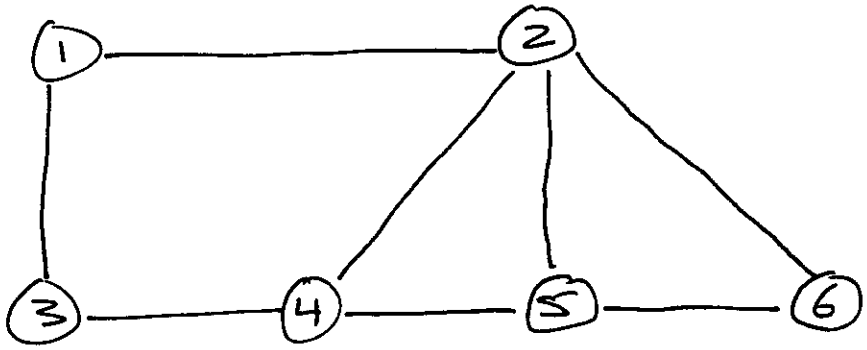
CSE 101 11-5-20

Paz: ext. 2 more days

Ex. DFS

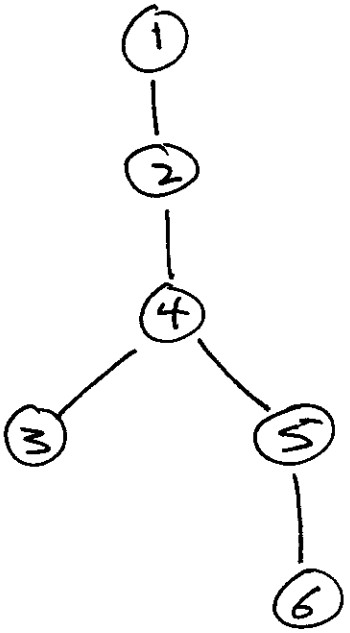


	adj	color	d	f	p
1	2 3	~~w~~ g b	1	12	n
2	1 4 5 6	~~w~~ g b	2	11	~~n~~ 1
3	1 4	~~w~~ g b	4	5	~~n~~ 4
4	2 3 5	~~w~~ g b	3	10	~~n~~ 2
5	2 4 6	~~w~~ g b	6	9	~~n~~ 4
6	2 5	~~w~~ g b	7	8	~~n~~ 5

time

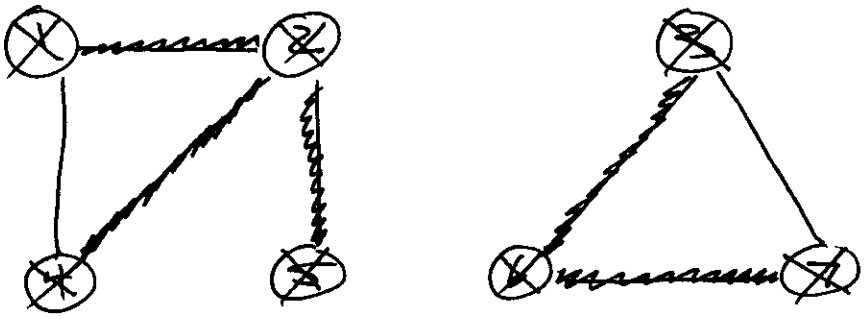
~~0~~
~~1~~
~~2~~
~~3~~
~~4~~
~~5~~
~~6~~
~~7~~
~~8~~
~~9~~
~~10~~
~~11~~
12

Predecessor subgraph - DFS forest

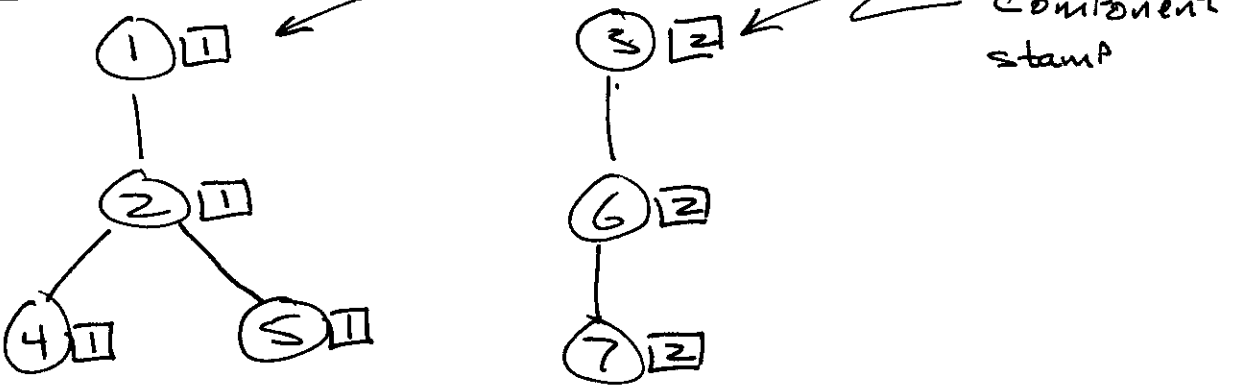


Thm if G is an undirected graph with k connected components, then the DFS-forest will have k trees.

Ex.



DFS Forest



	adj	d	f	p
1	2 4	1	8	n
2	1 4 5	2	7	1
3	6 7	9	14	n
4	1 2	3	4	2
5	2	5	6	2
6	3 7	10	13	3
7	3 6	11	12	6

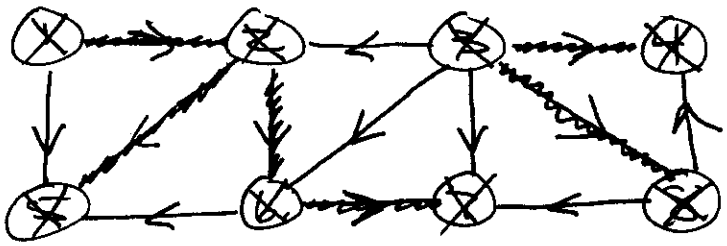
Exercise (for undirected case.)

re-write pseudo-code for DFS adding

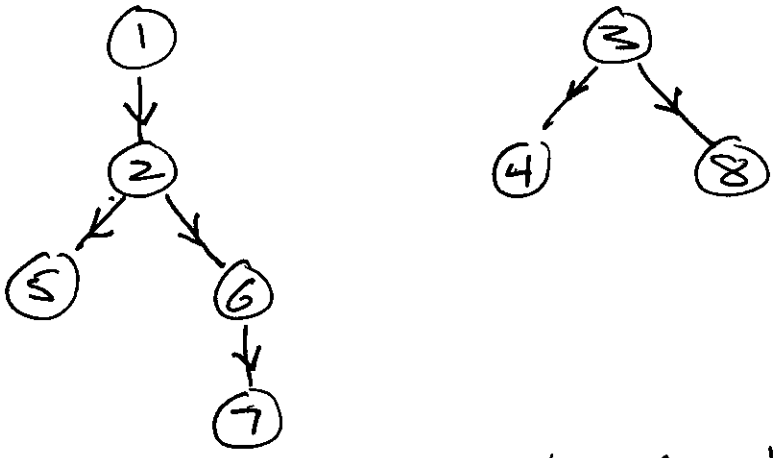
- count var, like time, local to DFS but static over calls to visit. init to 1.
- new vertex attribute: component
  set component[x] = count when visit is called.

Result: component[x] == component[y] iff x is reachible from y.

Ex. (digraph)



DFS forest



	adj	d	f	p
1		1	10	N
2		2	9	1
3		11	16	N
4		12	13	3
5		3	4	2
6		5	8	2
7		6	7	6
8		14	15	3

Runtime of DFS: $n = |V|$, $m = |E|$.

- Initialization: $\Theta(n)$
- main loop, (apart from calls to Visit) is also $\Theta(n)$
- Visit is called once on each vertex, has only const. cost OPs apart from the loop. This loop traverses each adj list exactly once for each $x \in V$
- cost of loop inside all calls to Visit is total length of all adj. lists.

$$\sum_{x \in V} (\text{len adj}[x]) = \left\{ \begin{array}{l} 2m \text{ undir case} \\ m \text{ dir. case} \end{array} \right\} = \Theta(m)$$

- total cost of DFS: $\Theta(n+m)$, i.e. linear in # bytes of adj list representation

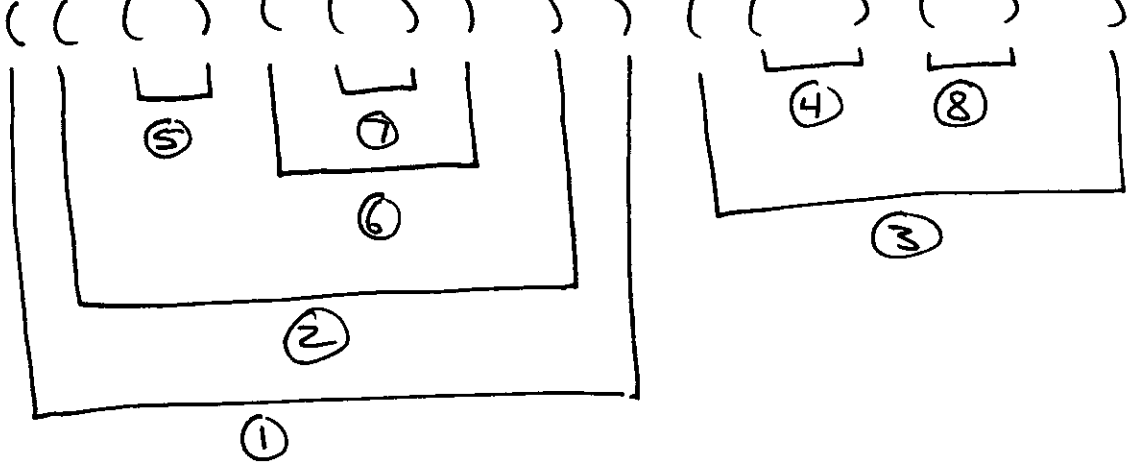
Parenthesis string:

Previous example: discover event = '('

finish event = ')'

times: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

string ((( ) (( ))) (( ) ( ))



Thm (Parenthesis)

Suppose $x, y \in V(G)$ and $d[x] < d[y]$. Then exactly one of the following hold

(1) $d[x] < f[x] < d[y] < f[y]$ — ( ) ( ) — x, y in diff trees, or cousins in same tree

or (2) $d[x] < d[y] < f[y] < f[x]$ — (( )) — y is a desc. of x in same tree.