

① GRAPHS

PATH - DISTANCE -

REACHABILITY / CONNECTED COMPONENTS
(UNDIRECTED)

◦ INDUCED SUBGRAPH

◦ SUBGRAPH

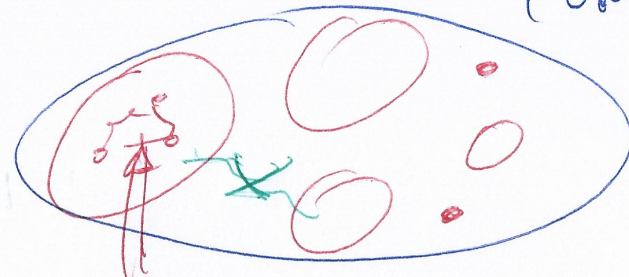
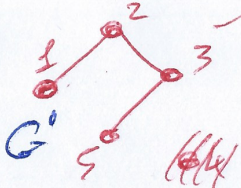
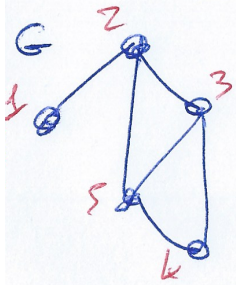
$G(V, E)$

G' IS A SUBGRAPH OF G

$G'(V', E')$ $V' \subseteq V$

$E' \subseteq E$

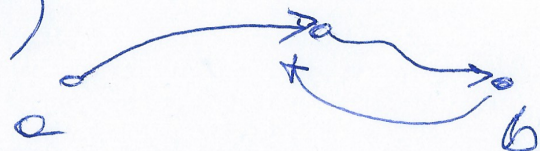
$E' \subseteq (E \cap (V' \times V'))$



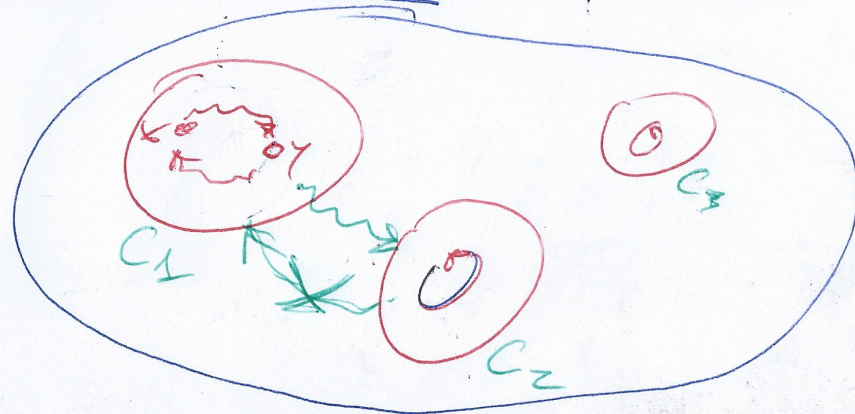
REACHABLE

CONNECTED COMPONENTS
(W.R.T. UNDIRECTED
VERSION)

DIRECTED
GRAPH



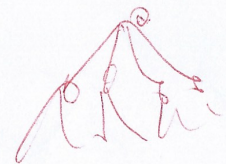
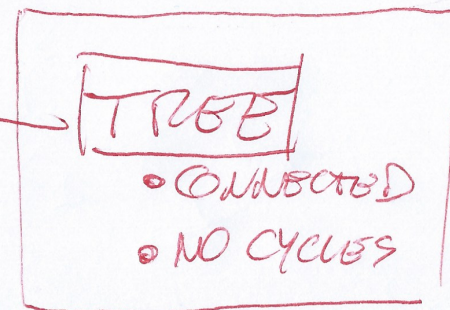
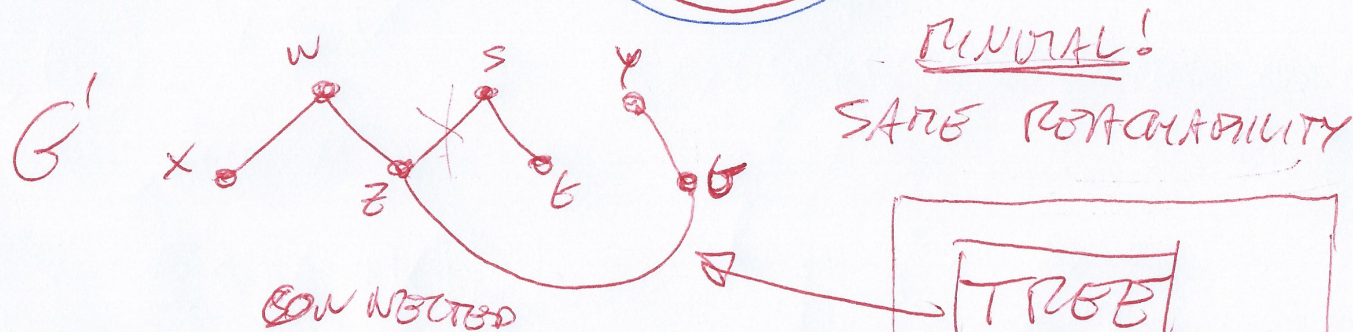
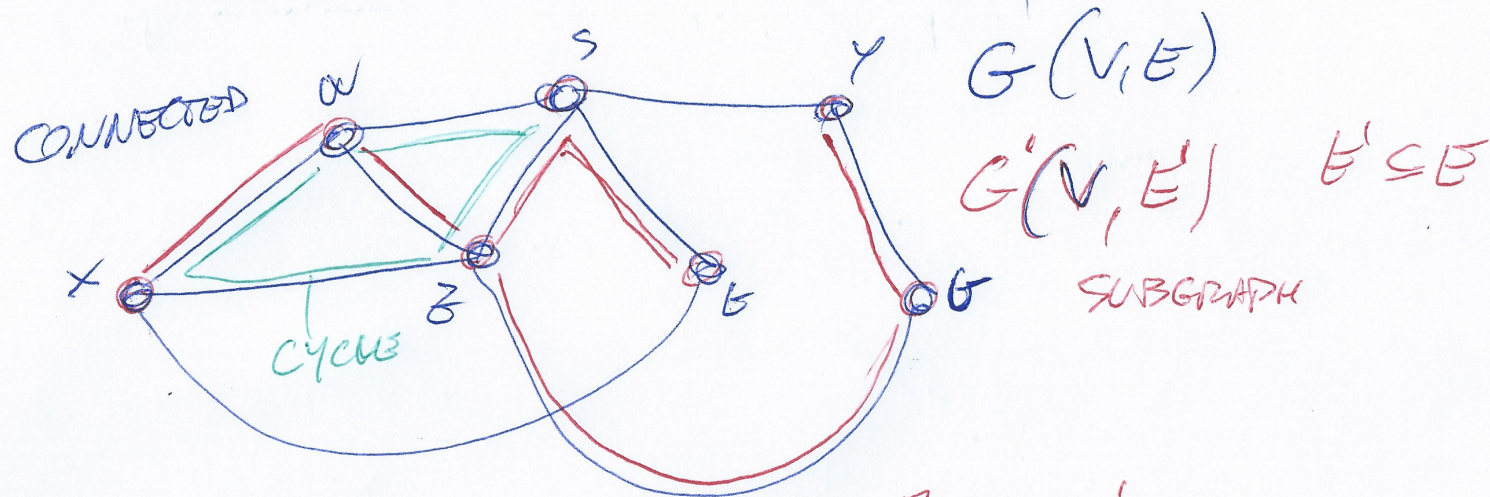
STRONGLY CONNECTED COMPONENTS



② INDUCED SUBGRAPH

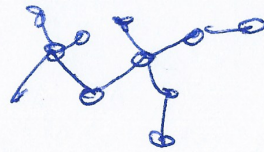
$$G(V, E) \quad \underline{G'} = (V', E \cap (V'))$$

$$V' \subseteq V$$



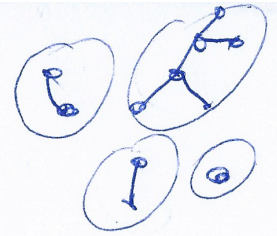
③ TREE

- CONNECTED
- ACYCLIC (NO SUBGRAPH IS A CYCLE)



FOREST

- ~~CONNECTED~~
- ACYCLIC



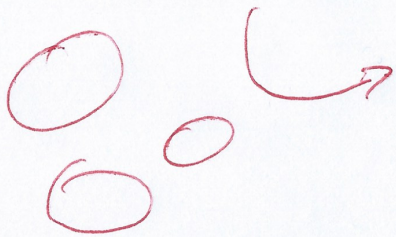
G
CONNECTED

T SUBGRAPH OF G
TREE, SAME VERTEX SET

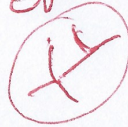
SPANNING TREE
OF G

DISCONNECTED

GRAPH G



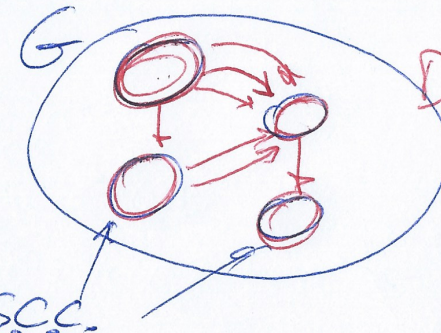
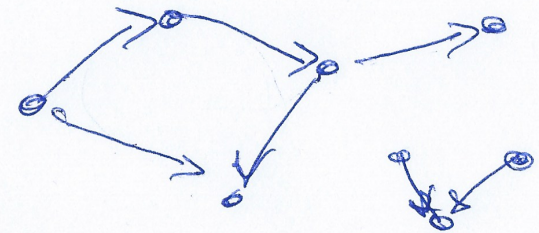
SPANNING
FOREST OF G



ACYCLIC
SUBGRAPH
SAME
CONNECTED
COMPONENTS
AS
 G



DIRECTED ACYCLIC GRAPHS (DAGs)



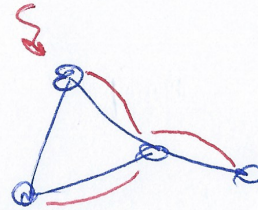
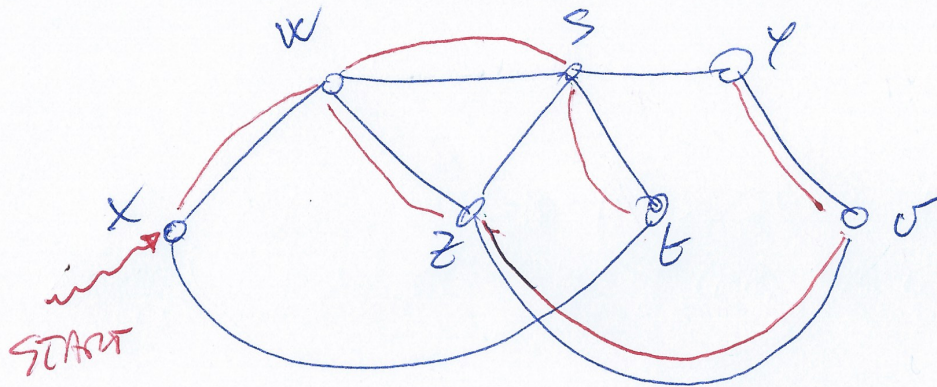
DAG STRUCTURE
OF S.C.C.

S.C.C.

④ VISITING A GRAPH

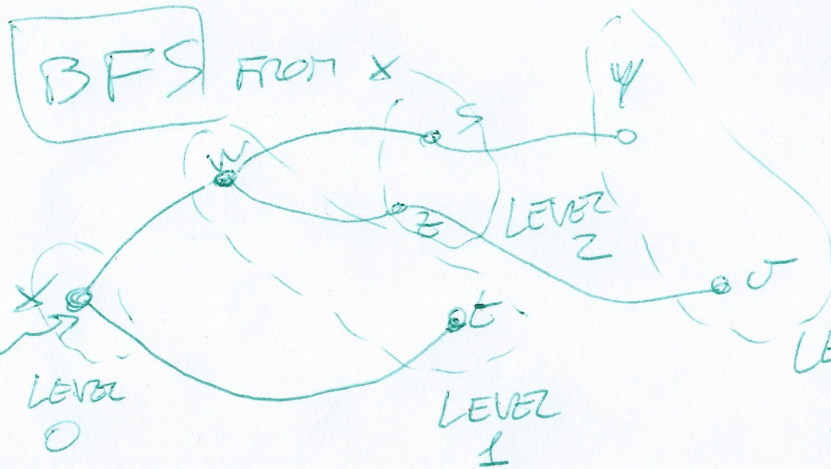
- START FROM A FIXED VERTEX
- WALK AS POSSIBLE REACHING (ALL) VERTICES

→ FINDING A SPANNING TREE (FOREST)

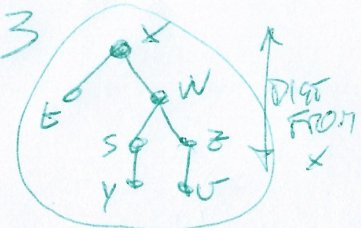


→ BFS
BREADTH FIRST SEARCH

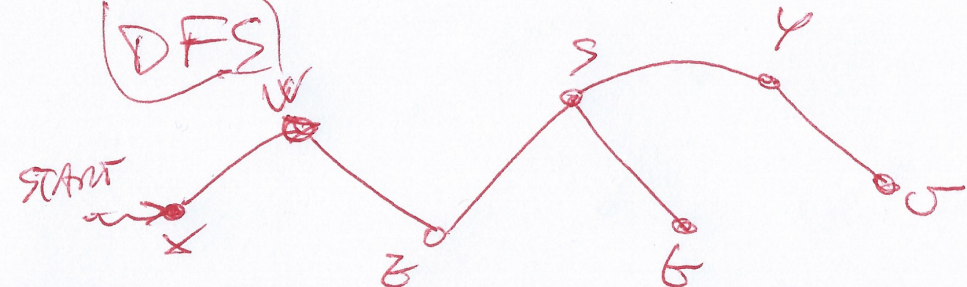
→ DFS
DEPTH FIRST SEARCH



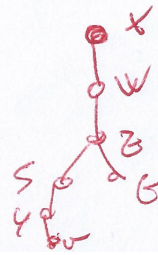
(A) BFS TREE OF G STARTING FROM X



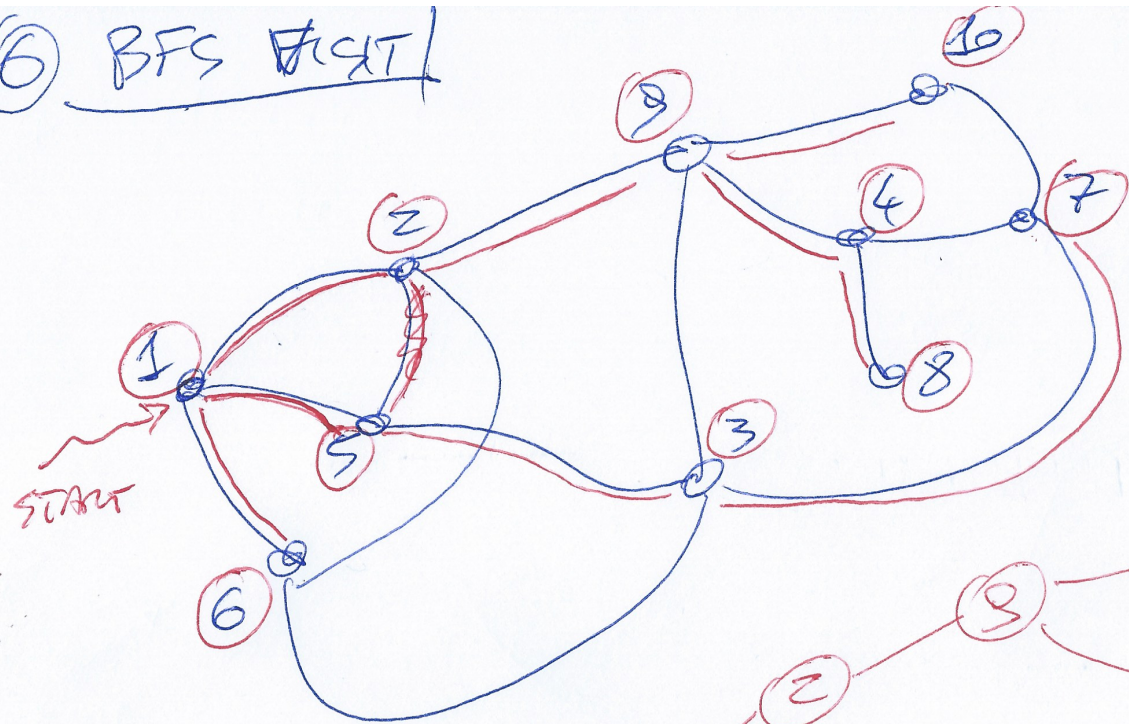
DFS



DFS TREE



⑥ BFS TRWT

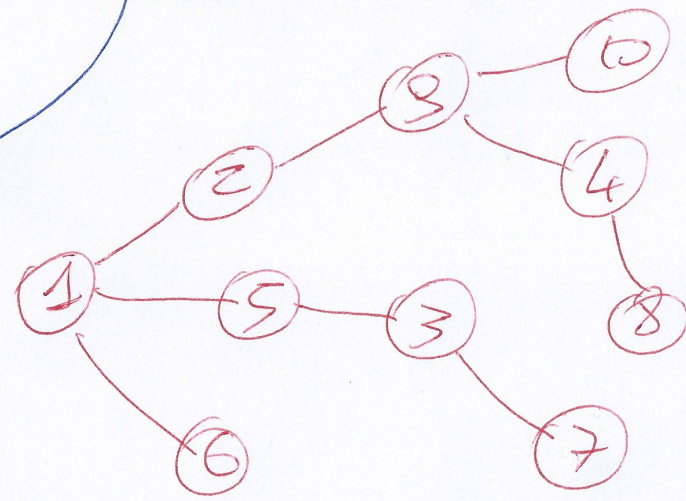


OUT $O(1)$ QUEUE IN $O(1)$

~~1~~ ~~2~~ ~~3~~ ~~4~~ ~~5~~ ~~6~~ ~~7~~ ~~8~~ ~~9~~ ~~10~~
 1 1 1 2 2 2 5 6 9 9
 10 7 7 8 7
 3 4 4 10

BFS TREE

○ VISITED VERVICES



① UNWEIGHTED GRAPH

BFS TREE GIVES SHORTEST PATHS FROM (X) START TO EACH OTHER VERTEX

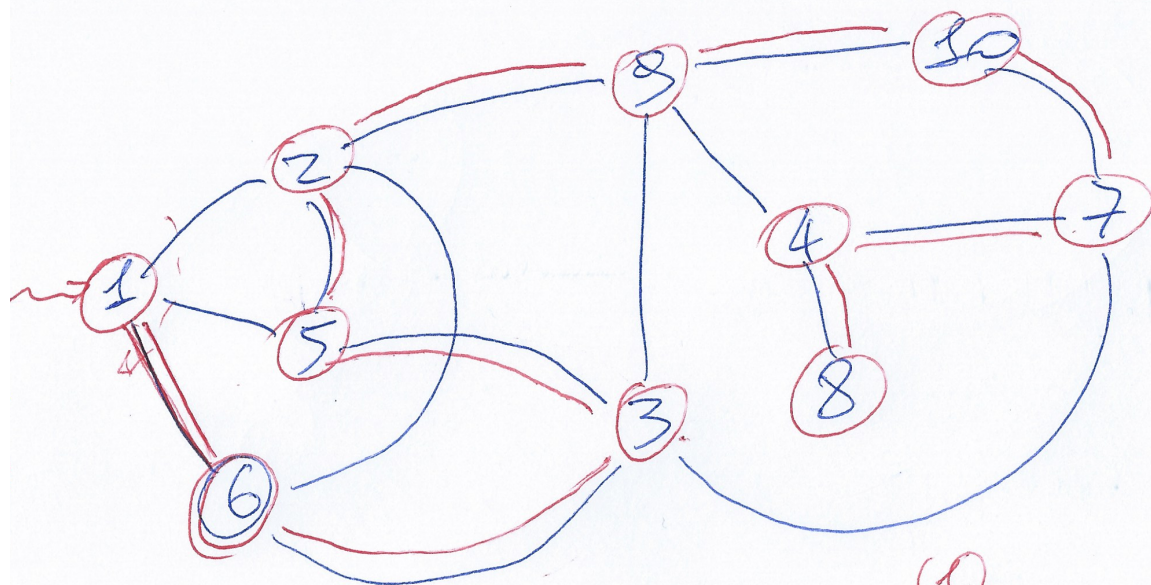
N N.O.F VERVICES
M N.O.F EDGES

$O(M)$

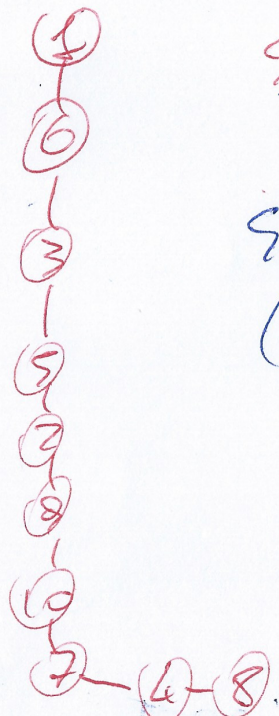
② COMPLEXITY

PUT AND GET VERVICES FROM Q 2 TIMES FOR EACH EDGE

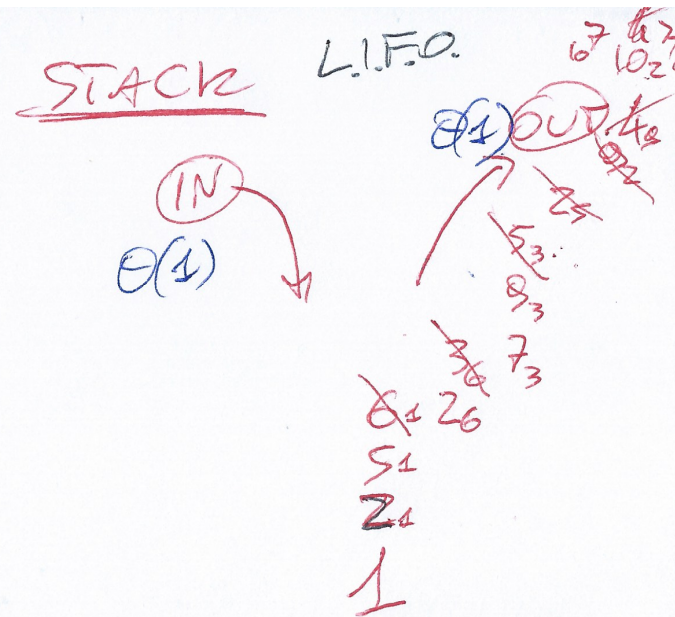
⑦ DFS VISIT



DFS TREE



$\Theta(m)$
WORST CASE
TIME



SPANNING
TREES

SPECIAL CASE
(NOT ALWAYS BY DFS)

!! IT IS A PATH !!
SIMPLE

HAMILTONIAN PATH

FIND A
H. PATH
IS
INTRACTABLE
WE ONLY
KNOW
 $O(2^n)$
ALGOS.