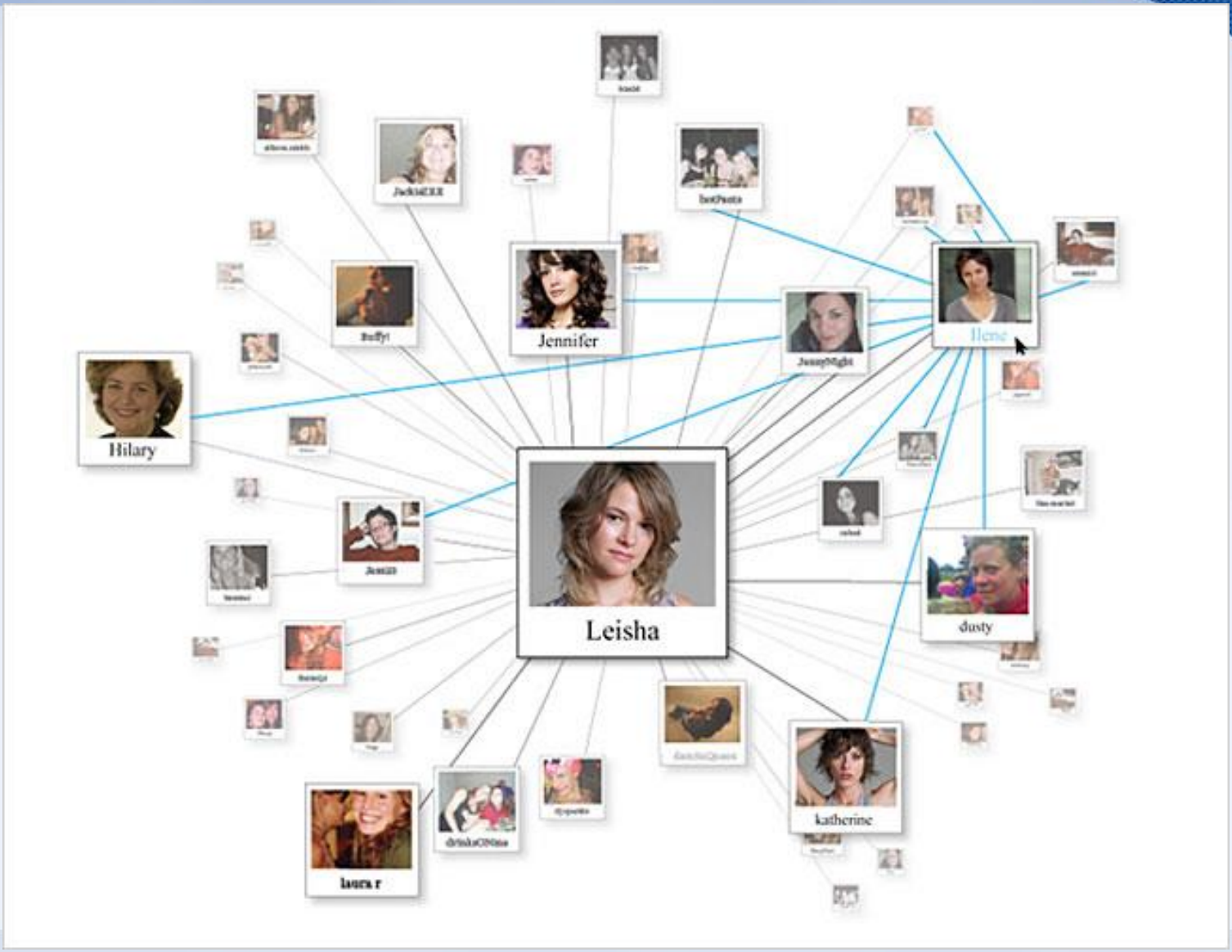
ACM DAMASCUS UNIVERCITY

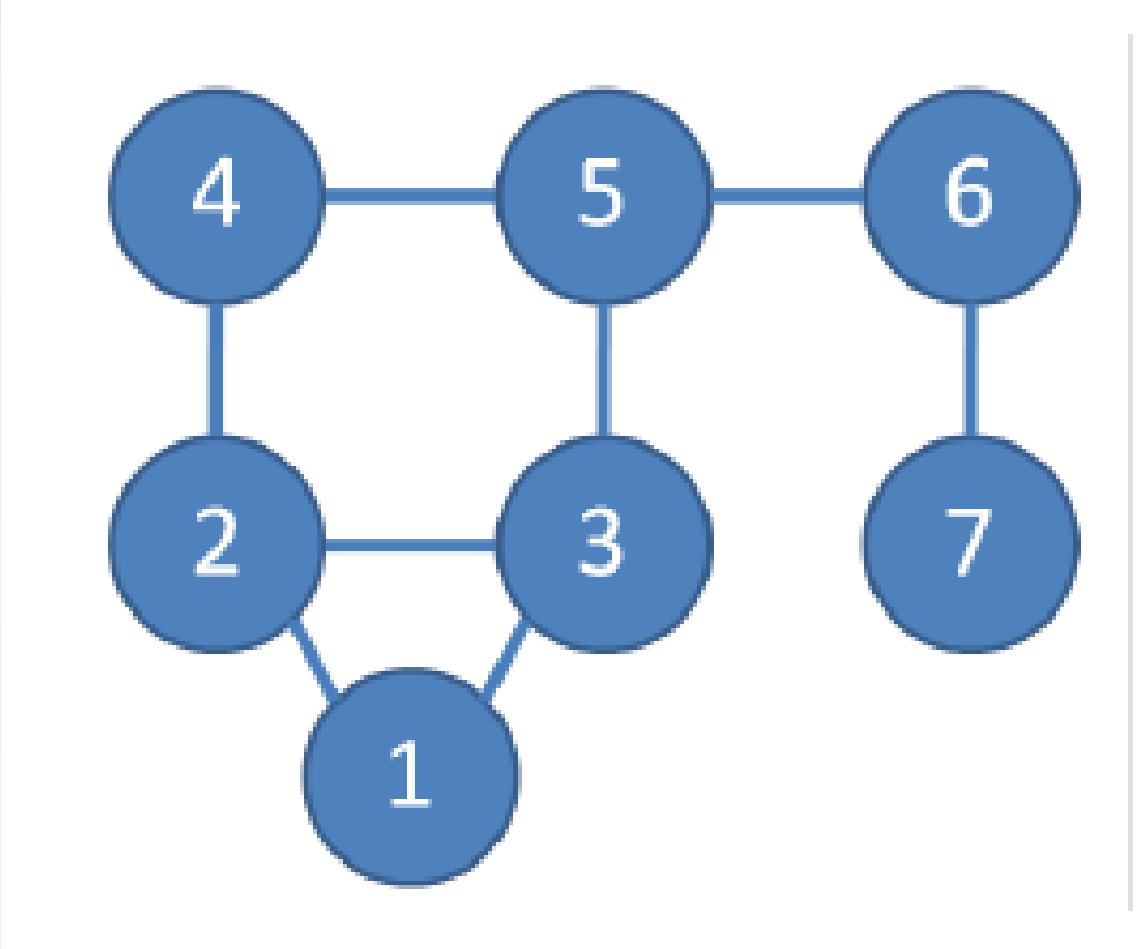
Feras AL-Kassar

Graph


Jennifer
Hilary
Leisha
dusty
katherine
laura r

Why Study Graph ?

- Lots of problems formulated and solved in terms of graphs
  - Shortest path problems
  - Network flow problems
  - Matching problems
  - 2-SAT problem
  - Graph coloring problem
  - Traveling Salesman Problem (TSP): *still unsolved!*
  - and many more…

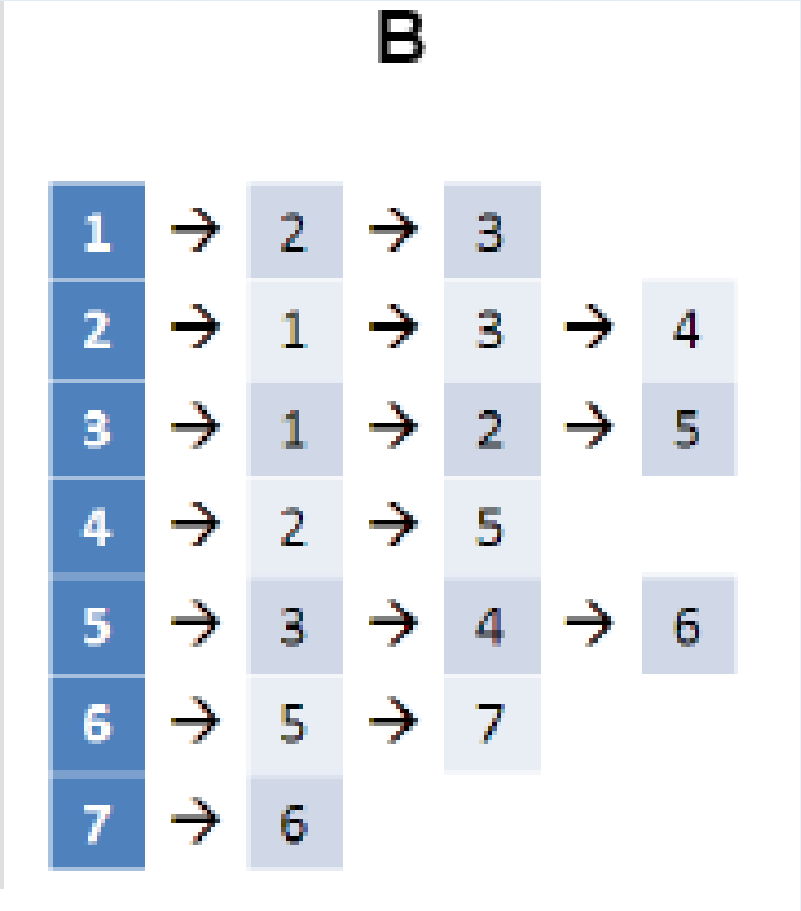

4
5
6
2
3
7
1

Structure 1

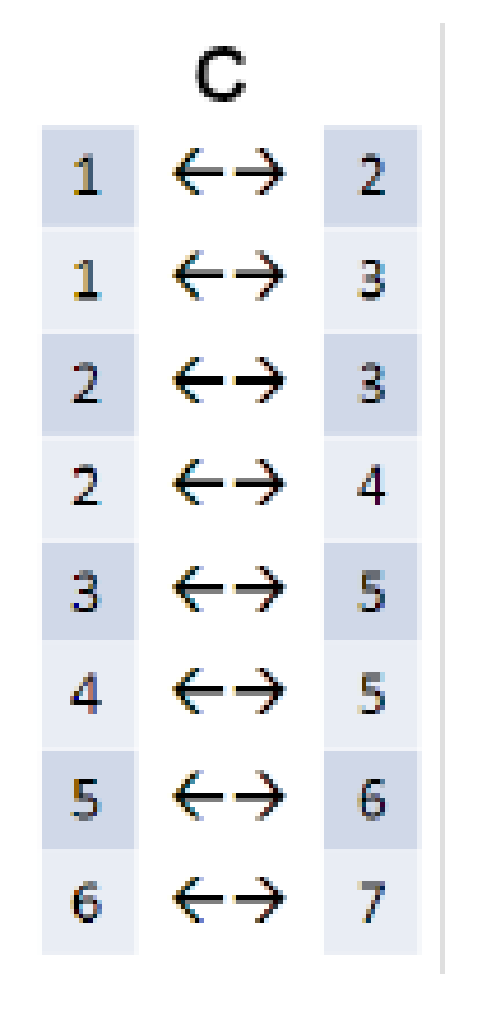
A

	1	2	3	4	5	6	7
1		1	1				
2	1		1	1			
3	1	1			1		
4		1			1		
5			1	1		1	
6					1		1
7						1	

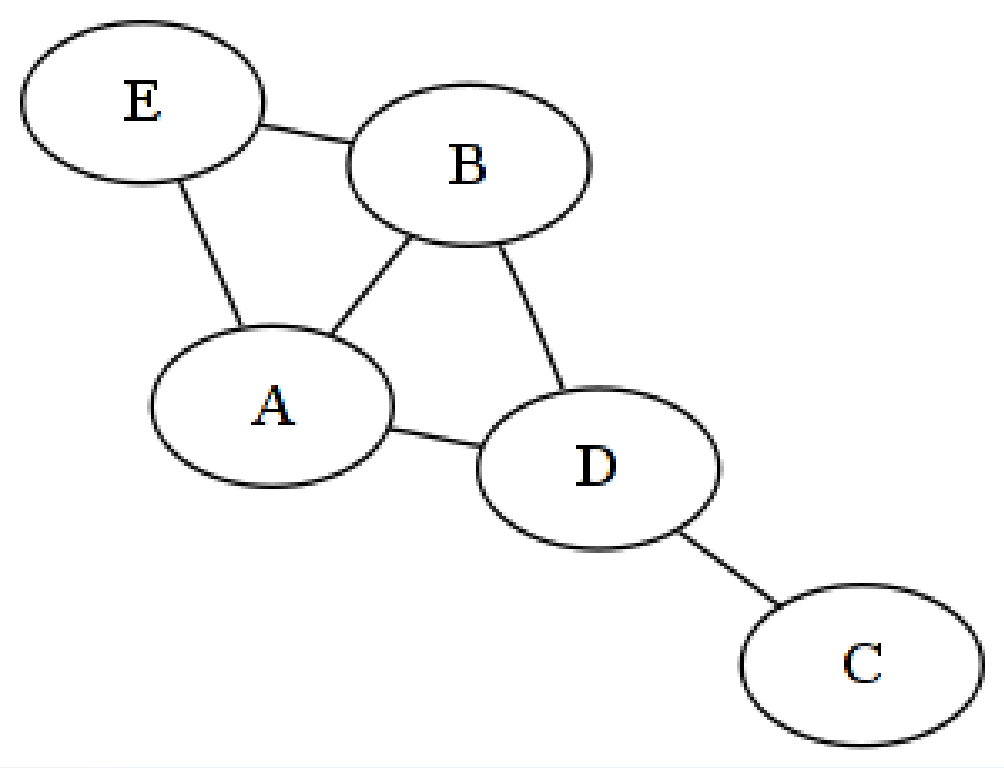
Structure 2



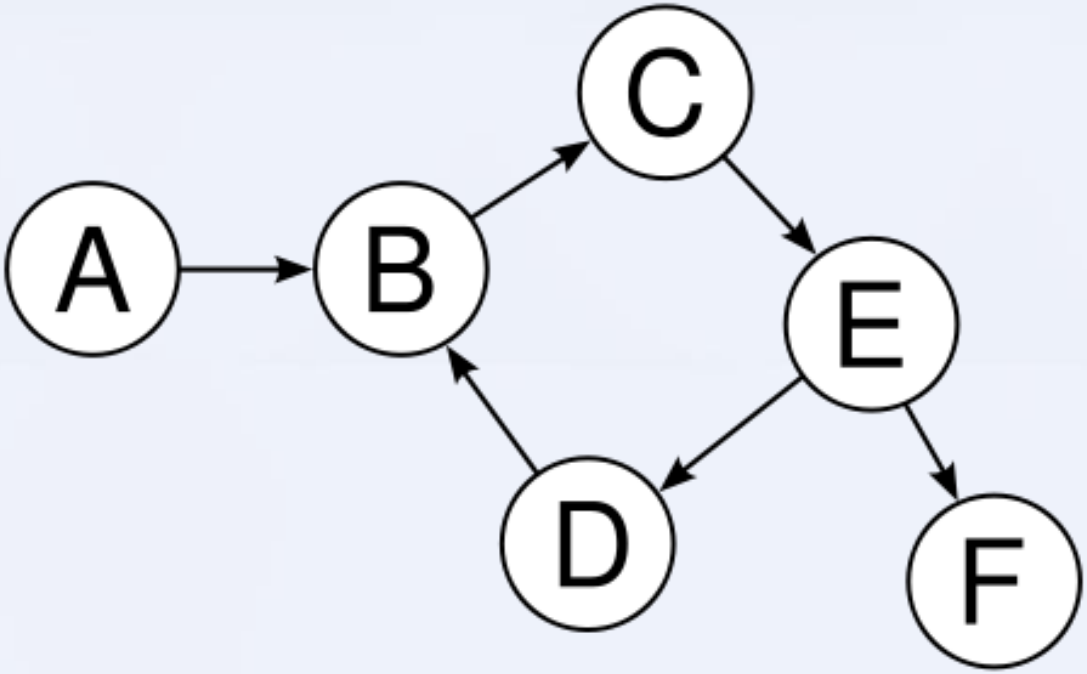
Structure 3



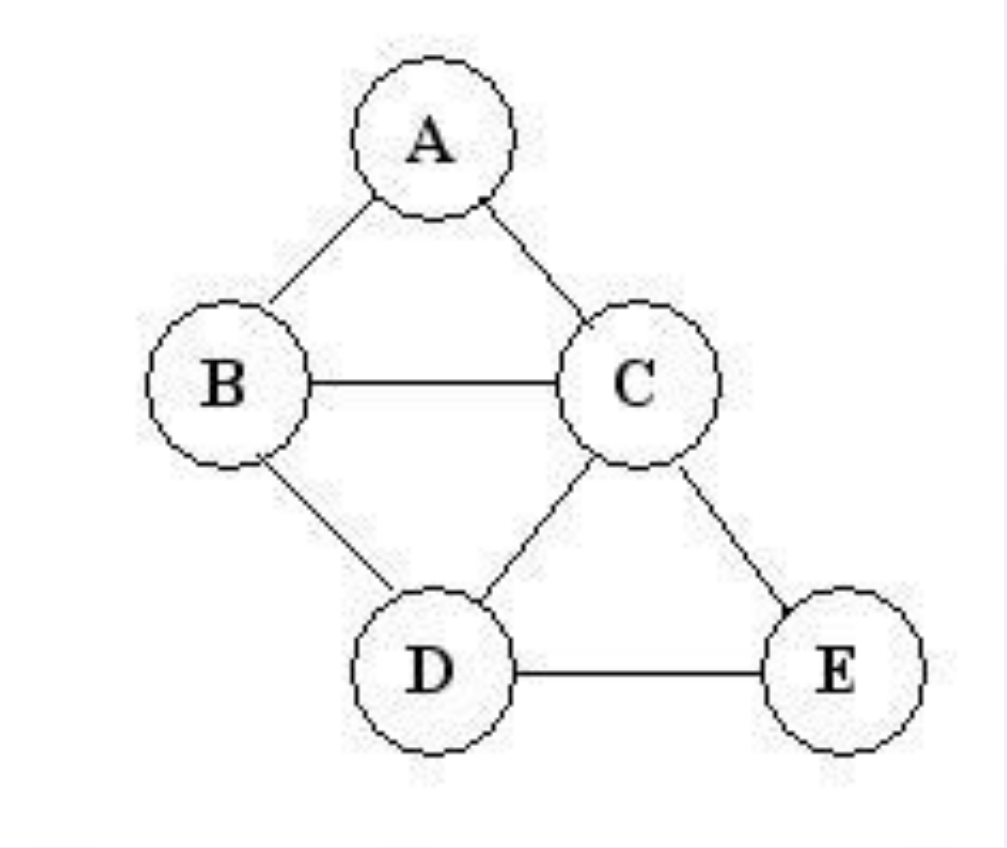
Un-Directed



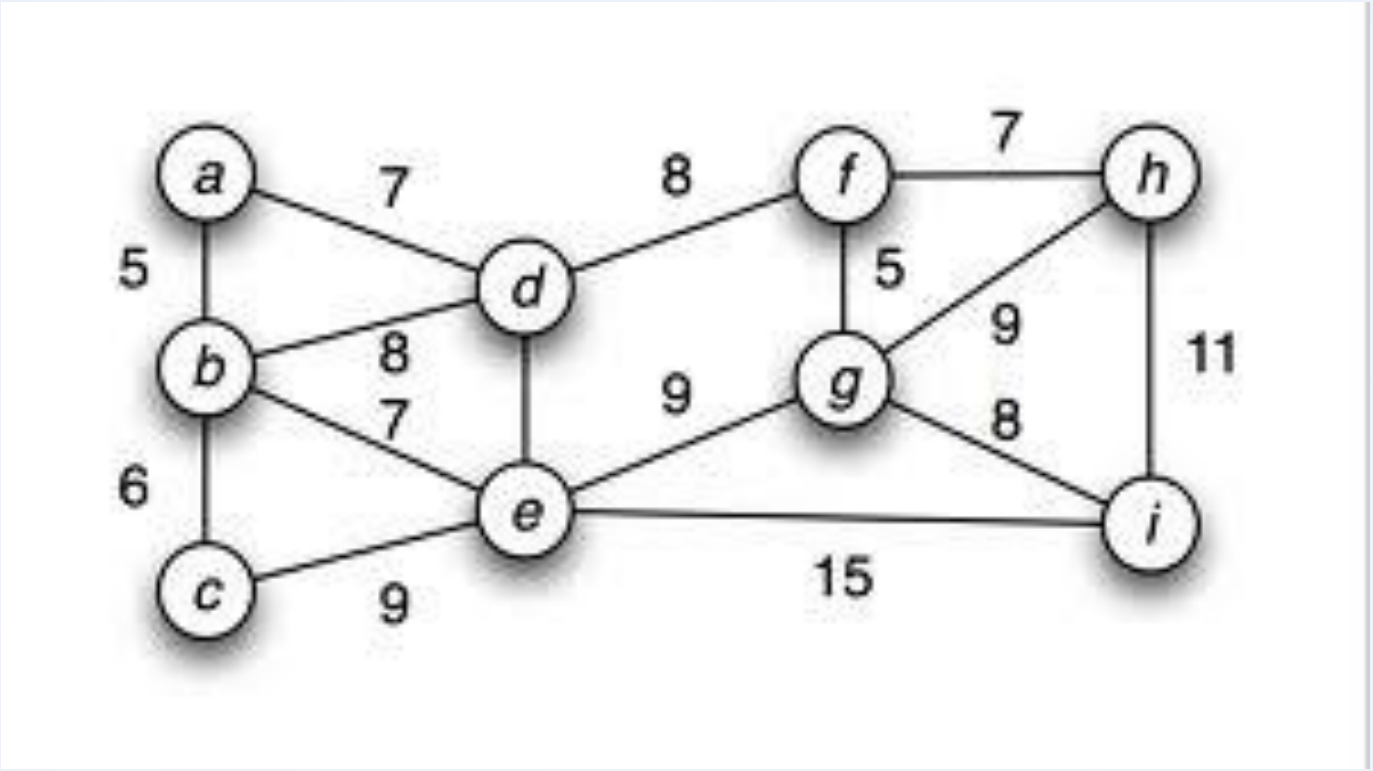
Directed



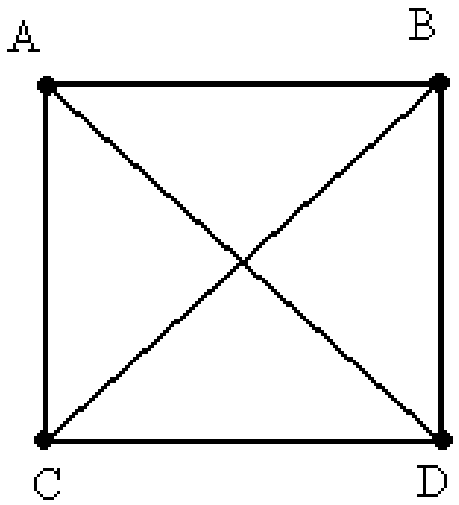
Un-weighted



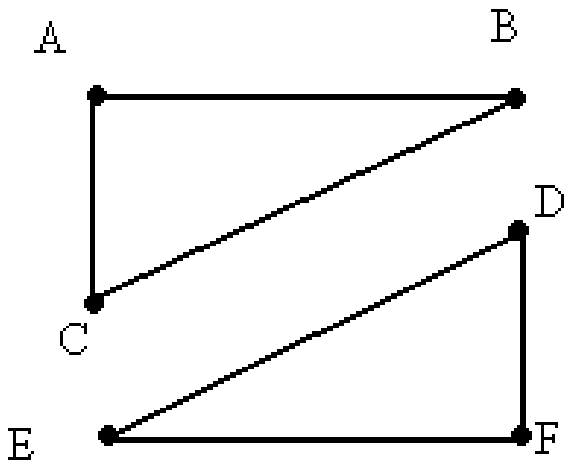
weighted



Connected / dis-connected



Connected graph



Disconnected graph

Input

N: number of vertices
M: number of edges

X Y: edge between X and Y
X Y Z: edge between X and Y weight Z

Structure 1 / un-Directed / un-weight

```
#include<iostream>
using namespace::std;
int main()
{
	int n,m;
	cin>>n>>m;
	int G[50][50]={0};
	for(int i=0;i<m;i++)
	{
		int x,y; cin>>x>>y;
		G[x][y]=1;
		G[y][x]=1;
	}
}
```

Structure 1 / Directed / un-weight

```
#include<iostream>
using namespace::std;
int main()
{
    int n,m;
    cin>>n>>m;
    int G[50][50]={0};
    for(int i=0;i<m;i++)
    {
        int x,y; cin>>x>>y;
        G[x][y]=1;
    }
}
```

Structure 1 / un-Directed / weight

```
#include<iostream>
using namespace::std;
int main()
{
	int n,m;
	cin>>n>>m;
	int G[50][50]={0};
	for(int i=0;i<m;i++)
	{
		int x,y; cin>>x>>y>>z;
		G[x][y]=z;
		G[y][x]=z;
	}
}
```

Structure 1 / Directed / weight

```
#include<iostream>
using namespace::std;
int main()
{
	int n,m;
	cin>>n>>m;
	int G[50][50]={0};
	for(int i=0;i<m;i++)
	{
		int x,y; cin>>x>>y>>z;
		G[x][y]=z;
	}
}
```

Structure 2 / un-Directed / un-weight

```cpp
#include<iostream>
#include<vector>
using namespace::std;
int main()
{
	int n,m;
	cin>>n>>m;
	vector<int> G[50];
	for(int i=0;i<m;i++)
	{
		int x,y; cin>>x>>y;
		G[x].push_back(y);
		G[y].push_back(x);
	}
}
```

Structure 2 / Directed / un-weight

```cpp
#include<iostream>
#include<vector>
using namespace::std;
int main()
{
	int n,m;
	cin>>n>>m;
	vector<int> G[50];
	for(int i=0;i<m;i++)
	{
		int x,y; cin>>x>>y;
		G[x].push_back(y);
	}
}
```

Structure 2 / un-Directed / weight

```cpp
#include<iostream>
#include<vector>
using namespace::std;
int main()
{
    int n,m;
    cin>>n>>m;
    vector<pair<int,int> > G[50];
    for(int i=0;i<m;i++)
    {
        int x,y,z; cin>>x>>y>>z;
        G[x].push_back(make_pair(y,z));
        G[y].push_back(make_pair(x,z));
    }
}
```

Structure 1 / Directed / weight

```
#include<iostream>
#include<vector>
using namespace::std;
int main()
{
    int n,m;
    cin>>n>>m;
    vector<pair<int,int> > G[50];
    for(int i=0;i<m;i++)
    {
        int x,y,z; cin>>x>>y>>z;
        G[x].push_back(make_pair(y,z));
    }
}
```

Note:

```
#include<iostream>
#include<vector>
using namespace::std;
int main()
{
     int n,m;
     cin>>n>>m;
     vector<pair<int,int> > G[50];
     for(int i=0;i<m;i++)
     {
          int x,y,z; cin>>x>>y>>z;
          G[x].push_back(make_pair(y,z));
     }
}
```

Structure 3 / un-Directed / un-weight

```
#include<iostream>
#include<queue>
using namespace::std;
int main()
{
     int n,m;
     cin>>n>>m;
     priority_queue<pair<int,int> >q;
     for(int i=0;i<m;i++)
     {
          int x,y,z; cin>>x>>y;
          q.push(make_pair(x,y));
     }
}
```

Structure 3 / Directed / un-weight

```
#include<iostream>
#include<queue>
using namespace::std;
int main()
{
     int n,m;
     cin>>n>>m;
     priority_queue<pair<int,int> >q;
     for(int i=0;i<m;i++)
     {
          int x,y,z; cin>>x>>y;
          q.push(make_pair(x,y));
     }
}
```

Structure 1 / un-Directed / weight

```
#include<iostream>
#include<queue>
using namespace::std;
int main()
{
     int n,m;
     cin>>n>>m;
     priority_queue<pair<int,pair<int,int> > >q;
     for(int i=0;i<m;i++)
     {
          int x,y,z; cin>>x>>y>>z;
          q.push(make_pair(z,make_pair(x,y)));
     }
}
```

Structure 1 / Directed / weight

```
#include<iostream>
#include<queue>
using namespace::std;
int main()
{
     int n,m;
     cin>>n>>m;
     priority_queue<pair<int,pair<int,int> > >q;
     for(int i=0;i<m;i++)
     {
          int x,y,z; cin>>x>>y>>z;
          q.push(make_pair(z,make_pair(x,y)));
     }
}
```

BFS

```
const int N=50;
int G[N][N];
int visited[N];
int n;

void BFS(int x)
{
    queue<int>q;
    q.push(x);
    while(!q.empty())
    {
        x = q.front(); q.pop();
        visited[x]=1;
        cout<<x<<endl;
        for(int i=0;i<n;i++)
            if(G[x][i] && !visited[i])
                q.push(i);
    }
}
```

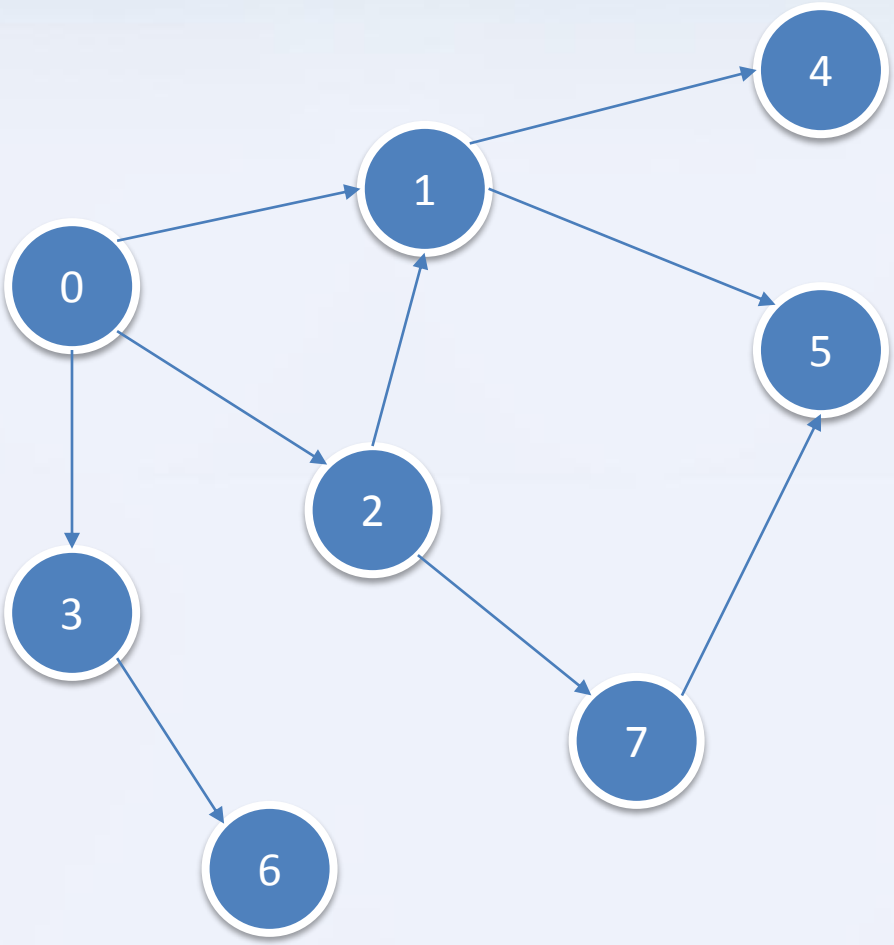
DFS

```
#include<iostream>
#include<queue>
using namespace::std;

const int N=50;
int G[N][N];
int visited[N];
int n;

void DFS(int x)
{
    visited[x]=1;
    cout<<x<<endl;
    for(int i=0;i<n;i++)
        if(G[x][i] && !visited[i])
            DFS(i);
    visited[x]=0;
}
```

DFS

```
int main()
{
    freopen("in.txt","r",stdin);
    int m;
    cin>>n>>m;
    for(int i=0;i<m;i++)
    {
        int x,y; cin>>x>>y;
        G[x][y]=1;
    }
    DFS(0);
}
```

BFS



BFS

0

1

2

3

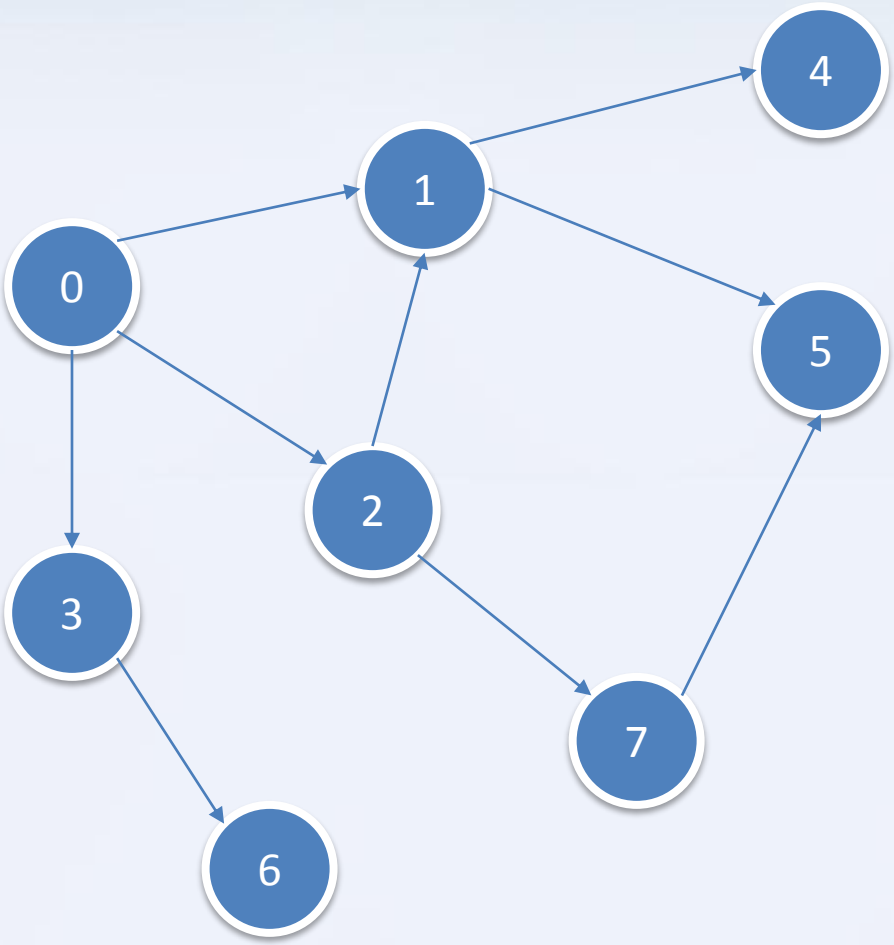
4

5

7

6

DFS



DFS

0

1

4

5

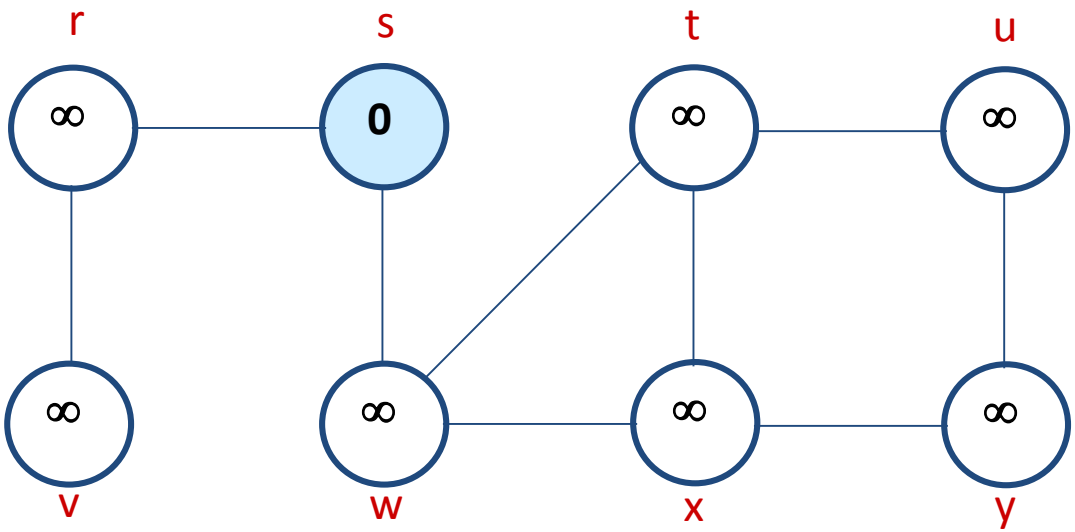
2

7

3

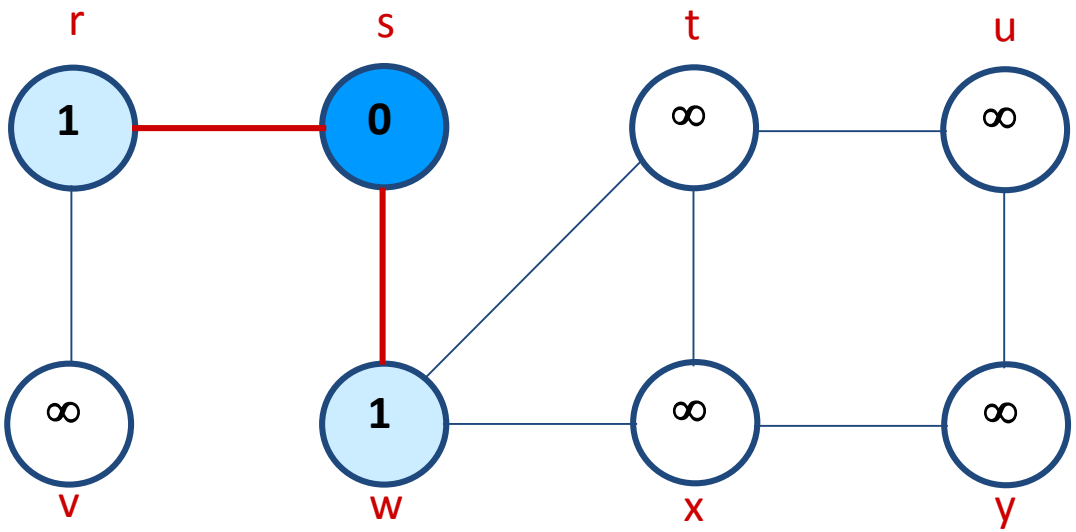
6

Example (BFS)



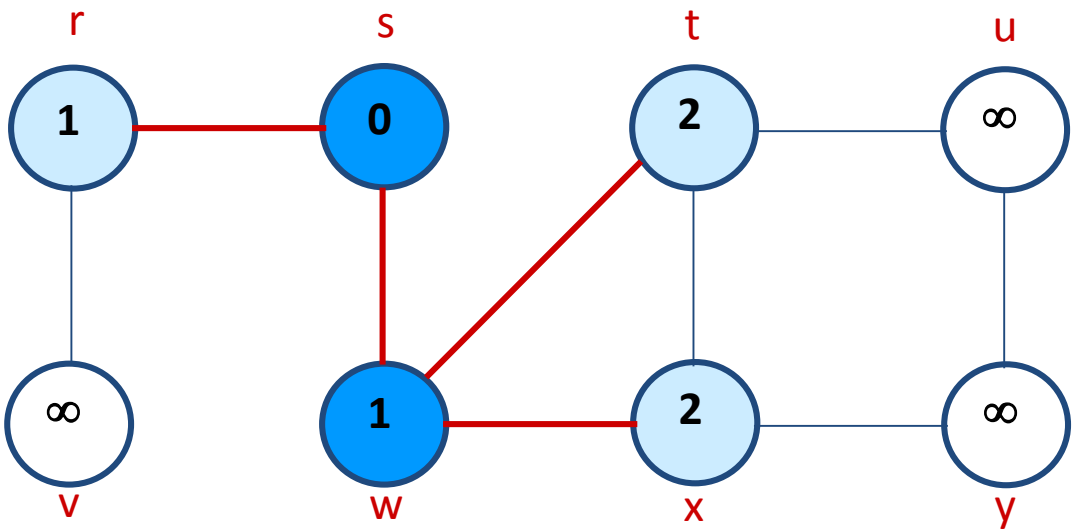
Q: s
0

Example (BFS)



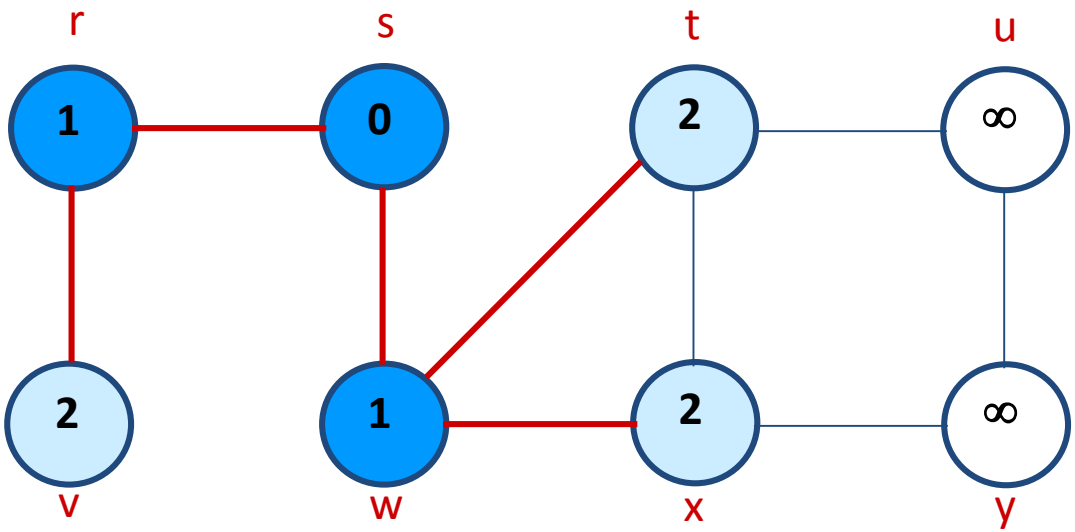
Q: w r
1 1

Example (BFS)



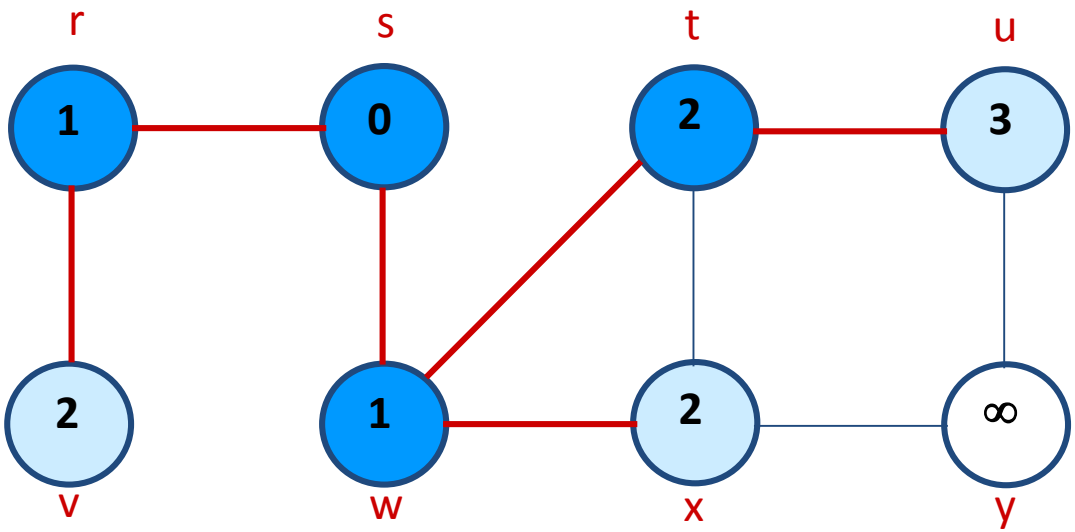
Q: r t x
1 2 2

Example (BFS)



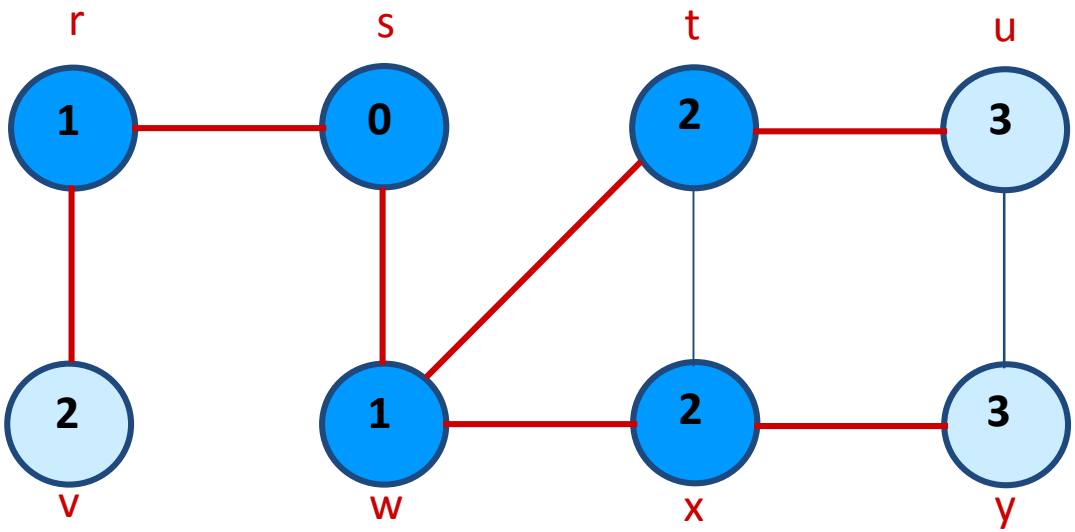
Q: t x v
2 2 2

Example (BFS)



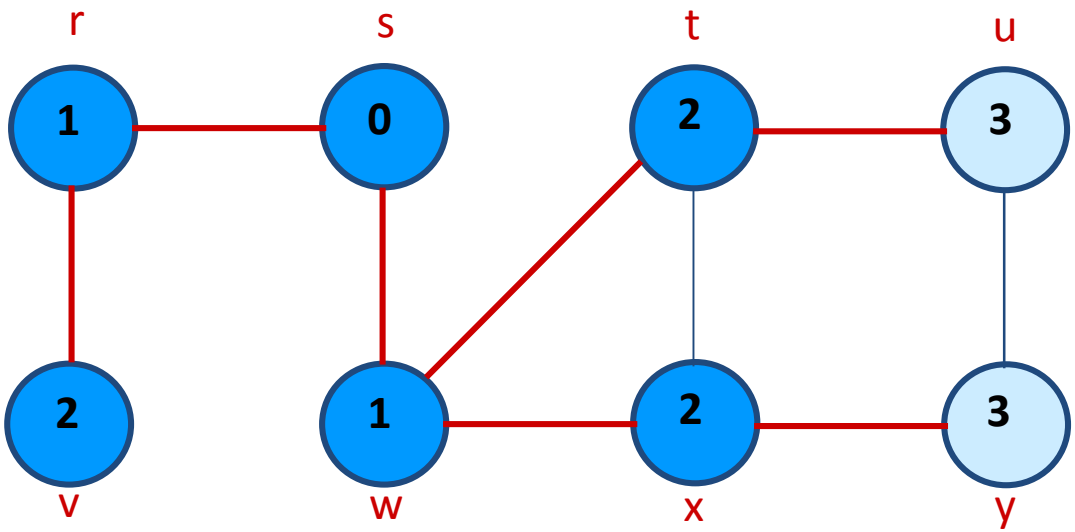
Q: x v u
2 2 3

Example (BFS)



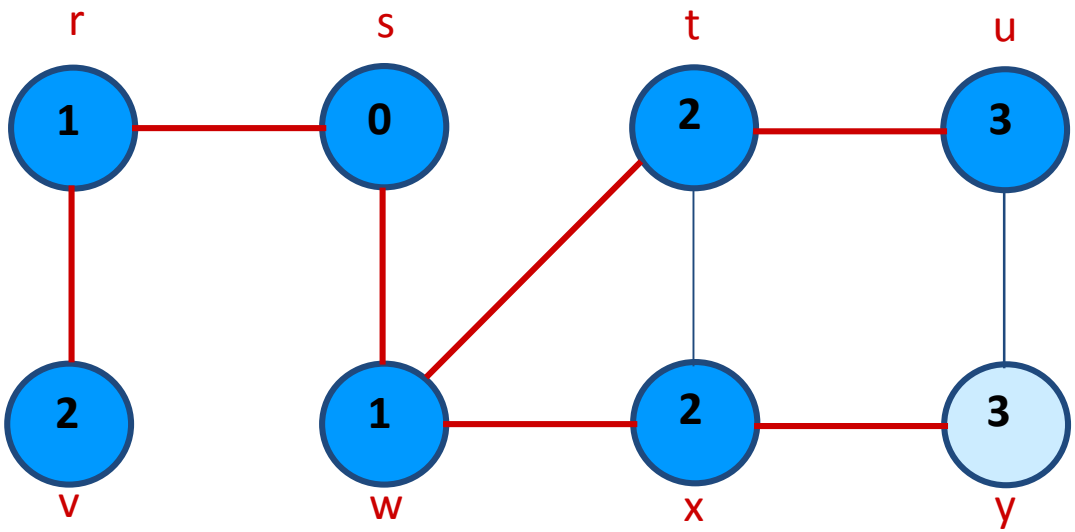
Q: v u y
2 3 3

Example (BFS)



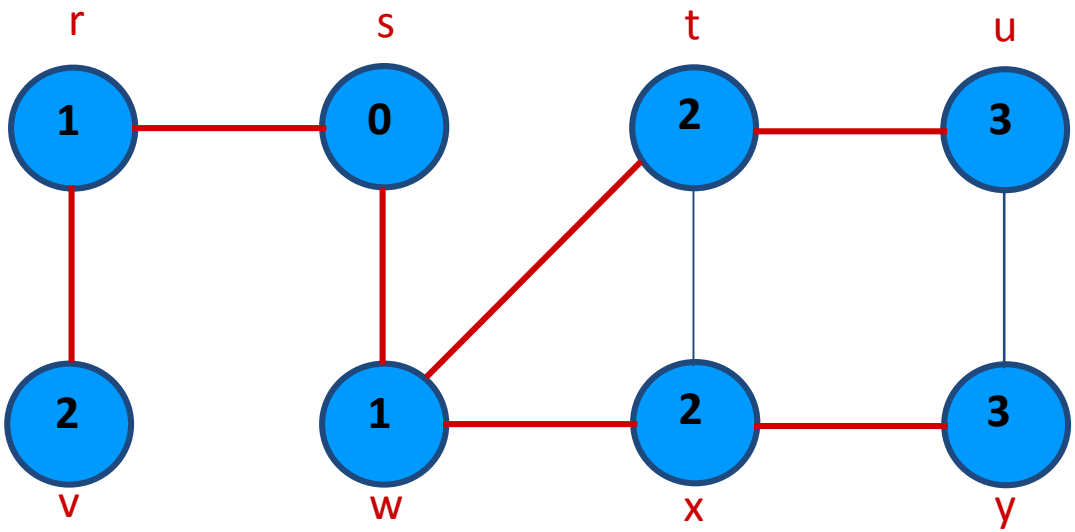
Q: u y
3 3

Example (BFS)



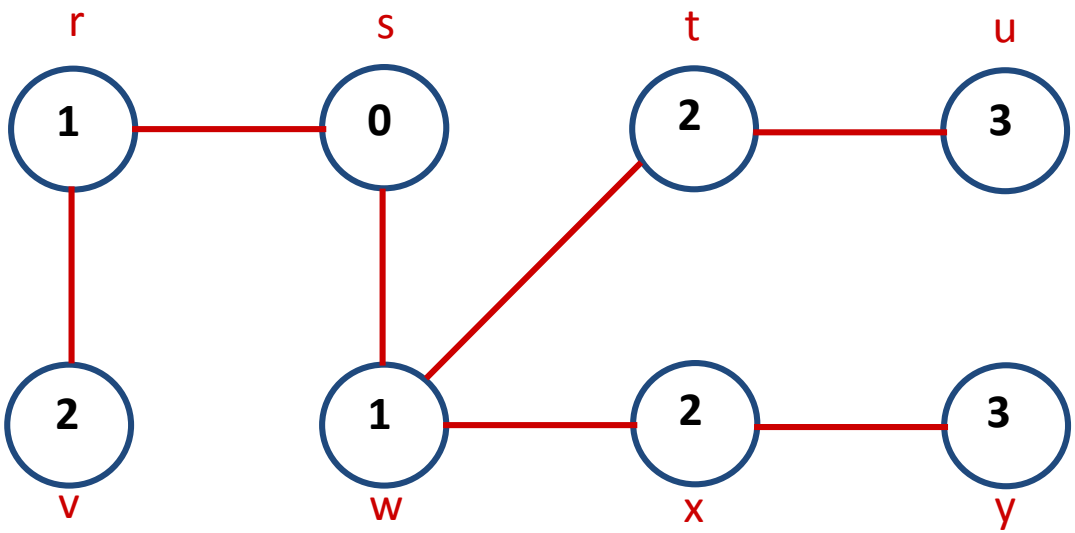
Q: y
3

Example (BFS)



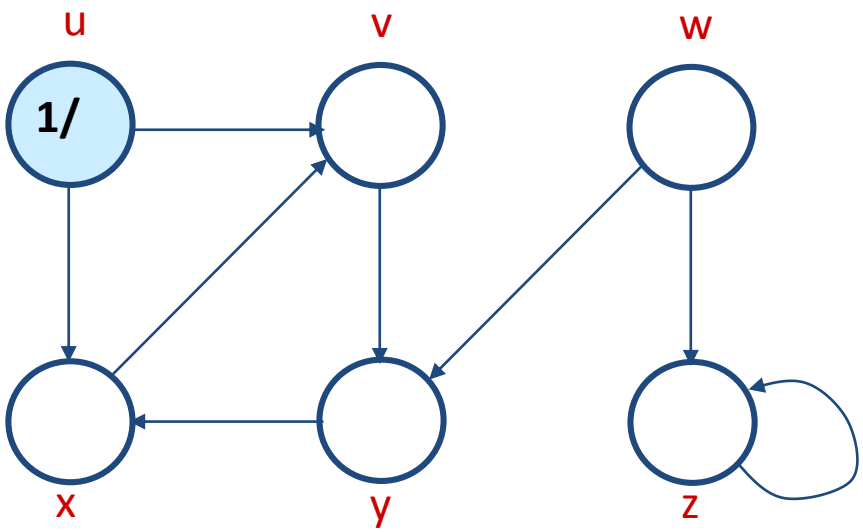
Q: ∅

Example (BFS)

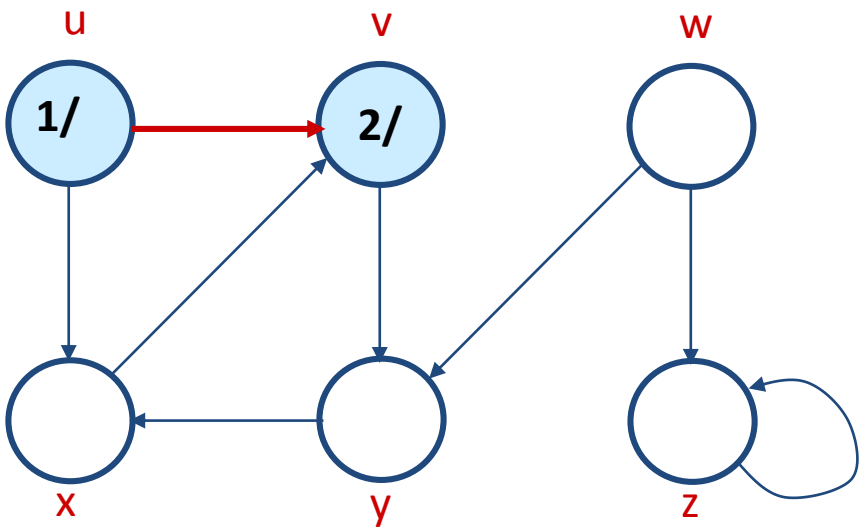


BF Tree

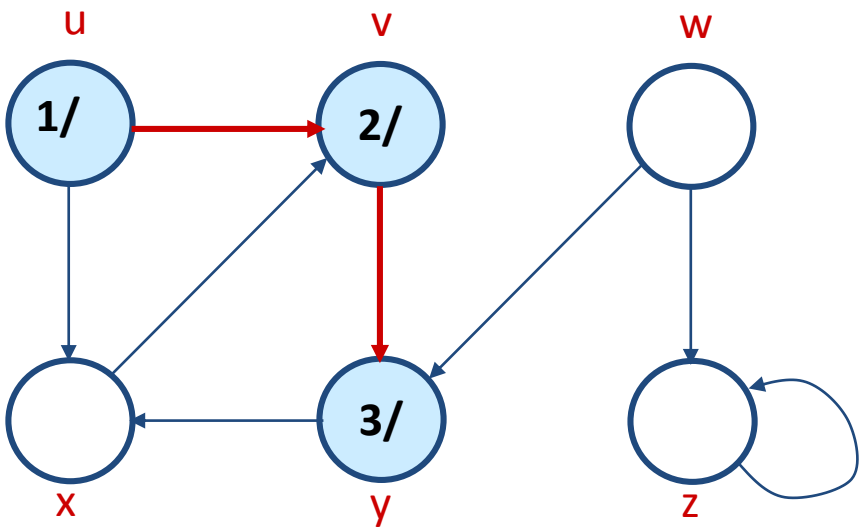
Example (DFS)



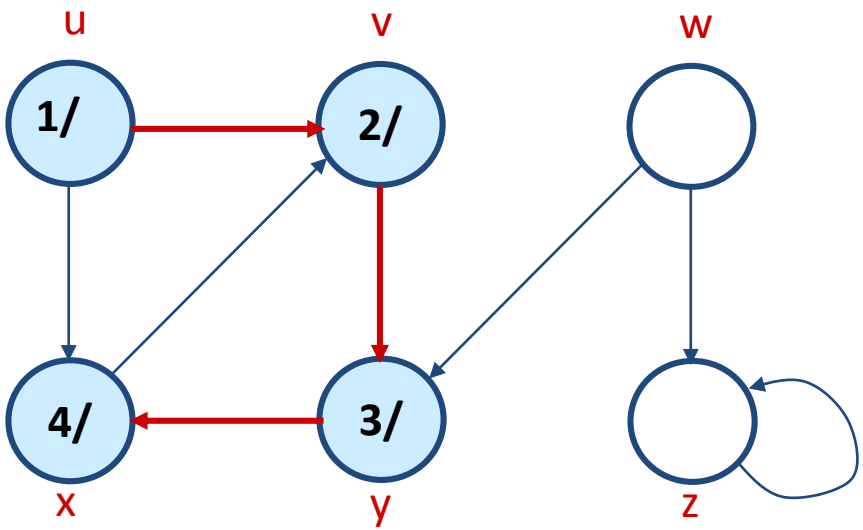
Example (DFS)



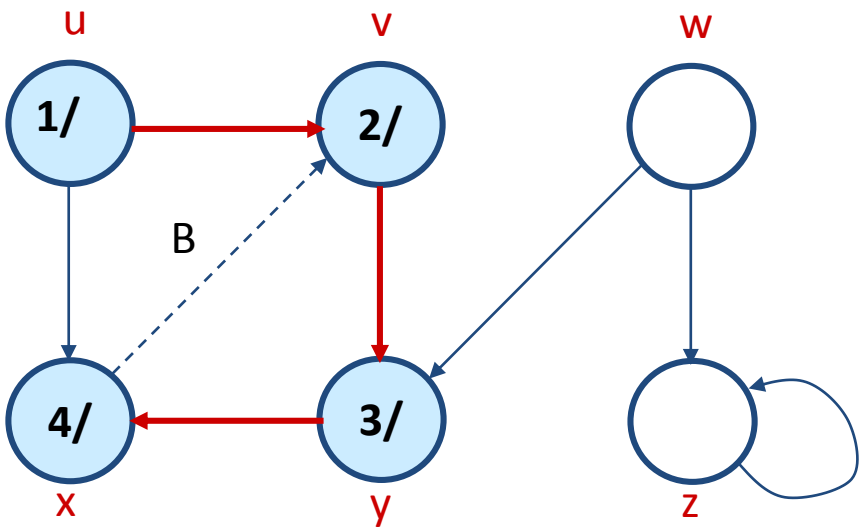
Example (DFS)



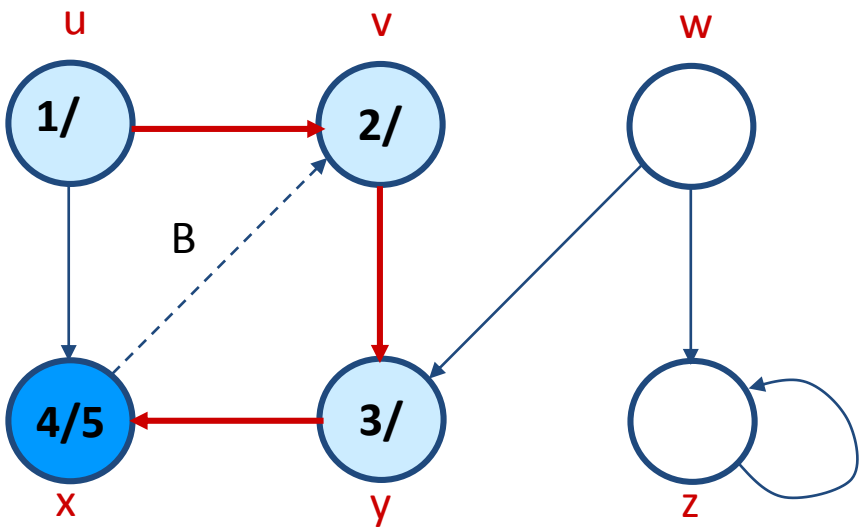
Example (DFS)



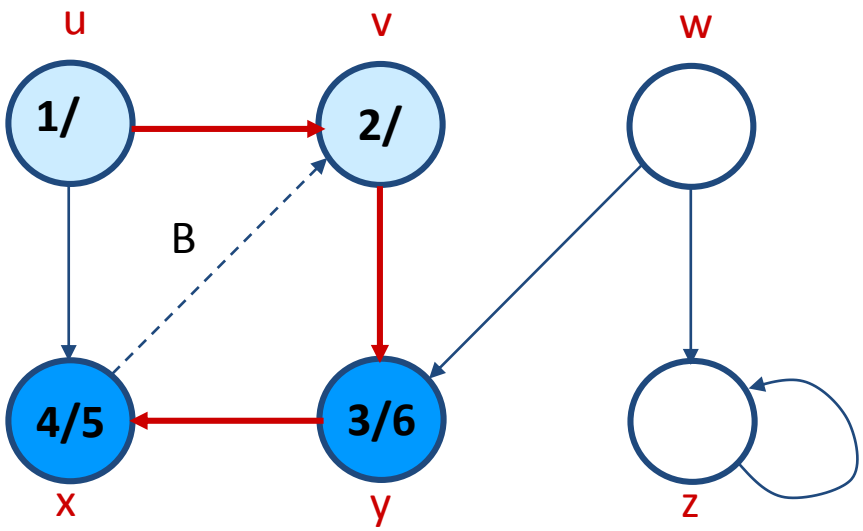
Example (DFS)



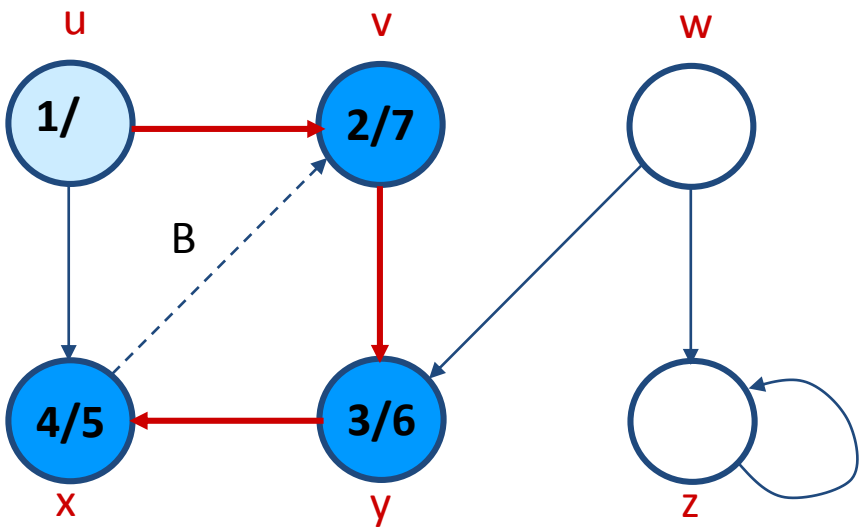
Example (DFS)



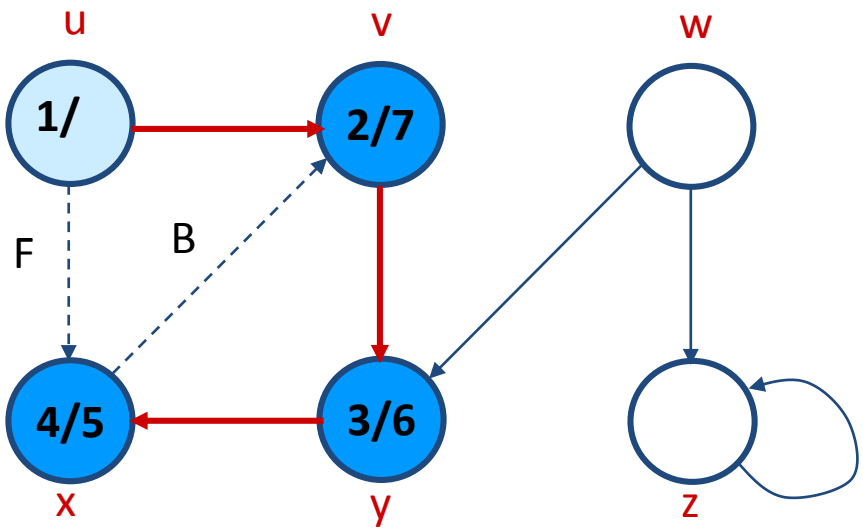
Example (DFS)



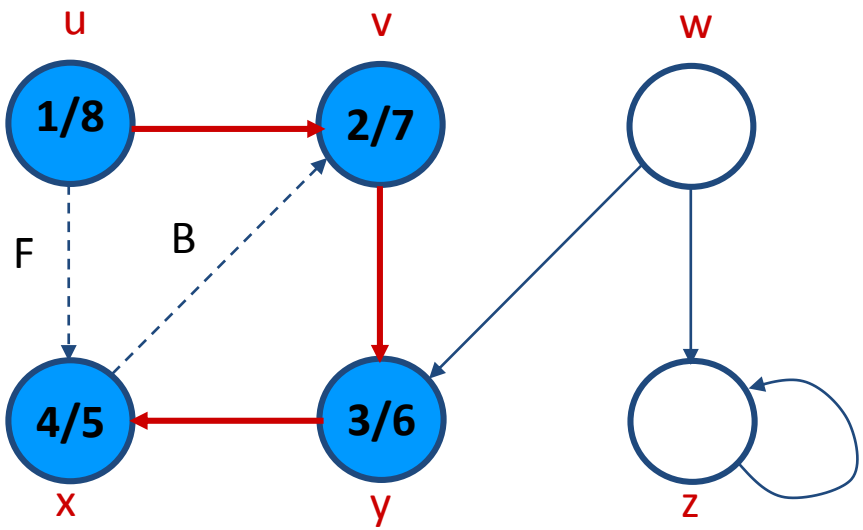
Example (DFS)



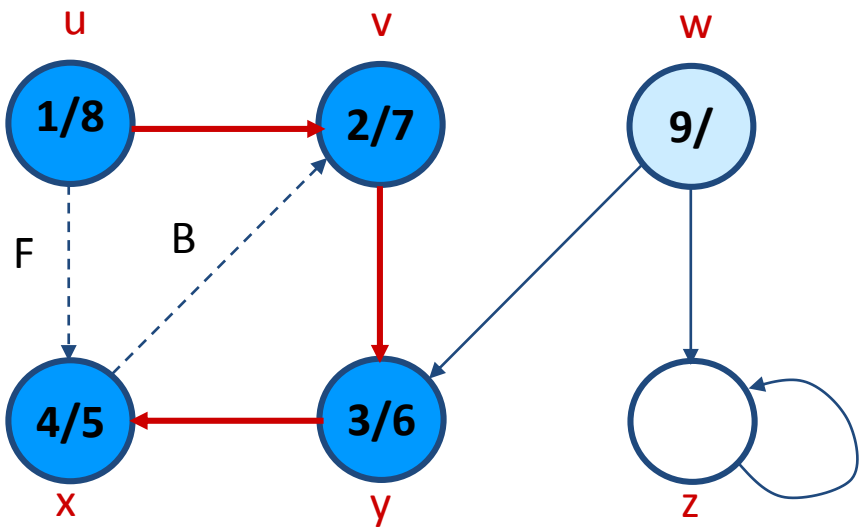
Example (DFS)



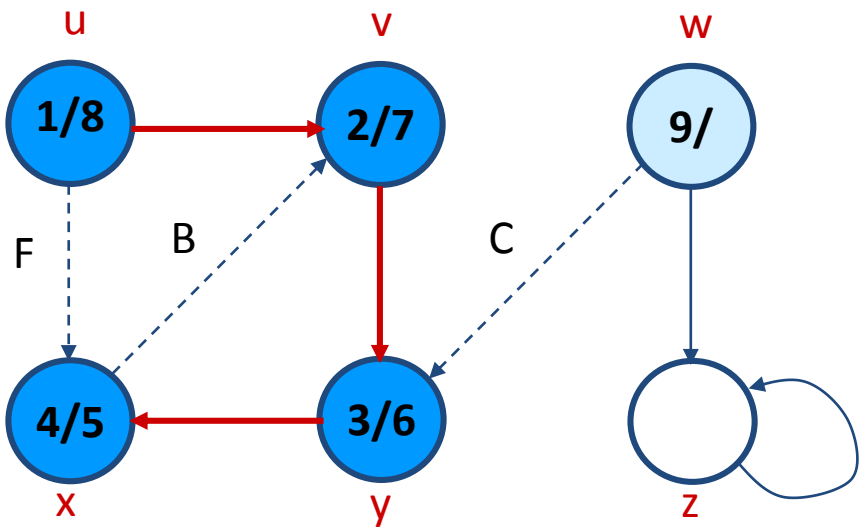
Example (DFS)



Example (DFS)



Example (DFS)



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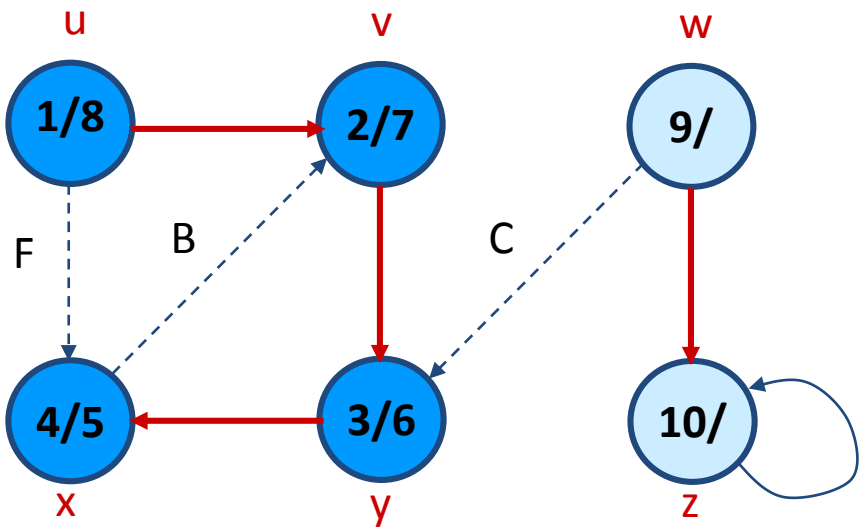

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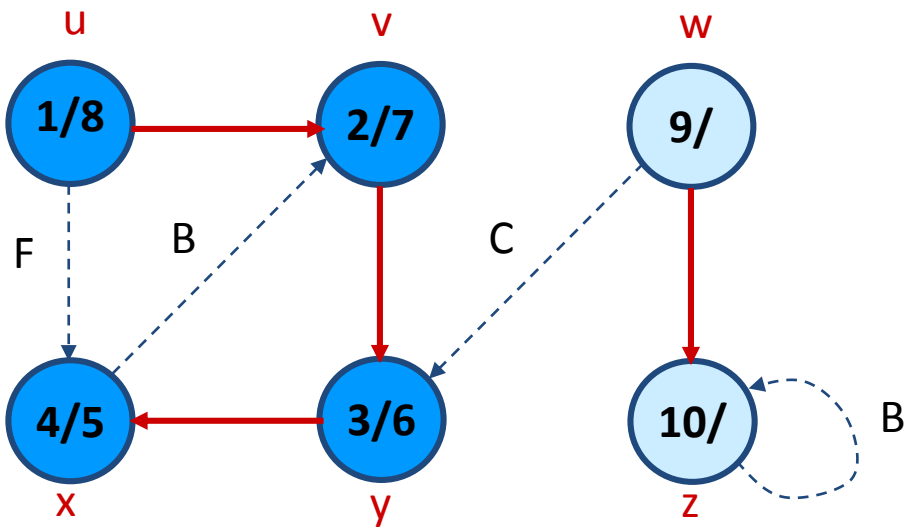
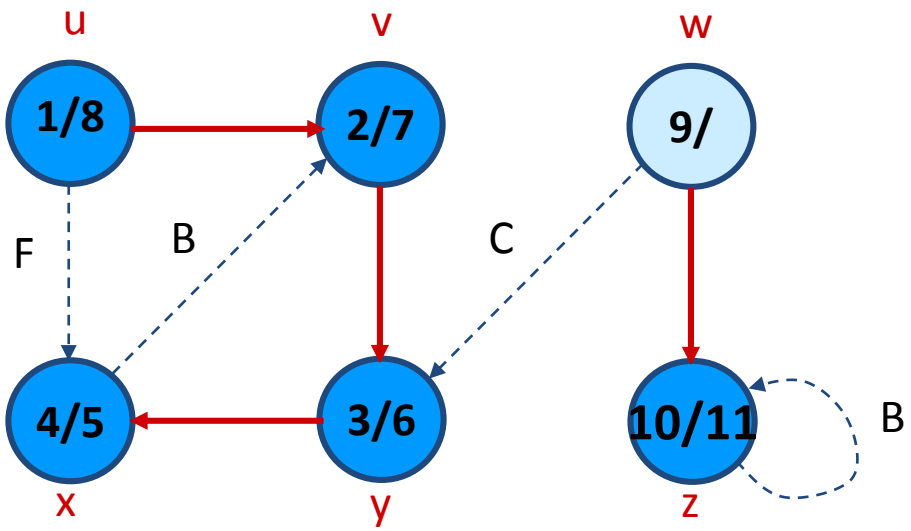


Example (DFS)



Example (DFS)