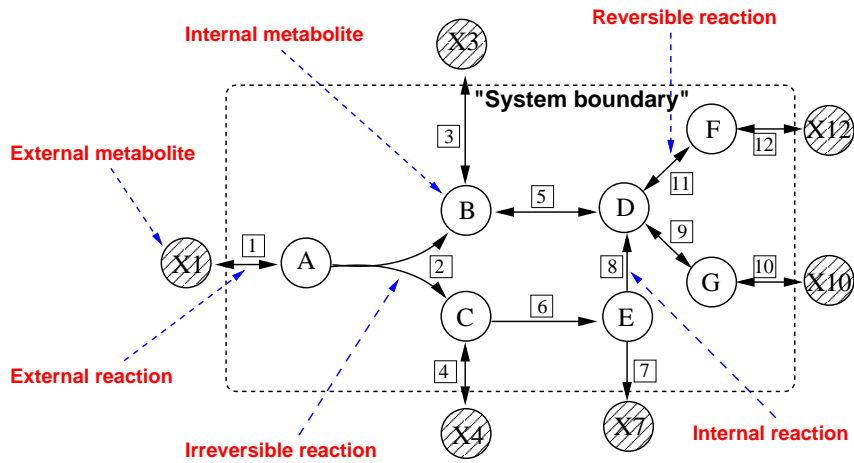
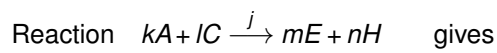


Application: Metabolic networks



Stoichiometric matrix

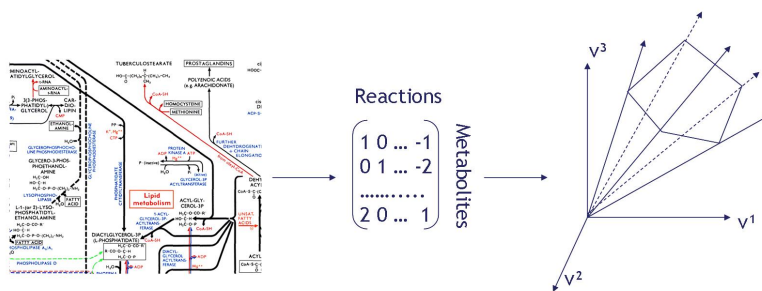
- Metabolites (internal) \rightsquigarrow rows
- Biochemical reactions \rightsquigarrow columns



$$\begin{matrix} A \\ B \\ C \\ D \\ E \\ F \\ G \\ H \end{matrix} \begin{pmatrix} \dots & -k & \dots \\ & 0 & \\ & -l & \\ & 0 & \\ & m & \\ & 0 & \\ & 0 & \\ \dots & n & \dots \end{pmatrix}$$

Flux cone

- Flux balance: $Sv = 0$
- Irreversibility of some reactions: $v_i \geq 0, i \in Irr$.
- Steady-state flux cone $C = \{v \in \mathbb{R}^n \mid Sv = 0, v_i \geq 0, \text{ for } i \in Irr\}$



Flux balance analysis

- Use linear programming to study flux distribution in a cell

$$\max \{c^T v \mid Sv = 0, v_{\min} \leq v \leq v_{\max}\}$$

- Objective function
 - Maximize biomass production
 - Maximize metabolite production (e.g. biofuel)
- Metabolic engineering