Organizational Remarks:

PS #2, 1b:

Correction: Plot k_a and k_b for $L = 0...2/K_L$

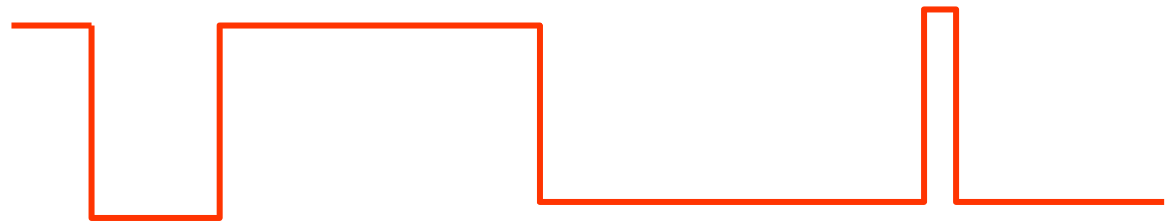
(NOT: Plot k_a and k_b for $L = 0...2K_L$)

Tomorrow's recitation topic:

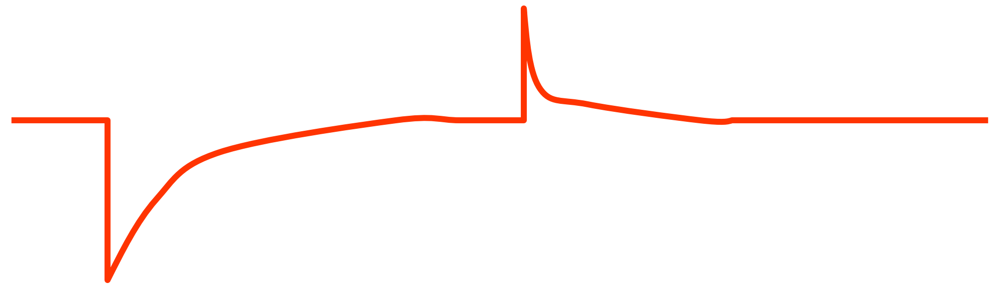
'PS #2 support'

Dynamical response of switches, chemotactic network and oscillators

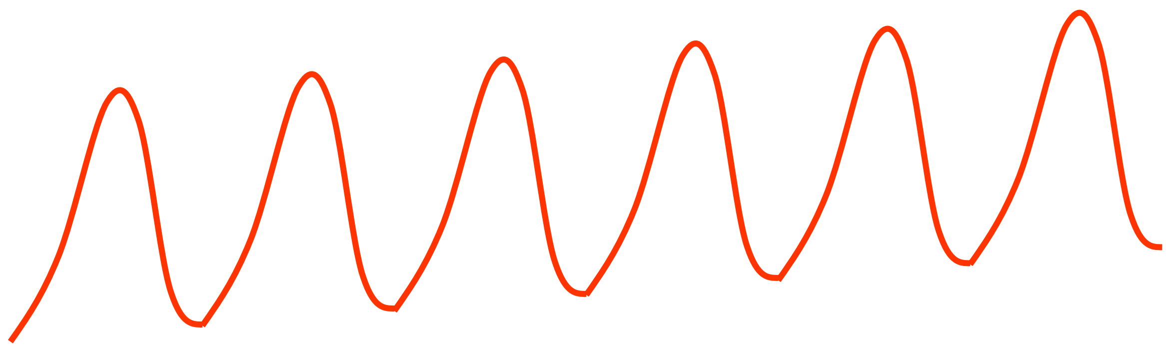
‘switch’



adaptation
(differentiator,
at least for small
frequencies)

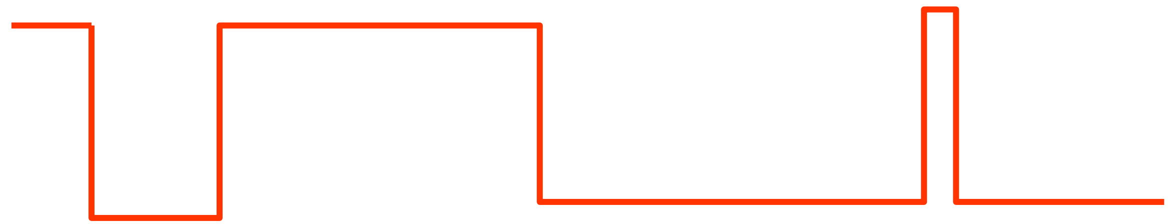


oscillator

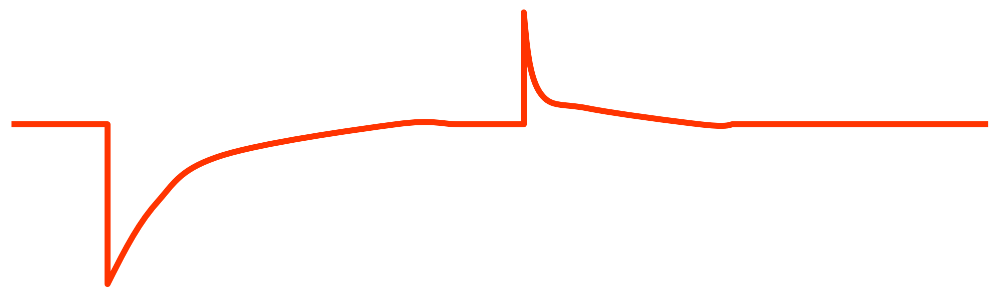


Dynamical response of switches, chemotactic network and oscillators

two stable
fixed points



one stable
fixed point



unstable
fixed point

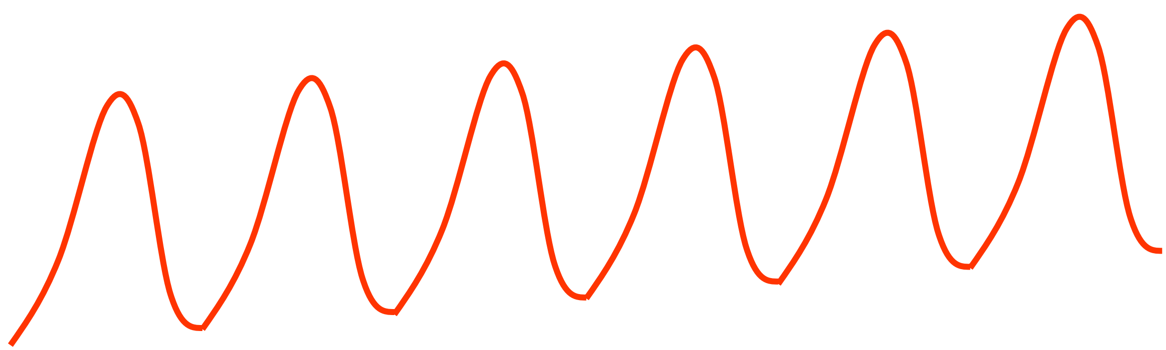


Image removed due to copyright considerations.

nullclines:

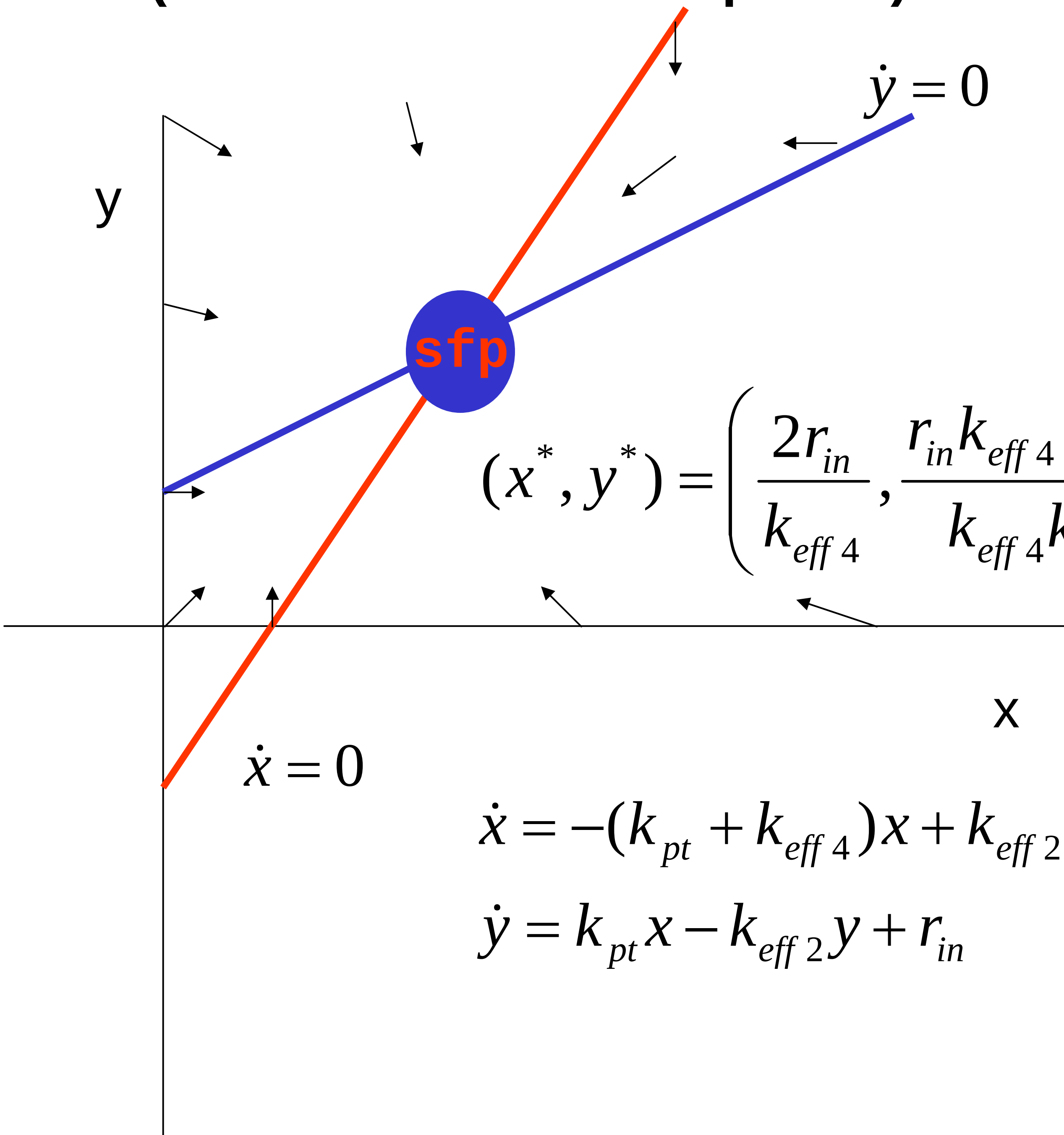
$$u = \frac{\alpha_1}{1+v^{\beta}}$$

$$v = \frac{\alpha_2}{1+u^{\gamma}}$$

$$\frac{du}{dt} = \frac{\alpha_1}{1+v^{\beta}} - u$$

$$\frac{dv}{dt} = \frac{\alpha_2}{1+u^{\gamma}} - v$$

Adaptation (one stable fixed point)

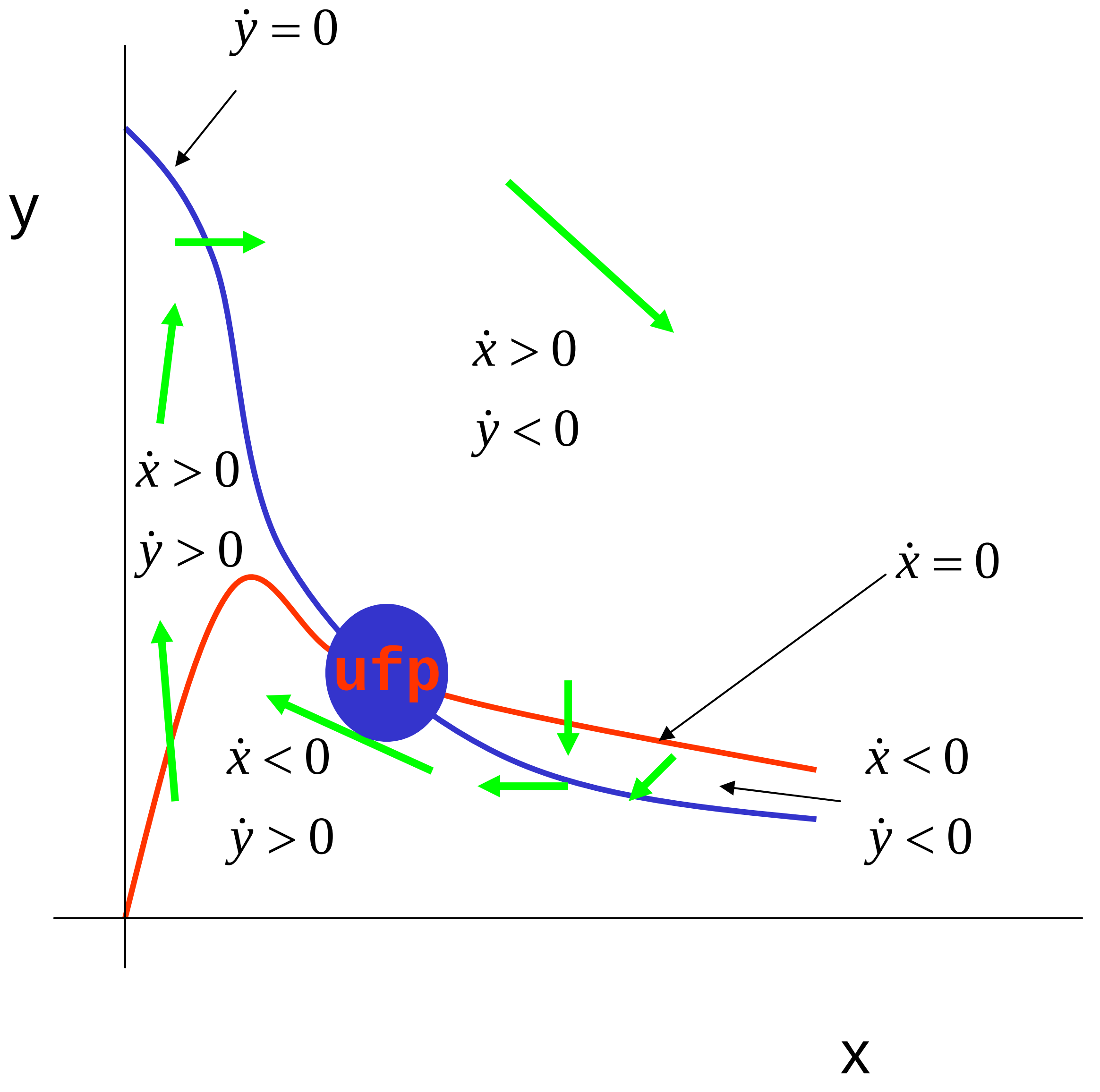


$$(x^*, y^*) = \left(\frac{2r_{in}}{k_{eff\,4}}, \frac{r_{in}k_{eff\,4} + 2r_{in}k_{pt}}{k_{eff\,4}k_{eff\,2}(L)} \right)$$

$$\dot{x} = -(k_{pt} + k_{eff\,4})x + k_{eff\,2}y + r_{in}$$

$$\dot{y} = k_{pt}x - k_{eff\,2}y + r_{in}$$

Oscillator (unstable fixed point)



Oscillators continued ....

$$\dot{x} = -x + ay + x^2 y$$
$$\dot{y} = b - ay - x^2 y$$

model for glycolysis

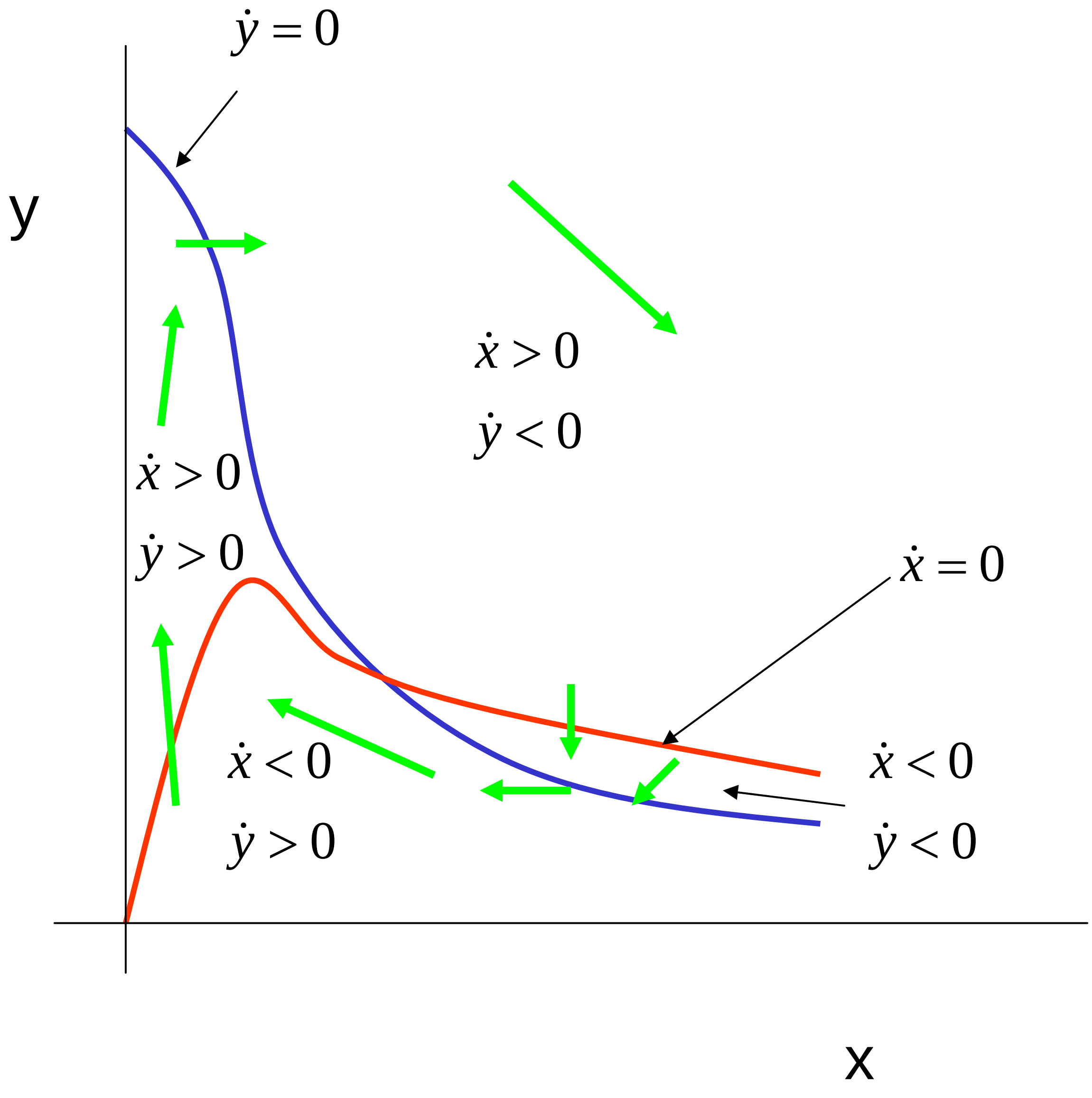
nullclines:

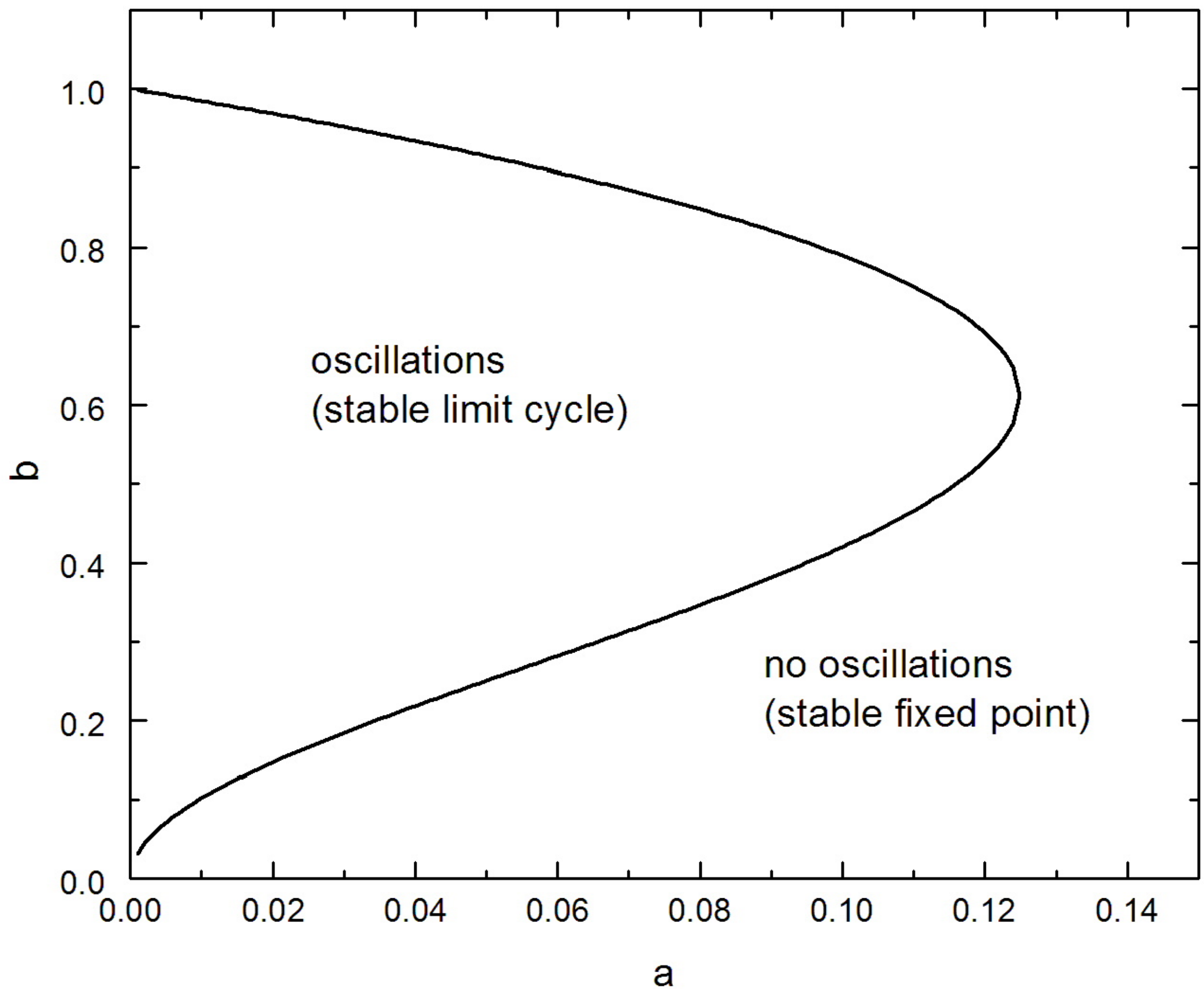
$$y = \frac{x}{a + x^2}$$
$$y = \frac{b}{a + x^2}$$

fixed point:

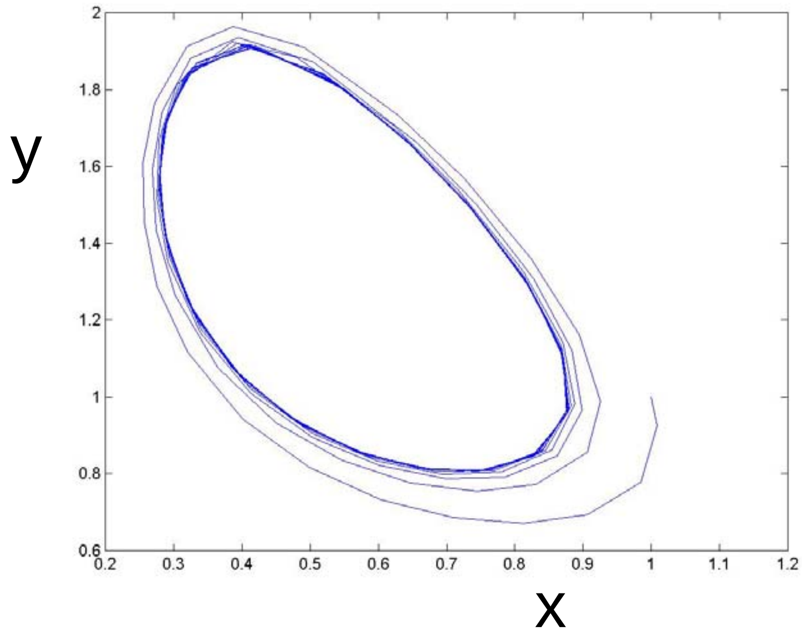
$$x^* = b$$
$$y^* = \frac{b}{a + b^2}$$

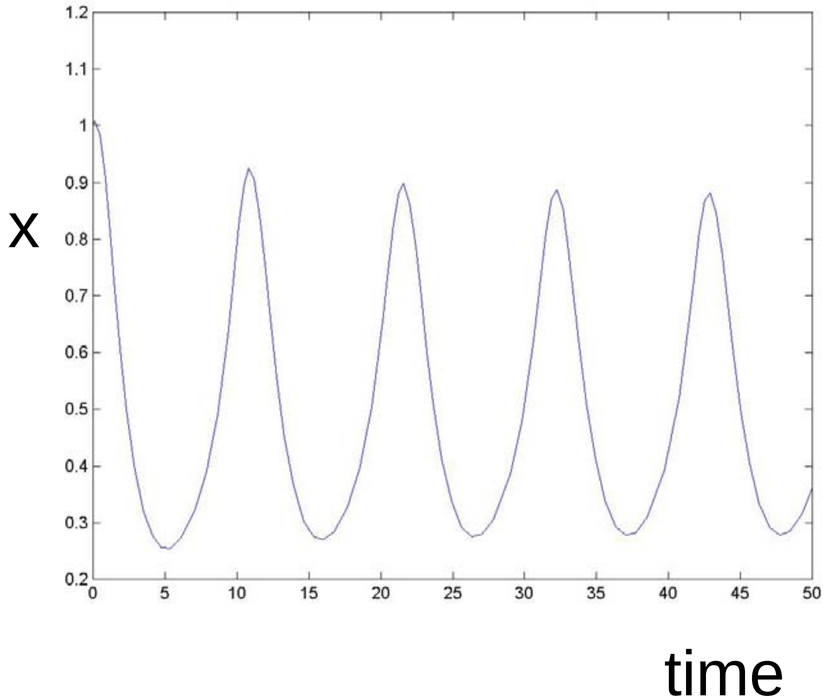
stable or unstable ?


$\dot{y} = 0$
y
$\dot{x} > 0$
$\dot{y} < 0$
$\dot{x} > 0$
$\dot{y} > 0$
$\dot{x} = 0$
$\dot{x} < 0$
$\dot{y} > 0$
$\dot{x} < 0$
$\dot{y} < 0$
x


oscillations
(stable limit cycle)
no oscillations
(stable fixed point)
b
1.0
0.8
0.6
0.4
0.2
0.0
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
a

limitcycle


y
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
1.2
x


x
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0
5
10
15
20
25
30
35
40
45
50
time

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