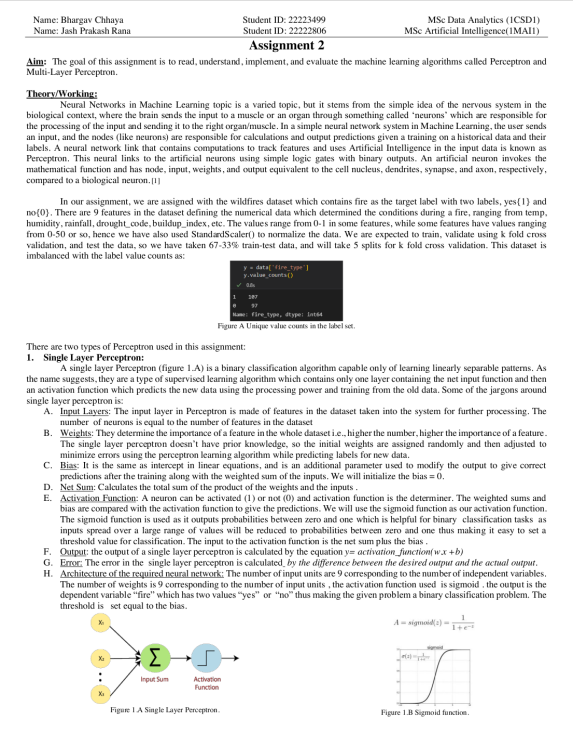
Digital Receipt

This receipt acknowledges that Turnitin received your paper. Below you will find the receipt information regarding your submission.

The first page of your submissions is displayed below.

Submission author:	Jash Prakash Rana
Assignment title:	Assignment 2 - pdf upload here
Submission title:	CT5165 - Assignment 2.pdf
File name:	CT5165_-_Assignment_2.pdf
File size:	528.32K
Page count:	10
Word count:	4,396
Character count:	22,130
Submission date:	12-Nov-2022 12:56PM (UTC+0000)
Submission ID:	1951842189



Name: Bhargav Chhaya — Student ID: 22223499 — MSc Data Analytics (1CSD1)
Name: Jash Prakash Rana — Student ID: 22222806 — MSc Artificial Intelligence(1MAI1)

Assignment 2

Aim: The goal of this assignment is to read, understand, implement, and evaluate the machine learning algorithms called Perceptron and Multi-Layer Perceptron.

Theory/Working:

Neural Networks in Machine Learning topic is a varied topic, but it stems from the simple idea of the nervous system in the biological context, where the brain sends the input to a muscle or an organ through something called 'neurons' which are responsible for the processing of the input and sending it to the right organ/muscle. In a simple neural network system in Machine Learning, the user sends an input, and the nodes (like neurons) are responsible for calculations and output predictions given a training on a historical data and their labels. A neural network link that contains computations to track features and uses Artificial Intelligence in the input data is known as Perceptron. This neural links to the artificial neurons using simple logic gates with binary outputs. An artificial neuron invokes the mathematical function and has node, input, weights, and output equivalent to the cell nucleus, dendrites, synapse, and axon, respectively, compared to a biological neuron.[1]

In our assignment, we are assigned with the wildfires dataset which contains fire as the target label with two labels, yes{1} and no{0}. There are 9 features in the dataset defining the numerical data which determined the conditions during a fire, ranging from temp, humidity, rainfall, drought_code, buildup_index, etc. The values range from 0-1 in some features, while some features have values ranging from 0-50 or so, hence we have also used StandardScaler() to normalize the data. We are expected to train, validate using k fold cross validation, and test the data, so we have taken 67-33% train-test data, and will take 5 splits for k fold cross validation. This dataset is imbalanced with the label value counts as:

```
y = data['fire_type']
y.value_counts()
✓ 0.0s

1    107
0     97
Name: fire_type, dtype: int64
```

Figure A Unique value counts in the label set.

There are two types of Perceptron used in this assignment:

1. **Single Layer Perceptron:**

A single layer Perceptron (figure 1.A) is a binary classification algorithm capable only of learning linearly separable patterns. As the name suggests, they are a type of supervised learning algorithm which contains only one layer containing the net input function and then an activation function which predicts the new data using the processing power and training from the old data. Some of the jargons around single layer perceptron is:

A. Input Layers: The input layer in Perceptron is made of features in the dataset taken into the system for further processing. The number of neurons is equal to the number of features in the dataset
B. Weights: They determine the importance of a feature in the whole dataset i.e., higher the number, higher the importance of a feature. The single layer perceptron doesn't have prior knowledge, so the initial weights are assigned randomly and then adjusted to minimize errors using the perceptron learning algorithm while predicting labels for new data.
C. Bias: It is the same as intercept in linear equations, and is an additional parameter used to modify the output to give correct predictions after the training along with the weighted sum of the inputs. We will initialize the bias = 0.
D. Net Sum: Calculates the total sum of the product of the weights and the inputs .
E. Activation Function: A neuron can be activated (1) or not (0) and activation function is the determiner. The weighted sums and bias are compared with the activation function to give the predictions. We will use the sigmoid function as our activation function. The sigmoid function is used as it outputs probabilities between zero and one which is helpful for binary classification tasks as inputs spread over a large range of values will be reduced to probabilities between zero and one thus making it easy to set a threshold value for classification. The input to the activation function is the net sum plus the bias .
F. Output: the output of a single layer perceptron is calculated by the equation *y= activation_function(w.x +b)*
G. Error: The error in the single layer perceptron is calculated, *by the difference between the desired output and the actual output*.
H. Architecture of the required neural network: The number of input units are 9 corresponding to the number of independent variables. The number of weights is 9 corresponding to the number of input units , the activation function used is sigmoid . the output is the dependent variable "fire" which has two values "yes" or "no" thus making the given problem a binary classification problem. The threshold is set equal to the bias.

Figure 1.A Single Layer Perceptron.

Figure 1.B Sigmoid function.