{i=1}^{m} w_i x_i$, m = number of inputs

b = bias

Bias here is important as it shifts the decision boundary away from the origin independent of x



Neural Networks

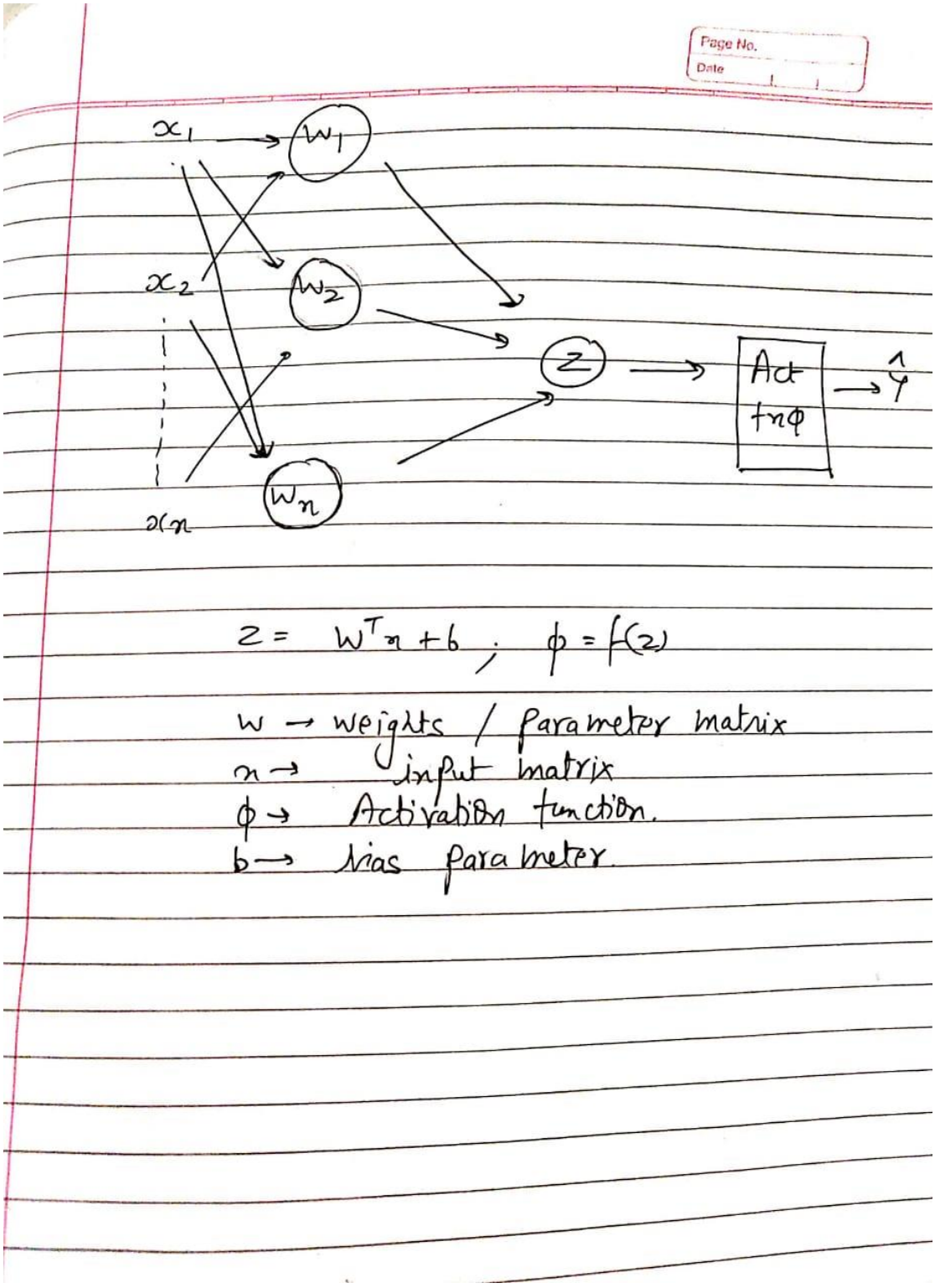
An algorithm modelled on the human brain and nervous system. It is a group of connected artificial neurons that uses computational or mathematical modelling for information

processing based on connectionistic approach to computation. Used for non linear statistical data modelling or decision making tools. Infer observations from data and can apply such learning to solve real world problems. Can model complex data without being explicitly programmed.

Applications of Neural Networks -

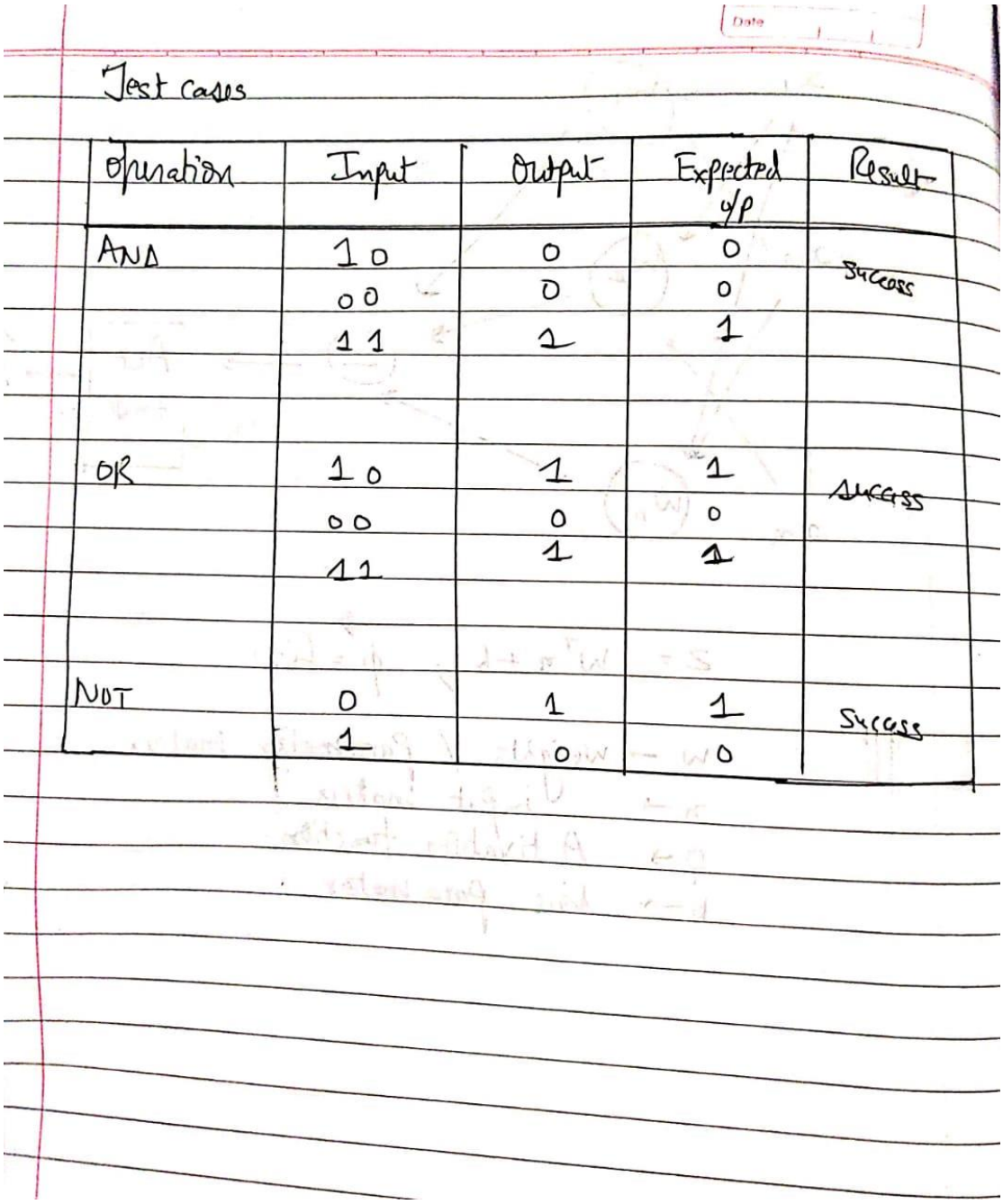
- ❖ Regression ie function approximation
- ❖ Classification
- ❖ Data Processing

Mathematical Model:



The neural network determines the ideal value of w and b to correctly approximately Yˆ such that loss function i.e L(Y,Yˆ) becomes minimum.

Activation function 0 is used to introduce nonlinearity as well as bound output of neurons to a well defined chaised set range.



Test cases

Operation	Input	Output	Expected o/p	Result
AND	1 0	0	0	Success
	0 0	0	0	
	1 1	1	1	
OR	1 0	1	1	Success
	0 0	0	0	
	1 1	1	1	
NOT	0	1	1	Success
	1	0	0	

Conclusion:

Successfully implemented single layer perception for boolean functions.