System Biology Course: Homework --- reproducing figures in Tyson et al. 2003

All the simulations were conducted through three python packages(functions), namely,

[1] scipy.integrate.odeint function was used for simulating one component system

[2] scipy.optimize.fsolve function was used for solving steady-state

[3] Gekko package was used for simulating and solving steady-state for system which has more than one component

I will provide the code snippets for every figure I made.

Figure1a: Linear response curve

Code link: ( <https://github.com/frankligy/exercise_codes/blob/master/ODE/script.py/#L8-L69> )



From left to right, they are solution curve (not required in the paper but I think it is important to generate), rate curve and signal-response curve.

Figure 1b: Hyperbolic response curve

Code link: ( <https://github.com/frankligy/exercise_codes/blob/master/ODE/script.py/#L71-L133> )



From left to right, solution curve, rate curve and signal-response curve

Figure 1c: sigmoidal response curve (buzzer)

Code link ( <https://github.com/frankligy/exercise_codes/blob/master/ODE/script.py/#L135-L208> )



From left to right: solution curve, rate curve and signal-response curve

Typo report: equation (d) in the original paper, the second argument should be k2\*S and ends up with 4 arguments in total instead of 5 arguments, which is paradoxical to the Goldbeter-Koshland function defined in the paper.

Figure1d: perfectly adapted (sniffer)

Code link: ( <https://github.com/frankligy/exercise_codes/blob/master/ODE/script.py/#L211-L259> )



From left to right: rate curve and solution curve.

Figure1e: positive feedback, mutual activation

Code link: ( <https://github.com/frankligy/exercise_codes/blob/master/ODE/script.py/#L261-L330> )



From left to right: rate curve and signal-response curve

Typo report: Box1 equation, dR/dt should be k2\*R instead of k2\*X\*R

Figure 1f: positive feedback mutual inhibition (toggler)

Code link: ( <https://github.com/frankligy/exercise_codes/blob/master/ODE/script.py/#L333-L400> )



From left to right: rate curve and signal-response curve

Typo report: Box1 equation, E(R) should be G(k4,k3R,J3,J4)

Figure1g: negative feedback, homeostasis

Code link: ( <https://github.com/frankligy/exercise_codes/blob/master/ODE/script.py/#L403-L446> )



From left to right: rate curve and signal-response curve

Figure2a: negative feedback, oscillator (blinker)

Code link: ( <https://github.com/frankligy/exercise_codes/blob/master/ODE/script.py/#L448-L480> )