Mathematics for Systems Biology and Bioinformatics

Lecture Prof. Dr. Thomas Filk

Tutorials Dr. Tim Maiwald, Christian Tönsing

Exercise sheet no. 6

Submission until 5. 12. 2012 10:00 am in the tutorials

Homework 9: Fixed Point Analysis I (4 Points)

Assume a system given by the ODE:

$$\frac{\mathrm{d}x}{\mathrm{d}t} = f(x) = x\,(a-x)\,(b-x) \tag{1}$$

($a, b \in \mathbb{R}$, x stands always for $x(t)$)
a) What are the three fixed points x^*? (Hint: if $f(x^*) = 0$, x^* is a fixed point)
b) Under which conditions (for a and b) are the fixed points stable?
(Hint: $f'(x^*) > 0 \Rightarrow$ unstable, $f'(x^*) < 0 \Rightarrow$ stable)
c) Is it possible to find a,b, with $0 < a < b$ such that the smallest fixed point is stable, the second largest is unstable and the larges is stable again? If so give an example, if not explain why!

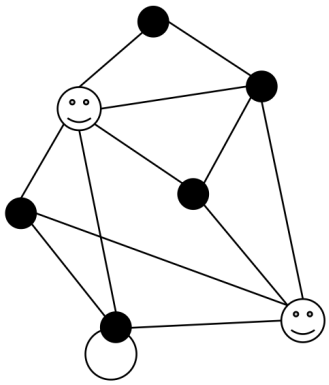
Homework 10: Fixed Point Analysis II (3 Points)

Analyse the system

$$\dot{x} = -x^3 + 2.5x^2 - x \tag{2}$$

a) Give the fixed points of the system and check for stability.
b) What happens qualitatively for starting values $x_0 = -1$, 0, 0.4, 0.5, 0.6, 2, and 3. Draw a sketch to illustrate the behaviour of the system (Hint: You do not need to find the solution x(t) of the ODE in order to answer the question!)

Homework 11: Graph Theory (3 Points)



a) What is the adjacency matrix of this graph?
b) What is the degree of each node?
c) How many paths exist between the two smileys? Sort them by their length.

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