
Math. Model & Sci. Comput. in Biosciences

Exercise 2: Biological Circuits

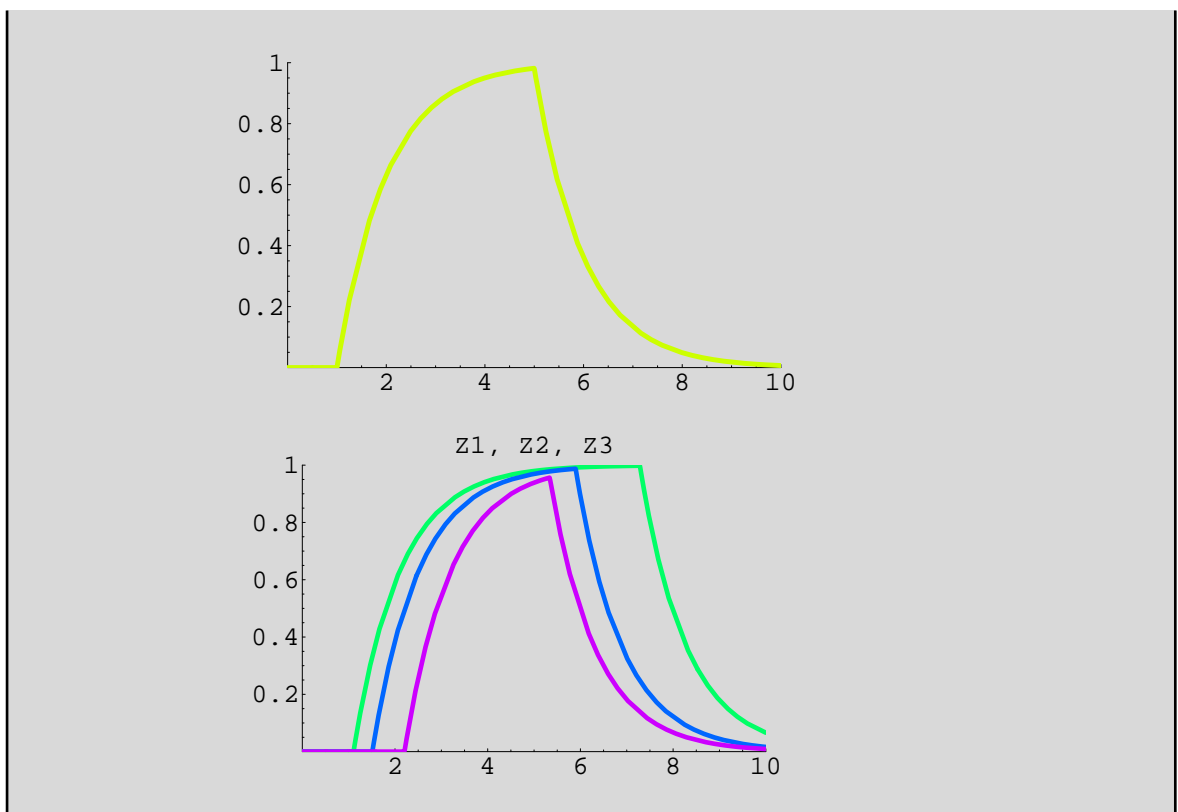
Instruction: complete and hand-in by **Friday, June 22.**

Temporal Order: First-In, First-Out

In Lecture 6, we saw that in developmental programs, a single regulator can control a group of genes.

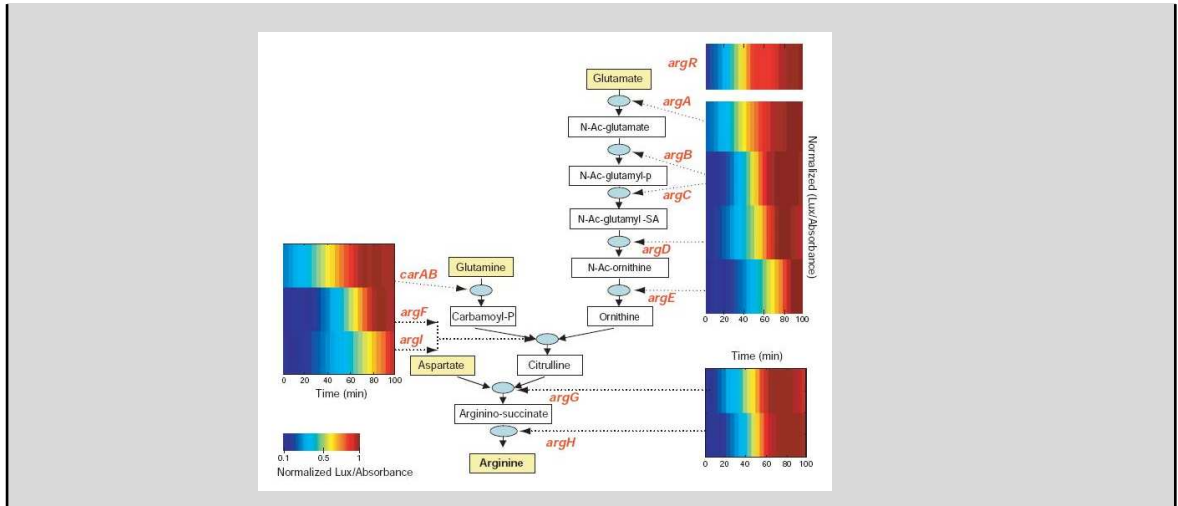
In particular, one may want certain genes to turn on and off in some predefined order, upon input from a single regulator.

We saw in Lecture 6 how to construct a system that responds to an input as follows:



Namely, taking the yellow curve in the top plot as the single regulator $X[t]$, the genes $Z1, Z2, Z3$ are turned on and off in the same order. Hence, the genes respond in a so-called **First-In, Last-Out** manner. That is, the first gene turned on ($Z1$) is also turned off last.

However, in many instances one would like to have a sequence of genes that are switched on and off in a **First-In, First-Out** manner, as illustrated below:



The task is now to construct a system of 3 genes that shows a **First-In, First-Out** temporal order, depending on the input $X[t]$.

This could be done using the knowledge of motifs as covered in lectures.

Construct such a system, and **show** some numerical simulations using any software (*Mathematica* as has been used in lectures, or Matlab, or anything else you might prefer).