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Assignment 4

Part 1: 10 points

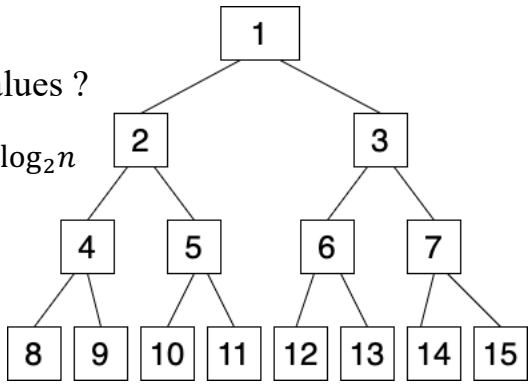
Question 1: 5 points

a) What is the maximum depth of a 2,3-Tree that has 15 values ?

When all nodes are 2 in 2-3 tree then it is the worst case, so the height is $\log_2 n$

$MaximumHeight = \log_2 15 = 3.91$

The maximum depth of a 2,3 Tree that has 15 values is 3.

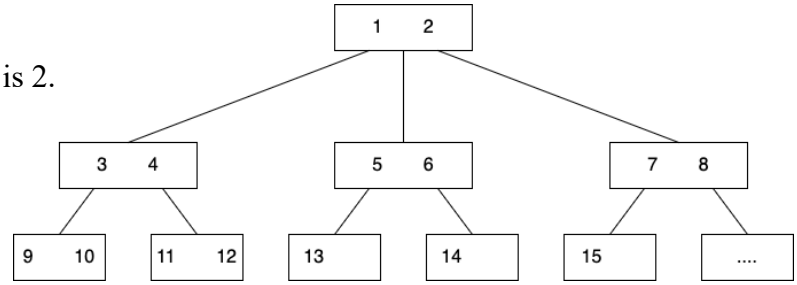


b) What is the maximum depth of a 2,3-Tree that has 15 values ?

When all nodes are 2 in 2-3 tree then it is the best case, so the height is $\log_3 n$

$MinimumHeight = log_2 15 = 2.46$

The maximum depth of a 2,3 Tree that has 15 values is 2.



c) What is the maximum depth of a BST that has 15 values ?

If there are n nodes in a BST, the maximum height of the BST is n-1:

$MaximumHeight = 15 - 1 = 14$

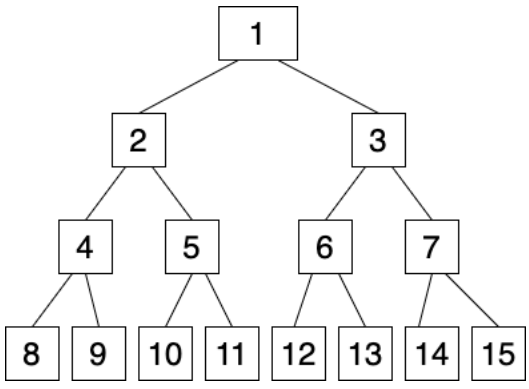
The maximum depth of a BST that has 15 values is 14.

d) What is the minimum depth of a BST that has 15 values ?

If there are n nodes in a BST, the minimum height of the BST is $log_2 n$

$MinimumHeight = log_2 15 = 2.46$

The minimum depth of a BST that has 15 values is 3.



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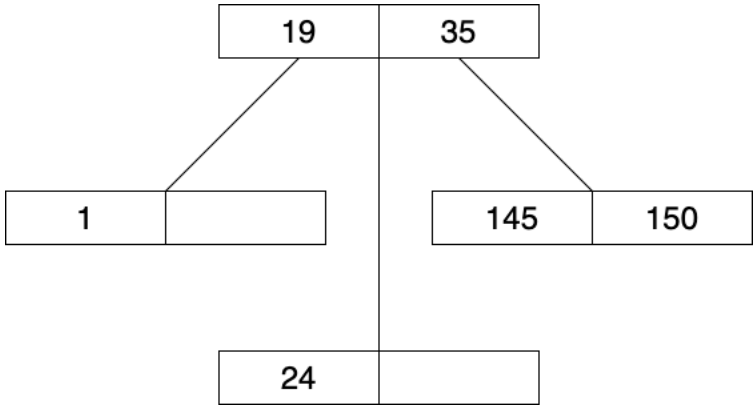
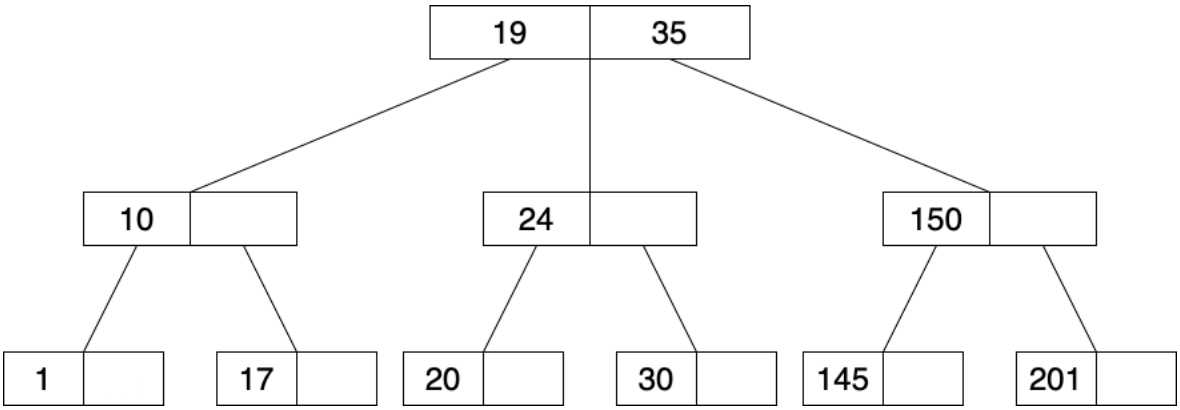
Question 2: 5 points

Draw the 2,4-Tree that you would get by starting with an empty tree and inserting the following values in order:

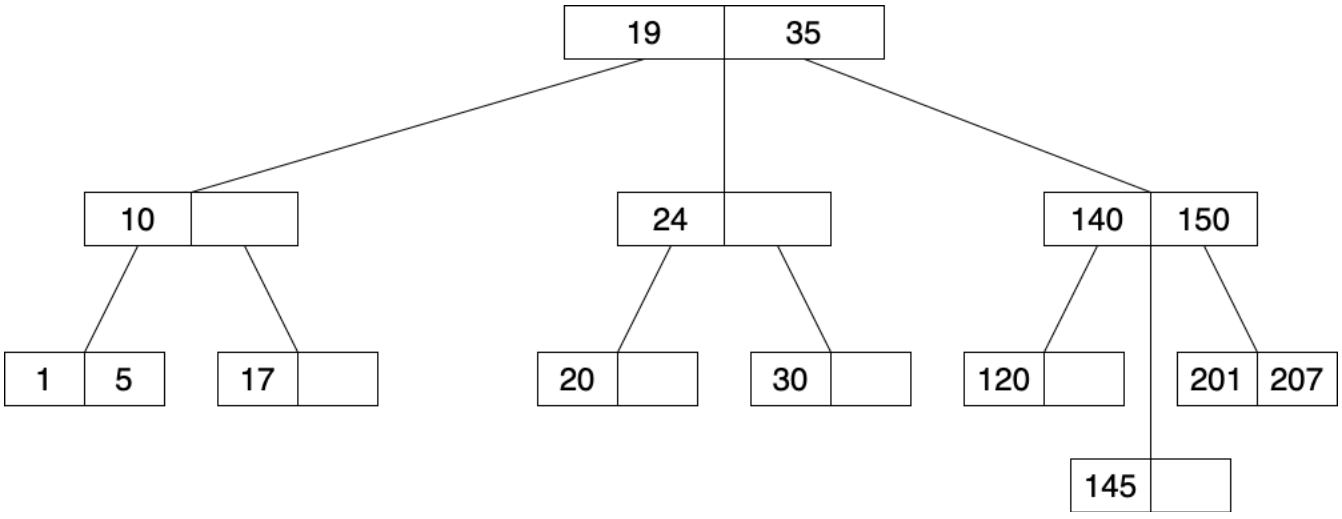
a) 1, 150, 35, 145, 19, 24*



b) 10, 17, 20, 30, 201 *



c) 115, 40, 7*



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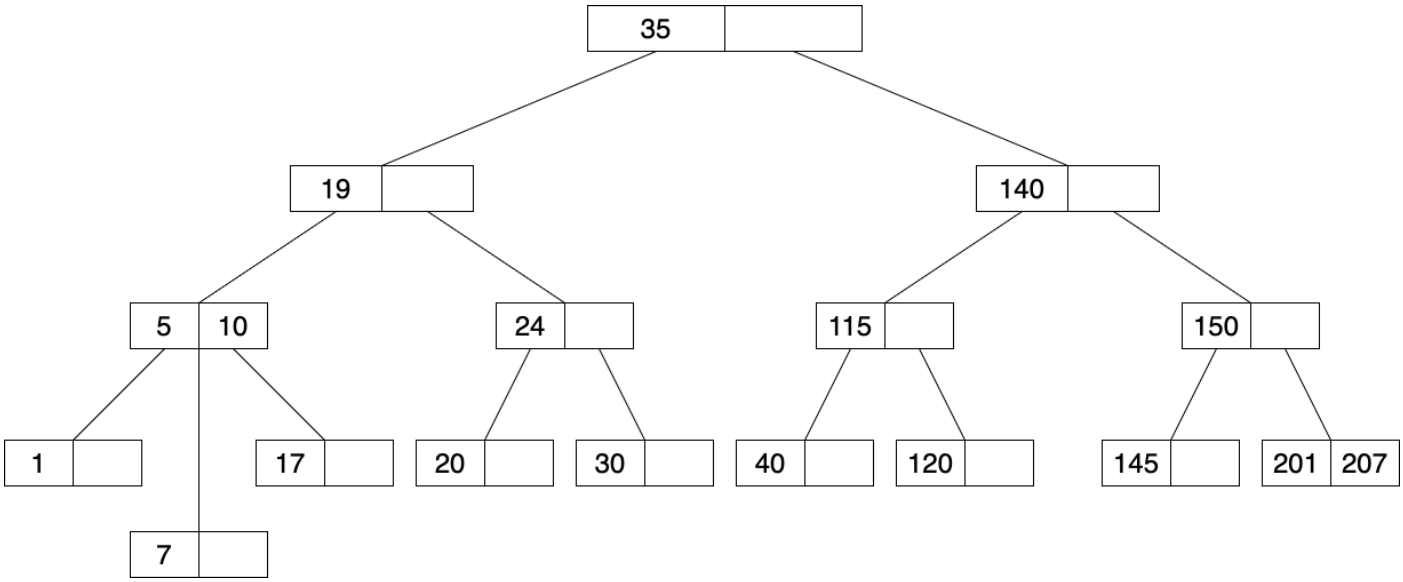
d) 115, 40, 7*



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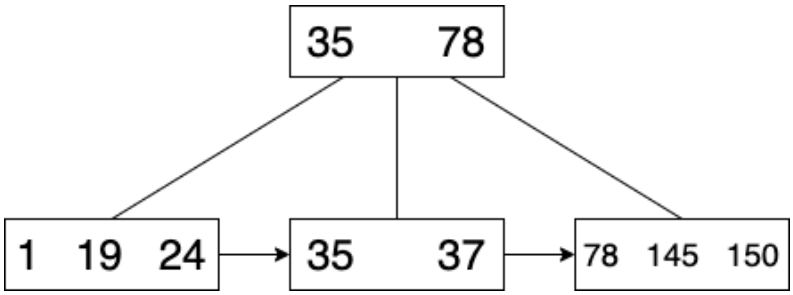
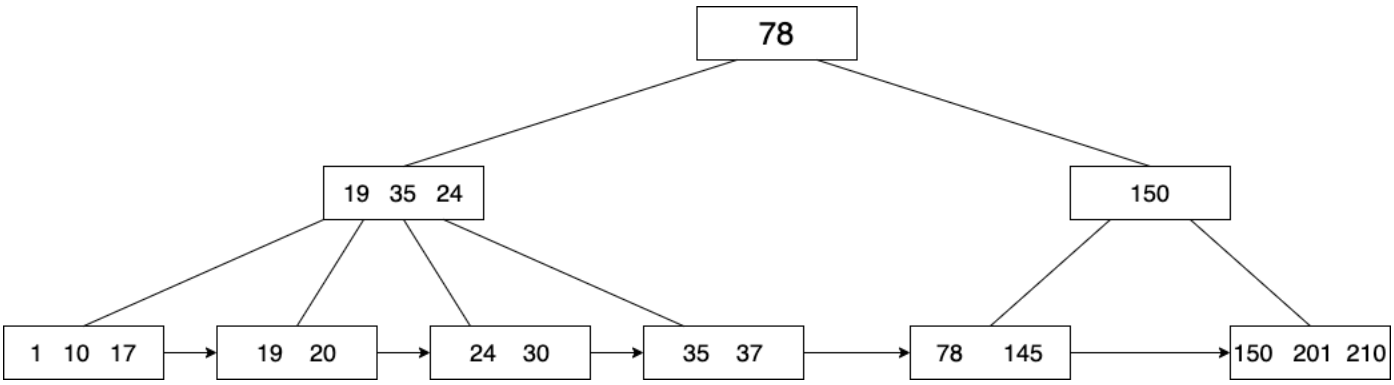
Question 3: 5 points

Draw the B+-tree of order 4 that you would get by starting with an empty tree and inserting the following values in order:

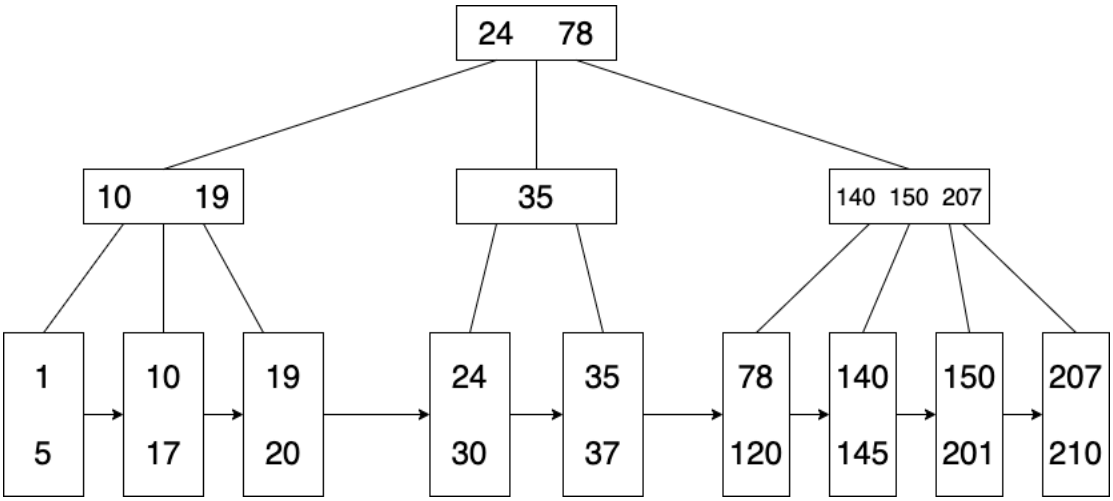
a) 1, 78, 37, 150, 35, 145, 19, 24*



b) 10, 210, 17, 20, 30, 201 *



c) 140, 207, 120, 5*



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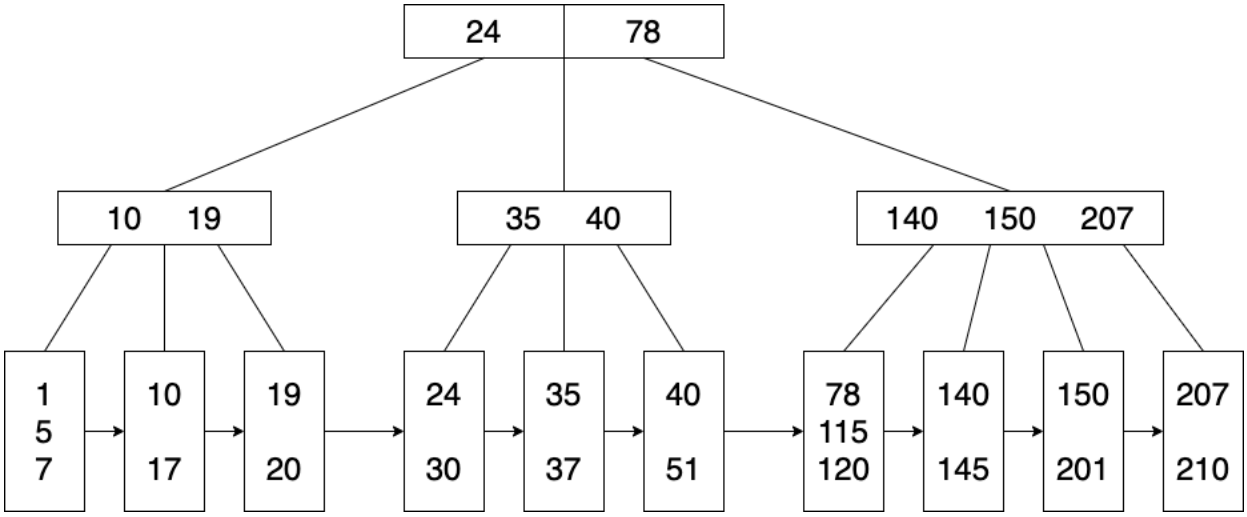
d) 115, 51, 40, 7*



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Question 4: 5 points

Compute the last-occurrence function and $f(j)$ for the following patterns

a) supercalifragilisticexpialidocious

33	32	22	20	10	29	24	25	30	9	12	17	21	27	31
s	u	p	e	r	c	a	l	i	f	g	t	x	d	o

b) abracadabra

10	8	9	4	6
a	b	r	c	d

Algorithm implementation :

```
import java.util.ArrayList;

public class lastOccurence {

      public static void findPattern(String t)
        {
            char[] text = t.toCharArray();
            ArrayList<Integer> indexs = new ArrayList<Integer>();

            ArrayList<Character> usedLetters = new ArrayList<Character>();

            for (int i=0; i<text.length;i++) {

                char currentLetter = text[i];
                int finalIndex = 0;

                if(usedLetters.contains(currentLetter)) {
                    continue;
                }

                for(int j=0; j<text.length; j++) {
                    if(currentLetter==text[j]) {
                        finalIndex = j ;
                    }
                }
                indexs.add(finalIndex);
                usedLetters.add(text[finalIndex]);

            };
            System.out.print(indexs);
            System.out.println();
            System.out.print(usedLetters);
            System.out.println();
            System.out.println();
         };

         public static void main(String[] args) {
             findPattern("supercalifragilisticexpialidocious");
             findPattern("abracadabra");
         };
};
```

```
Console  Problems  Debug Shell  Console
<terminated> lastOccurence [Java Application] /Users/johnpurcell/.p2/pool/plugins/org.eclipse.justj.openjdk.hotspot.jre.full.macosx.x86_64_14
[33, 32, 22, 20, 10, 29, 24, 25, 30, 9, 12, 17, 21, 27, 31]
[s, u, p, e, r, c, a, l, i, f, g, t, x, d, o]

[10, 8, 9, 4, 6]
[a, b, r, c, d]
```

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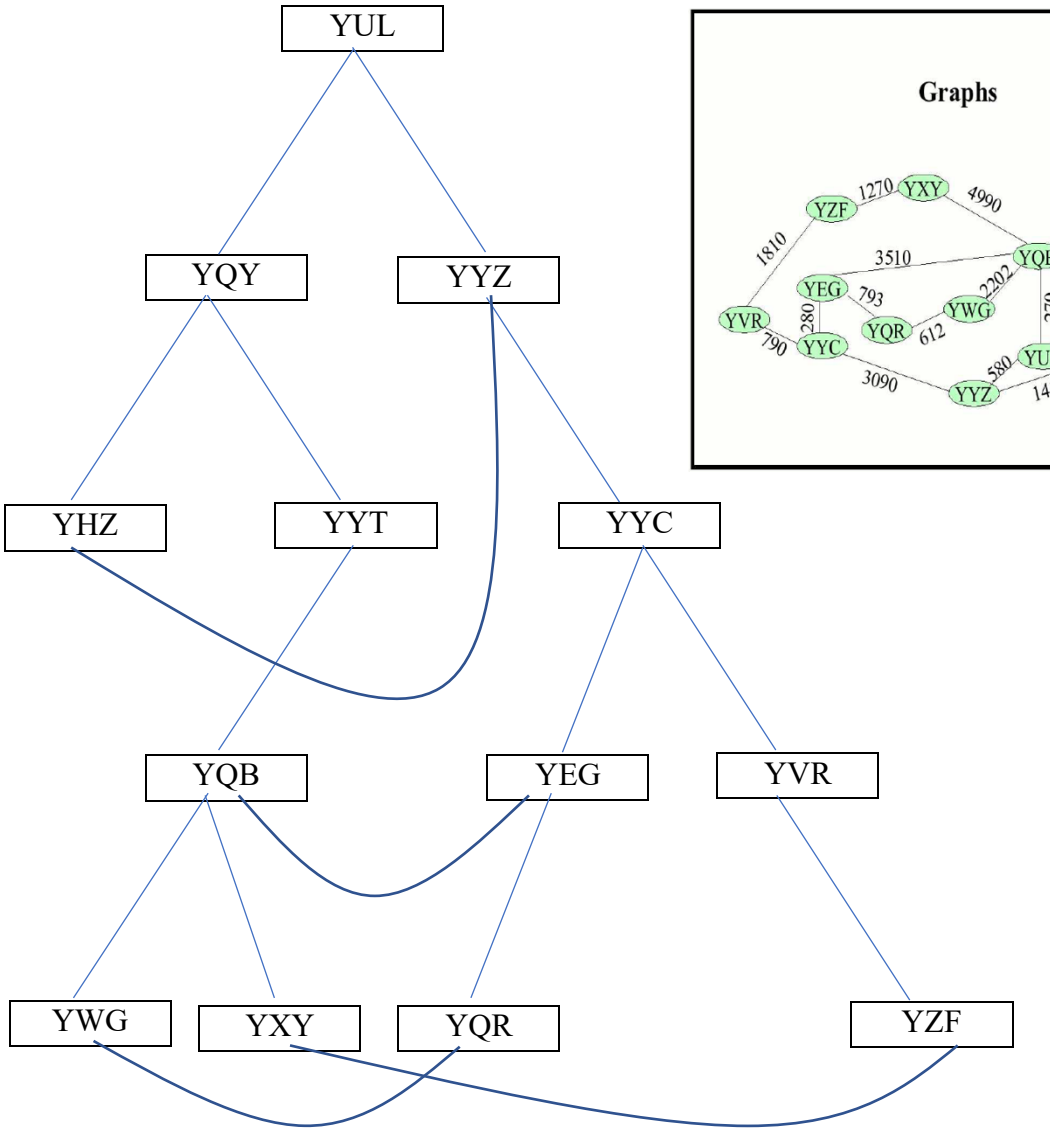
Question 5: 5 points

For the following graph, give the BFS and the DFS traversal starting from YUL assuming that the order of the nearest neighbor is clockwise starting from the noon position. Your answer should give the order of airports visited, the “explored" flight paths and the “cross" flight paths.

BFS:
→ Use a queue to help determine vertex-exploration order
→ Start from YUL and explore clockwise
→ Queues are FIFO

Queue:
BST →

YUL	YQY	YYZ	YYC	YYT	YQB	YEG	YUR	YWG	YXY	YQR	YZF



BFS:
YUL → YQY → YYZ → YYC → YYT → YQB → YEG → YVR → YWG → YXY → YQR → YZF

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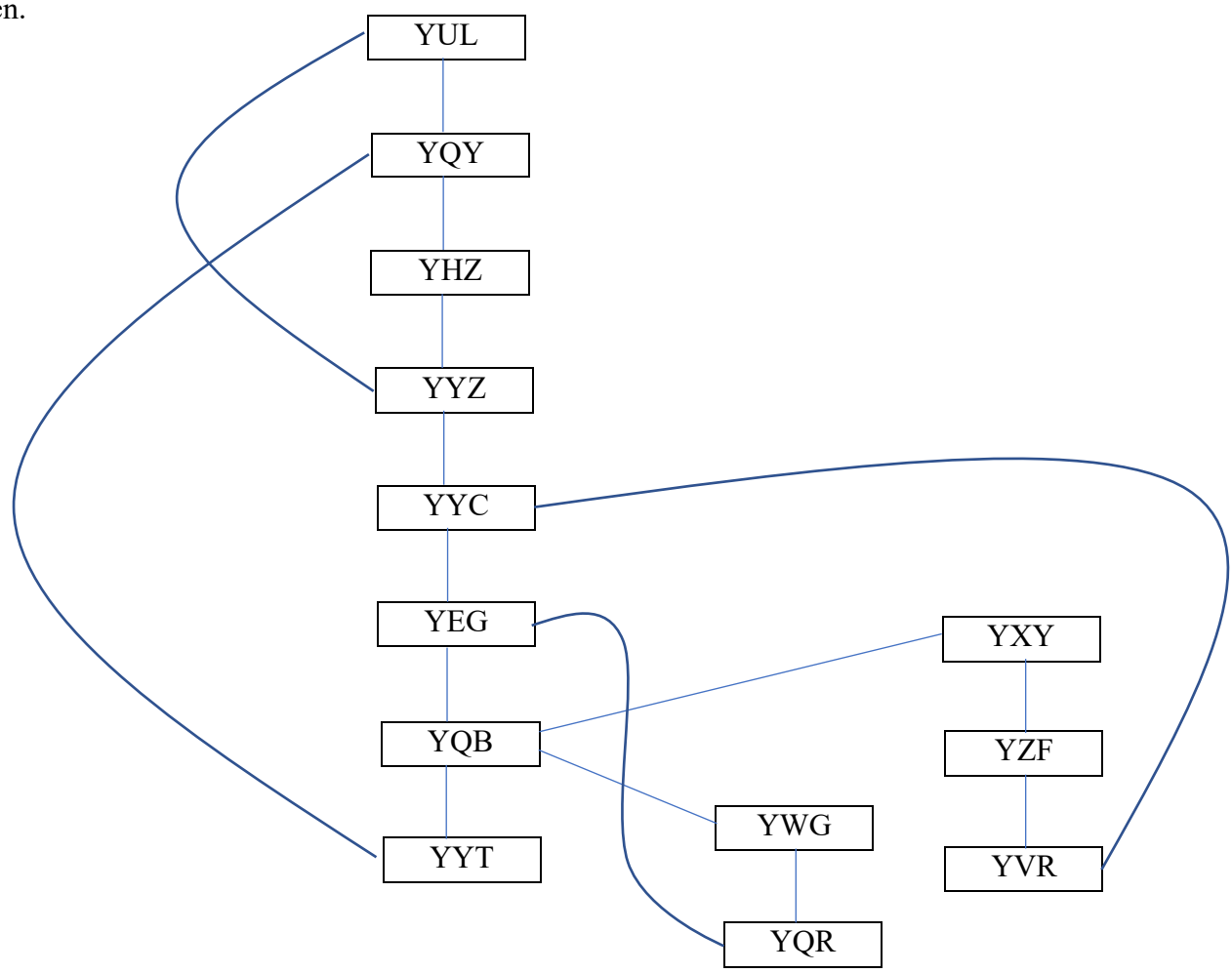
Assumptions:

DFS:
→ Use a stack to help determine search order
→ Stacks are LIFO in order
→ Once a new vertex is reached, store vertex position in stack; continue exploring until vertex no longer has any children.



DFS:
YUL → YQY → YHZ → YYZ → YYC → YEG → YQB → YYT → YWG → YQR → YXY → YZF → YVR