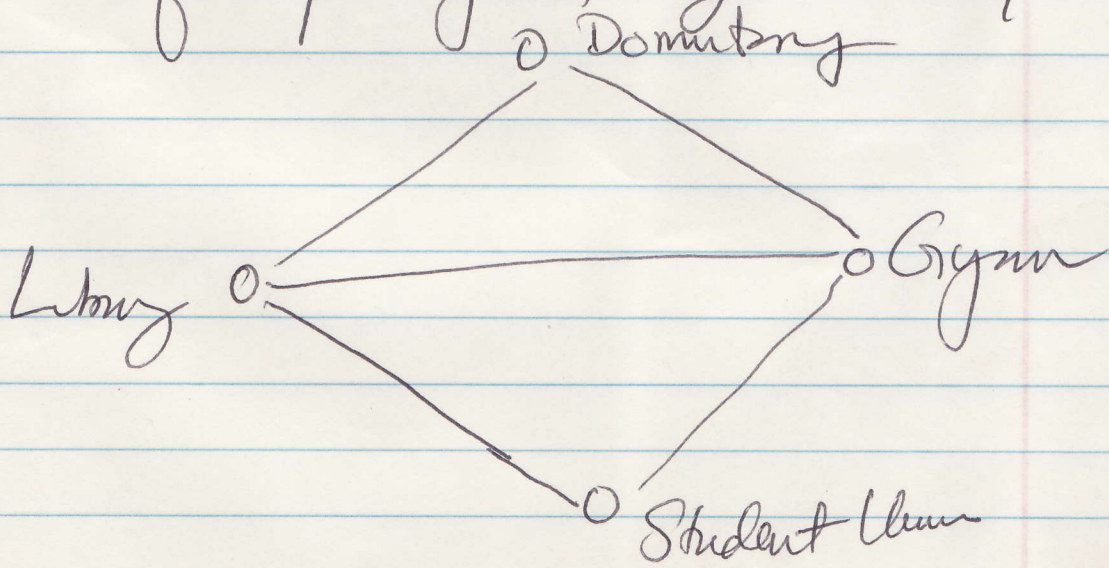
Graphs

Terminology

Graph G Consists of two sets:
a set V of Vertices or nodes
a set E of Edges that connect the vertices.

A Subgraph is a subset of graph's Vertices and subset of its edges.

Two Vertices of a graph are adjacent if they are joined by an edge.



A path between two vertices is a sequence of edges that begins at one vertex and end at another.

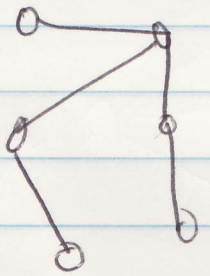
Dormitory → → → Student Union ~~Dormitory~~

Dorm → → Student Union

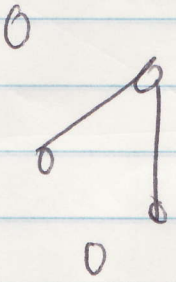
It is a simple path since the path doesn't pass through the same vertex twice.

Dorm → → → Dorm
a cycle.

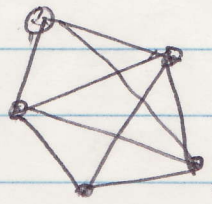
A graph is connected if there is a path between every pair of vertices.



Connected graph

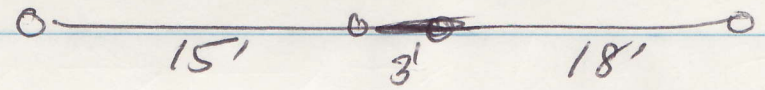


Disconnected graph

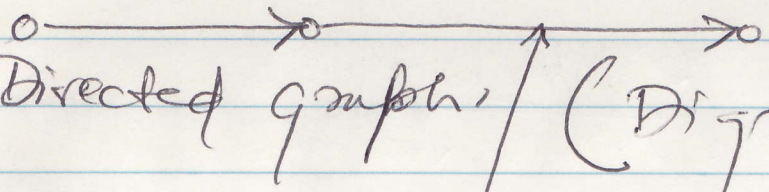


A complete graph

You can label the edges of a graph. When these represent a numeric values, the graph is called a weighted graph



Undirected graph.

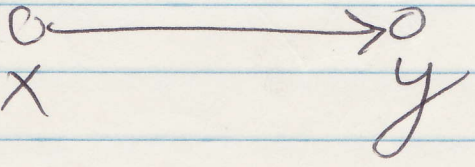


Directed graph (Digraph)

Directed edge.

Directed graph with 2 edges.

If there is a directed edge from vertex x to vertex y then y is adjacent to x.

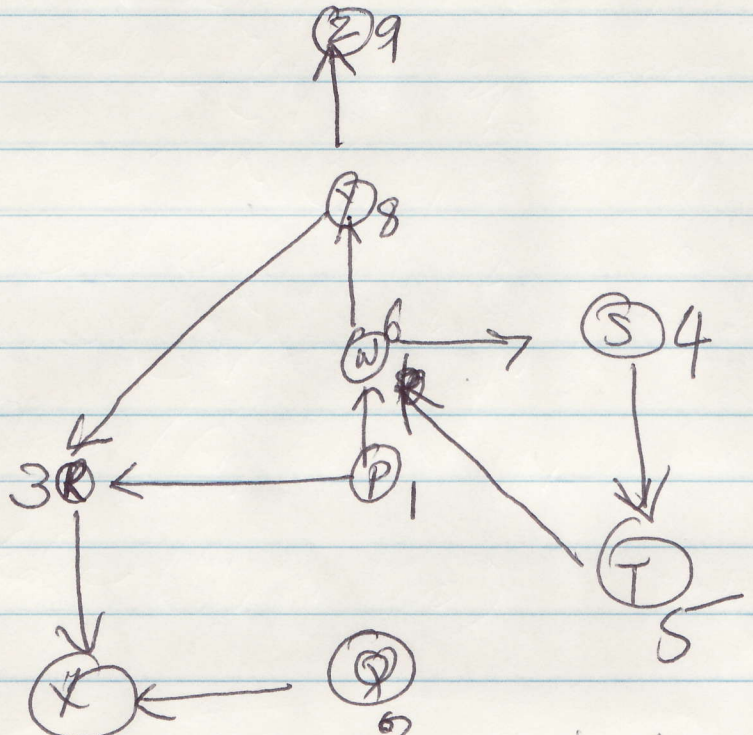


GraphW ADT:

Create (G)
IsEmpty (G)
InsertVertex (G, V, Screen)
InsertEdge (G, V1, V2, Screen)
DeleteVertex (G, V, Screen)
DeleteEdge (G, V1, V2, Screen)
Retrive (G, SearchKey, V, Screen) (retrive value)
Replace (G, SearchKey, V, Screen) Replace Vertex
IsEdge (G, V1, V2) Returns if there is an edge between V1, V2

Implementing a graph:

① Adjacency matrix and adjacency list.

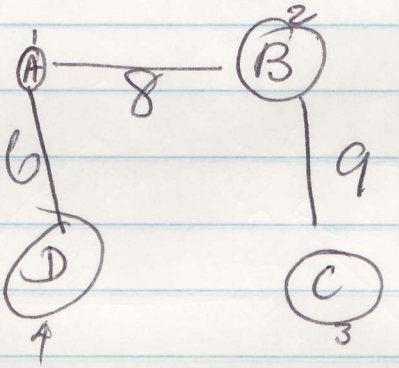


	P	Q	R	S	T	U	V	W	X	Y	Z
P			T					T			
Q									T		
R					T				T		
S				F				T			
T											
U											
V											
W				T						T	
X			T								T
Y											
Z											

all other are false

If it is weighted graph instead of T, & F put in true values.

Adjacency matrix



	1 A	2 B	3 C	4 D
1 A	0	8		6
2 B	8	0	9	
3 C		9	0	
4 D	6			0

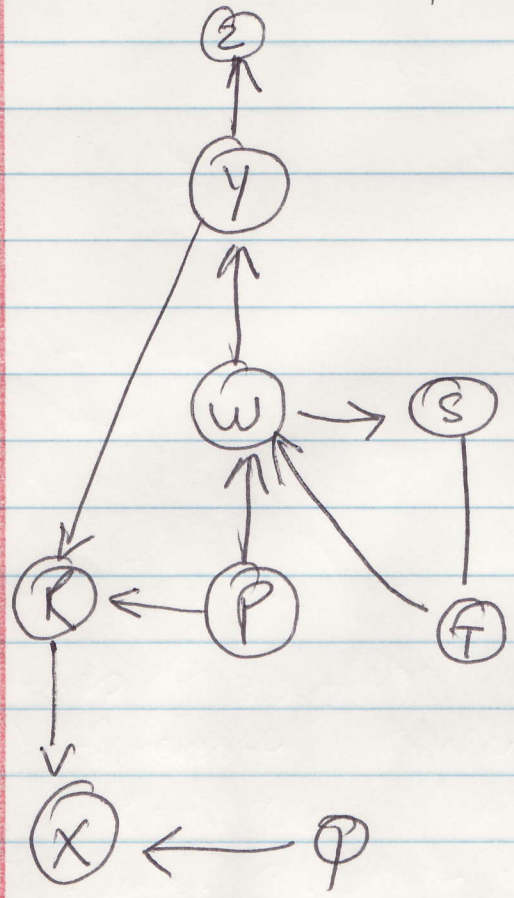
Operations on graphs:

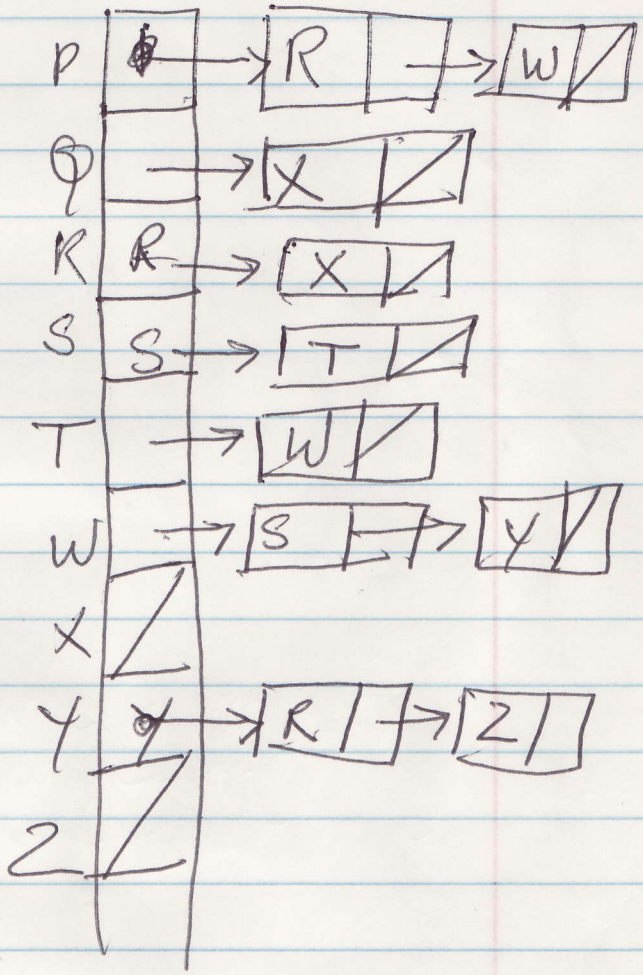
1. determine whether there is an edge between two vertices.
2. find all vertices adjacent to a given vertex.

just look at Matrix[i, j] given vertices i & j.

Adjacency list
a linked list.

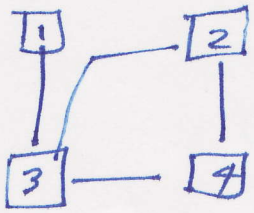
Requires space for each vertex and edge

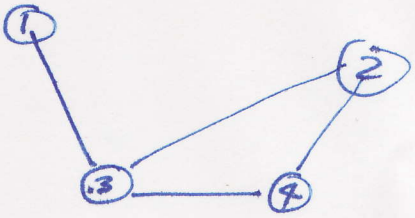




Find all vertices adjacent to a given vertex - can be found easily by traversing this LL.

A graph representation is made of the network.





To reach	Next hop
1	—
2	(1, 3)
3	(1, 3)
4	(1, 3)

Link between 1 & 3.

This is for node 1 All must go through 1, 3

To reach	Next hop
1	2, 3
2	—
3	2, 3
4	2, 4

For Node 2

To reach	Next hop
1	3, 1
2	3, 2
3	—
4	3, 4

For Node 3

1	4, 3
2	4, 2
3	4, 3
4	—

Shortest Path. Uses Dijkstra's algorithm

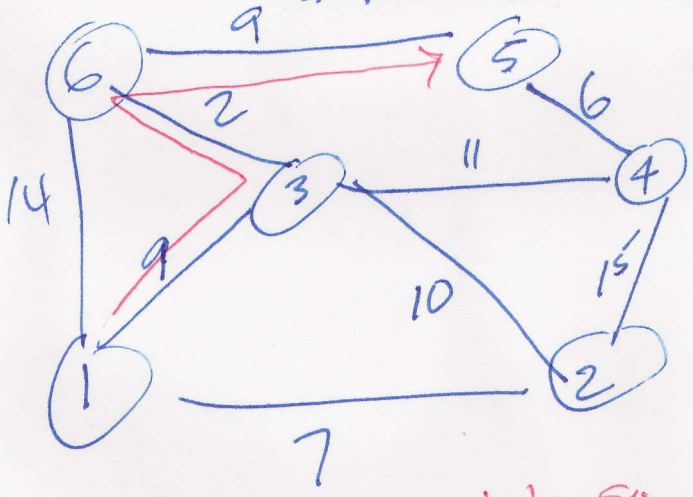
is a graph search algorithm used for routing.

For a given node in a graph, the algorithm finds path with ~~lost~~ lowest cost, or shortest path,

Algorithm.

~~Mark~~

1. Mark every node a distance value
   Initial node gets zero and all others gets infinity, initially.
2. Mark all nodes unvisited
3. For the current node consider all its unvisited neighbors and calculate their distance. If the distance is less than previously recorded, remember
4. After considering all neighbors, ~~Mark~~ Mark it Visited
5. Set the unvisited node with the smallest distance from the initial node as the next current node.



Want to go from 1 to 5

1 to 3 = 9

1 to 2 = 7 → 2 to 3 = 7+10 = 13 Compare to 1 to 3 9 is smaller

1 to 6 = 14 → 2 to 4 = 7+15 = 22 Keep

→ 3 to 6 = 9+2 = 11 which is less than 1 to 6 so keep

→ 6 to 5 = 11+9 = 20 which is less than 1 to 5 so keep

→ 6 to 5 = 14+9 = 23

Want to go from 1 to 4

1-3-4 = 20

~~1-2-4 = 22~~