BST281: Genomic Data Manipulation, Spring 2019

Monday 05: Introduction to Biological Networks

Sign up for midterm journal clubs!

 Email instructional team, groups of 2-5, 20+5min presentations

# Biological networks

A network or graph is collection of entities (nodes or vertices) and their relationships/interactions (edges).

 Used in biology to describe "parts lists" and their interactions, provides a flexible model of diverse systems.

## Biological network examples

Protein-protein interaction (physical binding) networks (PPIs).

Transcription factor (TF) to target gene (TG) regulatory networks.

Genetic interaction networks of epistatic relationships (synthetic lethality or rescue).

Ecological networks, evolutionary networks (trees are graphs), ontological relationships.

Can capture structural, regulatory, evolutionary, other molecular or higher-order relationships.

## Network properties

Networks can be:

 Directed or undirected, weighted or unweighted, cyclic or acyclic.

 Scale-free (power-law degree distribution, small diameter), small-world.

Nodes can be annotated with:

 Degree (incident edges, in or out), hubs (high degree nodes), betweenness, information flow, others.

Edges can be annotated with direction, sign, weight, others.

Groups of related nodes called modules, clusters, or communities represent complexes / pathways / etc.

 Motifs are recurring patterns of relationships that represent specific functional behaviors.

## Network data

BioGRID, IntAct, MINT, others.

Can be organized with tools like NetworkX, Cytoscape.

# Textbooks

Network analyses: Pevsner, Chapter 14 p670-685

Protein networks: Lesk, Chapter 11 p341-350, p361-365

# Literature

[Jeong H, Tombor B, Albert R, Oltvai ZN, Barabasi AL. "The large-scale organization of metabolic networks." Nature. 2000 Oct 5;407(6804):651-4](https://www.ncbi.nlm.nih.gov/pubmed/11034217)

[Shen-Orr SS, Milo R, Mangan S, Alon U. "Network motifs in the transcriptional regulation network of Escherichia coli." Nat Genet. 2002 May;31(1):64-8. Epub 2002 Apr 22](https://www.ncbi.nlm.nih.gov/pubmed/11967538)

[Girvan M, Newman ME. "Community structure in social and biological networks." PNAS. 2002 Jun 11;99(12):7821-6](https://www.ncbi.nlm.nih.gov/pubmed/12060727)