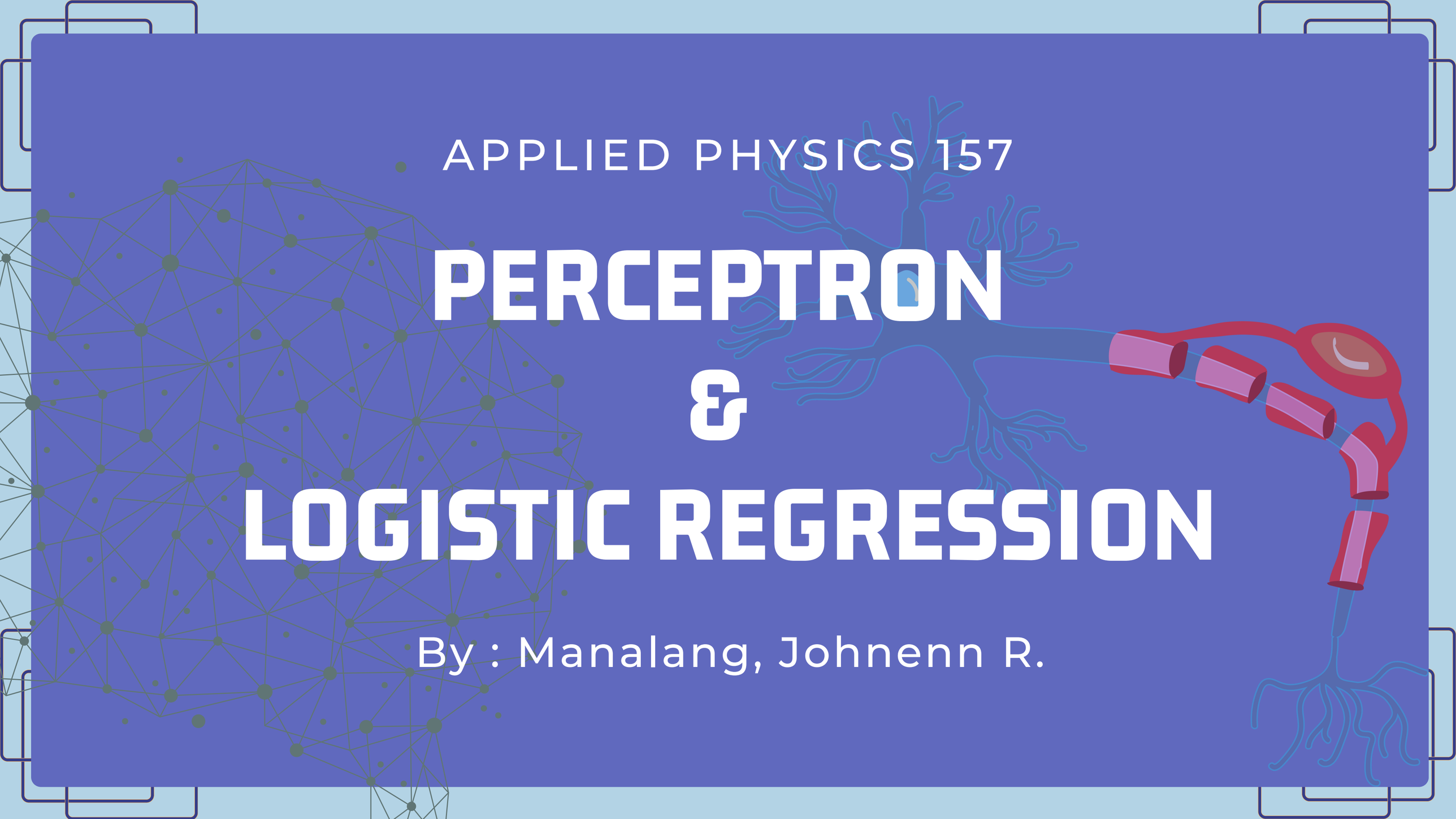
APPLIED PHYSICS 157

PERCEPTRON & LOGISTIC REGRESSION



By : Manalang, Johnenn R.

TABLE OF CONTENTS

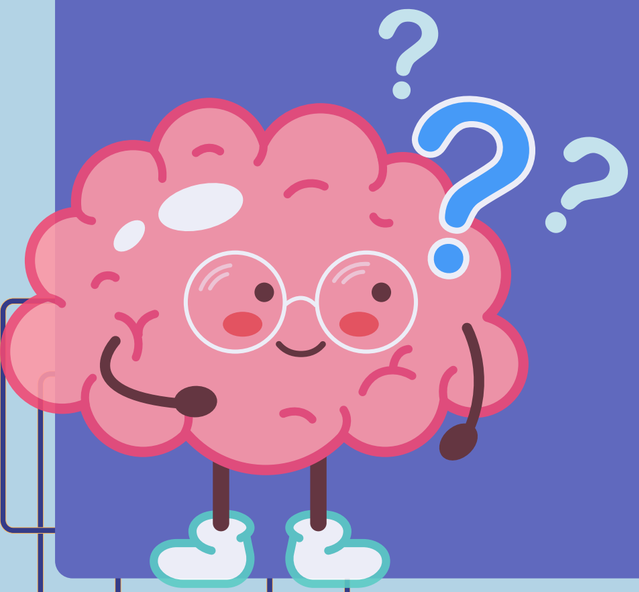
01 Objectives

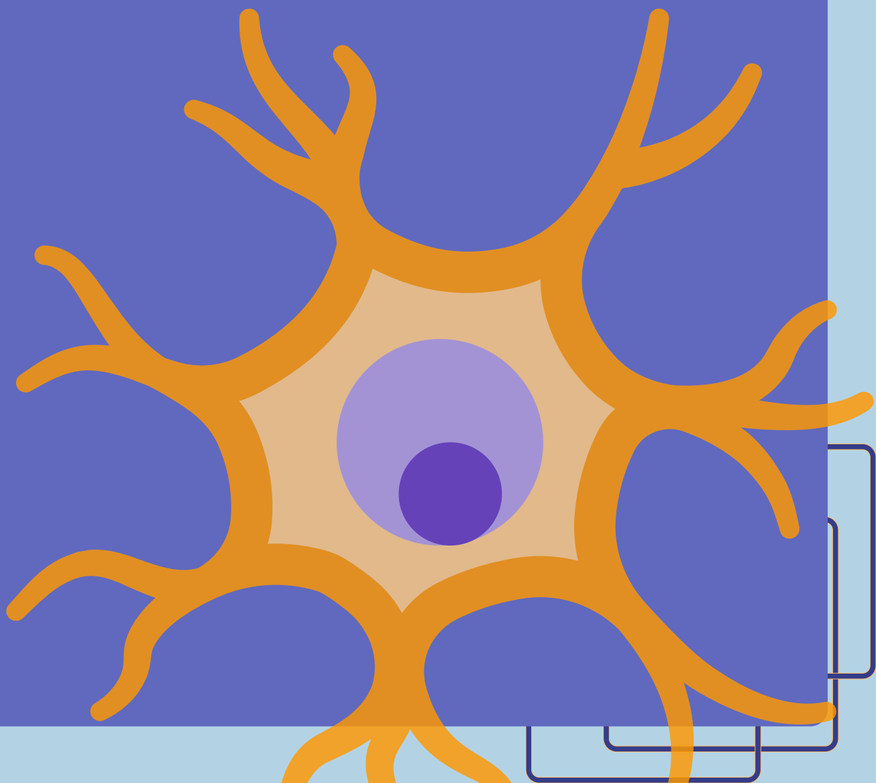
02 Overview

03 Perceptron

08 Logistic Regression

13 Reflection





OBJECTIVES

01.

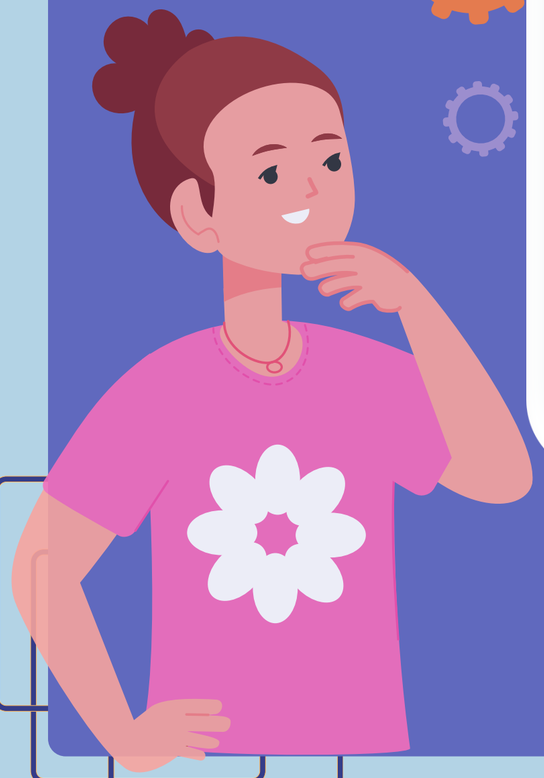
Use automated feature extraction for training images to be used for Machine Learning.

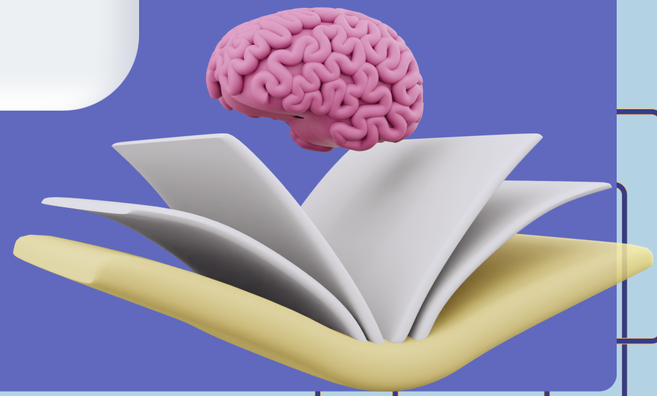
02.

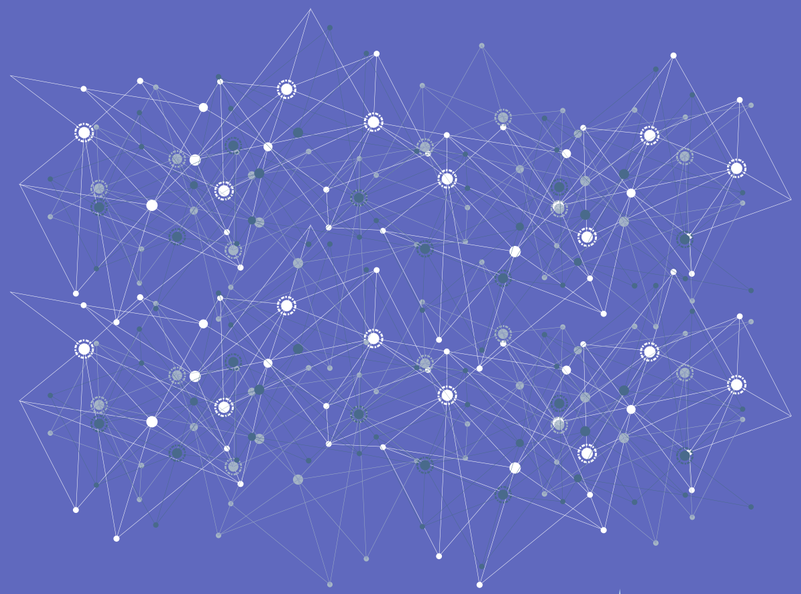
Use perceptron algorithm to classify data into two different fruit classes.

03.

Use logistic regression to predict the level of fruit ripeness based on the fruit's color.





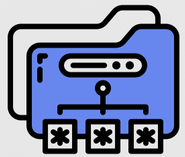


OVERVIEW

There are different algorithms used in Machine Learning. Two of the linear classification algorithms are Perceptron and Logistic Regression. They differ in their activation functions and training procedures. While Perceptron classifies the input using a step function, the logistic regression model uses the sigmoid function for probabilistic outputs [1,2]. In this activity, we'll use fruit datasets to classify the type of fruit and the level of ripeness using the perceptron and logistic regression, respectively.

PERCEPTRON

HOW TO: PERCEPTRON



Dataset Generation

Create or find a dataset of two different fruits.

Feature Extraction

Extract two features. I used greenness and eccentricity for the purpose of this report.

Training

Train the data using perceptron algorithm. Use a step function as the activation function (z = -1 or 1).

Plotting Decision Line

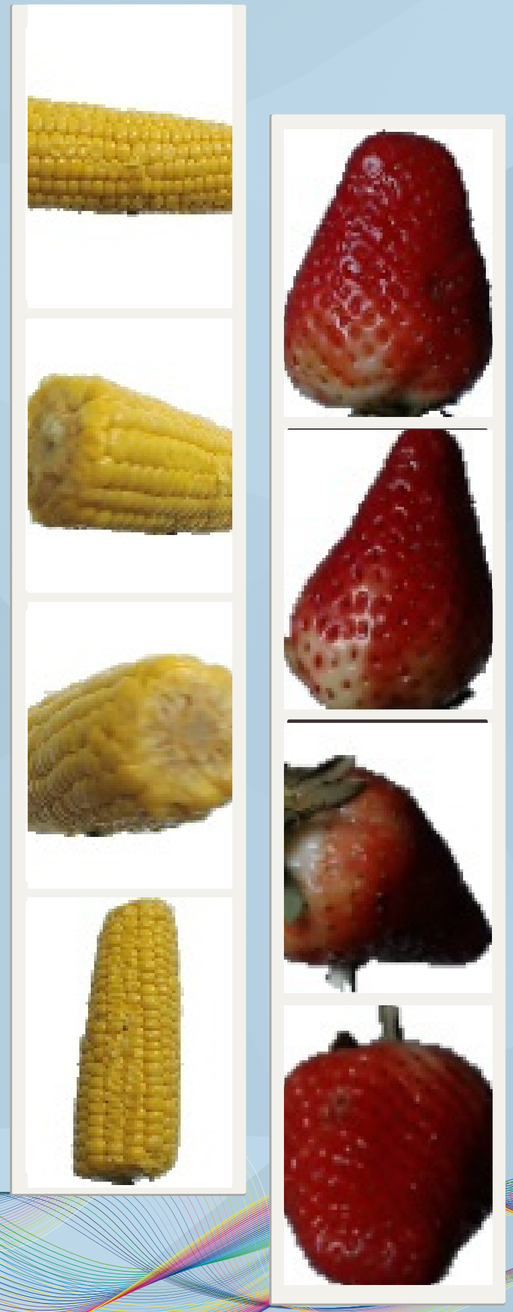
Plot data in feature space and overlay the decision line that separates the two classes.

Testing

Test perceptron if it can classify fruits using a testing dataset.

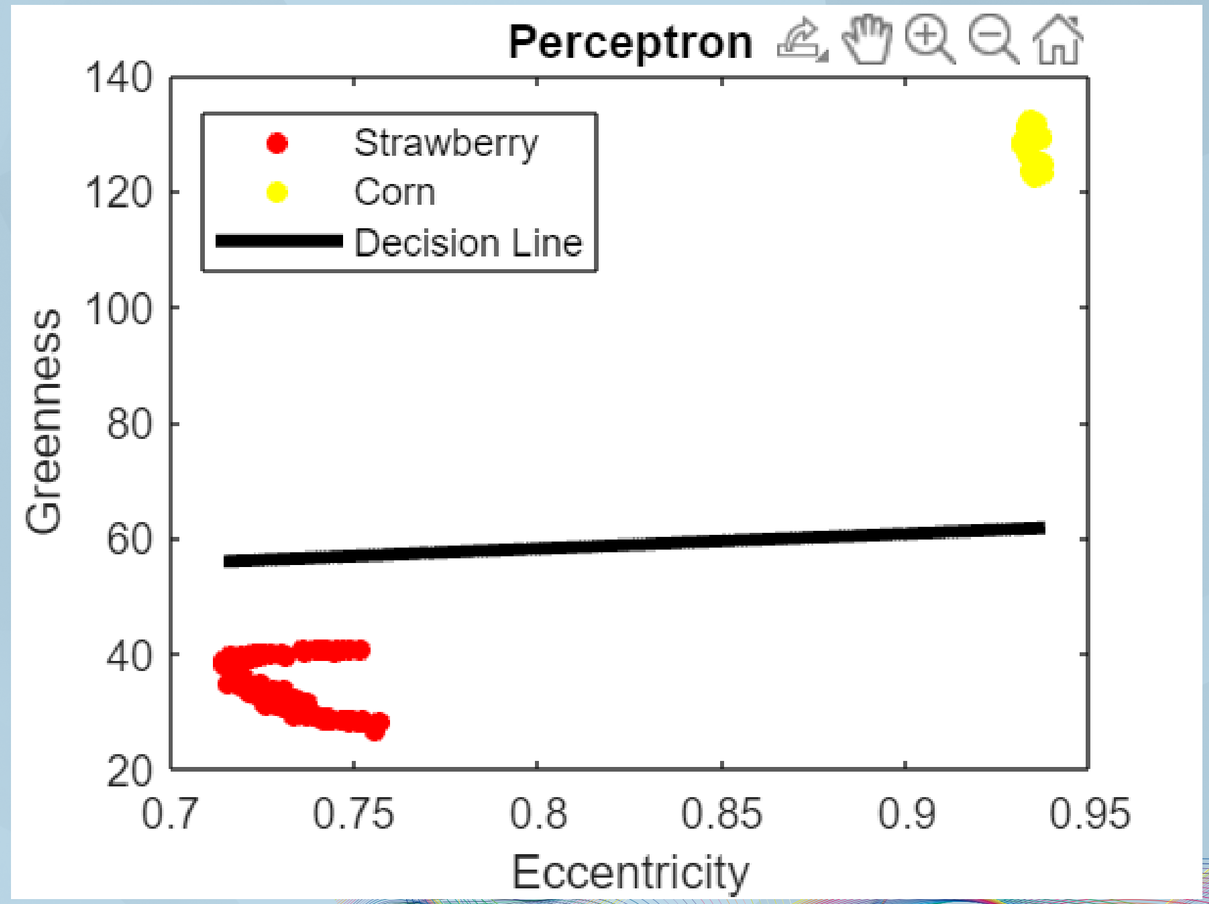
PERCEPTRON

The dataset that I used is fruits-360 from Kaggle [3]. I chose corn and strawberry because they have distinct shape and color. So, the features that I extracted are eccentricity and greenness. I only chose green since if I chose red, the different between the two fruits would be too big (as strawberry is red). After feature extraction, I used the perceptron algorithm for training with the step function as the activation function. The data is then plotted and the decision line is overlayed.



PERCEPTRON

The resulting plot is shown here. As observed, the decision line separates the two classes in the feature space. Therefore, the code for the perceptron algorithm is successful in classifying the fruits (corn and strawberry). To test this further, we can use different images for testing.

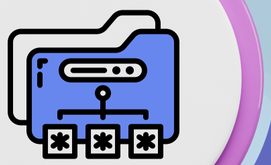


PERCEPTRON

Tada! After testing the perceptron, it can be seen that it successfully classified which fruit is in the image. Here are some of the random test images that I used and the resulting classification for them.

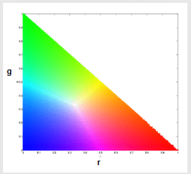
LOGISTIC REGRESSION

HOW TO: LOGISTIC REGRESSION



Dataset Generation

Create or find a dataset of a fruit that changes color as it ripens.



Color Averaging

For each imgae, get the average red., green, and blue color of the fruit. Label: 1 for ripe, 0 for unripe.

Training

Train the data using logistic regression algorithm. Use a sigmoid function as the activation function.

Plotting the function

Plot activation vs. activation function to see a sigmoid function and verify the result.

Testing

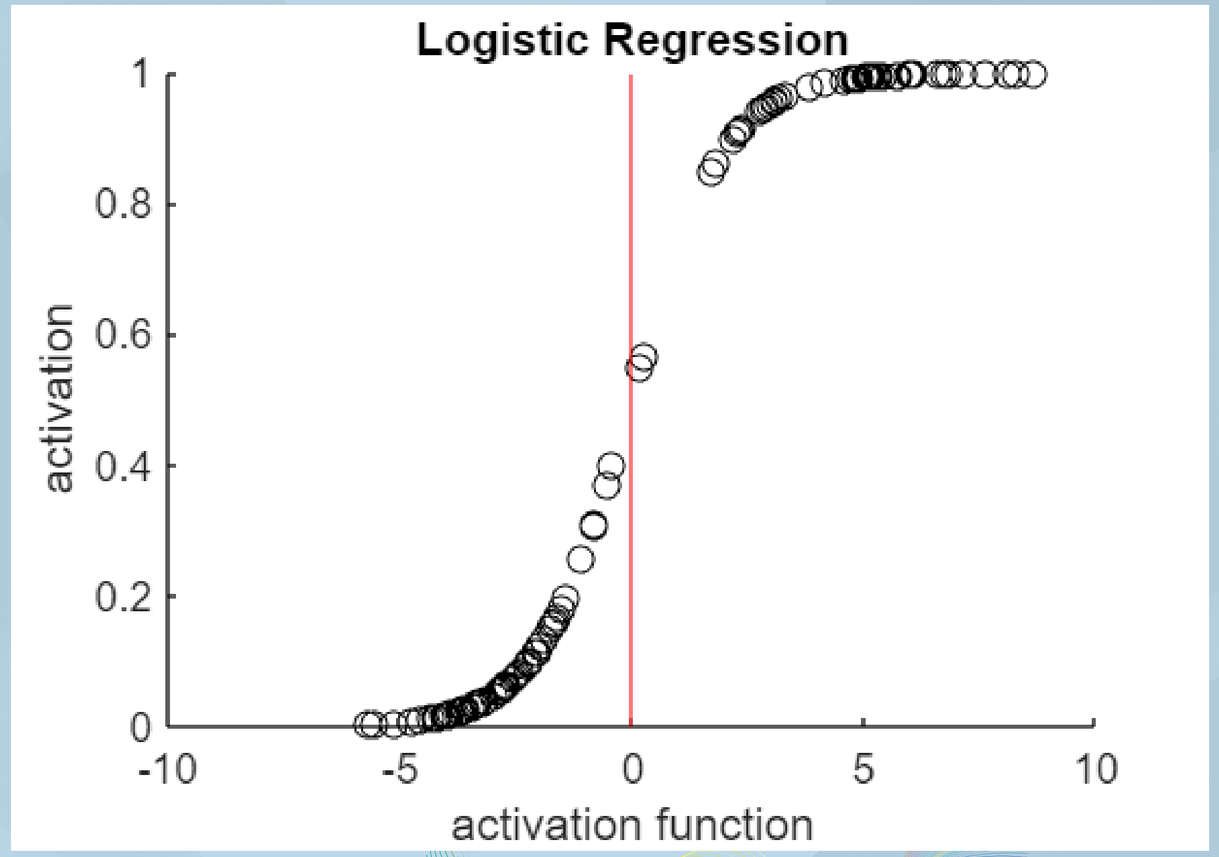
Test logistic regression algorithm if it can classify the level of ripeness of test images.

LOGISTIC REGRESSION

I used a dataset of ripeness of mango [4]. Some of the training images are shown here. For the mean of red, green, and blue color, I used the NCC colorspace. Then, I labeled the ripe mangoes as 1 and the unripe mangoes as 0. I then used the logistic regression algorithm for training with an sigmoid function as the activation function (beta = 1).

LOGISTIC REGRESSION

The resulting plot is shown here. As observed, the data points formed a sigmoid function. This means that each image has different levels of ripeness. Now, to test if the algorithm really works, I used the test images.



LOGISTIC REGRESSION

ripeness = 2.6728%

ripeness = 42.5628%

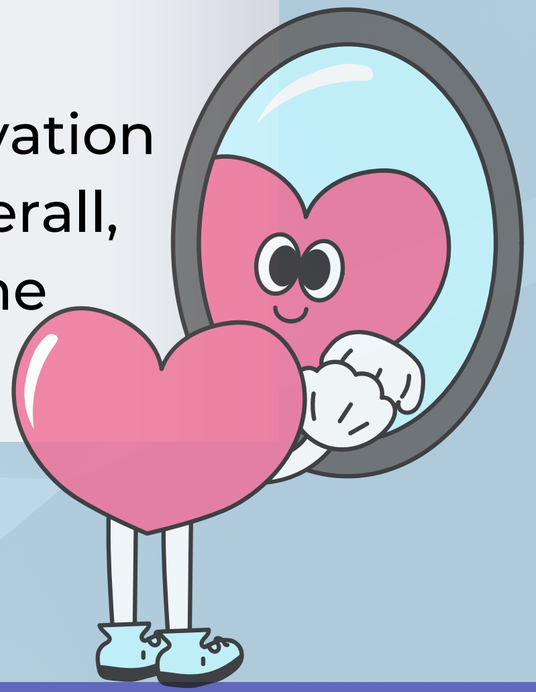
ripeness = 99.8407%

ripeness = 99.9729%

Here we see different levels of ripeness. The algorithm successfully classifies the level of ripeness of the test images.

REFLECTION

What's challenging in this activity is finding a dataset for training and testing. Then, the automated feature extraction should be done for all the images. I spent more time on that than the algorithms itself. The algorithms of perceptron and logistic regression are almost the same, they only differ on the activation function so it's not that hard to crate the code for them. Overall, this activity is fun and I learned a lot of things about machine learning.



REFERENCES

1. https://uvle.upd.edu.ph/pluginfile.php/885073/mod_resource/content/1/ML2%20-%20Perceptron.pdf
2. https://uvle.upd.edu.ph/pluginfile.php/885075/mod_resource/content/1/ML3%20-%20Logistic%20Regression.pdf
3. https://www.kaggle.com/datasets/moltean/fruits
4. Gururaj, N., Vinod, V. & Vijayakumar, K. Deep grading of mangoes using Convolutional Neural Network and Computer Vision. Multimed Tools Appl (2022). https://doi.org/10.1007/s11042-021-11616-2

REPORT GRADE

Criteria	Score
Technical Correctness	35
Quality of Presentation	35
Self Reflection	30
Initiative	10
TOTAL	100

EVALUATION

Overall, I know that I have accomplished all the tasks included in this activity. I have successfully demonstrated how the Perceptron and Logistic Regression works and have spent time looking for the appropriate dataset to use for both.