Q1

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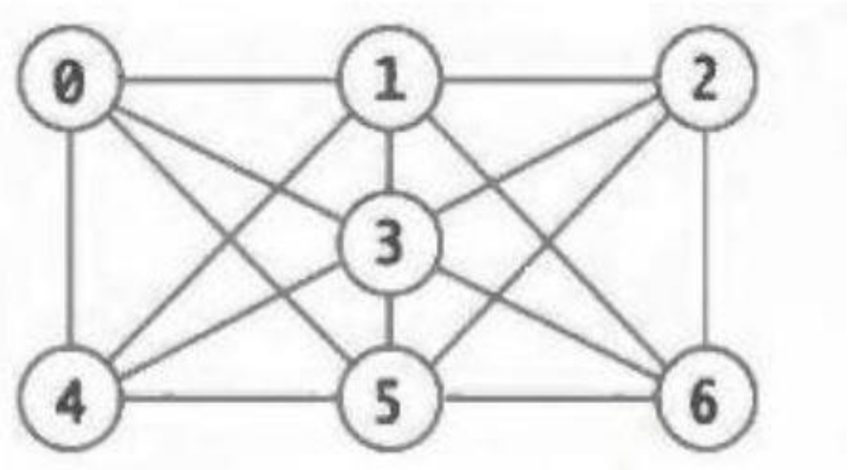
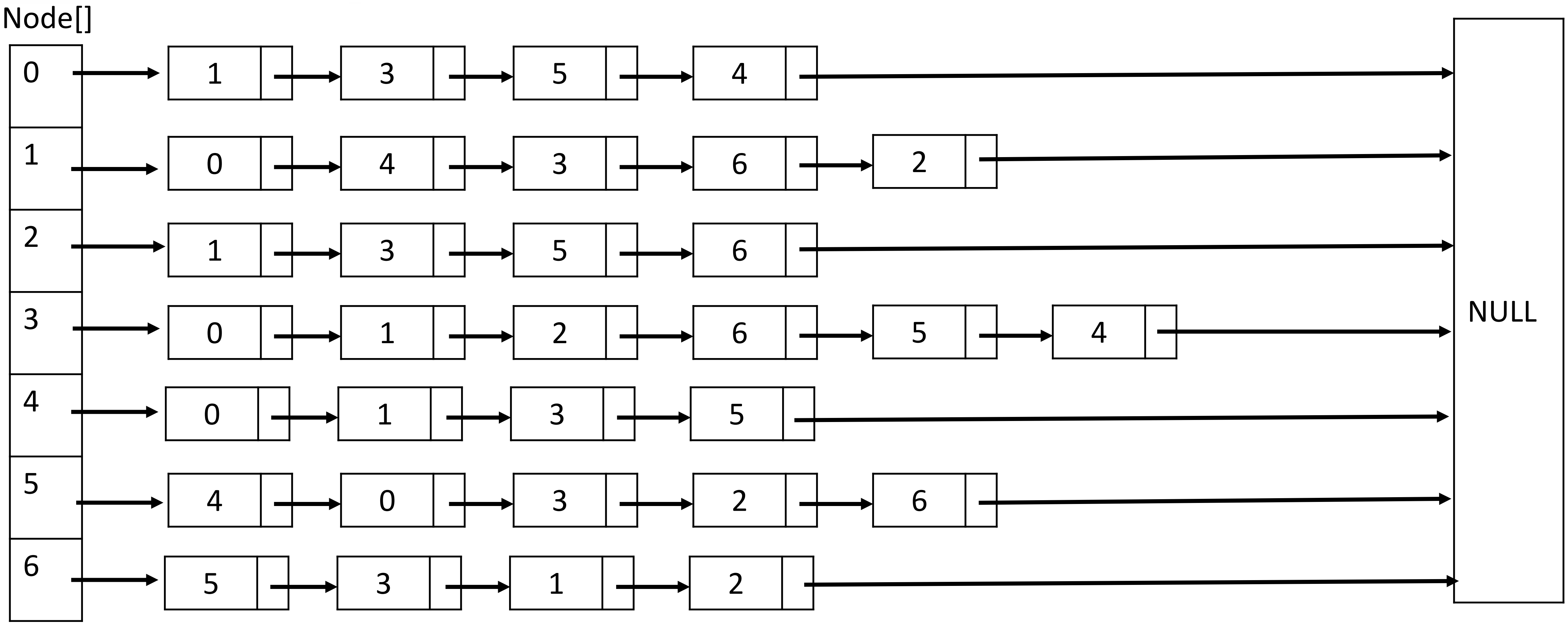
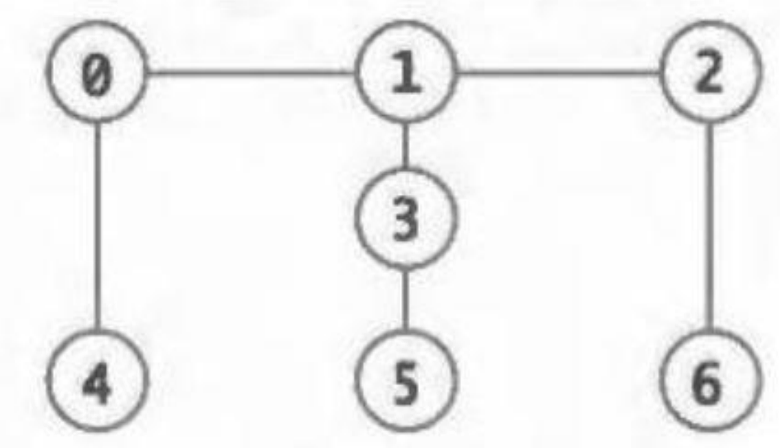
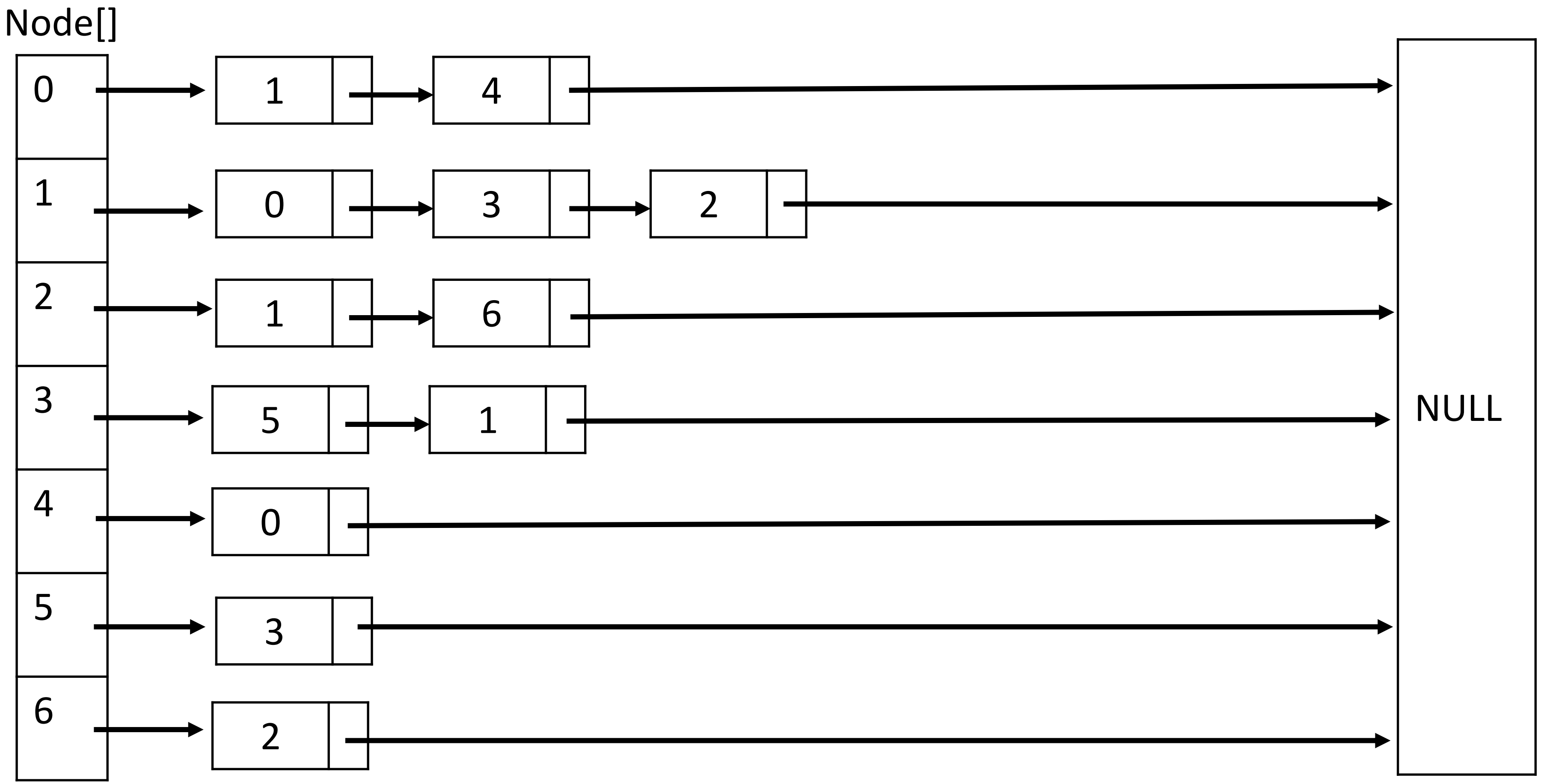
- Represent the graphs above using adjacency lists. Draw the corresponding data structure.

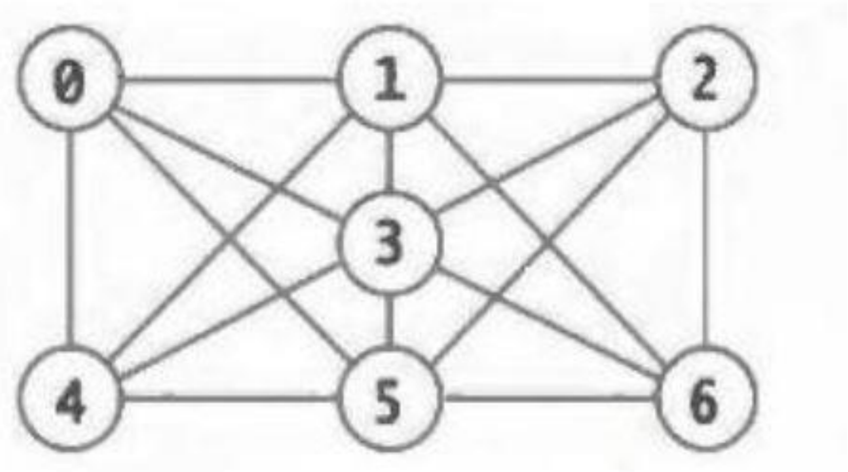

0
1
2
3
4
5
6


Node[]
0 → 1 → 3 → 5 → 4
1 → 0 → 4 → 3 → 6 → 2
2 → 1 → 3 → 5 → 6
3 → 0 → 1 → 2 → 6 → 5 → 4
4 → 0 → 1 → 3 → 5
5 → 4 → 0 → 3 → 2 → 6
6 → 5 → 3 → 1 → 2
NULL

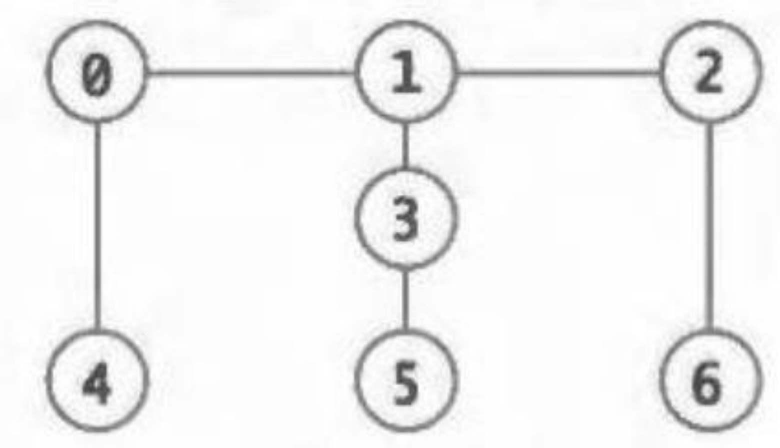

0
1
2
3
4
5
6


Node[]
0
1
4
1
0
3
2
2
1
6
3
5
1
4
0
5
3
6
2
NULL

Represent the graphs above using an adjacency matrix. Draw the corresponding data structure.

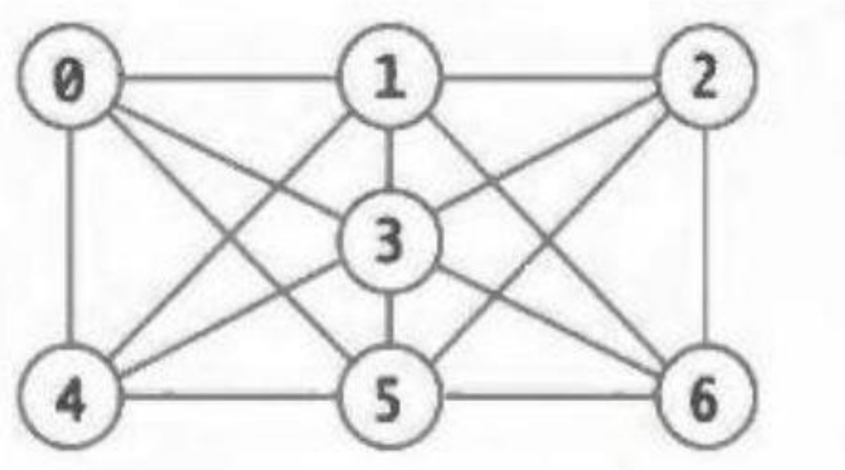


	0	1	2	3	4	5	6
0		1.0		1.0	1.0	1.0	
1	1.0		1.0	1.0	1.0		1.0
2		1.0		1.0		1.0	1.0
3	1.0	1.0	1.0		1.0	1.0	1.0
4	1.0	1.0		1.0		1.0	
5	1.0		1.0	1.0	1.0		1.0
6		1.0	1.0	1.0		1.0	



	0	1	2	3	4	5	6
0		1.0			1.0		
1	1.0		1.0	1.0			
2		1.0					1.0
3		1.0				1.0	
4	1.0						
5				1.0			
6			1.0				

For each graph above, what are the |V|=n, the |E|=m, and the density? Which representation is better for each graph? Explain your answers.



|V| = number of vertices = 7

|E| = number of edges = 16

The **density** of a graph is

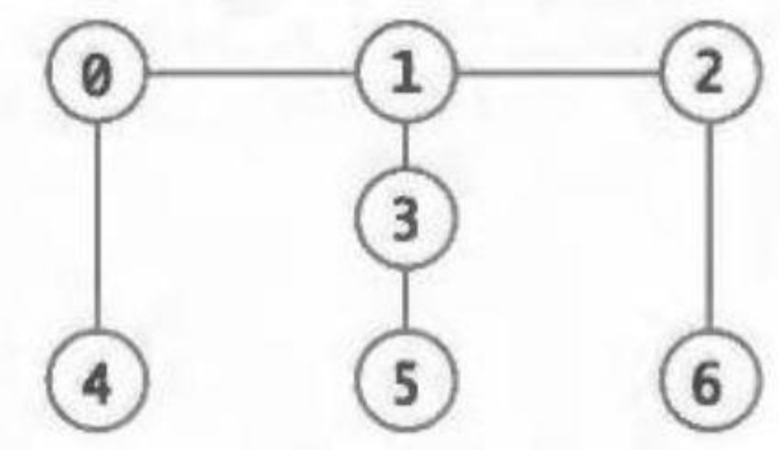
$$D = \frac{|E|}{\binom{|V|}{2}} = \frac{2|E|}{|V|(|V|-1)}$$

$$D = \frac{2x16}{7(7-1)} = \frac{32}{42} = 0{,}76$$

Dense graph is a graph in which the number of edges is close to the maximal number of edges. Here number of edges is usually $O(n^2)$ where n is the number of vertices. Therefore, adjacency matrix is preferred.

Sparse graph is a graph in which the number of edges is close to the minimal number of edges. Sparse graph can be a disconnected graph. Usually the number of edges is in O(n) where n is the number of vertices. Therefore, adjacency lists are preferred since they require constant space for every edge.

As a result since our graph is dense graph, adjacency matrix are preferred.



|V| = number of vertices = 7

|E| = number of edges = 6

The **density** of a graph is

$$D = \frac{|E|}{\binom{|V|}{2}} = \frac{2|E|}{|V|(|V|-1)}$$

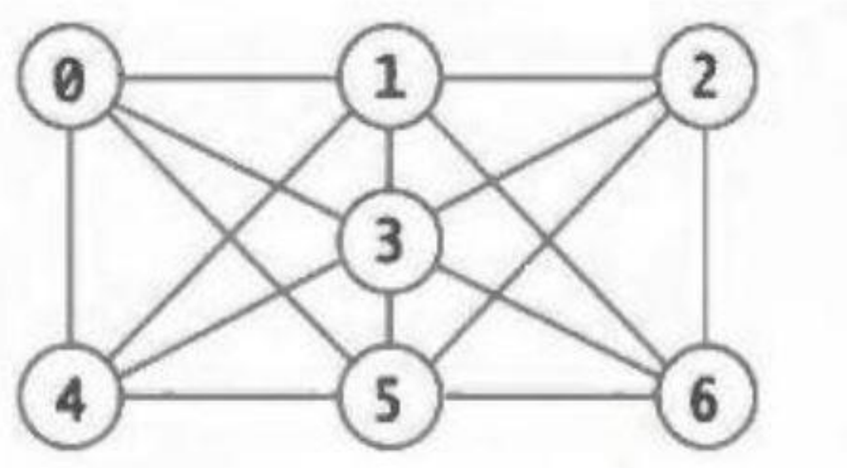
$$D = \frac{2x6}{7(7-1)} = \frac{12}{42} = 0{,}28$$

Dense graph is a graph in which the number of edges is close to the maximal number of edges. Here number of edges is usually $O(n^2)$ where n is the number of vertices. Therefore, adjacency matrix is preferred.

Sparse graph is a graph in which the number of edges is close to the minimal number of edges. Sparse graph can be a disconnected graph. Usually the number of edges is in O(n) where n is the number of vertices. Therefore, adjacency lists are preferred since they require constant space for every edge.

As a result since our graph is sparse graph, adjacency lists are preferred.

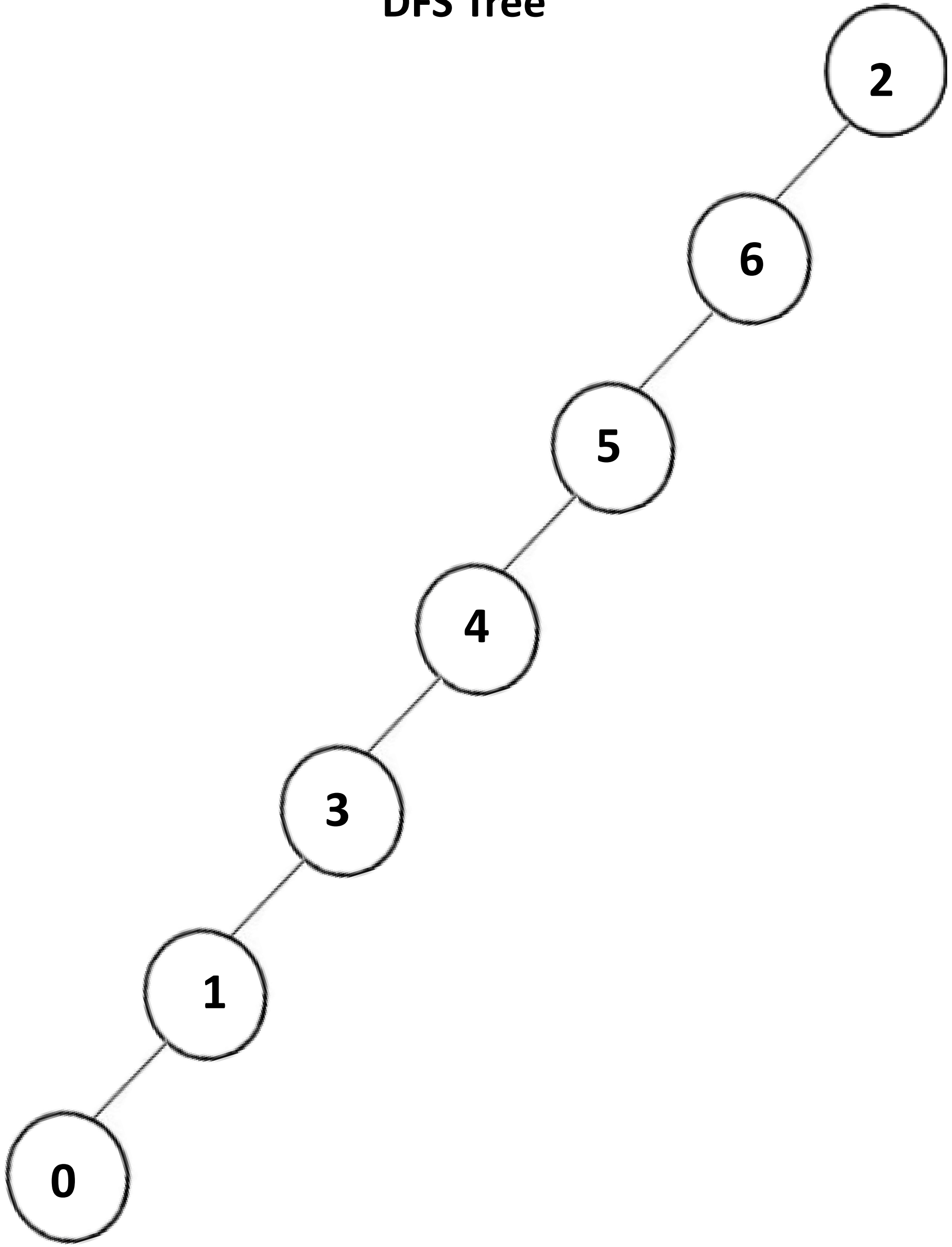
Draw DFS tree starting from vertex 2 and traversing the vertices adjacent to a vertex in descending order (largest to smallest).

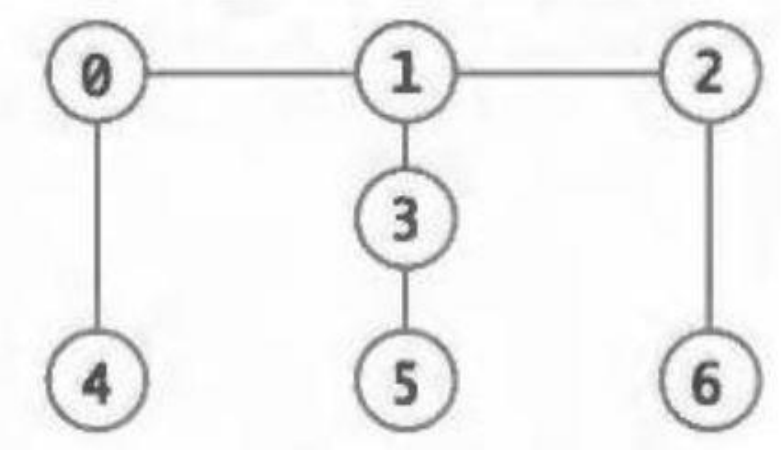


Discovery (Visit) order:
2, 6, 5, 4 ,3 , 1, 0

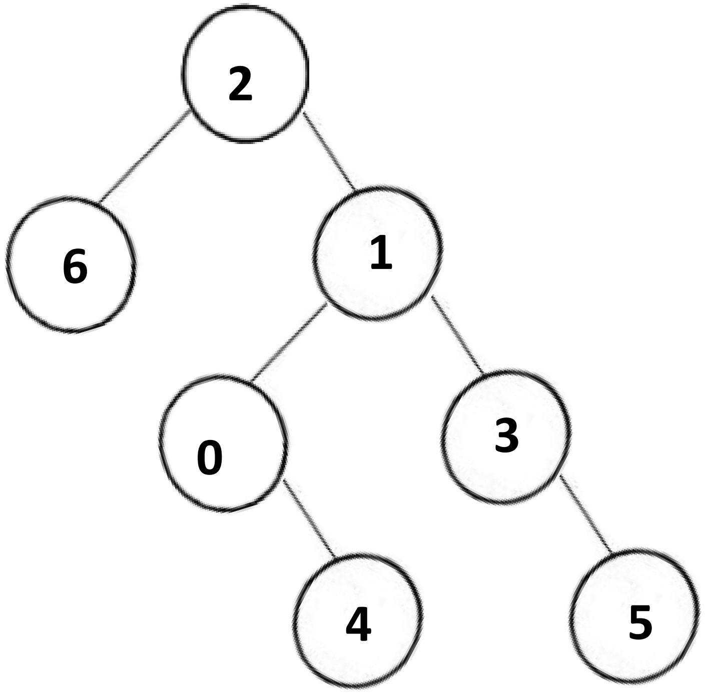
Finish order:
0, 1, 3, 4, 5, 6, 2

DFS Tree





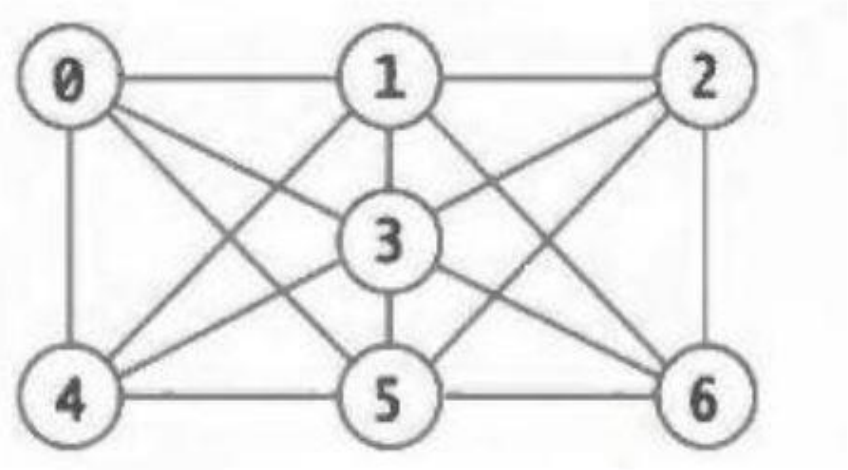
DFS Tree



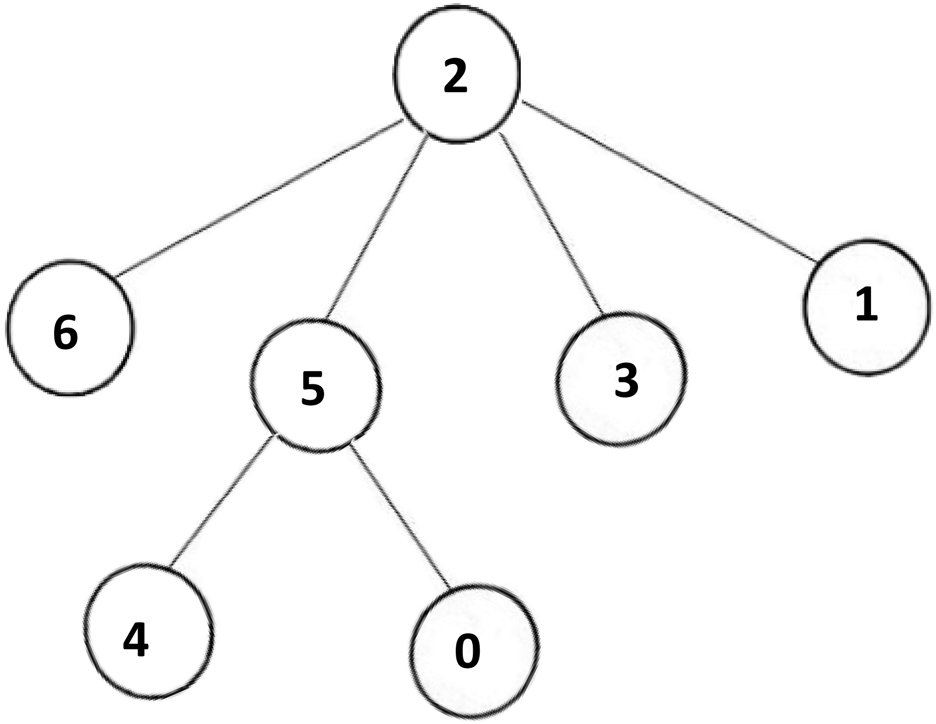
Discovery (Visit) order:
2, 6, 1, 3, 5, 0, 4

Finish order:
6, 5, 3, 4, 0, 1, 2

Draw BFS tree starting from vertex 2 and traversing the vertices adjacent to a vertex in descending order (largest to smallest).

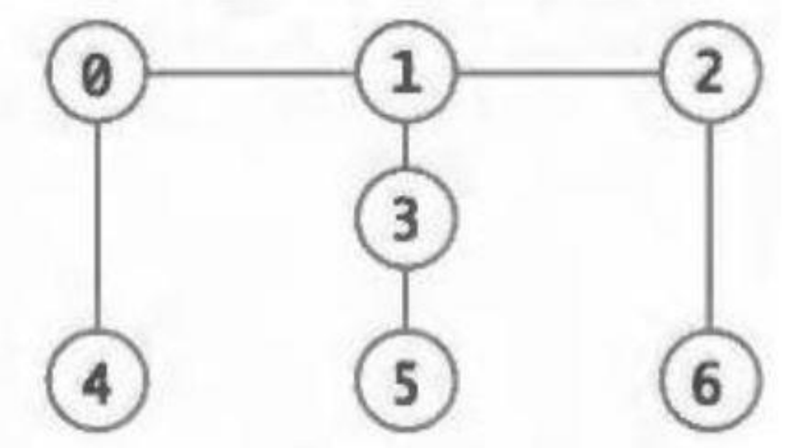


BFS Tree



Visit sequence:

2, 6, 5, 3, 1, 4, 0



Visit sequence:

2, 6, 1, 3, 0, 5, 4

BFS Tree