

What's an ADT? Abstract Data Type

Collection of behaviors provided by data container

Examples?

Queue

Stack

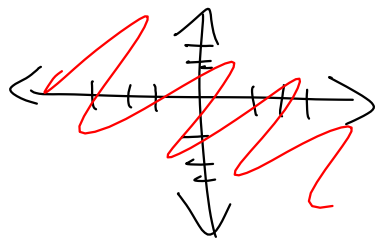
List

Dictionary

Priority Queue

Graph ← today

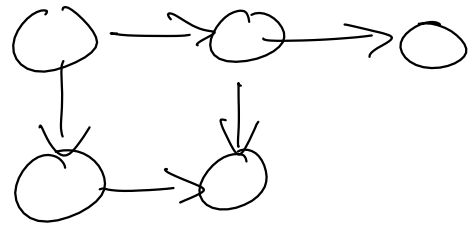
Graph



Cartesian plane

NOT THIS ONE

Graphs are good at capturing relationships

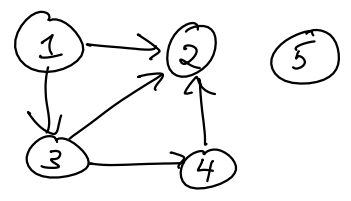
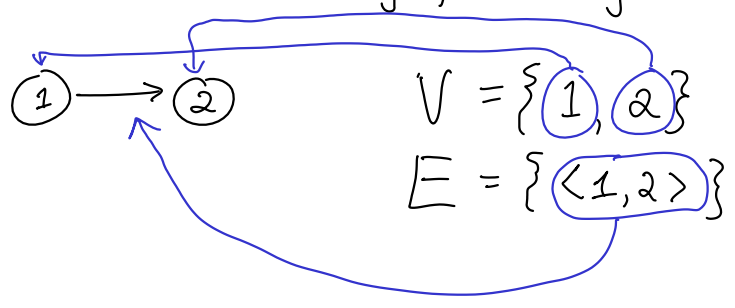


Graph is a pair of sets V, E .

$$G = \langle V, E \rangle$$

V is a set of vertices

E is a set of edges; each edge is a pair* between a source vertex and a target vertex



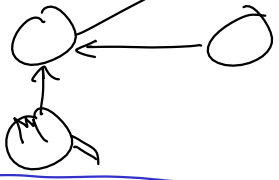
$$V = \{1, 2, 3, 4, 5\}$$
$$E = \{ \langle 1, 3 \rangle, \langle 1, 2 \rangle, \langle 3, 2 \rangle, \langle 3, 4 \rangle, \langle 4, 2 \rangle \}$$

Graphs are good at describing relationships

Food chain



relationship: eats



causes of climate change

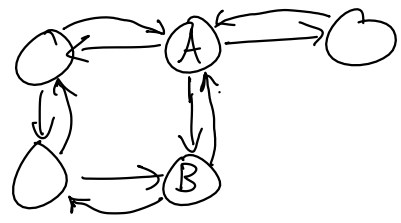
rel: causes



~ dependency graph

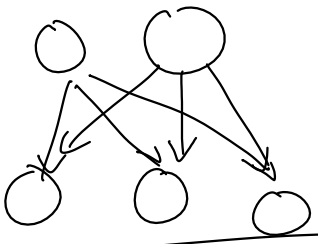
directed graphs

rel: acted in a movie with



undirected graph:

all edges $\langle v_1, v_2 \rangle \in E \Rightarrow \langle v_2, v_1 \rangle \in E$

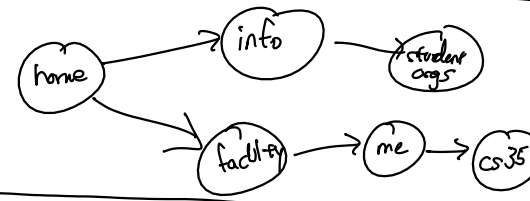


Family tree

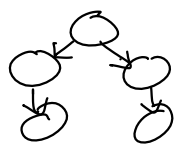
rel: is a parent of

web of crime

WWW



Trees are a kind of graph where every vertex has at most 1 in-degree and the graph is weakly connected



Defn.

in-degree: # edges pointing at a vertex
out-degree: # edges pointing away from a vertex

path $\langle 2, 4 \rangle, \langle 4, 3 \rangle$

not a path $\langle 1, 4 \rangle, \langle 7, 9 \rangle$

"strongly" weakly

path: sequence of edges where each target is the next source
connected: if every vertex has a path to every other vertex

connected: I would be connected if I were undirected

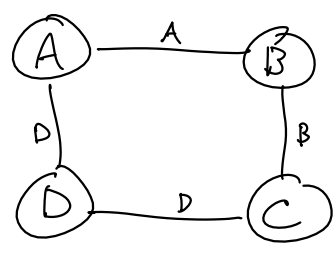
Teams playing other teams

$V = \{ \dots \text{all teams} \dots \}$

$E = \{ \dots \text{all games} \dots \}$

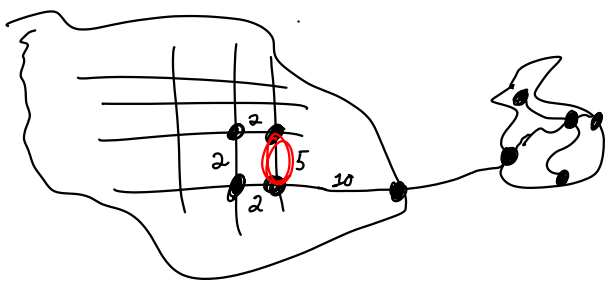
undirected

Edge is $\langle \text{source vertex, target vertex, label, weight} \rangle$



Who won?

label: just some info associated w/ edge
weight: \nearrow except usually numeric definitely comparable



Graph $\langle V, E, W \rangle$

type of name used to describe vertex

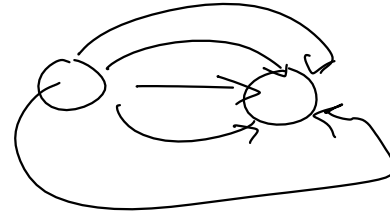
type of LABEL on each edge

type of WEIGHT on each edge

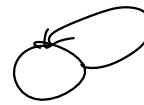
simple graph

* Between source V_1 and target V_2 , there is at most 1 edge.

* No self-loops; $\forall V_1. \langle V_1, V_1 \rangle \notin E$



NOT SIMPLE



NOT SIMPLE

Given a ^{simple} graph with $|V|$ vertices, how many edges can there be? $\max |E| = \frac{|V|(|V|-1)}{2}$

Given a graph w/ $|V|$ vertices, what is the max out-degree? $|V|-1$

