Transistor Output Prediction

Submitted By:
Bijendra Kumar Ray (15MI442)
Pankaj Gupta (15MI443)

Objective:

Objective: To Create a model for prediction of output regions (Active, Saturation and Cutoff) of Bipolar Junction Transistor.

Bipolar Junction Transistor has 3 output regions for different values of V_b, V_c and V_e. These regions are active, saturation and Cutoff . We have trained our model with different values of - V_b, V_c and V_e and after the training, our model is able to predict the output regions for any random values of V_b, V_c and V_e, provided that these values of voltages must be in range for BJT.

Methodology:

Condition for :

1.) Active Region

. $V_{be} > 0.7v$ & $V_e < V_b < V_c$

2.) Saturation Region

$V_b > V_c$ & $V_c = 0.2v$

3.) Cut-Off Region

$V_b < V_e$

The Output values Generation as:

If the Output value is 3 then transistor will be in Active Region

If the Output value is 2 then transistor will be in Saturation Region

If the Output value is 1 then transistor will be in Cut-Off Region

If the Output value is 0 then transistor Parameter will not possible.

Data Generation:-

V_b	V_e	V_c	Output
0.8	0	0.9	3
0.9	0.1	1.1	3
1.1	0.3	1.4	3
1.2	0.2	1.4	3
1.4	0.3	1.6	3
1.4	0.5	1.6	3
1.5	0.7	1.8	3
1.5	0.7	1.9	3
1.7	0.8	2.1	3
1.1	0.7	0.9	2
1.3	0.8	1	2
1.3	0.9	1.1	2
1.4	0.8	1.1	2
1.5	1	1.3	2
1.5	1.1	1.3	2
1.6	1.1	1.4	2
1.6	1.2	1.4	2
1.7	1.3	1.5	2
1.7	1.4	1.6	2
1.9	1.5	1.8	2
2.2	1.8	2	2
0.4	0.6	0.5	1
0.5	0.7	0.1	1
0.4	0.8	0.9	1
0.6	0.7	0.3	1
0.8	1	0.4	1
0.8	0.9	0.8	1
0.9	1.2	1.3	1
1	1.2	1.2	1
1.1	1.2	0.1	1
1.4	1.6	0.3	1
1.5	1.6	0.7	1
1.8	2	0.8	1
2.1	2.2	0.1	1
5.2	0.1	0.8	0
5.1	0.3	0.9	0
5.6	1.8	2.5	0

6.2	**1.2**	**0.9**	**0**
7.8	**1.8**	**1.1**	**0**
9.2	**0.9**	**2.3**	**0**
8.1	**0.7**	**1.8**	**0**
5.5	**2.3**	**3.9**	**0**
6.8	**5.4**	**0.8**	**0**
7.5	**2.8**	**0**	**0**
10.2	**0.3**	**4**	**0**
11.3	**0.5**	**0.7**	**0**
1	**6**	**0.9**	**0**
2.3	**5.8**	**2.4**	**0**
2.5	**7.4**	**2.9**	**0**
5.2	**10.4**	**2.9**	**0**
5.4	**5.4**	**5.4**	**0**
2.2	**8.2**	**0.9**	**0**
3.2	**10.2**	**10.2**	**0**
7	**7**	**7**	**0**
8.7	**9.8**	**2**	**0**
11.8	**15.9**	**6.7**	**0**
12.9	**2.4**	**5.8**	**0**
13.8	**2.3**	**10.9**	**0**
15	**22.8**	**2.4**	**0**

Data Generation:

Data has been generated using conditions of Different Voltages for all the regions of BJT .

Data is generated using the different conditions of all the regions of BJT

1.) Active Region

. $V_{be} > 0.7v$ & $V_e < V_b < V_c$

2.) Saturation Region

$V_b > V_c$ & $V_c = 0.2v$

3.) Cut-Off Region

$V_b < V_e$

Network Layers:

The layers used are
1. Dense layer with 40 neurons with ‘relu’ as activation function with input dimension 3.
2. Dense layer with 20 neurons with ‘relu’ as activation function.
3. Dense layer with 5 neurons and activation function as ‘relu’.
4. Dense layer with 1 neuron and activation function as ‘relu’ is the output layer.

Dense Layer:
A dense layer is just a regular layer of neurons in a neural network. Each neuron receives input from all the neurons in the previous layer, thus densely connected. The layer has a weight matrix W, a bias vector b, and the activations of previous layer a.

Output:

```
[66] result=model.predict(X_test)

[67] result

array([[ 0.00074535],
       [-0.00168527],
       [ 0.00095186],
       [ 0.00074535],
       [ 0.00119218],
       [ 0.00326217],
       [-0.00156778],
       [ 0.00074535],
       [-0.00031599],
       [ 0.00074535],
       [ 0.00318054],
       [ 0.00117476]], dtype=float32)
```

```
[68] X_test

array([[0.08, 0.09, 0.08],
       [0.51, 0.03, 0.09],
       [0.75, 0.28, 0.  ],
       [0.1 , 0.12, 0.12],
       [0.13, 0.09, 0.11],
       [0.11, 0.03, 0.14],
       [0.52, 0.01, 0.08],
       [0.1 , 0.6 , 0.09],
       [0.81, 0.07, 0.18],
       [0.05, 0.07, 0.01],
       [0.14, 0.03, 0.16],
       [0.13, 0.08, 0.1 ]])
```

Fig.: Comparison between the test data and predicted date

```
plt.scatter(range(12),result,c='r')
plt.scatter(range(12),y_test,c='g')
plt.show()
```

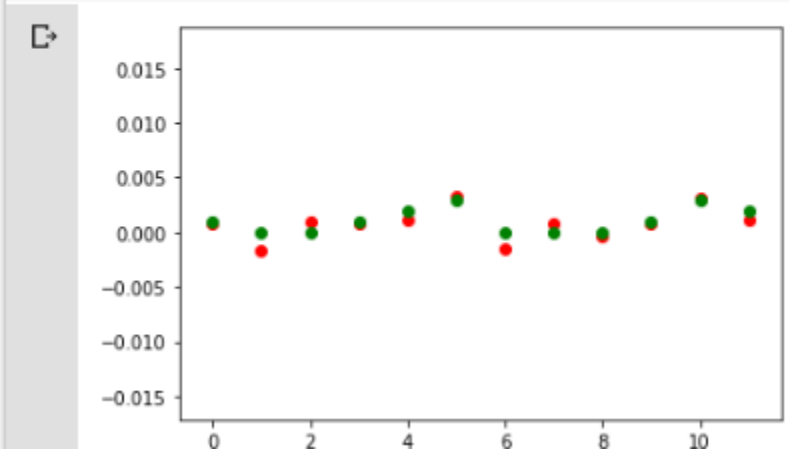

Fig.: Graph between the predicted values and test values