cse 101 4-6-21

Replacement lecture

- Quiz 1 : today 6-10 PM
- Pa1 : ext 1 day

Pa1 client: Lex.c

how can we indirectly sort a list using a list of ints?

Ex.

$$A = [\underset{0}{\text{"c"}}, \underset{1}{\text{"a"}}, \underset{2}{\text{"b"}}, \underset{3}{\text{"d"}}]$$

want

$$L = (1, 2, 0, 3)$$

Subarray 12

start : L = ( ) [ ]

insert 0 : L = (0) [c]

insert 1 : L = (0)

L = (1 0) [a c]

insert 2 : L = (1 0)

L = (1 0)

L = (1 2 0) [a b c]

insert 3 : L = (1 2 0)

L = (1 2 0)

L = (1 2 0)

L = (1 2 0)

L = (1 2 0 3) [a b c d]

Handouts

- ADTs vs. DataStructs.
- Graph Theory

  what is a graph?

  how do we represent graphs?

Defn

A graph is a pair of sets

$$G = (V, E)$$

$V \neq \phi$ is called vertex set.

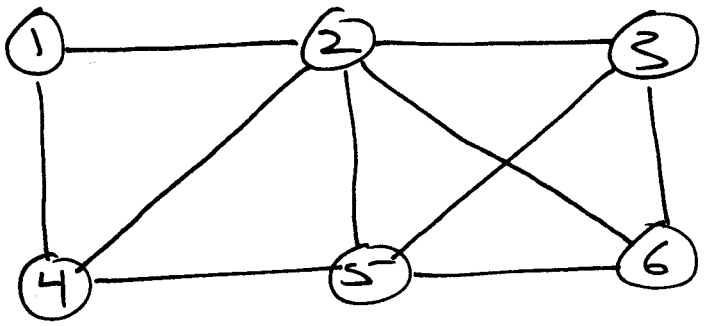
$E \subseteq V^{(2)} = \{$ 2-element subsets of $V\}$

say $V = \{1, 2, 3, 4\}$

and $e \in E$, $e = \{2, 3\}$ 

$= 23$

Ex.



- 1 is adjacent to 2
- edge 12 joins 1 to 2,
- vertex 2 is incident with 25
- 12 is adjacent to 14
- a 1-6 walk : 1, 2, 3, 5, 4, 2, 5, 6
  (1 = initial, 6 = terminal)

closed walk : initial = terminal.

length = # of edge traversals.

- a walk in which no edge is traversed more than once is a trail.

- a trail in which no vertex is visited more than once is called a Path.

- a trivial walk (trail, Path) has no edge traversals, length = 0.

Ex. 

- a cycle is a nontrivial closed Path.

Ex 4-3 Path 4, 2, 5, 3 len = 3

∴ cycle of len. 5 : 4, 2, 3, 6, 5, 4

- neighbors of 4 : {1, 2, 5}

degree of 4 : 3

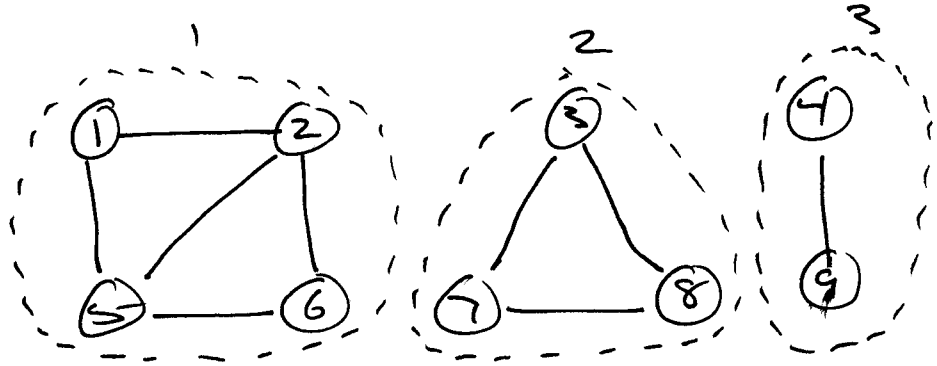
- not allowed :

$\{x, x\} = \{x\}$ not an edge

$\{x, y\} = \{x, y\}$

- G is called <u>connected</u> iff for all $x, y \in V(G)$, G contains an $x-y$ path. otherwise called <u>dis-connected</u>.

<u>Ex</u> Disconnected Graph



Connected components :

$H_1 = (\{1, 2, 5, 6\}, \{12, 15, 25, 26, 56\})$

$H_2 = (\{3, 7, 8\}, \{37, 38, 78\})$

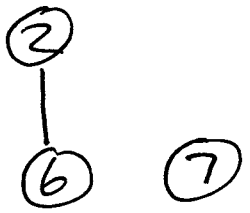
$H_3 = (\{4, 9\}, \{49\})$

- A <u>subgraph</u> H of a graph G is a graph with

$$V(H) \subseteq V(G)$$
$$E(H) \subseteq E(G).$$

Disconnected subgraph

$(\{2, 6, 7\}, \{26\})$



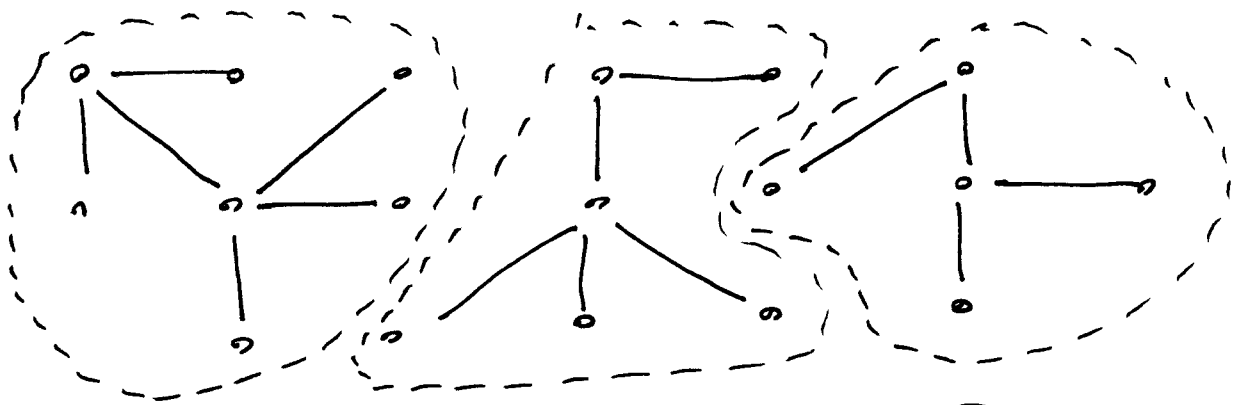
- A connected component of a graph is A subgraph H of G satisfying.

  (1) H is connected.

  (2) H is maximal with respect to property (1)

- A Graph is called acyclic (or a forest) if G contains no cycles.

Ex



# vert:	7	6	5
# edges:	6	5	4

Def A **tree** is a Graph that is both acyclic and connected

Theorem

If T is a tree with n vertices, then T has n-1 edges.

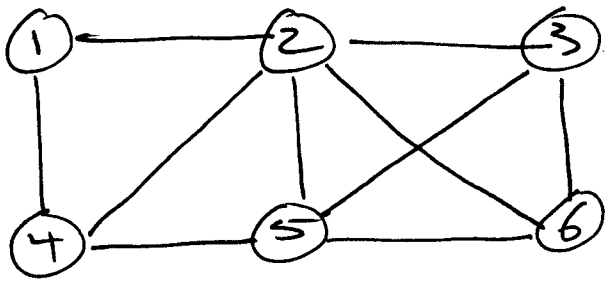
Representations of Graphs

- adjacency matrix
- Incidence matrix

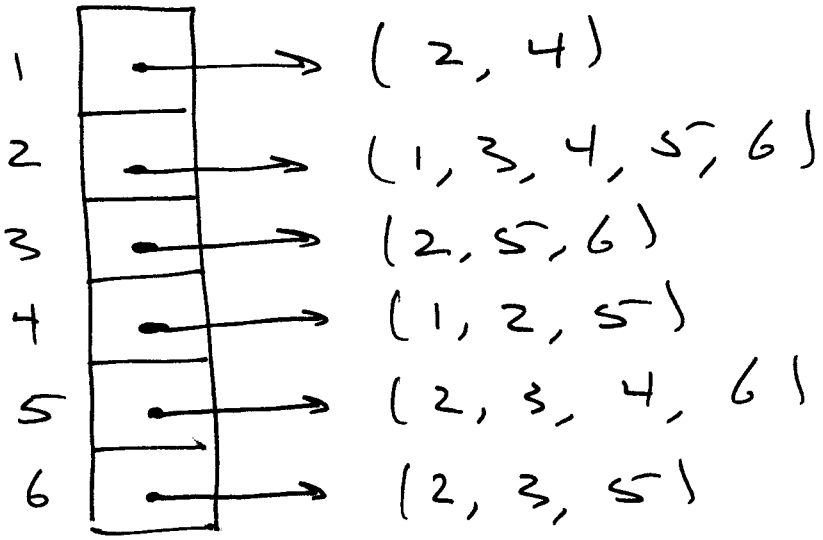
] Read in GraphThy handout

- **adjacency list**

Ex. Recall:



Adjacency list representation



For each vertex $x \in V$, maintain a list of neighbors of x

adj[x]

Handout: Graph Algorithms

Defn Let G be a graph, and $x, y \in V(G)$. Then

$$\delta(x,y) = \begin{cases} \text{min length of an } x\text{-}y \text{ path} & \text{(if such a path exists)} \\ \infty & \text{(if no } x\text{-}y \text{ path exists)} \end{cases}$$

Problem: SSSP

Given source $s \in V(G)$, determine

$$\delta(s,x) \text{ for all } x \in V(G).$$

Further, if $\delta(s,x) < \infty$, determine an s-x path of length $\delta(s,x)$.

SSSP: single source shortest path.

Pa 2:

write a Graph ADT with an operation that solves SSSP.

will use

- adjacency list Rep.
- algorithm: breadth first search (BFS).