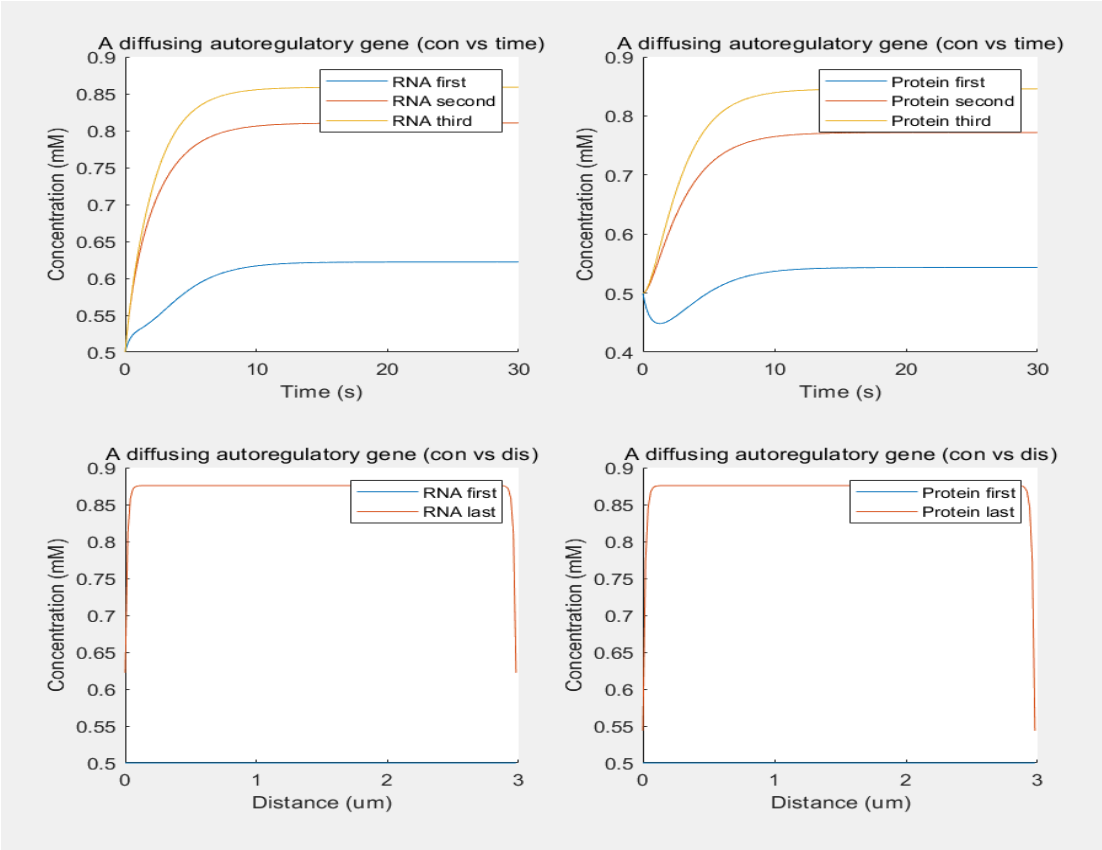
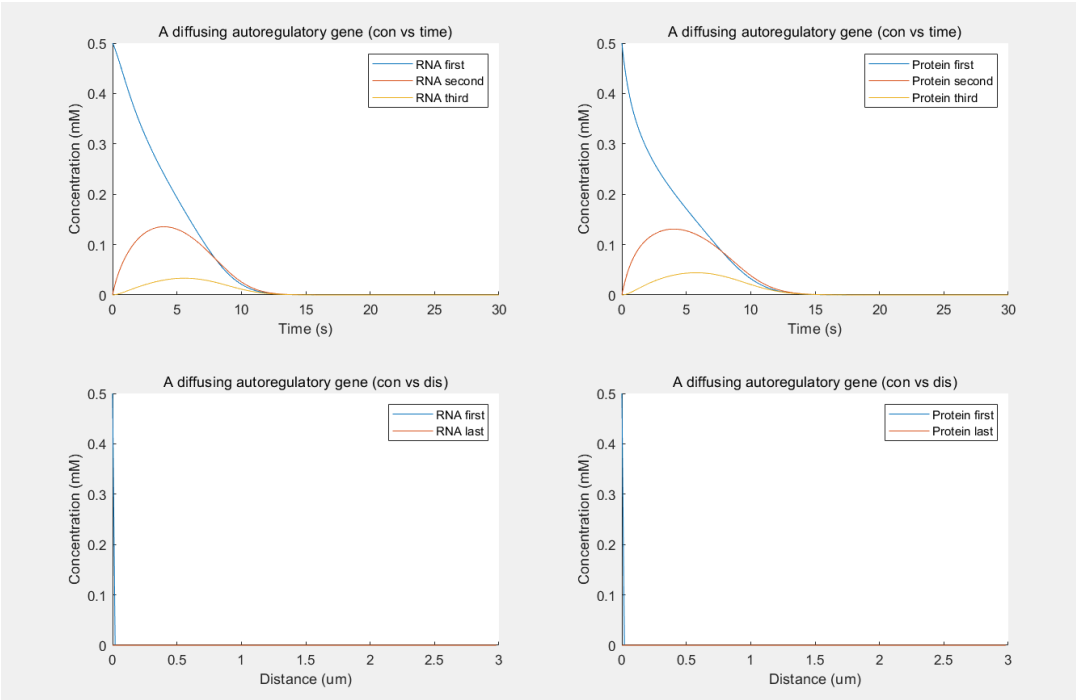
Part A

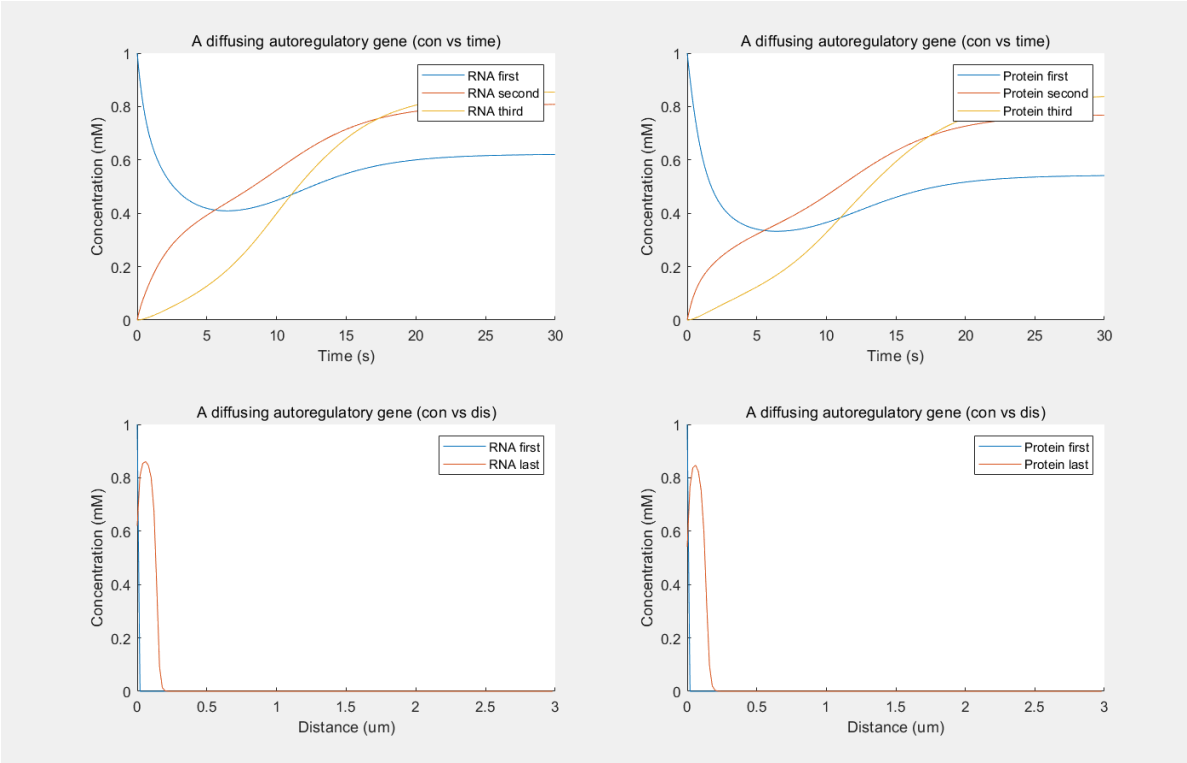
1.


A diffusing autoregulatory gene (con vs time)
RNA first
RNA second
RNA third
Concentration (mM)
Time (s)
A diffusing autoregulatory gene (con vs time)
Protein first
Protein second
Protein third
Concentration (mM)
Time (s)
A diffusing autoregulatory gene (con vs dis)
RNA first
RNA last
Concentration (mM)
Distance (um)
A diffusing autoregulatory gene (con vs dis)
Protein first
Protein last
Concentration (mM)
Distance (um)

2.

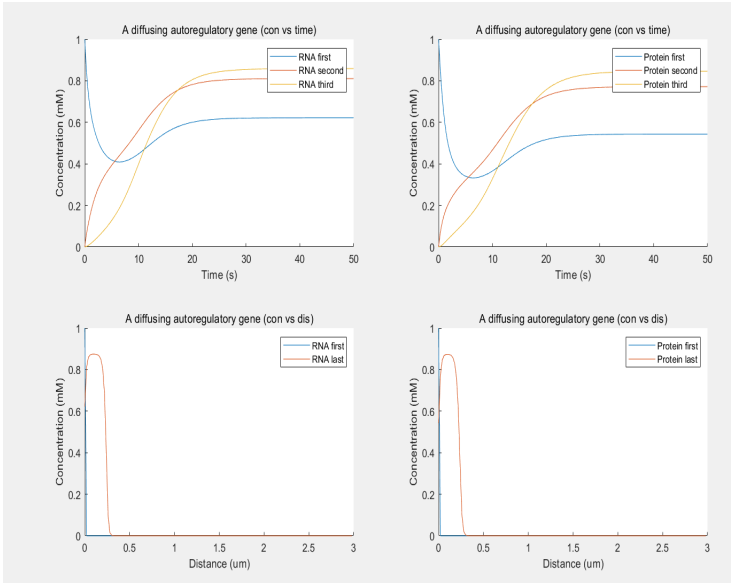

A diffusing autoregulatory gene (con vs time)
RNA first
RNA second
RNA third
Concentration (mM)
Time (s)
A diffusing autoregulatory gene (con vs time)
Protein first
Protein second
Protein third
Concentration (mM)
Time (s)
A diffusing autoregulatory gene (con vs dis)
RNA first
RNA last
Concentration (mM)
Distance (um)
A diffusing autoregulatory gene (con vs dis)
Protein first
Protein last
Concentration (mM)
Distance (um)

3.

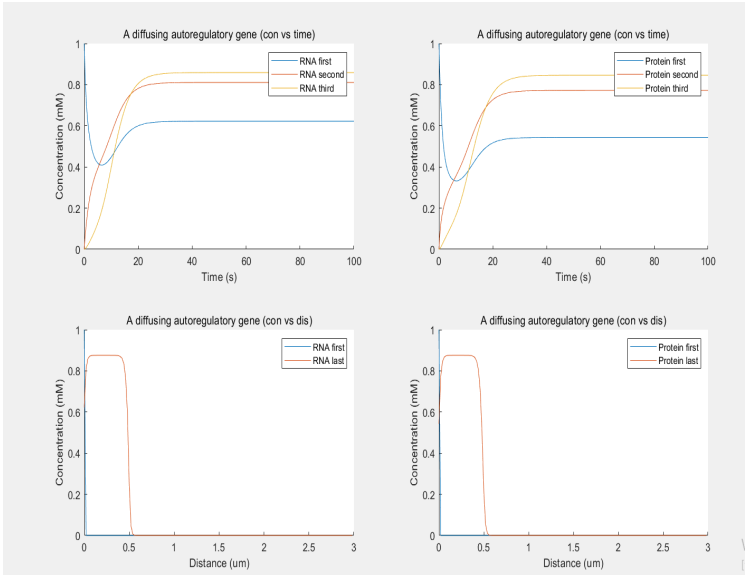


4.

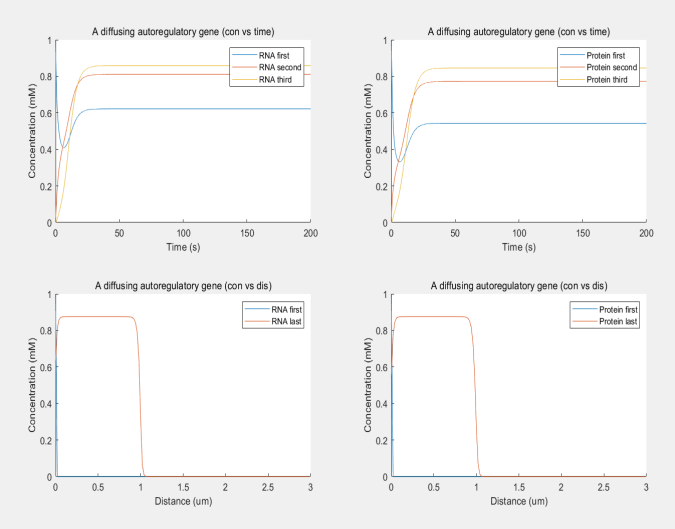
Total time =50



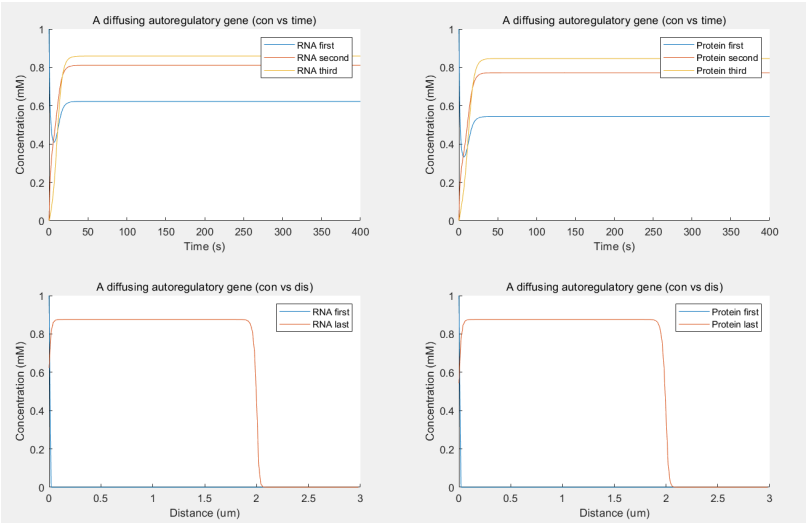
Total time = 100



Total time = 200



Total time = 400



5.

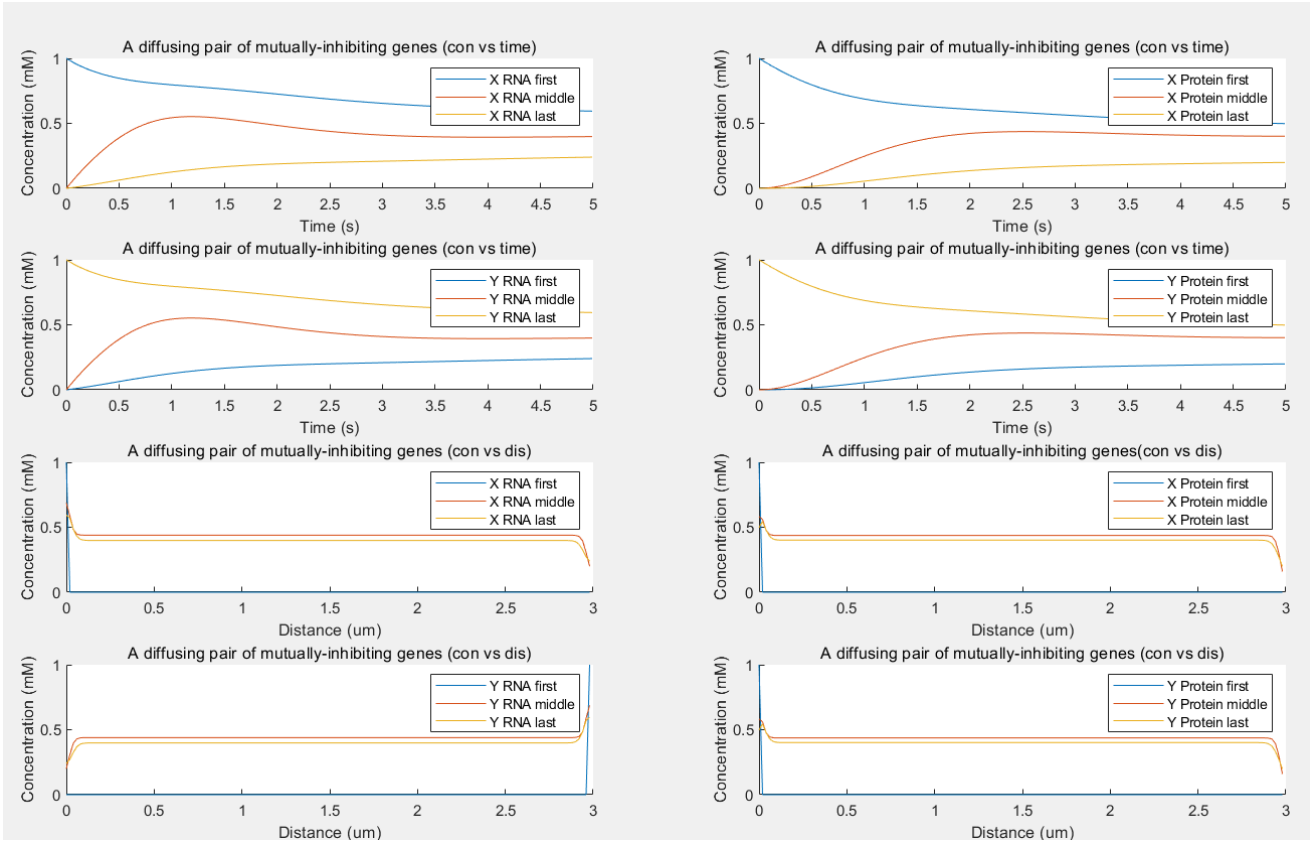
Setting the initial condition (positive real numbers) to all points in space increases the Laplacian value as the points move away from the boundary, x=1 or x=num. This can be confirmed through the concentration versus distance graph that the concentration is small in parts where the distance point is close to the boundary point. In addition, it can be seen that repelling manifold passes between RNA (0.5, 1) and protein (0.5, 1) by checking the graphs which converge to concentration 0 when the initial value is 0.5 and converges to another concentration value when 1.

When we plot the concentration of both protein and RNA versus distance at the last point in time, as the total time increases, more points in space reach the same non-zero concentration with steady states. This is because as time increases, the initial positive value of one point can affect the Laplacian value of more surrounding points. After enough time has passed, all the protein and RNA slope(ODEs) in each point in space reach zero leading to steady states.

Part B

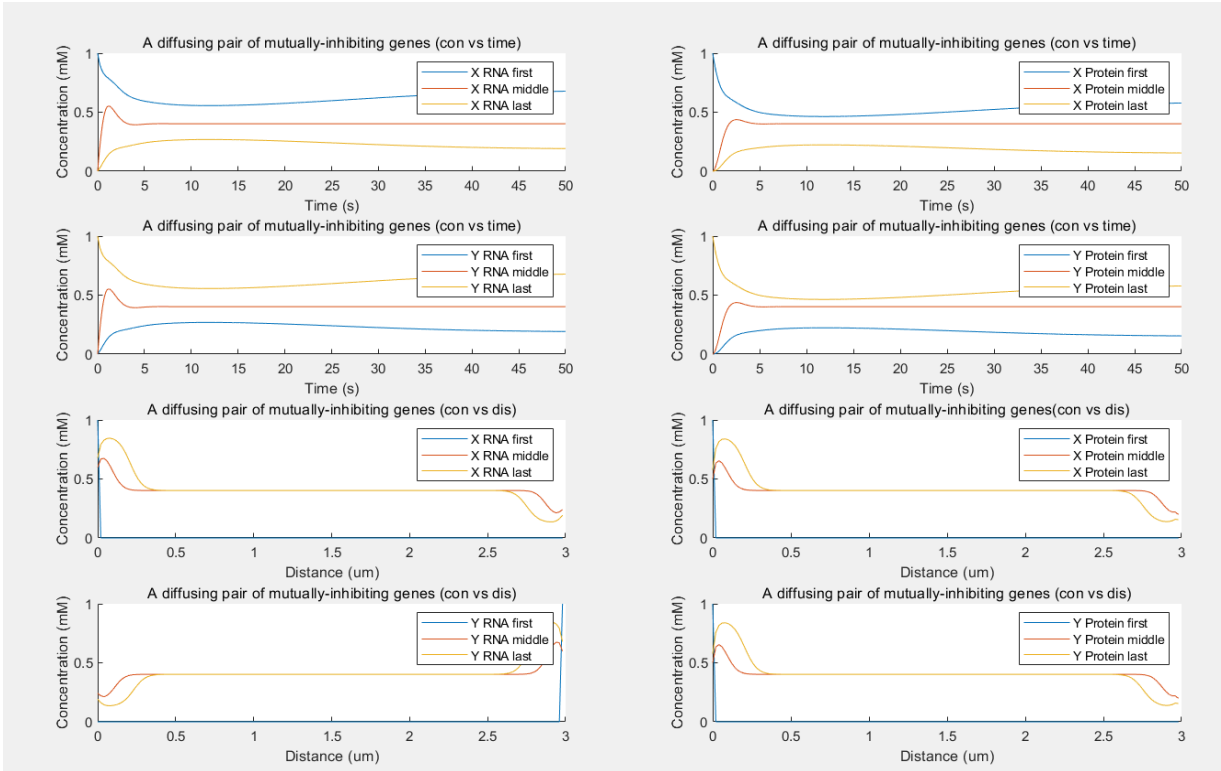
1.

2.

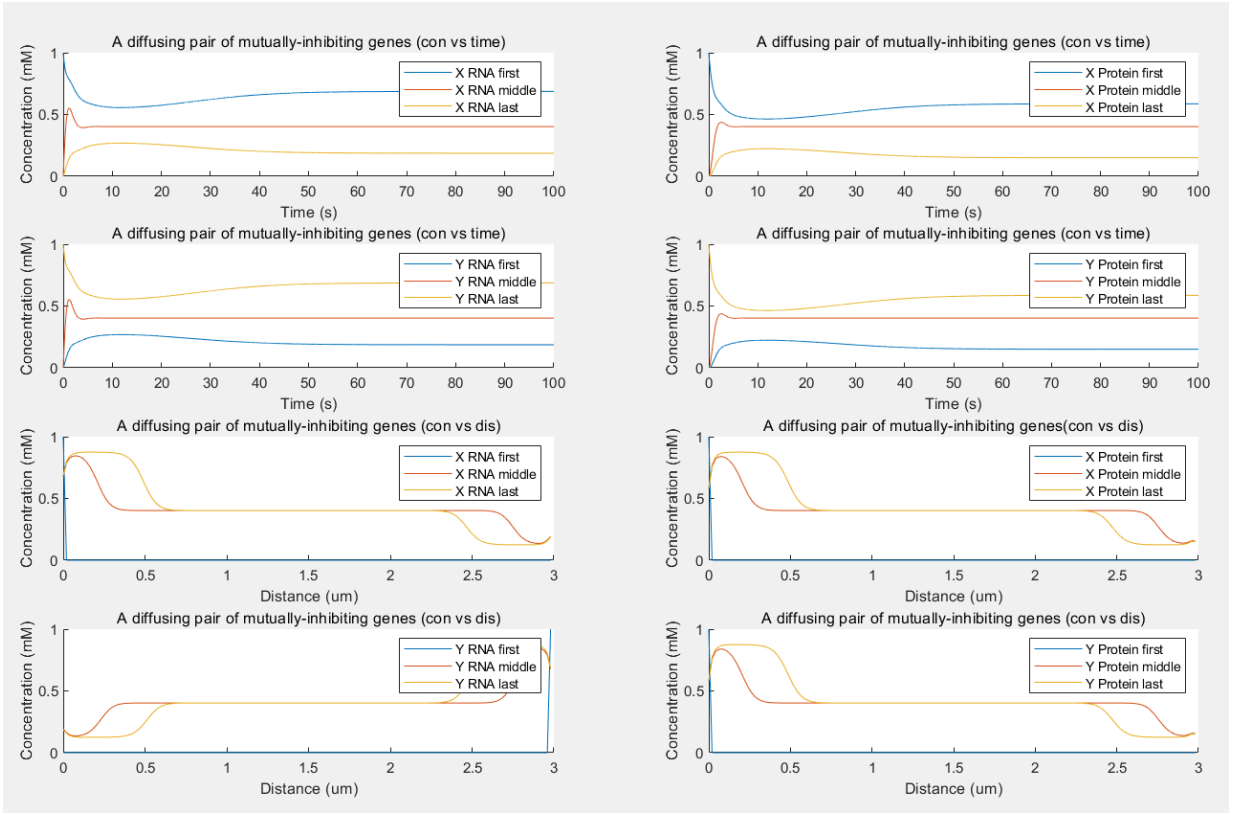


3.

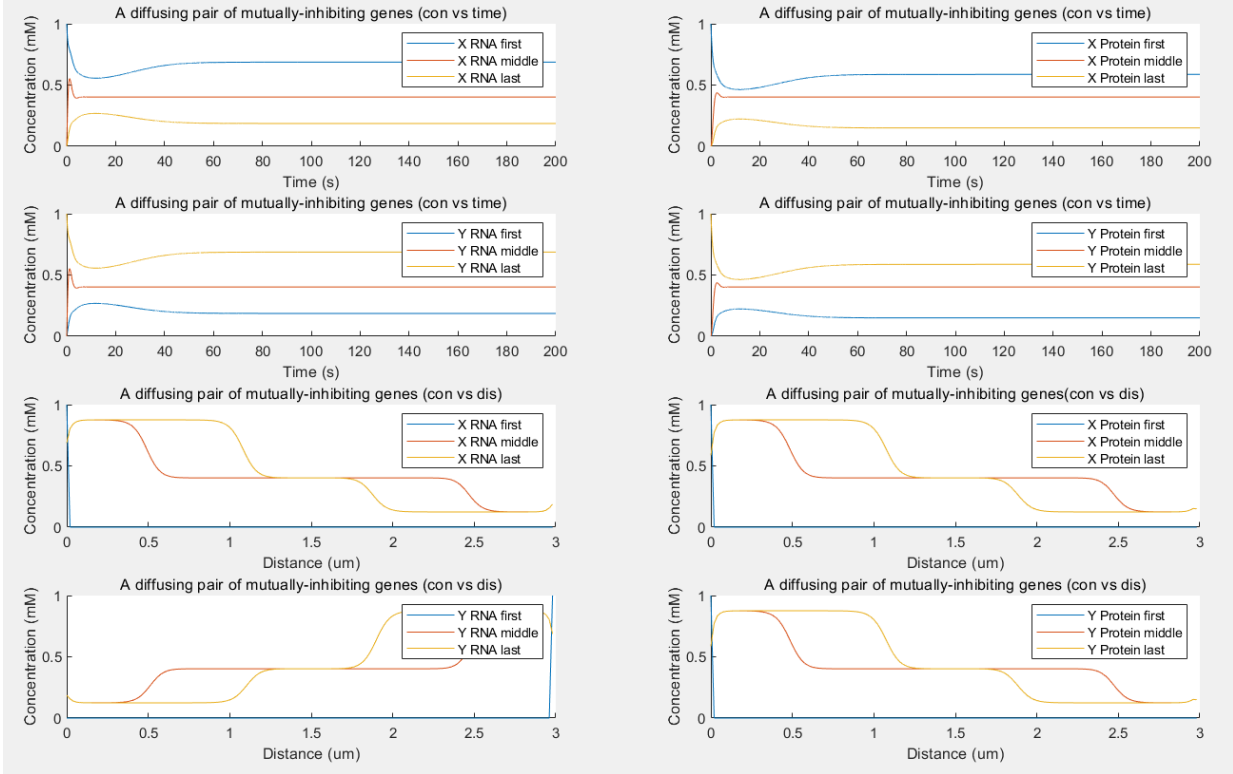
```
Total time =50
```



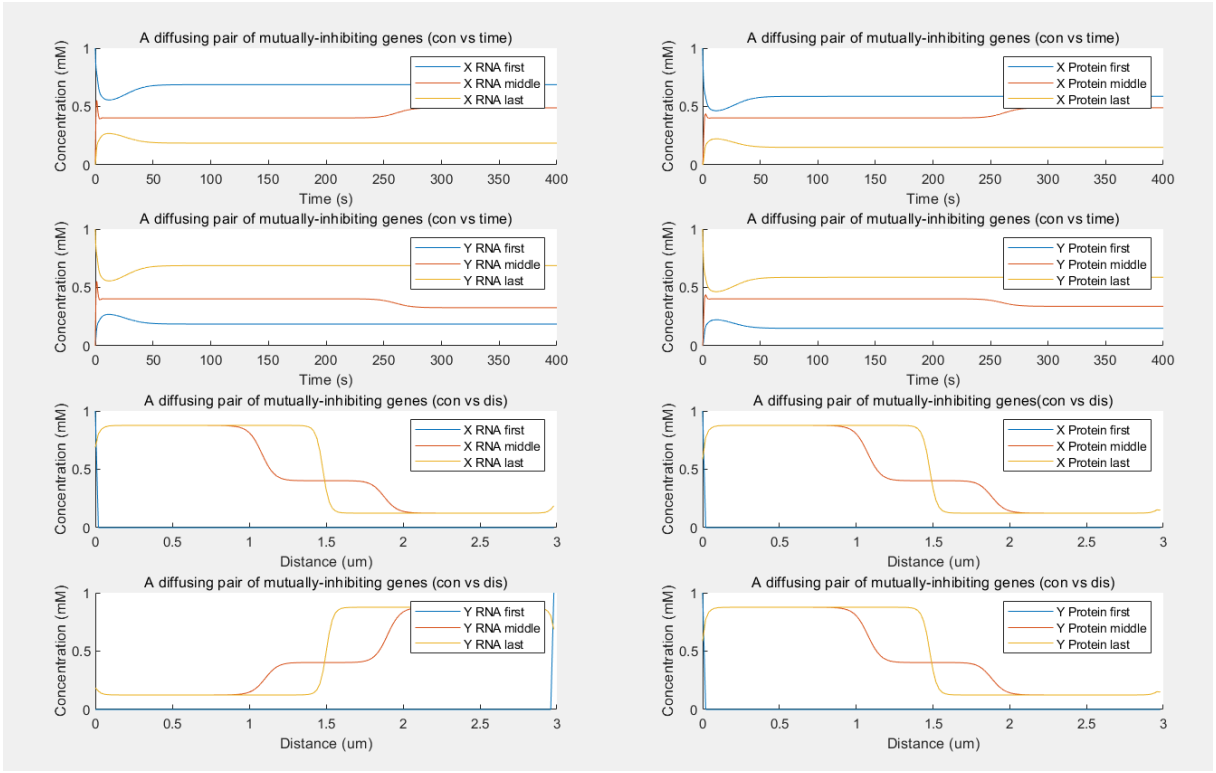
Total time =100



Total time =200

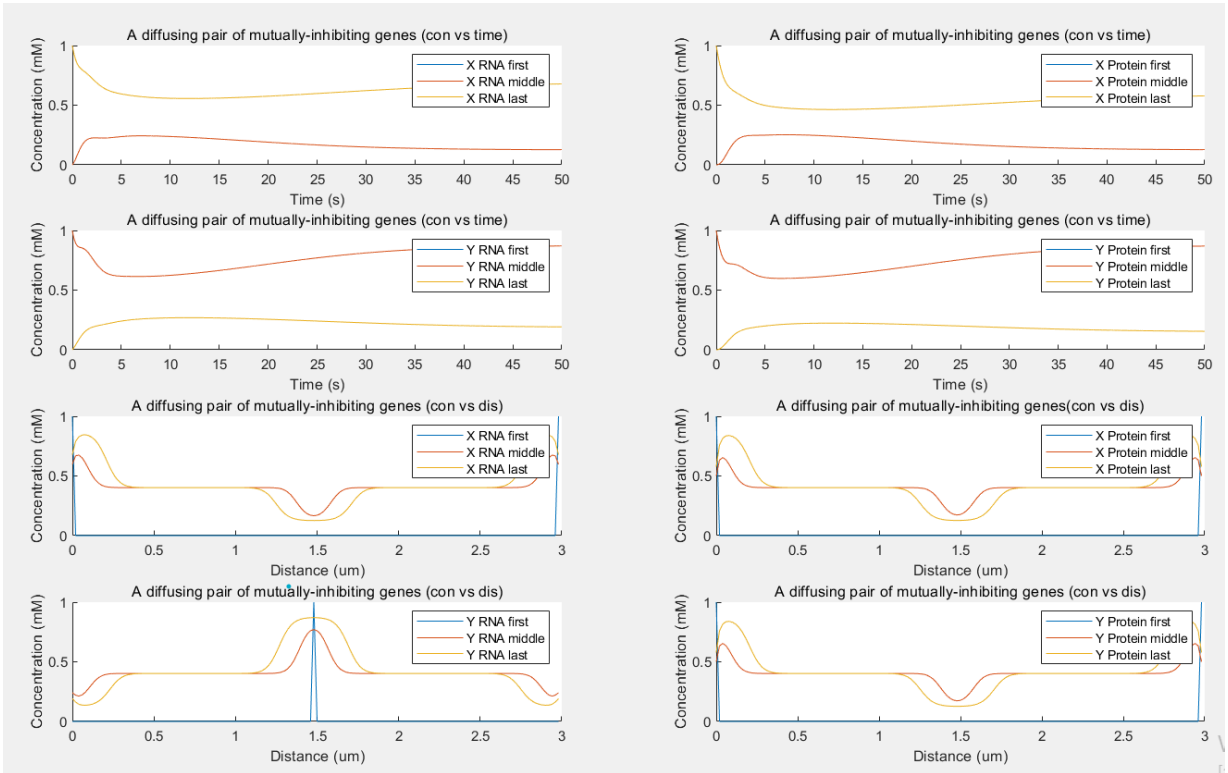


Total time =400

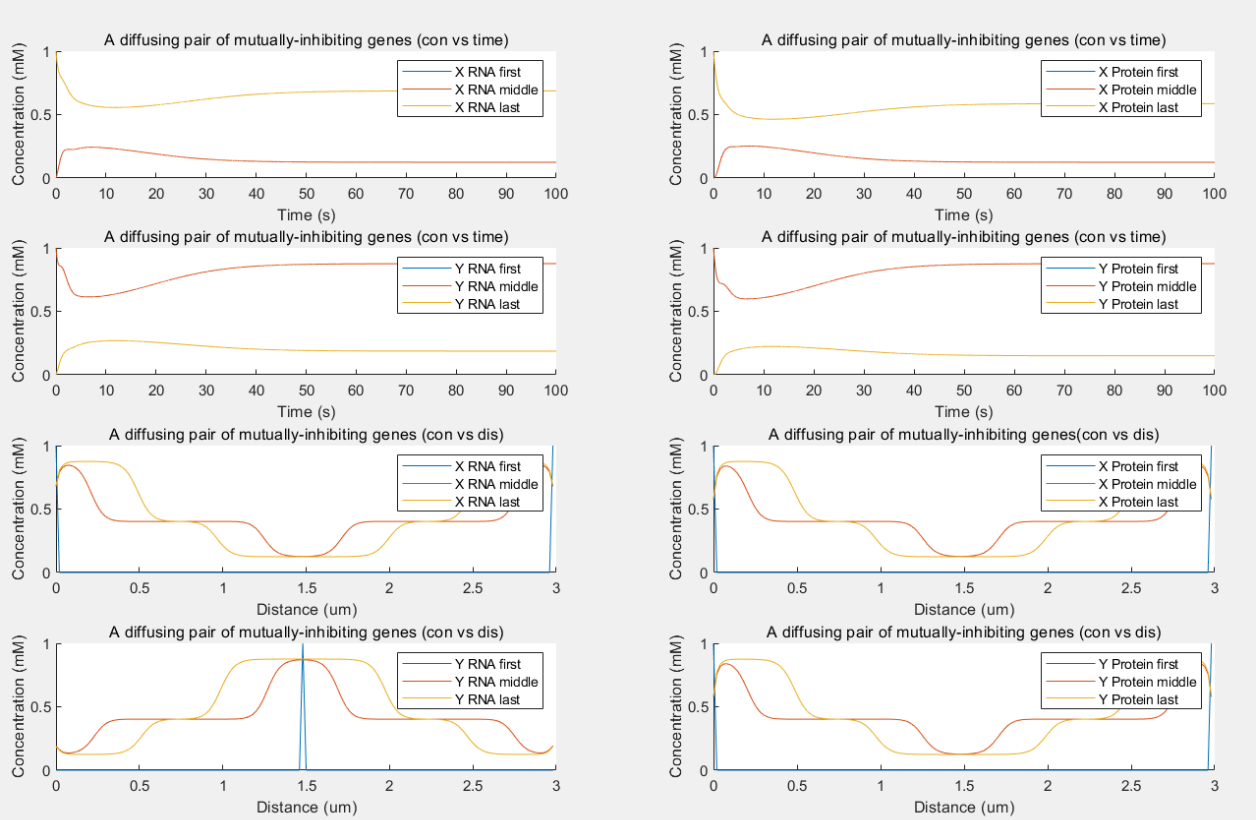


4.

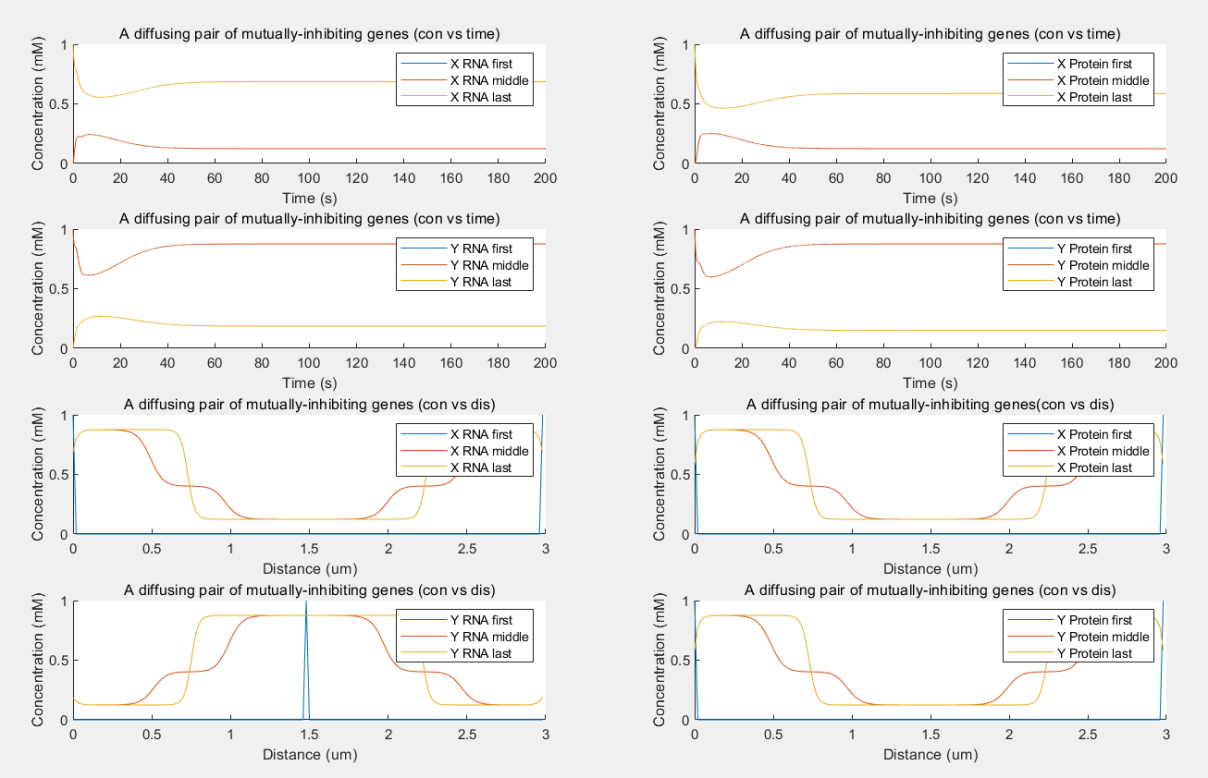
Total time =50



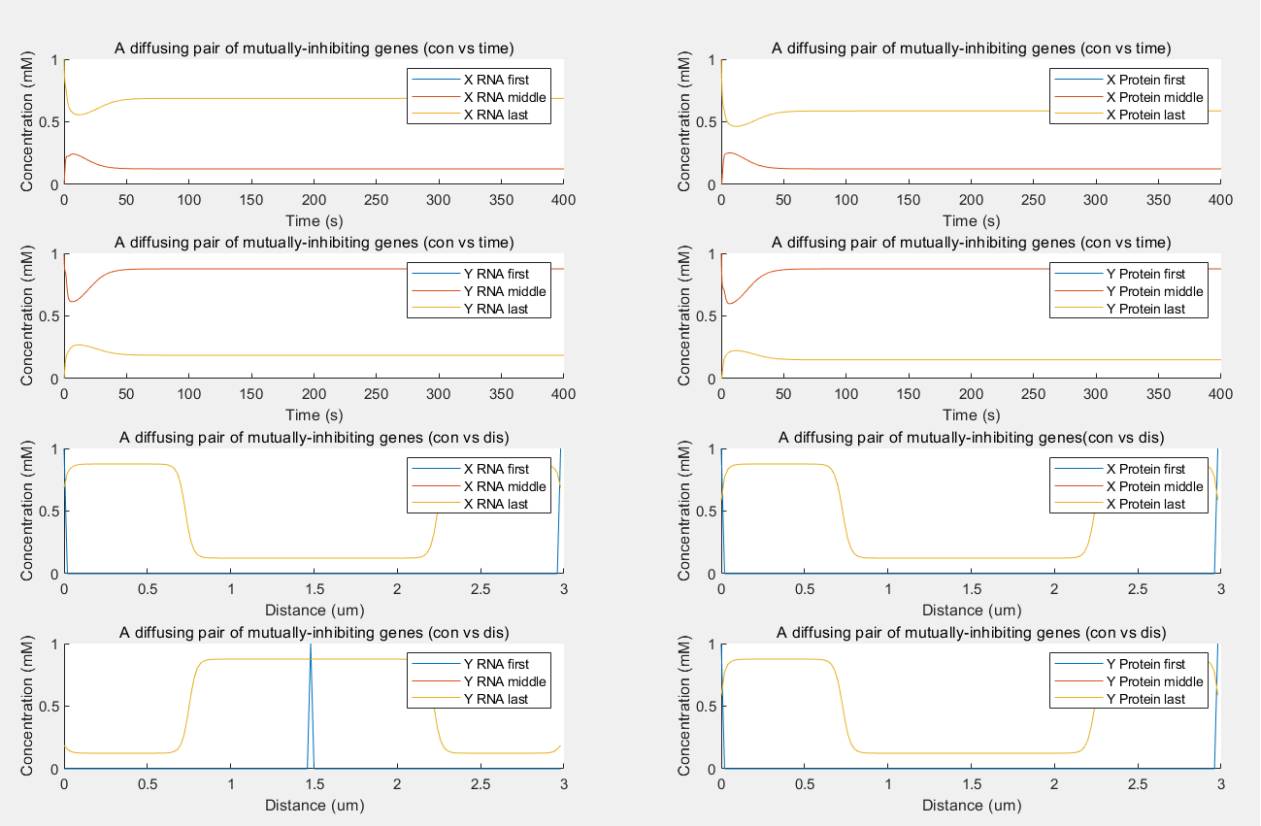
Total time =100



Total time =200



```
Total time =400
```



5.

As the points move away from the first or last point where the initial concentration value is non-zero, the value of the concentration at which the graph converges decreases. (excluding points near the boundary) In the concentration versus distance graph, if the positive initial condition is set to only one boundary point over time, the graph begins to resemble a sigmoid function model. That is when sufficient time has been offered, it converges to a or b with steady states if a point exceeds a specific point in space or not. (Except for the periphery of the boundary point) Alternatively, if the positive initial condition is set only at one point in the middle, a sigmoid-shaped graph is created on the left and right sides based on the point as the total time increases. On the other hand, when a positive initial condition is set for both boundary points of the graph, a vertically symmetrical graph appears.