

# Topological Sort

- Given a DAG, directed acyclic graph
- Find an ordering of the vertices such that is  $(v, w) \in E$  then  $v$  is before  $w$  in the ordering.

## Algorithm

- DFS(G)
- Output the nodes in order of decreasing finishing times

Running time:  $O(E)$

# Proof of Correctness

**Theorem** Topological Sort Algorithm is correct, i.e. if  $(x, y) \in E$  then  $f(x) > f(y)$ .

## **Proof**

Case 1: ( $d(x) < d(y)$ )

- At time  $d(x)$ ,  $y$  must be white.
- Using the parenthesis theorem,

$$d(x) < d(y) < f(y) < f(x).$$

Case 2: ( $d(x) > d(y)$ ).

- Because  $G$  is a DAG and we have an edge  $(x, y)$ , there is no path from  $y$  to  $x$ .
- This means that  $f(y) < d(x)$ .
- For any vertex  $d(x) < f(x)$ .
- Putting these two inequalities together we get  $f(y) < f(x)$ .