Overview of Networks
What is a Graph or Network?

A set of objects (nodes) with certain pairs connected by links (edges).
Technological Networks

The ARPANET, 1970

Nodes are computers or computer routers
Edges are cables linking the 13 computers

Easley and Kleinberg (2010)
Technological Networks
The Internet in 1998

Nodes are computers or computer routers
Edges are cables or optical fiber lines linking the computers

Technological Networks

The World Wide Web

Internet

Interconnected computers
Massive network of networks

World Wide Web

One service that runs on the internet
System of interlinked hypertext documents

Nodes are the web pages
Edges are the hyperlinks
Technological Networks

A flight path network

Nodes indicate airports
Edges indicate connecting flights
Social Networks

Pattern of friendships among members of a karate club

Nodes indicate individuals
Edges indicate friendships

Zachery (1977)
Social Networks

Political blogs prior to 2004 U.S. presidential election. There are clearly two node clusters corresponding to Democrats and Republicans.

Nodes indicate blogs
Edges indicate links between blogs

Easley and Kleinberg (2010)
Social Networks Amplified by the WWW

APAC = Asia-Pacific
MEA = Middle East and Africa
Biological Networks
A (directed) food chain network

Nodes indicate species
Directed edge indicates that the target species depends on the other species
Biological Networks
A (directed) biological neural network

Nodes indicate neurons or neural populations
Directed edge indicates that one neuron’s activity affects that of the target
Biological Networks
A (directed) synthetic neural network

Nodes sum the input from earlier layers
Directed edge is weighted and provides input to target vertices
Biochemical Networks

A (directed) gene transcription network

Nodes indicate proteins
Directed edge indicates that one protein regulates the transcription of the target protein
Biochemical Networks

A (directed) metabolic network

Nodes indicate molecules called metabolites
Directed edges indicate the conversion of metabolites to other metabolites
Biochemical Networks

A protein-protein interaction network

Nodes indicate proteins
Edges indicate that the connected proteins bind together and modify behavior
Epidemic Networks

A network for the spread of tuberculosis

Nodes indicate infected individuals

Edges indicate that infection spread between individuals
The End