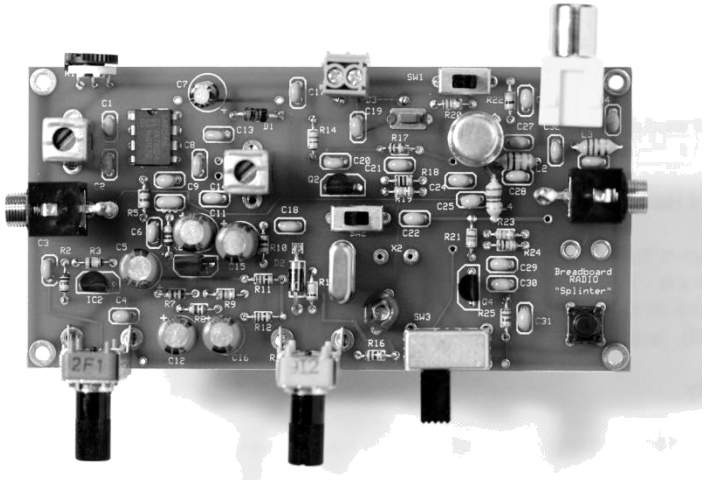


Modeling Molecular Processes in Cell

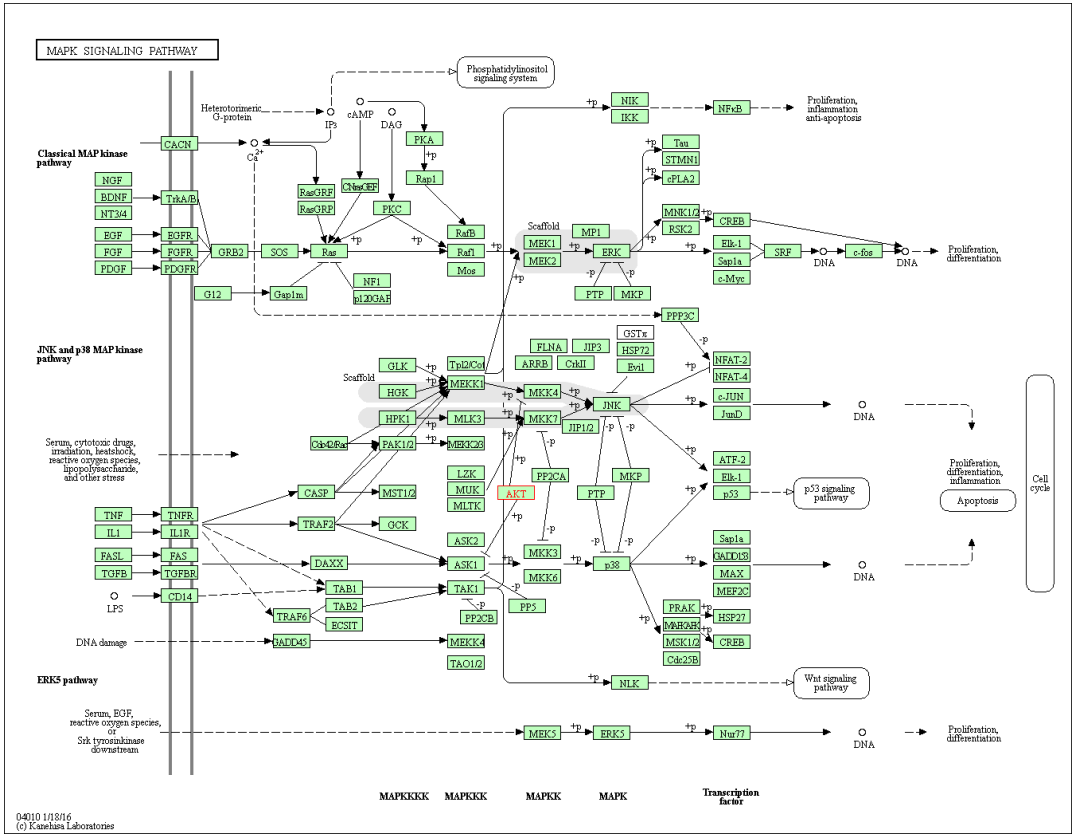
Biological molecular networks

1. Involves large number of molecules

2. Involves various types of processes

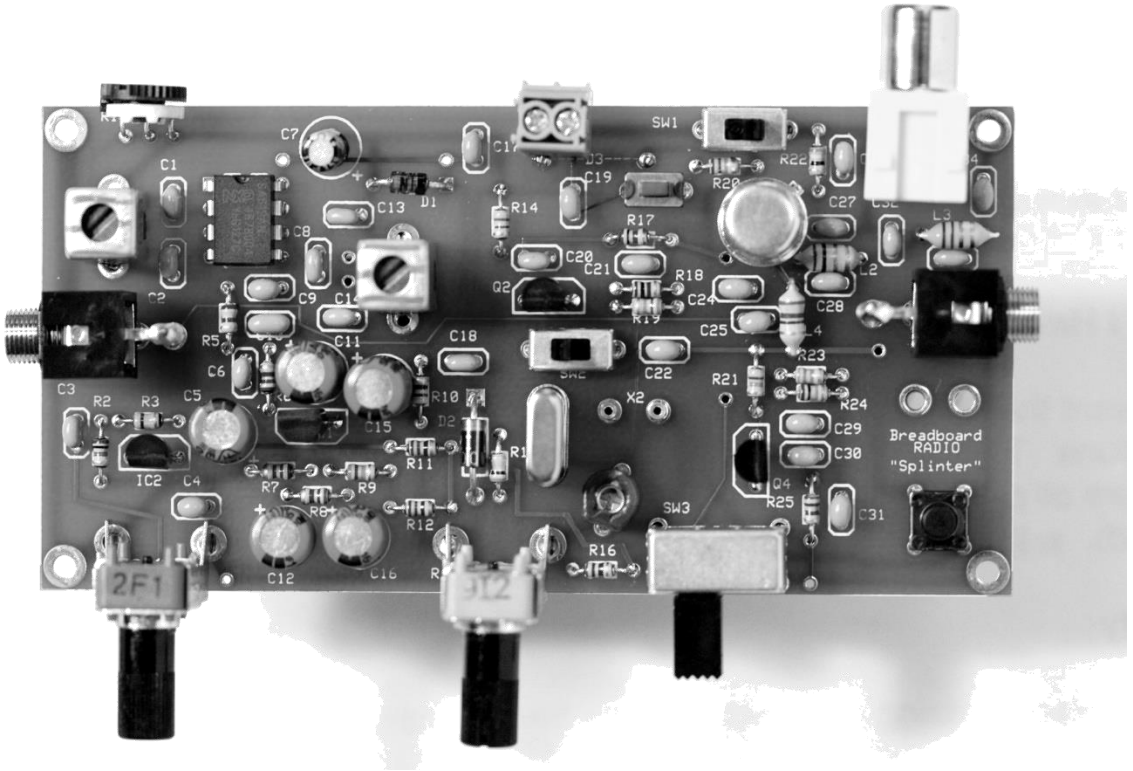
3. Difficult to collect information on dynamics of all the molecules by experiments

4. Difficult to estimate kinetic parameters and other quantitative information of all the molecules and processes



Building blocks for large network

A large complicated electronic circuit can be broken down into small parts having independent functions



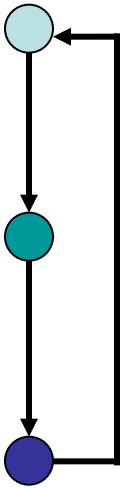
Network Motifs

A large network can be broken down in sub-networks or **motifs** involving a few molecular processes.

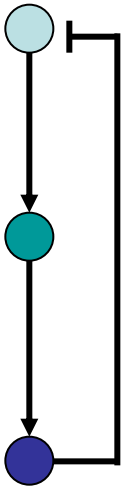
Such sub-networks occurs repeatedly and connect with each others to create a large network.

Each such sub-network has certain characteristic dynamical properties and functions

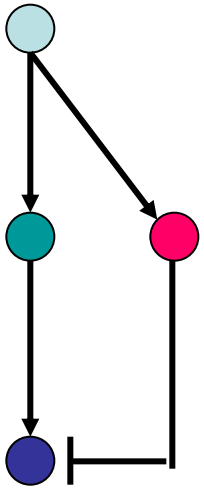
Common Network Motifs



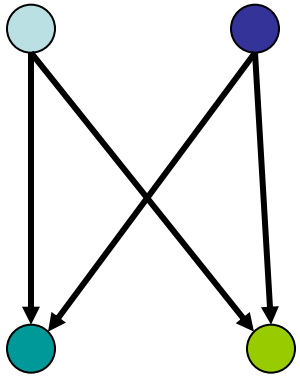
Positive Feedback



Negative Feedback

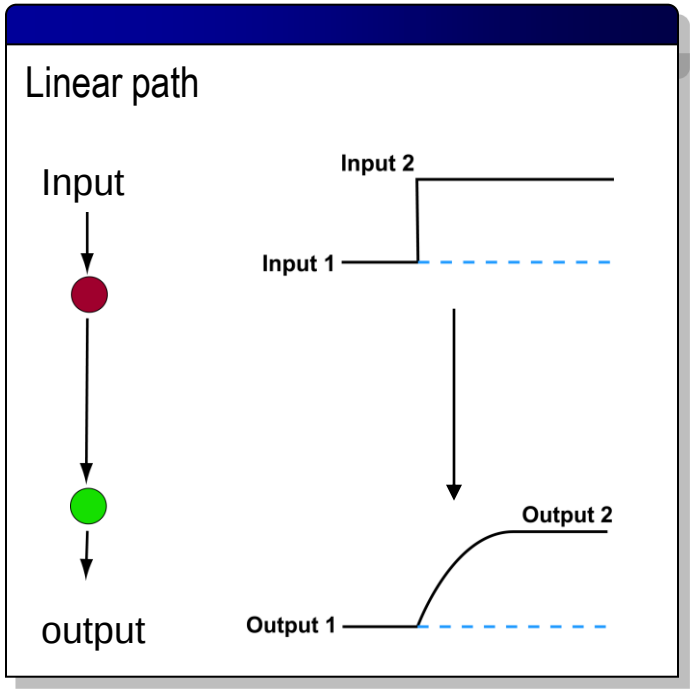


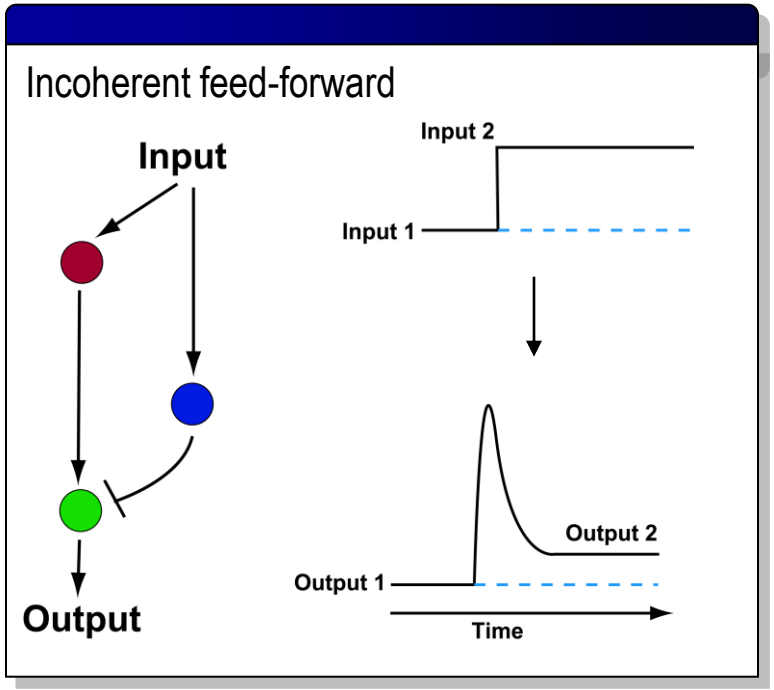
Incoherent feed-forward



Bi-fan

Network motif: Specific dynamics





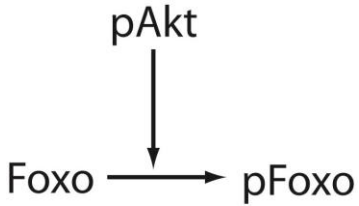
Elementary process

A large molecular network or a network motif can be broken down into multiple elementary processes.

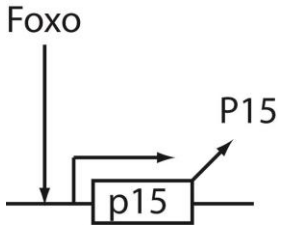
For example:

Ligand-receptor interaction: $EGF + EGFR \rightleftharpoons EGF\text{-}EGFR$

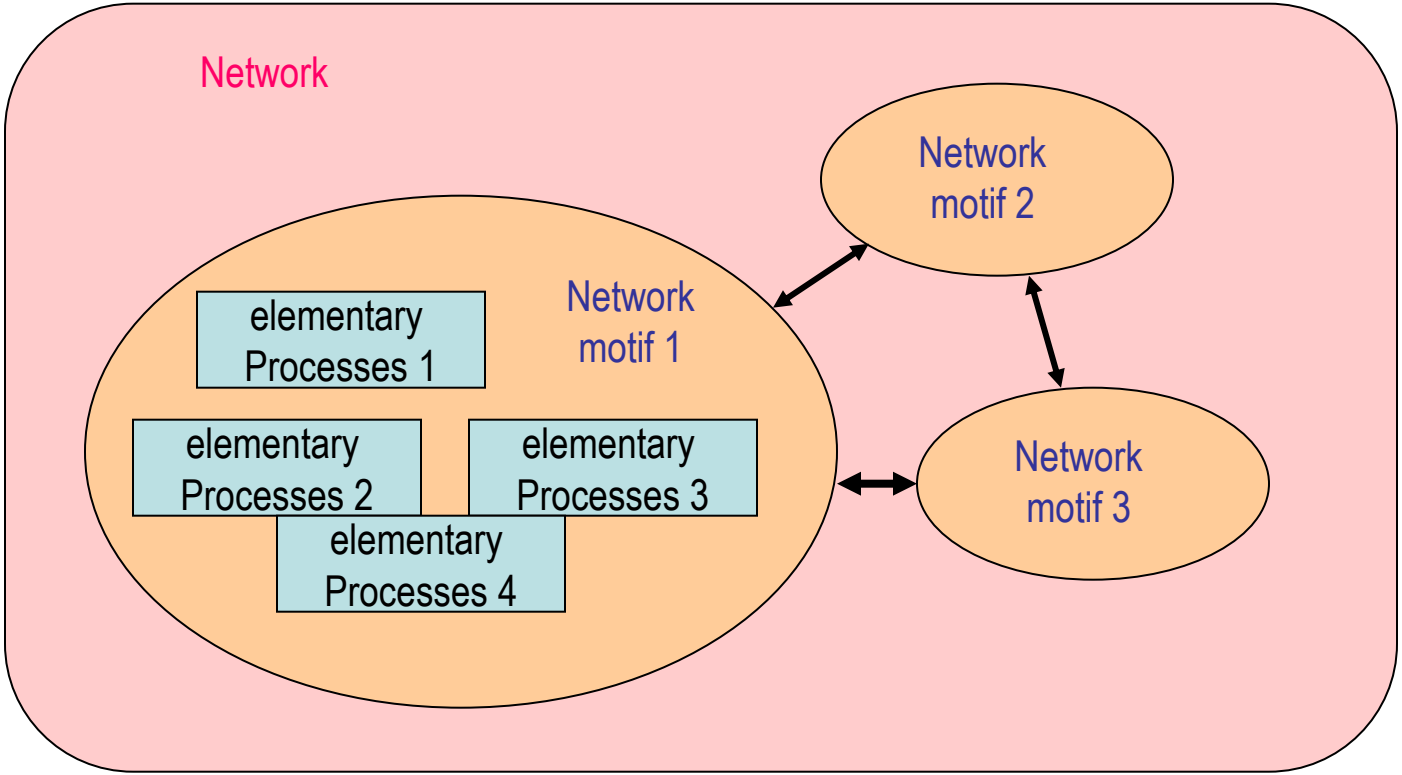
Enzymatic reaction:



Transcription:



Hierarchical structure of molecular networks



Key points:

1. A large molecular network controlling a cellular process involves large number of molecules and processes.
2. It is often difficult to study such large network as it is.
3. Recurring small sub-networks with specific dynamics and functions are called network motifs
4. A large network can be broken down into number of network motifs.
5. A network motif is made up of a few elementary processes.