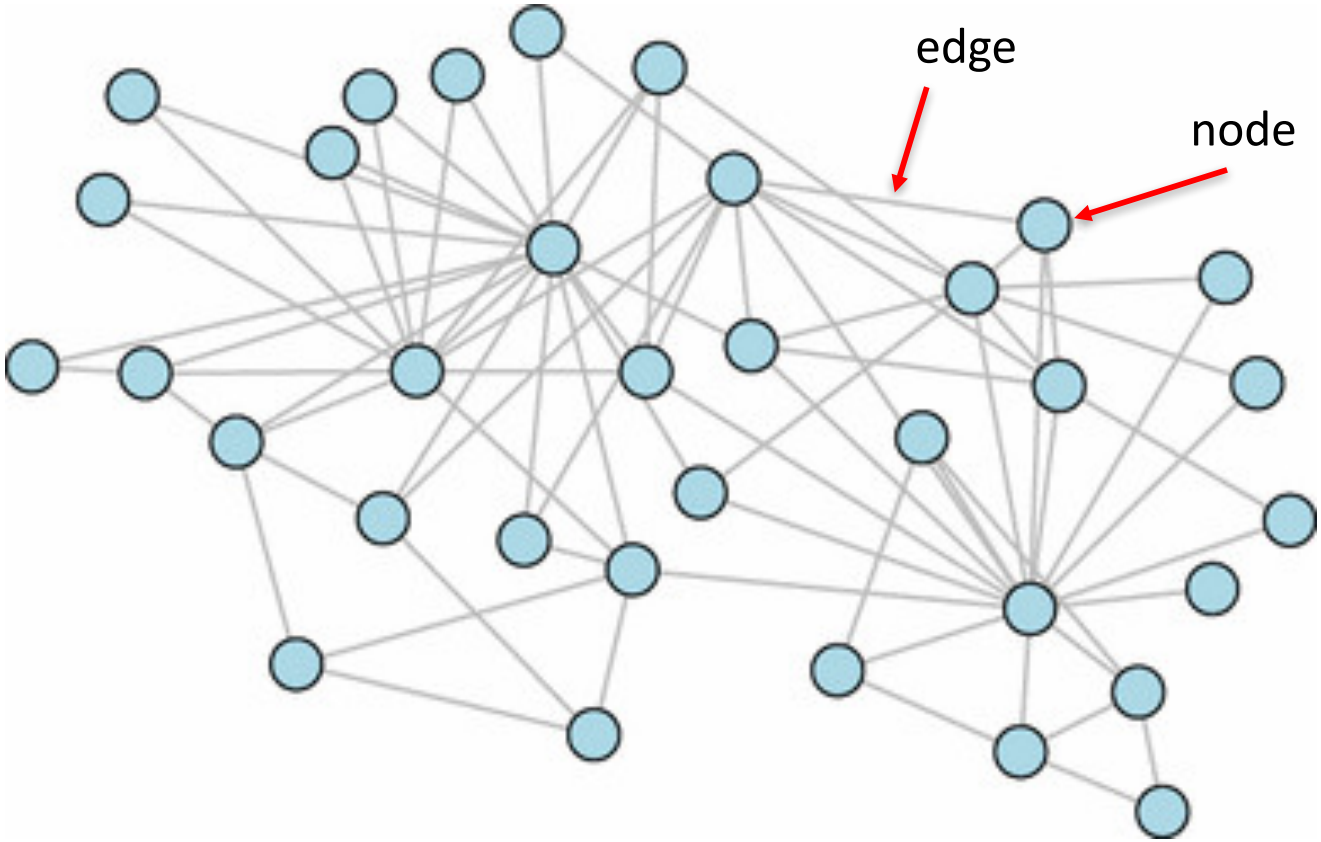
Overview of Networks

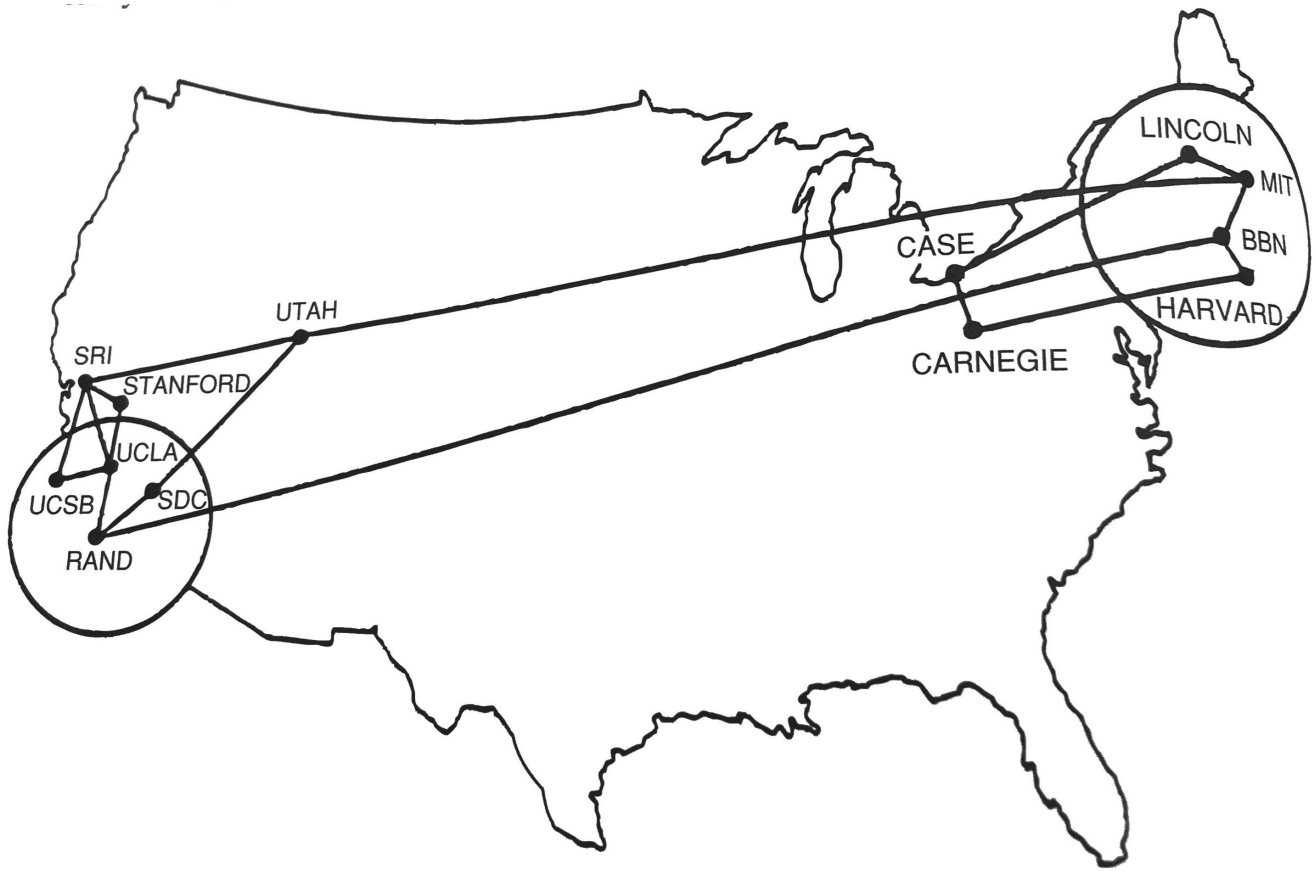
What is a Graph or Network?

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



Technological Networks

The ARPANET, 1970

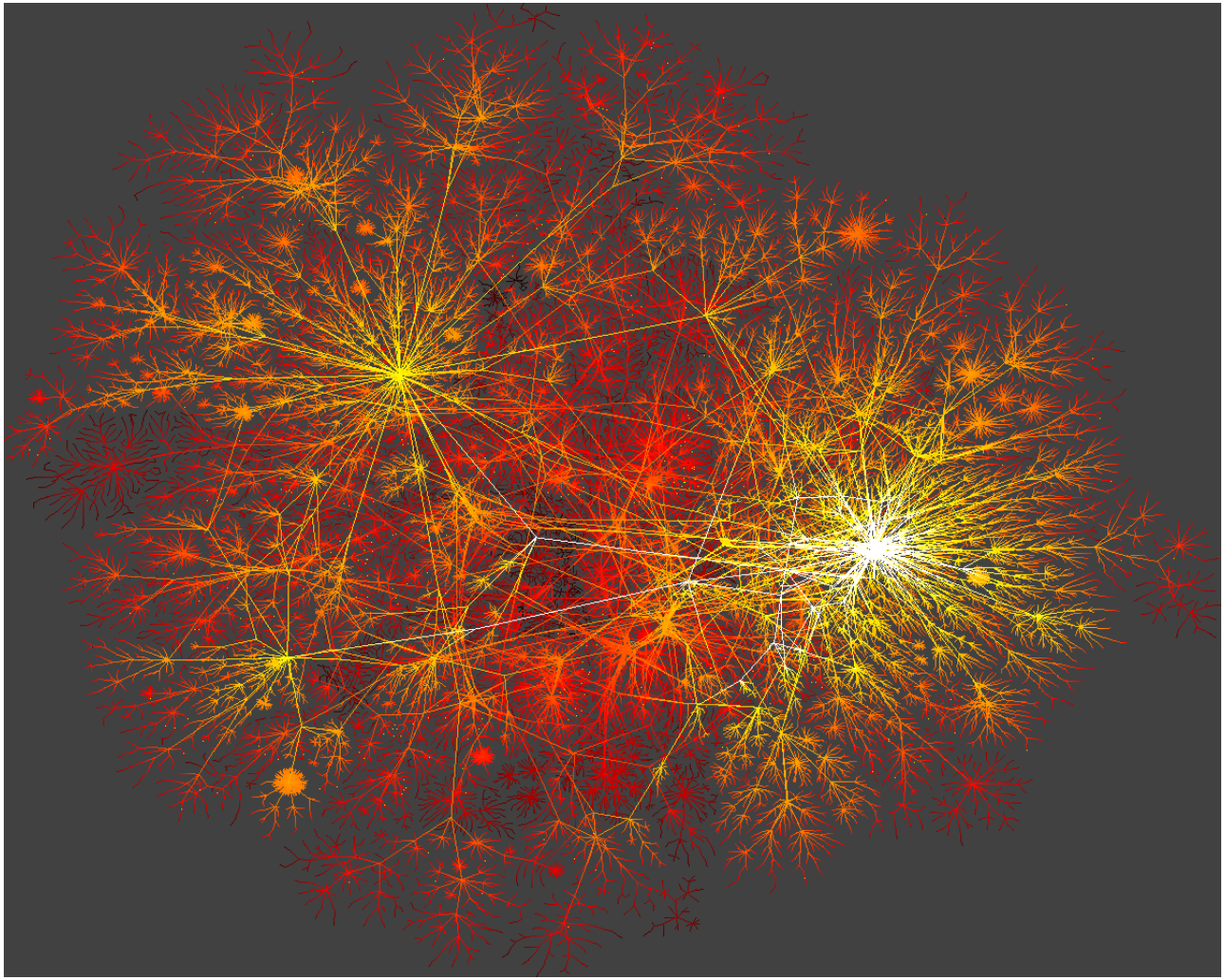


Easley and Kleinberg (2010)

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

Technological Networks

The Internet in 1998



CAIDA Annual Report (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

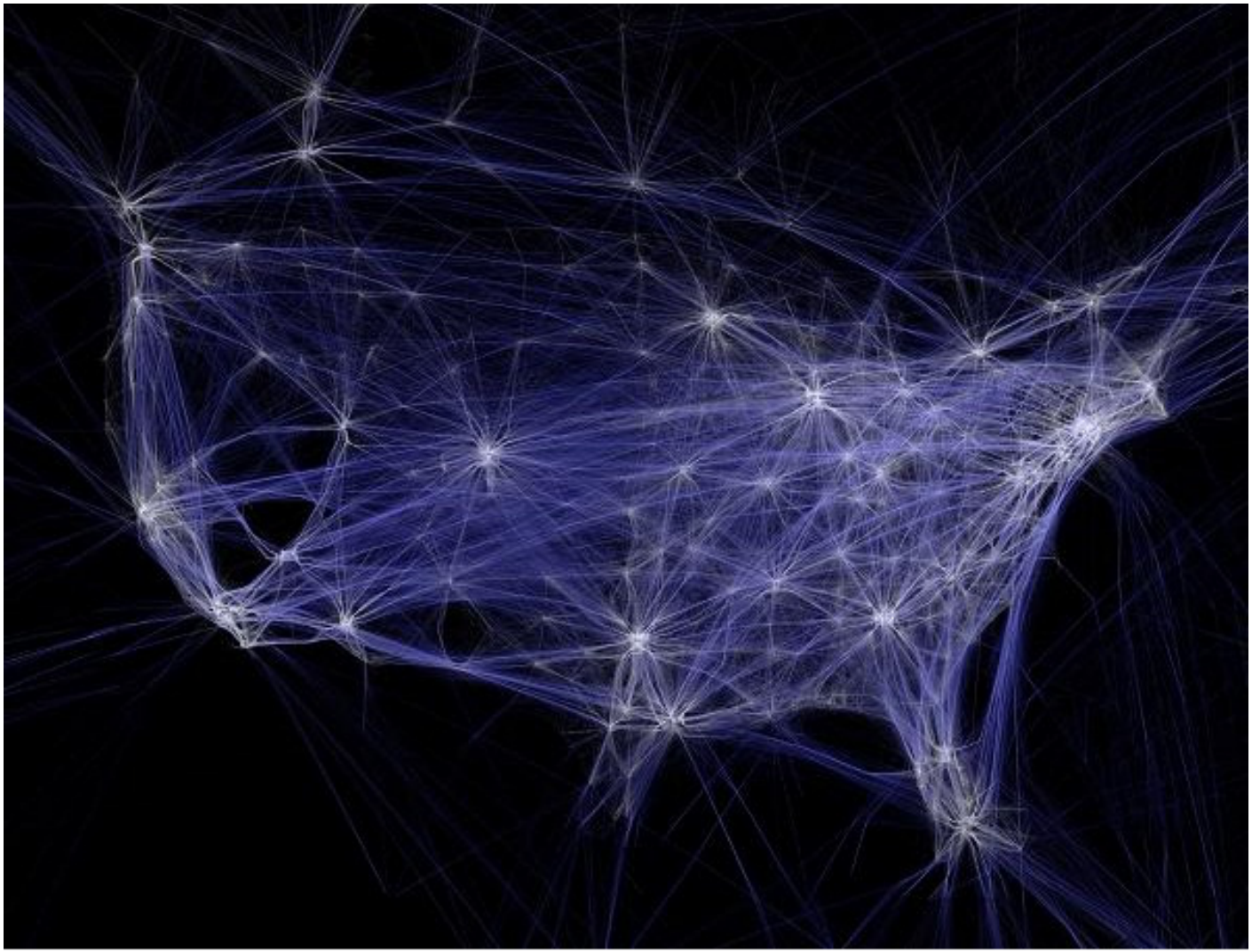
World Wide Web

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

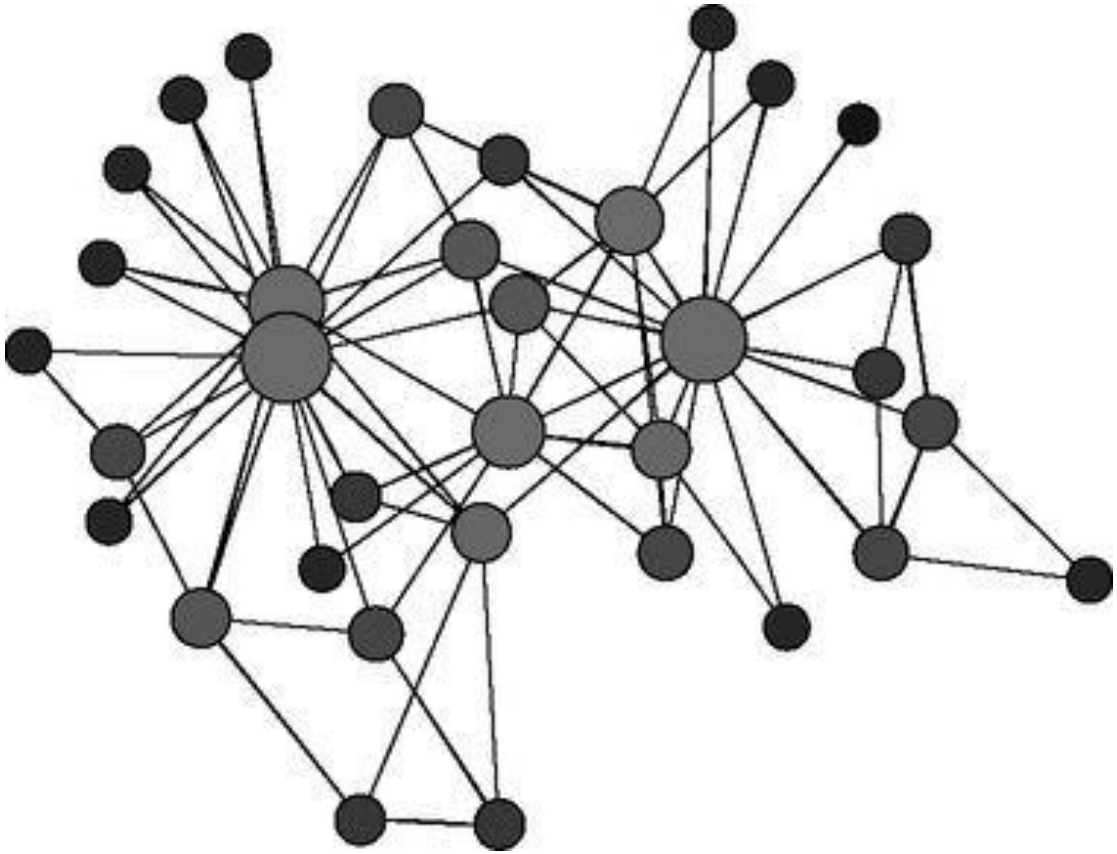


Nodes indicate airports

Edges indicate connecting flights

Social Networks

Pattern of friendships among members of a karate club

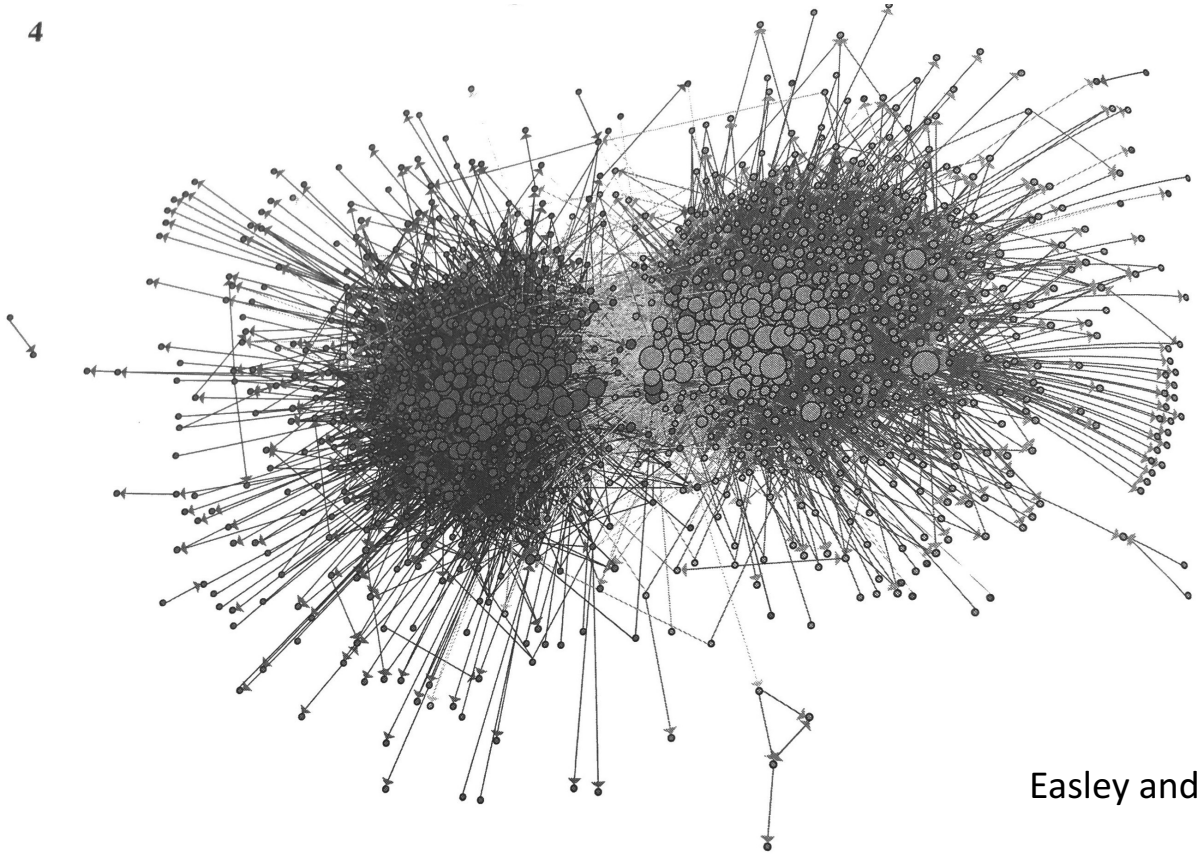


Nodes indicate individuals
Edges indicate friendships

Zachery (1977)

Social Networks

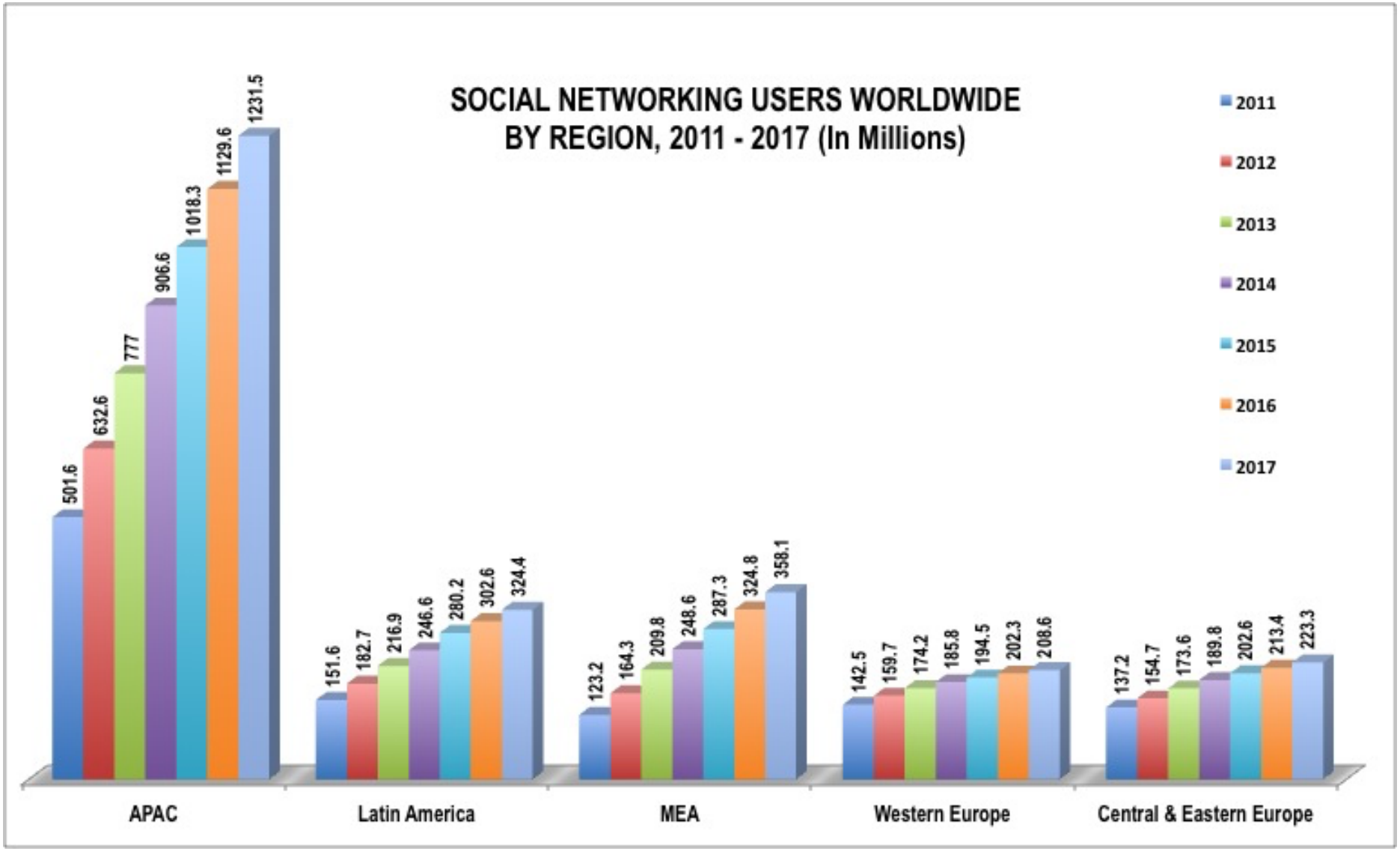
Political blogs prior to 2004 U.S. presidential election. There are clearly two node clusters corresponding to Democrats and Republicans



Easley and Kleinberg (2010)

Nodes indicate blogs
Edges indicate links between blogs

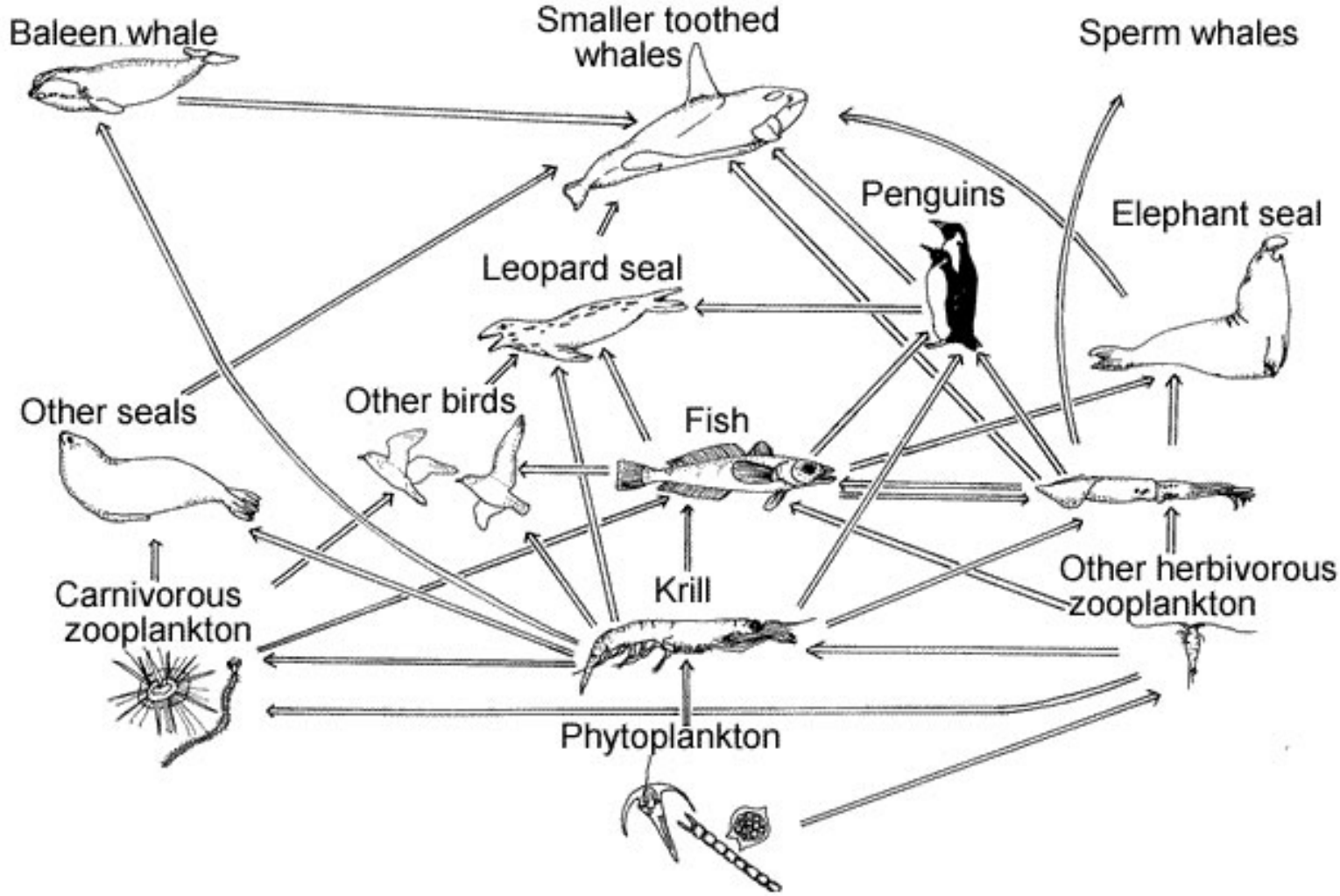
Social Networks Amplified by the WWW



APAC = Asia-Pacific
MEA = Middle East and Africa

Biological Networks

A (directed) food chain network

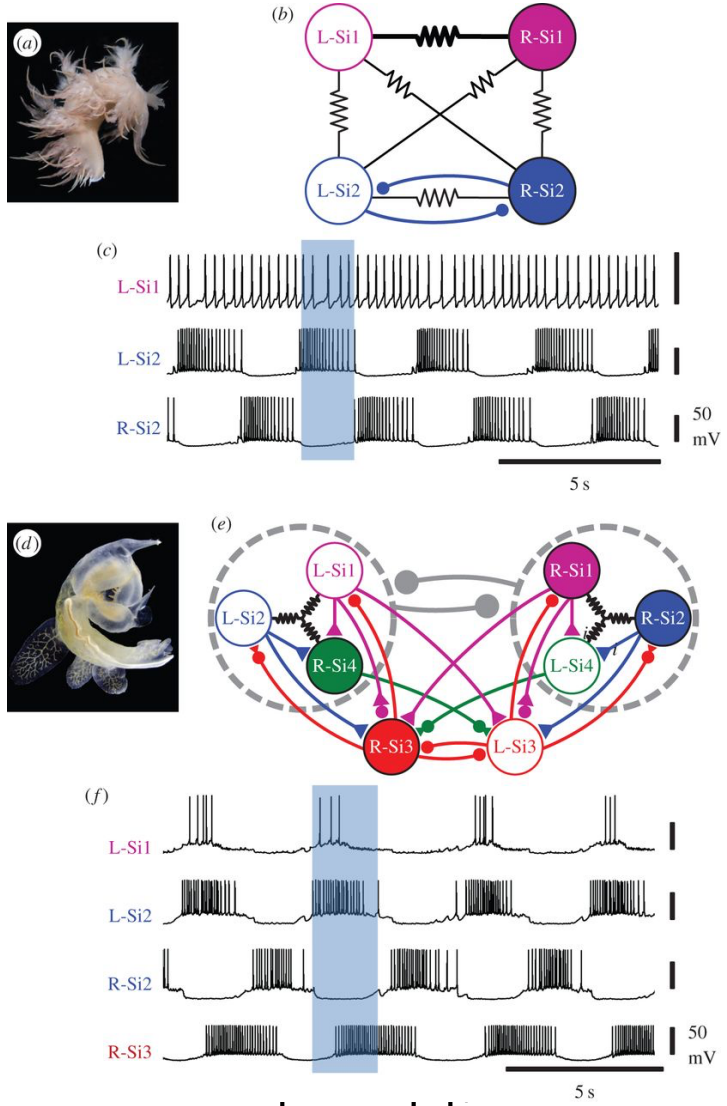


Nodes indicate species

Directed edge indicates that the target species depends on the other species

Biological Networks

A (directed) biological neural network

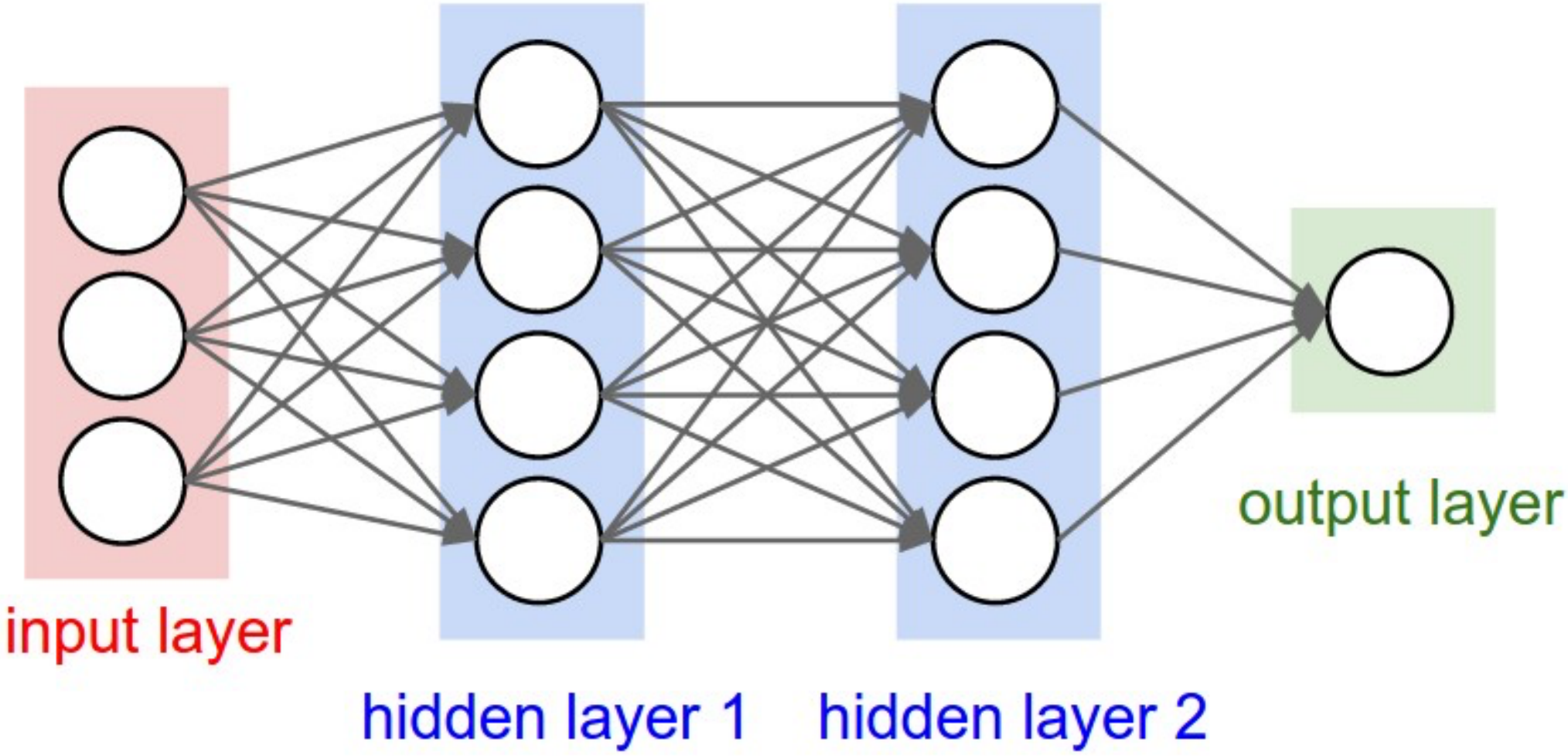


Nodes indicate neurons or neural populations

Directed edge indicates that one neuron's activity affects that of the target

Biological Networks

A (directed) synthetic neural network



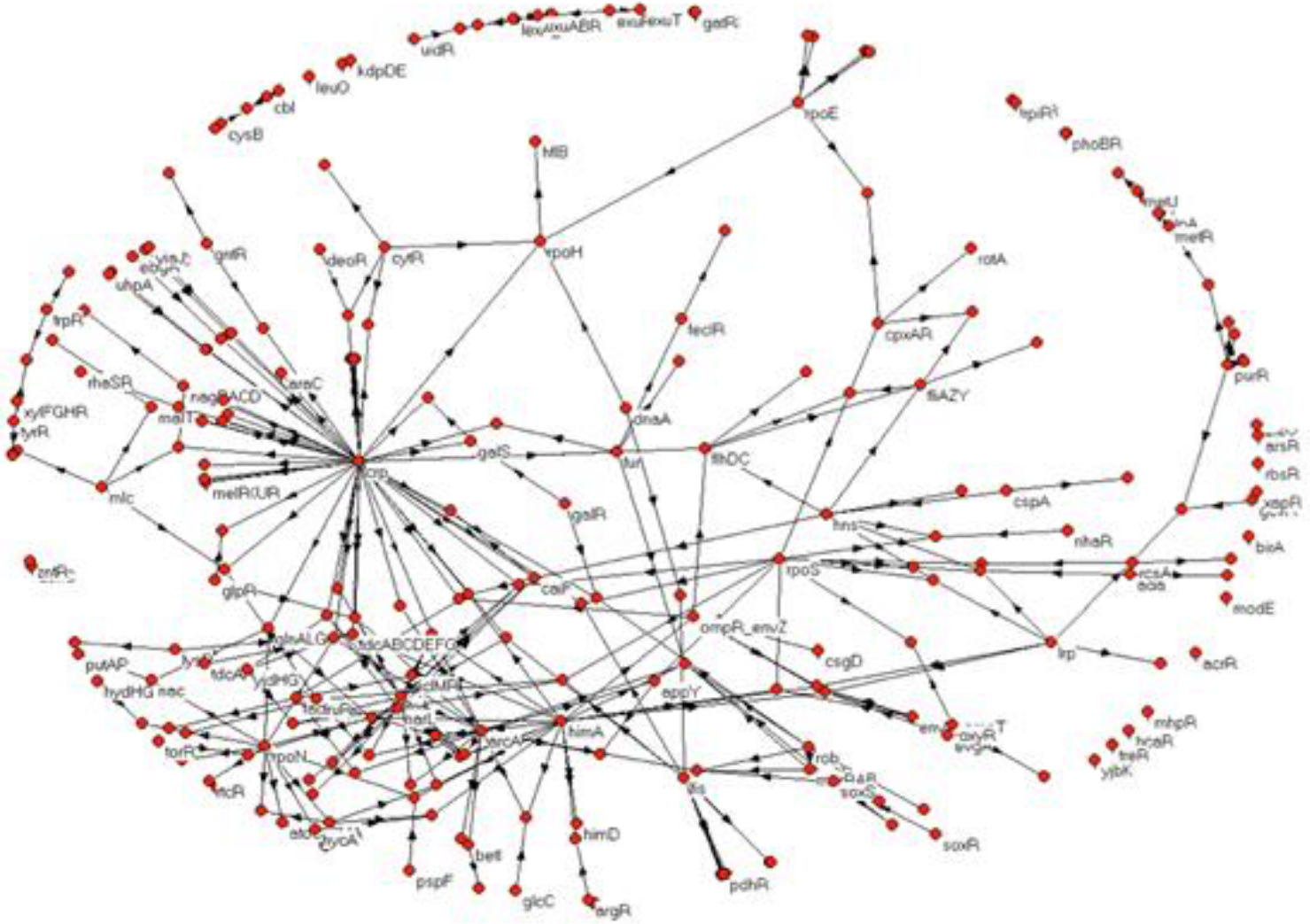
Nodes sum the input from earlier layers

Directed edge is weighted and provides input to target vertices

Biochemical Networks

Louis (2011)

A (directed) gene transcription network

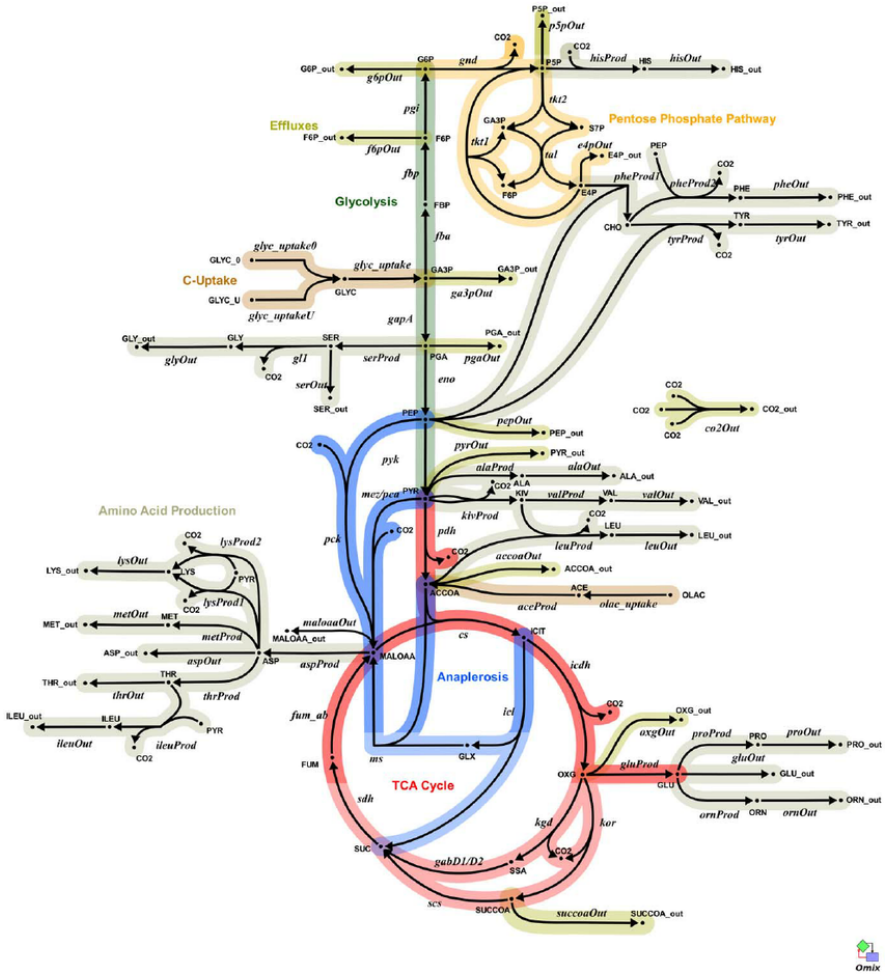


Nodes indicate proteins

Directed edge indicates that one protein regulates the transcription of the target protein

Biochemical Networks

A (directed) metabolic network

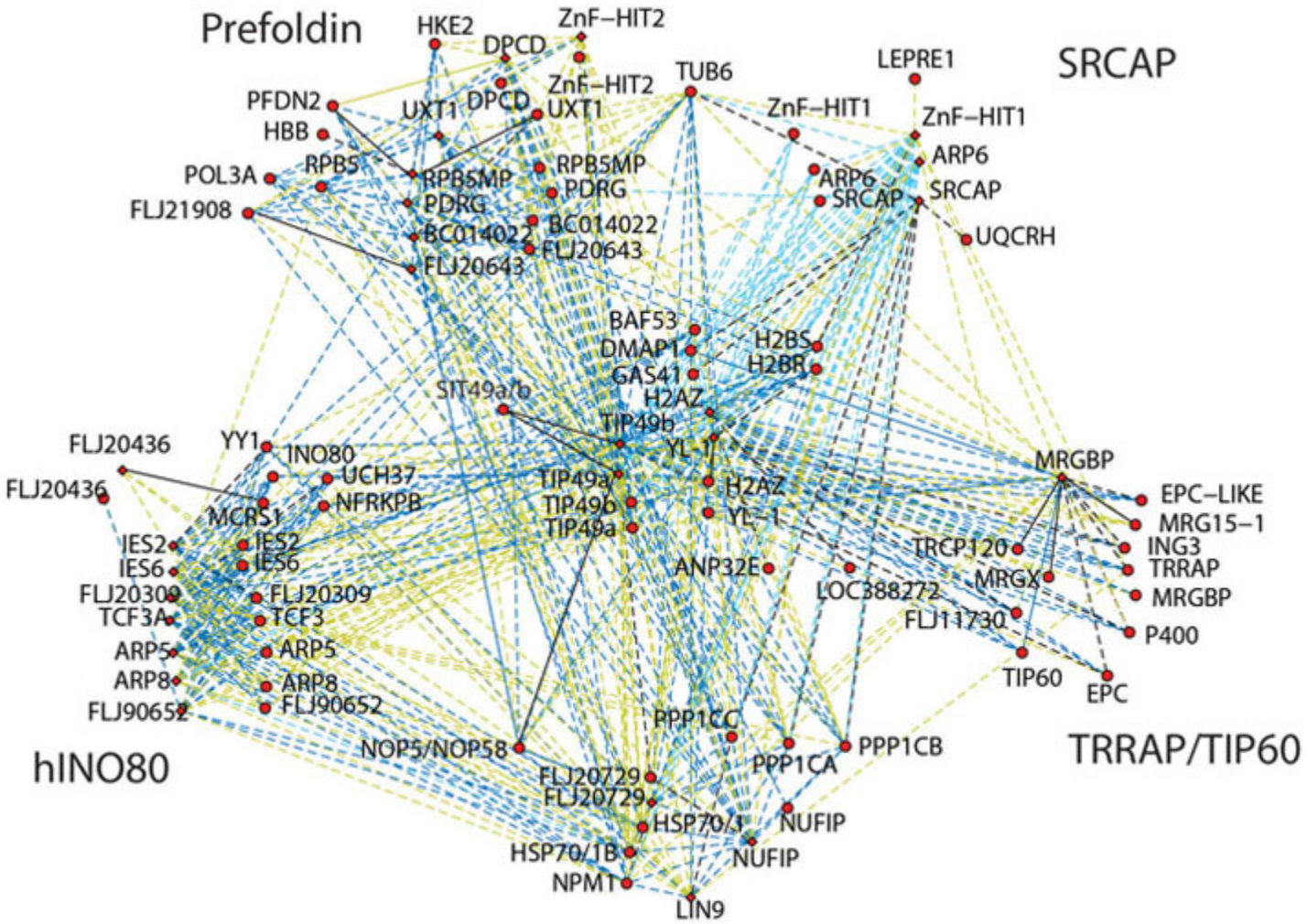


Nodes indicate molecules called *metabolites*

Directed edges indicate the conversion of metabolites to other metabolites

Biochemical Networks

A protein-protein interaction network

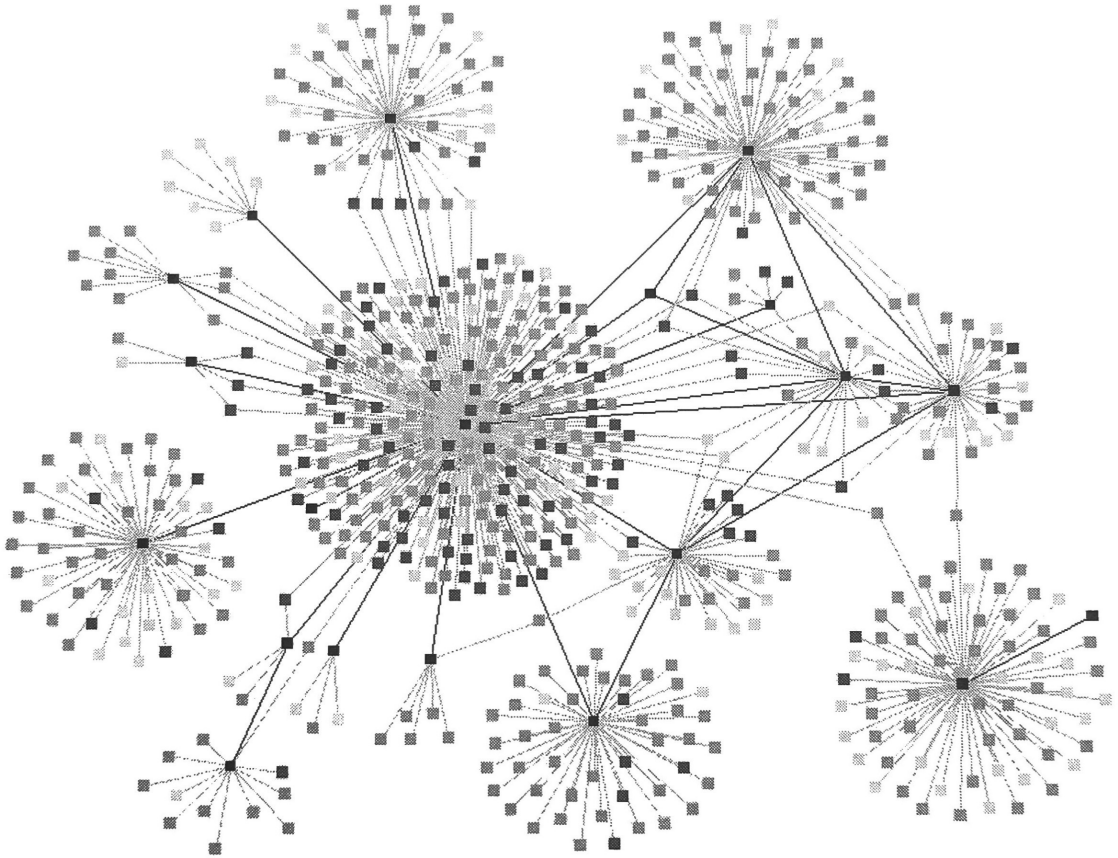


Nodes indicate proteins

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