

# Lecture outline

## March 2, 2015

- bifurcation diagram for positive feedback system
- survey of feedback mechanisms and their effects
- PS2 solutions
- review and comments on Quiz 1

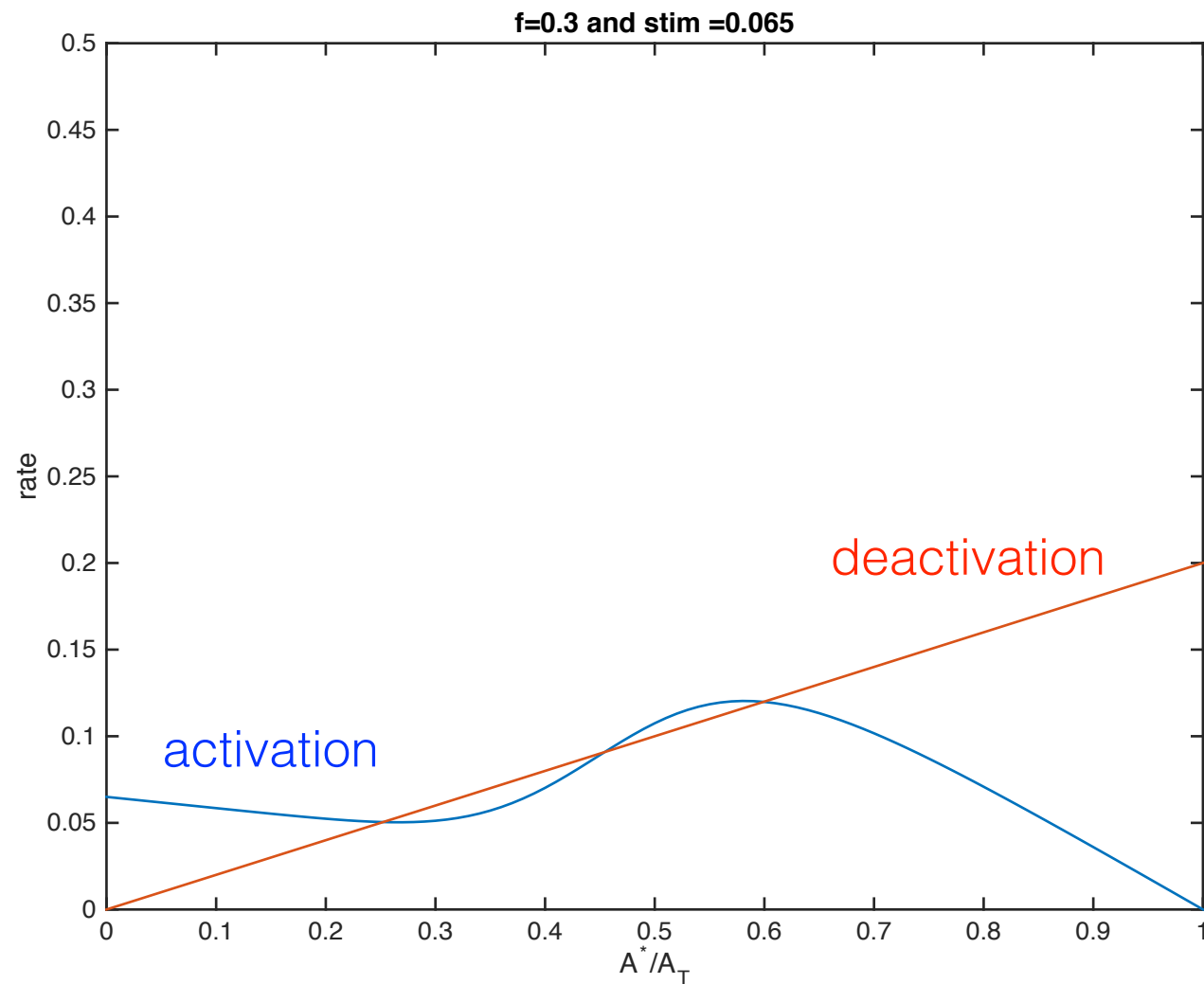
Examine effect of two parameters: *stimulus* and *f*

$$\frac{dA^*}{dt} = \left( \text{stimulus} + f \frac{A^{*n}}{K^n + A^{*n}} \right) (A_T - A^*) - k_i A^*$$

Consider  $n = 7$ ,  $K = 0.5$ ,  $A_T = 1$ ,  $k_i = 0.2$ .

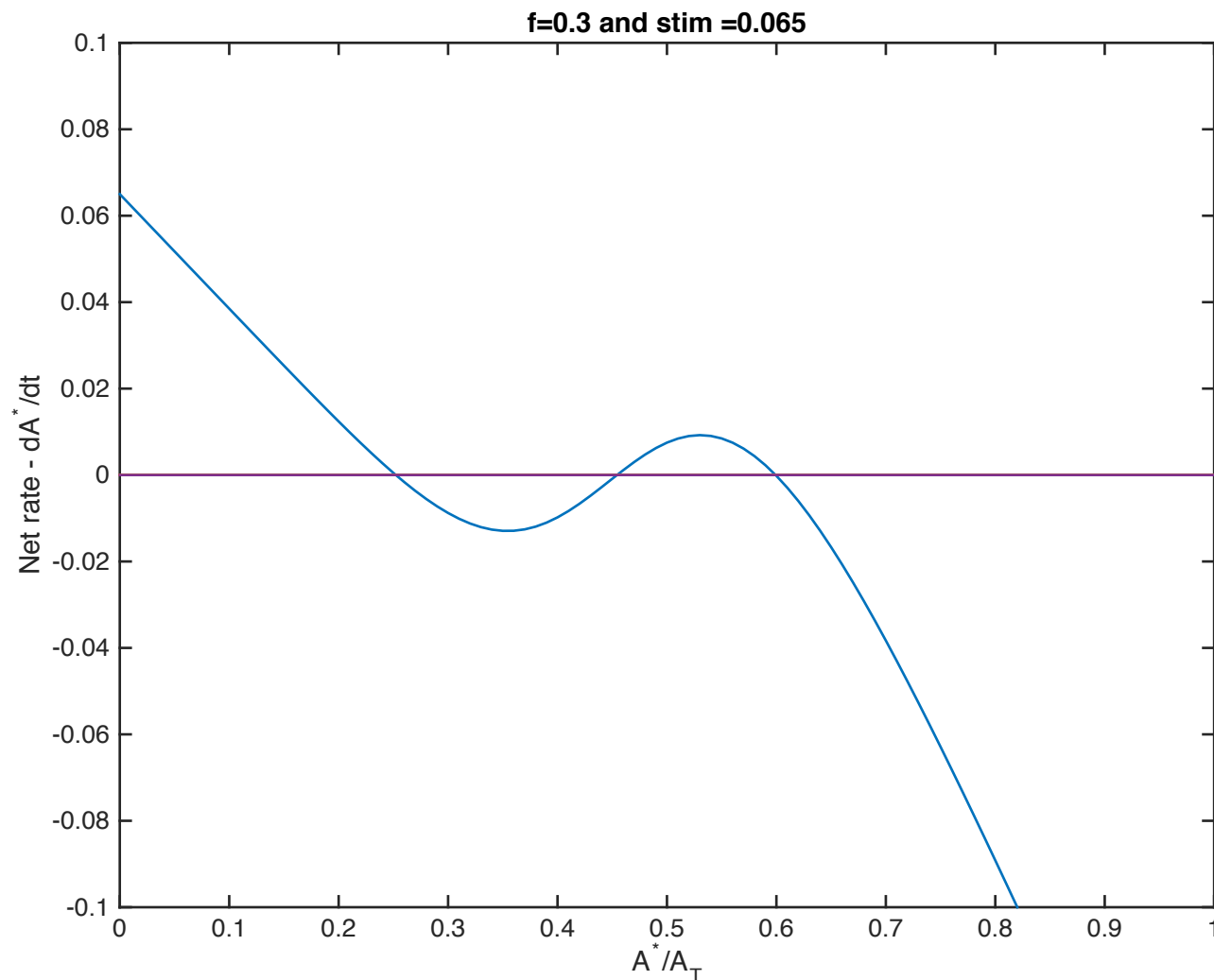
# Rate plots

*where are  
stable and  
unstable fixed  
points?*



*beyond the  
steady-states,  
what can you  
infer about  
dynamics?*

# Net rate gives the phase portrait



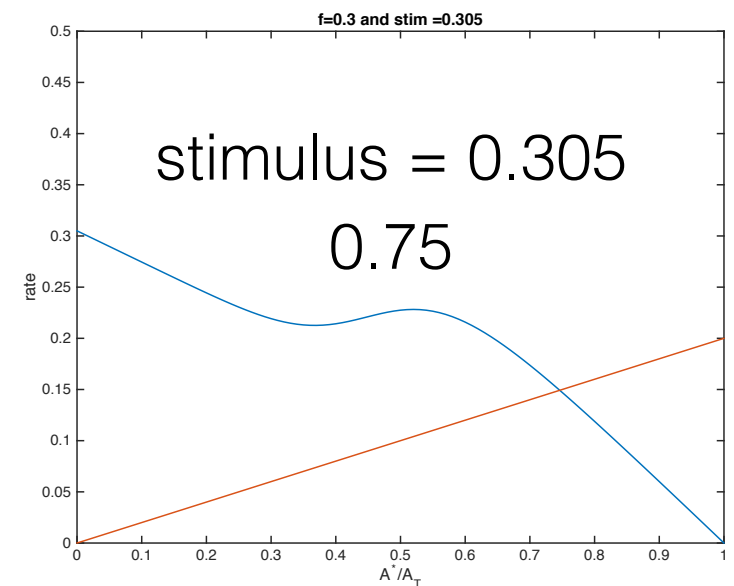
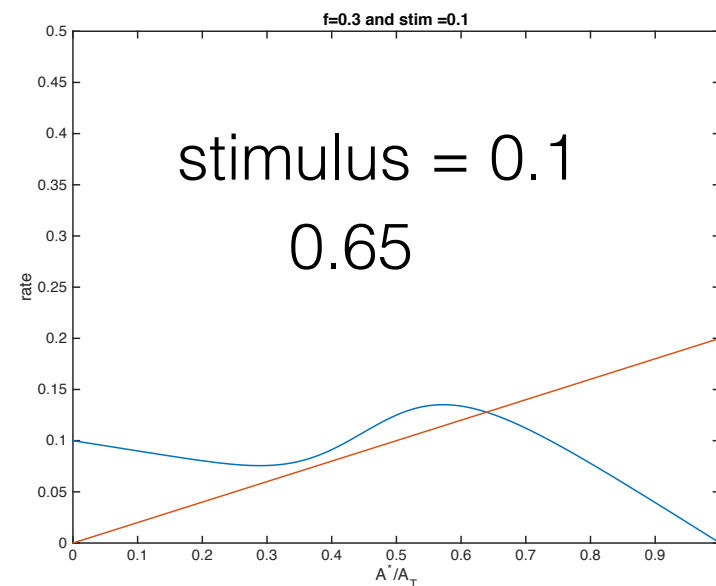
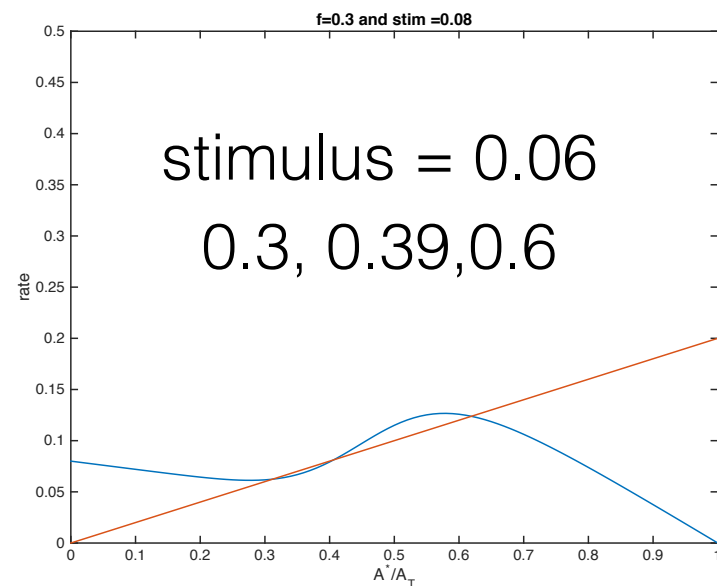
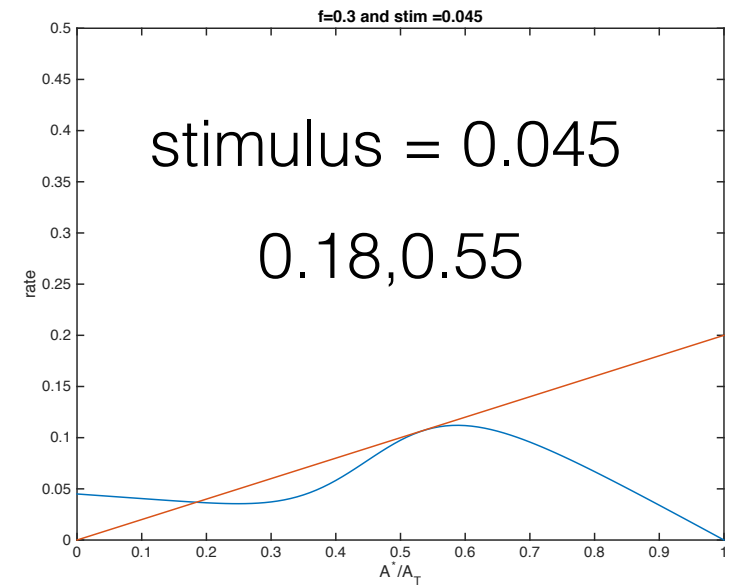
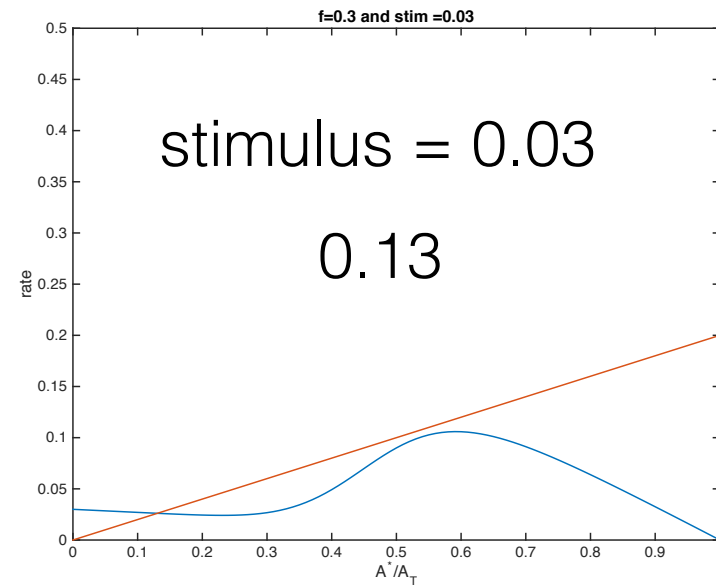
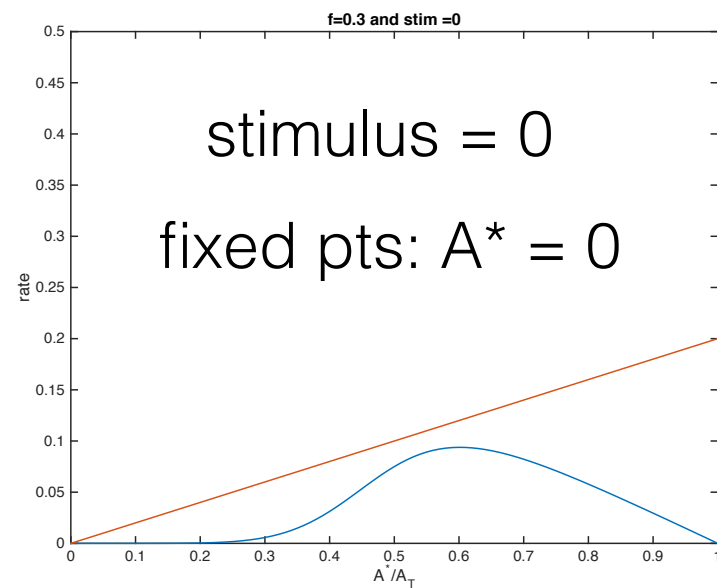
slope of  $dA^*/dt$  vs  $A^* < 0$  (stable)  
slope  $> 0$  (unstable)

*caution: not the 2nd derivative w.r.t. time*

what information lies in the  
magnitude of  $dA^*/dt$ ?

# Rate plots

## $f=0.3$ , vary stimulus



# Construct bifurcation diagrams

- see Matlab — follow the fixed points
- construct a plot of fixed points vs. parameter (stimulus) for  $f = 0.3$ .
- This is a bifurcation diagram.
- back to Matlab, now for  $f=0.4$ . Construct bifurcation diagram.