

JK Lakshmipat University Jaipur
INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination, 23 May 2022

BCA, Semester IV, 2021-22

CS1126: Algorithm Design and Analysis

Time: 2:00 Hours

Roll number

Max. Marks: 40

Read the following instructions carefully:

- There are 4 questions. The paper is printed on both sides.
- If in doubt, state your assumption(s) and continue.
- No marks unless justification and/or derivation accompanies the answer.

1. A 10×10 grid is provided in Figure 1. As discussed in the classes, from a point one may only go either in the right direction or downwards. One cannot go to left or up from any given point on the grid, i.e., from a point (i, j) one can either go to $(i + 1, j)$ with cost $c_{i+1,j}$ or $(i, j + 1)$ with cost $c_{i,j+1}$. The goal is to go from the top left point $(1, 1)$ to $(11, 11)$ such that the cost of the path is minimum.

- (a) Draw the grid with labels as mentioned above in the words.
- (b) Characterize the structure of an optimal solution.
- (c) Recursively define the value of an optimal solution.
- (d) Reason how can it help you achieve the goal, i.e., to reach from the start to the end in minimum cost.
- (e) Why is greedy approach not suitable for this problem? Show with the help of an example.

2+2+2+2+(2+2) Marks, CO4, CO5

2. You are provided BFS and DFS algorithm in Figure 1. You are also provided a graph in the same figure.

- (a) Run and show each and every step of BFS on this graph with details of each step.
- (b) Run and show each and every step of DFS on this graph with details of each step.

(c) What is the time complexity of function $ENQUEUE(Q, s)$? Justify.

(d) What is the time complexity of function $DFS-VISIT(u)$? Justify.

4+4+2+2 Marks, CO1, CO2

3. Write QuickSort algorithm to sort an array.

6 Marks, CO3

4. Create and draw a doubly linked list of 5 nodes and write the algorithms to perform the following operations on it.

- (a) Deleting a node from the linked list.
- (b) Searching for a key value in the linked list.
- (c) Inserting a node in the linked list.
- (d) What is the difference between an array and a linked list?

2+2+2+2+2 Marks, CO2

```

BFS(G, s)
1  for each vertex u  V [G] - {s}
2    do color[u] ← WHITE
3    d[u] ← ∞
4    π[u] ← NIL
5  color[s] ← GRAY
6  d[s] ← 0
7  π[s] ← NIL
8  Q ← ∅
9  ENQUEUE(Q, s)
10 while Q ≠ ∅
11   do u ← DEQUEUE(Q)
12   for each v  Adj[u]
13     do if color[v] = WHITE
14       then color[v] ← GRAY
15         d[v] ← d[u] + 1
16         π[v] ← u
17         ENQUEUE(Q, v)
18   color[u] ← BLACK

```

```

DFS(G)
1  for each vertex u  V [G]
2    do color[u] ← WHITE
3    π[u] ← NIL
4  time ← 0
5  for each vertex u  V [G]
6    do if color[u] = WHITE
7      then DFS-VISIT(u)
DFS-VISIT(u)
1  color[u] ← GRAY    »White vertex u has just been discovered.
2  time ← time + 1
3  d[u] ← time
4  for each v  Adj[u] »Explore edge(u, v).
5    do if color[v] = WHITE
6      then π[v] ← u
7          DFS-VISIT(v)
8  color[u] ← BLACK    » Blacken u; it is finished.
9  f [u] ← time ← time + 1

```

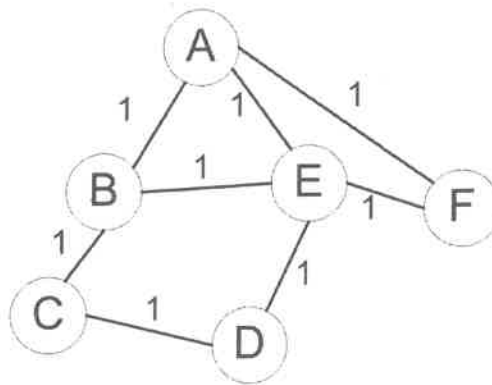
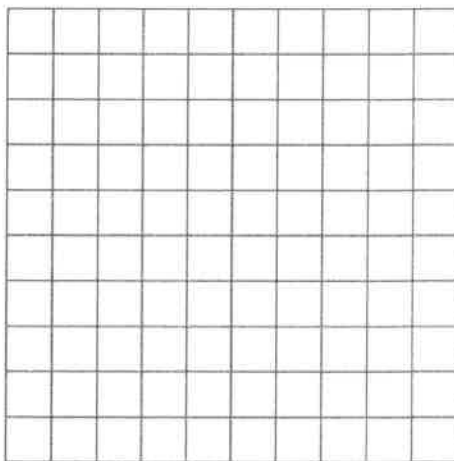


Figure 1: