

CSE 101 - 1-15-26

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## Graph Algorithms Handout

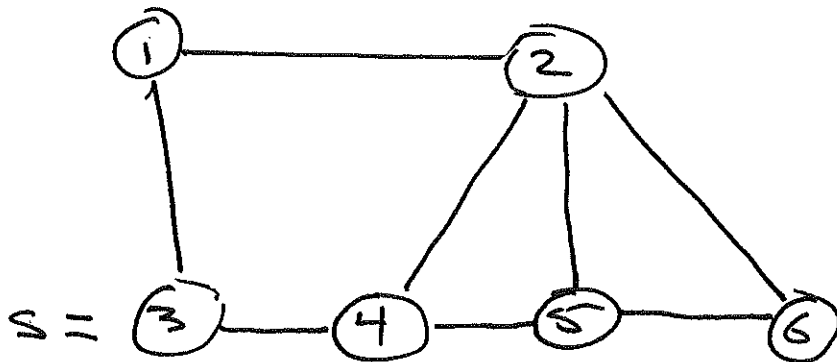
### Single source shortest Paths (SSSP)

Given  $s \in V(G)$

- (1) determine  $\delta(s, x)$  for all  $x \in V(G)$
- (2) for each  $x \in V(G)$  with  $\delta(s, x) < \infty$ ,  
determine a shortest  $s-x$   
Path.

Algorithm: Breadth First Search (BFS)

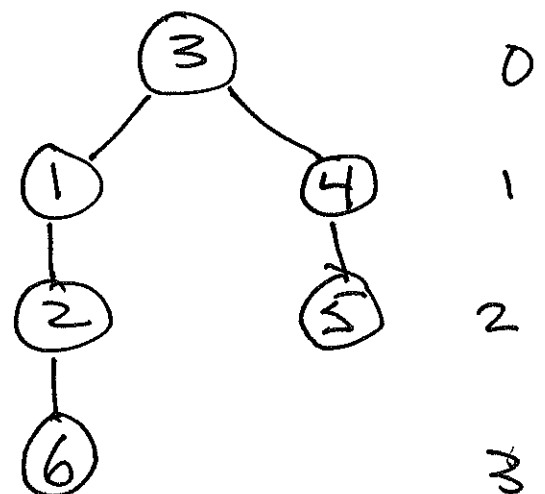
Ex. 2 = 3



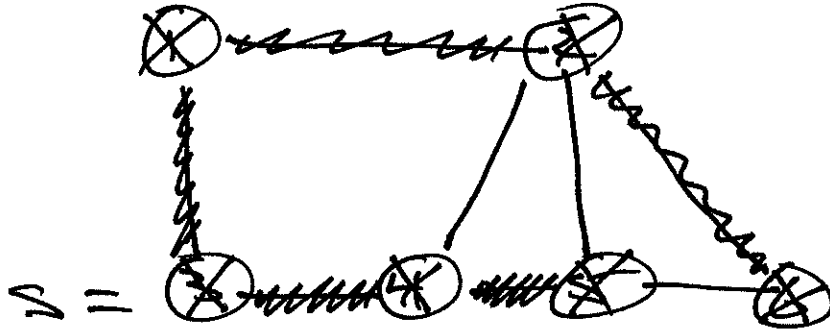
| x   | adj[x]                              | color                       | distance     | Parent       |
|-----|-------------------------------------|-----------------------------|--------------|--------------|
| 1   | <u>2</u> <u>3</u>                   | <del>w</del> <del>g</del> b | <del>1</del> | <del>3</del> |
| 2   | <u>1</u> <u>4</u> <u>5</u> <u>6</u> | <del>w</del> <del>g</del> b | <del>2</del> | <del>1</del> |
| * 3 | <u>1</u> <u>4</u>                   | <del>g</del> b              | 0            | 1            |
| 4   | <u>2</u> <u>3</u> <u>5</u>          | <del>w</del> <del>g</del> b | <del>1</del> | <del>3</del> |
| 5   | <u>2</u> <u>4</u> <u>6</u>          | <del>w</del> <del>g</del> b | <del>2</del> | <del>4</del> |
| 6   | <u>2</u> <u>5</u>                   | <del>w</del> <del>g</del> b | <del>3</del> | <del>2</del> |

BFS Tree dist

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



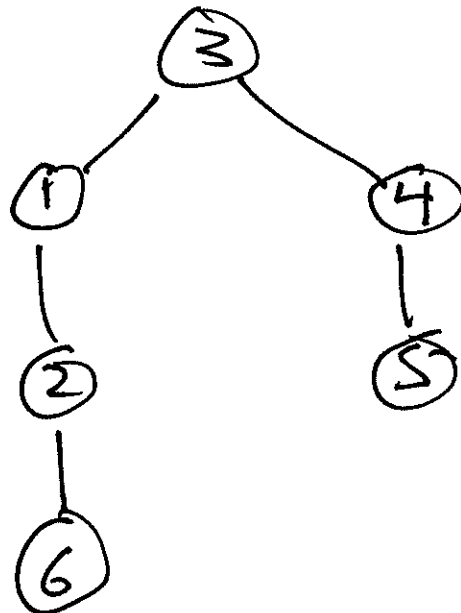
Ex. same



Q:  $\neq \neq \neq \neq \neq \neq$

BFS Tree!

(Predecessor  
Subgraph)



dist

0

1

2

∞

Predecessor Subgraph of  
 $G = (V, E)$

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

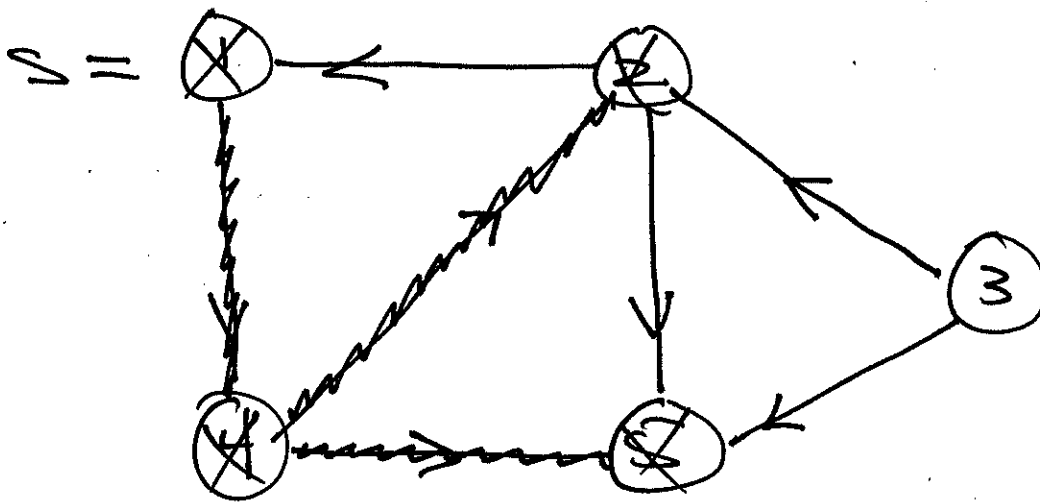
$$E_p = \{(\underbrace{p[x], x}) \mid p[x] \neq \text{nil}\}$$

unordered if  $G$  undirected  
 ordered if  $G$  directed

Source = 1

5

111 x.

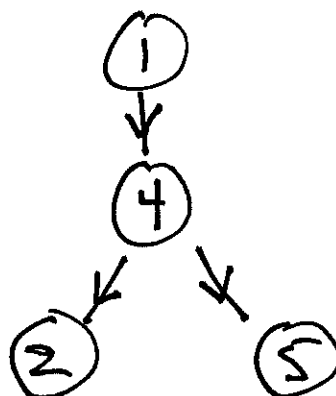


|     | adj | color          | d            | p            |
|-----|-----|----------------|--------------|--------------|
| * 1 | 4   | <del>g</del> b | 0            | n            |
| 2   | 1 5 | <del>w</del> b | <del>2</del> | <del>4</del> |
| 3   | 2 5 | w              | <del>2</del> | n            |
| 4   | 2 5 | <del>w</del> b | <del>1</del> | <del>1</del> |
| 5   |     | <del>w</del> b | <del>2</del> | <del>4</del> |

Q: X Y Z \$

BFS Tree

depth



0

1

2