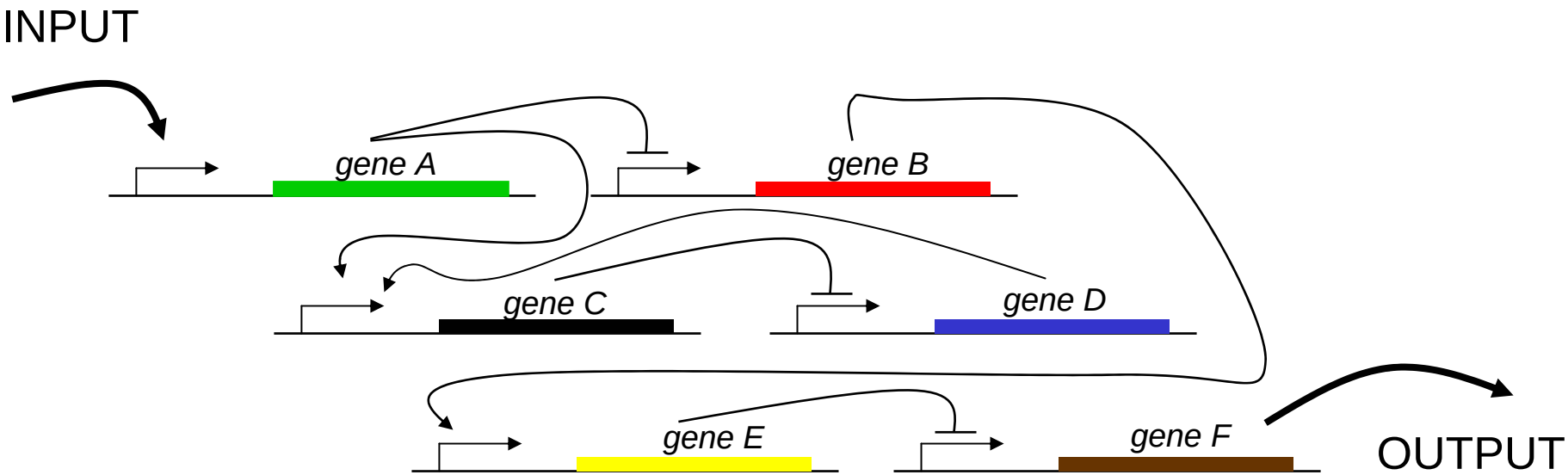
Systems Biology ?

Systems Biology ≈ Network Biology

GOAL: develop a quantitative understanding of the biological function of genetic and biochemical networks



- function of gene product A-F can be known in detail but this is not sufficient to reveal the biological function of the INPUT-OUTPUT relation
- a system approach (looking beyond one gene/protein) is necessary to reveal the biological function of this whole network
- what is the function of the individual interactions (feedbacks and feedforwards) in the context of the entire network ?

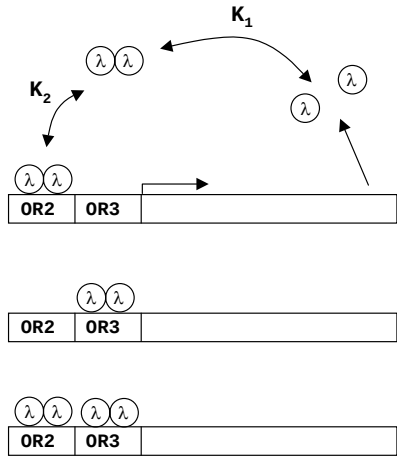
Alternatively,

Systems Engineering + Molecular Biology

Systems Engineering Molecular Biology

Systems Biology = Applying Systems Engineering concepts to Biological Systems

molecular biology vs systems biology

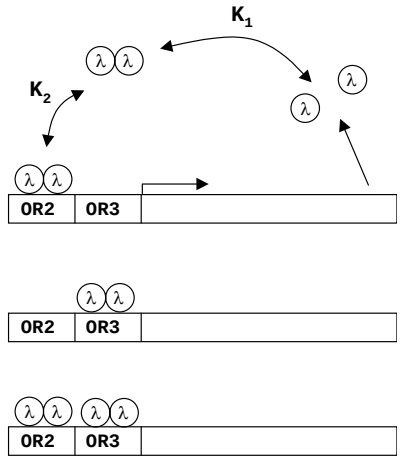


A traditional molecular biologist would ask:

- what is the molecular structure of the cI dimer ?
- what is DNA sequence recognized by the cI dimer ?
- what are the essential amino acids in cI responsible for dimerization ?
- what are the values for K_1 and K_2 ?
- is the sequence conversed during evolution ?

Focussed on the molecule cI.

molecular biology vs systems biology



A systems biologist would ask:

- what is the functional role of the feedback ?
- how can this lead to a hysteretic switch ?
- what is the role of noise in determining the stability of the switch ?
- is the performance of the switch sensitive to small changes in the parameters (fine-tuned) of not (robust).
- how are these parameters changed when this module is cross-talking to other modules.

Focussed on the network architecture.

Goal of this course:

- provide you with the essential mathematical tools to be able to model network modules, such as biological switches, oscillators, filters, amplifiers, etc.

- provide you with lots of example of biological problems that can be successfully tackled with a systems biology approach (first well-stirred systems, second diffusion-dominated systems) by discussing recent recent papers.