

CMPS 101:

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Date February 24, 2017

- Predecessor sub graph

BFS tree:

$$V_p = \{x \in V \mid P[x] \neq \text{nil}\} \cup \{s\}$$

$$E_p = \{(P[x], x) \in E \mid P[x] \neq \text{nil}\}$$

Order pair if G directed

Unordered pair if G undirected

$G_p = (V_p, E_p)$ is a tree

- PrintPath(G,s,x) Pre: BFS run with source s

1. if $x == s$
2. Print s
3. else if $P[x] == \text{nil}$
4. Print “ no path from” +s+”to”+x+”exists”
5. else
6. PrintGapth(G,s,P[x])
7. print x

- Runtime

BFS $n = |V|, m = |E|$

- Initialization: $\Theta(n)$
- Queue operations: $O(n)$
- Running adjacent lists: $\Theta(m)$
Total length of lists = $\begin{cases} 2m & \text{undirected} \\ m & \text{directed} \end{cases} = \Theta(m)$
- TOTAL runtime = $\Theta(n + m)$
I.E linear in size (in bytes) of adjacent list representation.

- Depth First Search (DFS)

- Vertex attributes:
color[x] = {white, grey, black}
P[x] Parent (predecessor) of x
d[x] discover time

$f[x]$ finish time

$0 \leq \text{time} \leq 2n$

- DFS() calls Visit()
- DFS(G)
 1. For all $x \in V$
 2. $\text{color}[x] = w$
 3. $P[x] = \text{nil}$
 4. $\text{time} = 0$
 5. for all $x \in V$
 6. if $\text{color}[x] = w$
 7. Visit(x)
- Visit(x)
 1. $\text{color}[x] = g$
 2. $d[x] = \text{time}++$
 3. for all $y \in \text{adj}[x]$
 4. if $\text{color}[y] = w$
 5. $P[y] = x$
 6. Visit[y]
 7. $\text{color}[x] = b$
 8. $f[x] = \text{time}++$
- Predessecor subgraph (DFS Forest)
 $G_p = (V, E_p)$
 $E_p = \{(P[x], x) \mid x \in V \text{ and } P[x] \neq \text{nil}\}$
- Example:

