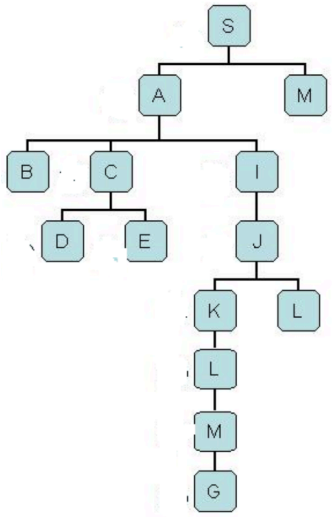
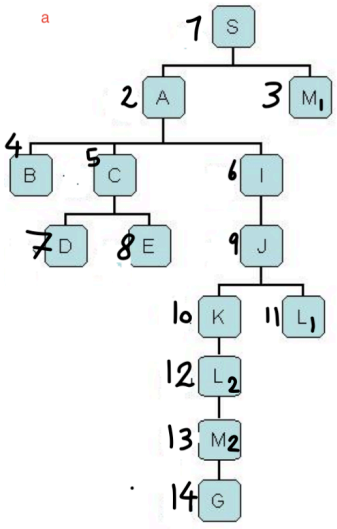
Mostafa Zamaniturk
AAI-501
Assignment 2.1
07-07-25

1- Consider the following tree



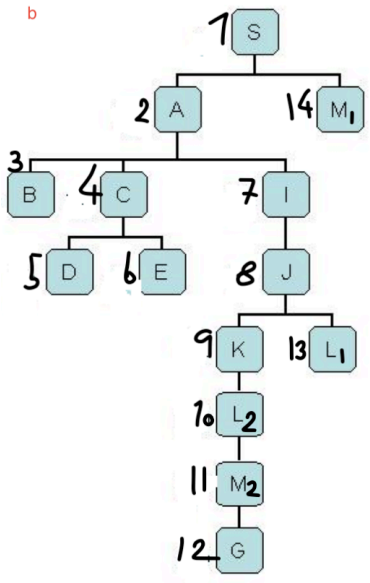
a) Breadth first search – Show the order in which the nodes will be visited by placing a number next to the node in the figure. For example if node E will be visited as 6th node place 6 next to the node in the tree. S will always be 1. [10 points]



Based on the BFS, the ordered nodes will be as below;
Note: There are two M and L in the graph, so I marked the first one with index 1 and the second one with index 2.
The L2 is the child of K and the L1 is the child of J (same level with K, which means sibling with K).
The M2 is the child of L2 (in level 6), and the M1 is the child of S (in level one)

S	1
A	2
M2	3
B	4
C	5
I	6
D	7
E	8
J	9
K	10
L1	11
L2	12
M1	13
G	14

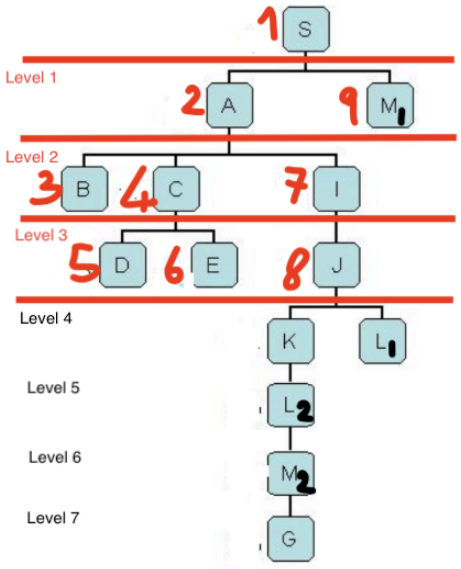
b) Repeat a) for depth first search [10 points]



S	1
A	2
B	3
C	4
D	5

E 6
I 7
J 8
K 9
L2 10
M2 11
G 12
L1 13
M1 14

c) Repeat a) for depth first search with limit *l*=3. [5 points]



The algorithm will stop before the level of 4, which means K and L1 are not counted.

S 1
A 2
B 3
C 4
D 5
E 6
I 7
J 8
M1 9

2- Provide a complete problem formulation for the following. Problem formulation should include: initial state, goal test, cost function. They can all be a few words or a sentence for each. [25 points]

a) Using only four colors, you have to color a planar map in a way such that no two adjacent regions have same color

Initial State:
A planar map where no region is colored. The map contains regions and information about which regions are adjacent.

Goal Test:
All regions are colored using one of the four colors, and no two adjacent regions share the same color.

Cost Function:
Number of colors used (optional, since it's fixed at 4), or more typically: uniform cost — each coloring step has equal cost. Total cost can be defined as the total number of assignment steps (regions colored), or as 0 if solved and (infinity ∞) if not solvable.

b) You have a program that outputs the message “illegal input record” when fed a certain file of input records. You know that processing of each record is independent of the other records. You want to discover what record is illegal.

Initial State:

A file containing N independent records, and a program that returns “illegal input record” for some unknown record(s).

Goal Test:

Identify a specific record (it can be a minimum set of records) such that when only that record is input to the program, the message “illegal input record” is still produced.

Cost Function:

The number of times the program must be run (or number of tests needed to isolate the illegal record). The objective is to minimize the number of program runs required to find the faulty record. This problem is well-suited for a divide-and-conquer (binary search) approach due to record independence.

3- Your goal is to navigate a robot out of a maze. The robot starts in the center of the maze facing north. You can turn the robot to face north, east, south, or west. You can direct the robot to move forward a certain distance although it will stop after hitting a wall. [20 points]

a) Formulate this problem. This means you will have to describe initial state, goal test, successor function, and cost function. Successor function is a description of the robots successive actions after the initial state.

We will define the coordinate system so that the center of the maze is at (0, 0), and the maze itself is a square from (−1,−1) to (1, 1)

Initial State:

Position of the robot is (0, 0) which is located at the center of the maze. And the orientation is facing north.

Goal Test:

The robot has reached a position outside of the maze boundary. It can be in any coordination where $x < -1$, $x > 1$, $y < -1$, $y > 1$.

Successor Function:

This successor function has two parts.

First is just turning the robot's face in different directions, not its position. Actions are turning North, turning South, turning East and turning West.

Second part is the moving forward process; the robot moves that direction until it hits a wall or boundary. The position updates to the furthest point in that direction within the maze or to the boundary if there is no obstacle. The action is “move forward” through the selected direction in the previous part.

Cost Function:

If it has uniform cost, so each action turn or moving forward has a cost of one. The total cost is the number of actions taken (turns + moves)

Project Deliverables and Format:

Submit as a single file: Word or PDF. If you take pictures with a phone or scan into PDF, use a large font (12 point and up) and high quality. Unreadable cluttered submissions with small font sizes will not be graded.