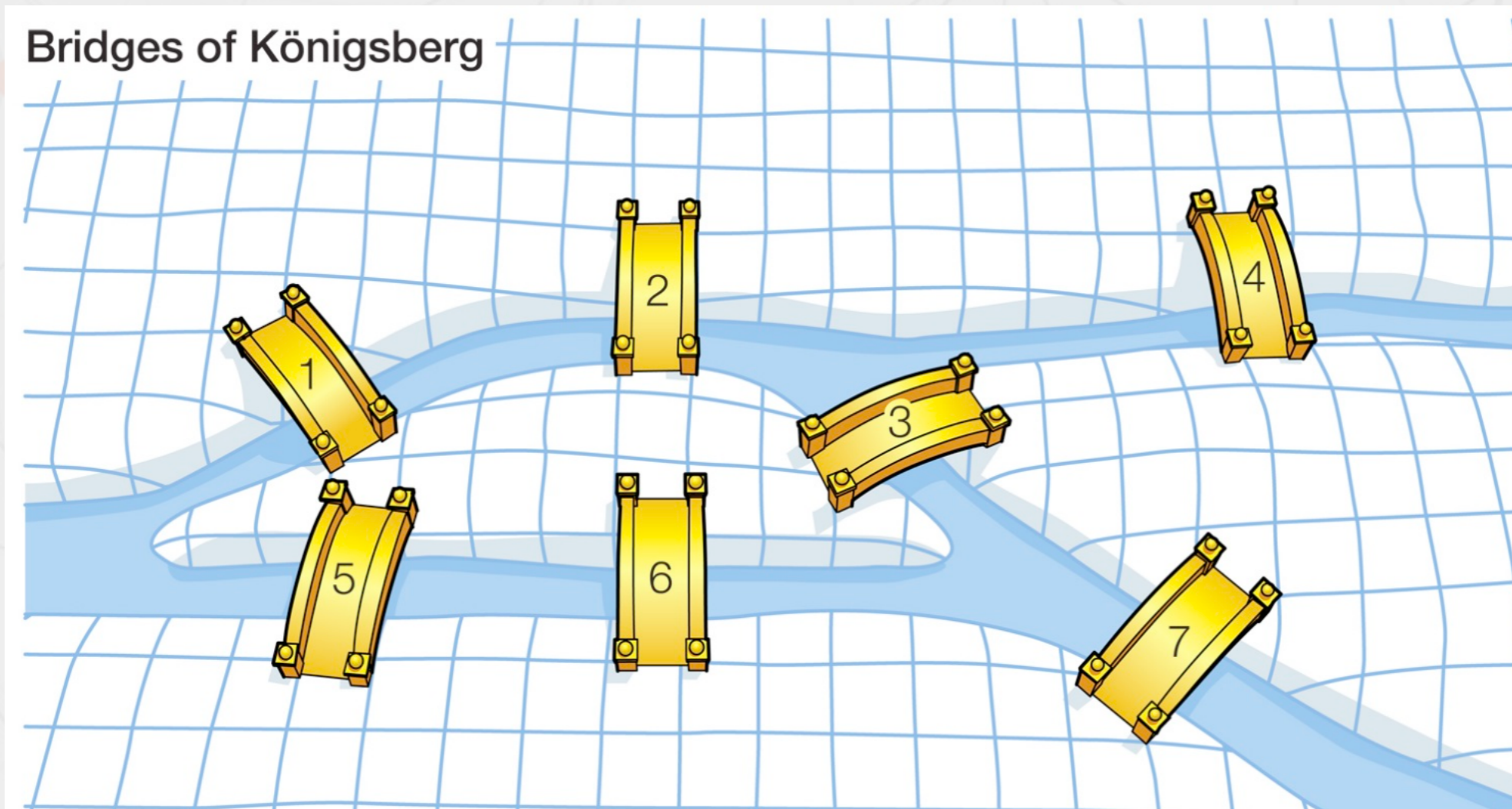


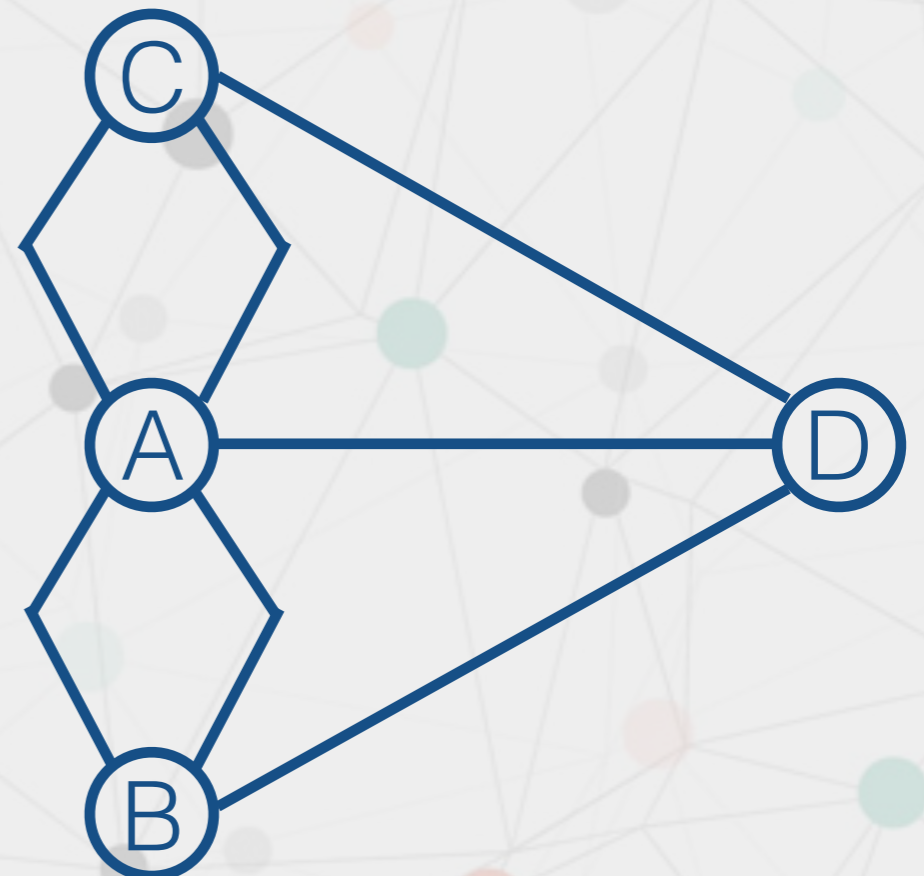
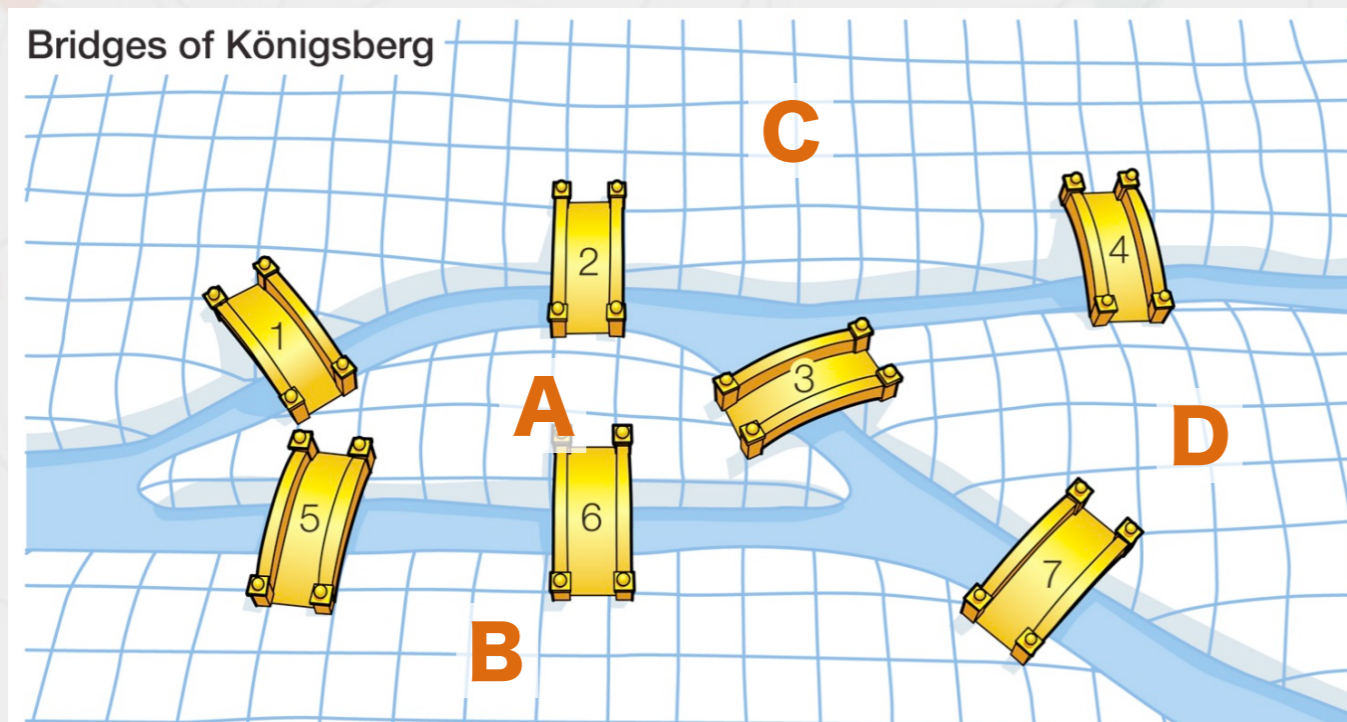
Graphs

柯尼斯堡七橋問題

Königsberg bridge problem





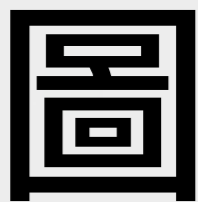
Euler's solution



degree是奇數...無解

名詞定義

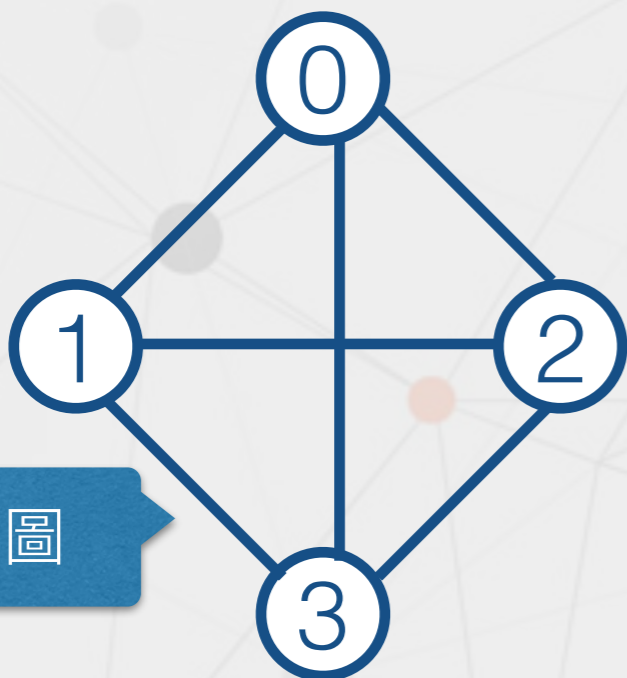
- 點 vertex 
- 邊 edge 
- 圖是有限的點和連接兩相異的邊構成



Graph

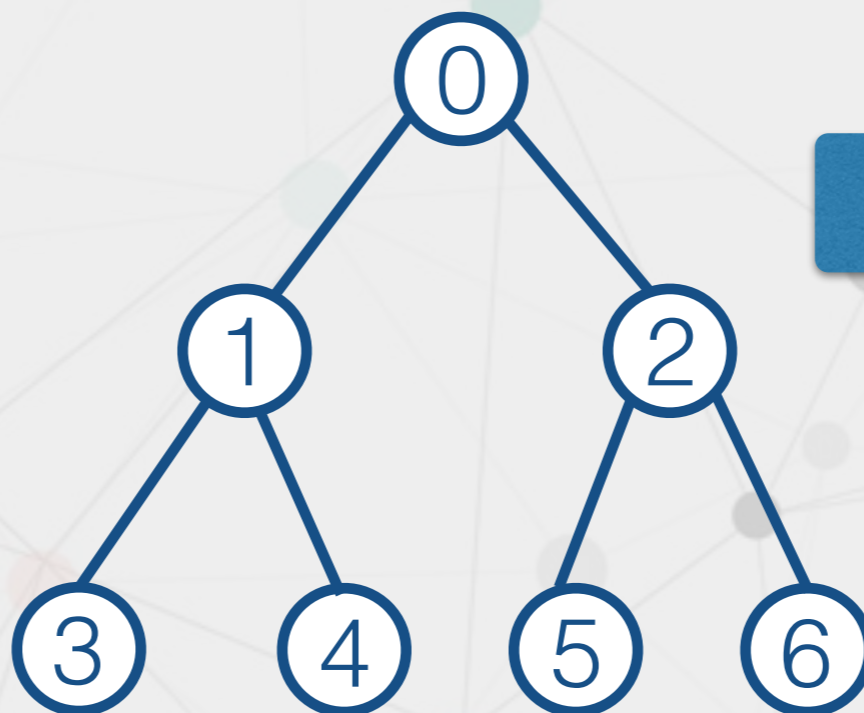
樹也是圖

無向圖



G1

有向圖



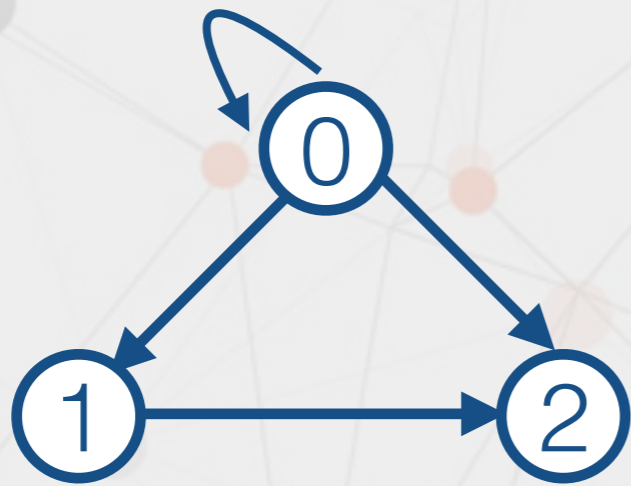
G2



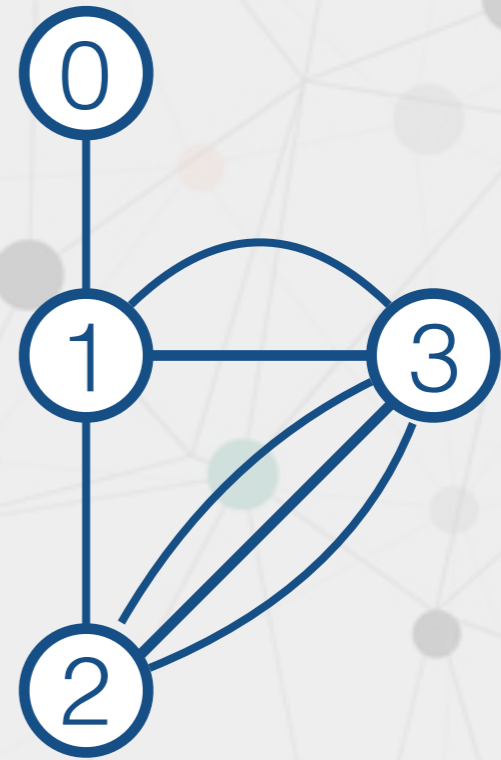
G3

特殊的圖

Special Graph

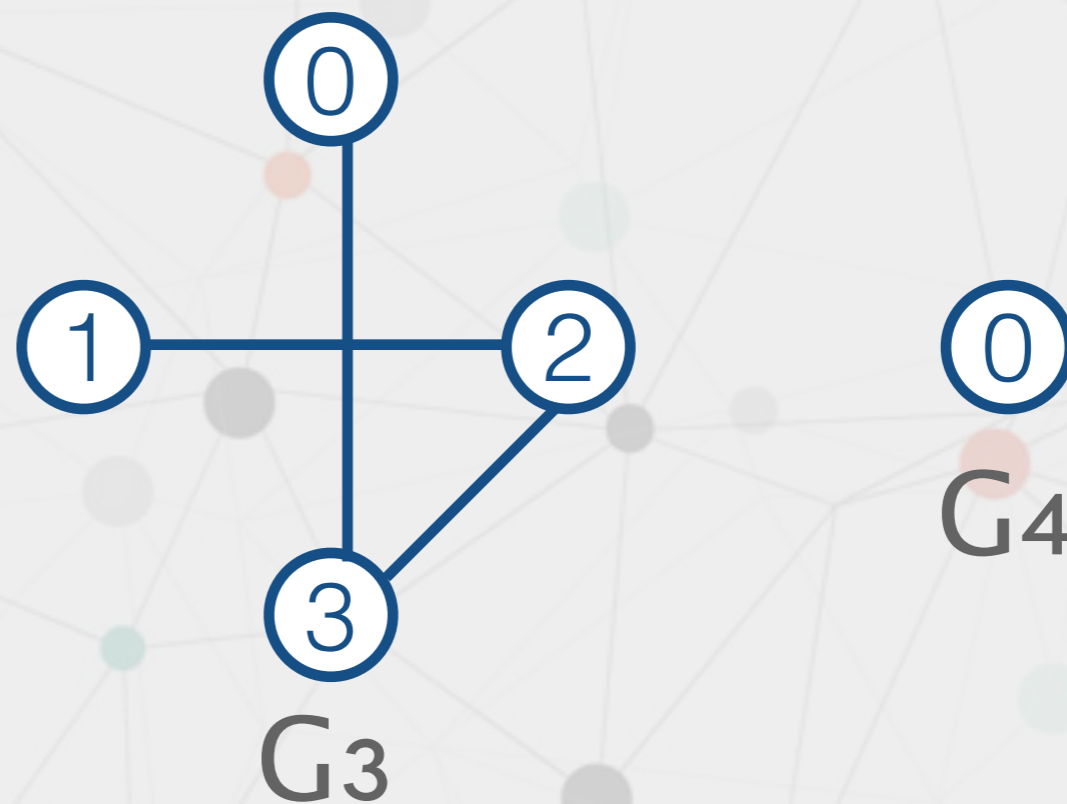
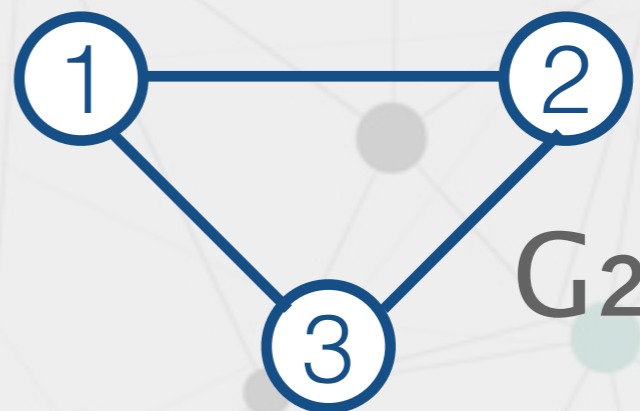
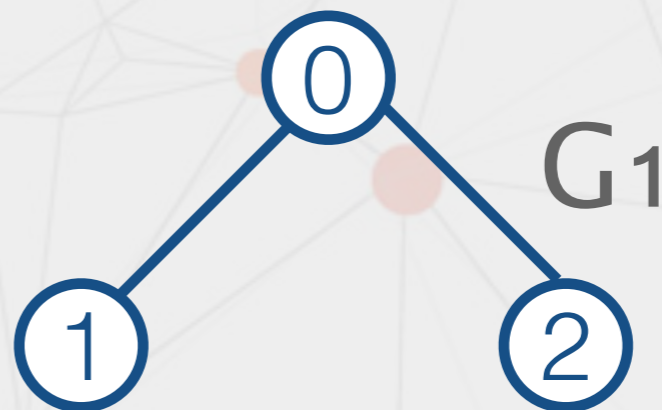
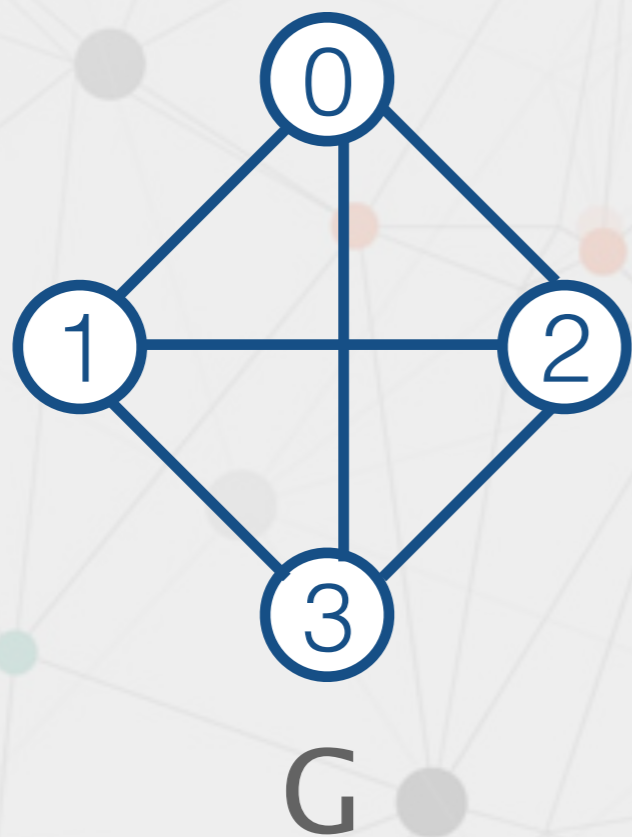


Graph with a self edge

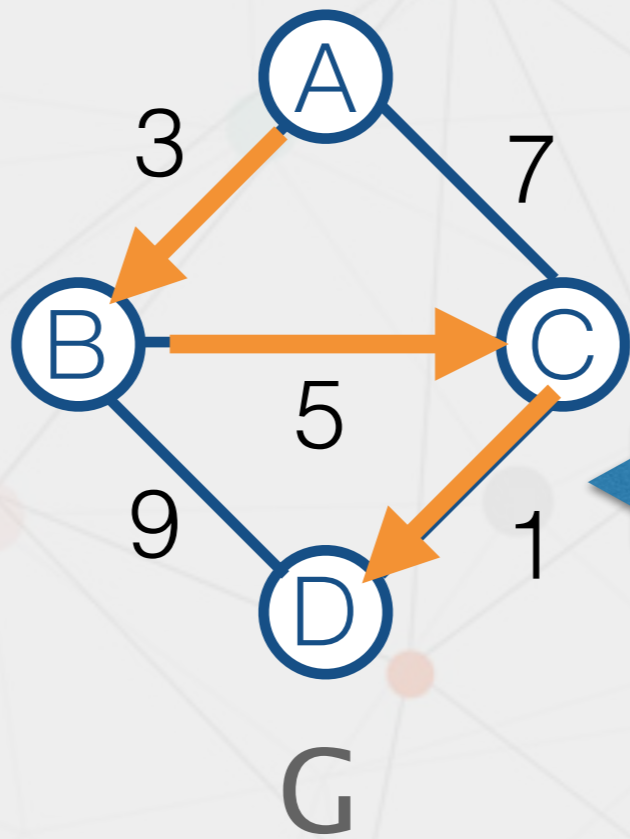


Multigraph

子圖 Subgraph



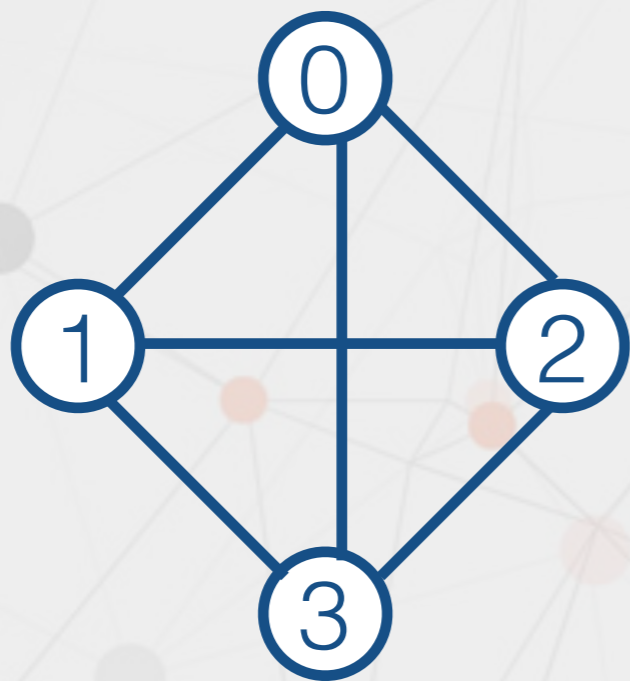
路徑 Path



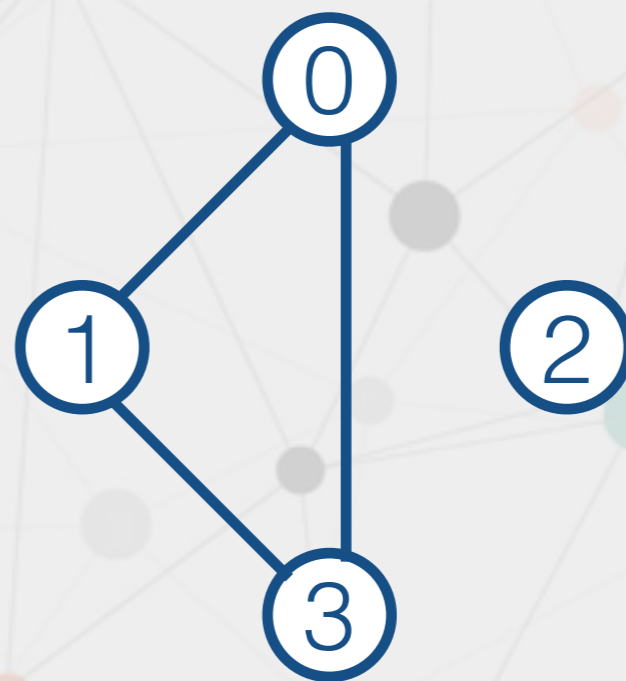
A 到 D 的最短路徑

連通圖

Connected component



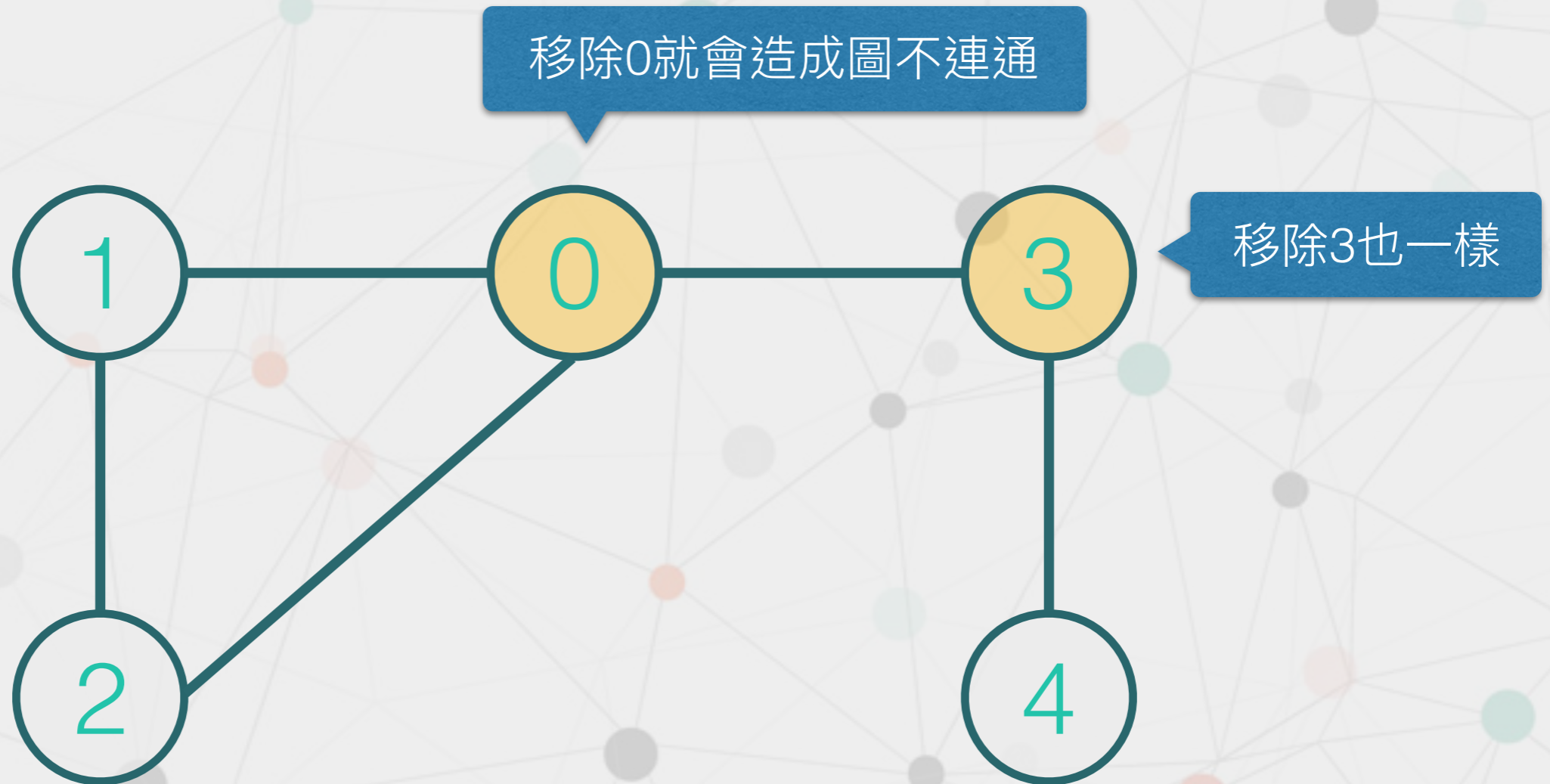
連通



不連通

關節點

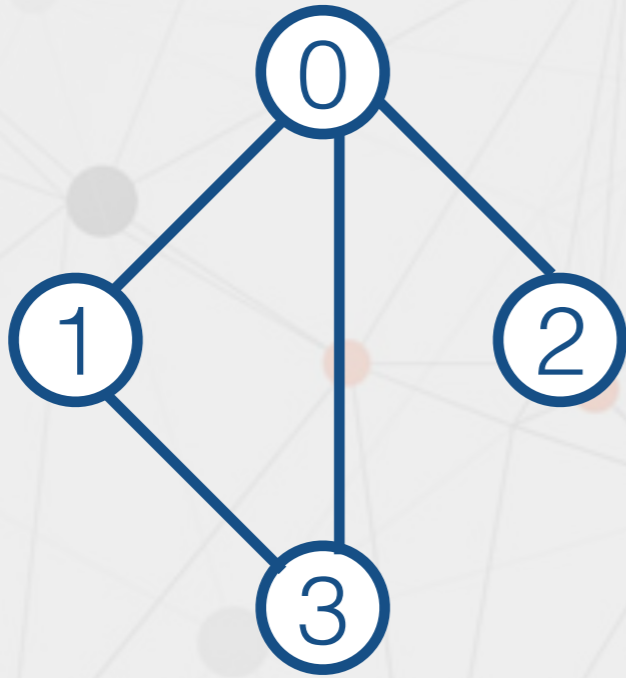
Articulation Point





圖的實作

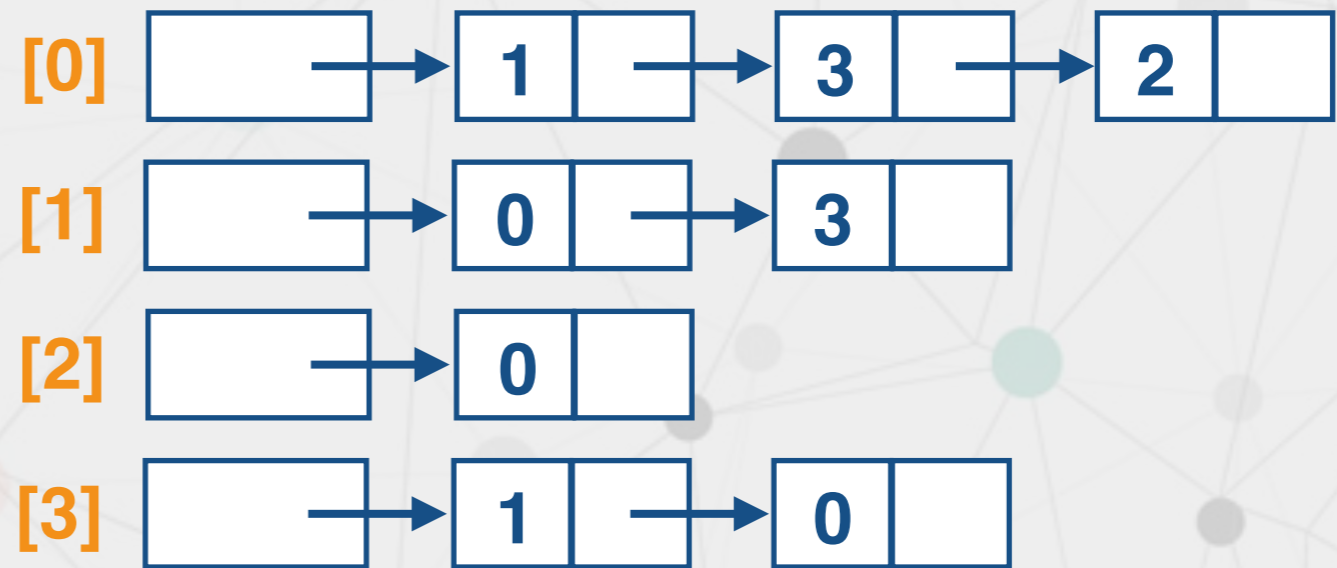
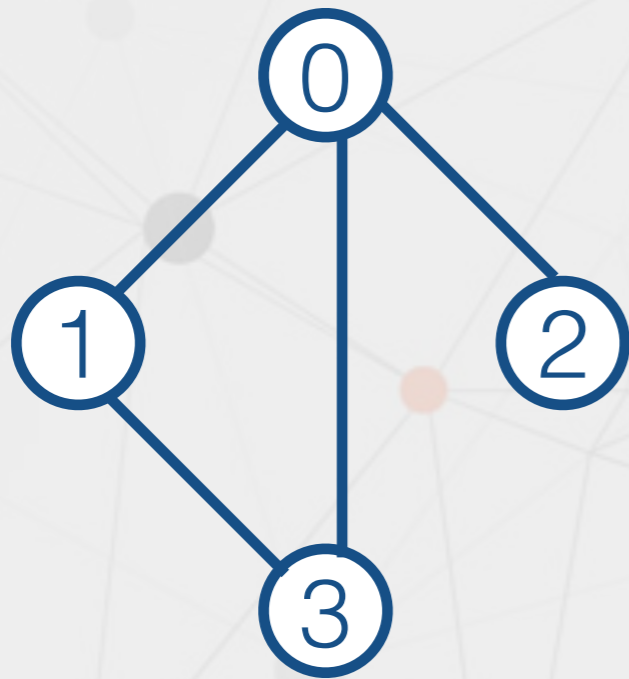
相鄰矩陣 Adjacency Matrix



	[0]	[1]	[2]	[3]
[0]	0	1	1	1
[1]	1	0	0	1
[2]	1	0	0	0
[3]	1	1	0	0

相鄰串列

Adjacency List

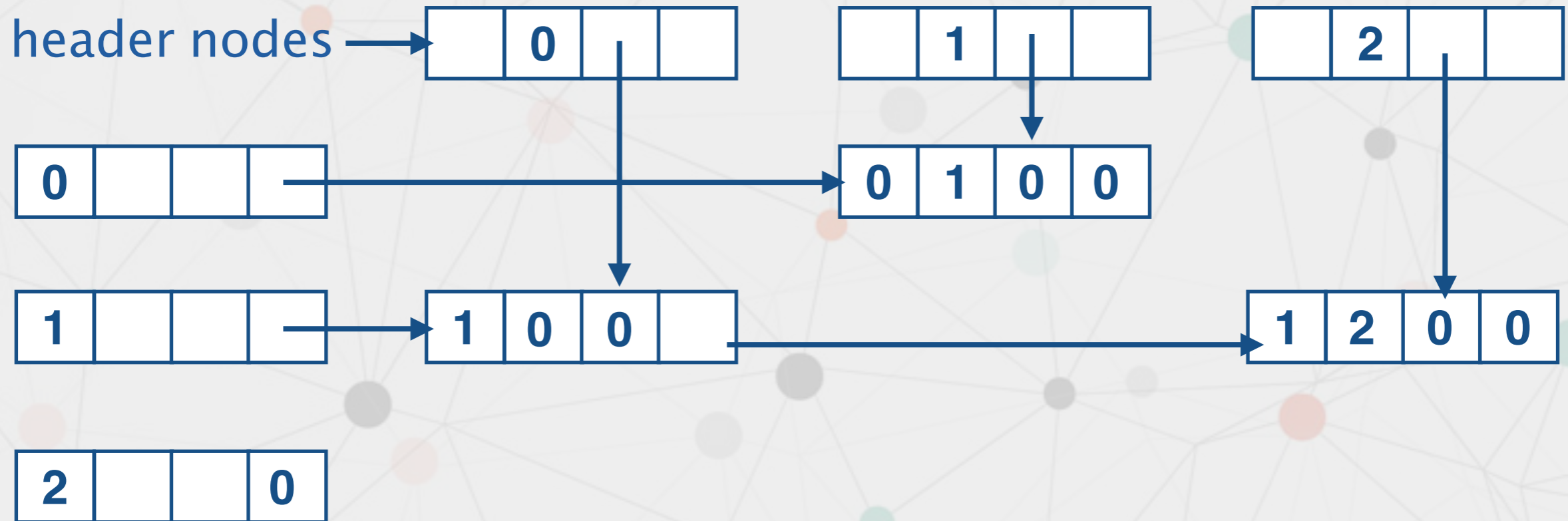


相鄰串列

Adjacency List

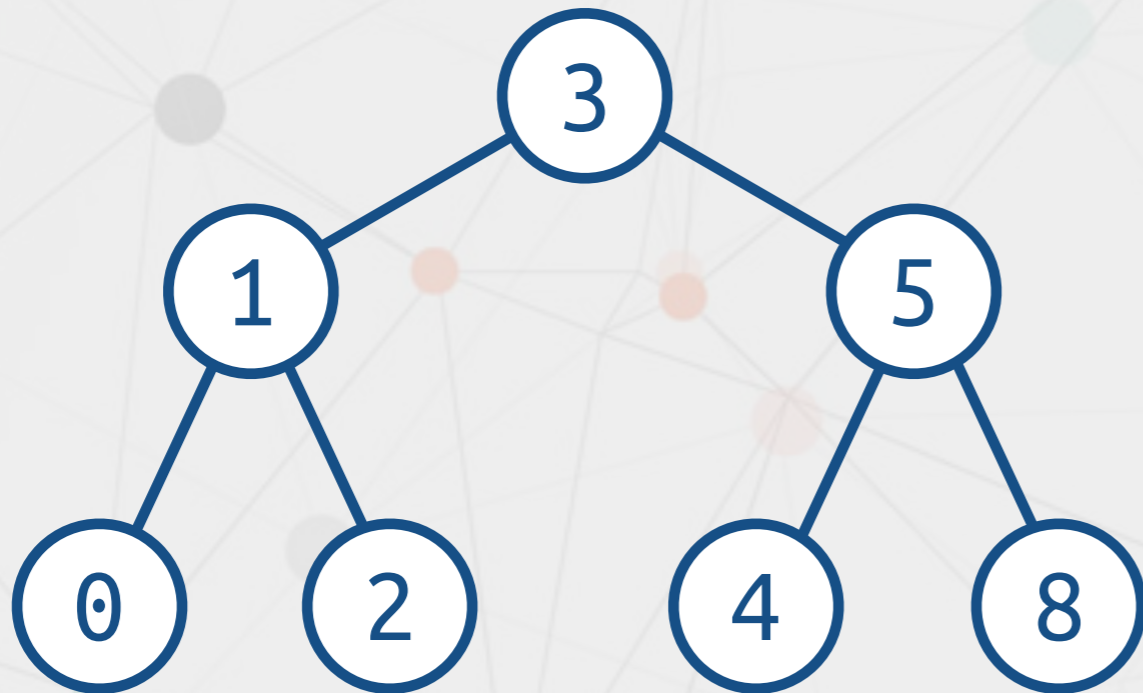


vertex1	vertex2	link1	link2
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深度優先搜尋

Depth First Search, DFS



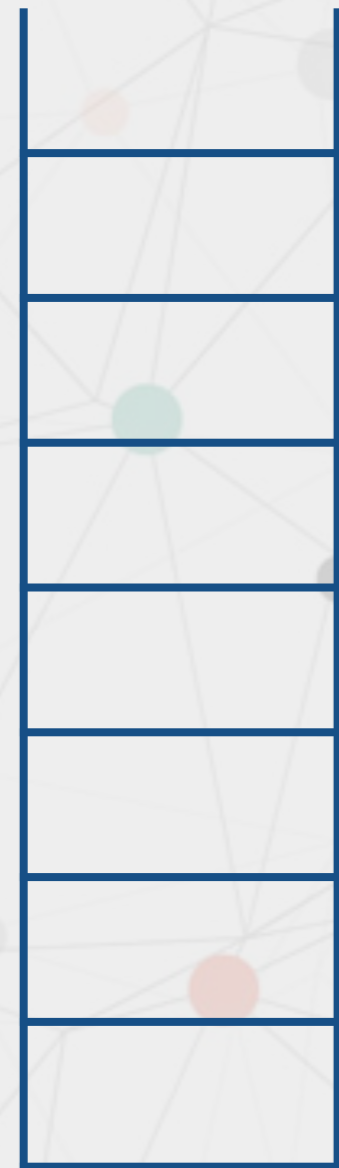
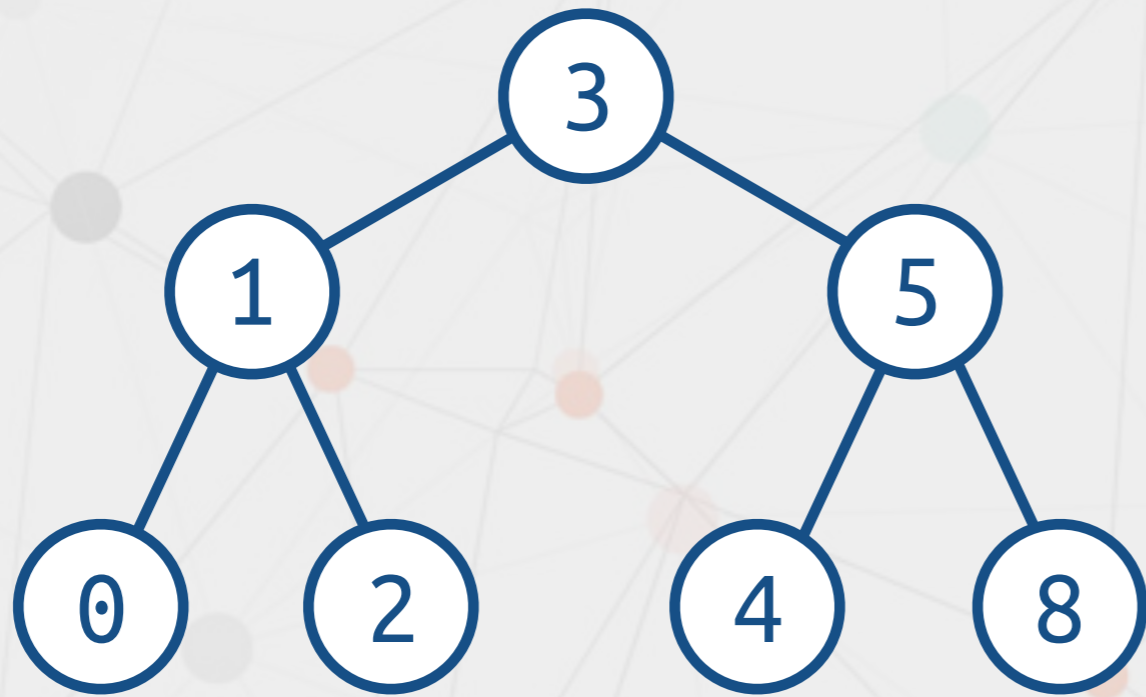
3,1,0,2,5,4,8

3,5,4,8,1,0,2

3,5,4,8,1,2,0

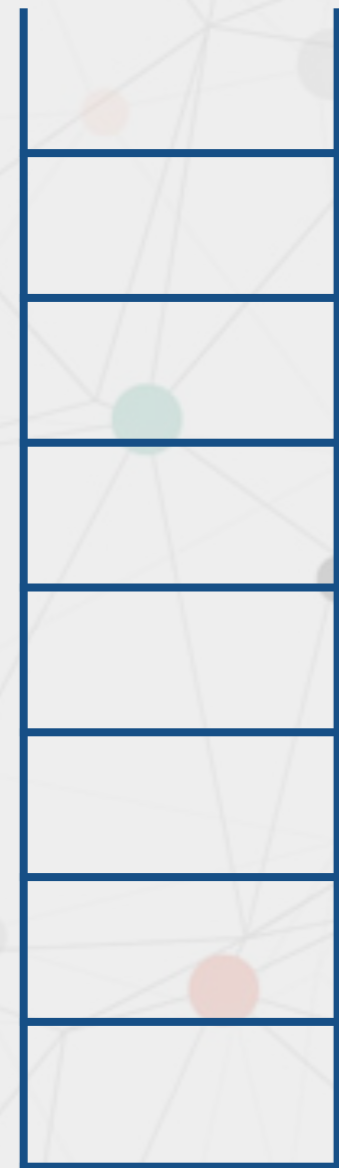
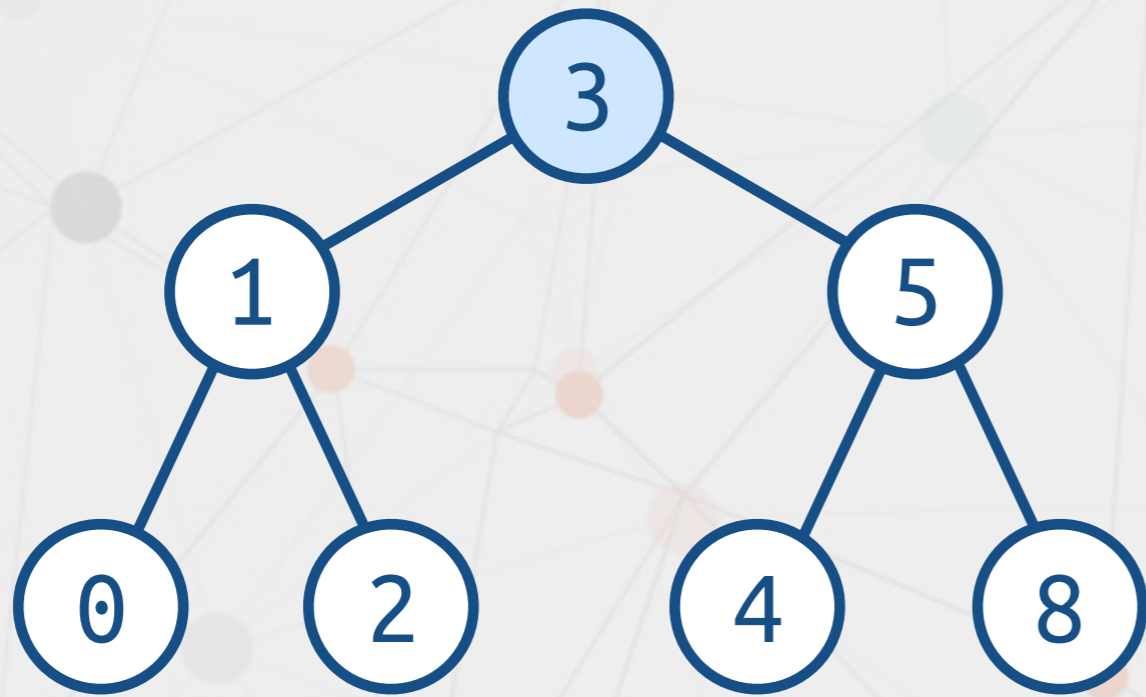
並非唯一順序

深度優先搜尋 DFS



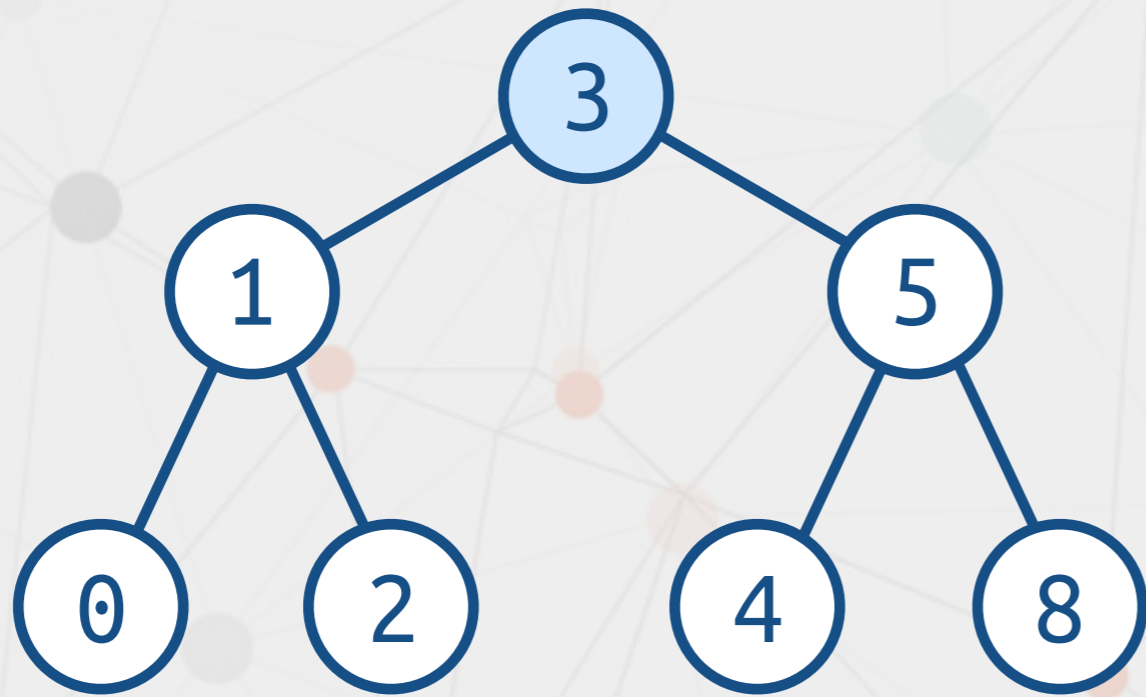
stack

深度優先搜尋 DFS



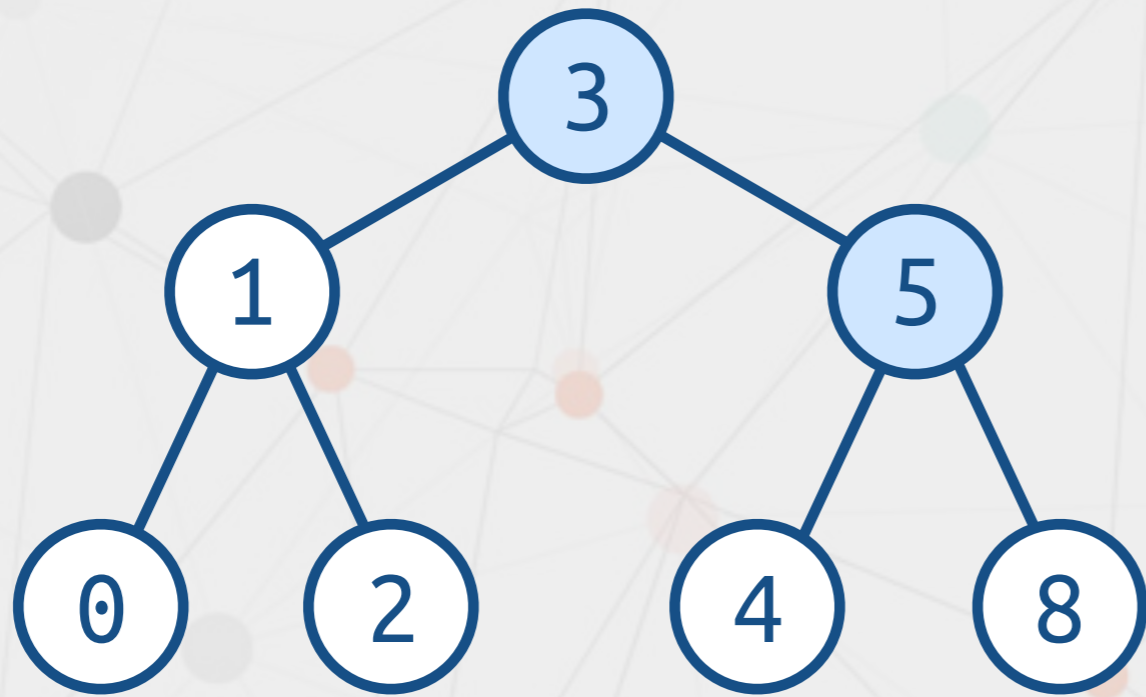
stack

深度優先搜尋 DFS



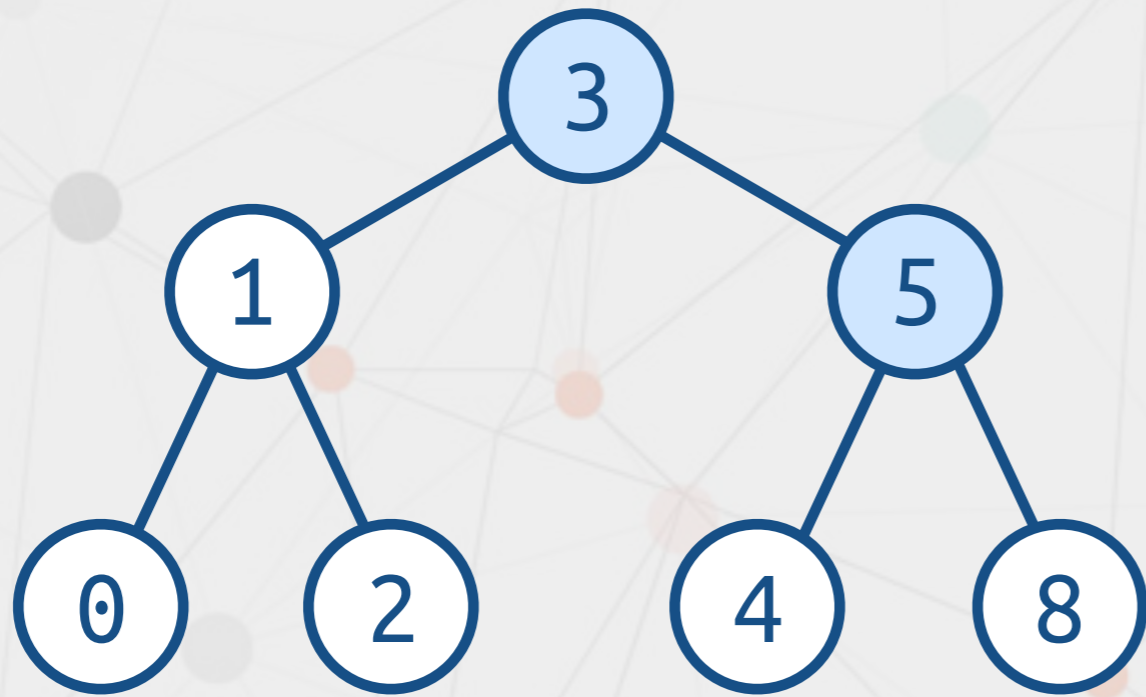
stack

深度優先搜尋 DFS



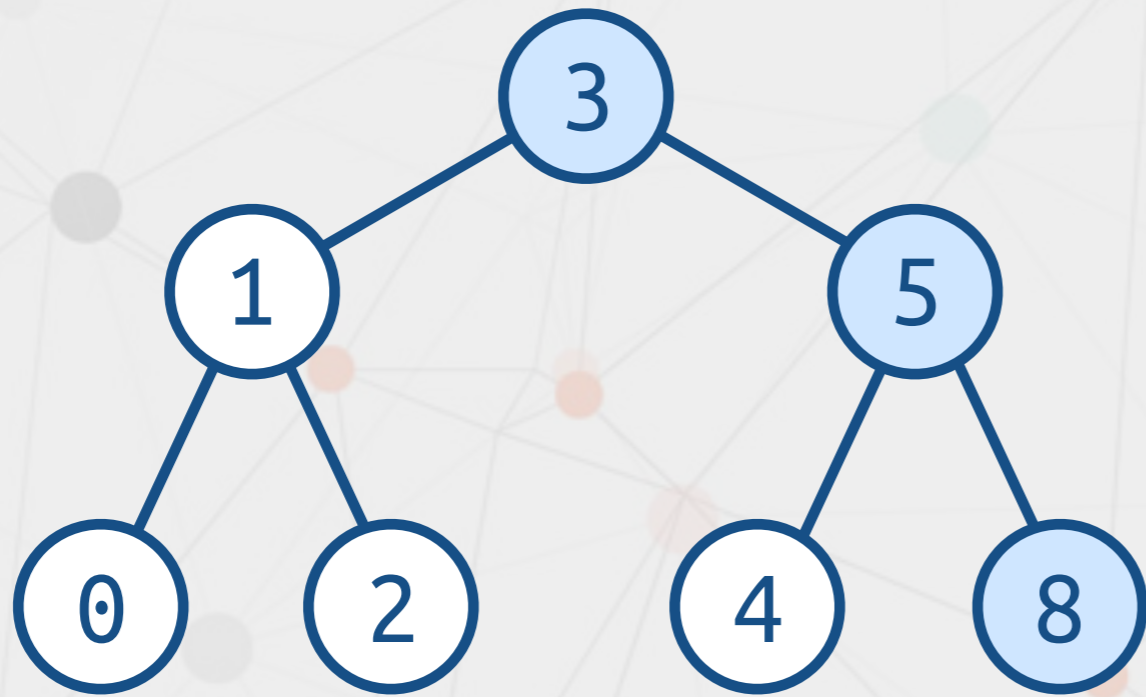
stack

深度優先搜尋 DFS



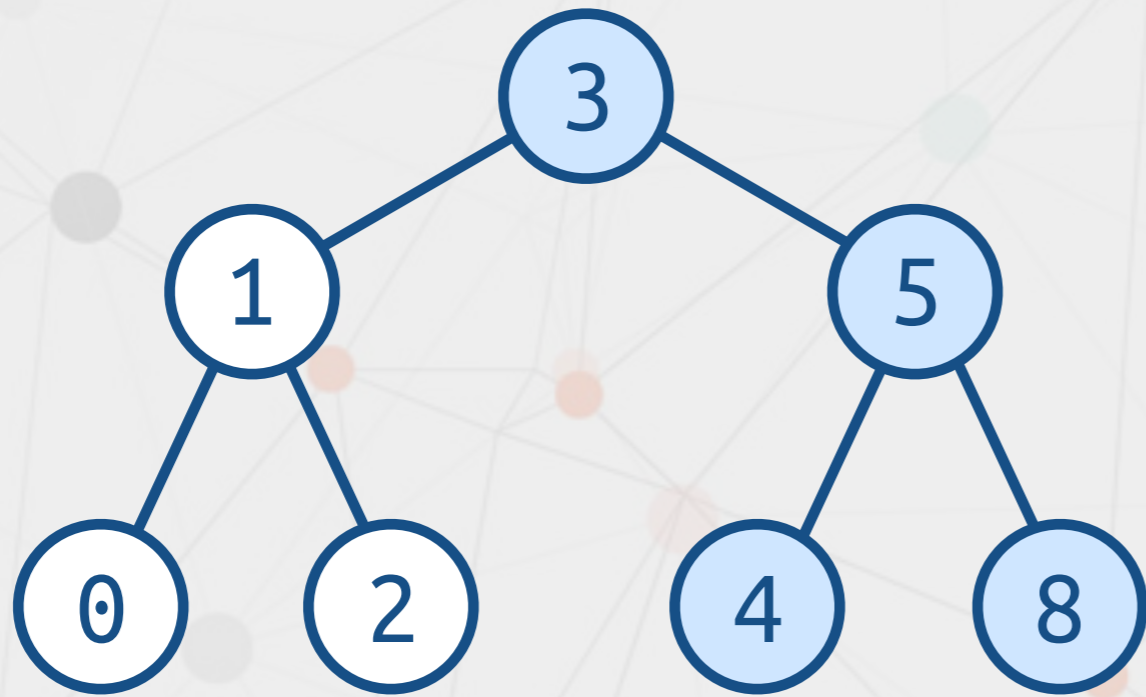
stack

深度優先搜尋 DFS



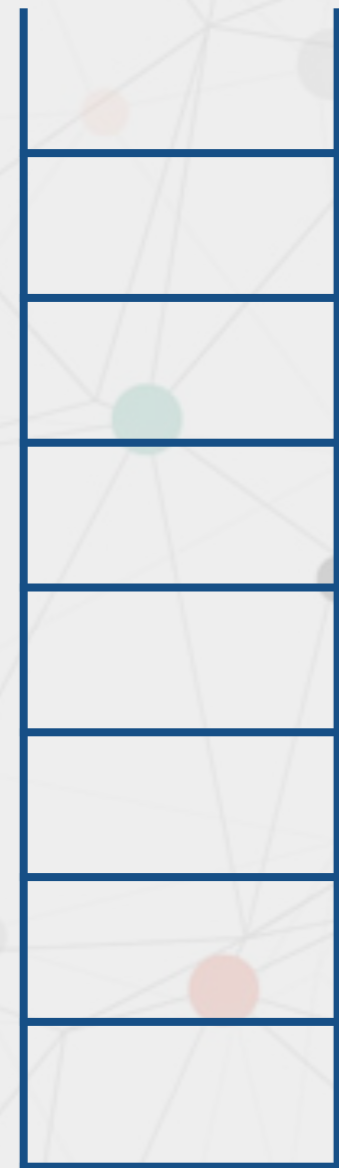
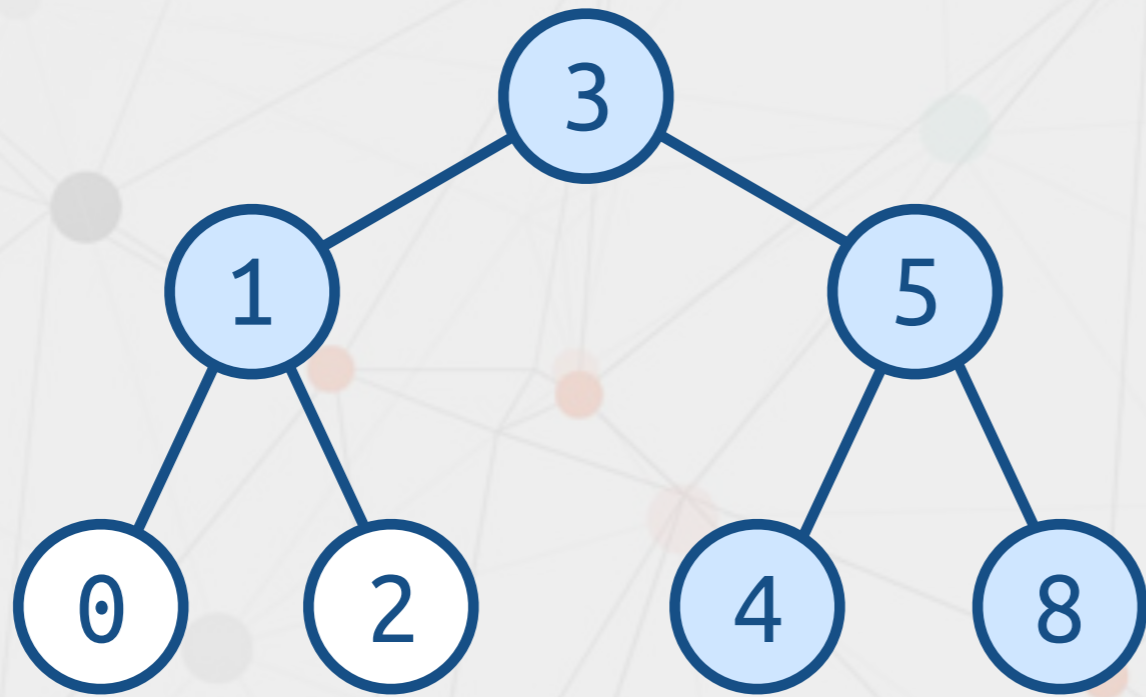
stack

深度優先搜尋 DFS



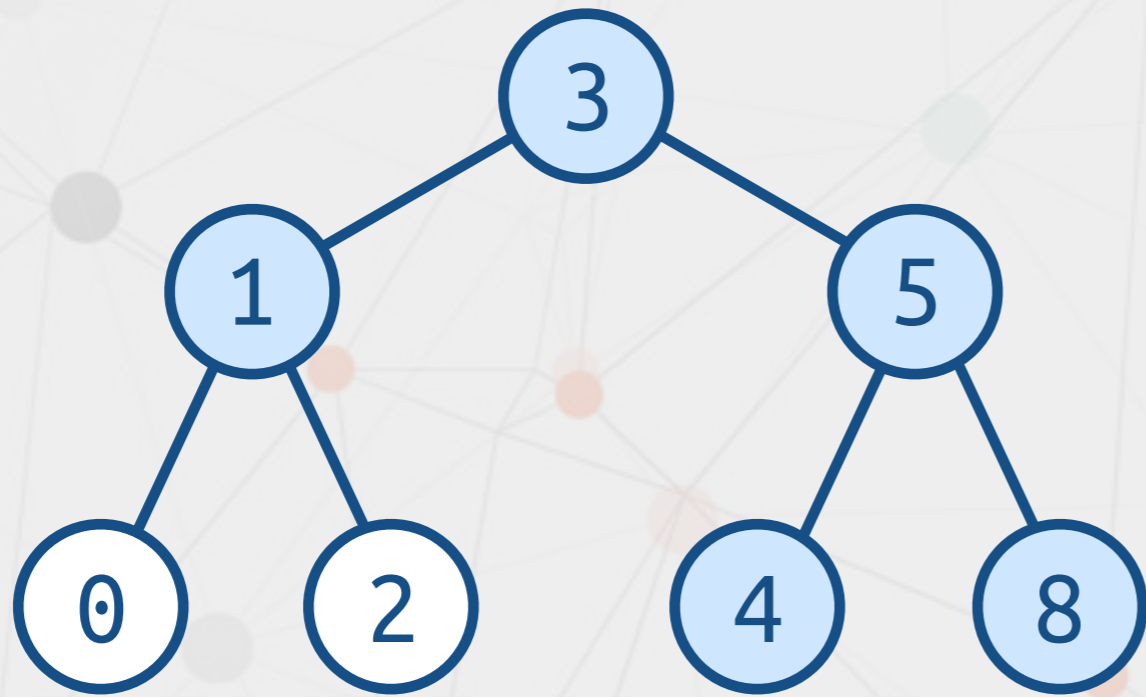
stack

深度優先搜尋 DFS



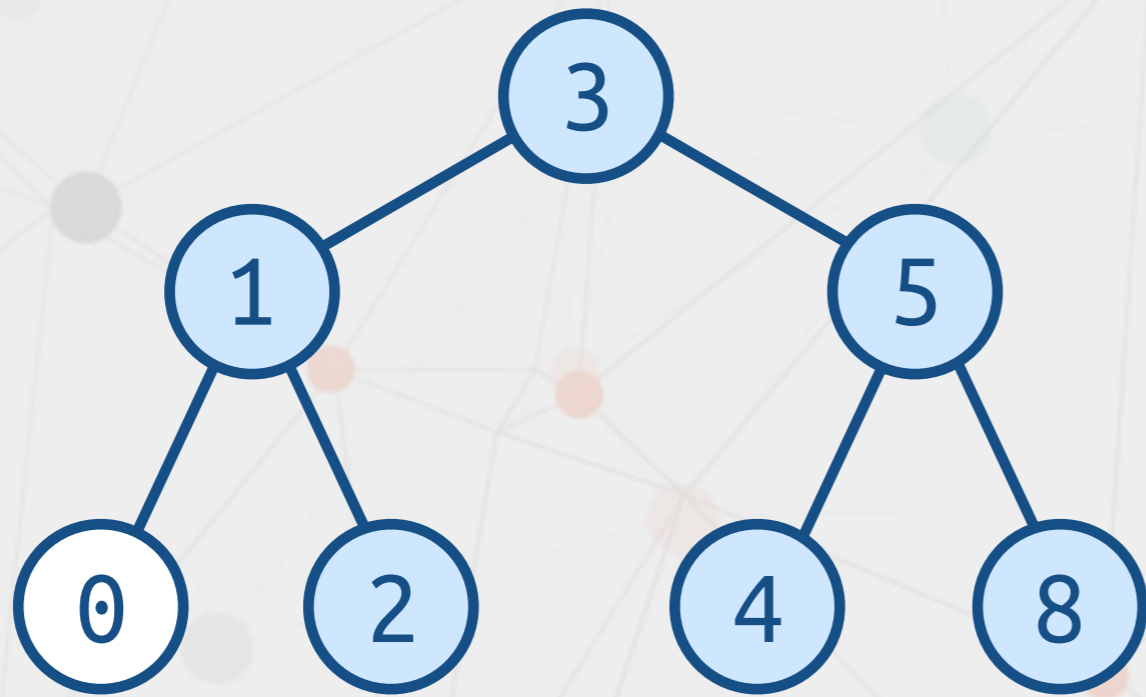
stack

深度優先搜尋 DFS



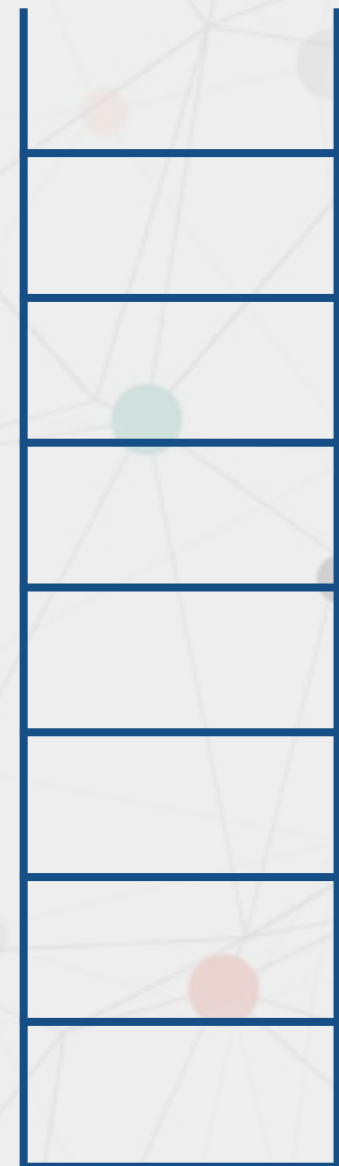
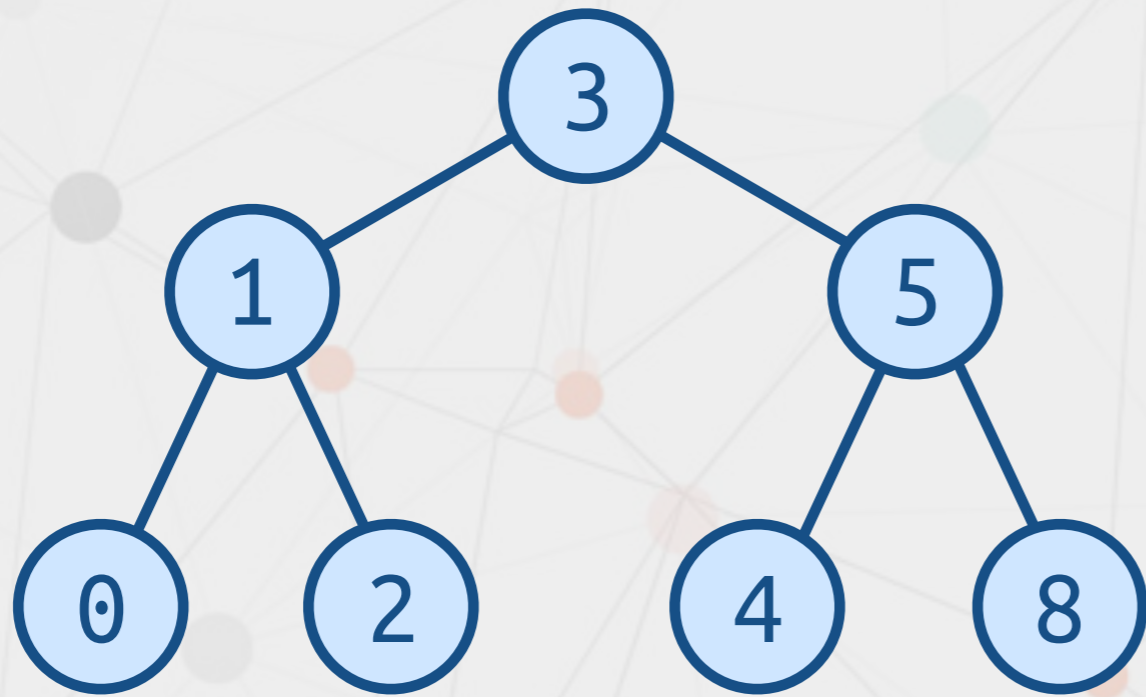
stack

深度優先搜尋 DFS



stack

深度優先搜尋 DFS



stack

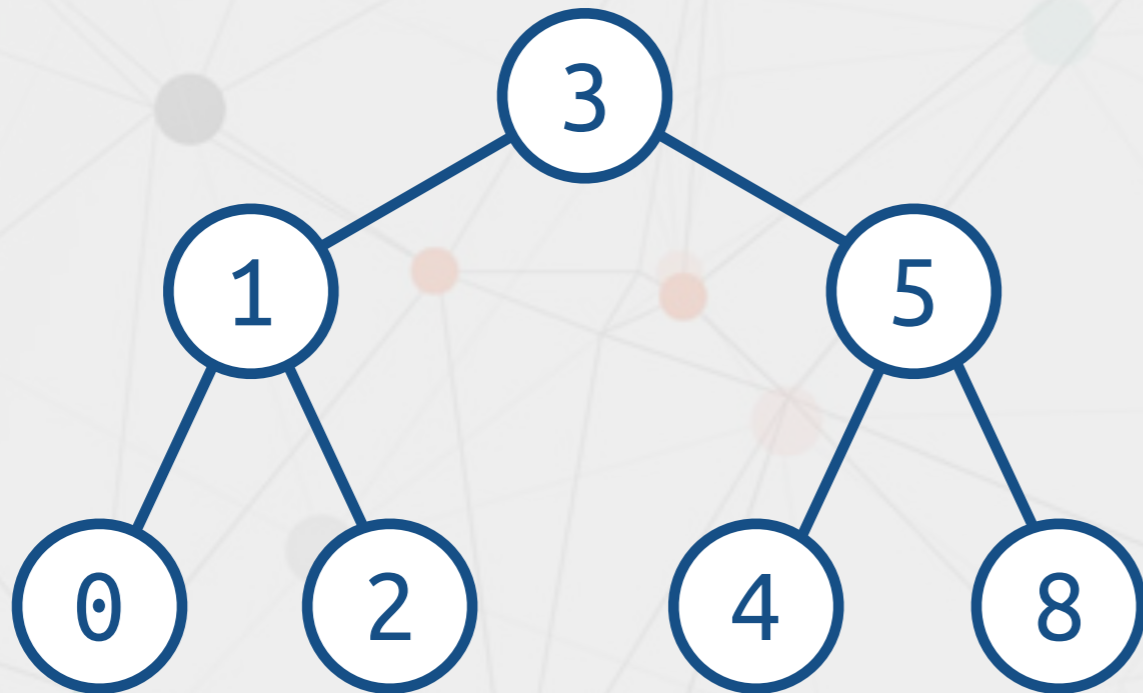
深度優先搜尋 DFS

```
1 procedure DFS(vertex v)
2   label v as visited
3   for each vertex w adjacent to v
4     if w is not labeled as visited
5       DFS(w)
6     end if
7   end for
8 end procedure
```

遞迴使用系統堆疊！

廣度優先搜尋

Breadth First Search, BFS



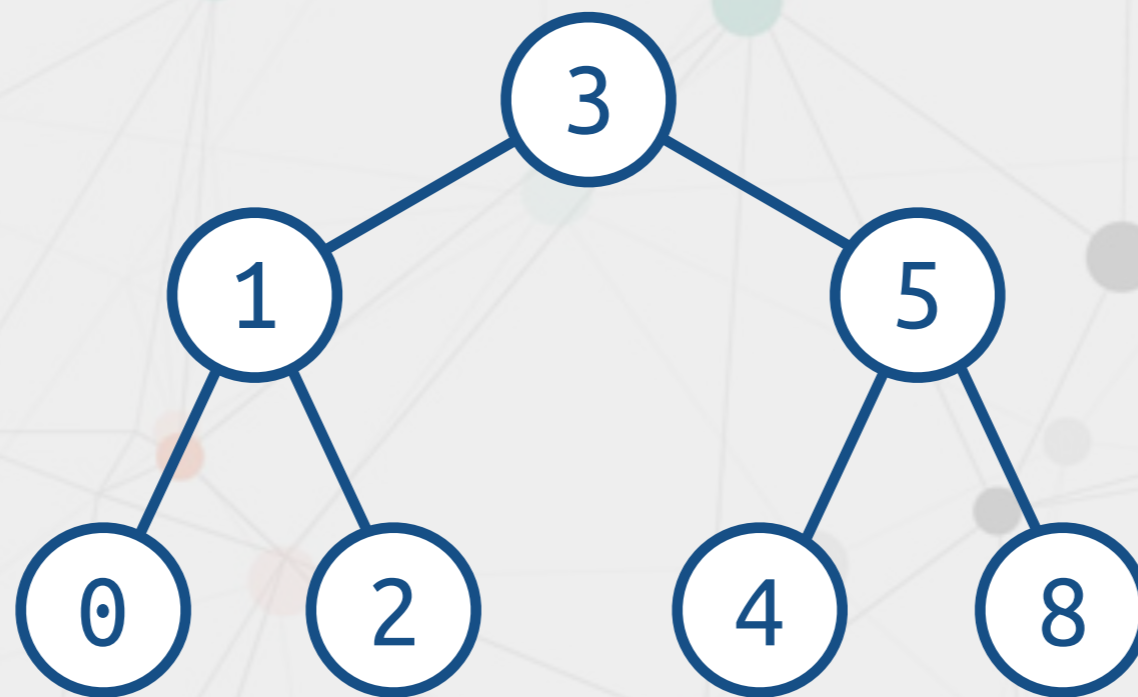
3,1,5,0,2,4,8

3,5,1,4,8,0,2

3,5,1,8,4,2,0

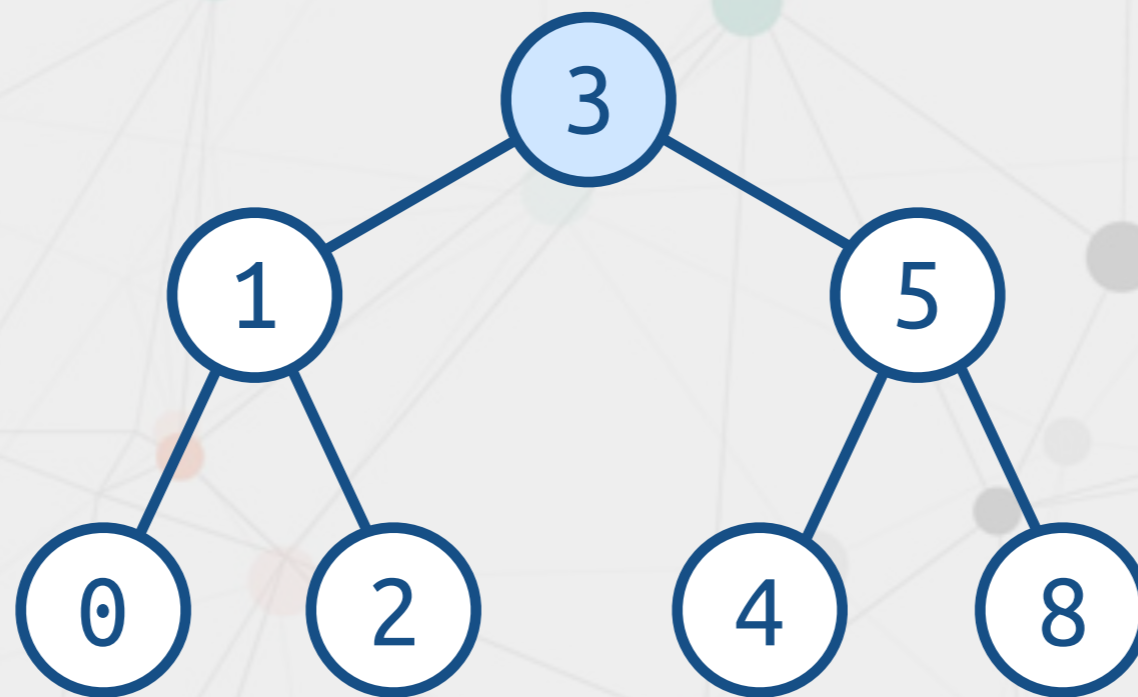
並非唯一順序

廣度優先搜尋 BFS



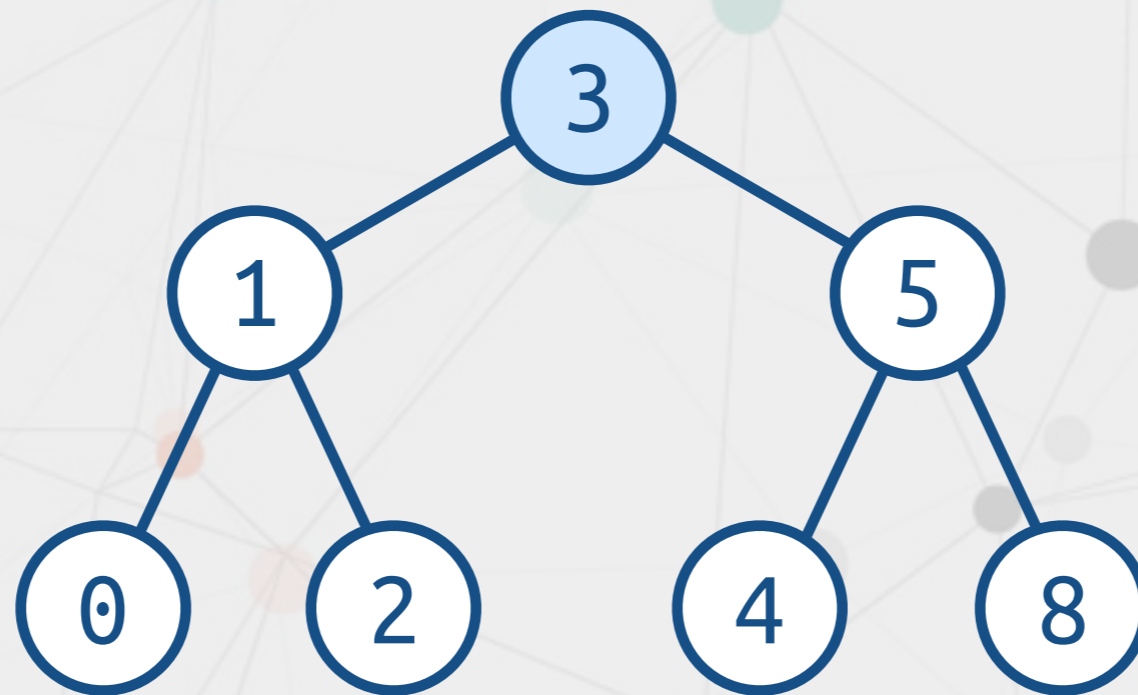
queue

廣度優先搜尋 BFS



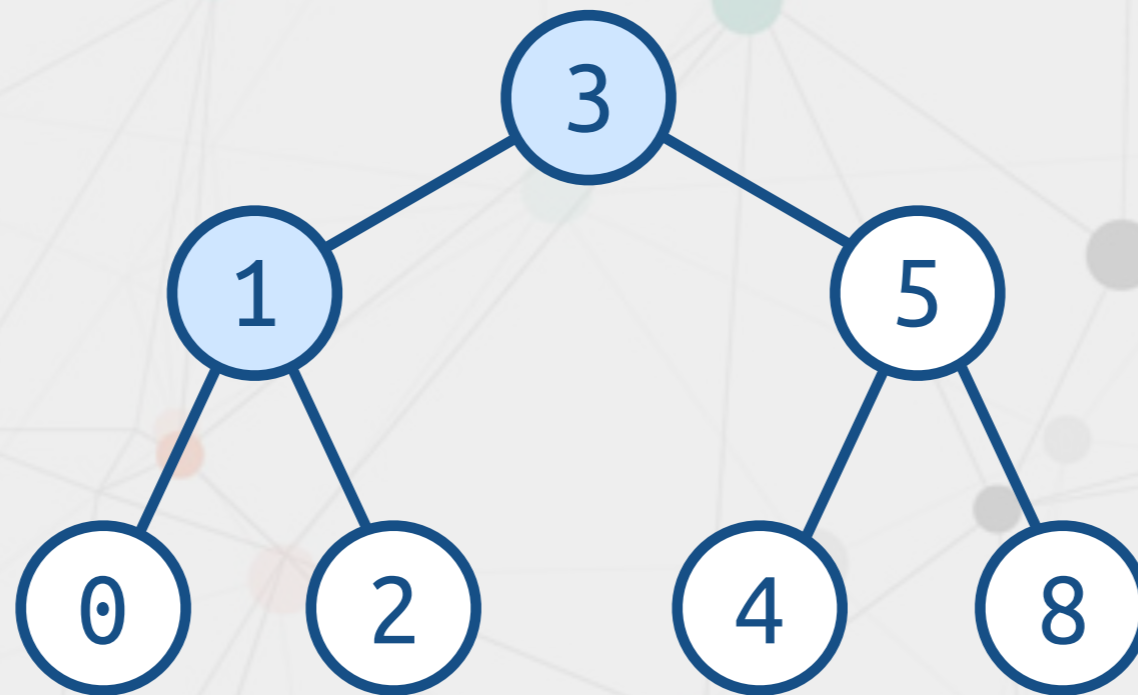
queue

廣度優先搜尋 BFS



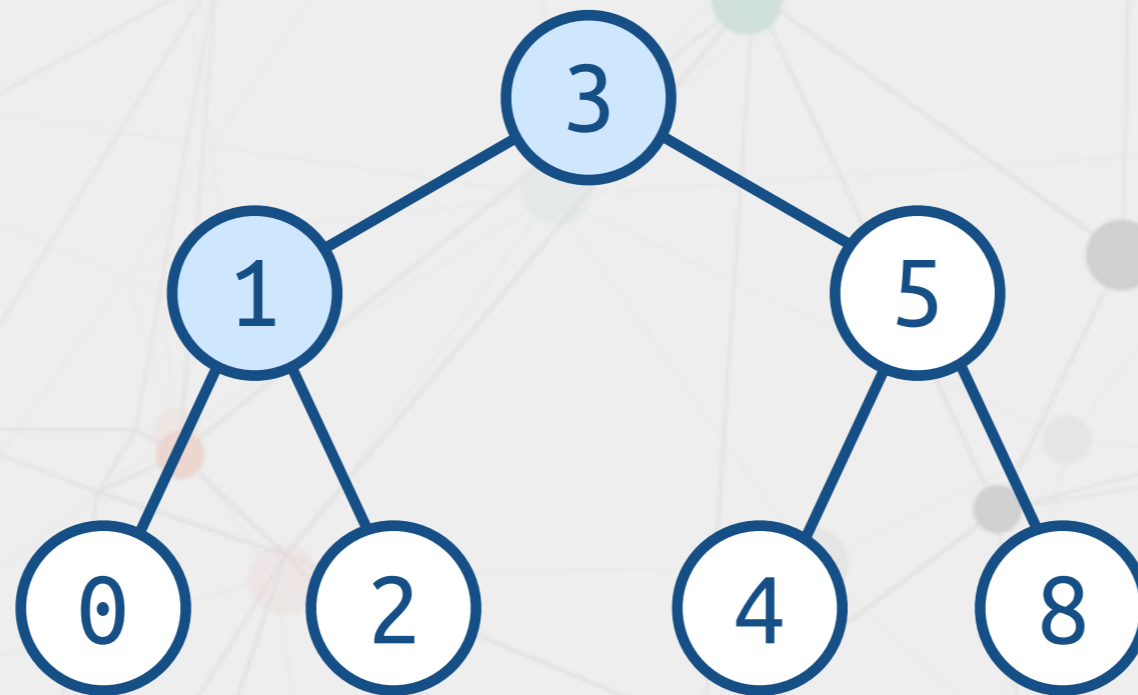
queue

廣度優先搜尋 BFS



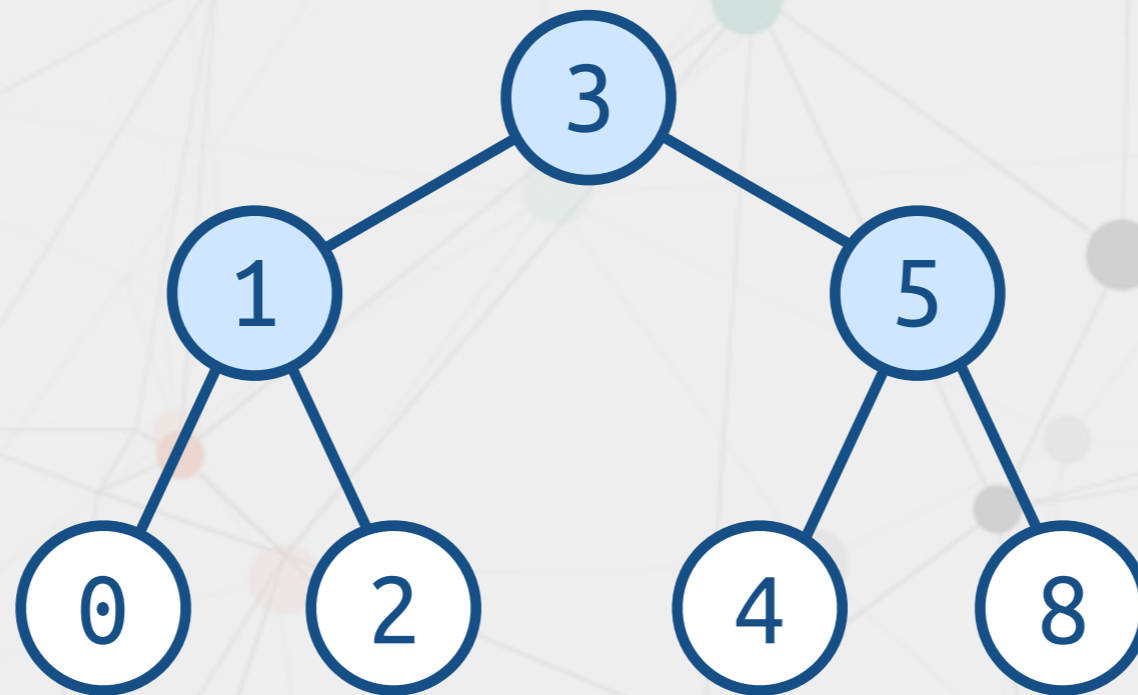
queue

廣度優先搜尋 BFS



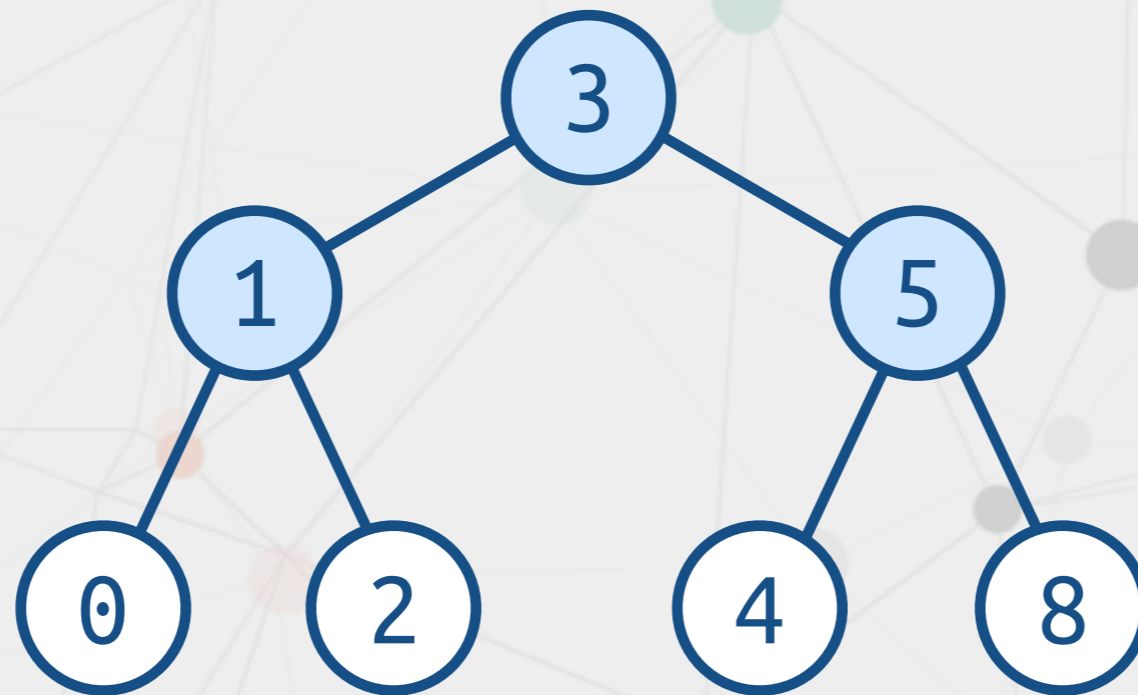
queue

廣度優先搜尋 BFS



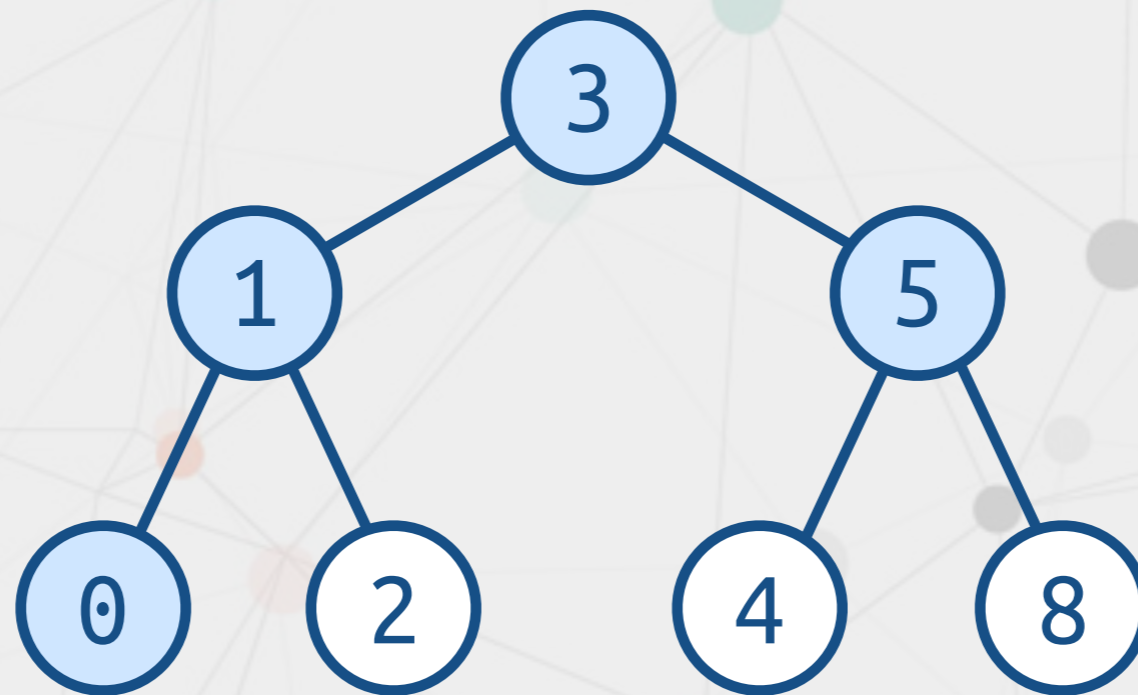
queue

廣度優先搜尋 BFS



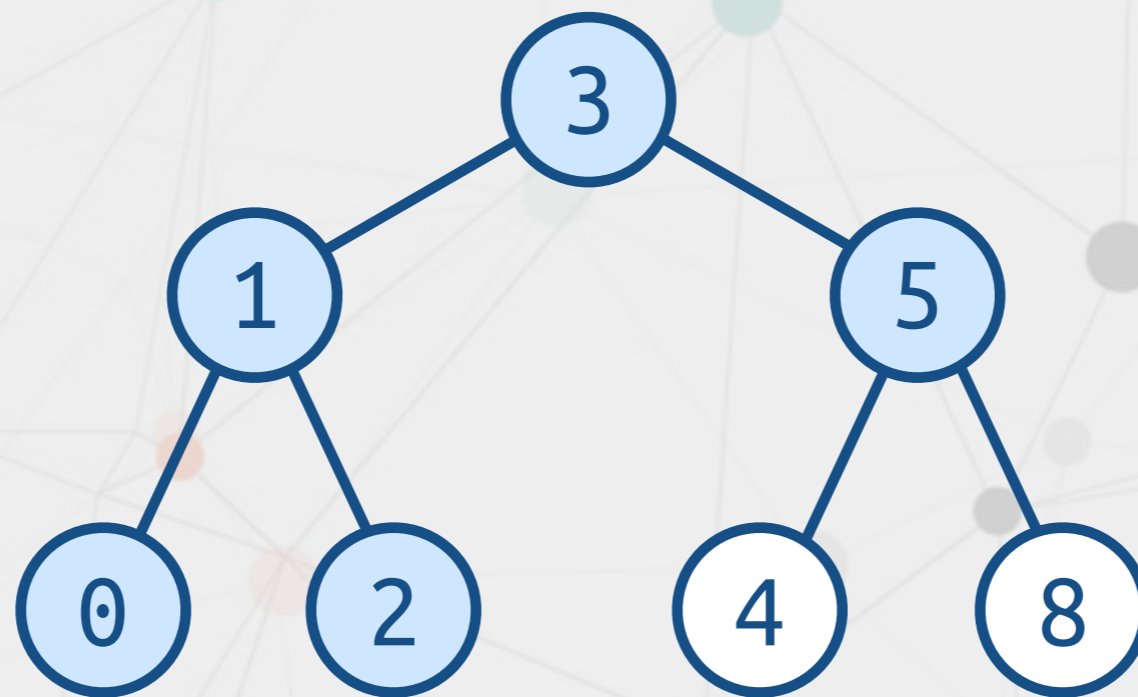
queue

廣度優先搜尋 BFS



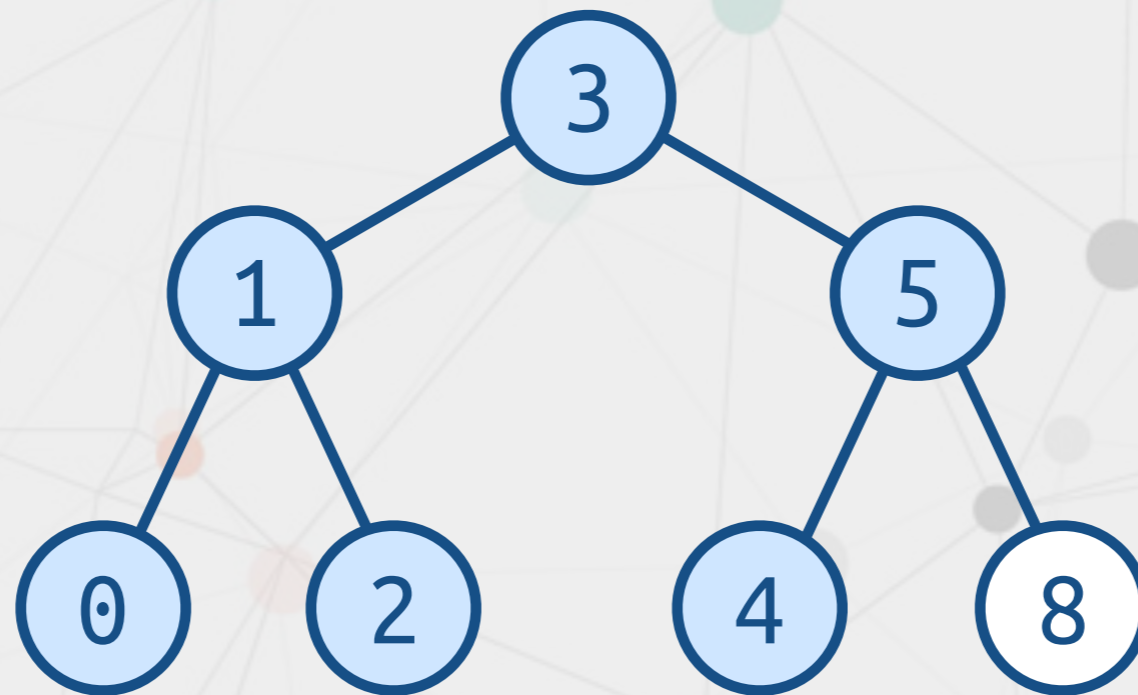
queue

廣度優先搜尋 BFS



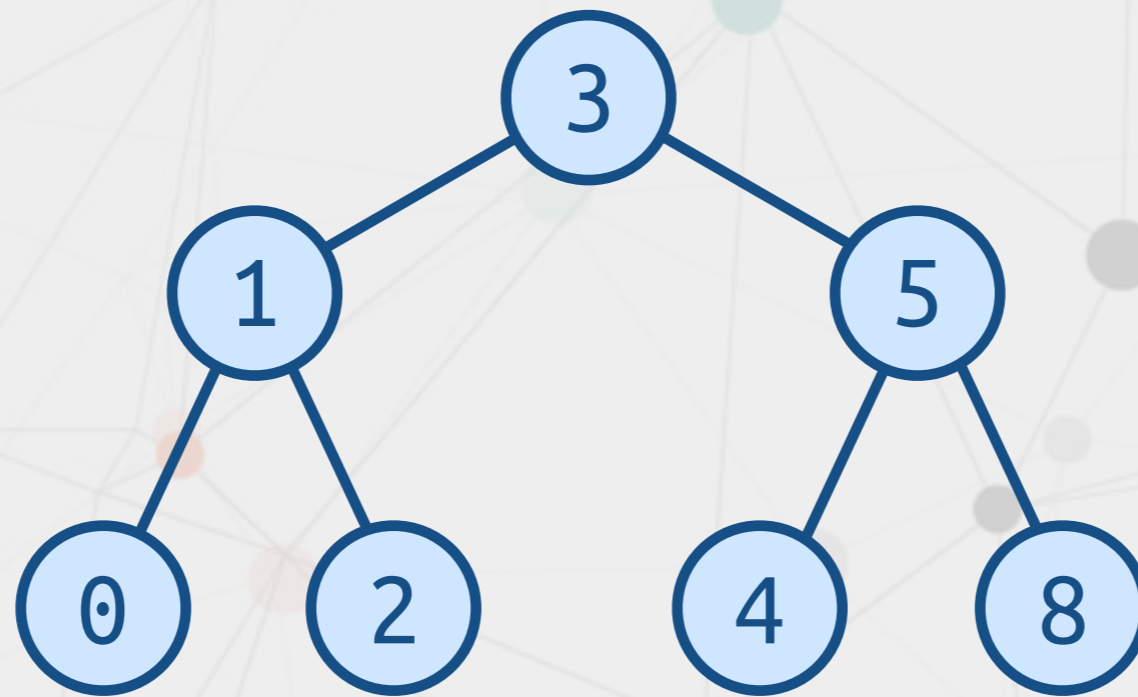
queue

廣度優先搜尋 BFS



queue

廣度優先搜尋 BFS



queue