Metabolic Networks SS 2015
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Exercise Sheet 4

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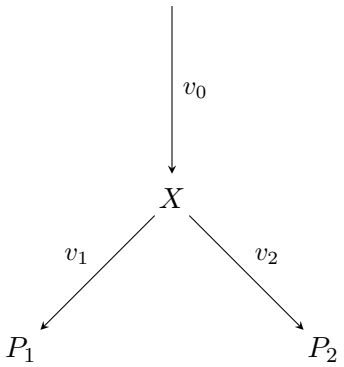
Exercise 1. *Tutorial*
Consider the following network:



The target fluxes are v_1 and v_2, the corresponding target metabolites are P_1 and P_2 with demand Γ_1 resp. Γ_2.
There exist two MGS (Minimal Gene Sets): $\chi_1 = \{g_0; g_1\}$ and $\chi_2 = \{g_0; g_2\}$.

- Which are the corresponding MFM (minimal flux modes)?
- What is the maximal number of different steady-states required to minimize the production time of the demanded output?
- How many possible strategies do we need to consider?
- Sketch the strategies.
- Assume that the kinetic parameters η are set to one: $\eta_j = 1$ for $j \in \{1, 2, 3\}$. Without loss of information we assume further that $\Gamma_1 = \tau v_1$ and $\Gamma_2 = \tau v_2$ and set $r := \frac{\Gamma_1}{\Gamma_2} = \frac{v_1}{v_2}$.
  Determine τ in dependence to the upper bounds of v_j and Γ_i for strategy A (only one flux) and B (two fluxes, each produces exactly one product).

- Determine τ for strategy A with the values of ub given by $ub_0 = 100\text{mol/h}$, $ub_1 = ub_2 = 10\text{mol/h}$ and and τ' for strategy B with the bounds given by $ub^1 = ub^2 = \frac{4}{3}ub$:
  1. $\Gamma_1 = \Gamma_2 = 50\text{mol}$
  2. $\Gamma_1 = 90\text{mol}$ and $\Gamma_2 = 10\text{mol}$

Exercise 2. *Homework*
Read the article of Covert, Schilling and Pallson about *Regulation of Gene Expression in Flux Balance Models of Metabolism* (doi:10.1006/jtbi.2001.2405), with special focus on a specific example:

1. EXAMPLE 1 – DIAUXIE ON TWO CARBON SOURCES
   Marthe & Balduin
2. EXAMPLE 2 – AEROBIC/ANAEROBIC DIAUXIE
   Marjan & Moritz
3. EXAMPLE 3 – GROWTH ON CARBON AND AMONI ACID WITH CARBON IN EXCESS
   David & Pascal