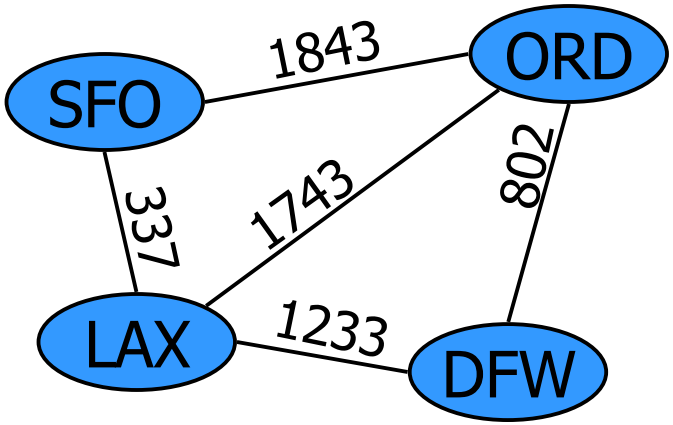
Graph Traversal



Searching a graph

- In a tree, searches start from the root.
- In general directed graph, there may not be a vertex from which every other vertex can be reached may not be possible to traverse entire digraph, *regardless of the start vertex*.
- To determine which nodes are reachable from a given node. Two standard methods of searching are

  depth-first search
  breadth-first search.

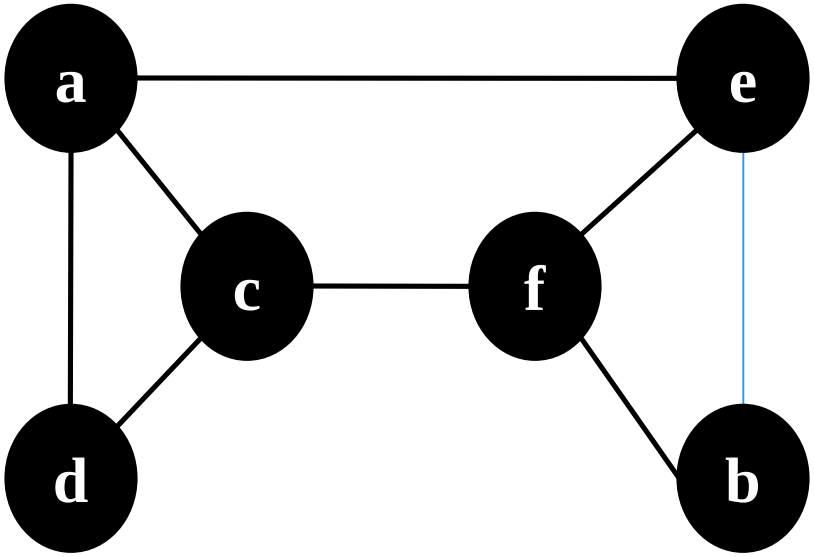
Depth First Search

- When given a graph, we are often interested in searching the vertices in the graph in some organized way.
  - Depth-first search (DFS) starts visiting a graph at some random unvisited vertex.
  - When a vertex is visited, a flag is marked to indicate that it has been visited.
  - At each vertex v, DFS recursively visits an unvisited neighbour of v.
  - If there are no unvisited neighbour, recursion stop and backs up.
- It is convenient to use stack in DFS
  - push vertex on the stack when visited first time
  - pop it when all of it becomes dead end

DFS algorithm

```
set DFSnumber for all vertices to be -1
for each unvisited vertex v (DFSnumber == -1)
        dfs(v)
---
dfs(v)
{
    set DFSnumber[v] = 1
    for each w adjacent to v
        if DFSnumber[w] == -1
            dfs(w)
}
```

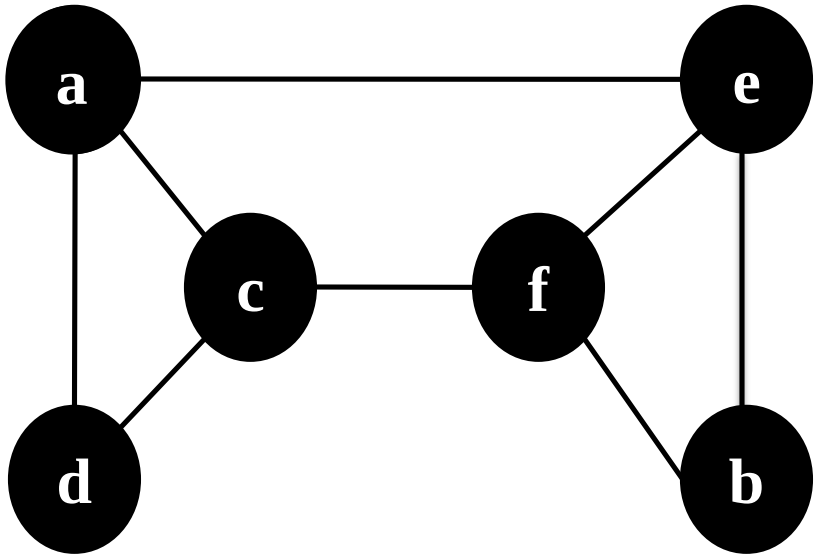
Depth-First Search



a	b	c	d	e	f
-1	-1	-1	-1	-1	-1

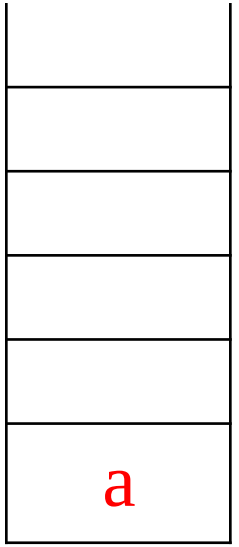
DFSnumber

Depth-First Search



Stack Ordering

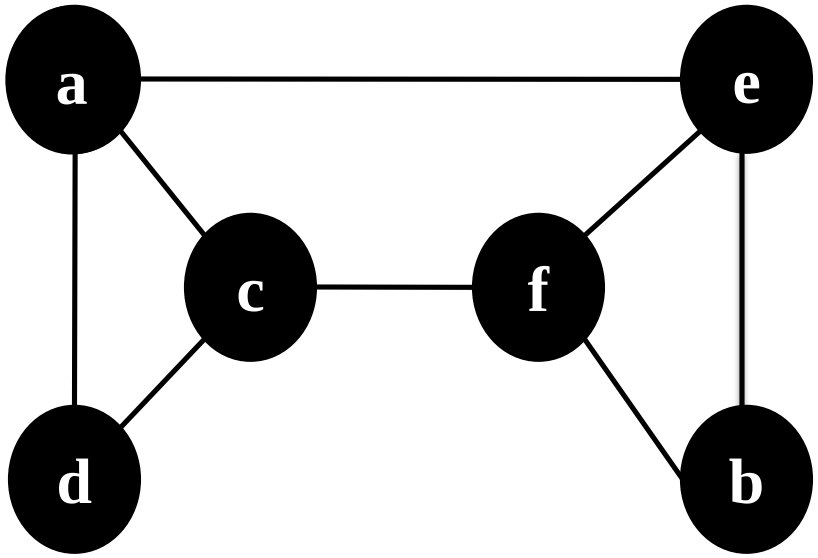
Vertex	Push	Pop
a	1	



a	b	c	d	e	f
1	-1	-1	-1	-1	-1

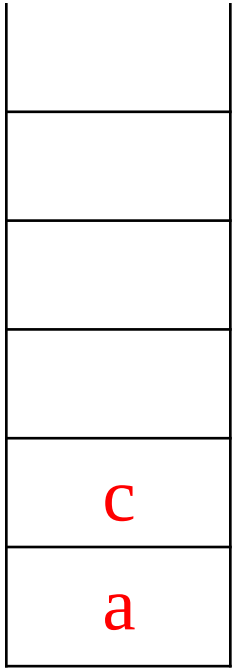
DFSnumber

Depth-First Search



Stack Ordering

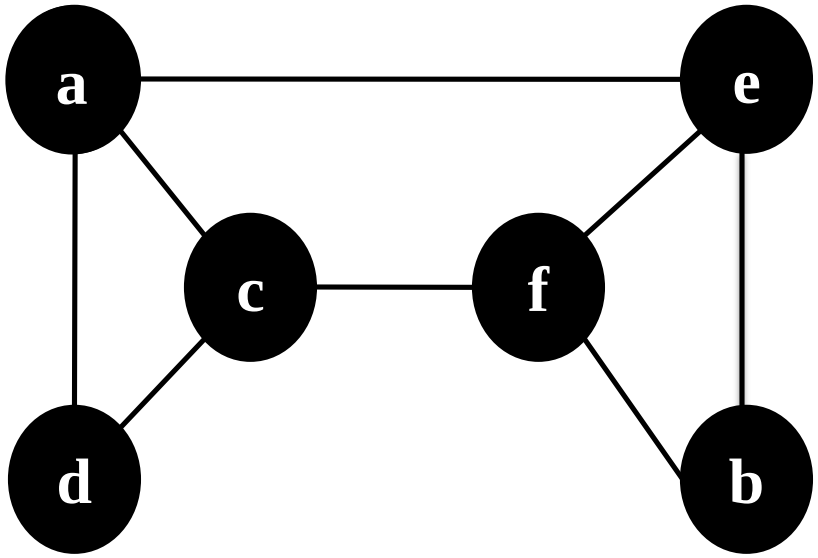
Vertex	Push	Pop
a	1	
c	2	



a	b	c	d	e	f
1	-1	1	-1	-1	-1

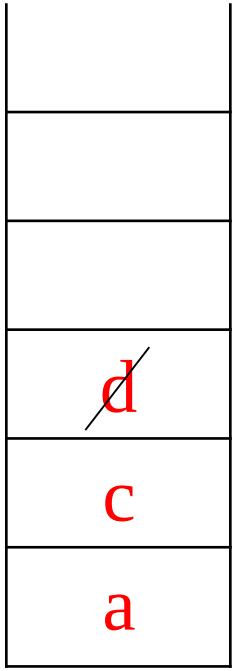
DFSnumber

Depth-First Search



Stack Ordering

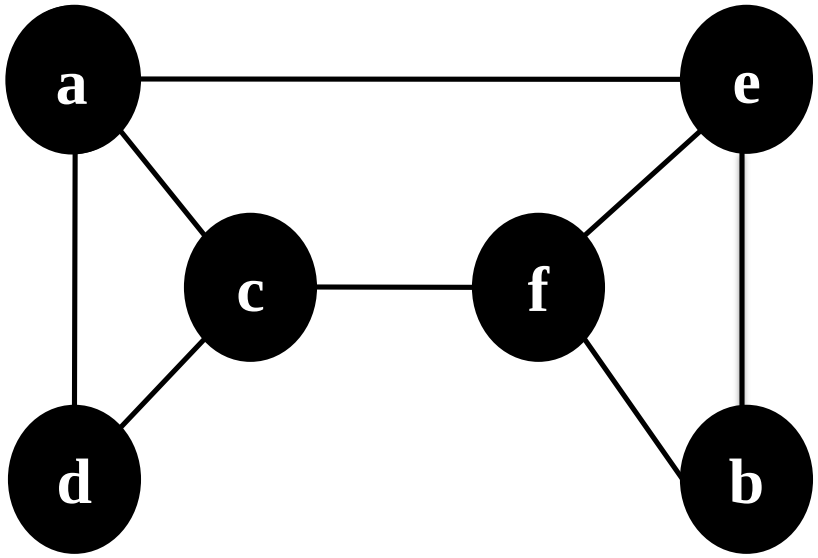
Vertex	Push	Pop
a	1	
c	2	
d	3	1



a	b	c	d	e	f
1	-1	1	1	-1	-1

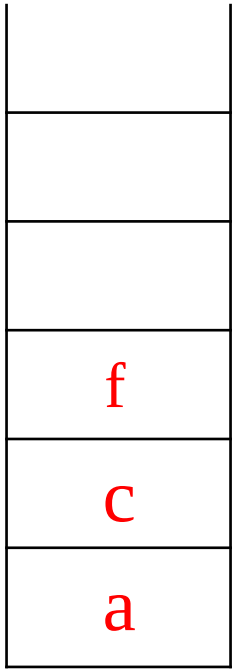
DFSnumber

Depth-First Search



Stack Ordering

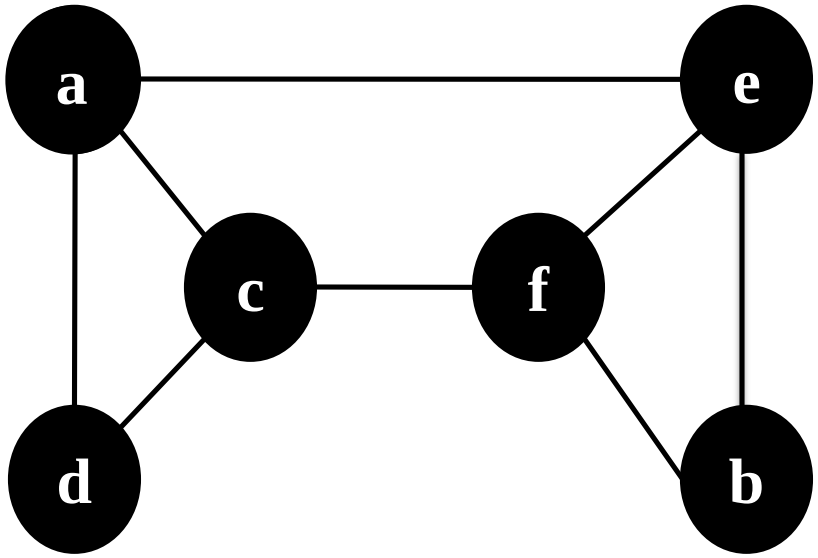
Vertex	Push	Pop
a	1	
c	2	
d	3	1
f	4	



a	b	c	d	e	f
1	-1	1	1	-1	1

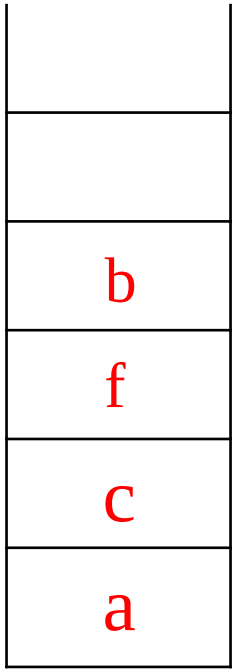
DFSnumber

Depth-First Search



Stack Ordering

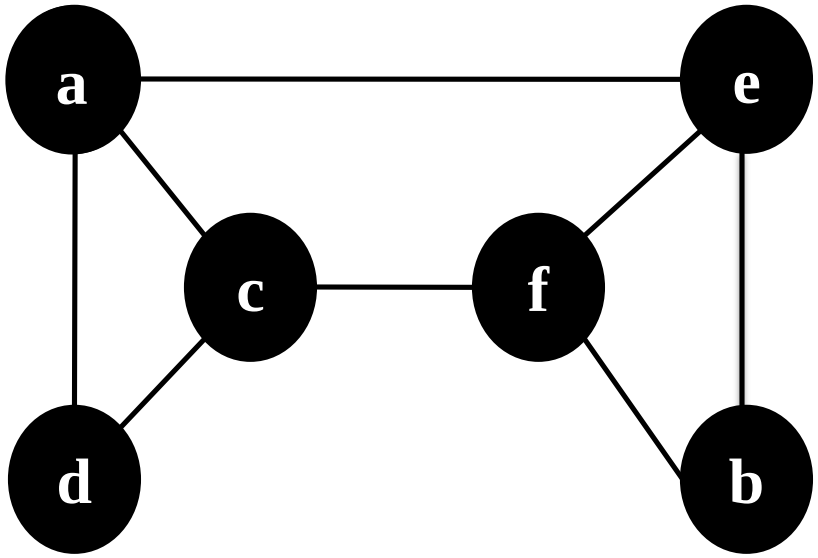
Vertex	Push	Pop
a	1	
c	2	
d	3	1
f	4	
b	5	



a	b	c	d	e	f
1	1	1	1	-1	1

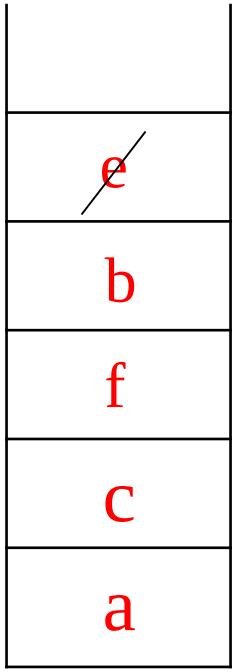
DFSnumber

Depth-First Search



Stack Ordering

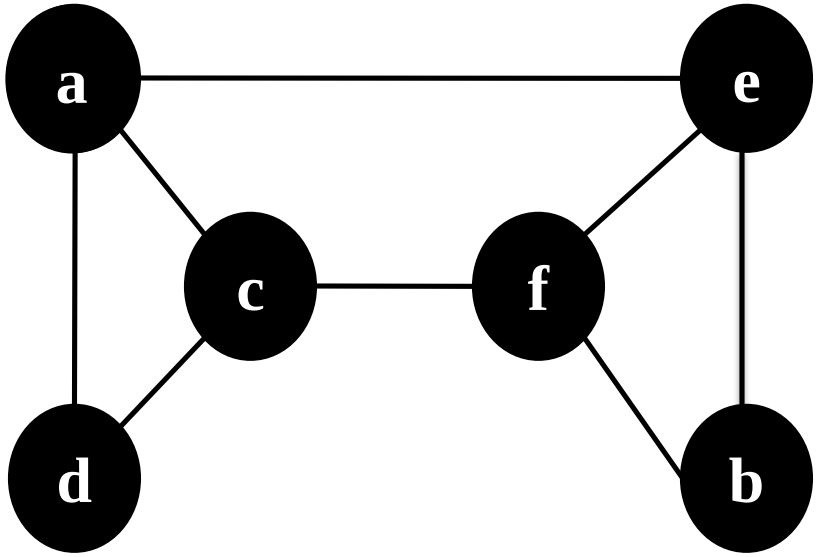
Vertex	Push	Pop
a	1	
c	2	
d	3	1
f	4	
b	5	
e	6	2



a	b	c	d	e	f
1	1	1	1	1	1

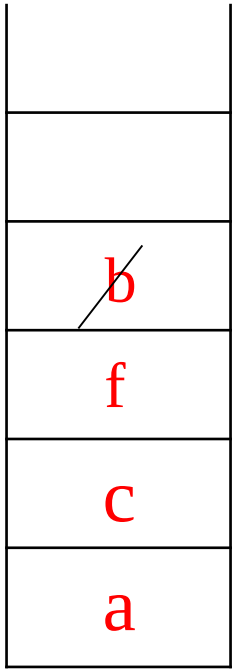
DFSnumber

Depth-First Search



Stack Ordering

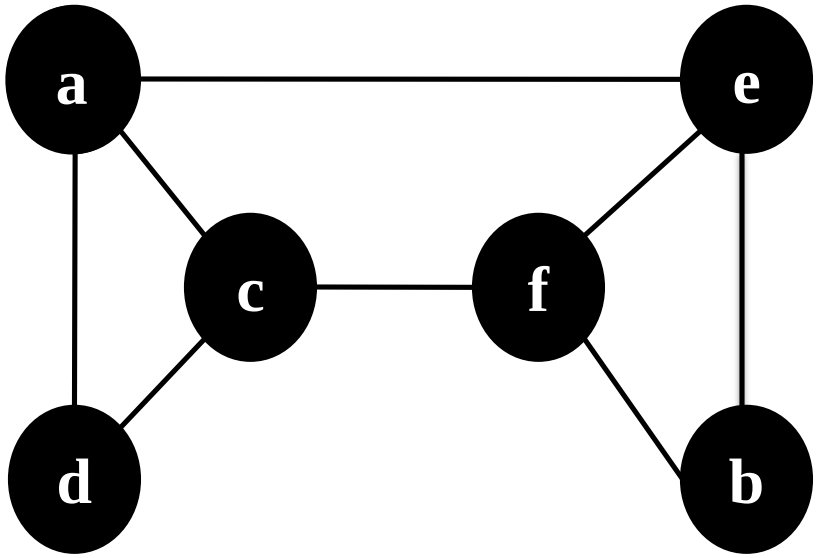
Vertex	Push	Pop
a	1	
c	2	
d	3	1
f	4	
b	5	3
e	6	2



a	b	c	d	e	f
1	1	1	1	1	1

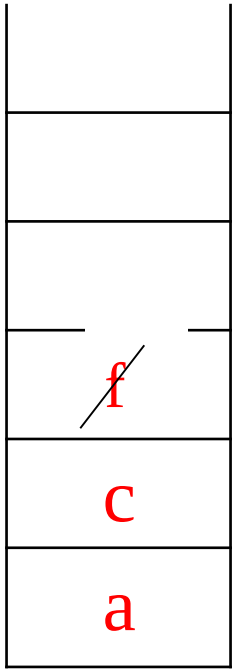
DFSnumber

Depth-First Search



Stack Ordering

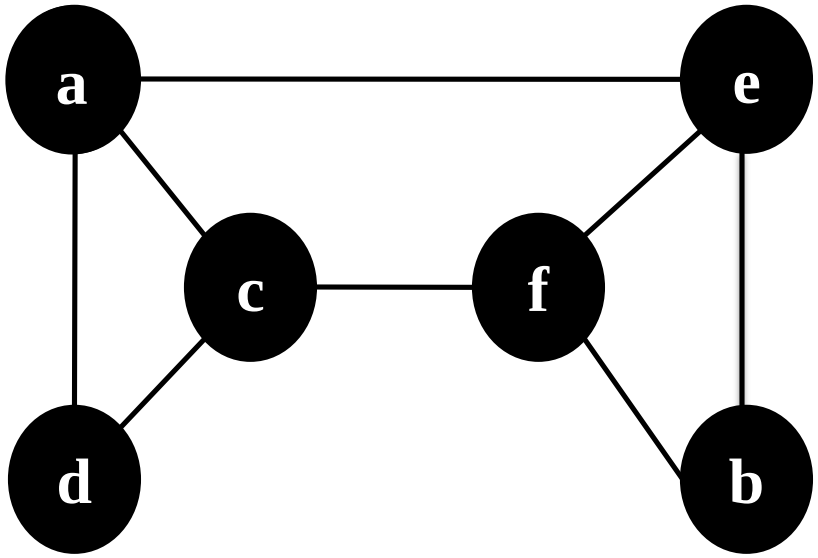
Vertex	Push	Pop
a	1	
c	2	
d	3	1
f	4	4
b	5	3
e	6	2



a	b	c	d	e	f
1	1	1	1	1	1

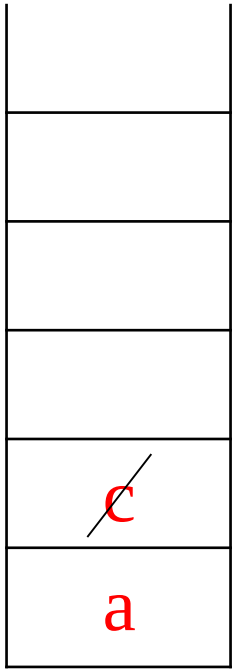
DFSnumber

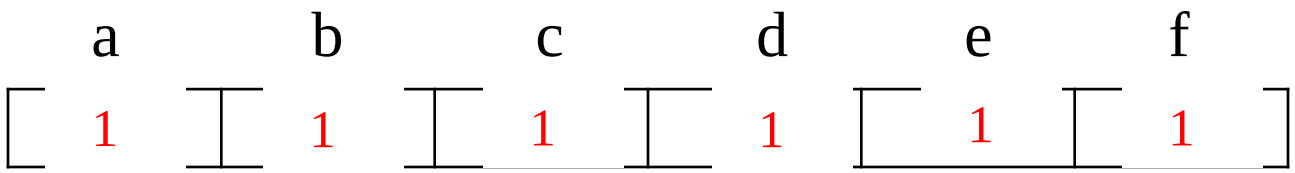
Depth-First Search



Stack Ordering

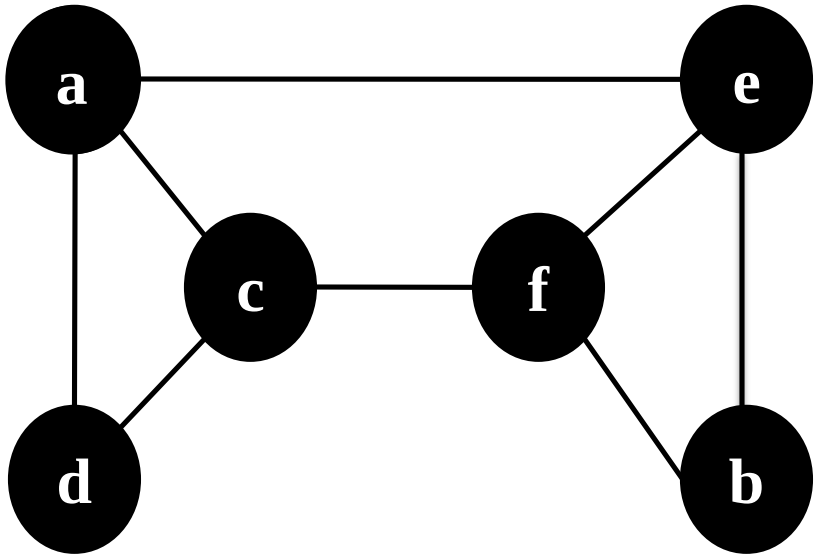
Vertex	Push	Pop
a	1	
c	2	5
d	3	1
f	4	4
b	5	3
e	6	2





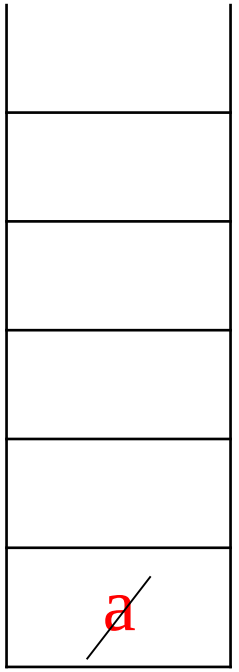
DFSnumber

Depth-First Search



Stack Ordering

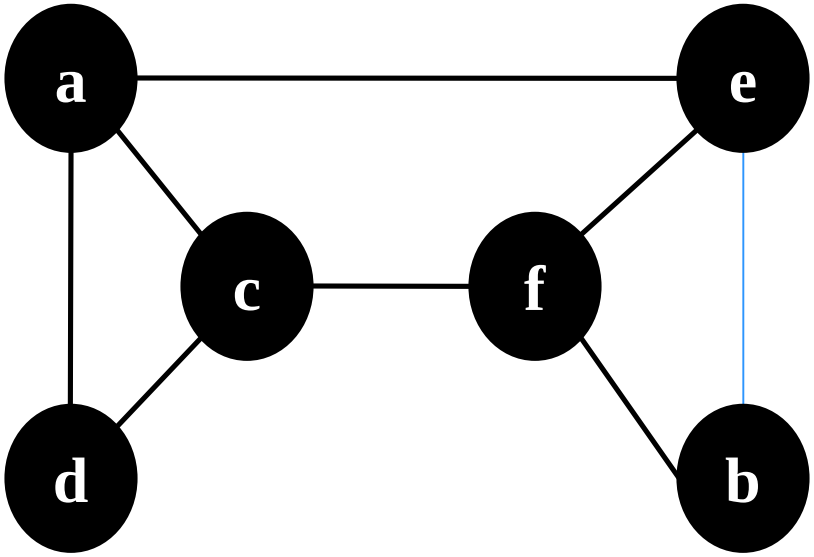
Vertex	Push	Pop
a	1	6
c	2	5
d	3	1
f	4	4
b	5	3
e	6	2

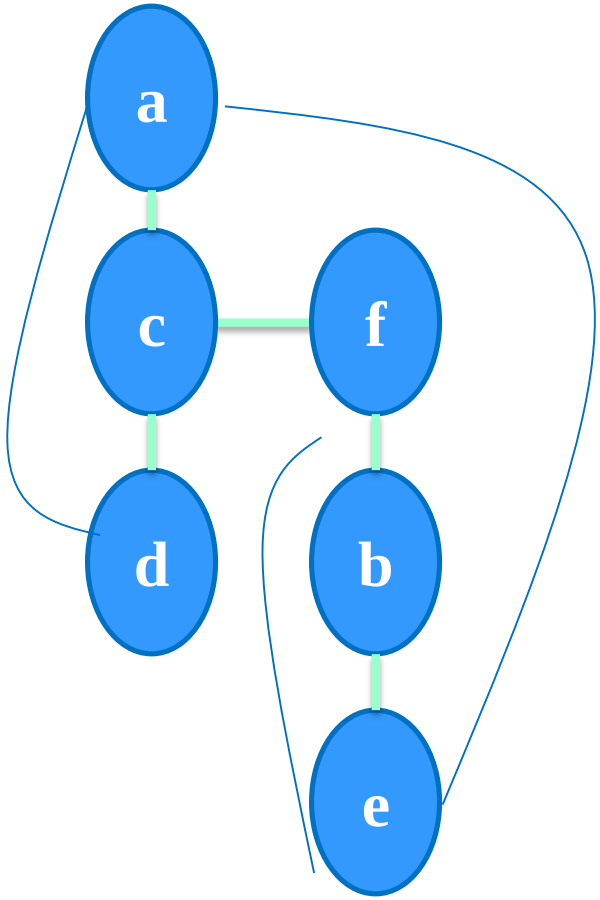


a	b	c	d	e	f
1	1	1	1	1	1

DFSnumber

Depth-First Search





- Stack Ordering:

  a16

  c25 f44

  d31 b53

  e62