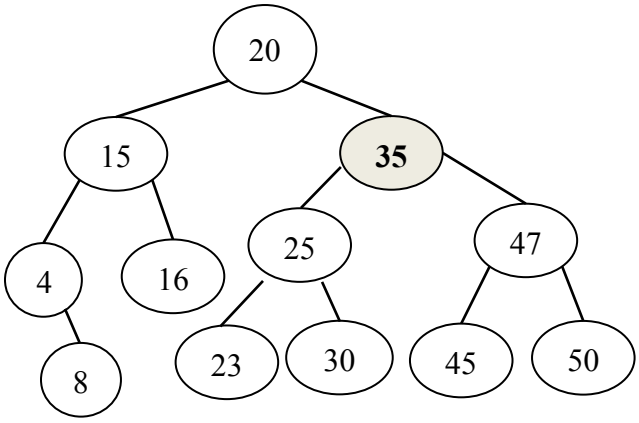
Trees & Search Trees Practice

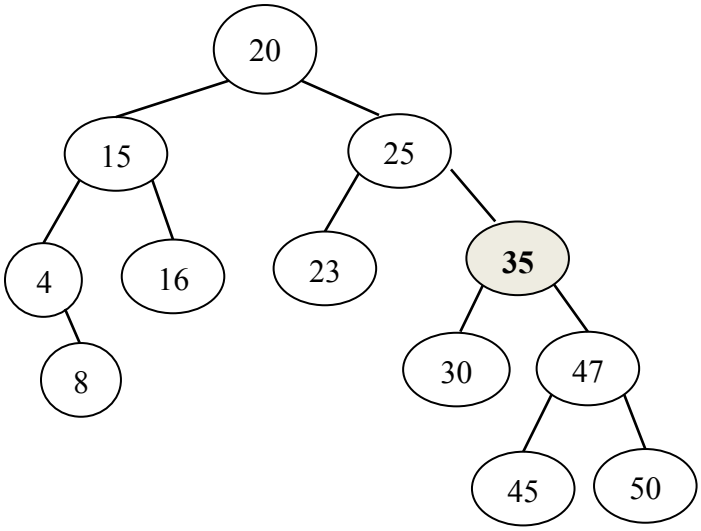
P1.

a) Could the sequence below (where 30 is the root) be a valid search in a BST for number **65**?
Justify your answer. **30, 80, 60, 50, 70, 65**

Ranges:
[30, 80]
[60, 80]
50 not in range

b) In the Binary Search Tree below do **a right rotation** at node **35** (rotate 35 to the right). Redraw the tree.



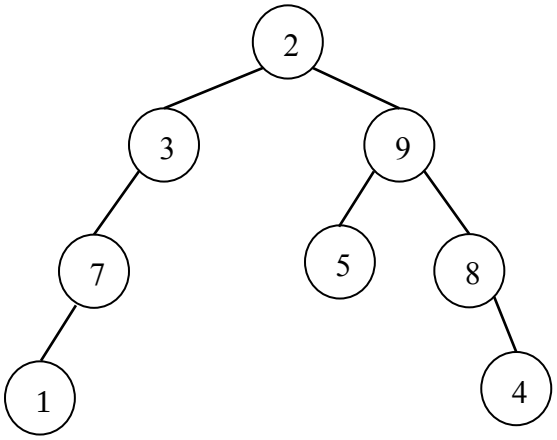


P2. Given the tree on the right, list the nodes in:

(The tree is NOT a BST)

Also fill in the order in which you visit the Root,

And the children (Left and Right)



1. Preorder (**Root**_, __**Left**_, _**Right**_)

   2, 3, 7, 1, 9, 5, 8, 4

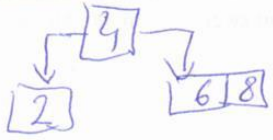
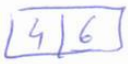
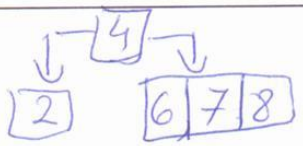
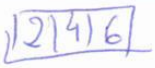
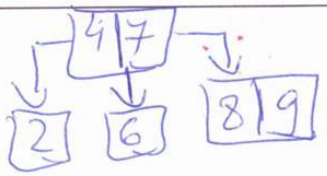
2. Inorder (**Left**_, **Root**_, _**Right**_)

   1, 7, 3, 2, 5, 9, 8, 4

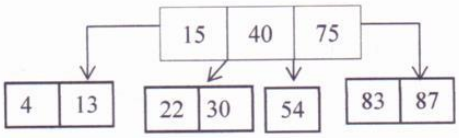
3. Postorder (__**Left**_, _**Right**_, **Root**_)

   1, 7, 3, 5, 4, 8, 9, 2

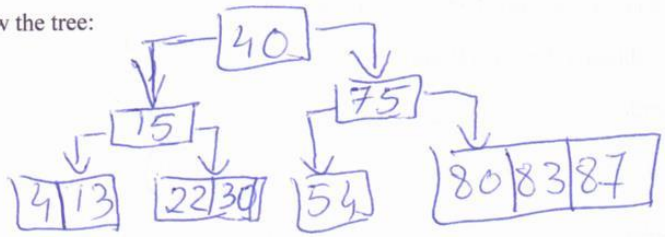
P3. (10 points) Given an empty 2-3-4 tree, insert numbers 4, 6, 2, 8, 7, 9 in this order. In the table below, draw the tree after each insertion.

N	Tree after inserting number N	N	Tree after inserting number N
4	Tree after inserting 4 in an empty tree: 	**8**	
6	Above tree after inserting 6 	**7**	
2		**9**	

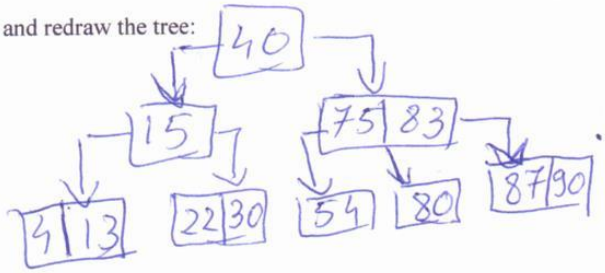
P4. Given the 2-3-4 tree:



a) (4 points) Insert 80 and redraw the tree:



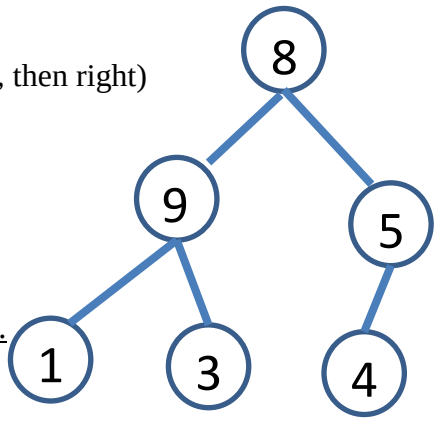
b) (4 points) After 80, insert 90 and redraw the tree:



P5. (25 points) Write a function `int follow_path(link root, int * A, int F)` that takes as arguments a tree (given by the root node, `root`), an array, `A`, and a number, F, and returns the item found in the tree, following the path given by the first `F` elements of `A`:

- if you see a **0** in `A`, go **left** in the tree;
- if you see a **1** in `A` go **right** in the tree.

Continue the same way. For the function calls below, assume that `root` is pointing to the root, 8, of the tree below.



- `follow_path(root, [0,1], 2)` returns 3 (from root, go left, then right)
- `follow_path(root, [1,0], 2)` returns 4
- `follow_path(root, [0,1,1,0], 2)` returns 3
- `follow_path(root, [1], 1)` returns 5
- `follow_path(root, [0,1], 0)` returns 8

You can **only** assume that `A` has at least `F` elements in it whenever it is called.

If anything goes wrong in the function call, it should return -1.

You can use a helper function if you want. The nodes and links are defined as follows:

```
typedef struct node * link;
struct node{
     int data;
     link left;
     link right;
};
```

a) (6 points) What special cases are there? Focus especially on cases that can crash your code. Give an example (function call and tree) that show each special case.

Solution not provided for this problem.

b) (4 points) **Fill in** the time complexity of the code you wrote for part c). (If needed, you can assume the tree has N nodes in total.)

O (_____)

c) (15 points) Write the **complete code** for the function. It should **deal with the special cases** that you mentioned. Each line or section that deals with a special case, should clearly indicate what case it deals with.

Solution not provided for this problem.

P6. (14 points) Write a function **`list print_reverse(link root)`** that takes a binary search tree (BST) as an argument and **returns a list** with the items in the tree in **reverse order**. If it helps, you can assume the following list functions are provided:

- `list new_list()` - creates and returns an empty list.
- `void add(list L, int x)`, - adds integer `x` **to the end** of the given list, `L`.

You can use a helper function if you want.

The nodes and links are defined as follows. (Do not worry about how the list is represented and implemented.)

```
typedef struct node * link;
struct node{
     int data;
     link left;
     link right;
};
```

a) (3 points) **Fill in** the time complexity of the code you wrote for part b). (Assume the tree has N nodes.)

O (_____)

b) (11 points) Write the **complete code** for the function. It should **not crash**. Do not use any global variables. 3 points will be deducted if any global variable is used.

Solution not provided for this problem.