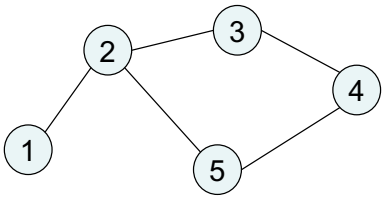
Lecture 3: Graph representations

G = (V,E) where
- V: vertices/nodes
- E: edges



V = {1,2,3,4,5}

E = {{1,2}, {2,3}, {3,4}, {2,5}, {4,5}}

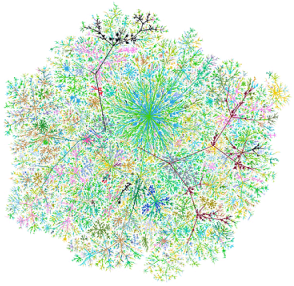
Undirected edges: symmetric relationship

Directed graphs

(x,y): edge *from* x *to* y

e.g.World wide web
- node URL
- edge (u,v) u points to v

Billions of nodes and edges!



How are graphs stored on a computer?

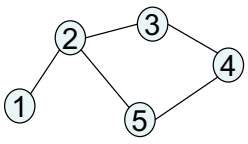
Adjacency matrix

V x V matrix A

A(i,j) = 1 if (i,j) is in E
0 otherwise

Symmetric if G undirected

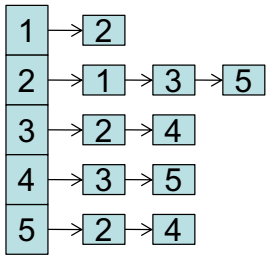
$$\begin{pmatrix} 0 & 1 & 0 & 0 & 0 \\ 1 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 & 0 \\ 0 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 & 0 \end{pmatrix}$$



PRO check for an edge in O(1) time
CON uses up $O(V^2)$ space

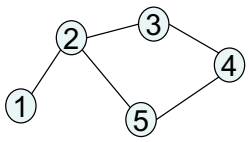
Adjacency list

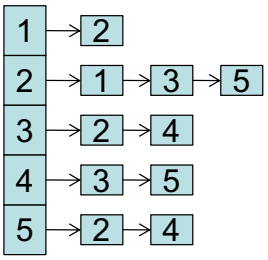
For each node, list of outgoing edges



PRO just O(V + E) space
CON check for an edge in O(V) time
PRO easily iterate through node's neighbors

Undirected graphs: adjacency list





Directed graphs: adjacency list