

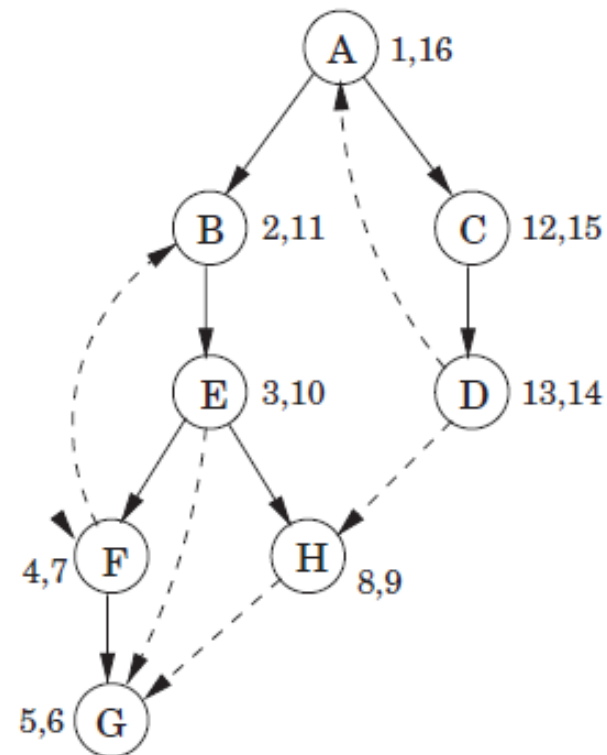
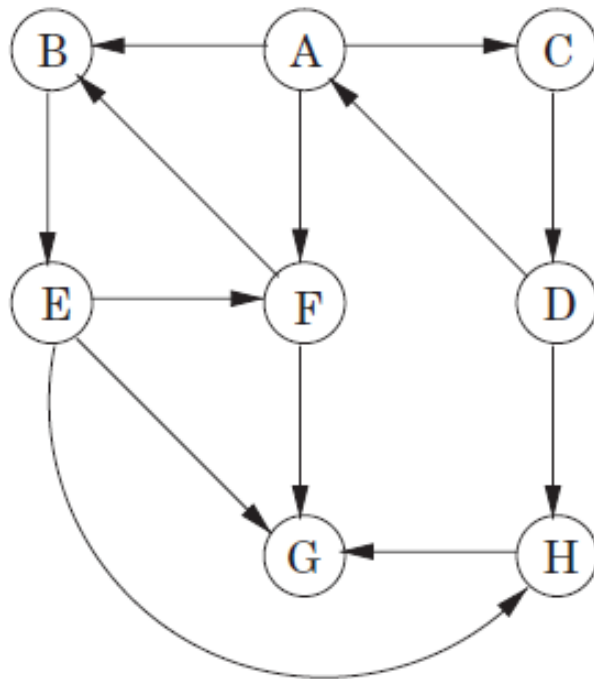
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“본 강의 동영상 및 자료는 대한민국 저작권법을 준수합니다. 본 강의 동영상 및 자료는 상명대학교 재학생들의 수업목적으로 제작·배포되는 것이므로, 수업목적으로 내려받은 강의 동영상 및 자료는 수업목적 이외에 다른 용도로 사용할 수 없으며, 다른 장소 및 타인에게 복제, 전송하여 공유할 수 없습니다. 이를 위반해서 발생하는 모든 법적 책임은 행위 주체인 본인에게 있습니다.”

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## 4.3 Depth-first search in directed graphs

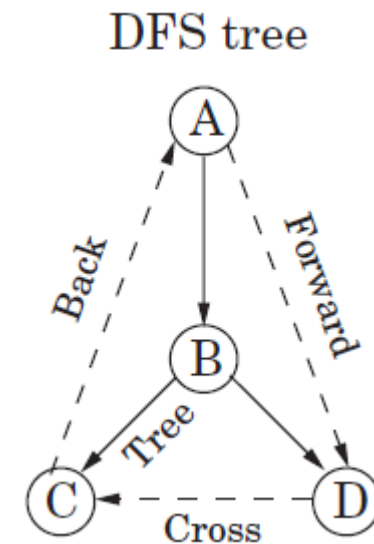
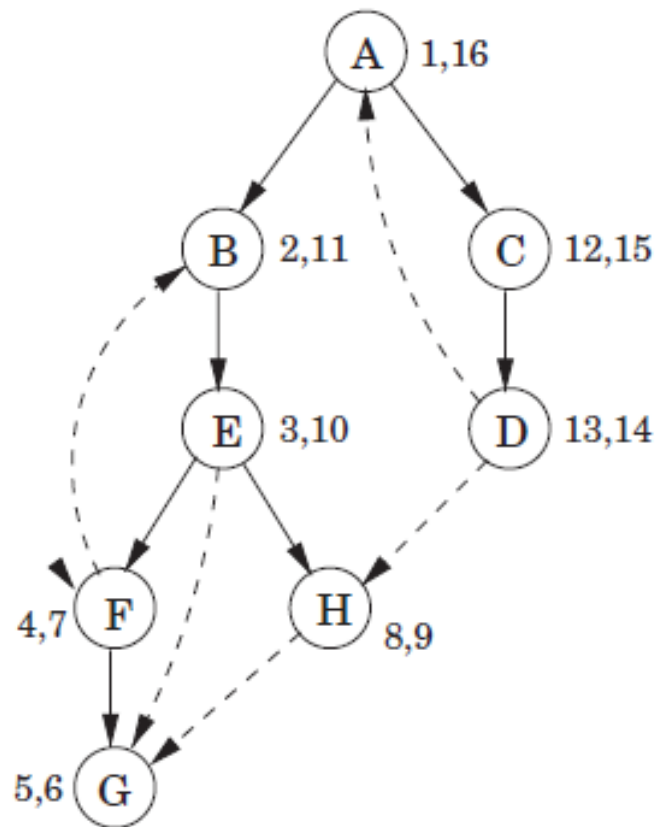
- Example of a depth-first search on digraph



## 4.3 Depth-first search in directed graphs

### (1) Types of edges

- An example on digraph  $\rightarrow$  DFS tree



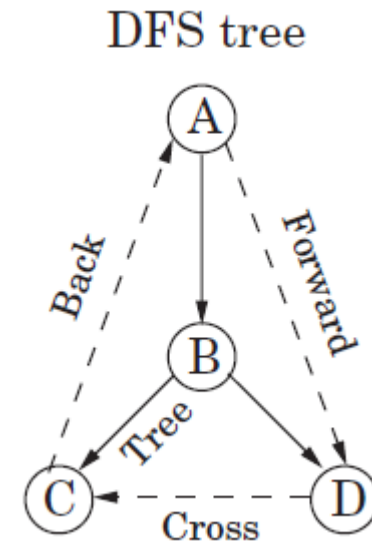
## 4.3 Depth-first search in directed graphs

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### (1) Types of edges

- Four types of edges in DFS tree

- Tree edge
  - Edges in the DFS tree
- Forward edge
  - To a non-child descendant
- Backward edge
  - To an ancestor
- Cross edge
  - To neither descendant nor ancestor



## 4.3 Depth-first search in directed graphs

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### (1) Types of edges

- Relation with pre and post
  - For an edge  $\langle u, v \rangle$

$\begin{bmatrix} [ & [ & ] & ] \\ u & v & v & u \end{bmatrix}$	Tree/Forward
$\begin{bmatrix} [ & [ & ] & ] \\ v & u & u & v \end{bmatrix}$	Backward
$\begin{bmatrix} [ & ] & [ & ] \\ v & v & u & u \end{bmatrix}$	Cross

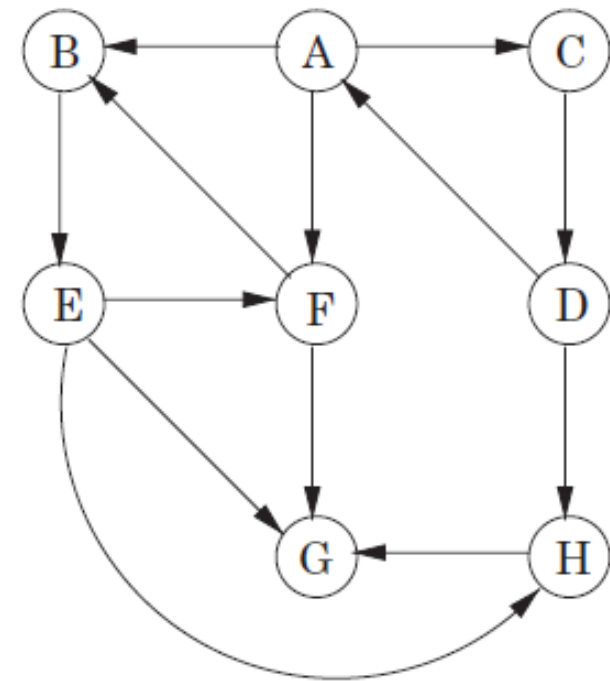
## 4.3 Depth-first search in directed graphs

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### (2) Directed Acyclic Graph (dag)

#### – Definitions (1)

- Cycle
  - A circular path in a directed graph
  - $u \rightarrow v \rightarrow w \rightarrow \dots \rightarrow u$
  - Cycles in this graph?
- Acyclic graph
  - A graph without a cycle



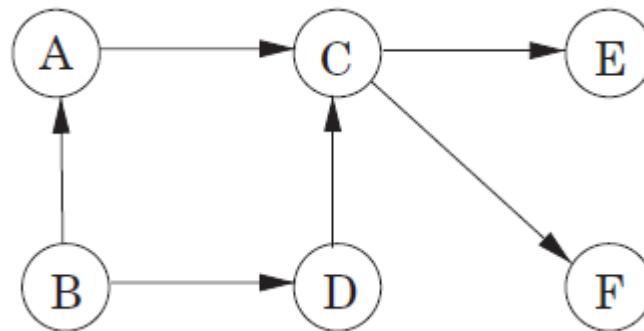
## 4.3 Depth-first search in directed graphs

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### (2) Directed Acyclic Graph (dag)

#### – Definitions (2)

- Source
  - A vertex that has only out-edges
- Sink
  - A vertex that has only in-edges



## 4.3 Depth-first search in directed graphs

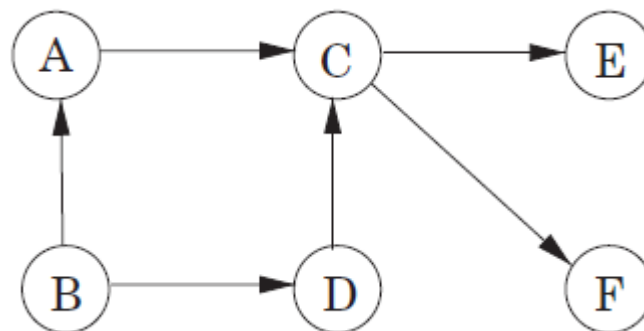
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### (2) Directed Acyclic Graph (dag)

- Definitions (3)

- Topological order

- Order the vertices one after the other in such a way that each edge goes from an earlier vertex to a later vertex
- Linearization
- How many linearizations in this graph?





## 4.3 Depth-first search in directed graphs

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### (2) Directed Acyclic Graph (dag)

#### – Properties

- A directed graph has a cycle if and only if its depth-first search reveals a back edge
- In a dag, every edge leads to a vertex with a lower post number
- Every dag has at least one source and at least one sink

# All about graph

Type	Purpose	Operations	Performance
DFS	Traverse all vertices	Visiting all vertices & visiting all edges	$O(n) + O(m)$
SCC			
BCC			
BFS			
Dijkstra			
Floyd			
Kruskal (Greedy)			
Prim (Greedy)			
MultiStage (Dynamic)			

## 4.2 Depth-first search in undirected graphs

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다음 중 DFS에 대한 설명 중 올바른 것을 모두 고르시오.

- (a) DFS의 결과로 만들어지는 Depth-first spanning tree는 항상 binary tree가 되지는 않는다.
- (b) Depth-first spanning tree의 depth는 graph의 vertex의 수에 비례한다.
- (c) Depth-first spanning tree의 depth는 graph의 edge의 수에 비례한다.
- (d) Depth-first spanning tree에서 root node에 더 가까운 vertex는 graph에서 root node에 해당하는 vertex에 더 가깝게 위치한다.
- (e) 모든 그래프에 대해서 하나의 depth-first spanning tree가 존재한다.