Models and Languages for Computational Systems Biology

Lecture 3: Net Invariants

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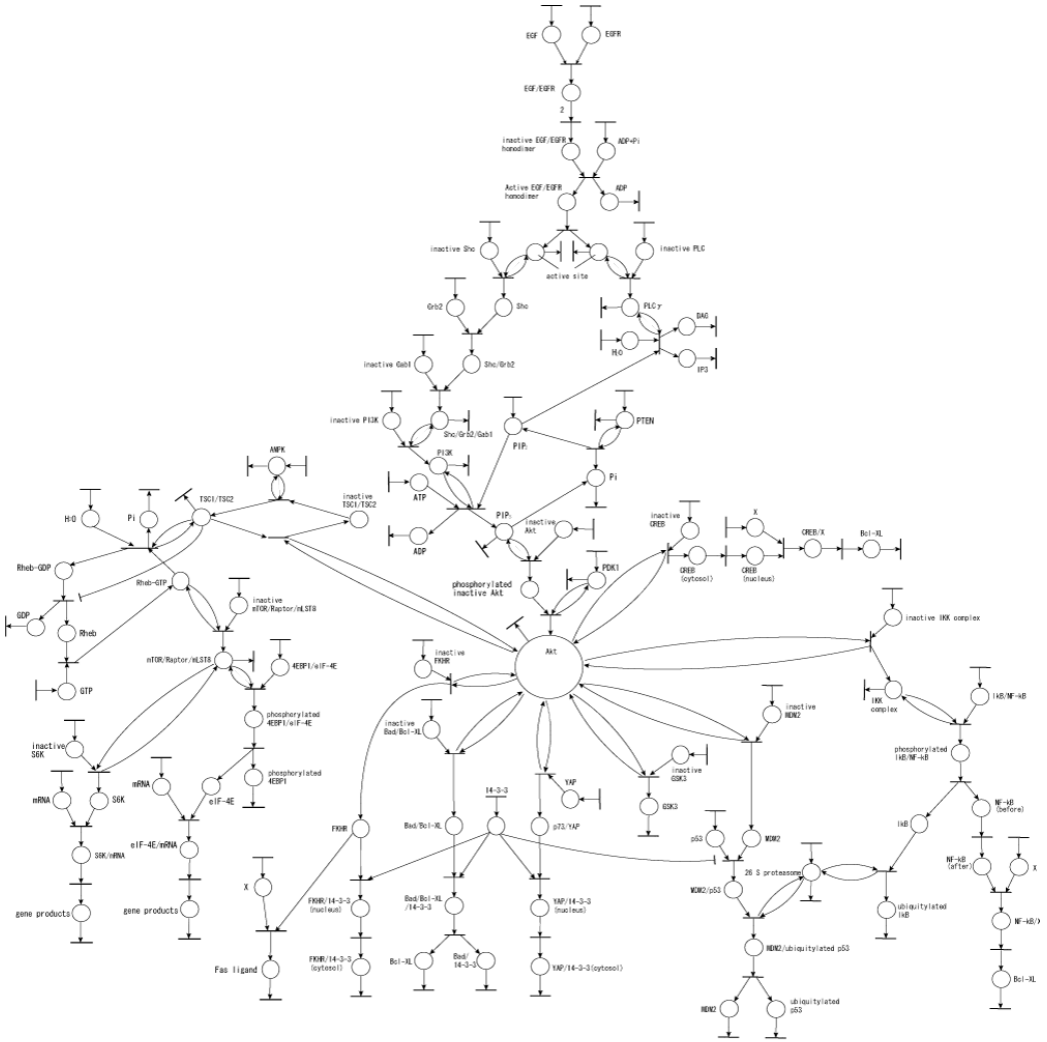
Semester 2 Week 2

Petri Nets for pathways

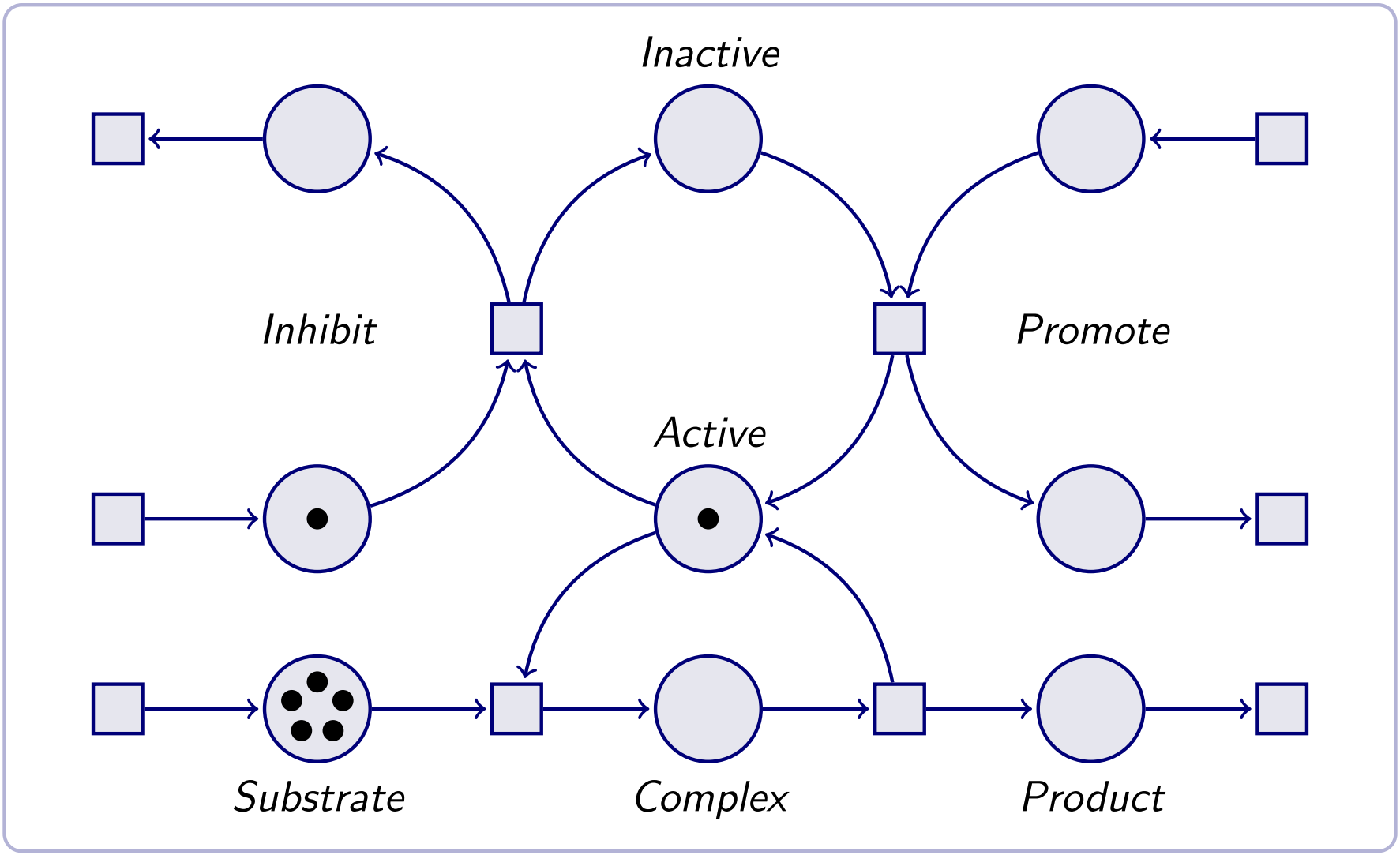


Epidermal Growth Factor (EGF) signalling from Petri Net Pathways

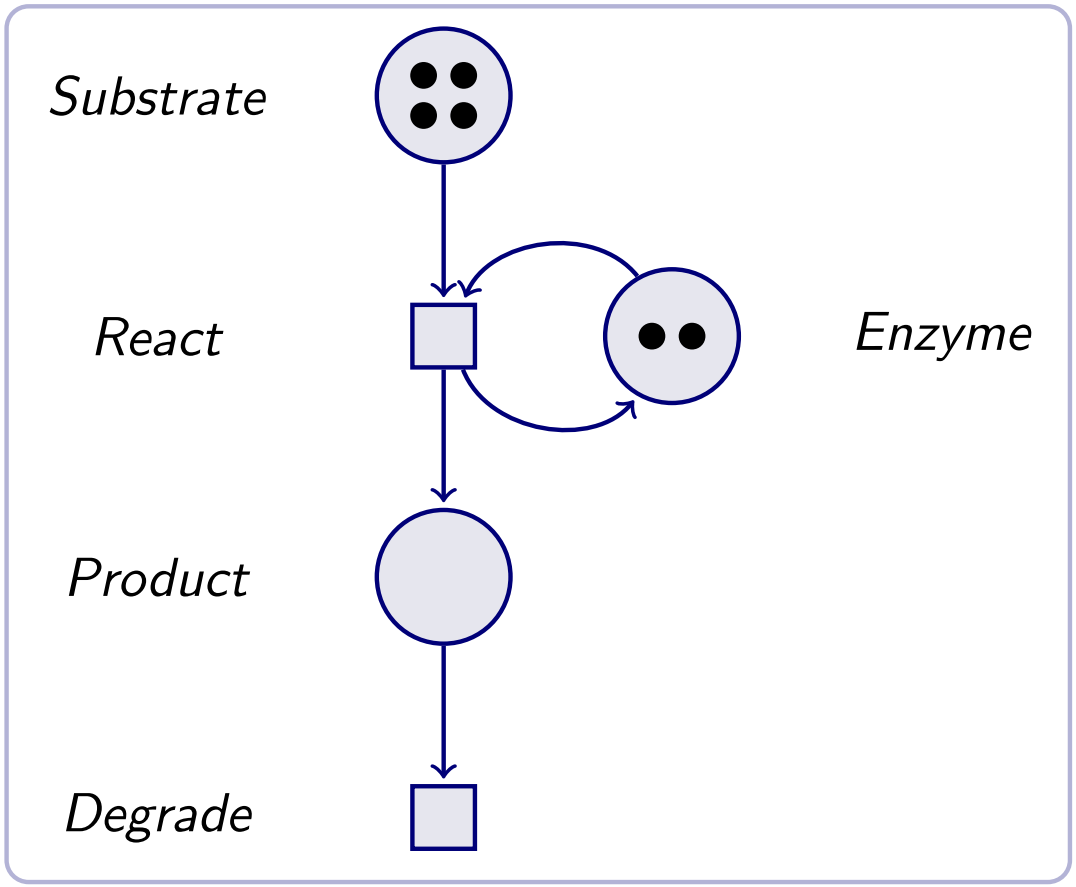
Petri Net animation

PIP2 hydrolysis from Petri Net Pathways

Petri Nets for small systems



Petri Net matrices



$$\mathrm{Pre} = \begin{array}{c} \begin{matrix} R & D \end{matrix} \\ \begin{pmatrix} 1 & 0 \\ 1 & 0 \\ 0 & 1 \end{pmatrix} \end{array} \begin{matrix} \textit{Substrate} \\ \textit{Enzyme} \\ \textit{Product} \end{matrix}$$

$$\mathrm{Post} = \begin{array}{c} \begin{matrix} R & D \end{matrix} \\ \begin{pmatrix} 0 & 0 \\ 1 & 0 \\ 1 & 0 \end{pmatrix} \end{array} \begin{matrix} \textit{Substrate} \\ \textit{Enzyme} \\ \textit{Product} \end{matrix}$$

$$\mathrm{M} = \begin{pmatrix} 4 \\ 2 \\ 0 \end{pmatrix} \begin{matrix} \textit{Substrate} \\ \textit{Enzyme} \\ \textit{Product} \end{matrix}$$

Reachability and Reversibility

Reachable States

A marking N is *reachable from* marking M if there is some sequence of transitions

$$M \xrightarrow{X_0} M_1 \xrightarrow{X_1} M_2 \ldots M_k \xrightarrow{X_k} N$$

A marking N is *reachable* in a particular net if it is reachable from the initial marking M_0.

Reversible Nets

A Petri net is *reversible* if the initial marking M_0 is itself reachable from every reachable marking.