VASAVI COLLEGE OF ENGINEERING (Autonomous)
IBRAHIMBAGH, HYDERABAD – 500 031
Department of Computer Science & Engineering

INNOVATION IN TEACHING

Course Name: Machine Learning **Faculty Name:** S.Komal Kour

Topic Name: Perceptron Rule learning **Year/Sem:** III/V

Innovative Teaching aid/Tool used: Neural Network Simulator on Supervised Learning

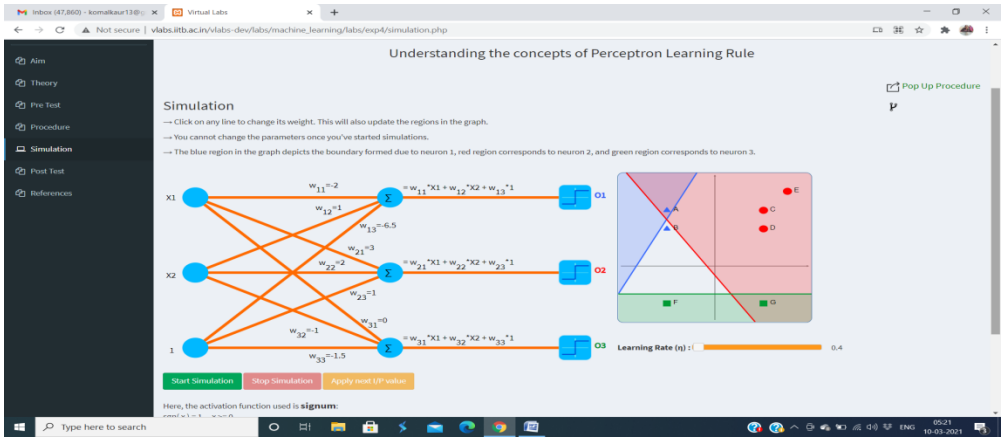
Description of the Tool:

- The perceptron learning rule has applied for supervised learning of neural network.
- Perceptron is an algorithm for supervised learning of binary classifiers. A binary classifier is a function which can decide whether or not an input, represented by a vector of numbers, belongs to some specific class. It is a type of linear classifier, i.e. a classification algorithm that makes its predictions based on a linear predictor function combining a set of weights with the feature vector.
- Multiclass classification is the problem of classifying instances into one of three or more classes.
- Multiclass perceptrons provide a natural extension to the multi-class problem. Instead of just having one neuron in the output layer, with binary output, one could have N binary neurons leading to multi-class classification.
- By using this simulator, we can classify the three classes which are Blue, Red and Green.
- We demonstrated the learning rule for 1 input of 1st iteration.
- Let the input vector be [-2, 3, 1]
- And the initial weight matrix, W be

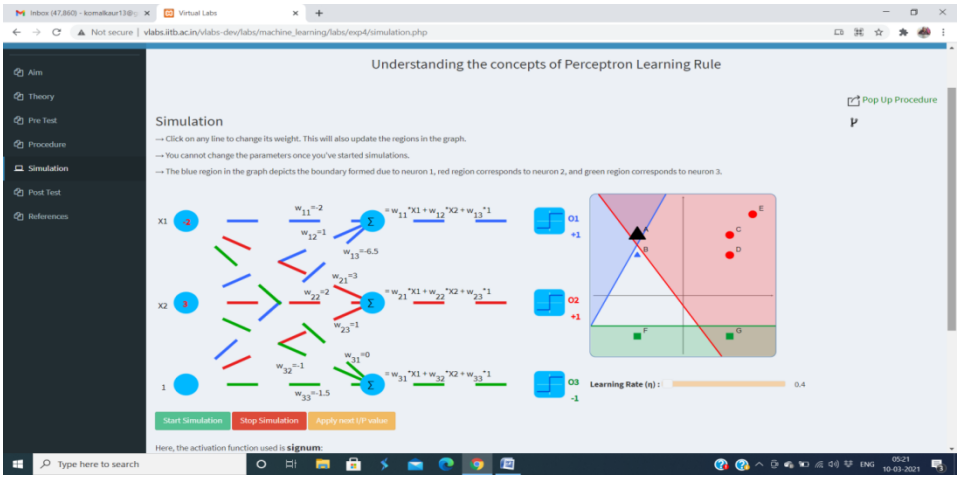
-2	1	-6.5
3	2	1
0	-1	-1.5

The learning constant is assumed to be $\eta = 0.4$

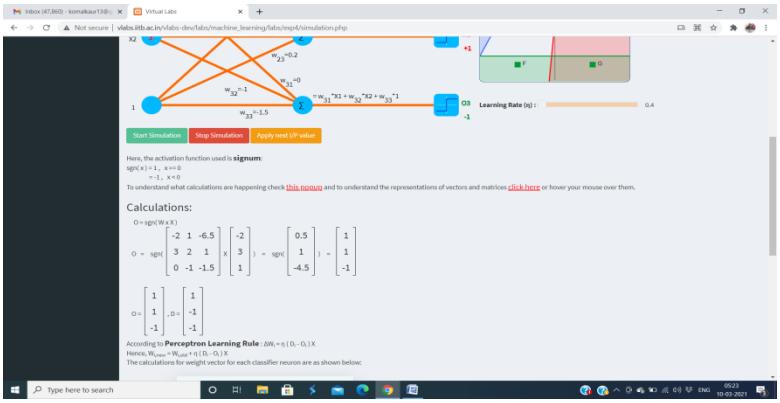
- The desired response for this input X is
  D = [1,-1,-1]
- The activation function used is signum:
  sgn(x) = 1 , x >= 0
  = -1 , x < 0
- Initially there are two inputs X1, X2 and bias.



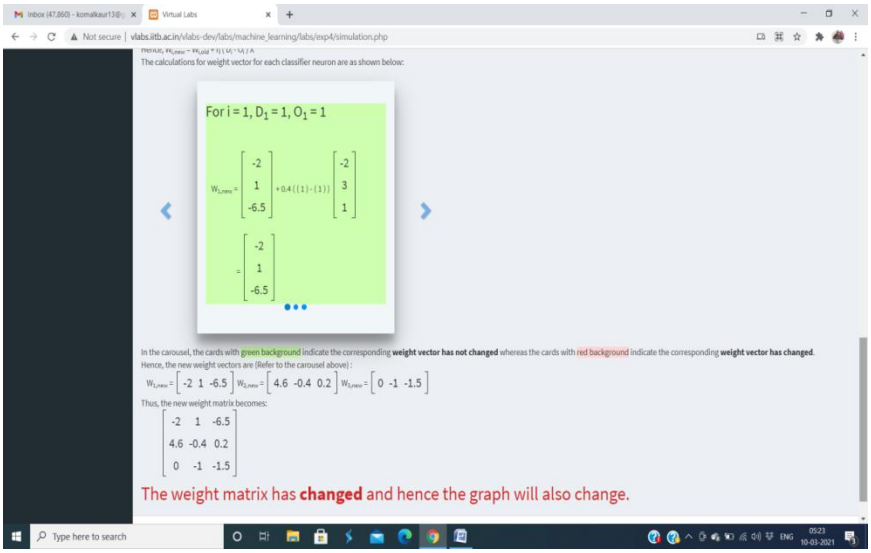
- When we begin our simulation process for neural network 1 it is highlighted by black triangle to classify the data



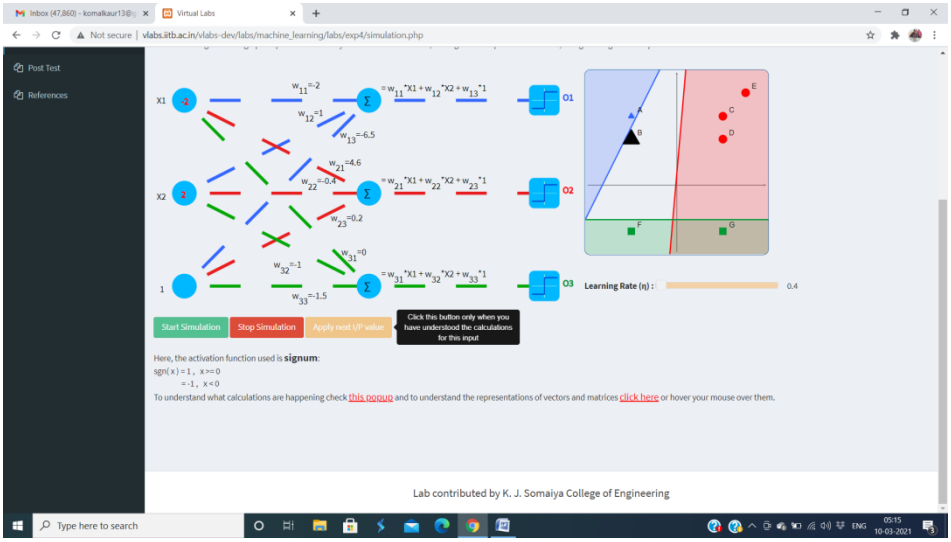
- After the first iteration, calculated the output of each neuron and compared with desired output.



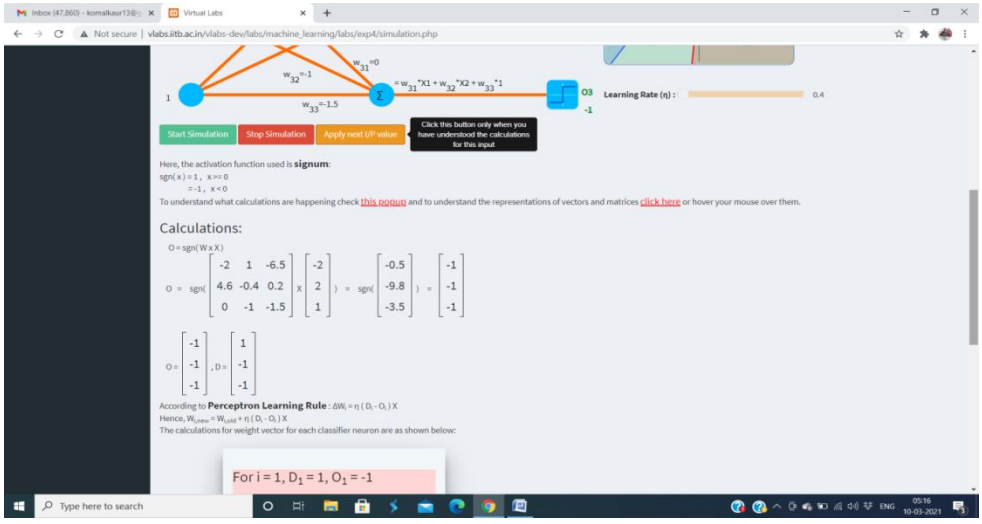
- The weights are modified according to the given formula i.e.,
  $\Delta Wi = \eta (Di - Oi) X$
  Where ΔWi= change in the weights
  n = learning rate
  Di= Desired output
  Oi= Actual output
  X=input



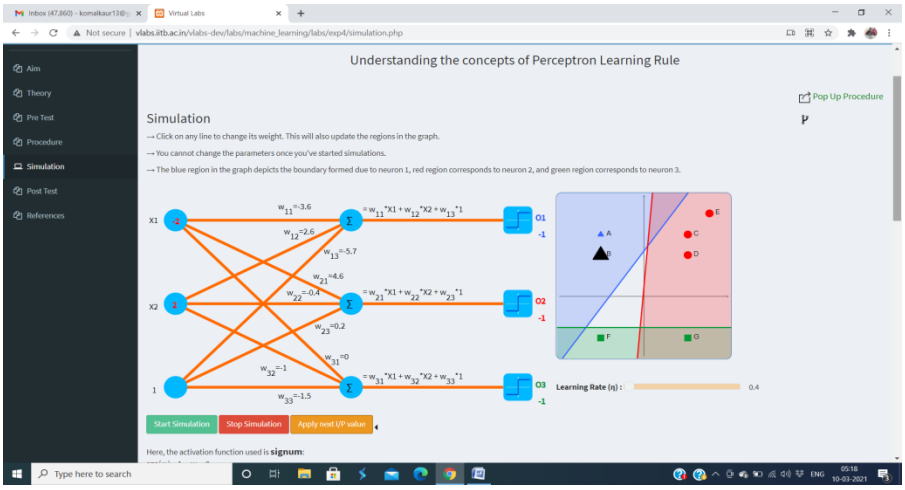
- For the second iteration, the changed weights are applied and begin the process to calculate and classify the data.



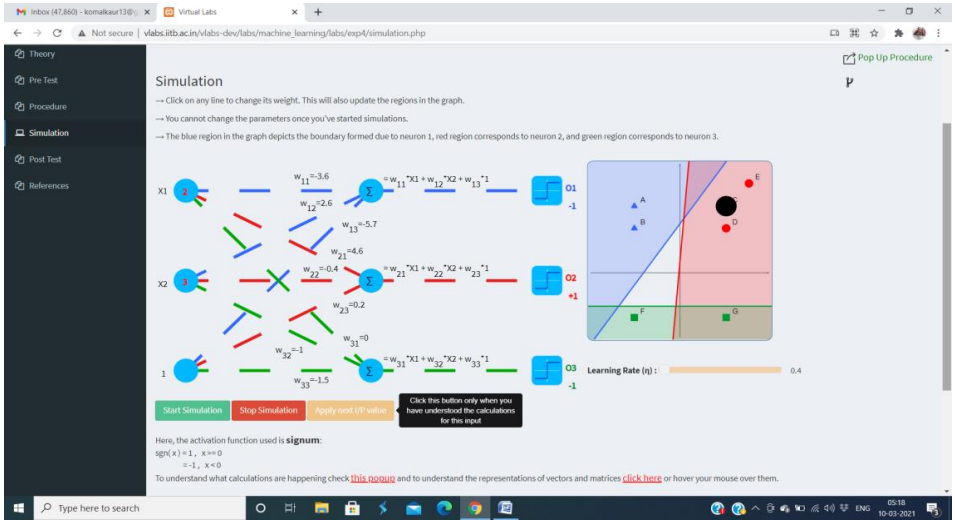
- Output is calculated and compared with desired output.



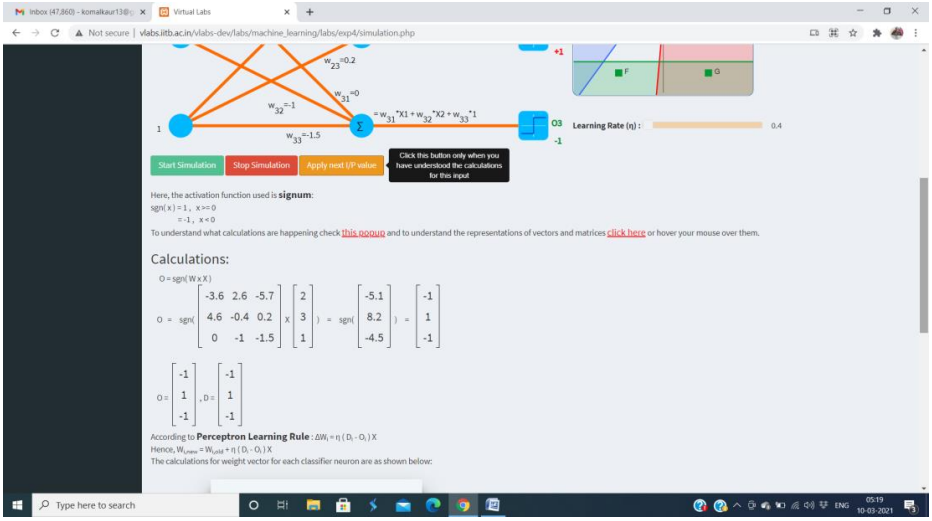
- Weights are modified the graph of classification is also changed.



- The process continued with third iteration and highlighted with black circle of red class.



- Calculate the output and compare with the desired output.



- Weights are not changed, graph remains unchanged and stops the simulation.

Tool usage in teaching:

The following procedure is to be followed for the simulation:

- Change the learning rate if you want to by using the slider for the same.
- Change the initial weights of the neural network if you want to by clicking on the links connecting the input nodes to summation nodes. You can see the weight changes in the alongside graph.
- Once the simulation is started, these can't be changed.
- After making changes as needed, click button start simulation. Now each input as highlighted in the graph will be chosen and learnt using the learning algorithm.
- If you want to stop the simulation in between you can do so by clicking the button stop simulation.
- After each input is completely processed, the button Apply next I/P value will get activated. Click on this button to learn using the next input.
- As you will see the regions will converge towards correct classification after each iteration. For correct classification, the regions should be such that for each input, the output of only one neuron should be +1 and that of other neurons should be -1. Thus, in the graph, each point should fall under one region only. Initially, they will fall under multiple regions. But as you will see, the position of the regions changes after every iteration so that each point falls under one region only.
- Thus you can consider the aim to be colours of the regions should match the colours of the points that they cover. And the regions should cover all the same colour points.