BT6270 - Assignment 1

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MATLAB code which simulates the Hodgkin Huxley model was provided and our aim was to find and plot the following:

1. Threshold values for the external applied currents $\mathbf{I_1}$, $\mathbf{I_2}$, and $\mathbf{I_3}$ in which shift of dynamical behavior from one to another is seen, such as *no AP, finite number of AP's, Continuous firing and then followed by distortion resulting in no more APs.*
2. A graph which depicts the firing rate (frequency) as you change the applied external current (i.e. I_{ext} vs. Firing rate (f)).

- The MATLAB code used for finding the number of peaks which are greater than the minimum value at which a waveform is considered as an AP is attached below.

That minimum value here was taken to be **10mv**. And the I_ext was varied from **0** to **0.6** with i_step_size = **0.0001**.

```
j=1;
realpeaks=zeros;
[peaks, locs]=findpeaks(vhist);
for temp=1:length(peaks)
    if   peaks(temp) >=10
        realpeaks(j)=peaks(temp);
        j=j+1;
    end
end
if realpeaks ~= 0
no_of_peaks(k)=length(realpeaks);
else
    no_of_peaks(k)=0;
end
k=k+1;
end
```

- The MATLAB code for finding I1, I2, I3 is attached below

```
for l=2:length(no_of_peaks)

       if no_of_peaks(l)>0 && no_of_peaks(l-1)==0
       I1=(l-1)*i_step_size;
       end

       if no_of_peaks(l)> no_of_peaks(l-1)+4
       I2=(l-1)*i_step_size;
      end

       if no_of_peaks(l)< no_of_peaks(l-1)-  2
       I3=(l-2)*i_step_size;
       end
end
```

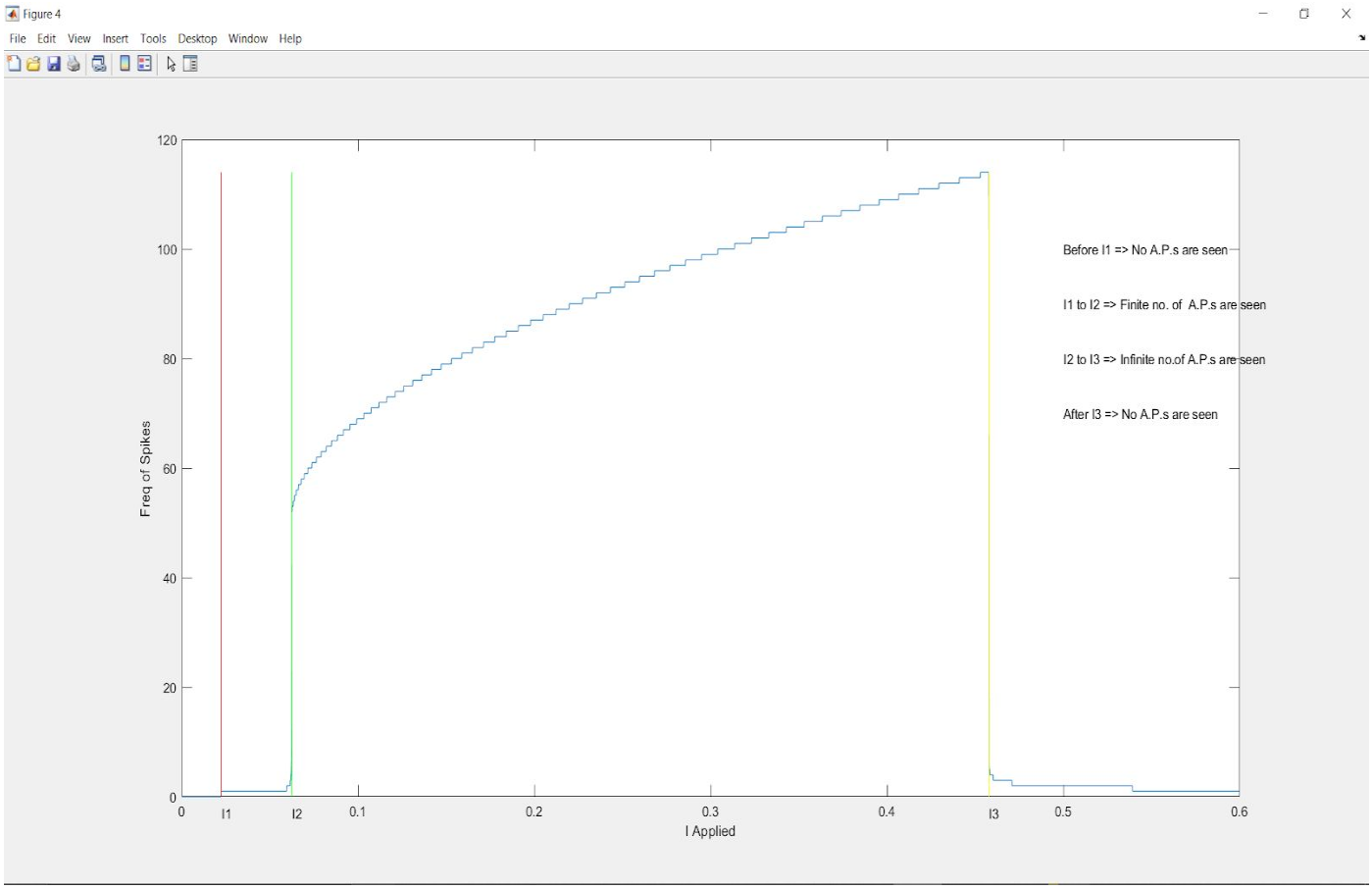
- The MATLAB code for plotting the graph and the above values is attached below

```
figure(4);
X=0:i_step_size:0.6;
plot(X,no_of_peaks*1000/(niter/100));
xlabel('I Applied');
ylabel('Freq of Spikes')
hold on
I1=0*no_of_peaks*1000/(niter/100)+I1;
plot(I1,no_of_peaks*1000/(niter/100),'r');
text(I1(1),-3,'I1');
I2=0*no_of_peaks*1000/(niter/100)+I2;
plot(I2,no_of_peaks*1000/(niter/100),'g');
text(I2(1),-3,'I2');
I3=0*no_of_peaks*1000/(niter/100)+I3;
plot(I3,no_of_peaks*1000/(niter/100),'y');
text(I3(1),-3,'I3');
text(0.5,100,'Before I1 => No A.Ps are seen');
text(0.5,90,'I1 to I2 => Finite no. of  A.P.s are seen');
text(0.5,80,'I2 to I3 => Infinite no.of A.P.s are seen');
text(0.5,70,'After I3 => No A.P.s are seen');
```

The values of I1, I1, I2 obtained were (in microamperes):

- **I1 = 0.0224**
- **I2 = 0.0625**
- **I3 = 0.4578**

The graph observed is attached below:



- From the graph as we know we can observe after a certain threshold (I1 = 0.0224) below which no Action potential was observed, finite number of Action potential starts firing , and after (I2 = 0.0625) the Action potential starts firing continuously, And after a point (I3 = 0.4578) the Action potential gets distorted resulting in no more Action potentials.