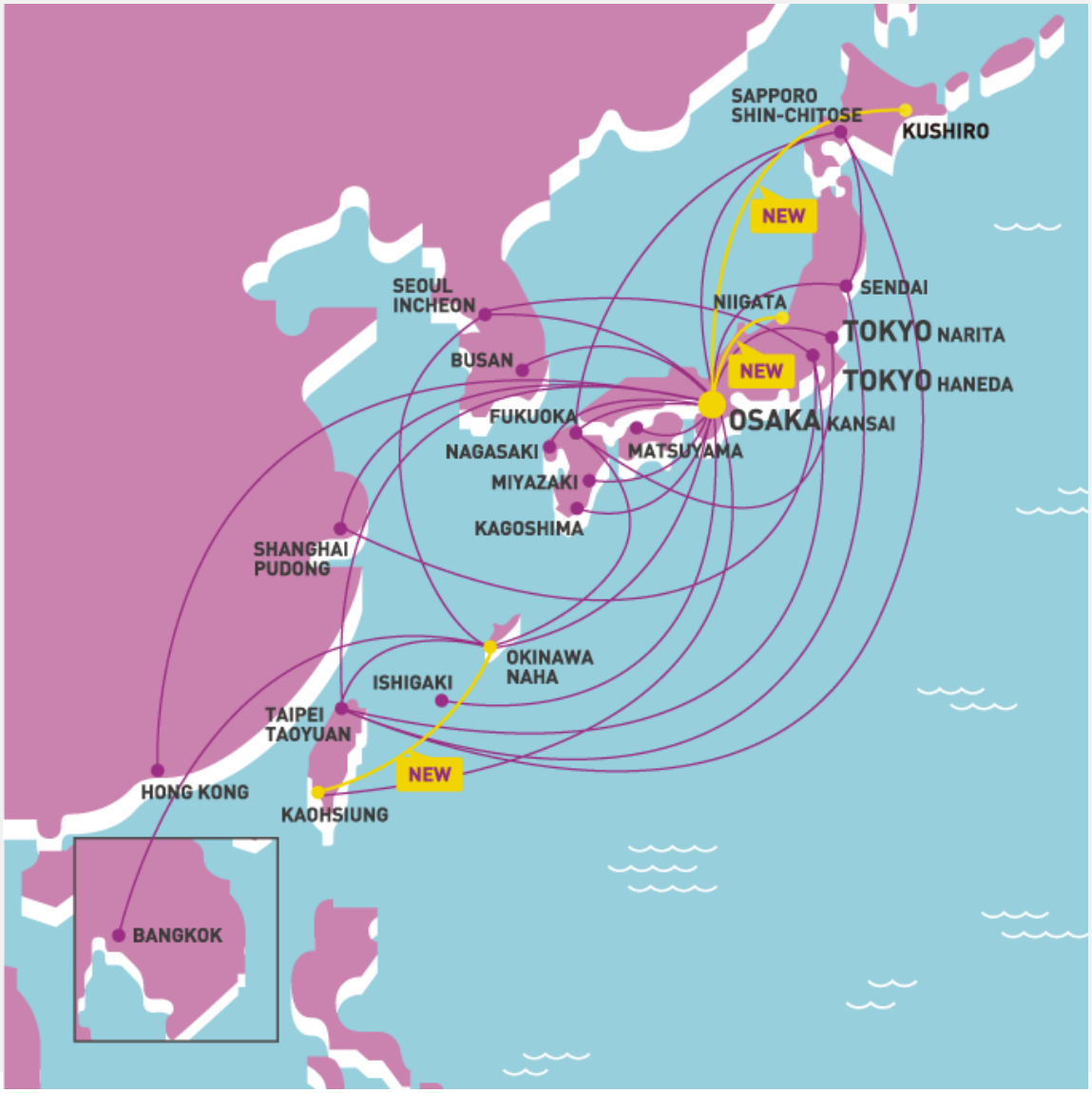
Module4—Graph

1. กราฟคืออะไร ทำไมต้องใช้โครงสร้างข้อมูลแบบกราฟ
2. นิยามของกราฟ digraph, undigraph, vertice, edge, adjacent, incident, degree, path
3. การเก็บกราฟด้วย adjacency list
4. การท่องกราฟด้วย BFS

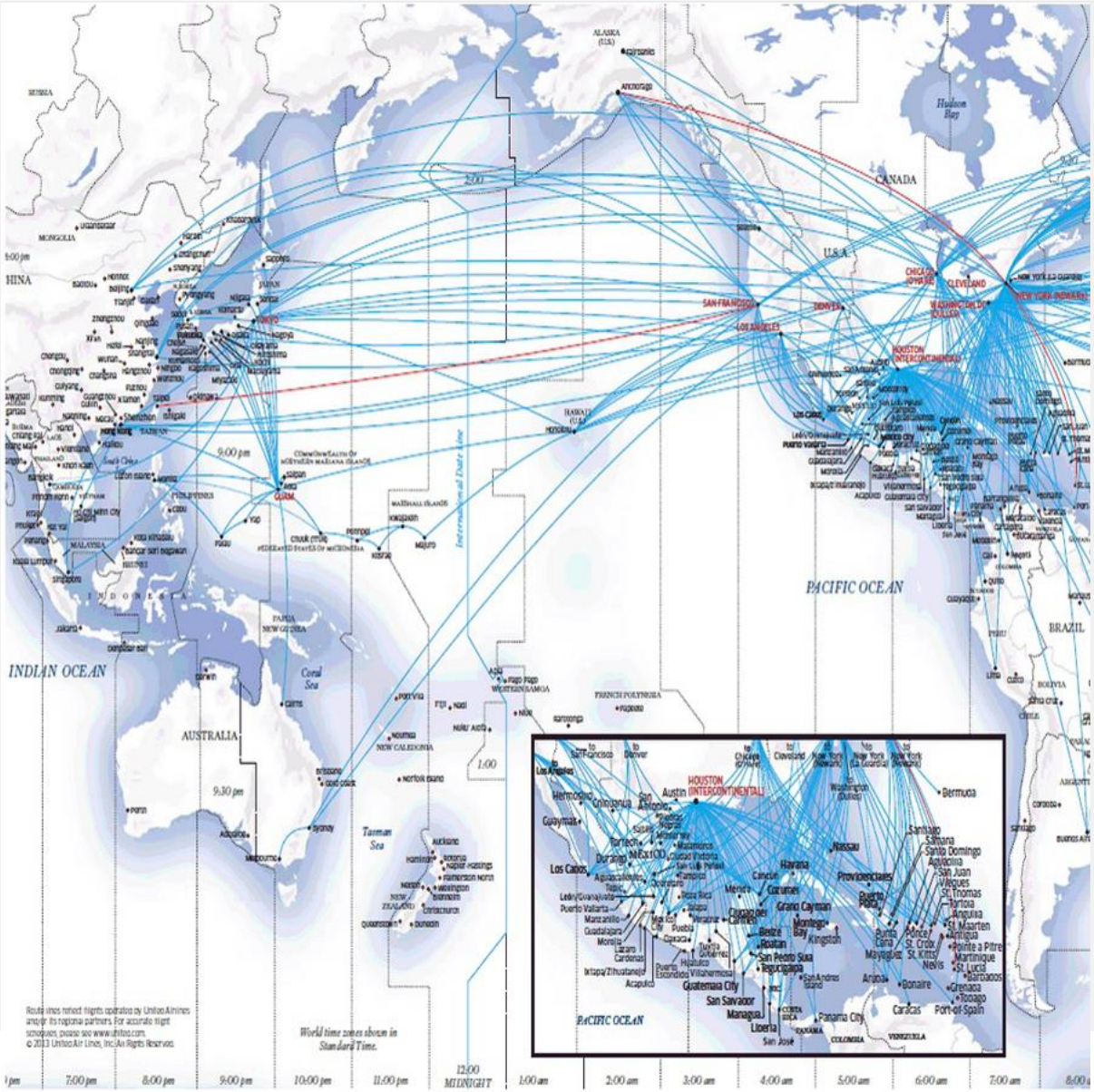


เก็บข้อมูล

- มีทิศทาง
- มีระยะทาง

ตัวอย่างงาน

- การวางข่าย งานคอมพิวเตอร์
- การวิเคราะห์เส้นทางวิกฤติ
- ปัญหาเส้นทาง ที่สั้นที่สุด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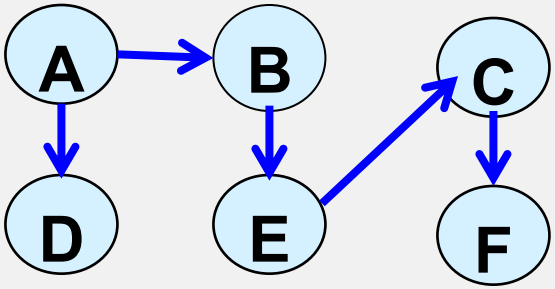
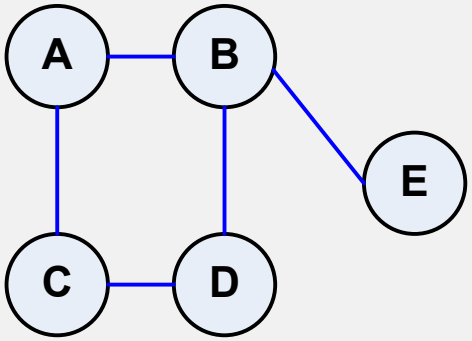
4.1 Definition

เกี่ยวอย่างมีทิศทาง

1. directed graph(digraph)
2. Undirected graph(Undigraph)



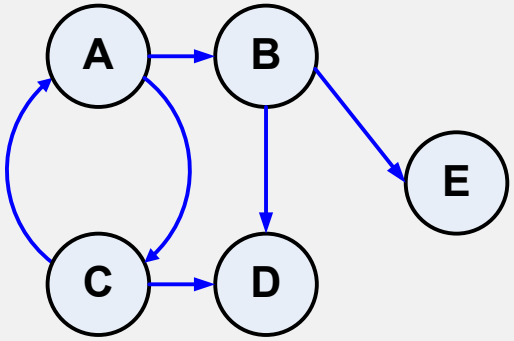


4.1 Definition

1) A directed graph(or digraph) G : is a pair(V,E), where V is a finite set and E is binary relation on V.

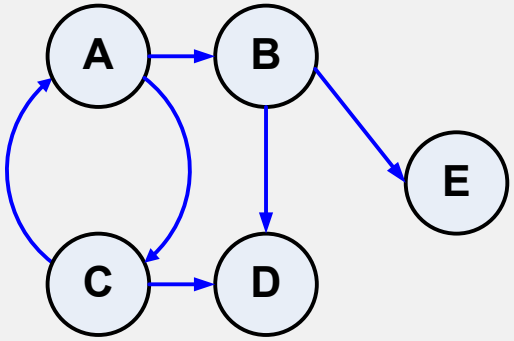
- The ***set V*** is called the **vertex set** of G, and its elements are called vertices.

V={A,B,C,D,E}



(A,B) (A,C) (B,D) (B,E)
(C,A) (C,D)

- The ***set E*** is called the **edge set** of G, and its elements are called edges.



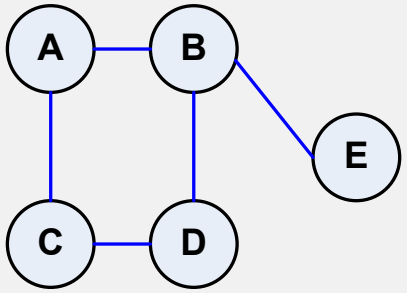
The edge set E consists of ordered pairs of vertices

มีลำดับ

V={A,B,C,D,E}
E={ (A,B), (A,C), (B,D), (B,E), (C,A),(C,D) }

2) An undirected graph G :

G = (V,E) , the edge set E consists of unordered pairs of vertices, rather than ordered pairs.



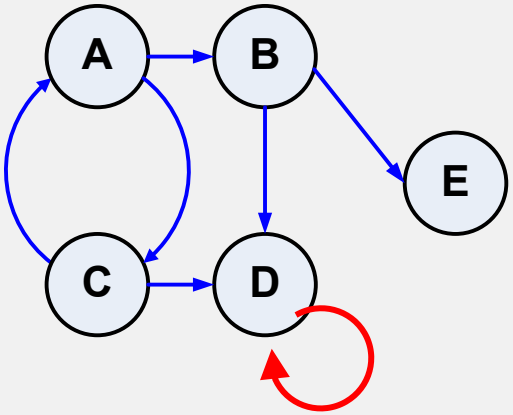
V={A,B,C,D,E}

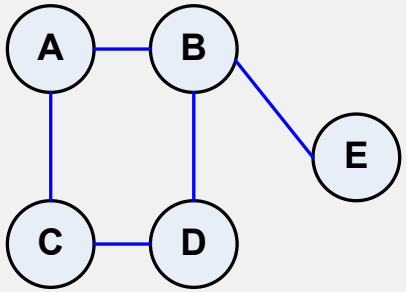
E={ (A,B), (B,A), (A,C), (C,A), (B,D),(D,B), (B,E), (E,B), (C,D),(D,C) }

3) self-loops : edges (เส้นเชื่อม) from a vertex to itself.

Undigraph self loop are forbidden, and so every edge consists of exactly two distinct vertices. $u \neq v$

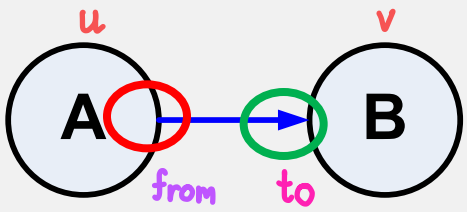
Cycle : a cycle in a graph is a non-empty trail in which only the first and last vertices are equal





4) Incident :

digraph : if (u,v) is an edge in a directed graph G=(V,E), we say that(u,v) is



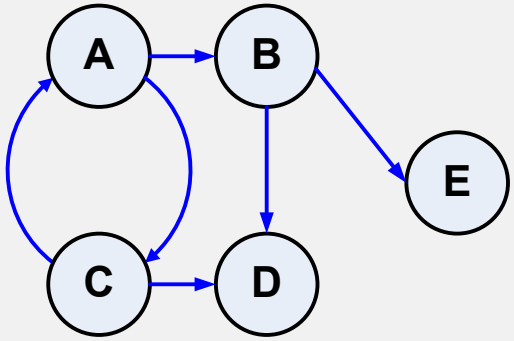
incident from or leaves vertex u

incident to or enters vertex v.

Question edge (B,E)

Incident from ..B..

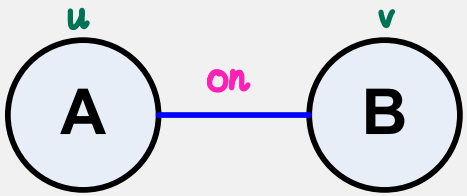
Incident to ..E..



undigraph : if (u,v) is an edge in a directed graph G=(V,E), we say that(u,v) is ***incident on*** vertices u and v

ติดต่อ

is ***incident on*** vertices u and v



Question edge (A,B)

Incident from ....

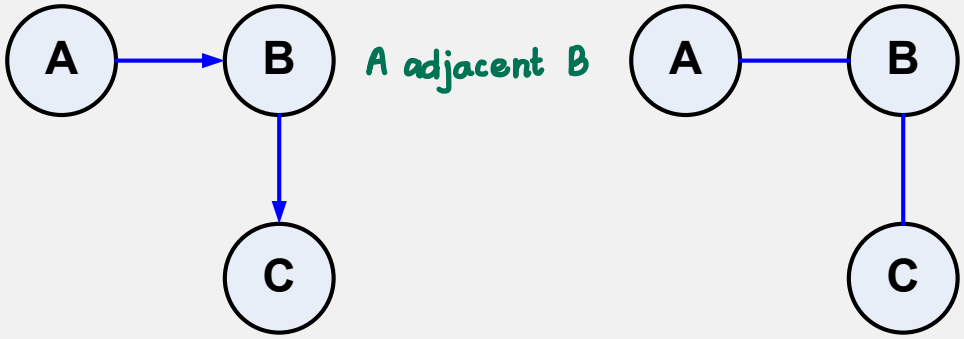
Incident to ....

Edge (A,B) is incident on vertices A and B

5) adjacent ประชิด

Digraph : If (u,v) is an edge in a graph G=(V,E), we say that v is adjacent to vertex u. If v is adjacent to u denote by u -> v

Undigraph : Adjacent relation is symmetric.

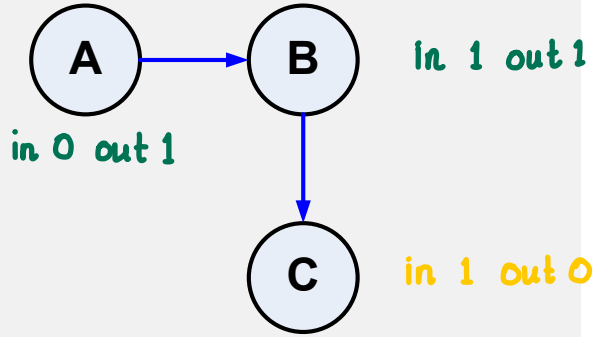


B ประชิด A A->B

B ประชิด A และ A ประชิด B

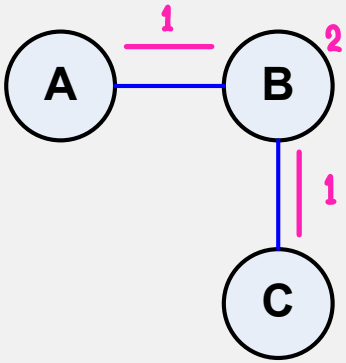
6) Degree

Digraph : in degree (number of edges entering it.), out degree (Opposite in degree.)



A in degree = 0
A out degree = 1

Undigraph : is the number of edges incident on it.

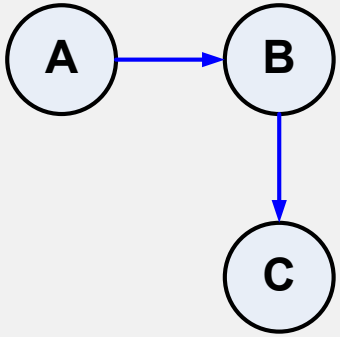


A degree = 1

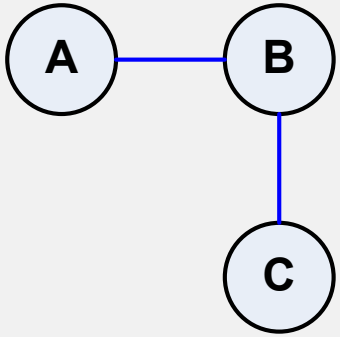
B degree = 2

C degree = 1

7) path of length : Path k from a vertex u to a vertex u' in a graph G=(V,E) is a sequence $(v_o,v_1,..,v_k)$ of vertices such that $u = v_0$, $u' = v_k$, and $(v_{i-1}, v_i) \in E$ for i = 1, 2, .., k



A,C (A,B,C)



A,C

(A,B,A,B,C)

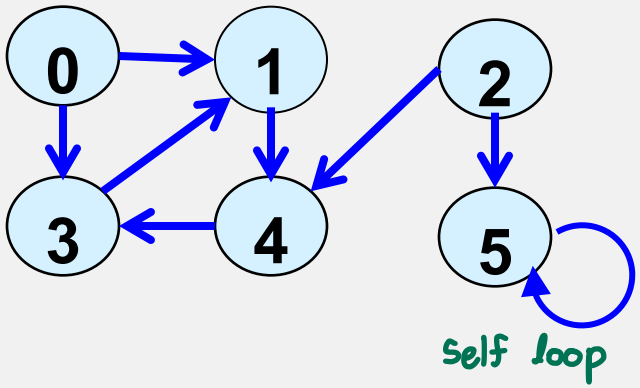
(A,B,C)

4.2 โครงสร้างข้อมูลที่ใช้เก็บข้อมูลในรูปแบบกราฟคือ

1. Adjacency list
2. Adjacency Matrix

โครงสร้างข้อมูลทั้ง 2 แบบนี้จะสามารถเก็บกราฟได้ทั้ง digraph และ undigraph

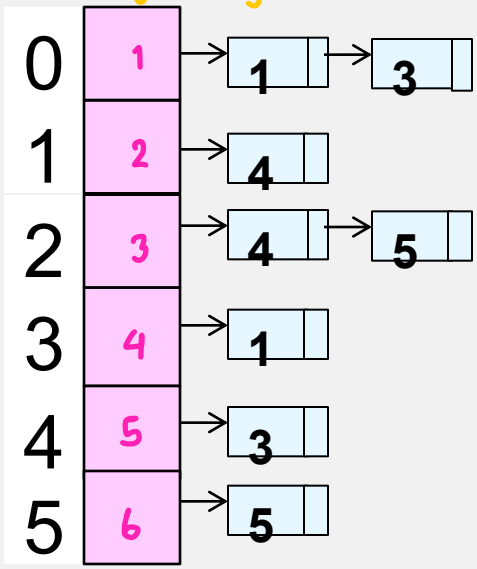
Digraph



1. Adjacency list ✓
2. Adjacentcy matix

Com

adjacency list



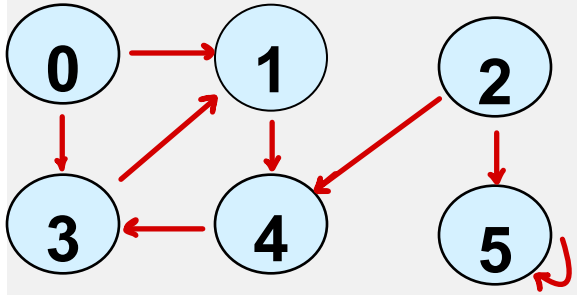
โครงสร้างในการเก็บกราฟ

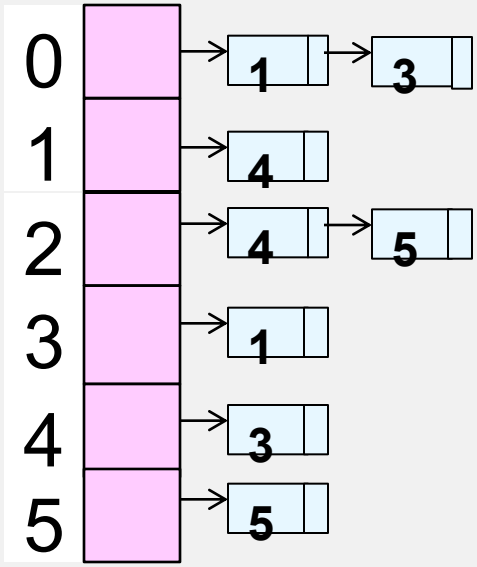
	0	1	2	3	4	5
0	0	1	0	1	0	0
1	0	0	0	0	1	0
2	0	0	0	0	1	1
3	0	1	0	0	0	0
4	0	0	0	1	0	0
5	0	0	0	0	0	1

```
struct record * adj [6];
```

```
struct record {
    int value;
    struct record *next;
};
```

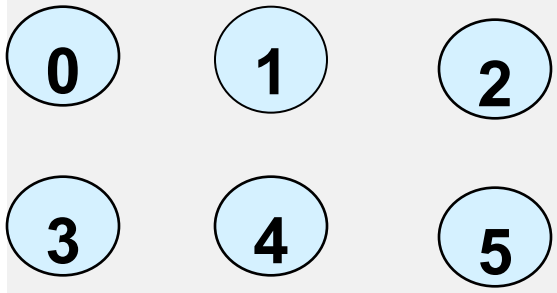
Digraph





1. Adjacency list
2. Adjacentcy matix

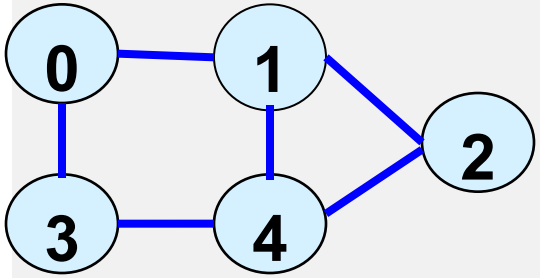
Digraph



	0	1	2	3	4	5
0	0	1	0	1	0	0
1	0	0	0	0	1	0
2	0	0	0	0	1	1
3	0	1	0	0	0	0
4	0	0	0	1	0	0
5	0	0	0	0	0	1

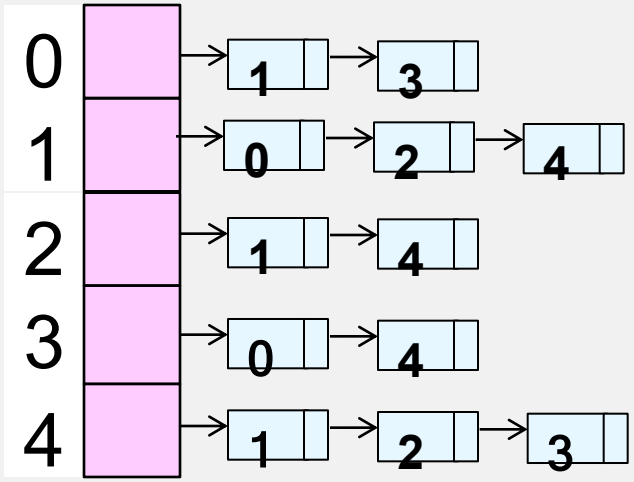
1. Adjacency list
2. Adjacentcy matix

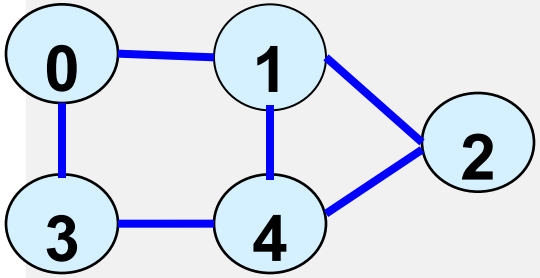
Undigraph



Adjacency list

12 loops forward - Back



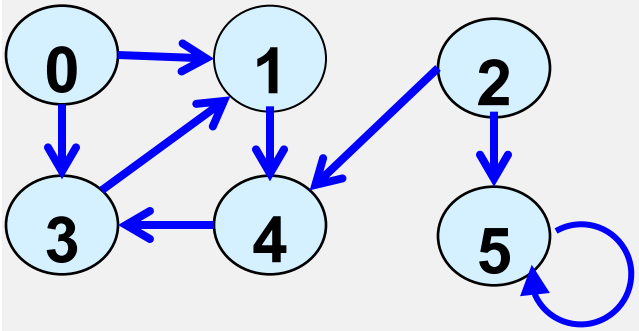


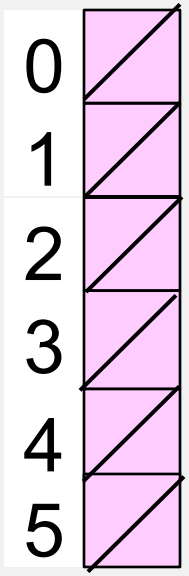
Adjacency Matrix

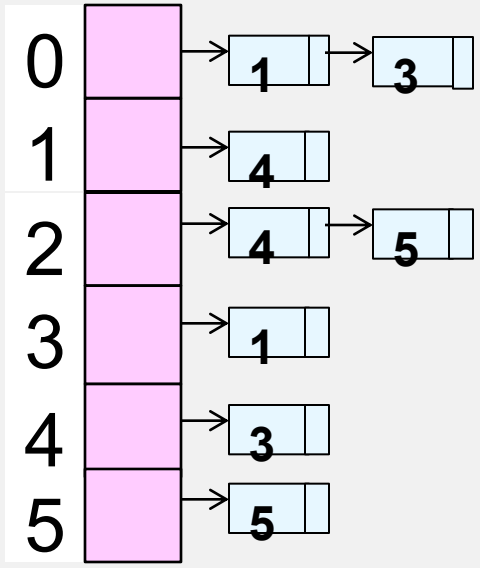
	0	1	2	3	4
0	0	1	0	1	0
1	1	0	1	0	1
2	0	1	0	0	1
3	1	0	0	0	1
4	0	1	1	1	0

mirror

การบ้าน ข้อ 1







Enter
#0 : 1 3 -1
#1 : 4 -1
...

```
for ( int i = 0 ;  i < 6 ; i++){
    adj [i] = NULL ;
```