Prelim 1 - Problem 2
CHEME 5440 Spring 2020
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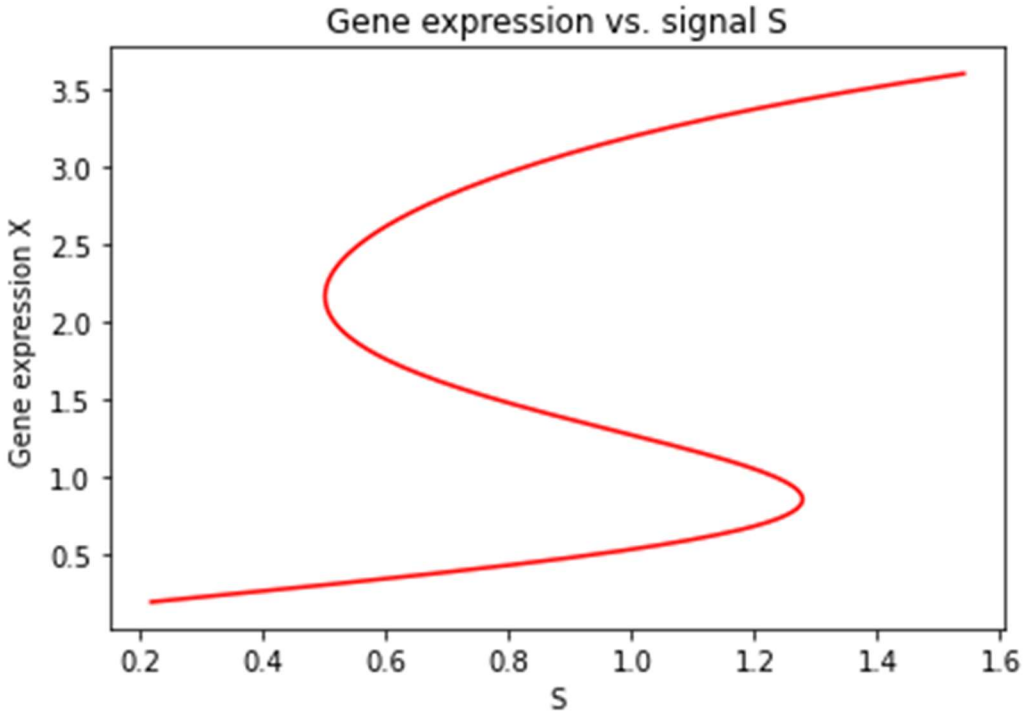
2.

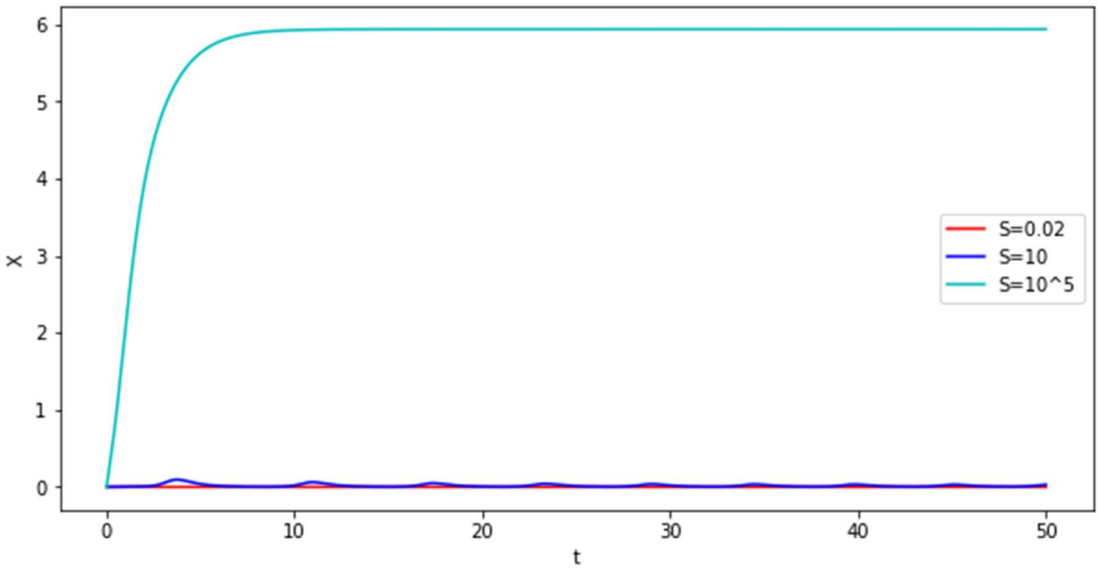
c) Supplementary code in Github

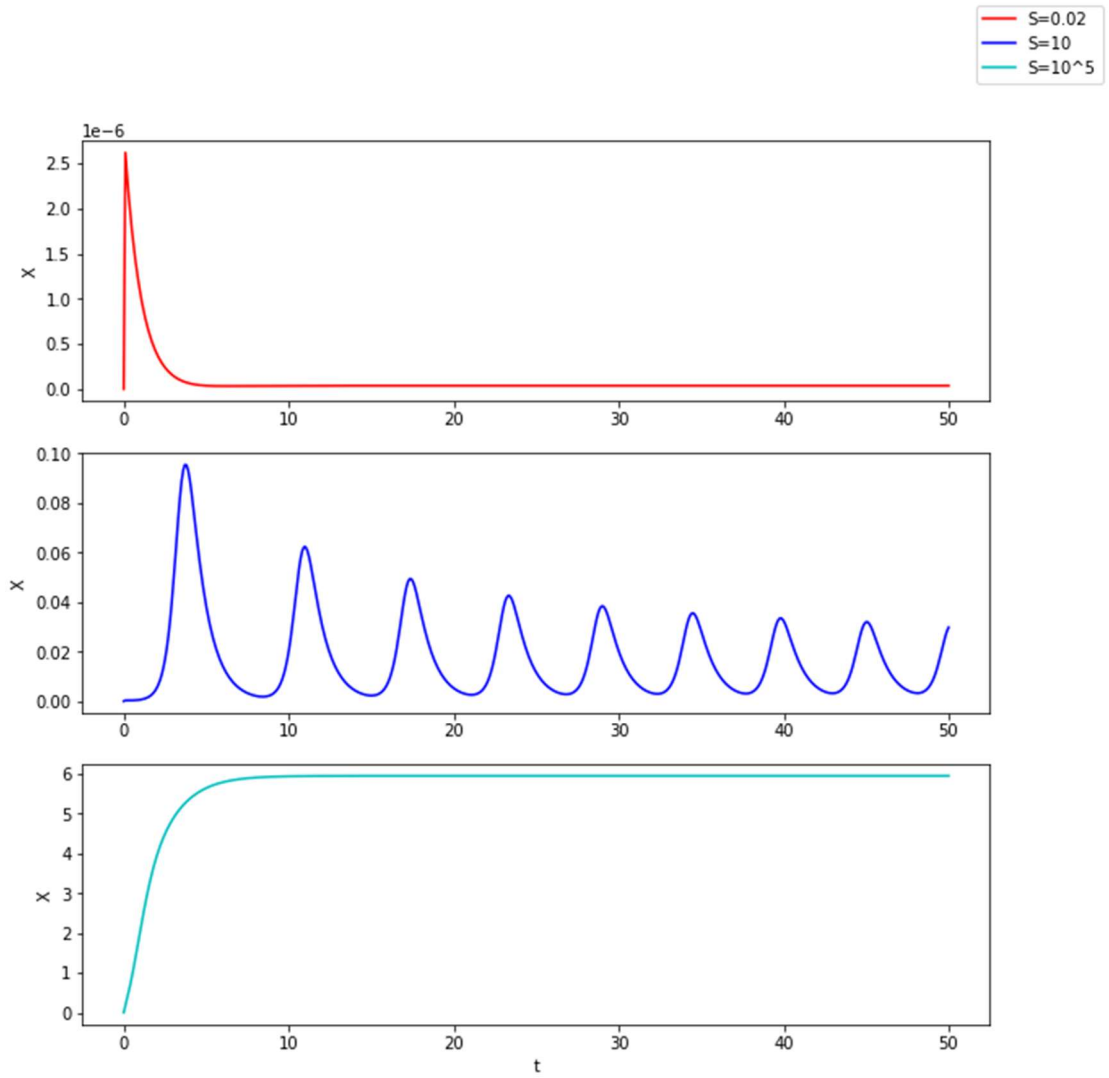


Yes, it can be reproduced.

2.

d) Supplementary code in Github





The results are similar to the results in Figure 2.

2.

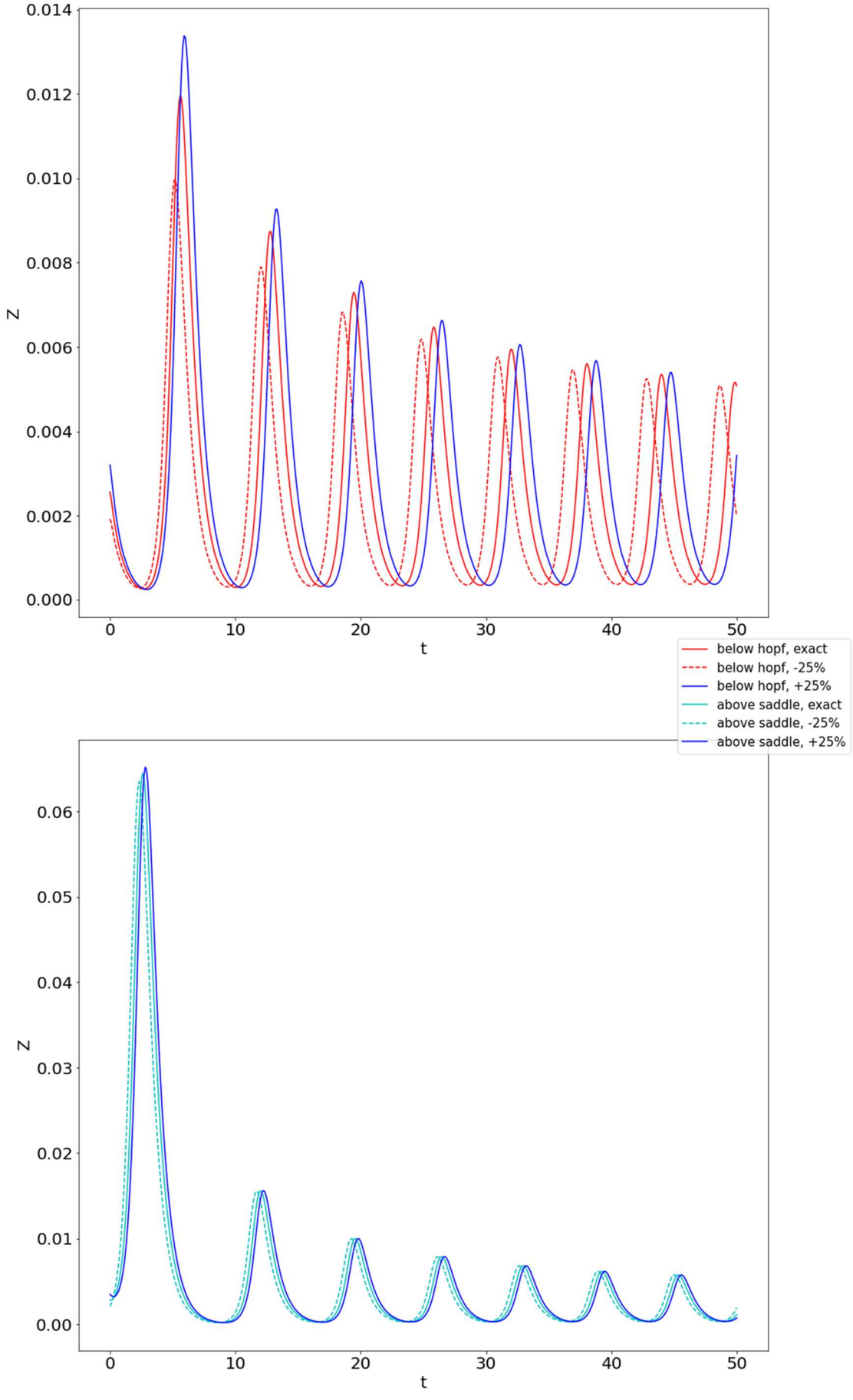
e)

Chosen value of S below Hopf point: 0.04

Chosen value of S above saddle node: 43000

Shown in the figure below, the oscillations below the Hopf bifurcation point are incoherent (out of phase), and the oscillations above the saddle node bifurcation are coherent.

Since the initial part of the Hopf bifurcation starts close to the spiral point already, this may cause a lot of cells to have different initial concentrations, so they are easily out of phase. On the other hand, the saddle bifurcation starts not so close to the spiral point, so it will have cells with more uniform concentrations, leading to a coherent oscillation.


0.014
0.012
0.010
0.008
0.006
0.004
0.002
0.000
Z
0
10
20
30
40
50
t
below hopf, exact
below hopf, -25%
below hopf, +25%
above saddle, exact
above saddle, -25%
above saddle, +25%
0.06
0.05
0.04
0.03
0.02
0.01
0.00
Z
0
10
20
30
40
50
t

2.

(f)

I think it is possible because from 2. (e) , the results showed that coherent oscillations could still be achieved by applying a signal step change.