Tutorial sheet - 5.

Sol 1- Using BFS, we can find the minimum no. of nodes b/w a source node and destination node, while using DFS, we can find if a path exists b/w two nodes

- Applications :-

BFS : To detect cycles in a graph, min distance comparison, gps navigator.

DFS : To detect & compare multiple paths, detect cycle in a graph.

Sol 2 :- DFS : We use stack to implement DFS because "order doesn't has much importance".

BFS : We use queue Data structure to implement BFS because "order matters in this case".

Sol 3 :- Sparse graph :- No. of edges is close to minimal no. of edges.

Dense Graph :- No of edges is close to maximal no. of edges.

Sol 4 :- Cycle Detection in BFS :-

1. Compute in degree (no. of incoming edges) for each of the vertex present in graph & count no. of nodes = 0.
2. Pick all the vertices with indegree as 0 & add them to queue.
3. Remove a vertex from the queue, then
   - increment count by 1.
   - Decrease in degree by 1 for all neighbours

- If in-degree of a neighbouring node is = 0, add to queue.

4. Repeat 3 until queue is empty.
5. If no. of visited nodes is not equal to no. of nodes, then graph has a cycle.

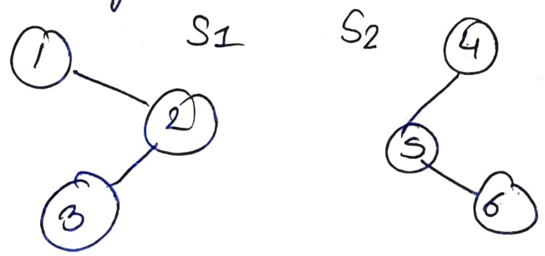
Cycle Detection in DFS

- A similar process is done in DFS as null, but in DFS, we have the option of doing recursive calls for vertices which are adjacent to the current node & are not yet visited. If recursive function returns false, then graph does not have a cycle.

Sol 5:- Disjoint Set Data Structure:-

It is a DS that is used in various aspects of cycle detection. This is literally grouping of two or more disjoint sets.

eg :

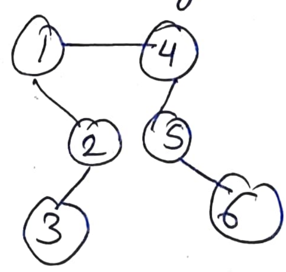


S1 = {1,2,3}
S2 = {4,5,6}

Operations:-

(1) Union:- Merge two sets when edge is added

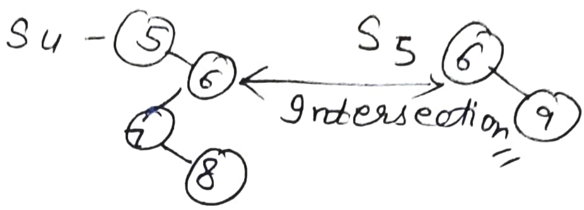
$S_1 \cup S_2 = S_3 \rightarrow$



(2) Find() tells which element belongs to which set. Find (1) = S1 / Find (4) = S2.

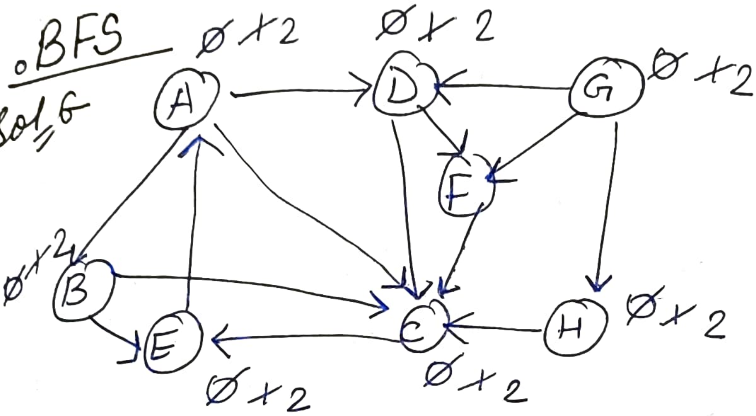
(3) Intersection - outputs another set as common elements

$S_1 \cap S_2 = \{ \phi \}$ $S_4 \cap S_5 = \{6\}$



• BFS

Sol 6

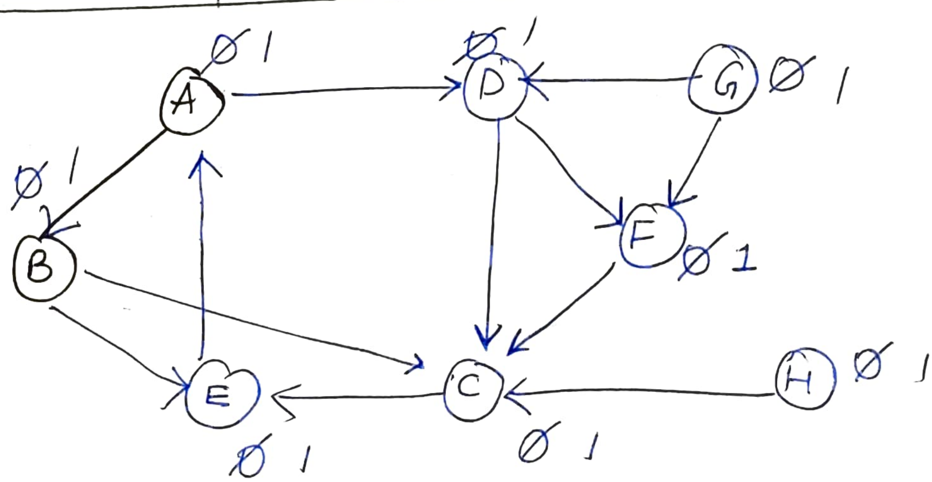


Node	G	H	F	D	C	E	A	B
Parent		G	G	G	H	C	E	A

All visited from source G.

Source	Destination	Path.
G	A	G → H → C → E → A
G	B	G → H → C → A → B
G	C	G → H → C
G	D	G → D
G	E	G → H → C → E
G	F	G → F
G	H	G → H

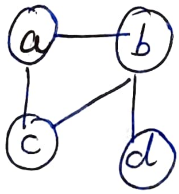
• DFS



Nodes Processed	Stack
	G
G	DFH
D	CFH
C	EFH
E	AFH
A	BFH
B	FH

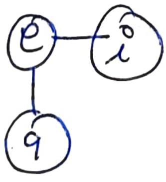
Source	Destination	Path
G	A	$G \to D \to C \to E \to A$
G	B	$G \to D \to C \to E \to A \to B$
G	C	$G \to D \to C$
G	D	$G \to D$
G	E	$G \to D \to C \to E$
G	F	$G \to F$
G	H	$G \to H$.

Sol 7:- (1)



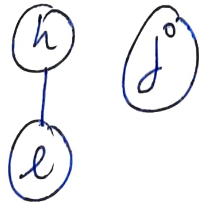
No. (V) = 4
No. (CC) = 1

(2)



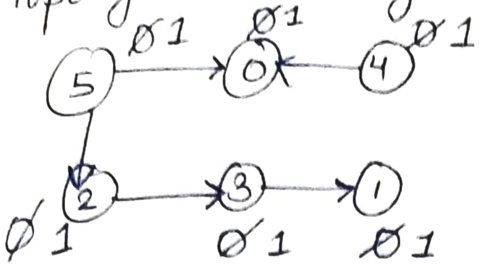
No. (V) = 3
No. (CC) = 1.

(3)



No. (V) = 3
No. (CC) = 2.

Sol 8 :- Topological Sorting



Adjacency List

0 →
1 →
2 → 3
3 → 1
4 → 0, 1
5 → 2, 0

stack | 0 | 1 | 3 | 2 | 4 | 5 |

Topological = 5 4 2 3 1 0

DFS stack → | 4 | 0 | 1 | 3 | 2 | 5 | Head →

DFS → 5 → 2 → 3 → 1 → 0 → 4

Sol 9:- Applications of Priority Queue.

1. Dijkstra's algo ⇒ we need to use a priority queue here so that minimal edges can have higher priority.

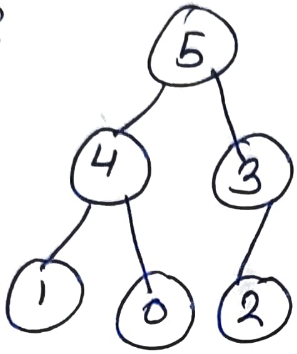
2. Load Balancing ⇒ load balancing can be done from branches of higher priority to those of lower priority.

3. Interrupt Handling ⇒ To provide proper numerical priority to ~~more~~ imp. interrupt.

4. Huffman Code ⇒ For data compression in Huffman code.

Sol 10:- Max. Heap ⇒ where parent is bigger than both children.

eg:



Min Heap ⇒ where parent is smaller than both children.

eg -