582653 Computational methods of systems biology, Autumn 2009
Homework 5
Group 1: Thursday Dec. 10th 14-16 B119
Group 2: Thursday Dec. 10th 16-18 B119

General instructions

Problems for each exercise session will be distributed approximately one week before the session. You are expected to be prepared to present your solutions in the exercise session.

Assignments

1. Consider the metabolic network given by the following reactions:

$$
\begin{aligned}
r_1 &: \quad \rightarrow m_1 \\
r_2 &: \quad \rightarrow m_2 \\
r_3 &: \quad \rightarrow m_3 \\
r_4 &: \quad m_1 + m_4 \rightarrow m_6 + m_7 \\
r_5 &: \quad m_2 \rightarrow m_4 + m_5 \\
r_6 &: \quad m_3 \rightarrow m_5 \\
r_7 &: \quad m_5 \rightarrow m_8 \\
r_8 &: \quad m_6 \rightarrow \\
r_9 &: \quad m_7 \rightarrow m_9 \\
r_{10} &: \quad m_8 \rightarrow m_9 \\
r_{11} &: \quad m_9 \rightarrow
\end{aligned}
$$

   Answer the following questions:

   (a) Which reactions are exchange reactions?
   (b) What is the stoichiometric matrix corresponding to this model? Draw a bipartite graph corresponding to this model.
   (c) Define the Flux Balance Analysis optimization problem where you constrain the fluxes $0 \leq v_1, v_2, v_3 \leq 1$. The other fluxes remain unconstrained. Solve the problem by maximizing flux v_{11}. You may use Matlab's linprog or some other software, or solve the problem by hand.
   What is the maximum value for v_{11}? Is this solution unique? Why/why not?

2. [Alon, Exercise 5.1]
3. [Alon, Exercise 5.2]
4. [Alon, Exercise 5.5]
5. [Alon, Exercise 6.1] For b) assume that the logic input function for Y_1 is $Y_1 = (X_1 > 0.5)\,\mathrm{OR}\,(Y_2 < 0.5)$ and the logic input function for Y_2 is $Y_2 = (X_1 < 0.5)\,\mathrm{AND}\,(Y_1 < 0.5)$.
6. [Alon, Exercise 6.2]