Assignment 2

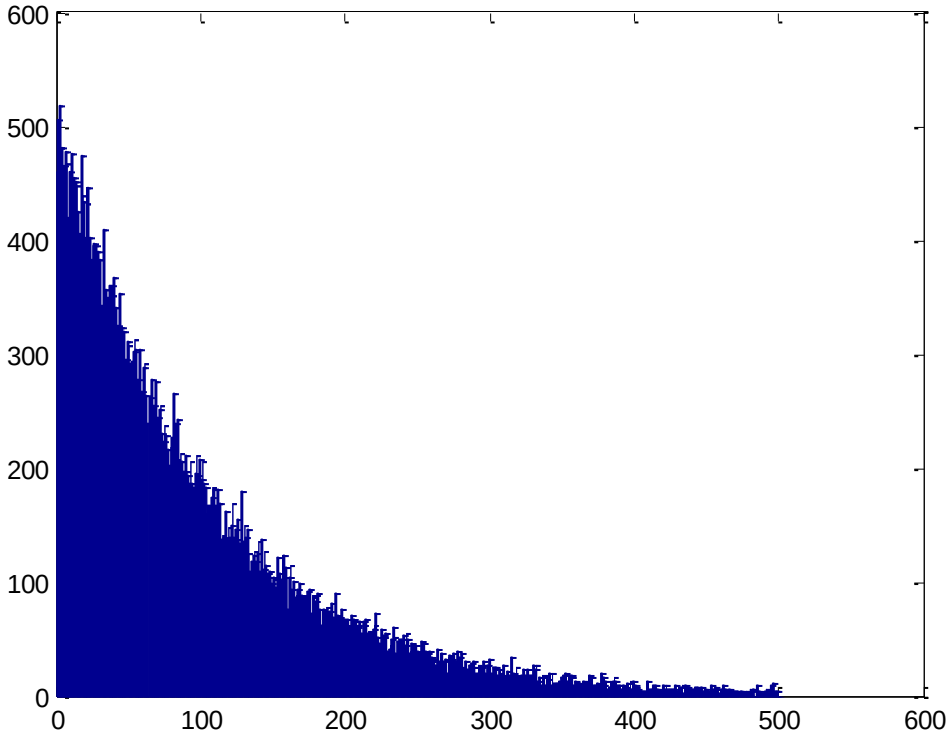
EE 746

Neuromorphic Engineering

Question 1:

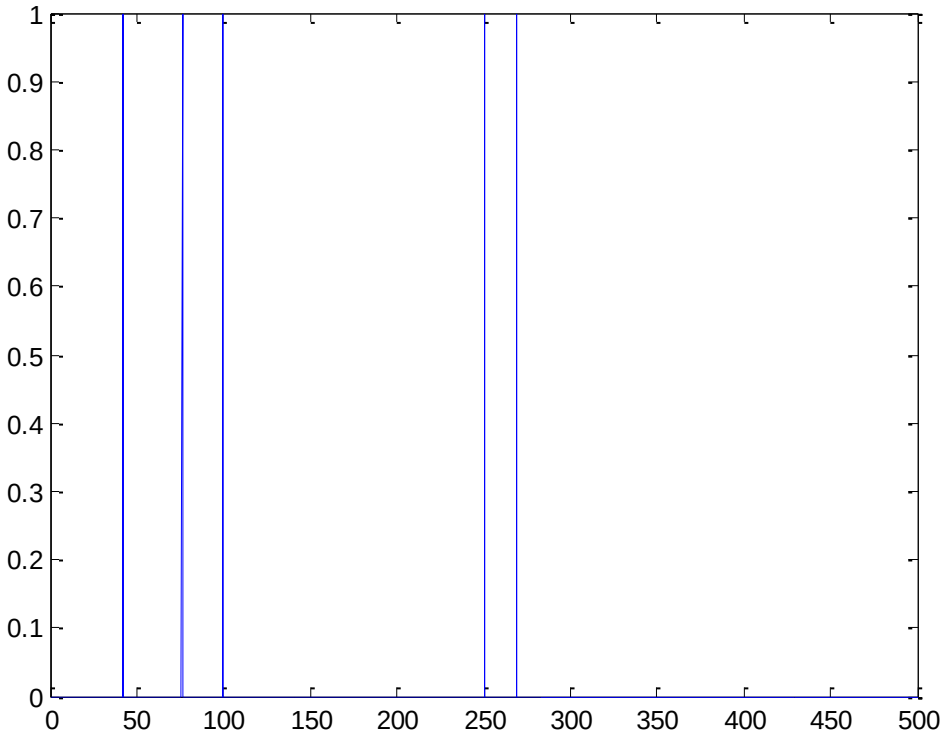
The code was run for T = 5000 seconds, and the inter-arrival time was plotted, to check for the correctness of the code.

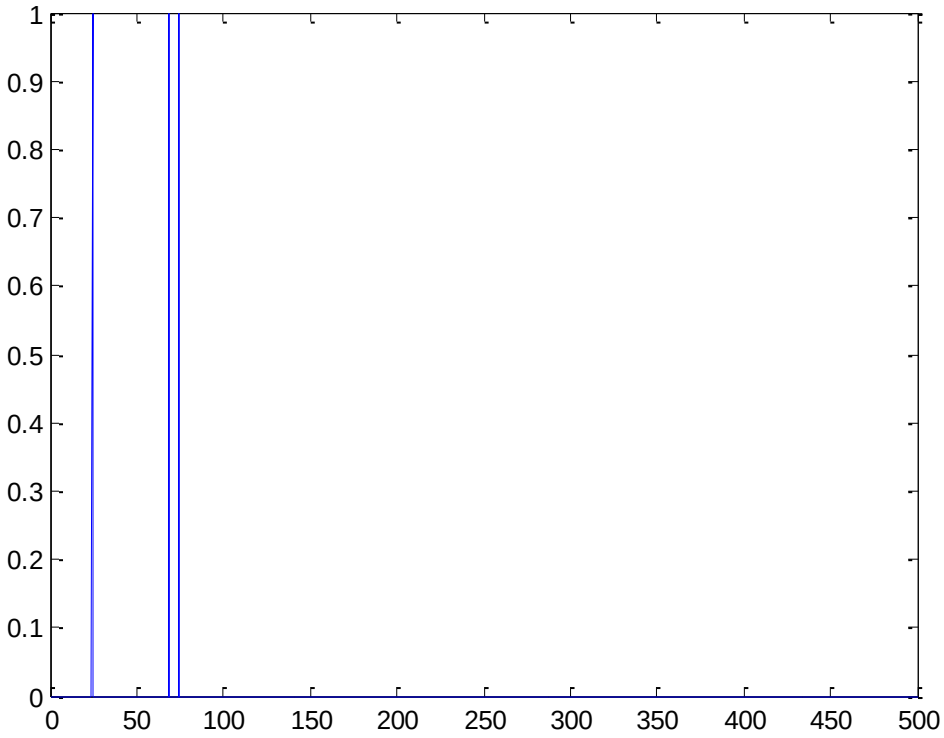
The following histogram for inter arrival time was obtained:

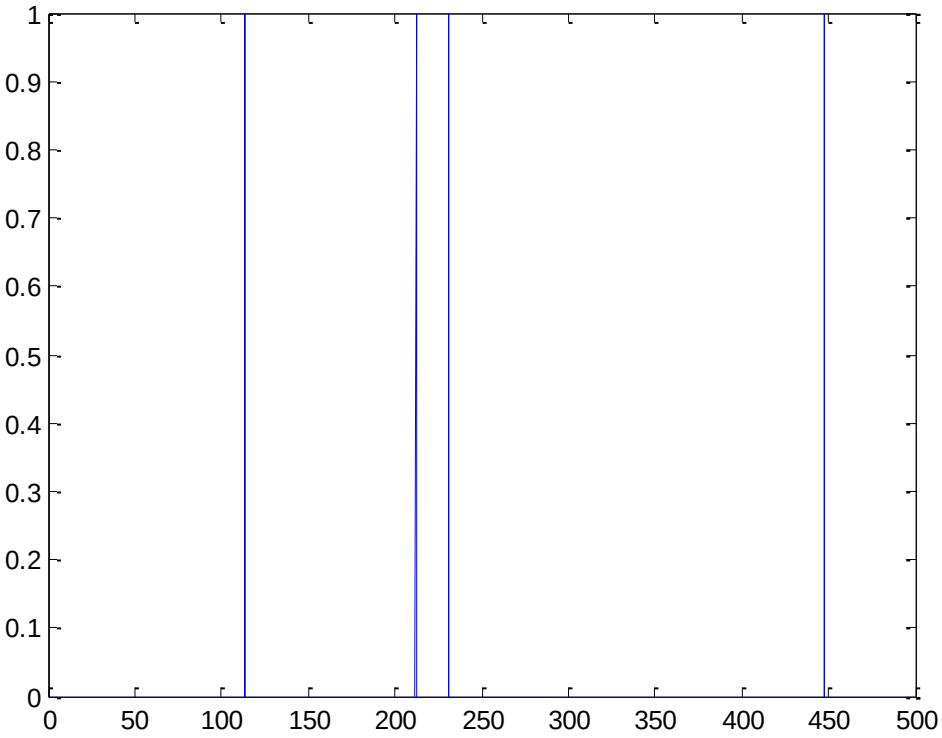


Then, the code was run for T = 500 ms, and the arrival times were plotted:

The following results were obtained, for two different runs of the code:


1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
50
100
150
200
250
300
350
400
450
500

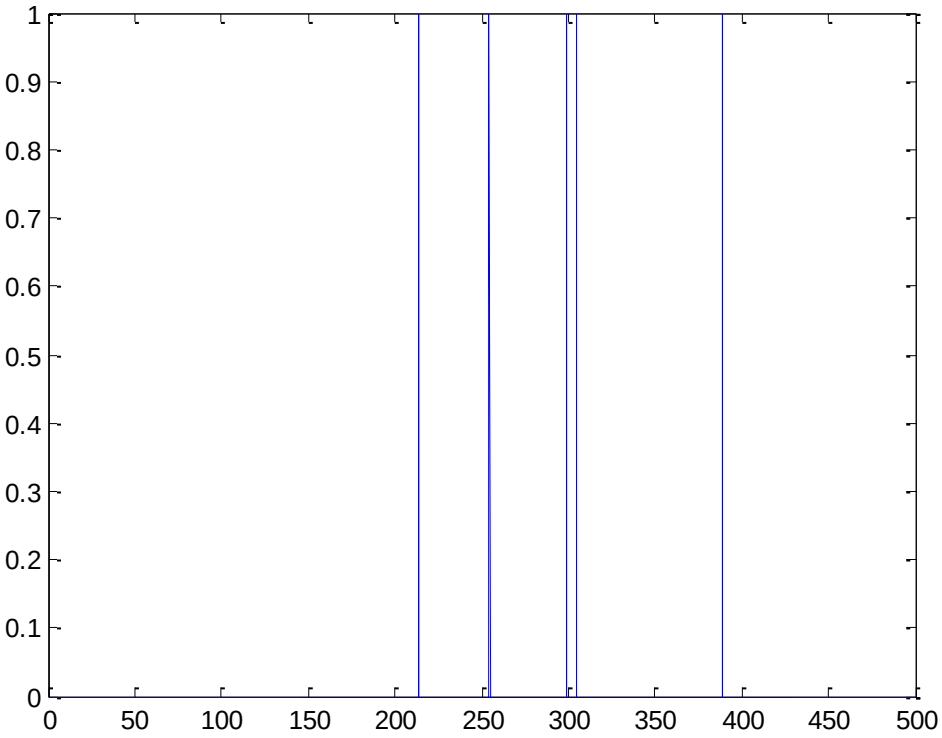

1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
50
100
150
200
250
300
350
400
450
500



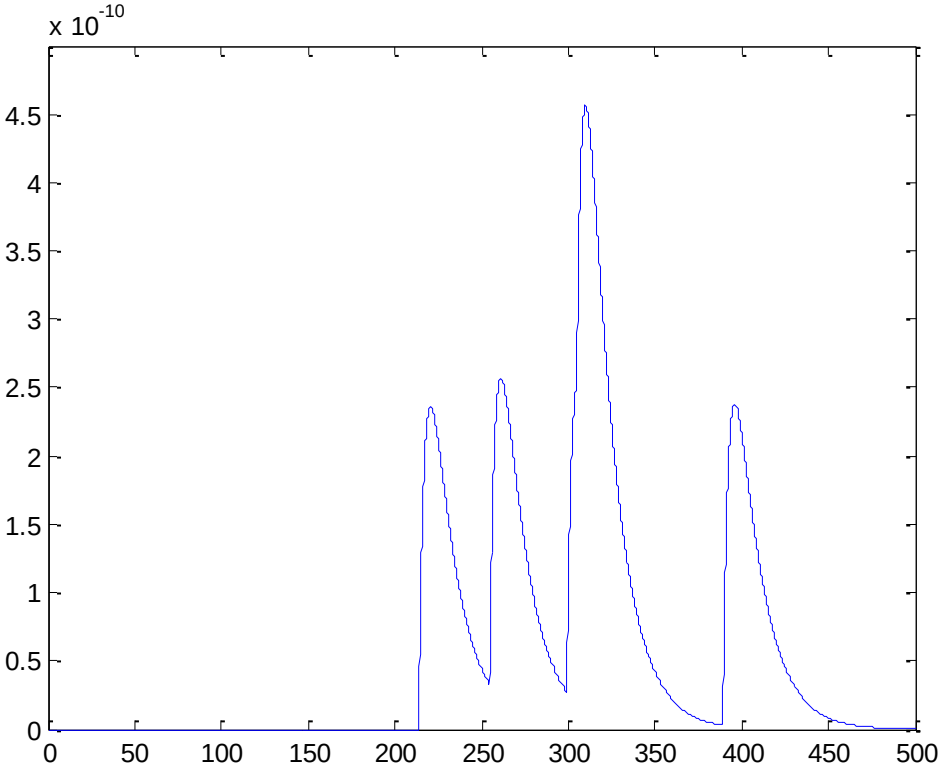
For the second part, the stimulus generated in the first part is given as input to a RS AEF neuron.

The input current, the stimulus, and the output potential are plotted, as asked, for different stimuli:

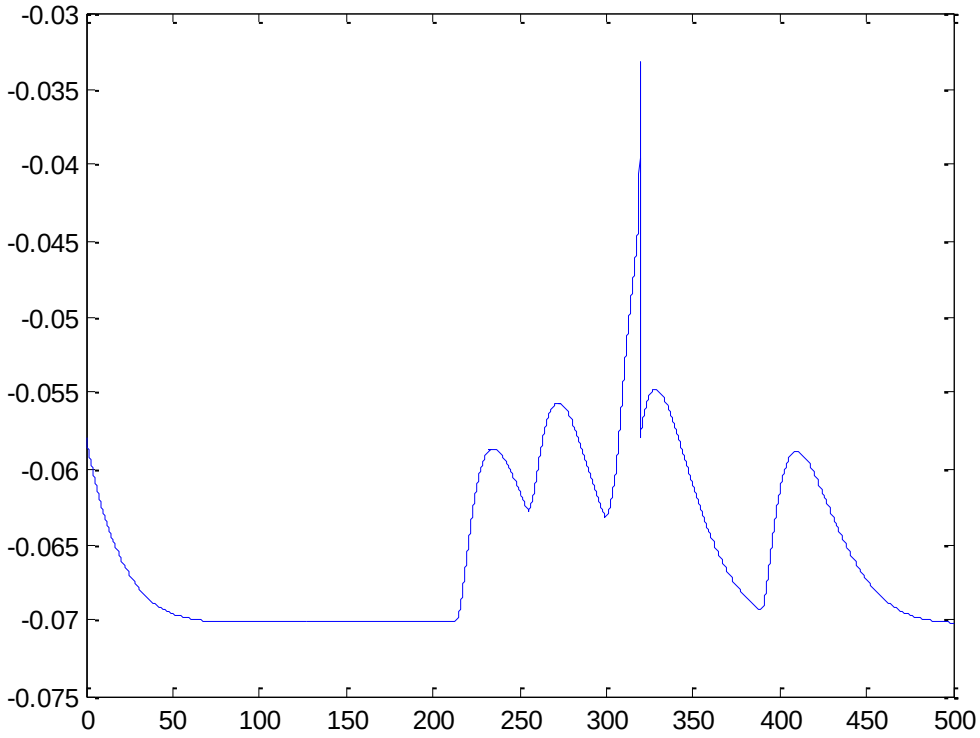
Stimulus:



Input current:

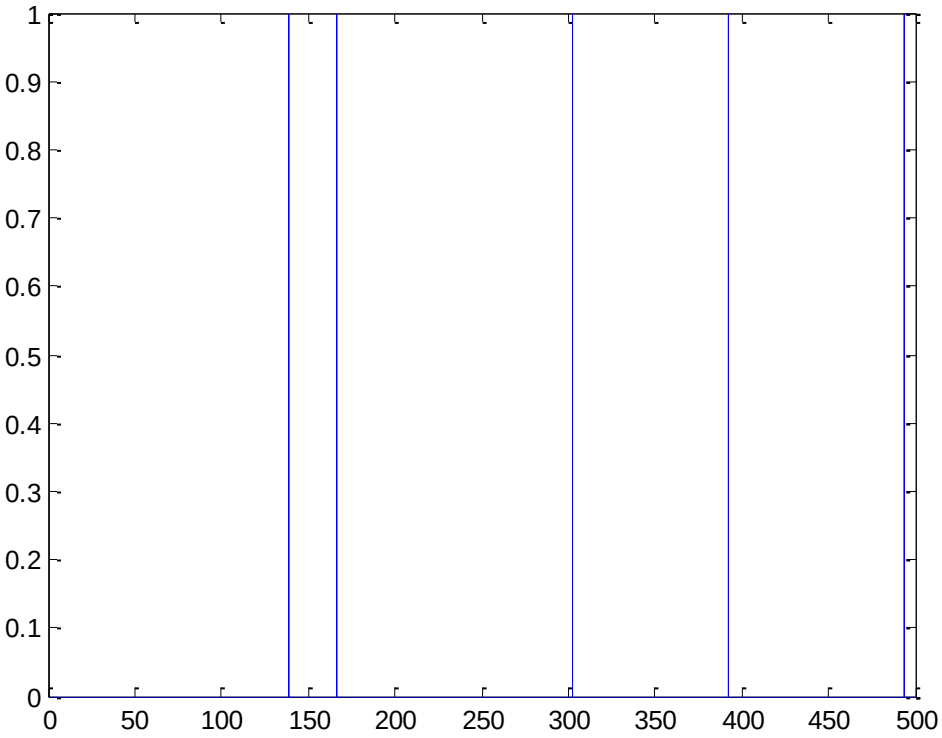


Output potential:

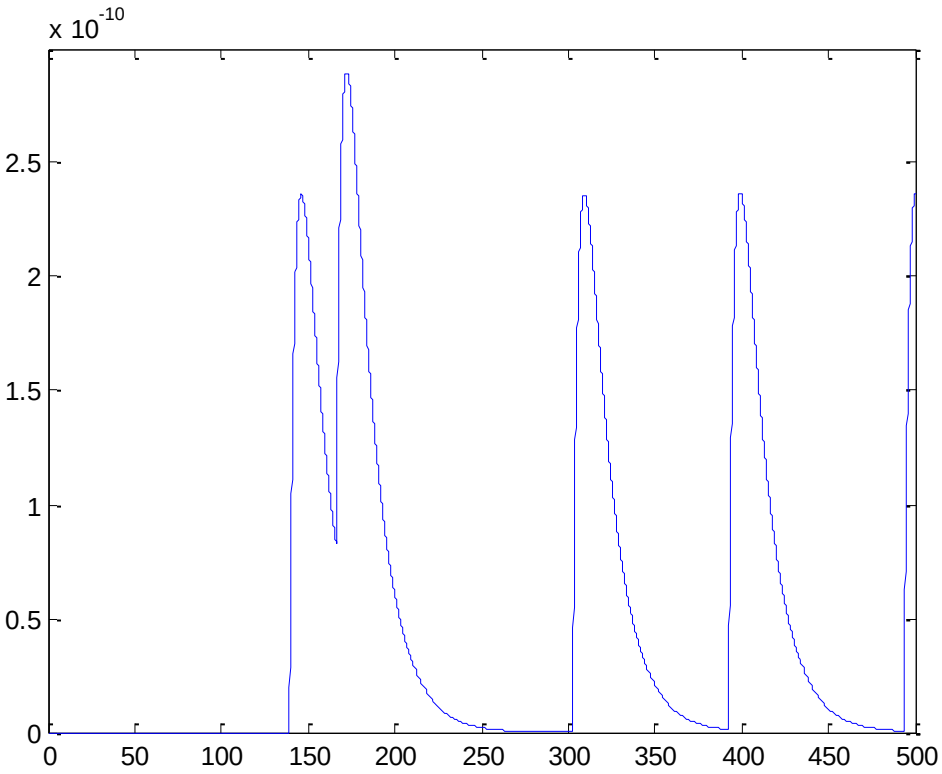


No. of spikes = 1.

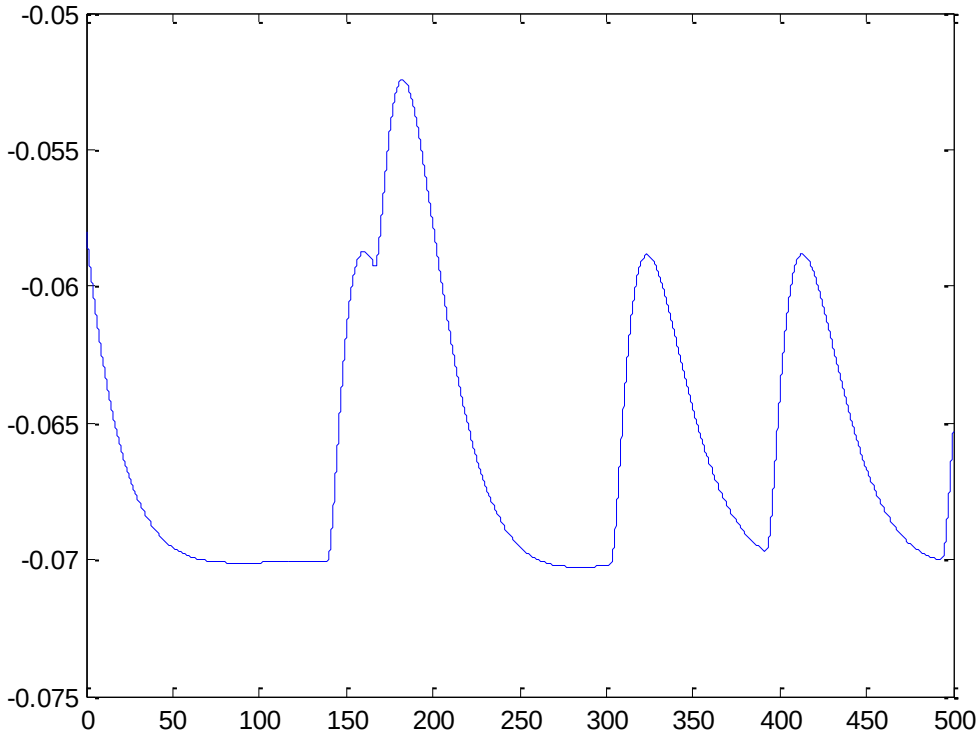
Stimulus:



Input current:



Output potential:



No. of spikes = 0.

Thus, from the above two cases, we can clearly see that there is a spike, only when input stimuli are very close to each other.

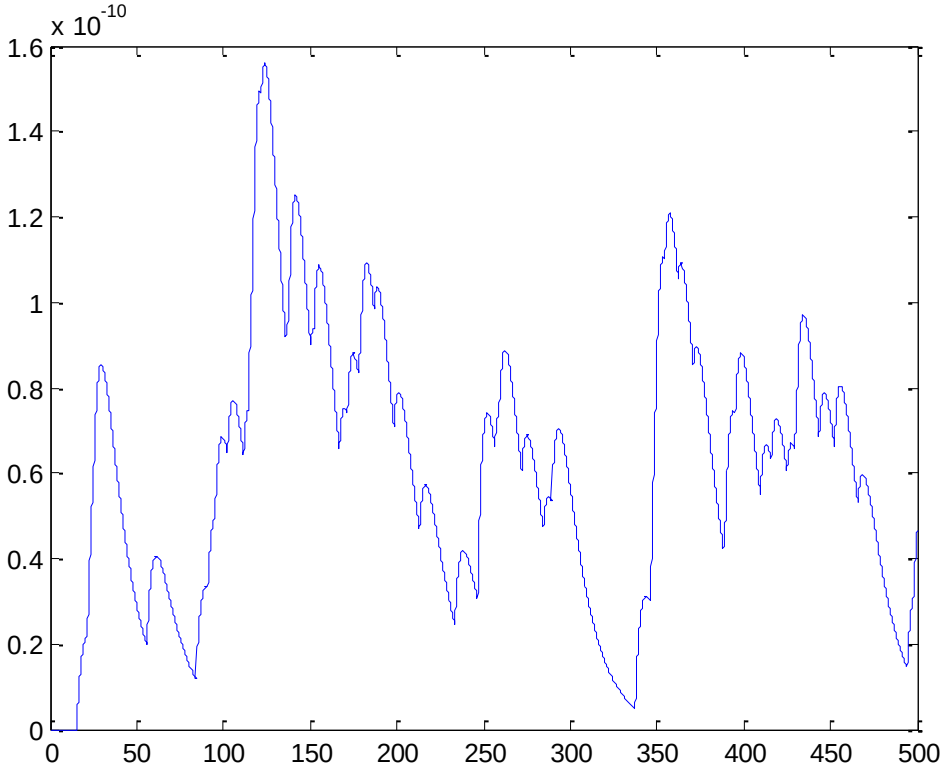
Thus, we can see that the neuron will observe spikes, only if the input stimuli are closely placed. There is one spike for Case I, whereas no spike for Case II, as in Case I, the two stimuli are very closely placed.

Question 2:

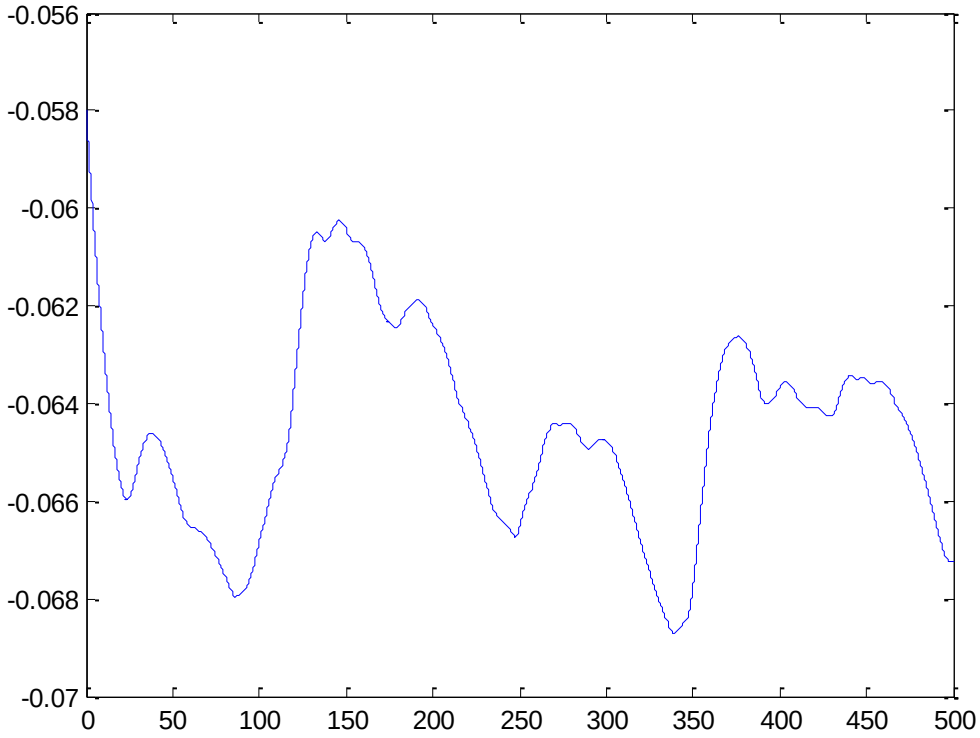
Part 1:

Mean = 50, and sigma = 5 gives the following results:

Current input:



Output potential:

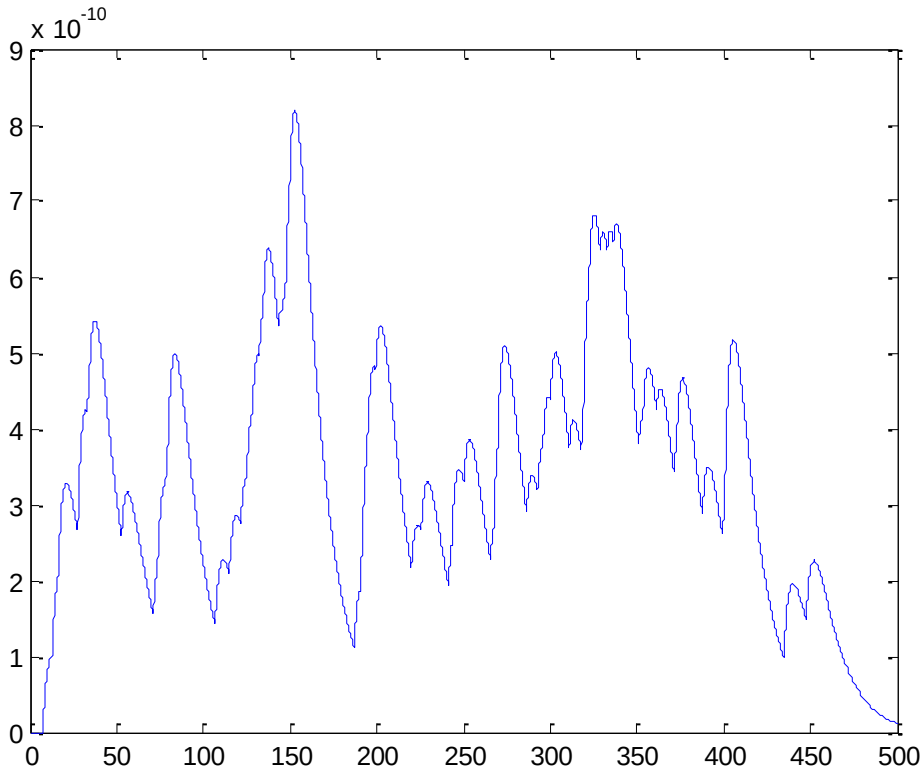


The number of spikes are 0.

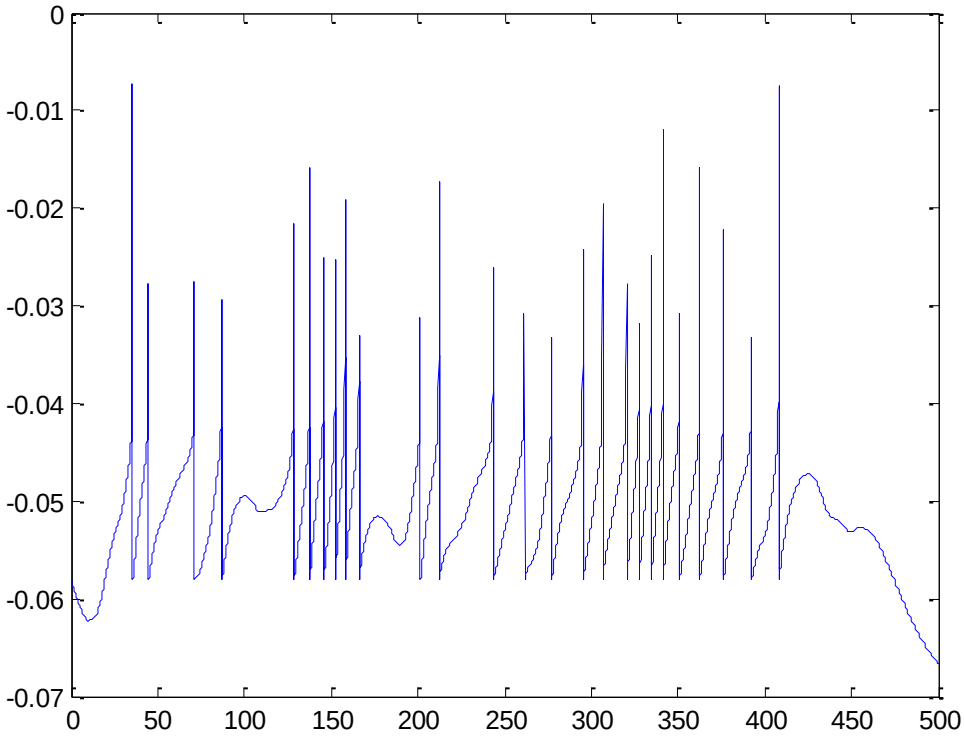
Part 2:

For mean = 250, and sigma = 25, the following result is seen:

Input current:



Output potential:



The number of spikes seen are, on an average, about 20.

Question 3:

The code for the third question was run, and the time instant where the membrane potential is maximum was found.

This time instant is max_pos = 3247.

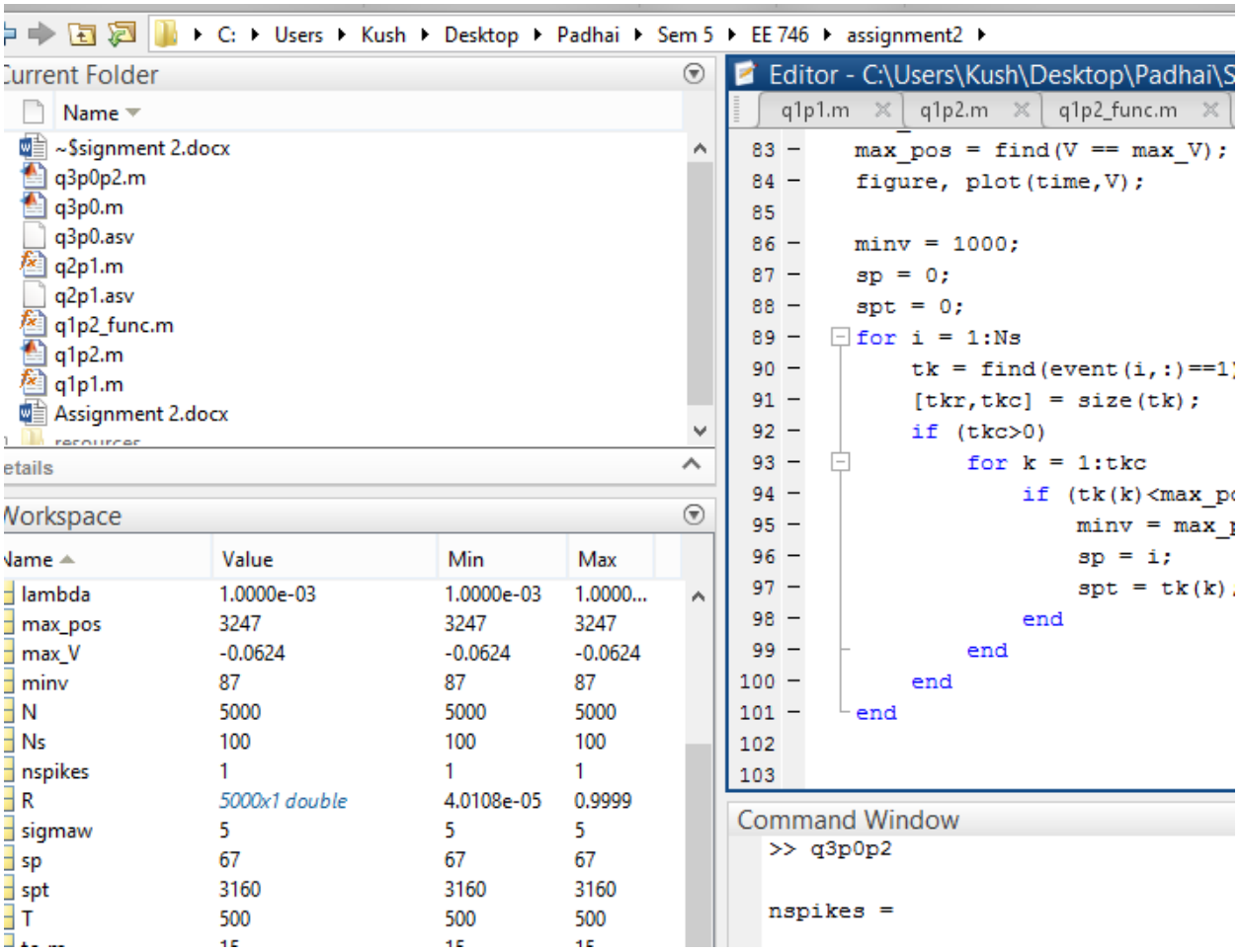
Then, corresponding to this time instant, the closest occurring spike was found, and the synapse leading to this spike was identified.

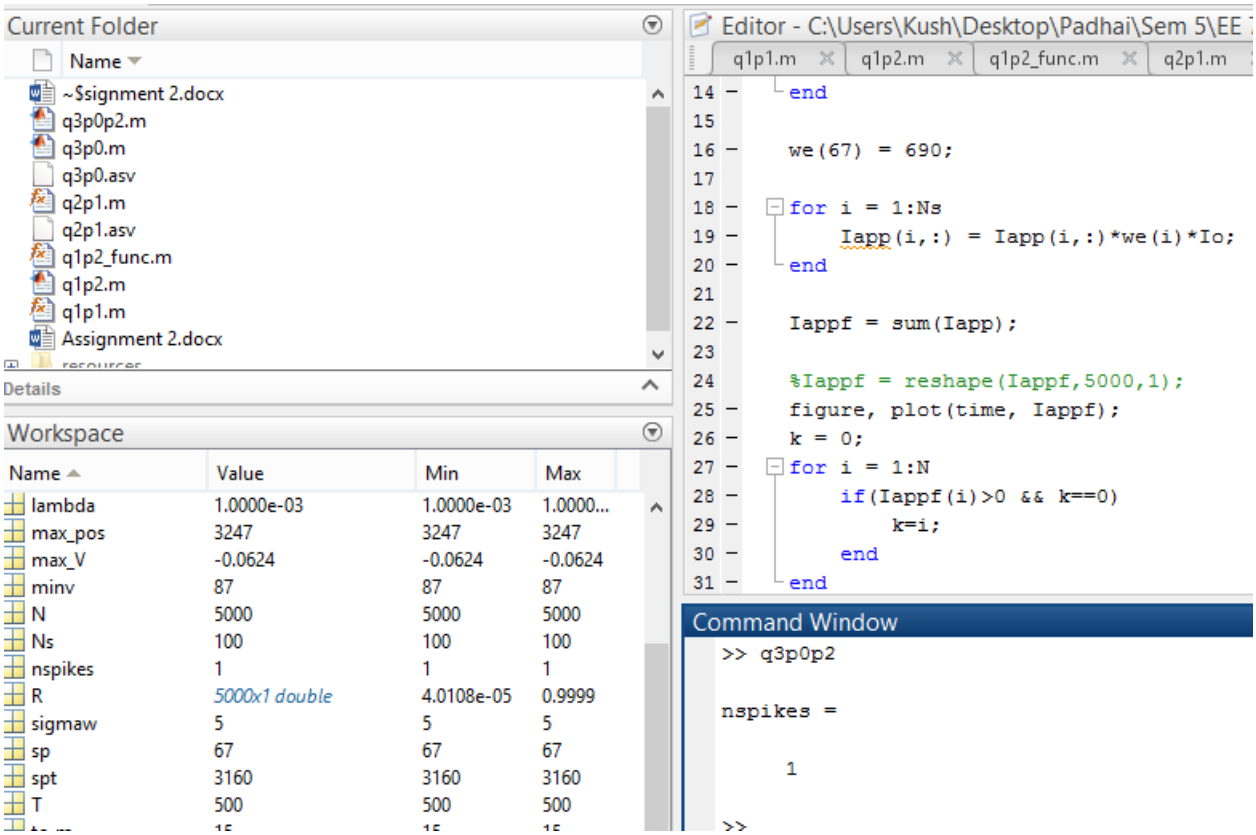
This was synapse number, sp = 67.

And the time of closest spike was spt = 3160, ie minv = 87.

Strength of synapse 67 initially was 48, and this was was gradually increased, till 690, at which a spike was observed.

Screenshots:


C: ▸ Users ▸ Kush ▸ Desktop ▸ Padhai ▸ Sem 5 ▸ EE 746 ▸ assignment2 ▸
Current Folder
Name
~$signment 2.docx
q3p0p2.m
q3p0.m
q3p0.asv
q2p1.m
q2p1.asv
q1p2_func.m
q1p2.m
q1p1.m
Assignment 2.docx
Workspace
Name
Value
Min
Max
lambda 1.0000e-03 1.0000e-03 1.0000...
max_pos 3247 3247 3247
max_V -0.0624 -0.0624 -0.0624
minv 87 87 87
N 5000 5000 5000
Ns 100 100 100
nspikes 1 1 1
R 5000x1 double 4.0108e-05 0.9999
sigmaw 5 5 5
sp 67 67 67
spt 3160 3160 3160
T 500 500 500
Editor - C:\Users\Kush\Desktop\Padhai\S
q1p1.m
q1p2.m
q1p2_func.m
83 max_pos = find(V == max_V);
84 figure, plot(time,V);
85
86 minv = 1000;
87 sp = 0;
88 spt = 0;
89 for i = 1:Ns
90 tk = find(event(i,:)==1
91 [tkr,tkc] = size(tk);
92 if (tkc>0)
93 for k = 1:tkc
94 if (tk(k)<max_p
95 minv = max_
96 sp = i;
97 spt = tk(k)
98 end
99 end
100 end
101 end
102
103
Command Window
>> q3p0p2
nspikes =



The average number of iterations is 4-5.

HTML file published can be seen in the HTML folder for the code and the output.

Question 4:

The average number of iterations to remove the spikes is 7-8.

The HTML published can be seen in the HTML folder for the code and the output.

Question 5:

The above written codes for question 3 and 4 were made into functions, and they were used to suppress one stimulus, and cause a spike response for the other stimulus.

HTML files have been published, which can be seen in the HTML folder.