355 fall 2022 assignment 4

For this assignment, post CLARIFYING QUESTIONS ONLY on eclass. Posting suggestions or your answers or hints on eclass or any other site – e.g. a discord server or anywhere else – is plagiarism.

You can work on this assignment in groups of up to 5: within your group, you can discuss any questions, but you cannot copy answers. Each student must submit their own assignment. Discussing or copying with any student outside your group is plagiarism.

We might ask you later to explain your answers: if you are unable to do so, we might deduct some or all marks and report this to the faculty of science.

For this assigment, each student's secret number is the 4th and 5th integer of their student id, interpreted as a 2-digit number. E.g. if your id is `***91**`, then your secret number is 91. Some questions ask you for m, your secret number mod 3. E.g. if your secret number is 91, your m is 1.

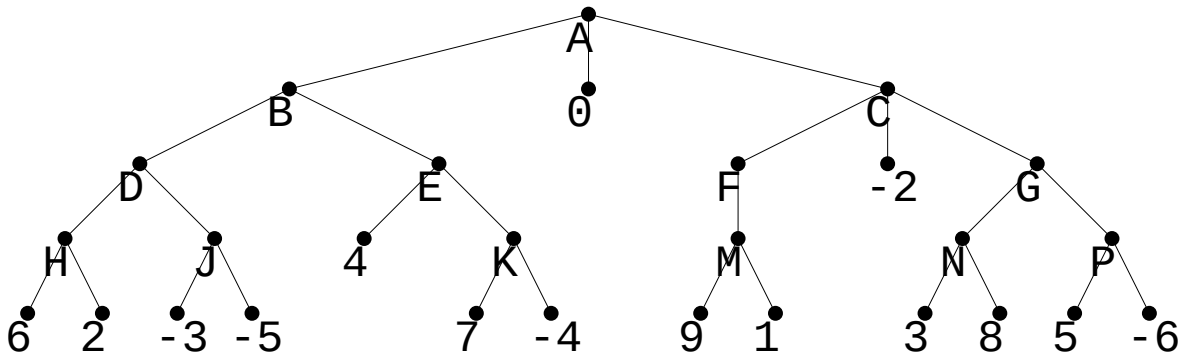
Submit each answer on eclass. There are 7 questions, each worth 1 mark.

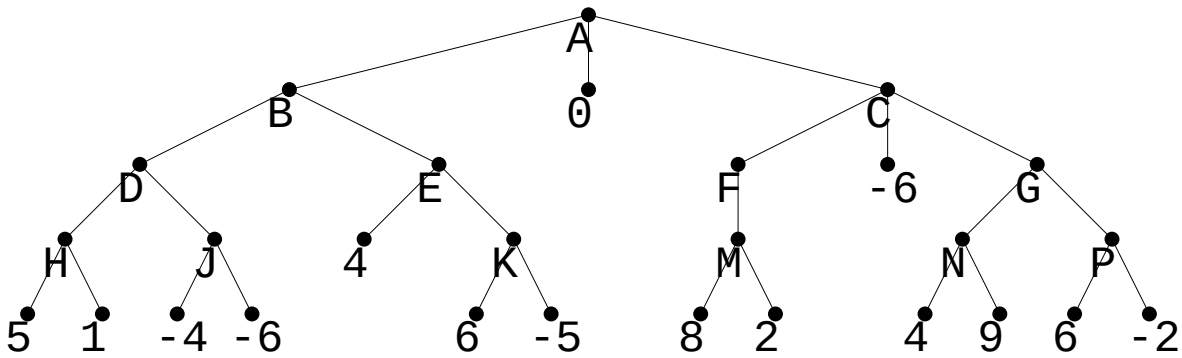
1. **If you do not answer this question we will not mark the assignment and your assignment score will be 0.**

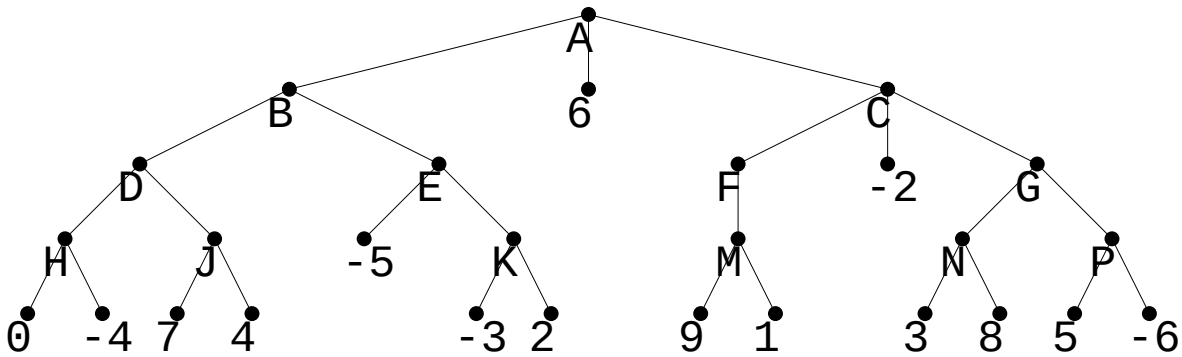
   (a) In your own words, state that you accept the plagiarism policy above.

   (b) Give the names and ccids of all members of your discussion group (including yourself). Explain how you worked together: e.g. discussed every question, discussed only questions 1 and 3 with group members X and Z, etc.

2. Below are game trees T_0, T_1, T_2: your tree is T_m. In this question, assume that Max plays first and that the score at each leaf node is for Max. For each node, give the minimax score for Max. Answer like this: A 11, B 12, C 13, D -95, ...







3. Unless we say otherwise, we assume that the two-person games we discuss are zero-sum games: so, in a game tree Min's negamax score will be the negative of Max's, and vice versa.

   Use the trees of the previous question, but in this question assume that each leaf node score is for the player-to-move (PTM).

   For each node, find the PTM minimax score (you could use the negamax algorithm to do this).

4. These class slides trace alphabeta minimax:

   http://webdocs.cs.ualberta.ca/~hayward/355/p.pdf

   This minimax trace considers child nodes from left to right. Show the final labelled tree if instead the algorithm considers child nodes from right to left. (Use the same notation as in the example.)

5. Below are sliding tile positions P_0, P_1, P_2: your position is P_m.

```
 7  9  5 15      7 15 13 1     10 11  4 15
11 13  3 10      2  6  3 8     12  6  7  8
12  8  4  2     10 12 14 5      5  2 14  9
 1  6 14         4 11  9           1  3 13
```

   Recall: in `15puzzle.py` from the class github repo, `optlevels =`

   `[[[1,2], [3,4], [5,6,7,8], [9,10,11,12,13,14,15]]]` uses the intermediate subgoal (baby steps) method to go from the start to position A below, then fix tiles {1,2} and go to B, then also fix tiles {3,4} and go to C, and then also fix tiles {5,6,7,8} and finish.

```
A   1  2  *  *    B   1  2  3  4      C   1  2  3  4
    *  *  *  *        *  *  *  *          5  6  7  8
    *  *  *  *        *  *  *  *          *  *  *  *
    *  *  *           *  *  *             *  *  *
```

   a) For your puzzle, execute `15puzzle.py` from the class repo for the above value of optlevels. Give the total number of nodes searched and the number of moves in the solution found.

   b) Repeat a) with `optlevels =`

   `[[[1], [2], [3,4], [5], [6], [7,8], [9,13], [10,14], [11,12,15]]]`

   c) Repeat a) with `optlevels =`

   `[[[1,2,3,4], [5,9,13], [6,7,8,10,11,12,14,15]]]`

6. Below are sliding tile positions P_0, P_1, P_2: your position is P_m.

```
8 7 6     8 7 6     8 1 7
5 4 1     1 5 4     6 5 4
3 2       3 2       3 2
```

a) Explain briefly why your position is solvable. Hint: use the solvability formula.

b) Explain briefly why it is possible to go from your position to the position Q below. Hint: I mentioned this in class. Use the solvability formula again.

```
1 2 4
3 5 _
6 8 7
```

c) Assume that in Q you fix the locations of tiles 1 and 2 and then try to finish solving the puzzle. Explain briefly why this is never possible.

d) Explain briefly why using `optlevels =`

`[[[1,2,3], [4], [5,6,7,8], [9,10,11,12,13,14,15]]`

to solve the 15 puzzle is a bad idea:

pick one of the following answers, and justify your answer briefly.

W) This will always fail to find a solution.

X) On some inputs, this will fail to find a solution.

Y) This will always return an incorrect solution.

Z) On some inputs, this will return an incorrect solution.