CSE 5360 Assignment 3

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Question 1:

(a): It is possible to win a game of tic-tac-toe within 5 to 9 moves, so we must find the number of games possible from inclusively 5 to 9 moves.

At 5 moves: 8 possible lines to win, 3 X's, 2 O's in any other 6 placements: 8 * 3! * 6 * 5 = 1440

At 6 moves: 8 possible lines to win, 3 X's, 3 O's in any other 5 placements: 8 * 3! * 6 * 5 * 4 = 5760
Though, at 6 moves, there is a chance to have 3 X's or O's in a row (therefore winning the game), so after placing 3 X's, there are two rows possible to place O's. So, we can conclude: 6 * 3! * 2 * 3! = 432.
At 6 moves: 5760 – 432 = 5328

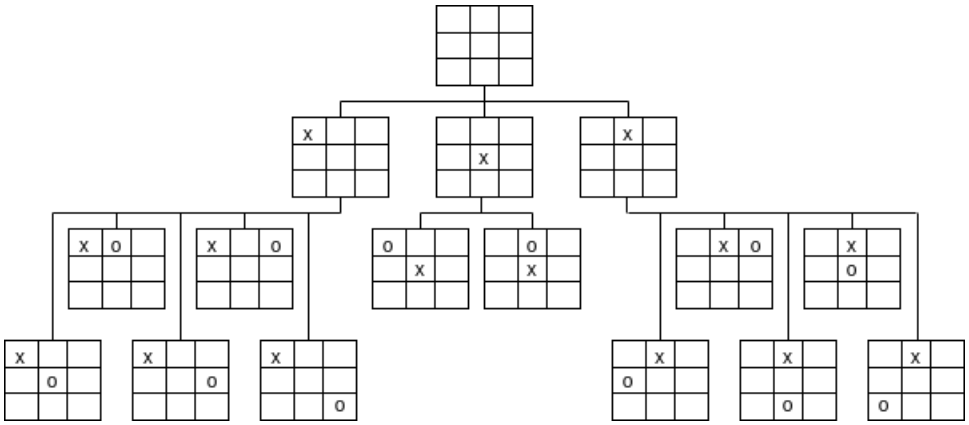
At 7 moves: 8 possible lines to win, 4 X's, 3 O's: 8 * 3 * 6 * 3! * 5 * 4 * 3 = 51840
Removing the chance of 3 X's or 3 O's in a row: 6 * 3 * 6 * 3! * 3! = 3888
At 7 moves: 51840 – 3888 = 47952

At 8 moves: 8 possible lines to win, 4 X's, 4 O's: 8 * 3 * 6 * 3! * 5 * 4 * 3 * 2 = 103680
Removing the chance of 3 X's or 3 O's in a row: 6 * 3 * 6 * 3! * 2 * 4! = 31104
At 8 moves: 103680 – 31104 = 72576

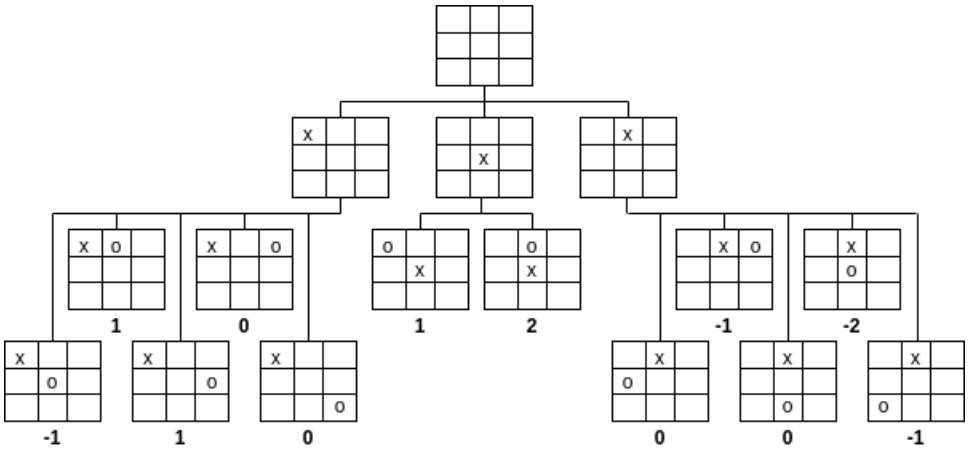
At 9 moves: There are four different scenarios.
Scenario 1: The game is a draw: 16 * 5! * 4! = 46080
Scenario 2: Three in a row vertically or horizontally: 6 * 3 * 4 * 4! * 4! = 41472
Scenario 3: Three in a row diagonally: 2 * 3 * 8 * 4! *4! = 27648
Scenario 4: One makes two different lines or 3, where two lines intersect: 22 * 1 * 4! * 4! = 12672
Total at 9 moves: 46080 + 41472+ 27648 + 12672 = 127872

Total: 1440 + 5328 + 47952 + 72576 + 127872 = 255168

(b):

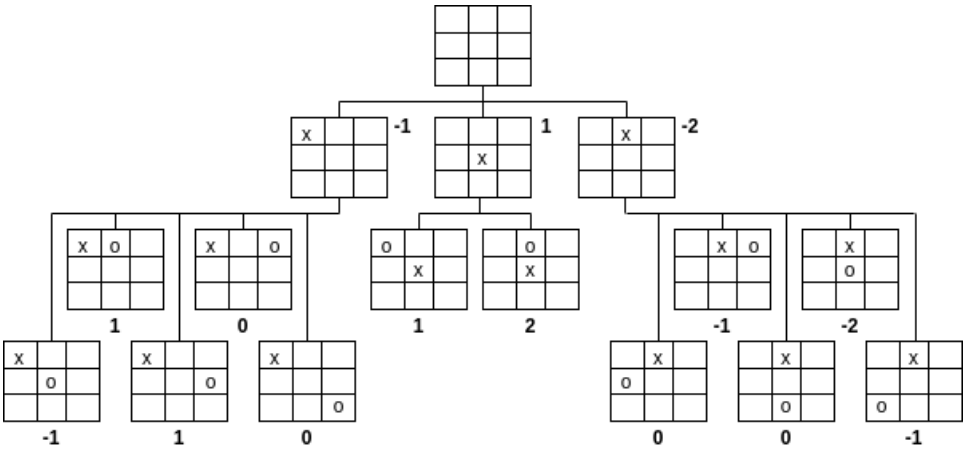


(c):

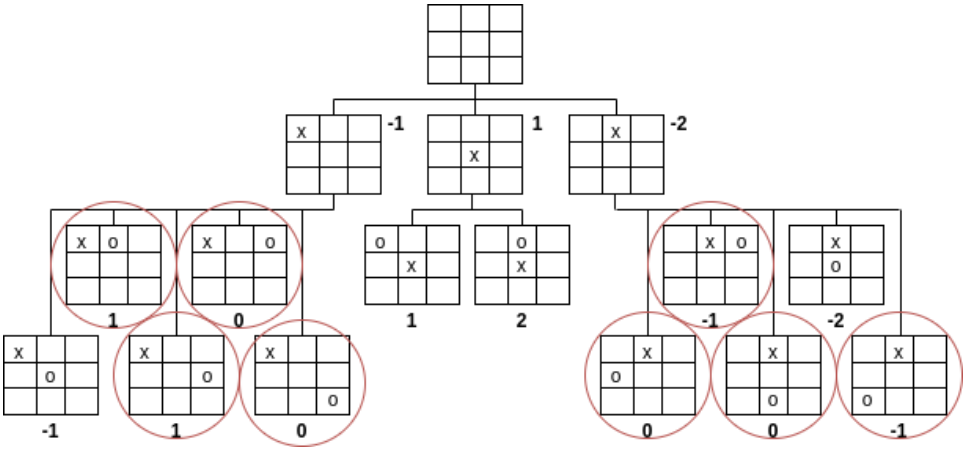


(d):

Placing X in the center is the best choice



(e):
Done in order from left to right



Question 2:

(a): For my formulation, there will be a variable to each of the n^2 positions on the board.

(b): The values of each variable could take on a binary value of either 1 or 0 to show that the space is either occupied or vacant, respectively.

(c): The constrained sets would be the complete set of squares so that the number of occupied squares is m. Also, all the pairs of the squares split by the knight's possible moves are constrained so that they cannot both be occupied at the same time.

(d): The use of local search algorithm can ensure that there cannot be any attacks at any given point in time. Possible actions that are available are to add a knight to an un-attacked square, to move a knight to any un-attacked square, or to remove any knight.

(e): A reasonable heuristic function would be using the A* search f(n) = g(n) + h(n). The g(n) will represent the moves the knight makes from start to n, while h(n) represents the lowest cost path from n to the goal.