The Shortest Way Back Home

Data Structures Assignment 3
Tree

2021.4.28

NTHU EECS

Background

- Sia is a mountain climber, she goes to mountain climbing every week.
- One day, she accidentally got lost on top of the mountain.
- Please help her find out the shortest path back home safely.

Overview

- Input
  - A pair of row & column of the matrix
  - A starting position
  - A matrix of digits
- Task
  - Convert nonzero digits in matrix into a tree
  - The input matrix guarantees no cycle
- Output
  - The distance of the shortest path

Tree Specification

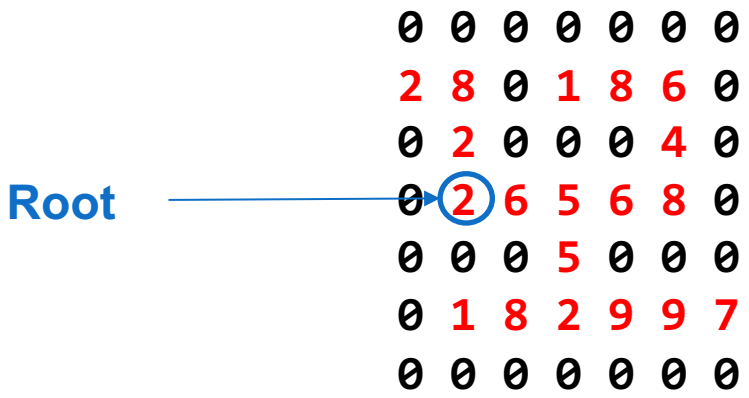
- Each cell in the matrix contains a digit value (range: -1, 0, 1, 2… 9)
  - -1 represents dead road
  - 0 represents no road
  - 1 – 9 represent distance of the road
  - Each cell can only be visited at most once
- The starting position represents the root
  - Root cannot be NULL (i.e., 0)
- Each node in the tree can have up to 4 children: Left, Down, Right, Up

Example 1 (Input)

- 7 7 # Row & Column of the Matrix
- 1 3 # Position of the Starting Point (X and Y)
- 0 0 0 0 0 0 0 # 2D Matrix
- 2 8 0 1 8 6 0
- 0 2 0 0 0 4 0
- 0 2 6 5 6 8 0
- 0 0 0 5 0 0 0
- 0 1 8 2 9 9 7
- 0 0 0 0 0 0 0

Tree Specification

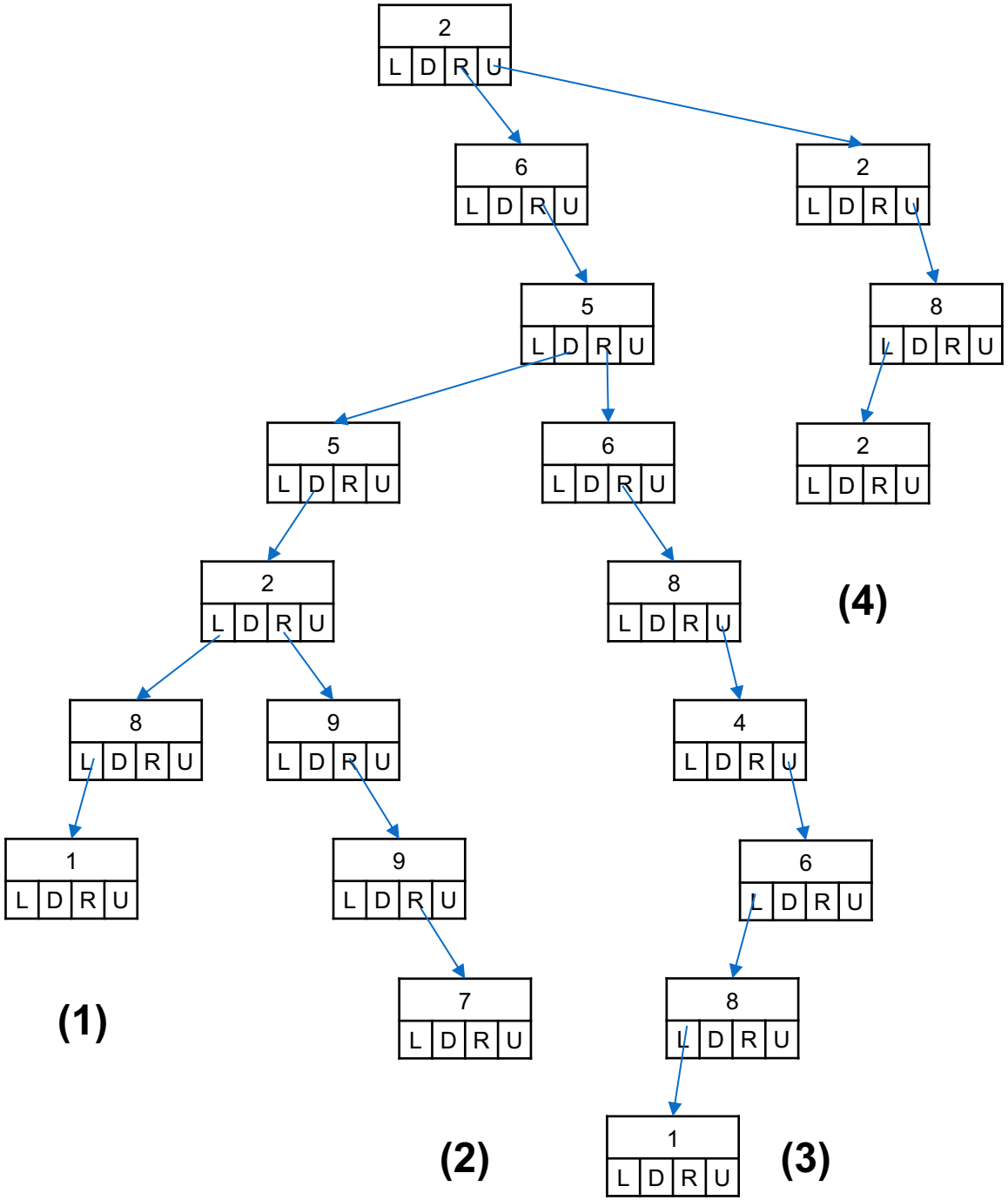
- Take the figure as an example
  - The root is 2, and it has two children
  - Up for 2 and right for 6
  - The right child of the root only has one right child (5)
    - Since the left cell is visited (root)



Example 1

```
0 0 0 0 0 0 0
2 8 0 1 8 6 0
0 2 0 0 0 4 0
0 2 6 5 6 8 0
0 0 0 5 0 0 0
0 1 8 2 9 9 7
0 0 0 0 0 0 0
```

Root



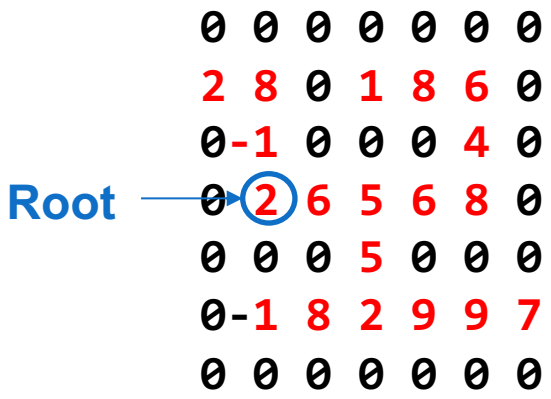
Example 1 (Output)

- Path (1) : 2 6 5 5 2 8 1 -> sum = 29
- Path (2) : 2 6 5 5 2 9 9 7 -> sum = 45
- Path (3) : 2 6 5 6 8 4 6 8 1 -> sum = 46
- Path (4) : 2 2 8 2 -> sum = 14

- Since Path (4) has the shortest distance, the output will be 14

Example 2 (Input)

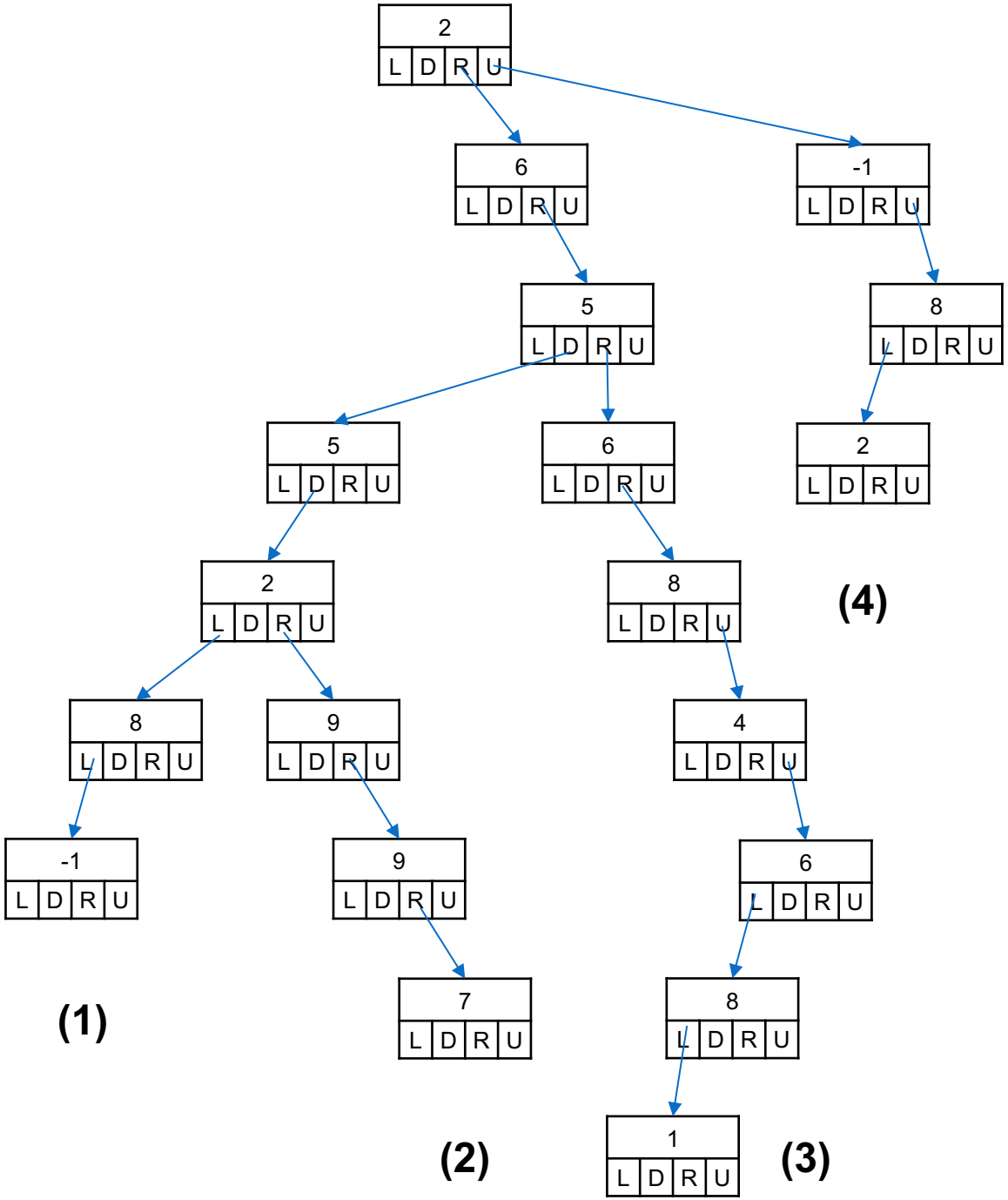
- 7 7 # Row & Column of the Matrix
- 1 3 # Position of the Starting Point (X and Y)
- 0 0 0 0 0 0 0 # 2D Matrix
- 2 8 0 1 8 6 0
- 0-1 0 0 0 4 0
- 0 2 6 5 6 8 0
- 0 0 0 5 0 0 0
- 0-1 8 2 9 9 7
- 0 0 0 0 0 0 0



Example 2

```
0 0 0 0 0 0 0
2 8 0 1 8 6 0
0-1 0 0 0 4 0
0 2 6 5 6 8 0
0 0 0 5 0 0 0
0-1 8 2 9 9 7
0 0 0 0 0 0 0
```

Root



Example 2 (Output)

- Path (1) : 2 6 5 5 2 8 -1 -> sum = ∞
- Path (2) : 2 6 5 5 2 9 9 7 -> sum = 45
- Path (3) : 2 6 5 6 8 4 6 8 1 -> sum = 46
- Path (4) : 2 -1 8 2 -> sum = ∞

- Since Path (1), Path (4) have dead road, the shortest distance will be Path (2), hence, the output is 45

Matrix Coordinate

- Notice that the starting point is from left-top, instead of left bottom.
- For example: (1, 3) = 2

	0	1	2	3	4
0					
1					
2					
3		2			
4					

HW3 Timeline

- HW3 Registration:

  4/28 9:00 a.m. - 4/29 9:00 a.m.
- HW3 Deadline:

  5/10 12:00 p.m.
- Quiz3:

  5/10 18:30 p.m. - 20:30 p.m.