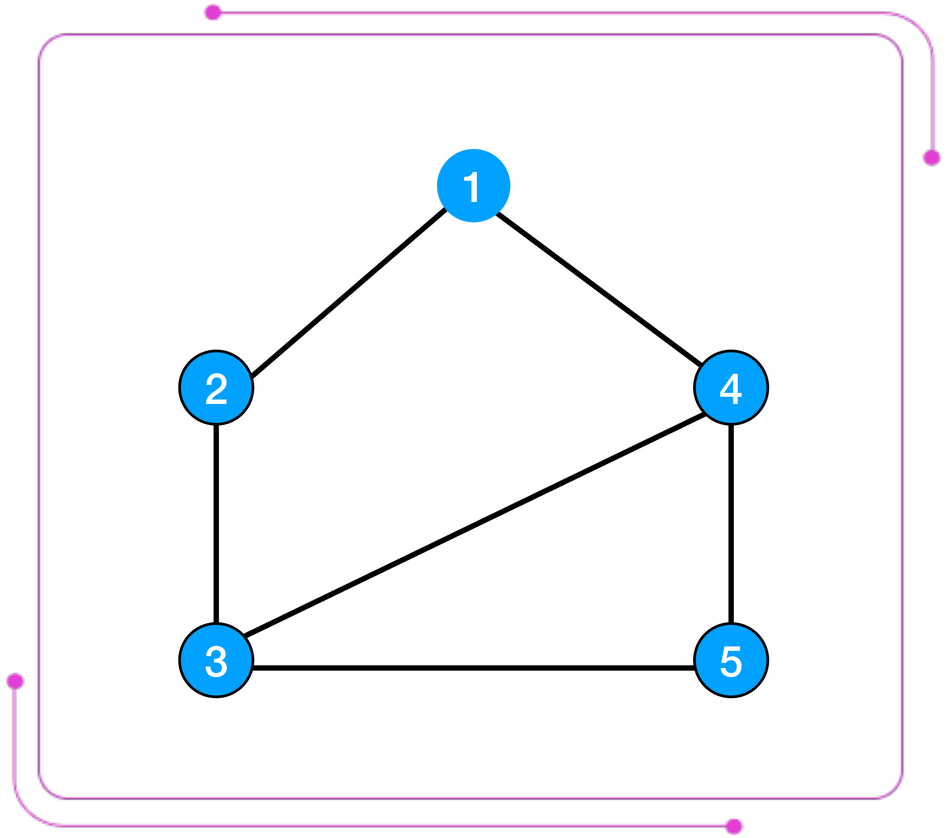
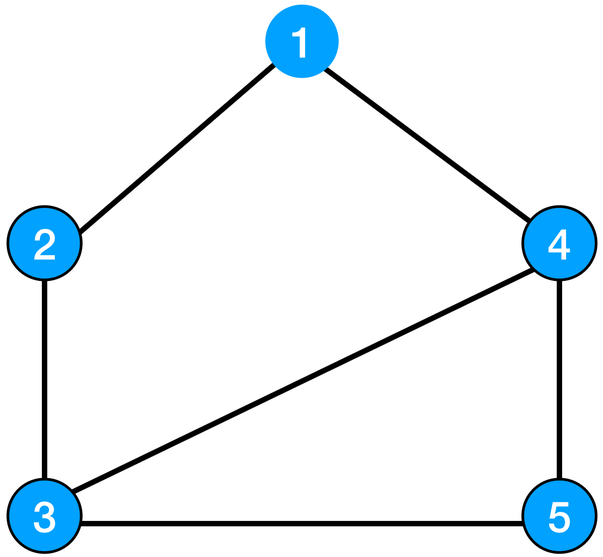


What is Graph ?

- Graph là một cấu trúc dữ liệu phức tạp, bao gồm một tập hợp các đỉnh (nút) và một tập hợp các cạnh kết nối giữa các đỉnh. Mỗi cạnh có thể biểu diễn một mối quan hệ hoặc liên kết giữa hai đỉnh.

- Graphs được sử dụng rộng rãi trong khoa học máy tính và các lĩnh vực khác để mô hình hóa và giải quyết nhiều loại bài toán phức tạp, như đường đi ngắn nhất, mạng xã hội, mô hình mạng lưới, và hơn thế nữa.

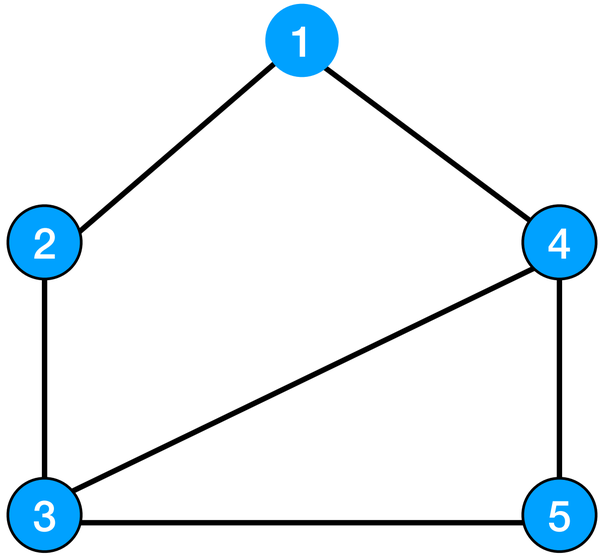
List of vertex and edge



V = {1,2,3,4,5}

E = { (1,2),(1,4),(2,3),(3,4),(3,5),(4,5) }

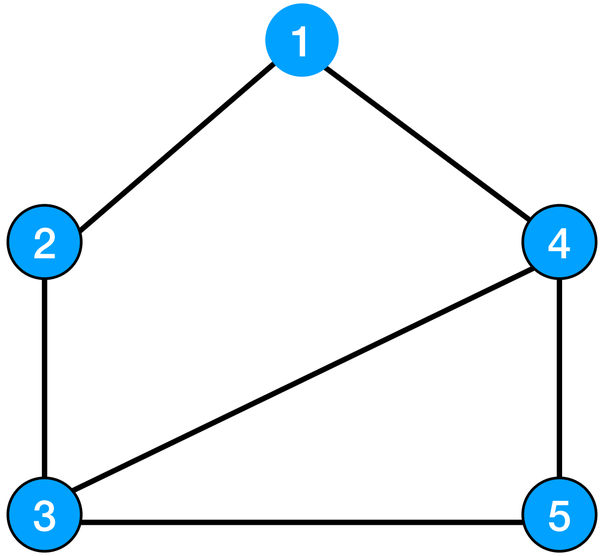
Neighbors and degree



neighbor(1) = {2,4}

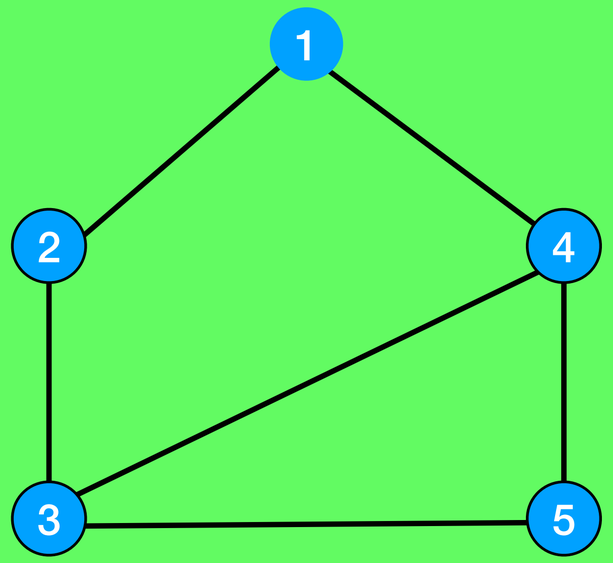
degree(1) = 2 edge

Path and cycle

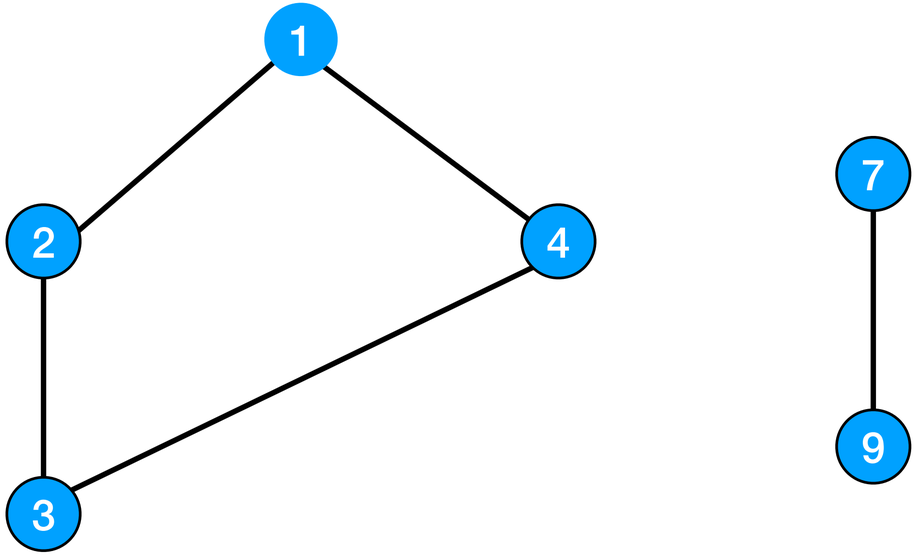


Path : 1 → 2 → 3 → 4

Cycle: 1 → 2 → 3 → 4 → 1

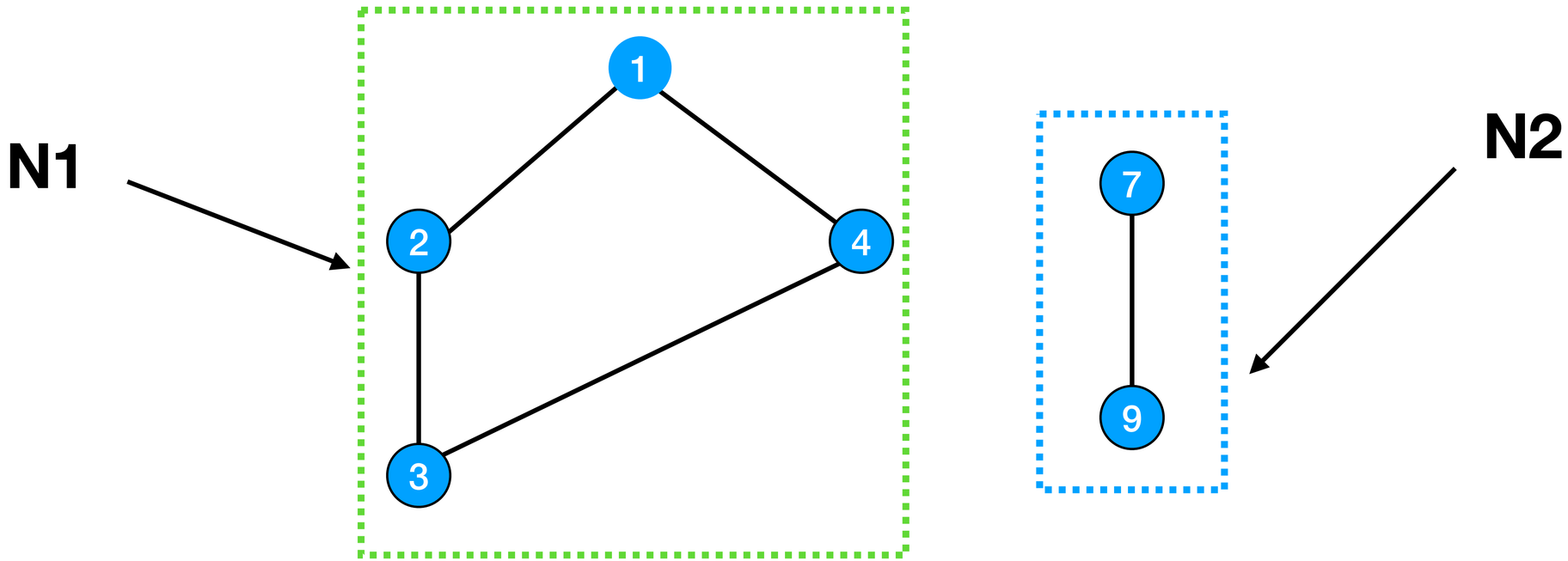


Connectivity



Disconnect

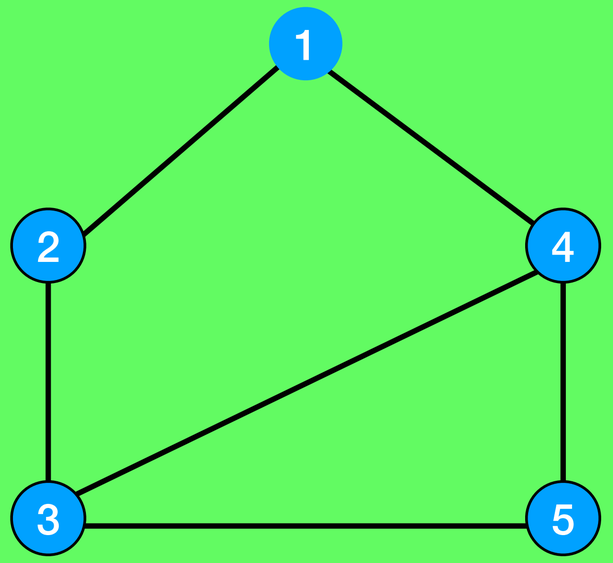
Connectivity component



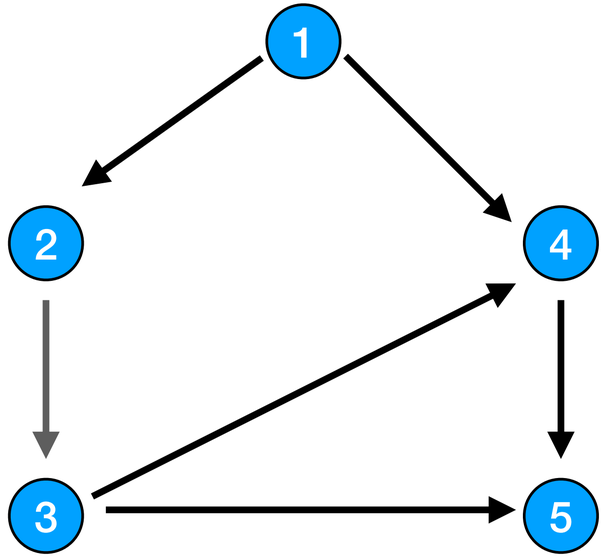
N1 = {1,2,3,4}

N2 = {7,9}

Có 2 dạng Grap

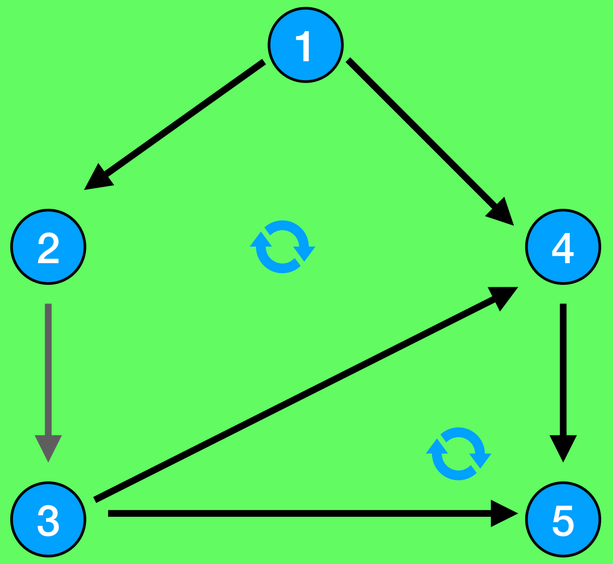


Undirected
(Vô hướng)

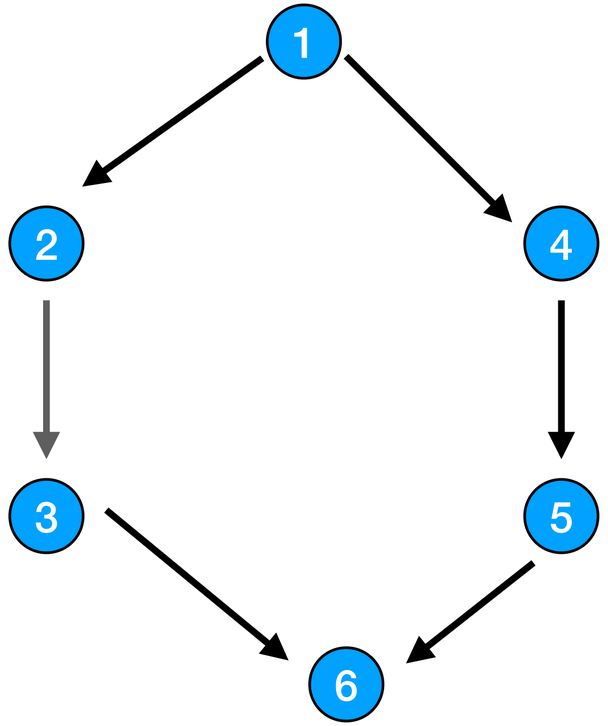


Directed
(Có hướng)

Directed

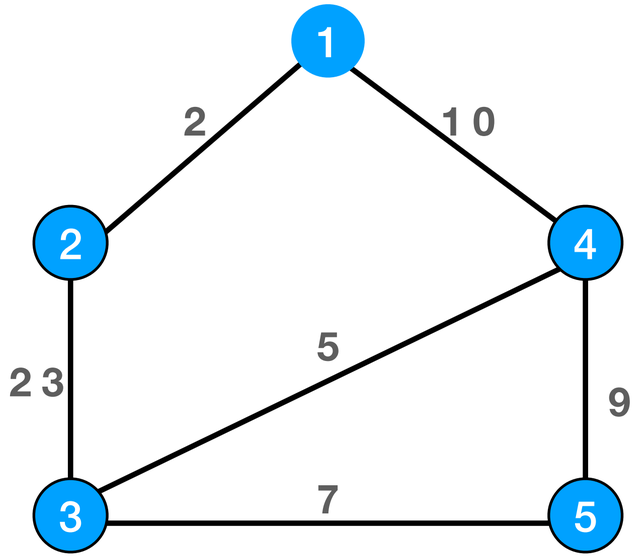


Directed Cyclic graph

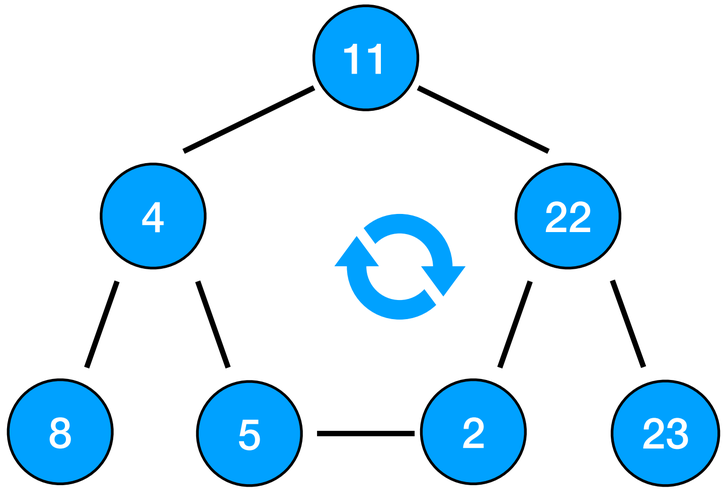


Directed ACyclic graph

Weighted graph



Graph(Tree)

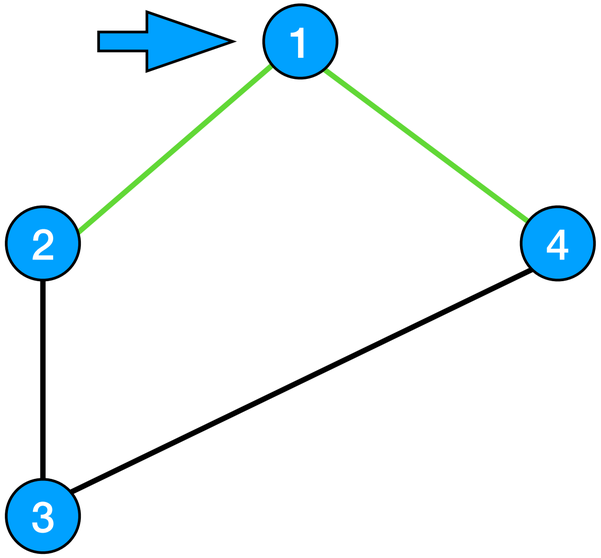


- Graph không có cycle

-Remove 1 node là thành disconnected graph

-Add 1 edge thì thành Directed Cyclic graph

Vô hướng



	1	2	3	4
1	0	1	0	1
2				
3				
4				

Edge List

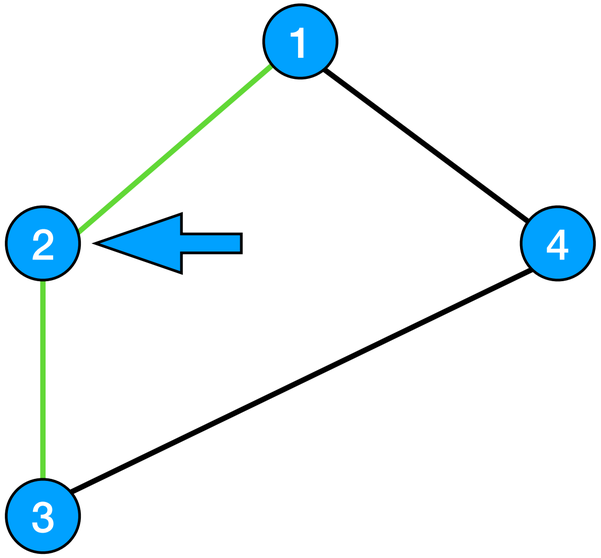
```
{
  {1,2}, {1,4}
}
```

Hash table

```
{
  1:[2,4]
}
```

Matrix

```
[
 [0, 1, 0, 1],
 [0, 0, 0, 0],
 [0, 0, 0, 0],
 [0, 0, 0, 0]
]
```



	1	2	3	4
1	0	1	0	1
2	1	0	1	0
3				
4				

Edge List

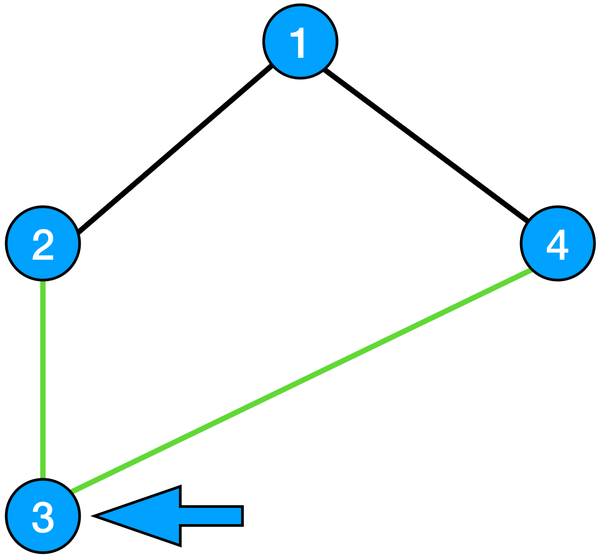
```
{
  {1,2}, {1,4},
  {2,3}
}
```

Hash table

```
{
  1:[2,4],
  2:[1,3],
}
```

Matrix

```
[
 [0, 1, 0, 1],
 [1, 0, 1, 0],
 [0, 0, 0, 0],
 [0, 0, 0, 0]
]
```



	1	2	3	4
1	0	1	0	1
2	1	0	1	0
3	0	1	0	1
4				

Edge List

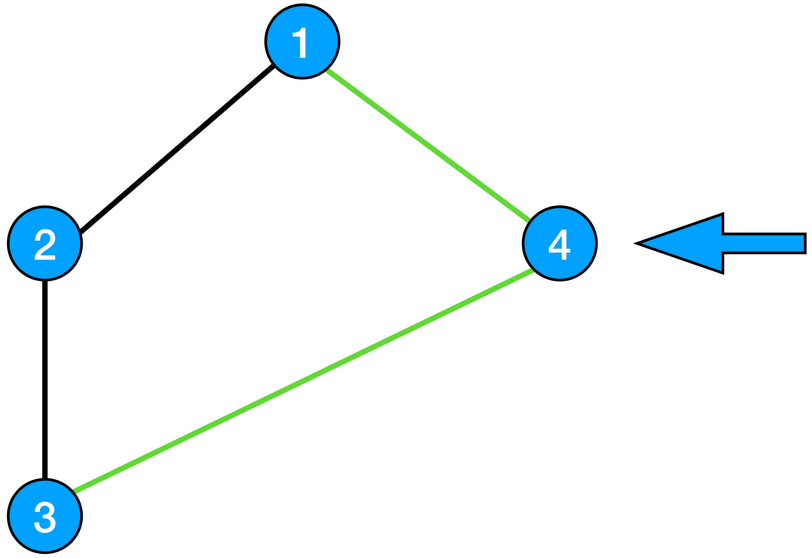
```
{
  {1,2}, {1,4},
  {2,3}, {3,2}
}
```

Hash table

```
{
  1:[2,4],
  2:[1,3],
  3:[2,4],
}
```

Matrix

```
[
 [0, 1, 0, 1],
 [1, 0, 1, 0],
 [0, 1, 0, 1],
 [0, 0, 0, 0]
]
```



	1	2	3	4
1	0	1	0	1
2	1	0	1	0
3	0	1	0	1
4	1	0	1	0

Edge List

```
{
  {1,2}, {1,4},
  {2,3}, {3,4}
}
```

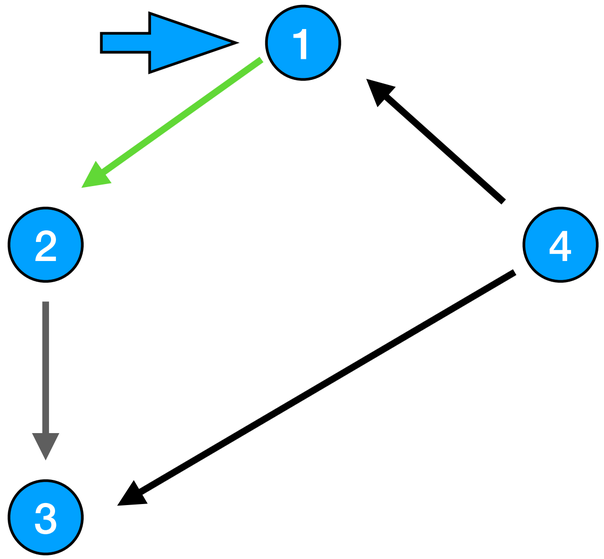
Hash table

```
{
  1:[2,4],
  2:[1,3],
  3:[2,4],
  4:[3,1],
}
```

Matrix

```
[
 [0, 1, 0, 1],
 [1, 0, 1, 0],
 [0, 1, 0, 1],
 [1, 0, 1, 0]
]
```

Có hướng



	1	2	3	4
1	0	1	0	0
2				
3				
4				

Edge List

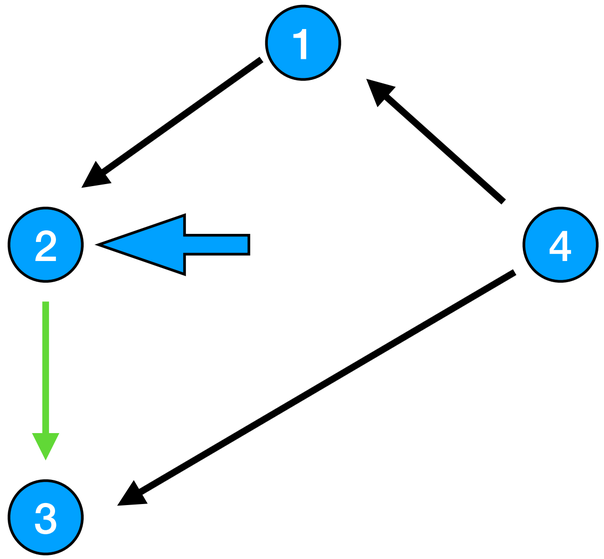
```
{
  {1,2},
}
```

Hash table

```
{
  1:[2]
}
```

Matrix

```
[
 [0, 1, 0, 0],
 [0, 0, 0, 0],
 [0, 0, 0, 0],
 [0, 0, 0, 0]
]
```



	1	2	3	4
1	0	1	0	0
2	0	0	1	0
3				
4				

Edge List

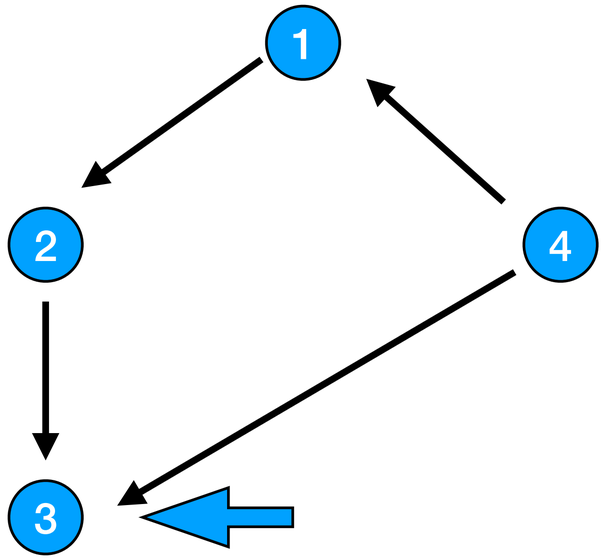
```
{
  {1,2},
  {2,3},
}
```

Hash table

```
{
  1:[2],
  2:[3],
}
```

Matrix

```
[
 [0, 1, 0, 0],
 [0, 0, 1, 0],
 [0, 0, 0, 0],
 [0, 0, 0, 0]
]
```



	1	2	3	4
1	0	1	0	0
2	0	0	1	0
3	0	0	0	0
4				

Edge List

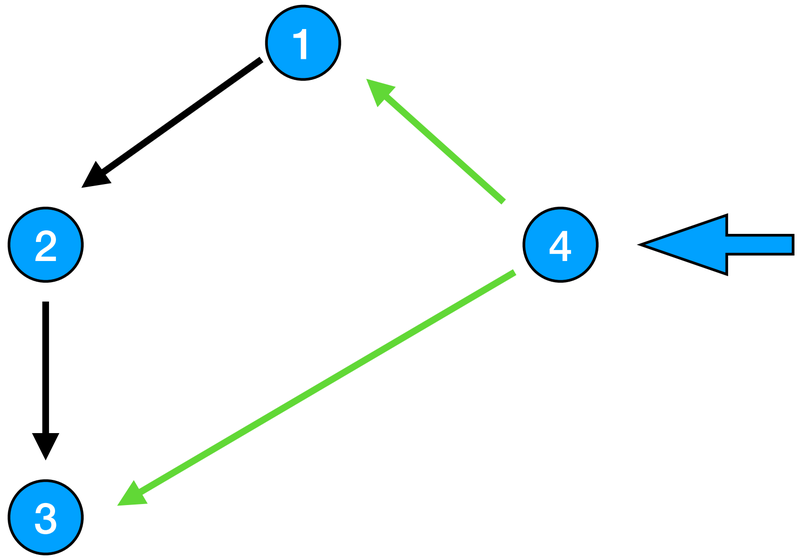
```
{
  {1,2},
  {2,3},
}
```

Hash table

```
{
  1:[2],
  2:[3],
  3:[],
}
```

Matrix

```
[
 [0, 1, 0, 0],
 [0, 0, 1, 0],
 [0, 0, 0, 0],
 [0, 0, 0, 0]
]
```



	1	2	3	4
1	0	1	0	0
2	0	0	1	0
3	0	0	0	0
4	1	0	1	0

Edge List

```
{
  {1,2},
  {2,3},
  {4,3},{4,1}
}
```

Hash table

```
{
  1:[2],
  2:[3],
  3:[],
  4:[3,1]
}
```

Matrix

```
[
 [0, 1, 0, 0],
 [0, 0, 1, 0],
 [0, 0, 0, 0],
 [1, 0, 1, 0]
]
```