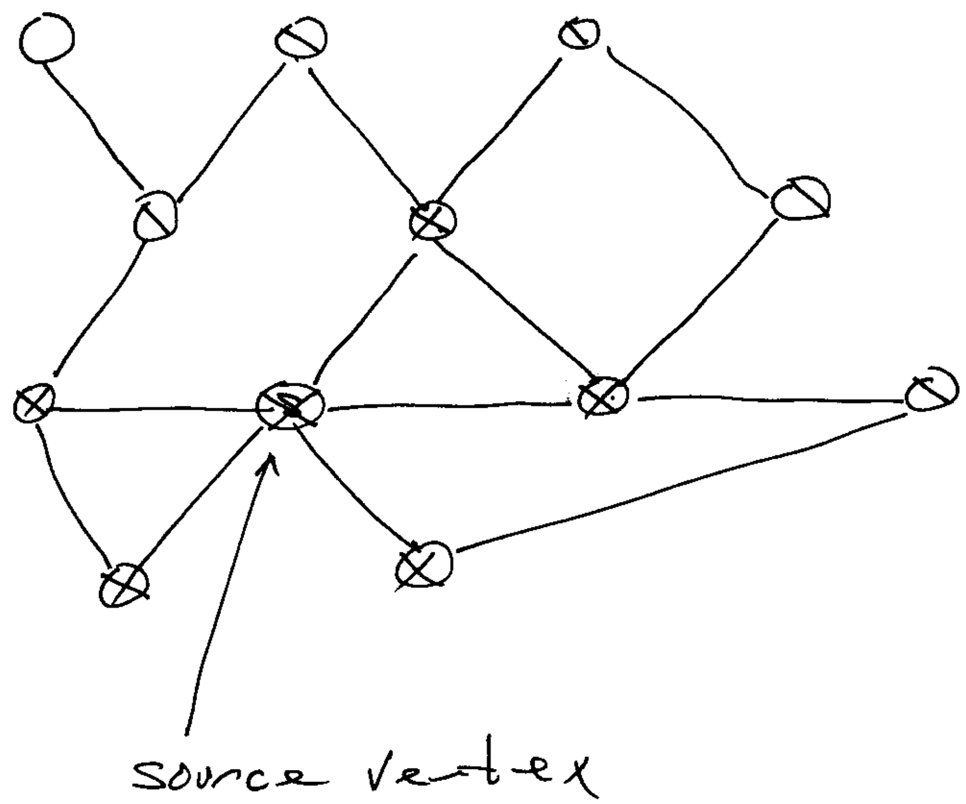
CSE 101 10-27-20

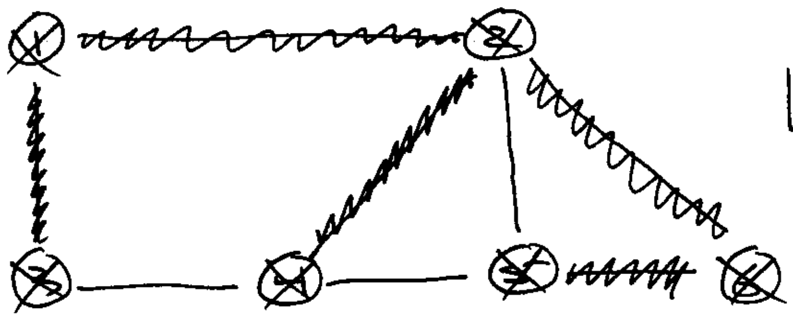
- quizz Today
- Pa2 2 more days, last ext.
- Pa3 Posted.

BFS - examples

Boundry between discovered & undiscovered vertices is expanded uniformly across frontier.



Ex.

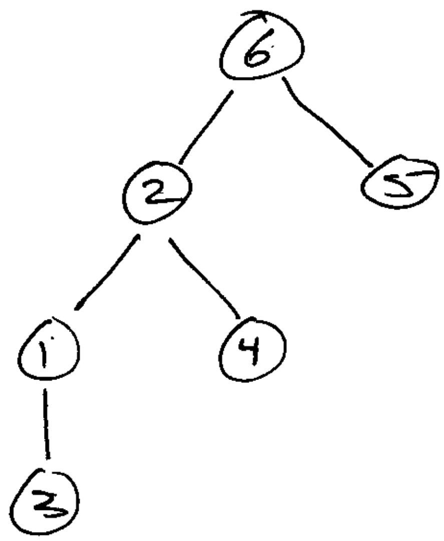


$\boxed{s=6}$

	adj	color	d	p
1	2 3	b	2	2
2	1 4 5 6	b	1	6
3	1 4	b	3	1
4	2 3 5	b	2	2
5	2 4 6	b	1	6
6	2 5	b	0	n

Q: ~~6~~ ~~2~~ ~~5~~ ~~1~~ ~~4~~ ~~3~~

Tree



dist

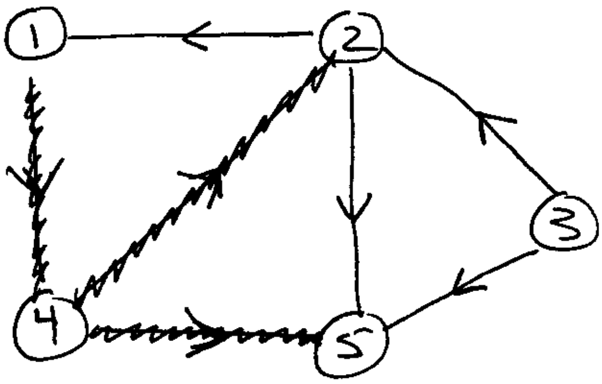
0

1

2

3

Ex

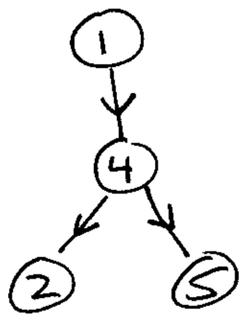


$\boxed{s = 1}$

	adj	color	d	p
1	4	~~g~~ b	0	n
2	1 5	~~w~~ ~~g~~ b	~~∞~~ 2	~~n~~ 4
3	2 5	w	∞	n
4	2 5	~~w~~ ~~g~~ b	~~∞~~ 1	~~n~~ 1
5		~~w~~ ~~g~~ b	~~∞~~ 2	~~n~~ 4

Q: ~~1~~ ~~4~~ ~~2~~ ~~5~~

BFS Tree:



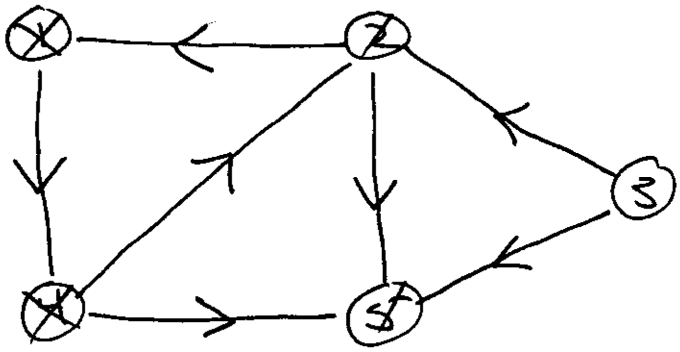
dist

0

1

2

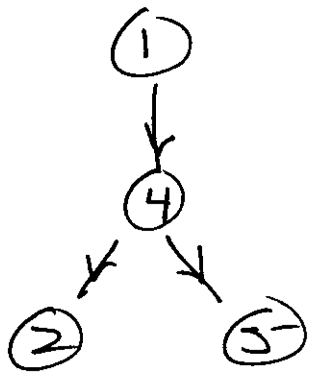
same example



$\boxed{S=1}$

Q: ~~1~~ ~~4~~ ~~2~~ ~~5~~

Tree



<u>Defn</u>

The <u>Predecessor subgraph</u> (or <u>BFS tree</u>) is $T = (V_p, E_p)$ where

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

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

- ordered pair in digraph case
- unordered pair $\{P[x], x\}$ in graph case.

<u>note</u>: The Pred. subgraph must be a tree since: (1) it must be acyclic since vertices are added to Q at most once, so no 'cycles' of discovery; and (2) $|V_p| = |E_p| + 1$, i.e. $|E_p| = |V_p| - 1$. It follows from treeness thm that $T = (V_p, E_p)$ is a tree.

Thm

for any $x \in V_p$, the unique s-x path in T is a shortest s-x path in G. (Thm 22.5 in CLRS.)

To find shortest paths from $P[\,]$, use

PrintPath(G, s, x) Pre: BFS(G, s) has run.

```
if x == s
    print(s)
else if P[x] == nil
    print(x, 'not reachable from', s)
else
    PrintPath(G, s, P[x])
    print(x)
```