CS CM 182 Lab 7

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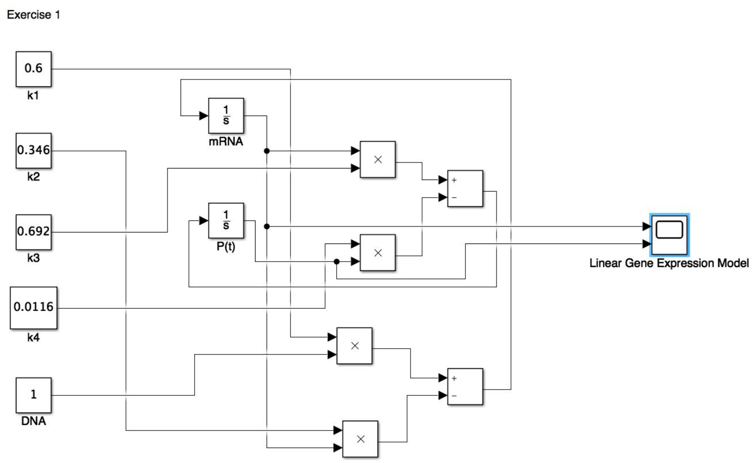
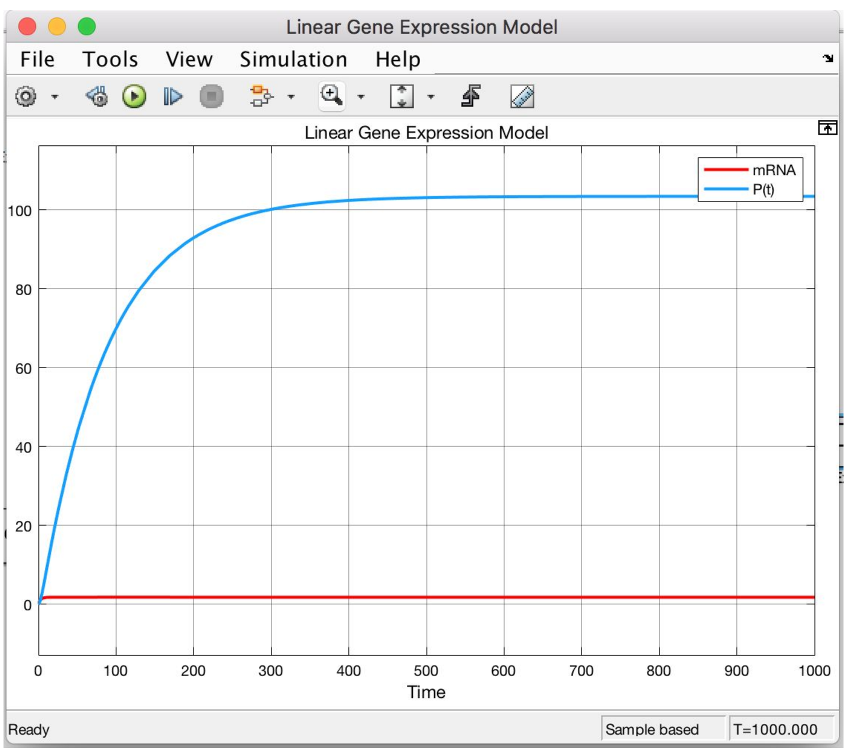
I completed this written part of the homework, lab report, or exam entirely on my own.

Exercise 1

Simulink

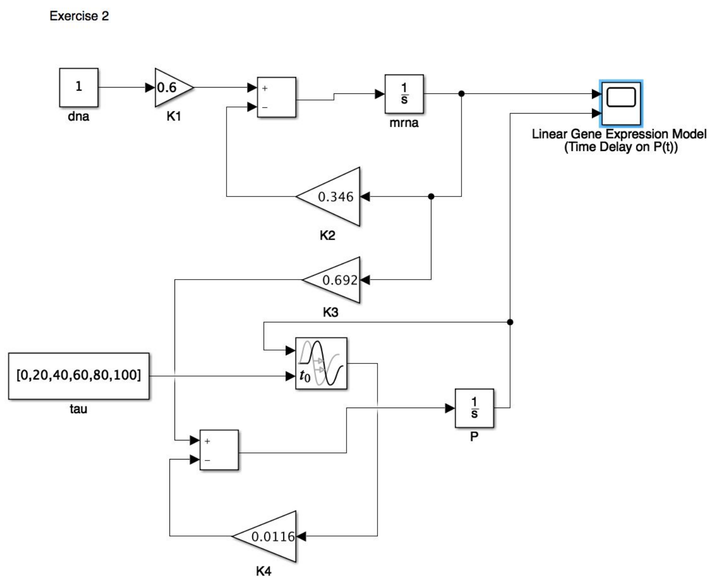


Graph

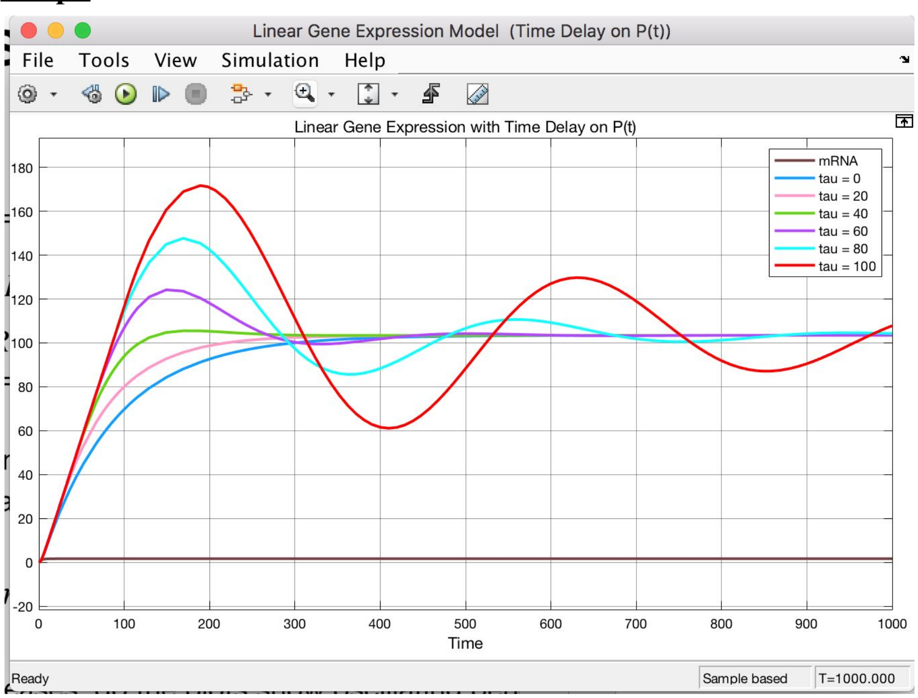


Exercise 2

Simulink



Graph

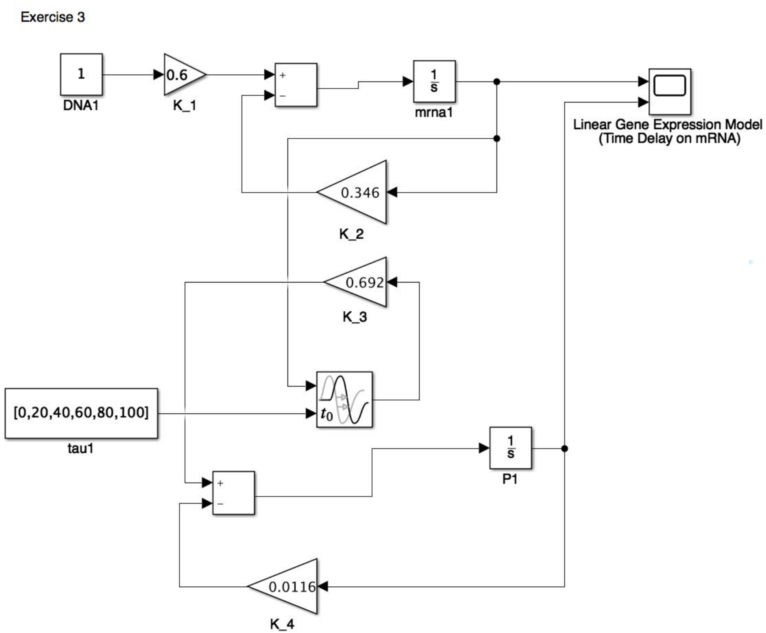


Analysis

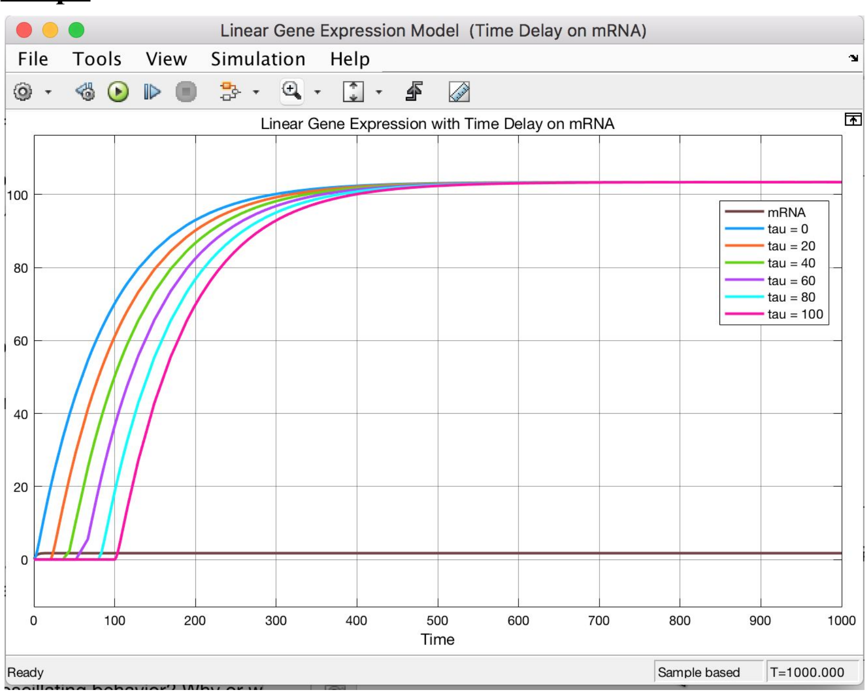
As tau increases, the plots show oscillating behavior. It is because the solution is unstable. Instabilities are characteristic of biological feedback control systems with time delays in the loop. The delay introduced at the feedback loop. When tau in the equation: dP(t)/dt = k3mRNA(t) - k4P(t-tau) becomes larger, dP/dt becomes more negative. As a result, the slope of the graph decreases further. When tau in the equation becomes smaller, dP/dt becomes more positive and less negative. The relationship between mRNA(t) and P(t-tau) creates the oscillation.

Exercise 3

Simulink



Graph

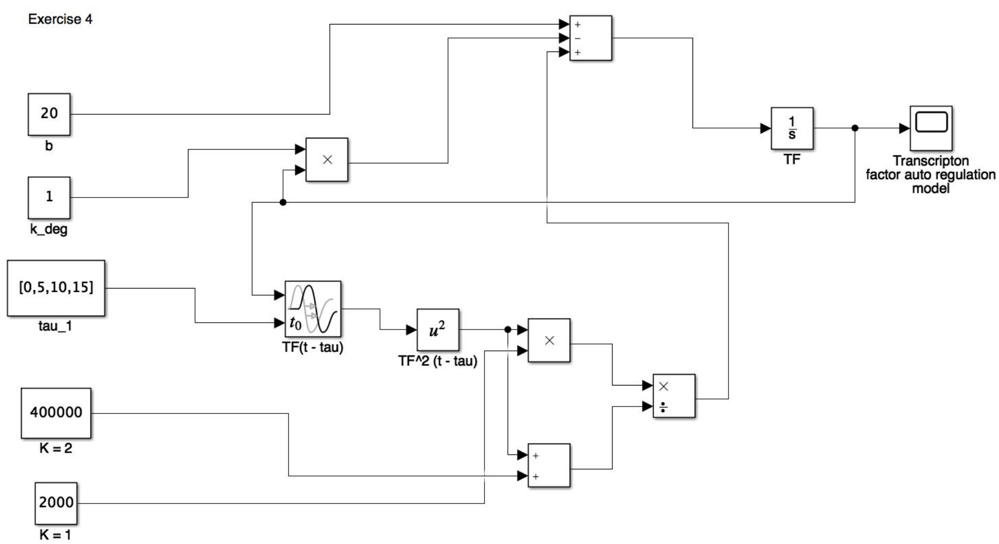


Analysis

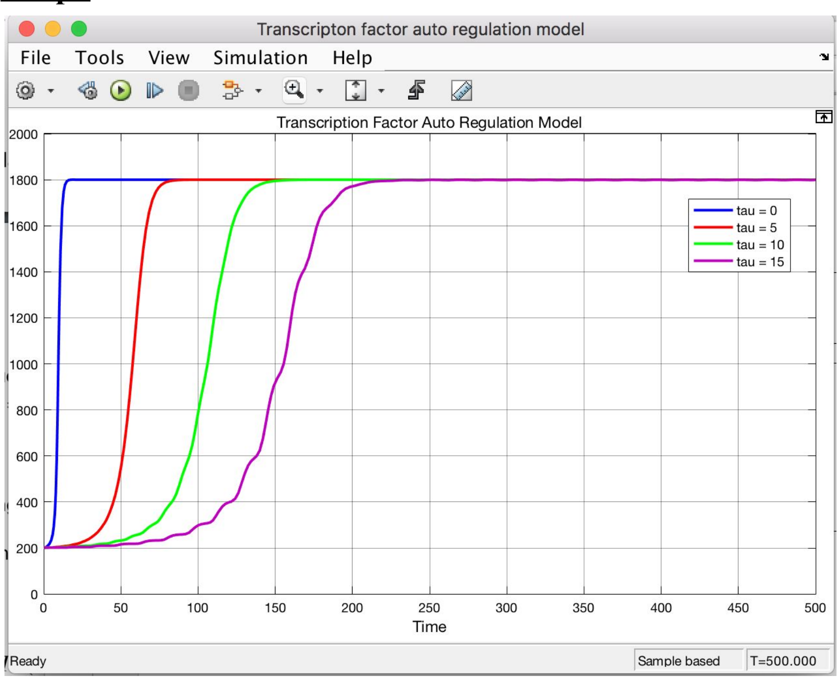
As tau increases, the plot does not show oscillating behavior. It is because the term k3mRNA(t - tau) in the equation: dP(t)/dt = k3mRNA(t - tau) - k4P(t) does not participate in the feedback loop of the model. Secod, the value of the mRNA seems to be constant most of the time. Therefore, the delay on mRNA term in the equation does not affect the slope of the graph that much. There is no obvious oscillation in the graph.

Exercise 4

Simulink



Graph



Exercise 5

Analysis

Yes, the regulation could be considered as a hill function and it is a second order hill function. For all four of the time delay curves, the maximum steady value they reach is 1800 and their initial condition is 200. The time it takes for tau = 0 to reach saturation is roughly 12.5 seconds. The time it takes for tau = 5 to reach saturation is roughly 75 seconds. The time it takes for tau = 10 to reach saturation is roughly 150 seconds. The time it takes for tau = 15 to reach saturation is 225 seconds. However, as tau increases, the curve starts to wiggle from the bottom to the top. For tau = 10, the curve has slight wiggle at the bottom and tends to stretch out as it goes up. For tau = 15, the wiggle is more obvious and the oscillation starts at the bottom and continues to the top. Finally, it becomes a flat line once the curve reaches the saturation value.