Data Structure and Algorithm Analysis(H)
Southern University of Science and Technology
Mengxuan Wu
12212006

Work Sheet 13

Mengxuan Wu

Question 13.1

1.

To find the in-degree of one vertex with adjacency list, we need to traverse the whole list to find the vertex. So the time complexity is $O(|V| + |E|)$.

2.

To find the in-degree of all vertices with adjacency list, we need to traverse the whole list to find the vertex. So the time complexity is $O(|V| + |E|)$.

3.

To find the in-degree of one vertex with adjacency matrix, we need to traverse one column of the matrix. So the time complexity is $O(|V|)$.

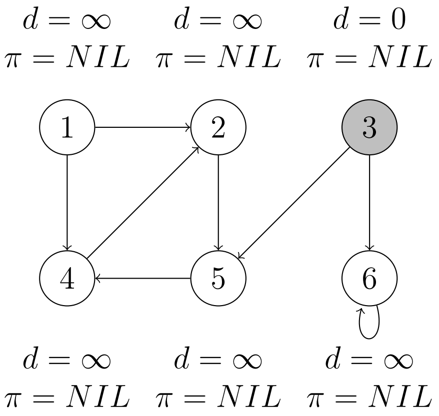
4.

To find the in-degree of all vertices with adjacency matrix, we need to traverse all columns of the matrix. So the time complexity is $O(|V|^2)$.

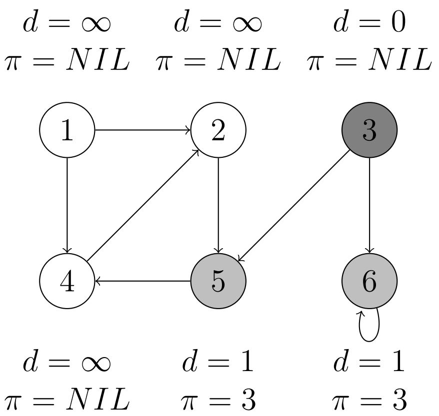
Question 13.2

The mayor's strategy is not always optimal. Consider the graph that all the vertices are connected to each other. Then the mayor's strategy will put two cameras on two vertices, while the optimal strategy is to put one camera on one vertex.
However, this strategy sometimes can be optimal. Consider a triangle shape graph with 3 vertices and 3 edges. Then the mayor's strategy will put two cameras, which is optimal.
The mayor's strategy's efficiency mainly depends on the shape of the graph. If there are many loops with odd number of vertices, then the mayor's strategy will be good, since in an odd loop there must be one edge that has cameras on both ends.
The greedy strategy for this problem is that put cameras on the vertices that have the most unmonitored edges.

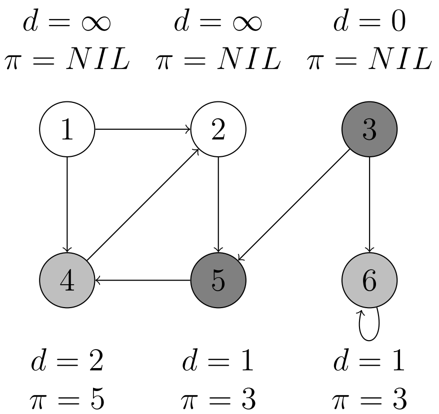
Question 13.3



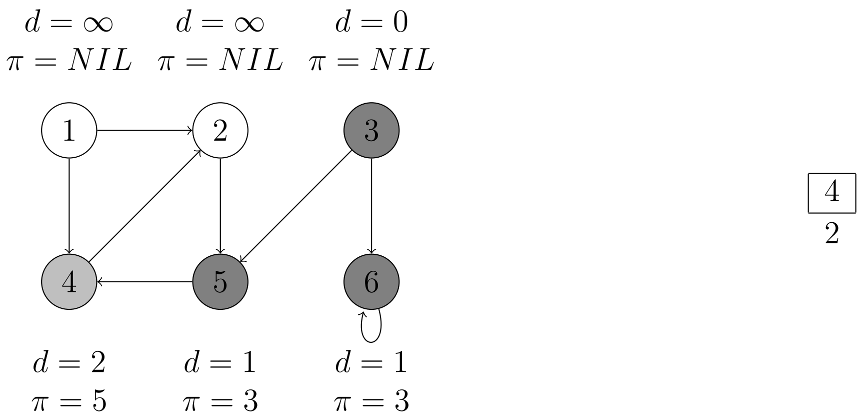
3
0

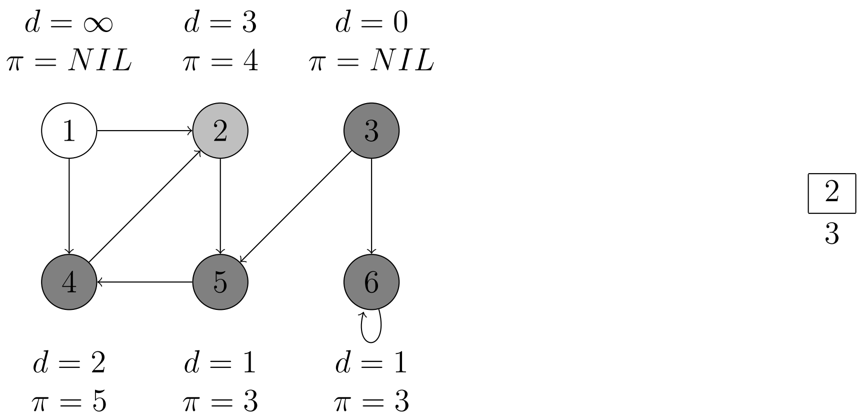


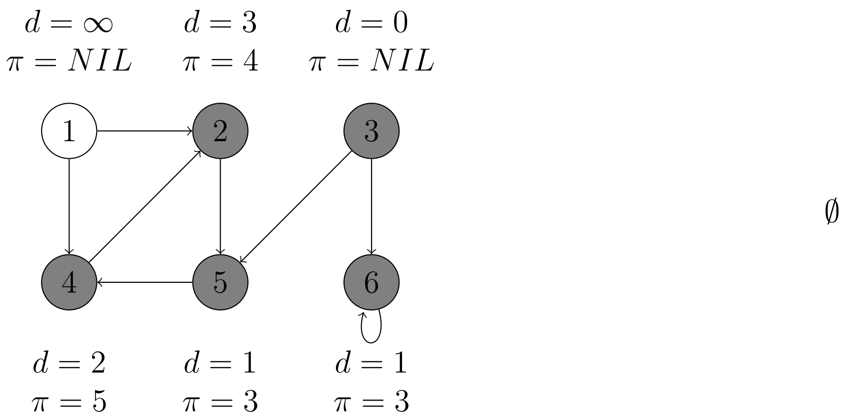
5	6
1	1



6	4
1	2







Question 13.4

If we use 1 bit to store color in BFS, there is no difference with current implementation. However, we do lose the information of whether the vertex is processed or not.

Question 13.5

If we use adjacency matrix to implement BFS, we need to traverse the whole row to find the adjacent vertices. And since we need to traverse all vertices, the time complexity is

$O(|V| \times |V|) = O(|V|^2)$.