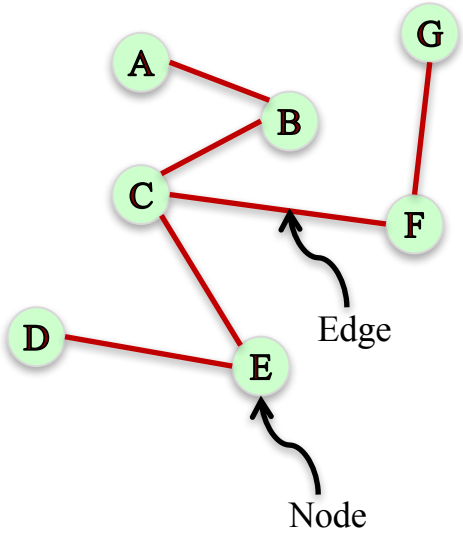
Network Definition and Vocabulary

Network (or Graph): A representation of connections among a set of items.

- Items are called nodes (or vertices)
- Connections are called edges (or link or ties)

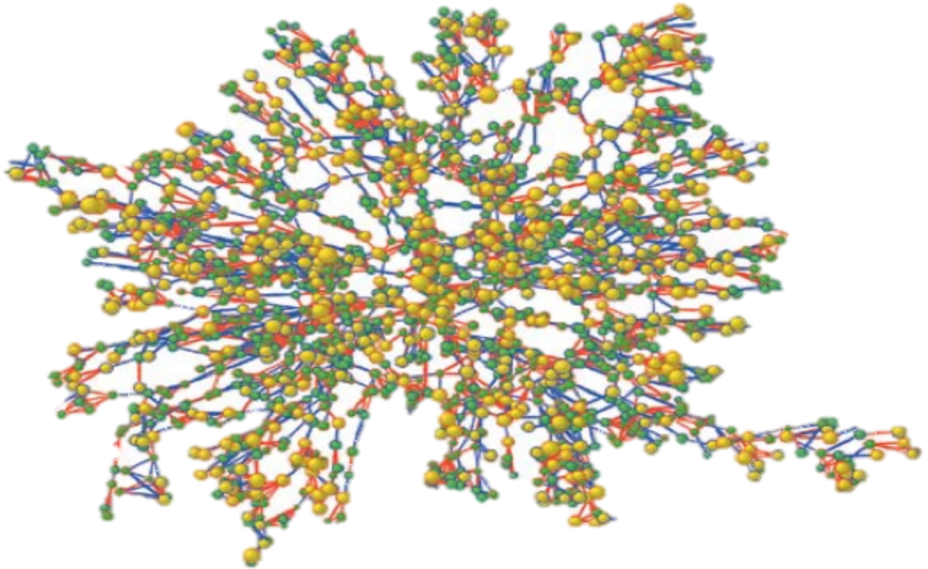



```
import networkx as nx
G=nx.Graph()
G.add_edge('A','B')
G.add_edge('B','C')
```

Nodes: People

Edges: Friendship, marital, or family ties

(Mostly) **Symmetric relationships**

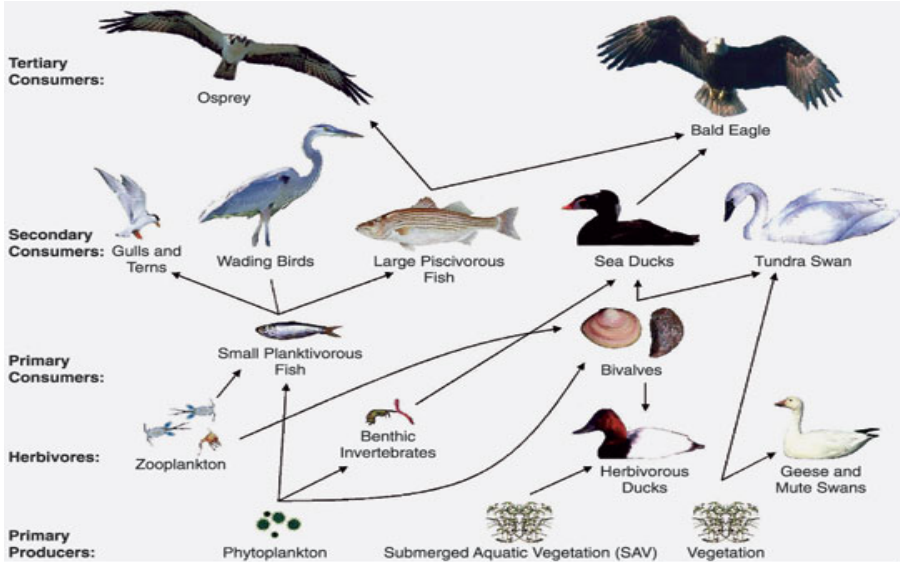


Network of friendship, marital tie, and family tie among 2200 people

Nodes: Birds

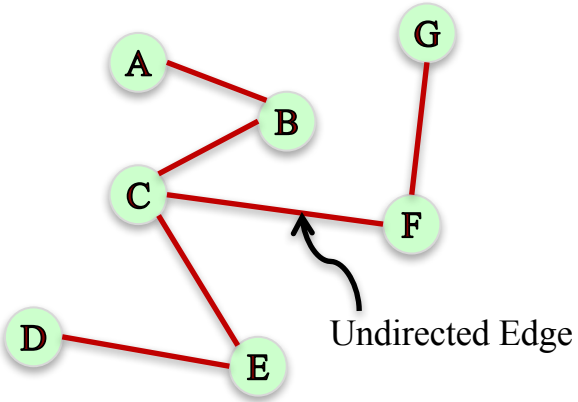
Edges: What eats what

Asymmetric relationships



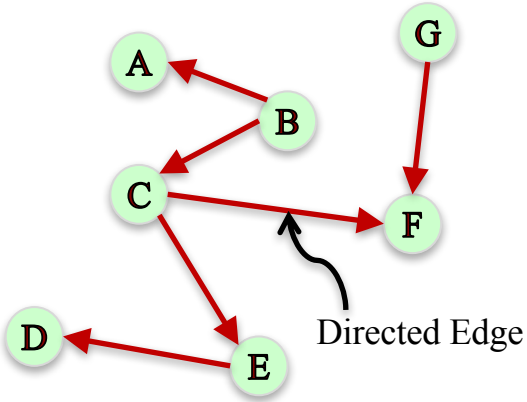
Chesapeake Bay Water bird Food Web

Edge Direction



Undirected network:
edges have no direction

```
G=nx.Graph()
G.add_edge('A','B')
G.add_edge('B','C')
```



Directed network:
edges have direction

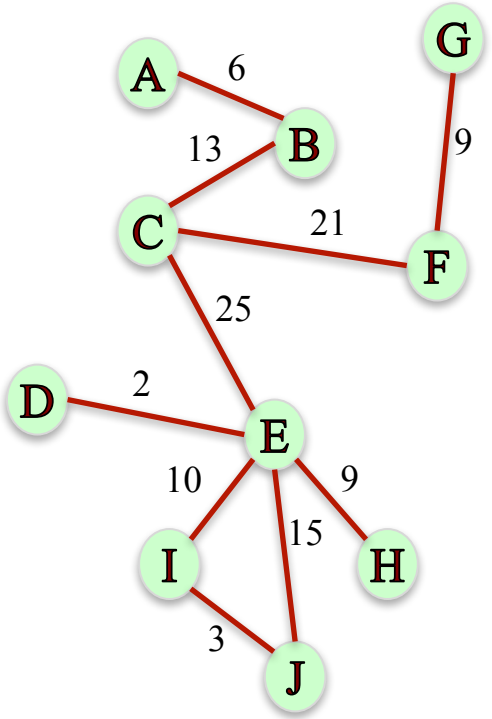
```
G=nx.DiGraph()
G.add_edge('B', 'A')
G.add_edge('B','C')
```

Weighted Networks

Not all relationships are equal.
Some edges carry higher weight than others.

Weighted network: a network where edges are assigned a (typically numerical) weight.

```
G=nx.Graph()
G.add_edge('A','B', weight = 6)
G.add_edge('B','C', weight = 13)
```



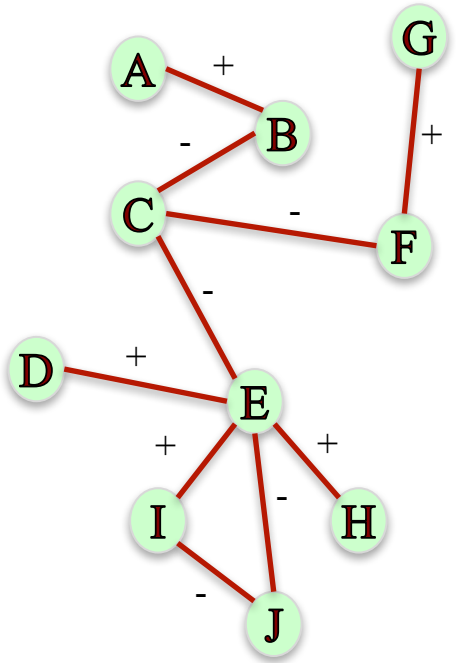
Number of times coworkers had lunch together in one year

Signed Networks

Some networks can carry information about friendship and antagonism based on conflict or disagreement.
Ex: In Epinions and Slashdot people can declare friends and foes.

Signed network: a network where edges are assigned positive or negative sign.

```
G=nx.Graph()
G.add_edge('A','B', sign= '+')
G.add_edge('B','C', sign= '-')
```

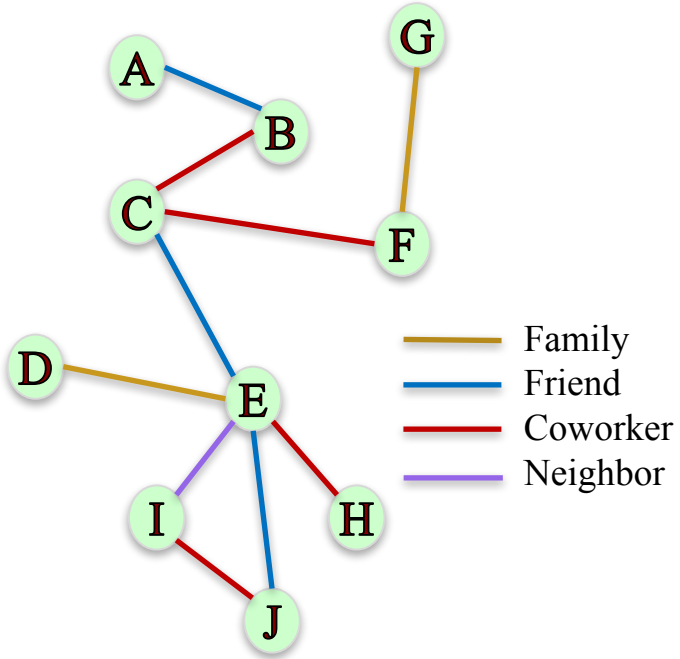


Friends and enemies

Other Edge Attributes

Edges can carry many other labels or attributes

```
G=nx.Graph()
G.add_edge('A','B', relation= 'friend')
G.add_edge('B','C', relation= 'coworker')
G.add_edge('D','E', relation= 'family')
G.add_edge('E','I', relation= 'neighbor')
```

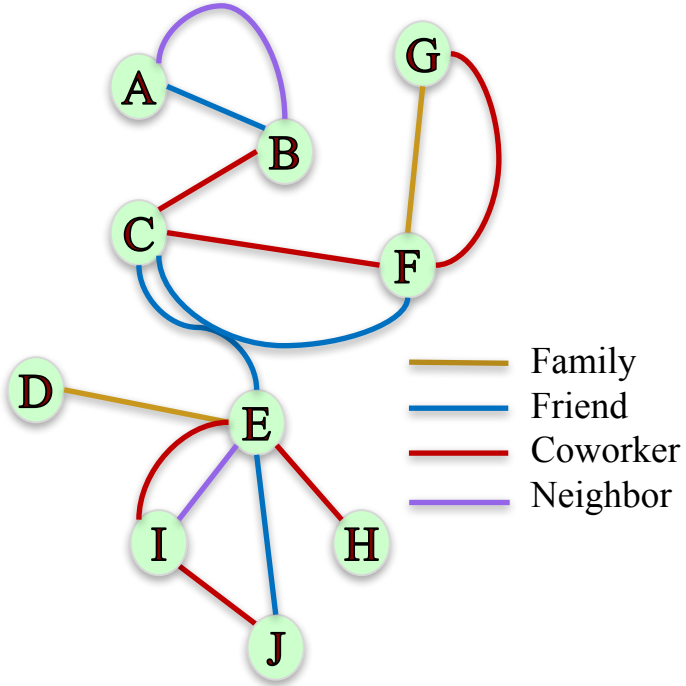


Mutigraphs

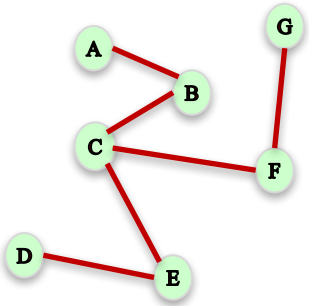
A pair of nodes can have different types of relationships simultaneously

Multigraph: A network where multiple edges can connect the same nodes (parallel edges).

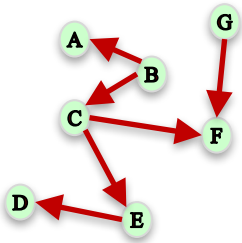
```
G=nx.MultiGraph()
G.add_edge('A','B', relation= 'friend')
G.add_edge('A','B', relation= neighbor')
G.add_edge('G','F', relation= 'family')
G.add_edge('G','F', relation= 'coworker')
```



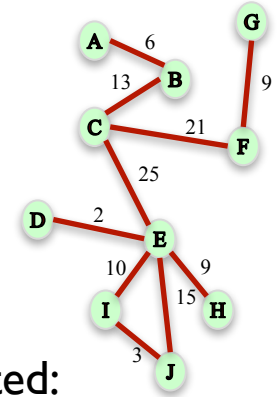
Summary



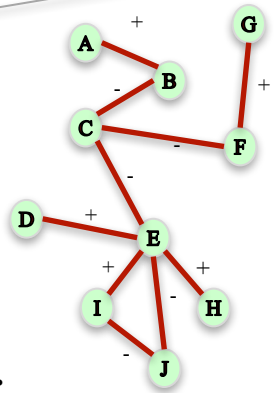
Undirected:
G=nx.Graph()



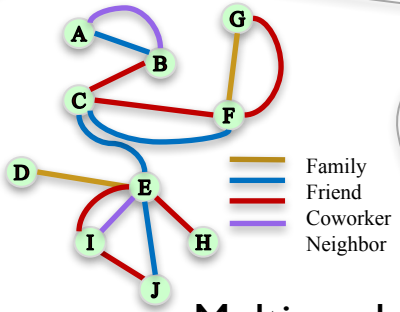
Directed:
G=nx.DiGraph()



Weighted:
G.add_edge('A','B', weight = 6)



Signed:
G.add_edge('A','B', sign= '+')



Multigraph:
G=nx.MultiGraph()