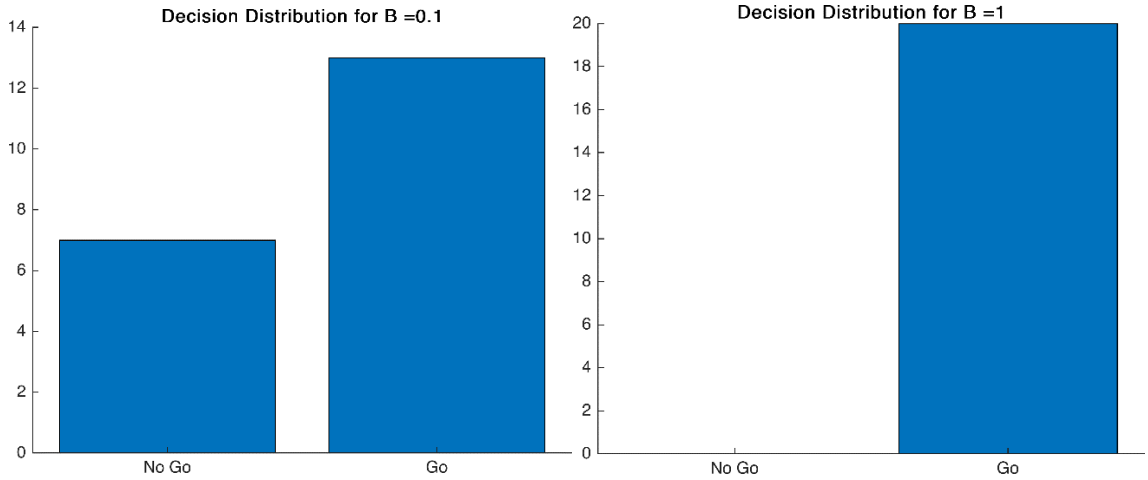
In the name of God

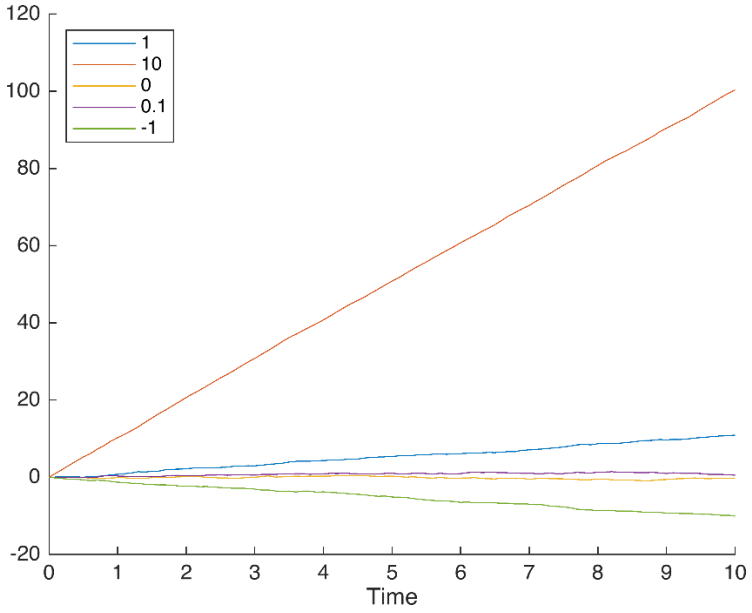
Advanced Neuroscience – Homework 7

Arsalan Firoozi – 97102225

1. Simple_model function is implemented in simple_model.m file.
2. You can see decision distribution with different Bias values:

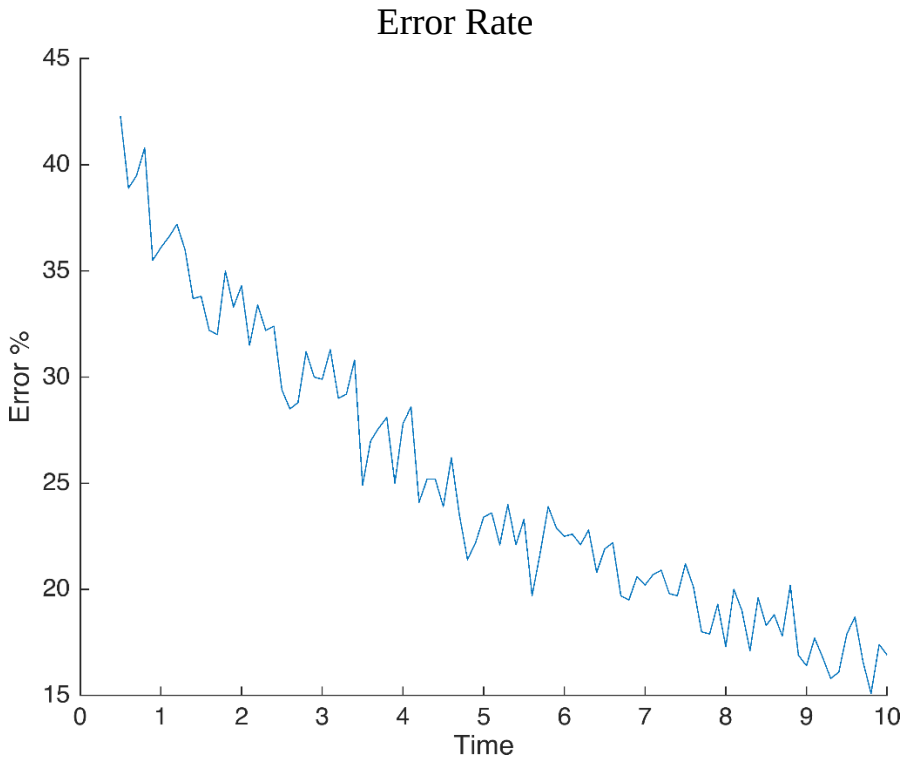


Decision variables for B = {1, 10, 0, 0.1, -1}, σ=1 and dt=0.1 for 10 seconds trials:



3. I assume that error rate is the ratio of wrong answers number and the total number of answers. By this definition, as you can see below, error rate

decreases by increasing the time of decision making. This indicates that spending more time on a decision leads to better performance. Since random factor has less impact in decision variable over time, it's reasonable to see a decreasing trend.

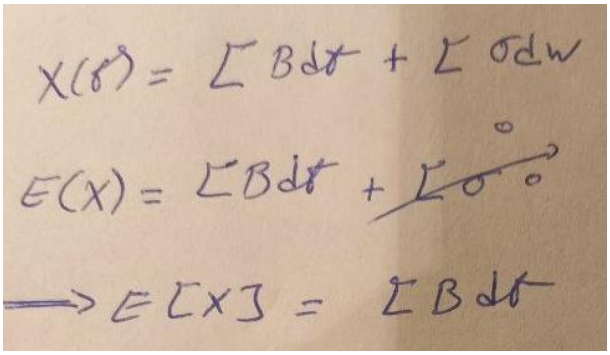


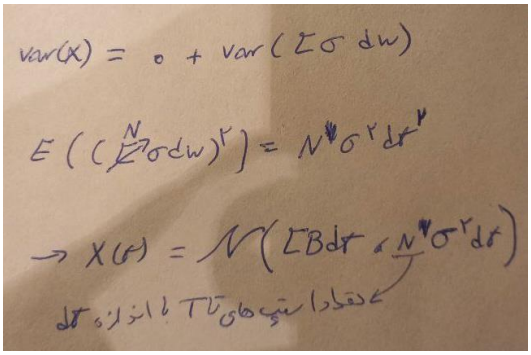
4. First of all, in theory we get to these expected value and variance for decision variable:

$$E[X(T)] = BT$$

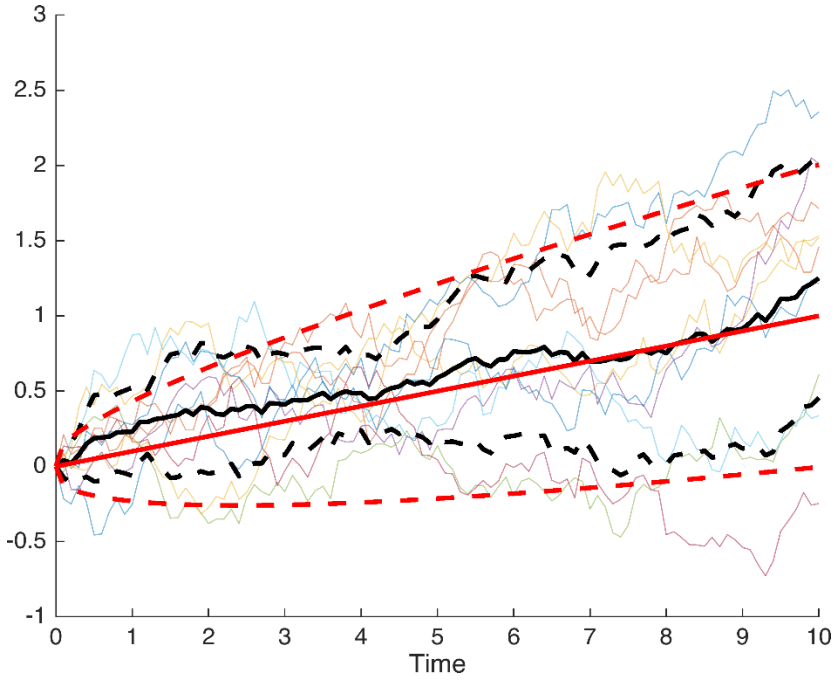
$$var(X(T)) = N\,\sigma^2 dt^2, N = \frac{T}{dt}$$

➔ $X(T) \backsim N(BT, N\,\sigma^2 dt^2)$



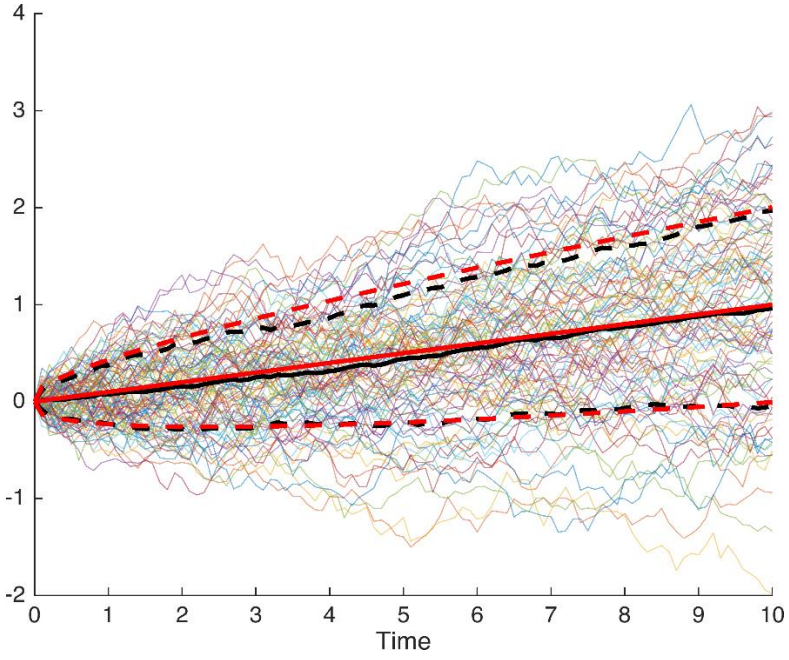


For 10 trials:



Solid red line is the theoretically expected value.
Dashed red line show theoretically shifted line by standard deviation.
Black lines are calculated by calculating mean of all trials and deviation in time.

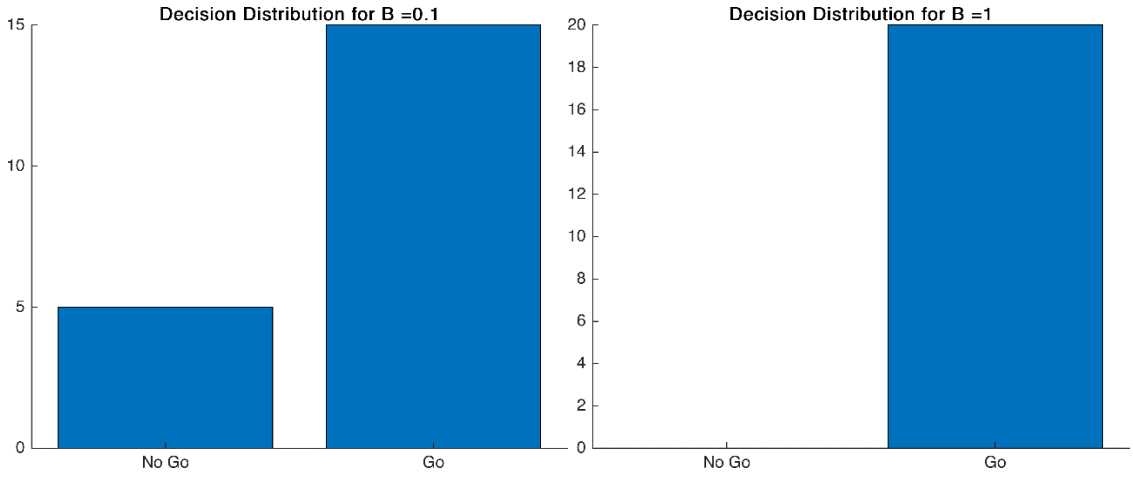
For 100 trials:



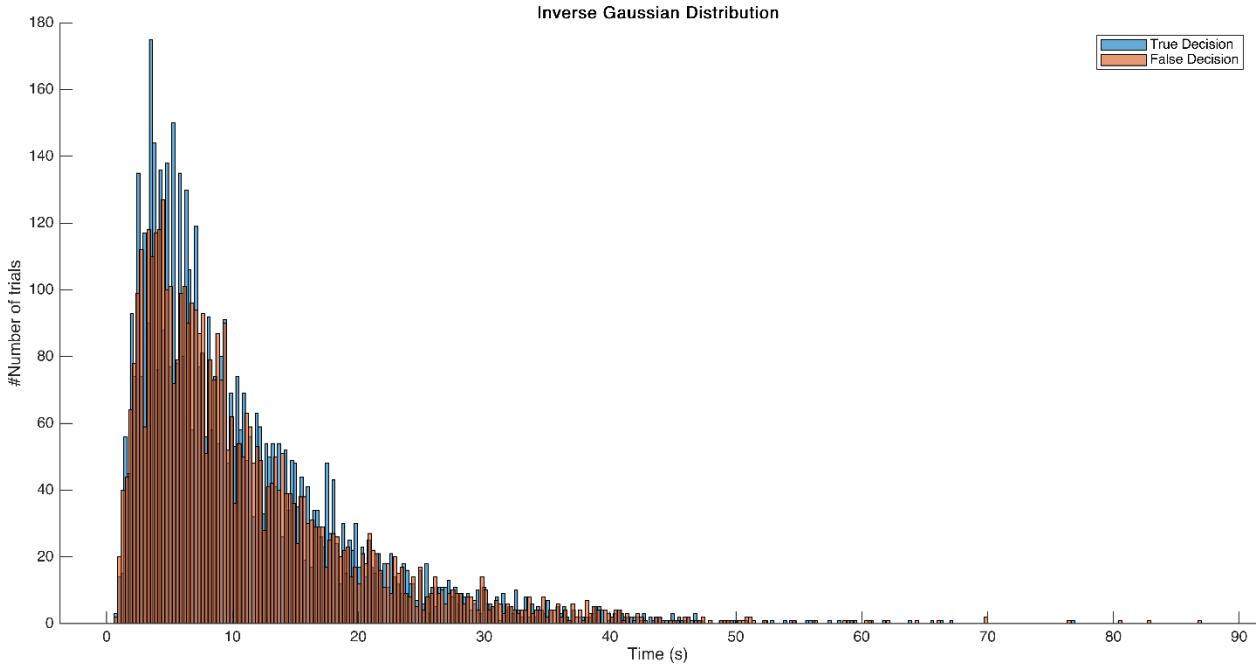
Most of trajectories seem to have a increasing trend like the expected value.

5. Simple_model2 is implemented in simple_model2.m

Distribution of decisions for different bias values:

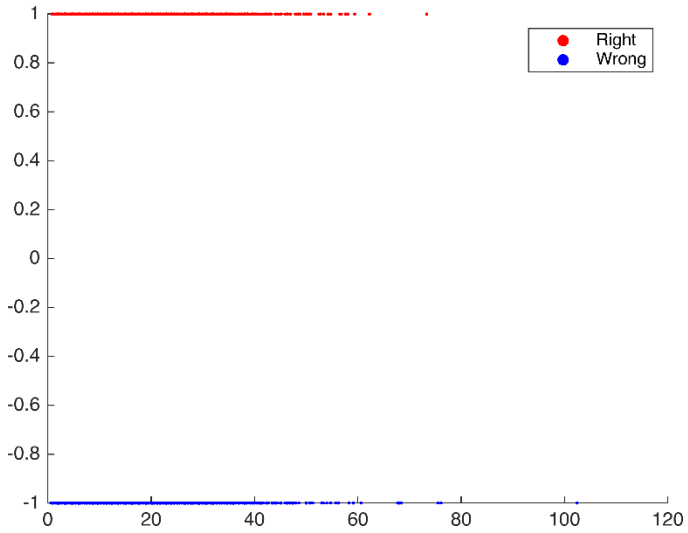


6. Function two_choice_trial is implemented in two_choice_trial.m.
7. By this function I plot the histogram of reaction time which I expect to have an Inverse Gaussian distribution:

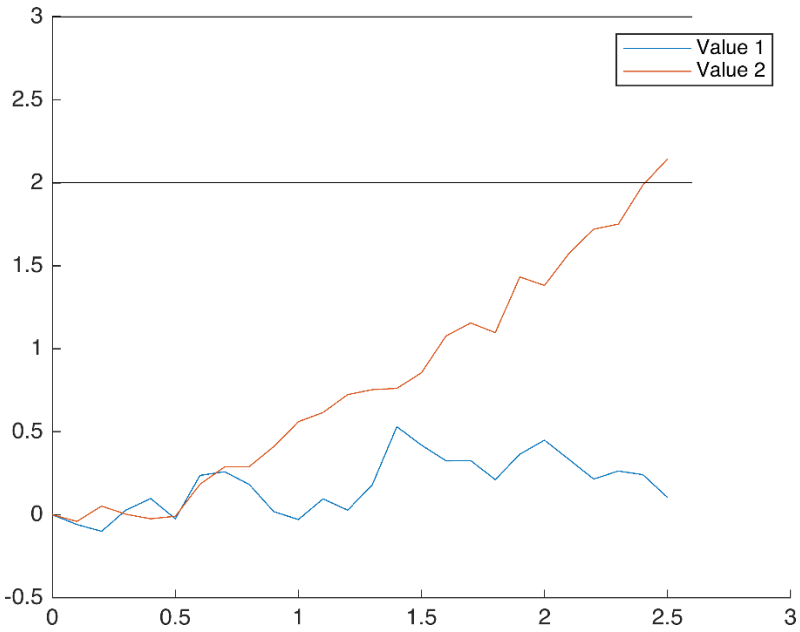


For both True and False decisions, it seems that we have same inverse gaussian distribution with no change in mean.

Also as the question said, the plot for wrong and right trials:

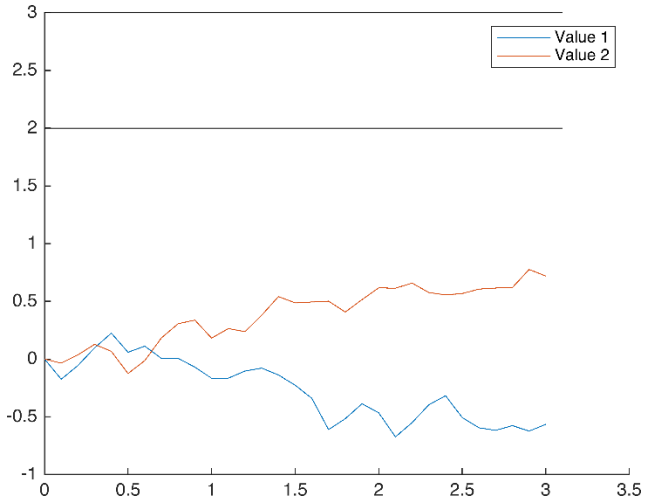


8. Race_trial is implemented in race_trial.m file.
   Here is a sample. The decision is made when the threshold is passed:



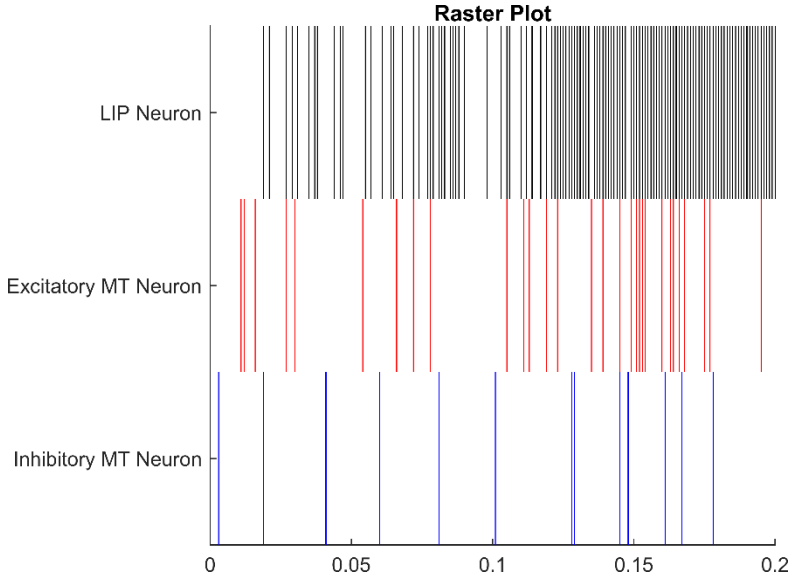
Black lines show thresholds for 2 decision variables

9. The decision is made when the maximum time is passed:



10. By modifying the lip_activity function and parameters:

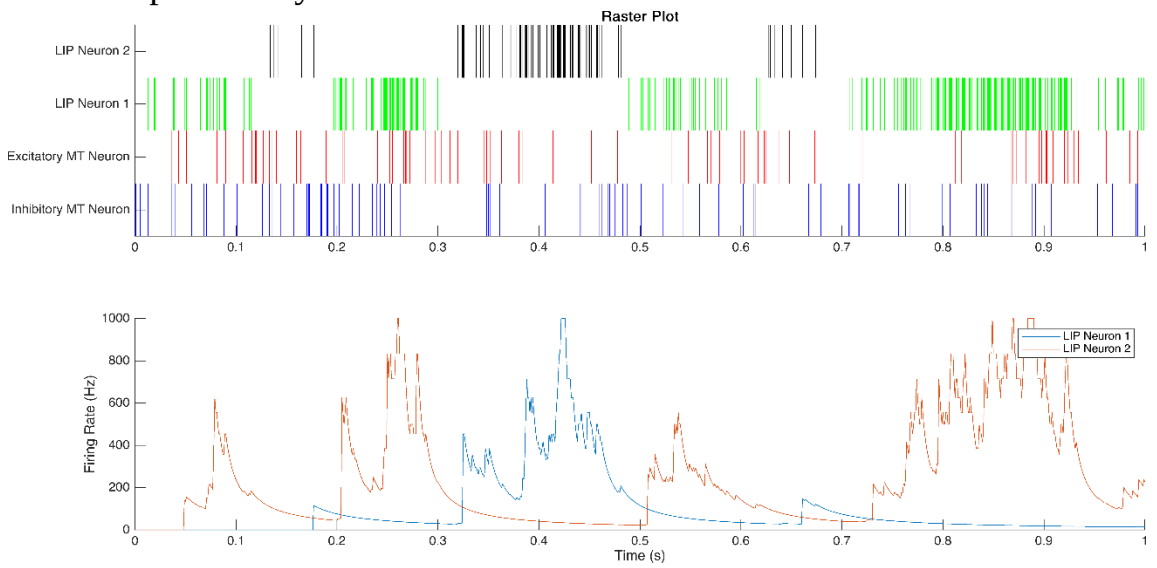
```
MT_p_values = [0.15;0.1];
LIP_weights = [0.1;-0.1];
LIP_threshold = 10000;
M = 5;
```



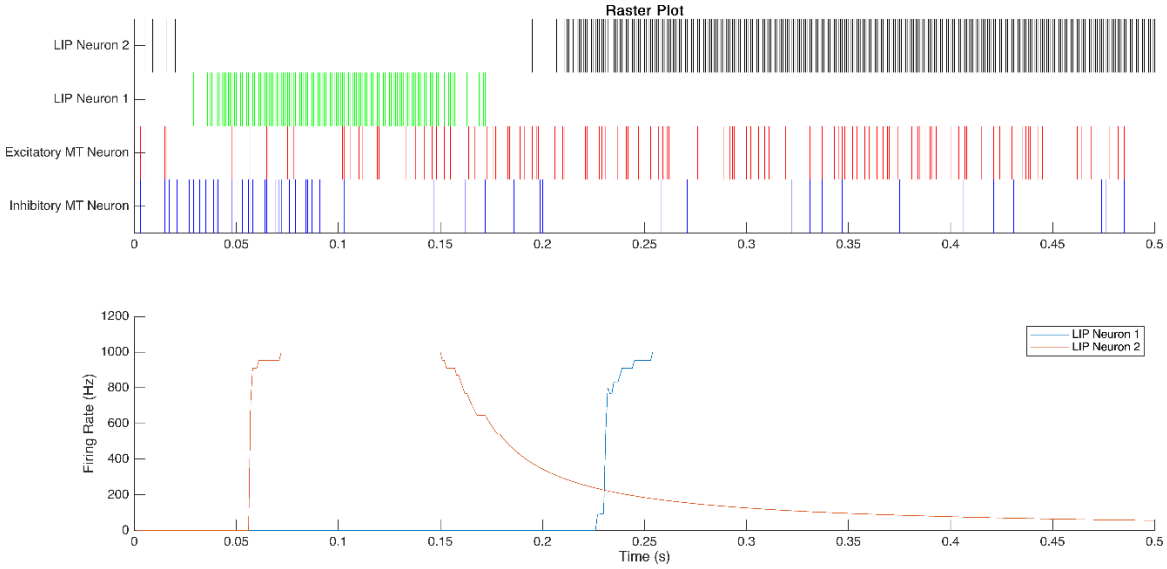
11. I've tested the model by different stimuluses.

```
MT_p_values = [0.1;0.1];
LIP_weights = [0.1 -0.1;-0.1 0.1];
LIP_threshold = [10000 10000];
M = 20;
```

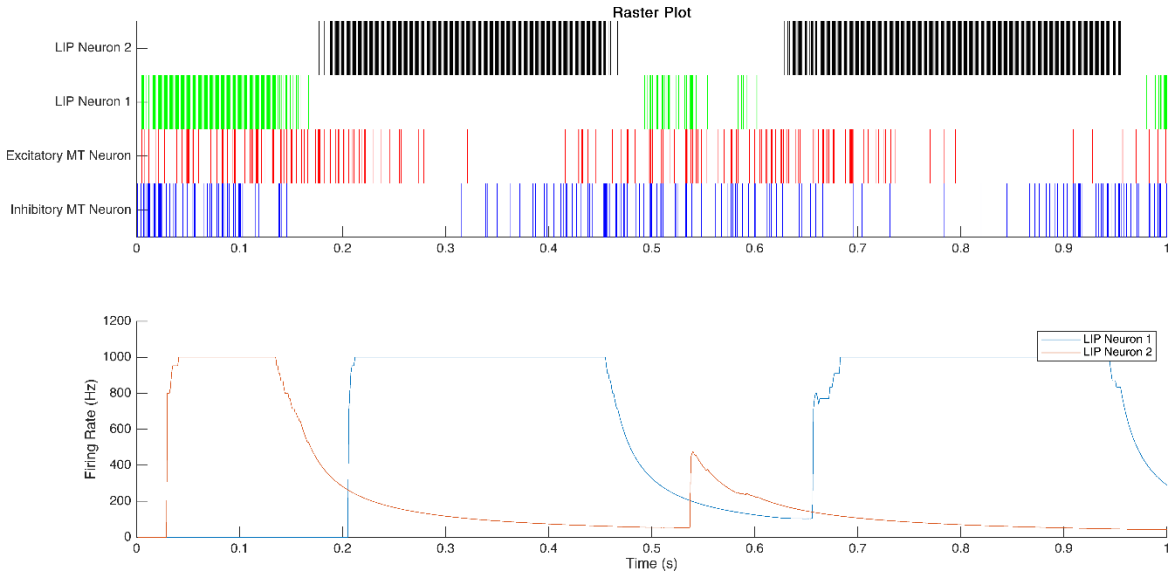
Same 0.1 probability:



Step stimulation (`0.2*(t>0.1)+0.05`):



Sine and Cosine stimulus (0.2(1+sin(2*pi*t*2))):



Sine and Cosine stimulus (0.5(1+sin(2*pi*t*2))):