Depth-First Search in Directed Graphs

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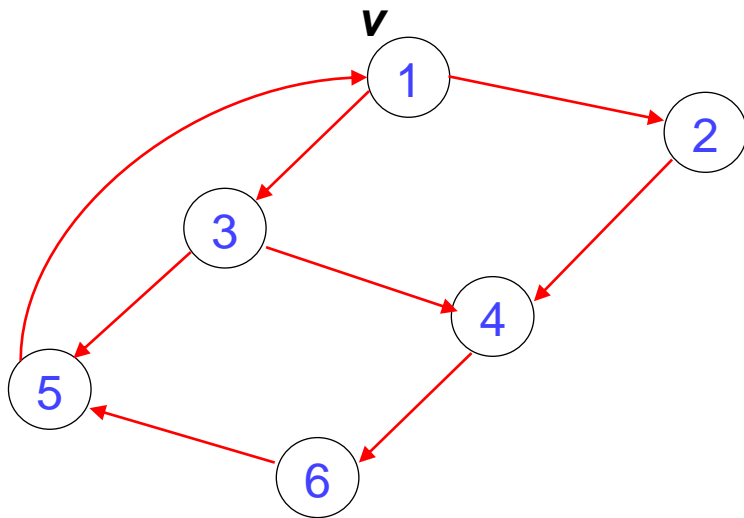
DFS in Directed Graphs

- How does *depth-first search* in directed graphs differ from *depth-first search* in undirected graphs?

- Let's take an example of a directed graph
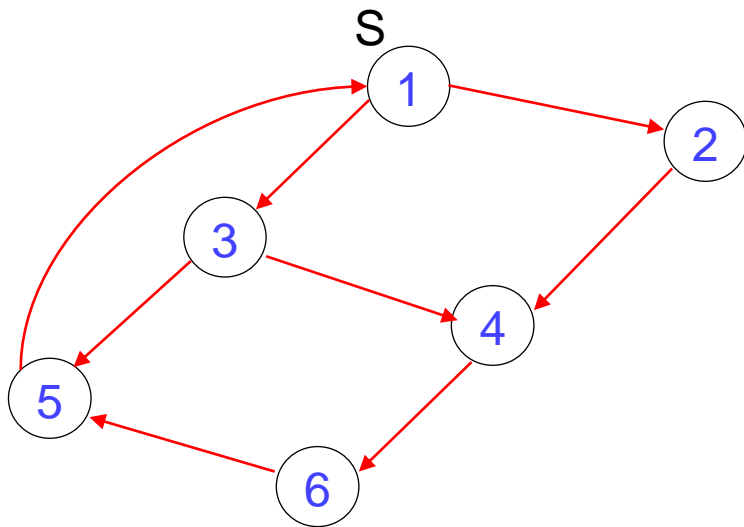

```
depthFirstSearch(v)
{
    visited[v] = 1;
    for (for all vertex u adjacent from v) do
        if !visited[u] then
            depthFirstSearch(u);
}
```

In-adjacent vs. Out-adjacent

- The DFS process is going to be exactly the same

- What is *adjacent* in directed graphs?
  - A vertex *u* will be called adjacent to vertex *v,* if the edge goes from *v* to *u*

Vertex *5* is in-adjacent to vertex *v*
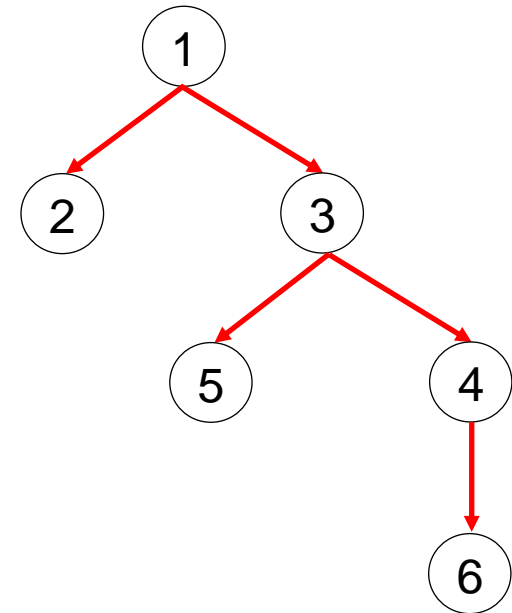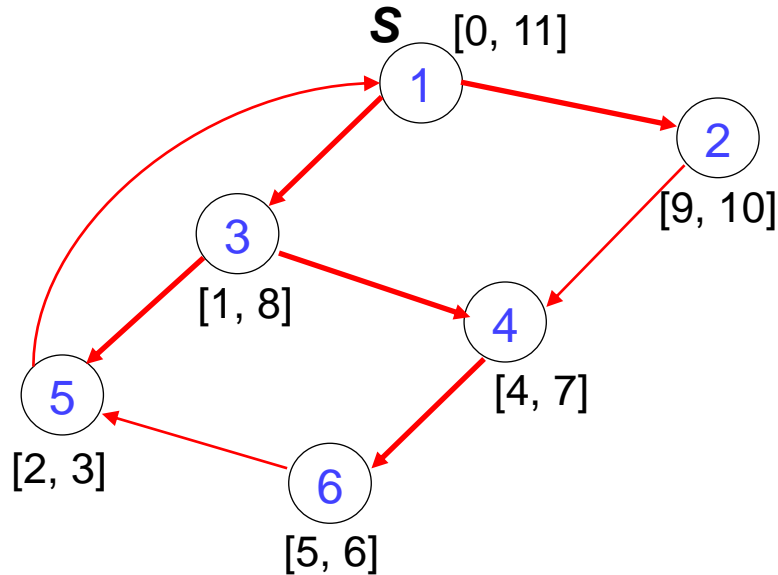
Vertex *3* is out-adjacent to vertex *v*

Vertex *2* is out-adjacent to vertex *v*

- In directed graphs, when we talk of adjacent we mean out-adjacent
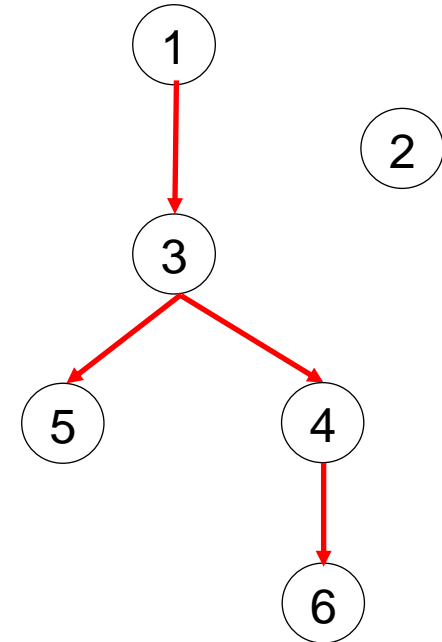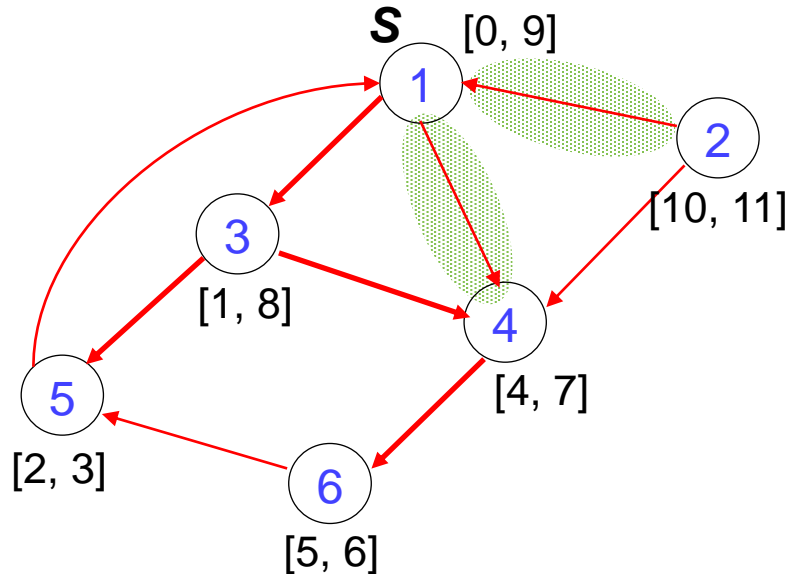
The DFS Tree

- What is the DFS tree here?

- What is the arrival time and departure time for each of the vertices?

Another Example

- What will happen to vertex **2**? When will that get visited?

- DFS will not visit all vertices if the graph is not connected
  - However, both DFS and BFS should visit every vertex
  - A new DFS has to be started from vertex **2**

S   [0, 9]

1

2   [10, 11]

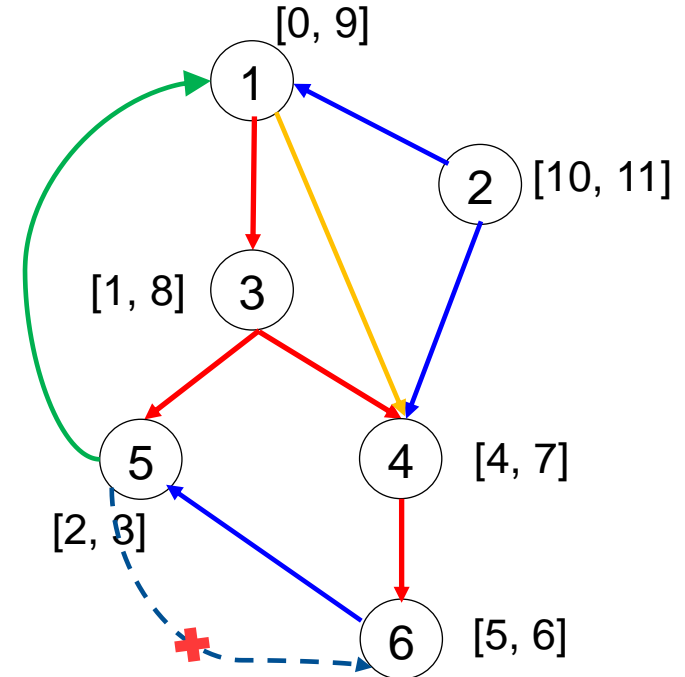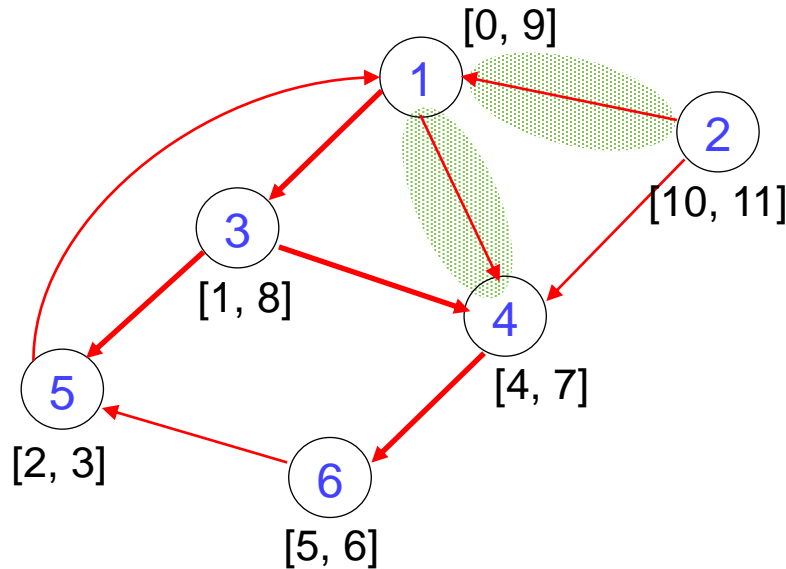3   [1, 8]

4   [4, 7]

5   [2, 3]

6   [5, 6]

Types of Edges

- **Red edge:** Tree edge (an edge along which we traverse in the tree)
- **Yellow edge:** Forward edge (an edge that is going forward in the graph)
- **Green edge:** Back edge (an edge that is going backward in the graph)
- **Blue edge:** Cross edge (an edge that is not going either forward or back in the graph)
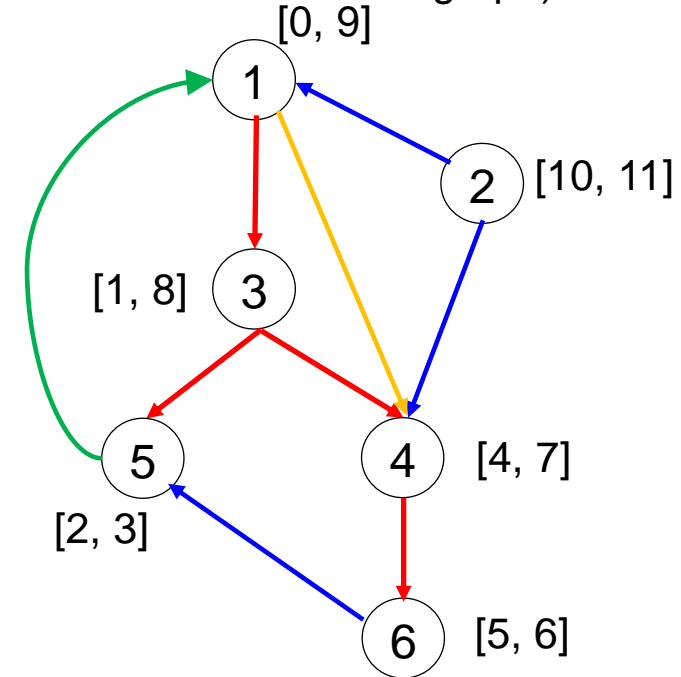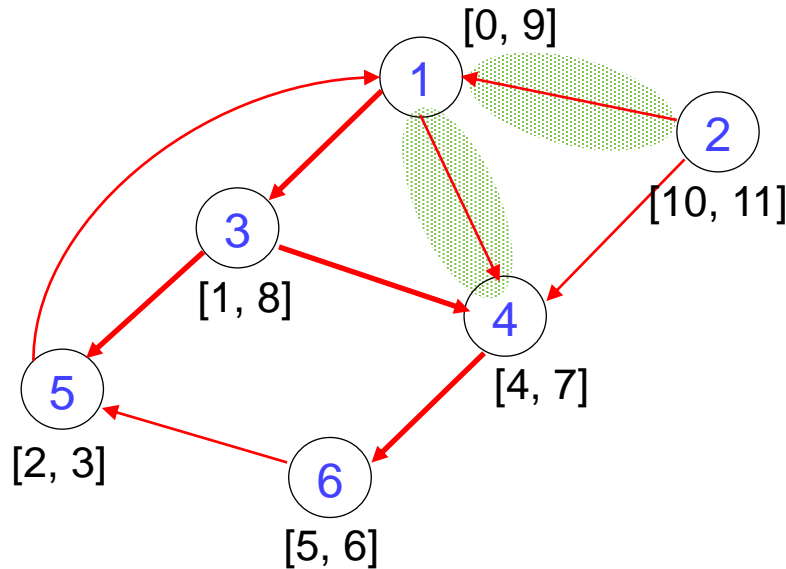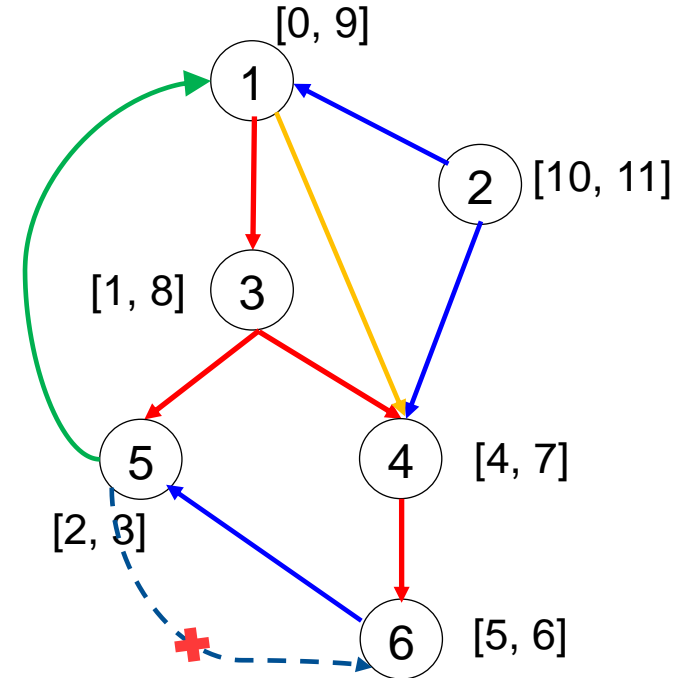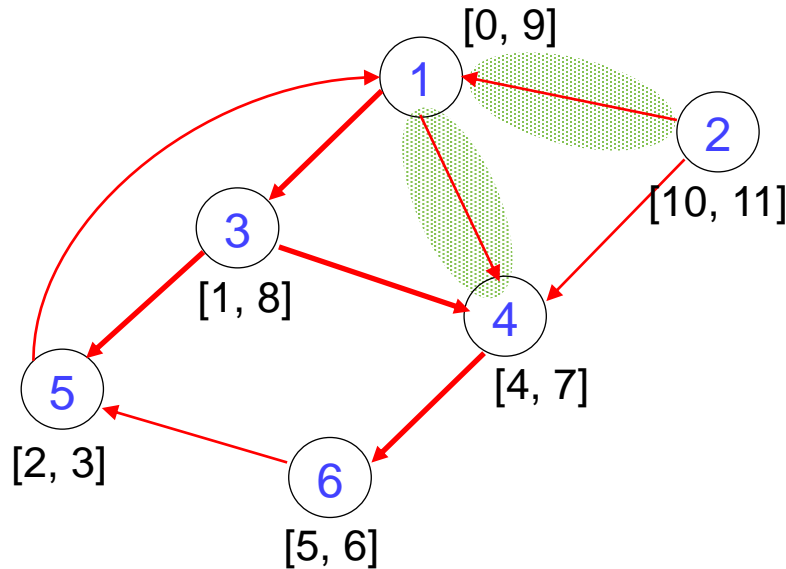
Back Edges

- If (***u***, ***v***) is a back edge
  - arr[***u***] > arr[***v***]
  - dept[***u***] < dept[***v***]
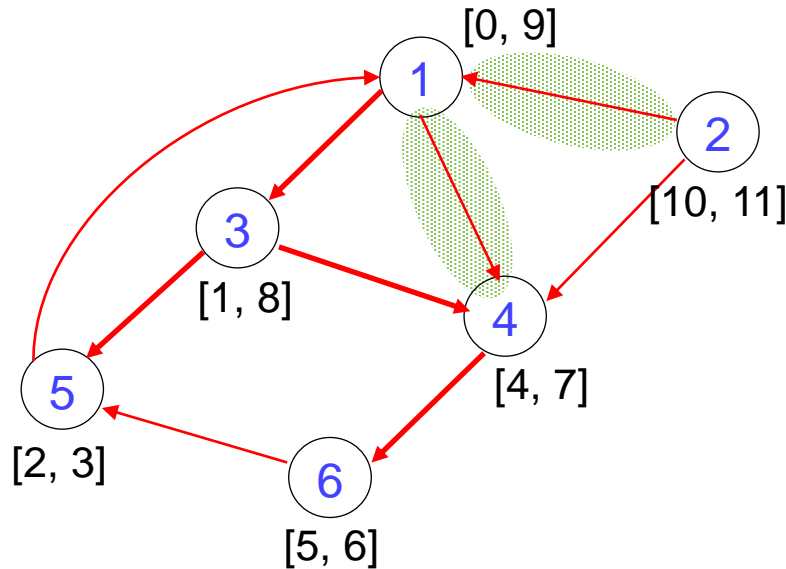
Forward Edges

- If (**u**, **v**) is a forward edge
  - arr[**u**] < arr[**v**]
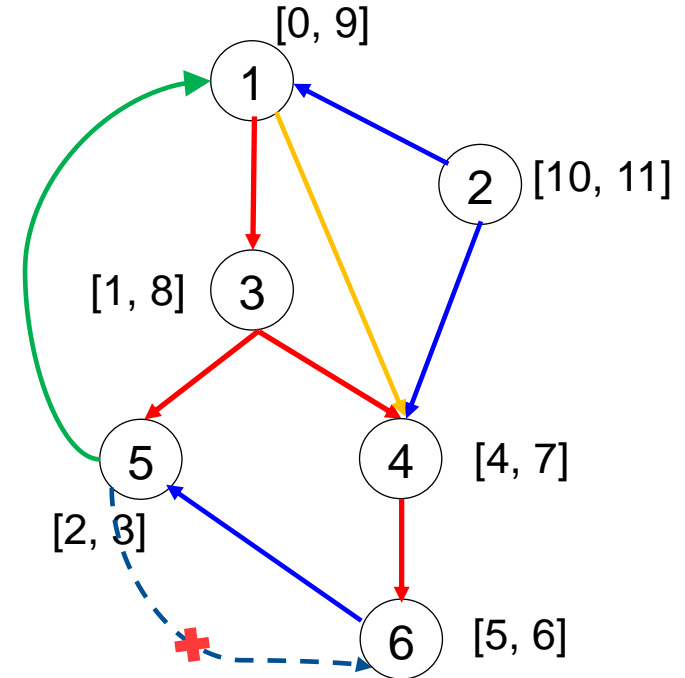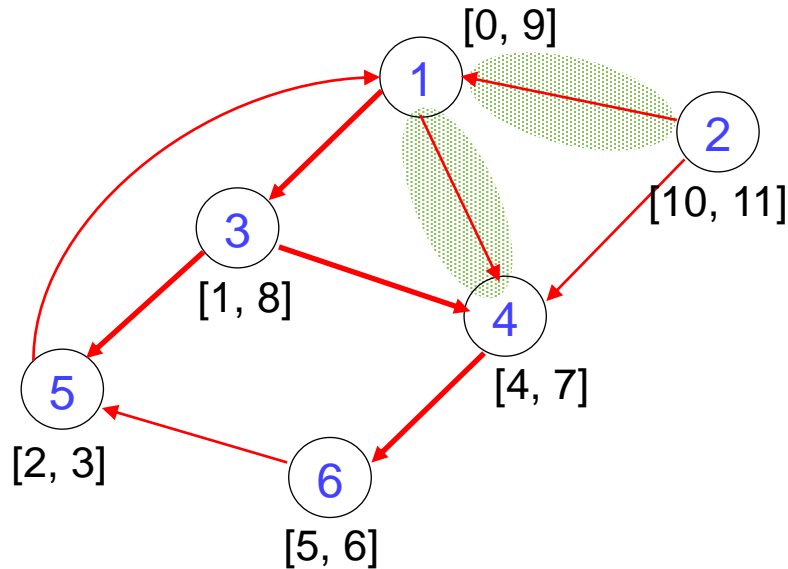 - dept[**u**] > dept[**v**]

Cross Edges

- For two end points in the **cross edge**, none of them is a ancestor of the other

- Cross edge is going in one direction only: **right to left**
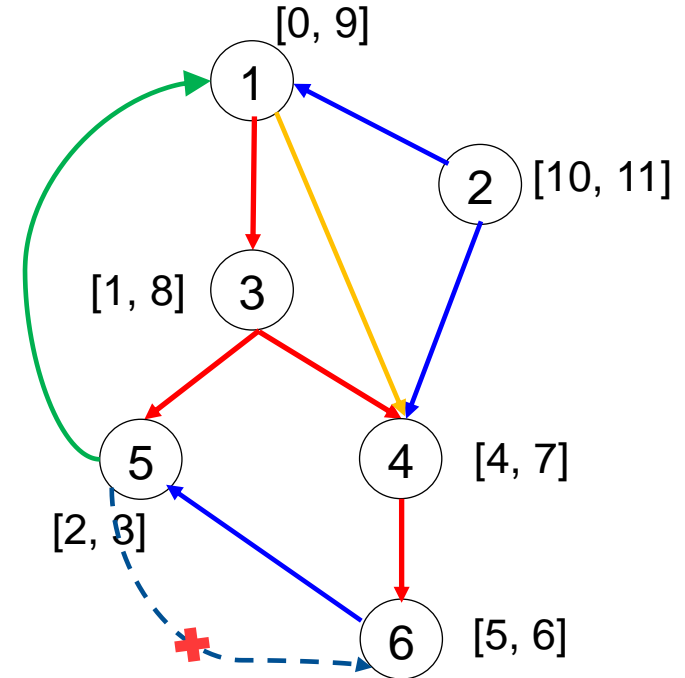
Cross Edges

- If (***u***, ***v***) is a cross edge
  - arr[***v***] < dept[***v***] < arr[***u***] < dept[***u***]

Next Lecture

Applications of DFS in Directed Graphs

Thank you for your attention...

Any question?

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