

Data structure

Workshop 6

I. Exercise

1.1 In a graph, the sum of the degrees of all vertices is equal to () times the number of edges?

1.2 In a directed graph, the sum of the in-degrees of all vertices is equal to () times the sum of the out-degrees of all vertices.

1.3 A directed graph with n vertices can have at most () edges.

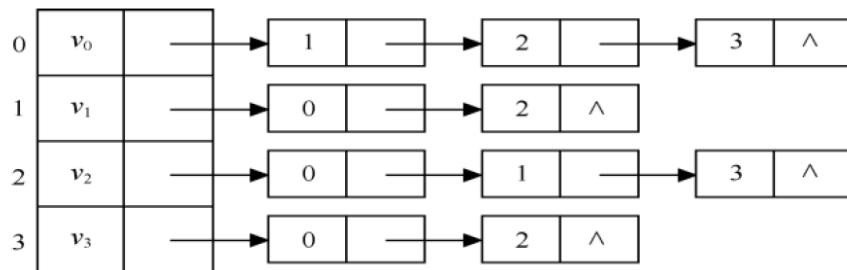
1.4 When a connected undirected graph with n vertices is represented by an adjacency matrix, the matrix has at least () non-zero elements.

1.5 G is a disconnected undirected graph with a total of 28 edges. The graph has at least () vertices.

1.6 Given the adjacency matrix of a graph as shown in the following figure, what is the result of the Depth-First Search (DFS) traversal starting from vertex v_0 ?

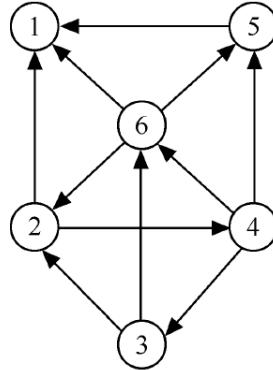
$$\begin{matrix} v_0 & \left[\begin{array}{ccccccc} 0 & 1 & 1 & 1 & 1 & 0 & 1 \\ 1 & 0 & 0 & 1 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 & 1 & 0 & 0 \\ 1 & 1 & 0 & 0 & 1 & 1 & 0 \\ 1 & 0 & 1 & 1 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 & 1 & 0 & 1 \\ 1 & 1 & 0 & 0 & 0 & 1 & 0 \end{array} \right] \\ v_1 \\ v_2 \\ v_3 \\ v_4 \\ v_5 \\ v_6 \end{matrix}$$

1.7 Given the adjacency list of a graph as shown in the following figure, the result of the Breadth-First Search (BFS) traversal starting from vertex v_0 is (), and the result of the Depth-First Search (DFS) traversal starting from vertex v_0 is ().



1.8 Given the directed graph shown in the following figure, please provide the following:

- ① The in-degree and out-degree of each vertex;
- ② The adjacency matrix;
- ③ The adjacency list;
- ④ The inverse adjacency list.



1.9 Given the adjacency matrix of a graph as shown in the following figure, draw the Depth-First Search (DFS) spanning tree and Breadth-First Search (BFS) spanning tree obtained by traversing starting from vertex 1, respectively.

	1	2	3	4	5	6	7	8	9	10
1	0	0	0	0	0	0	1	0	1	0
2	0	0	1	0	0	0	1	0	0	0
3	0	0	0	1	0	0	0	1	0	0
4	0	0	0	0	1	0	0	0	1	0
5	0	0	0	0	0	1	0	0	0	1
6	1	1	0	0	0	0	0	0	0	0
7	0	0	1	0	0	0	0	0	0	1
8	1	0	0	1	0	0	0	0	1	0
9	0	0	0	0	1	0	1	0	0	1
10	1	0	0	0	0	1	0	0	0	0

II. Experiment

Problem Description:

1. Implement both **adjacency matrix** and **adjacency list** representations for an undirected graph.
2. Implement **Depth-First Search (DFS)** and **Breadth-First Search (BFS)** traversals for both representations.
3. Test your implementations with a sample graph and print the traversal results starting from a specified vertex.

Input Format:

One line for vertices (e.g. 0, 1, 2, 3, 4)

One line for edges (e.g. (0,1), (0,2), (1,3), (1,4), (2,4), (3,4))

Output Format:

1. Output the adjacency matrix of the input graph.
2. Output the DFS traverse sequence of the adjacency matrix.
3. Output the BFS traverse sequence of the adjacency matrix.
4. Output the adjacency list of the input graph.
5. Output the DFS traverse sequence of the adjacency list.
6. Output the BFS traverse sequence of the adjacency list.