

MPRI 2.19 Biochemical Programming

Rule-based Modeling **Introduction**

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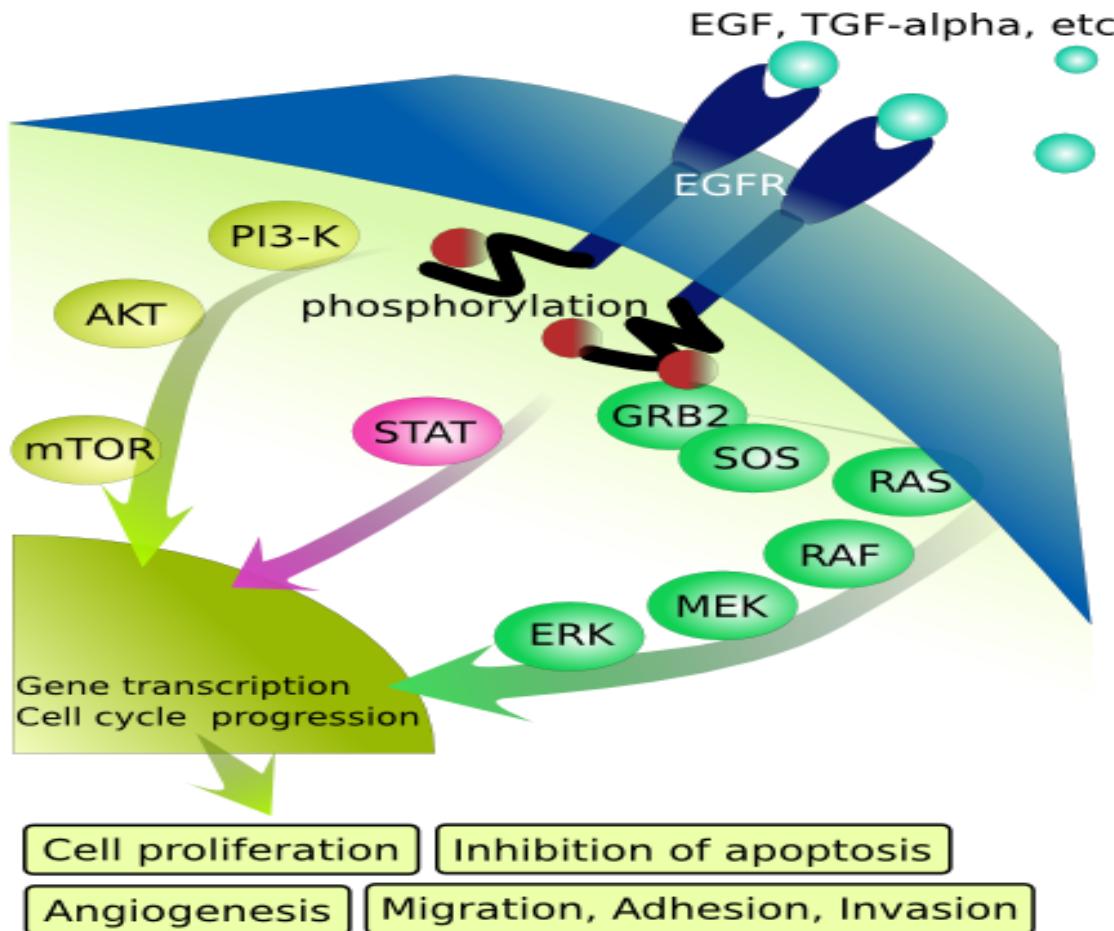
DIENS (ÉNS, CNRS, INRIA, PSL)



kappalanguage.org

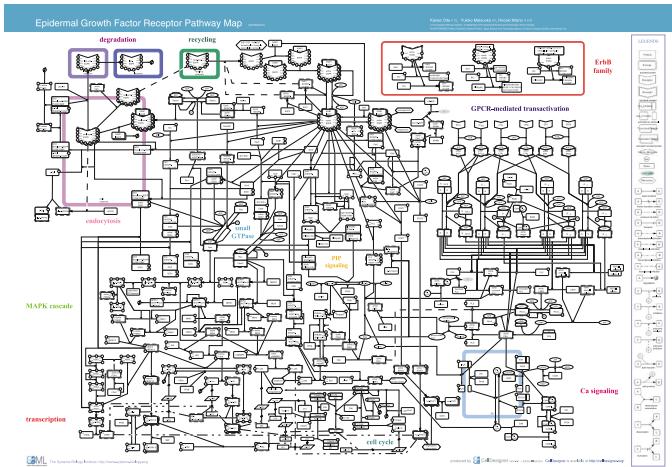
Monday, the 4th of December, 2023

Signalling Pathways



Eikuch, 2007

Bridging the gap between. . .



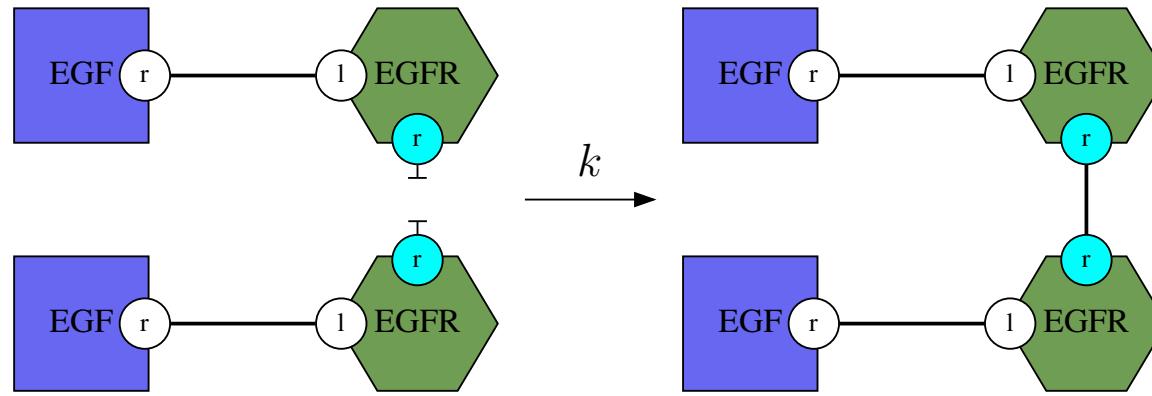
knowledge representation

and

models of the behaviour of systems

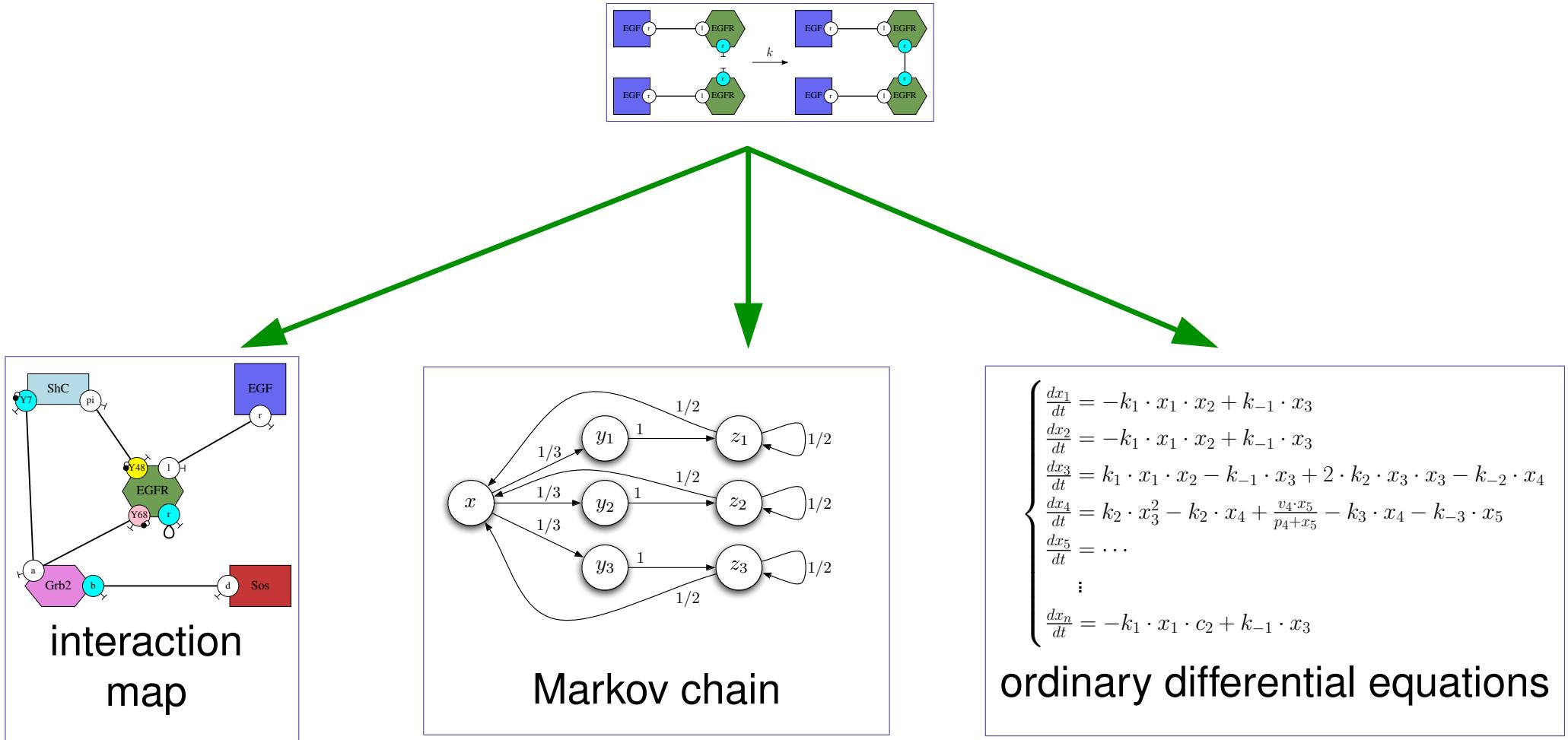
$$\left\{ \begin{array}{l} \frac{dx_1}{dt} = -k_1 \cdot x_1 \cdot x_2 + k_{-1} \cdot x_3 \\ \frac{dx_2}{dt} = -k_1 \cdot x_1 \cdot x_2 + k_{-1} \cdot x_3 \\ \frac{dx_3}{dt} = k_1 \cdot x_1 \cdot x_2 - k_{-1} \cdot x_3 + 2 \cdot k_2 \cdot x_3 \cdot x_3 - k_{-2} \cdot x_4 \\ \frac{dx_4}{dt} = k_2 \cdot x_3^2 - k_2 \cdot x_4 + \frac{v_4 \cdot x_5}{p_4 + x_5} - k_3 \cdot x_4 - k_{-3} \cdot x_5 \\ \frac{dx_5}{dt} = \dots \\ \vdots \\ \frac{dx_n}{dt} = -k_1 \cdot x_1 \cdot c_2 + k_{-1} \cdot x_3 \end{array} \right.$$

Site-graphs rewriting

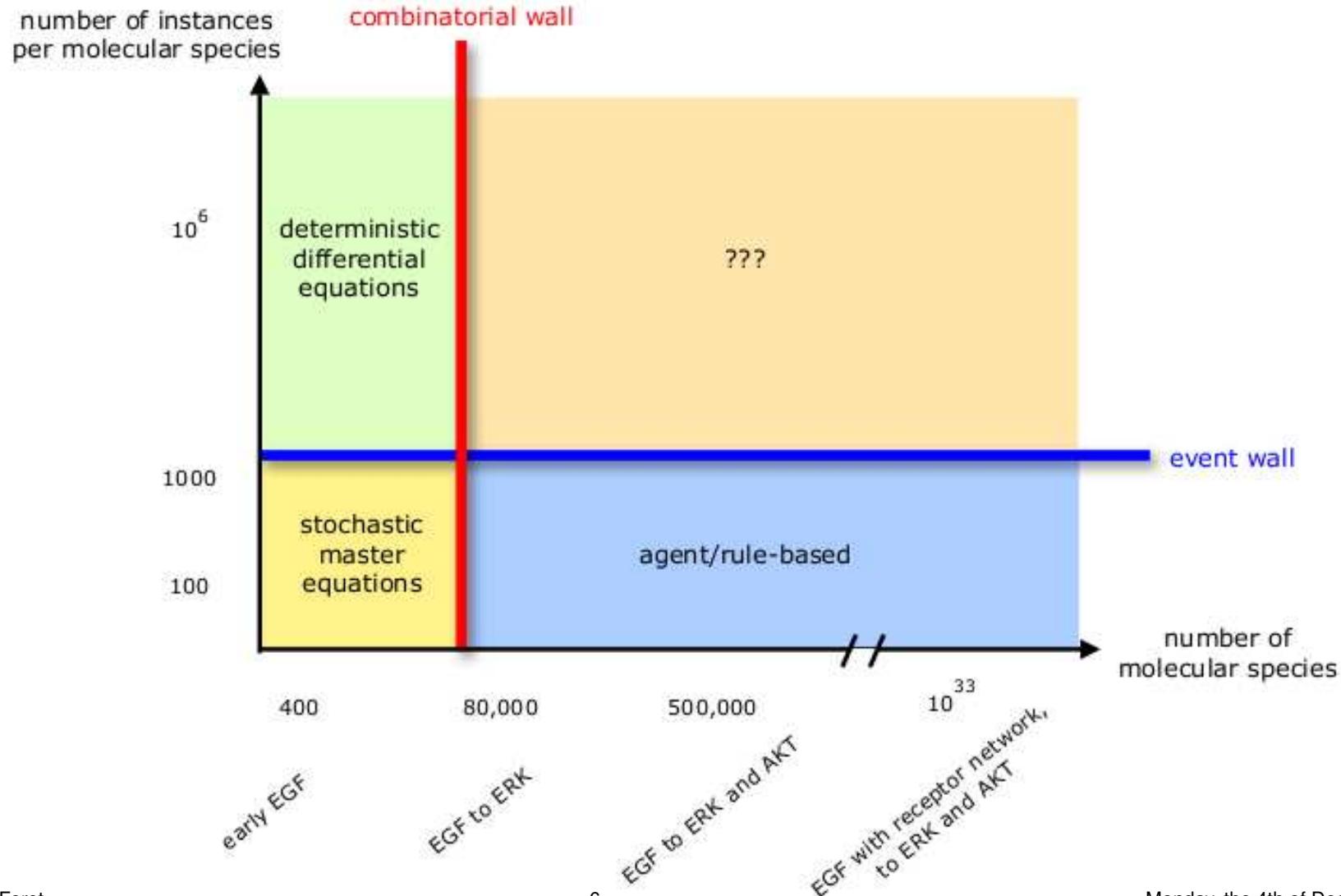


- a language close to knowledge representation;
- rules are easy to update;
- a compact description of models.

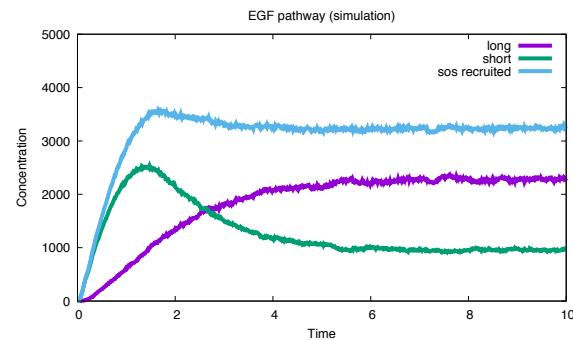
Choices of semantics



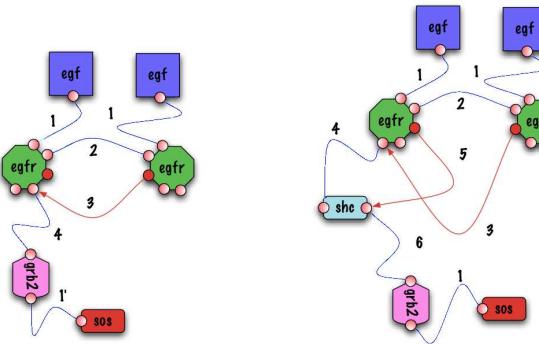
Complexity walls



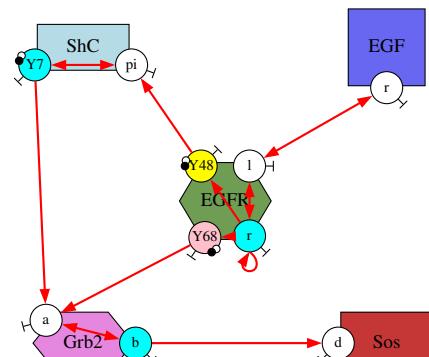
Abstractions offer different perspectives on models



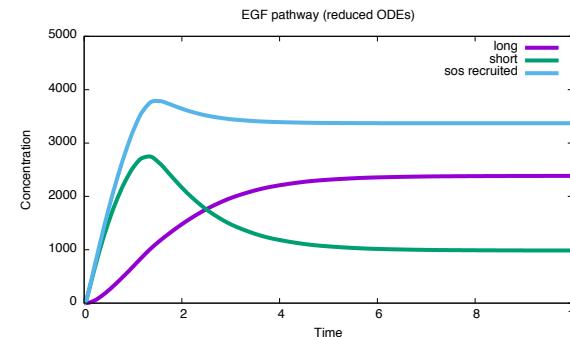
concrete semantics



causal traces



information flow



exact projection
of the ODE semantics