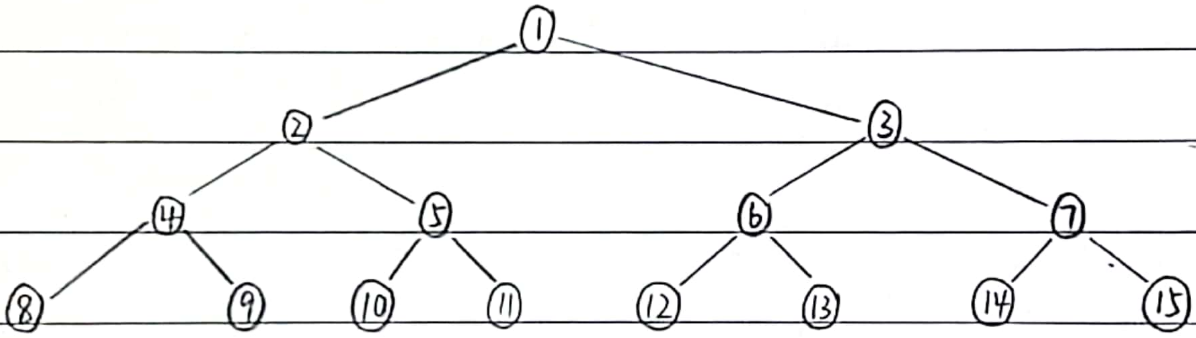
3.8 Homework 2

Problem 1:

Solutions:

a. According to the title, the state space is:



b. When using breadth-first search, the list will be:

1 2 3 4 5 6 7 8 9 10 11

when using depth-limit search with limit 3, the order is:

1 2 4 8 9 5 10 11

when using iterative deepening search:

1. 1 2 3. 1 2 4 5 3 6 7. 1 2 4 8 9 5 10 11

Problem 2:

Solutions:

a. This statement is right. When the cost of each edge g(n) is equal, the uniform-cost search becomes Breadth-first search.

b. This statement is right. When the forward cost $h(n) = -depth(n)$, the best-first tree search ~~because~~ becomes Depth-first search.

c. This statement is right. Since the A^* search orders by the sum of backward cost $g(n)$ and forward cost $h(n)$ while the Uniform-cost search only considers $g(n)$, the later one will become A^* when $h(n) = 0$ for all n.

Problem 3:

Solutions:

a. The branching factor $b = 4$ because the number of the neighbors for each node is 4.

b. The number of the distinct states at depth k is $4k$ (for $k > 0$) because every node has 4 choices for the next location.

c. When using the breadth-first tree search, we can at most expand

$$\sum_{i=1}^{|x|+|y|} 4^i = \frac{4 - 4^{|x|+|y|+1}}{1-4} = \frac{4^{|x|+|y|+1} - 4}{3}$$ nodes

d. When using the breadth-first graph search, we can at most expand

$\sum_{i=1}^{|x|+|y|} 4i = \frac{[4+4(|x|+|y|)](|x|+|y|)}{2} = 2(|x|+|y|)(|x|+|y|+1)$ nodes.

e. Yes. Proof:

$\because h = |u-x| + |v-y|$. so $h \geq 0$

Besides, h is the sum of the vertical and horizontal distances between (u,v) and (x,y), which is always equal or less than the true distance between two points. According to the definition, h is an admissible heuristic.

f. According to A^* ~~gragh~~ graph search, the number of expanded nodes is:

$|0-x| + |0-y| = |x| + |y|$ when initial location is $(0,0)$.

g. Yes. When some links are removed, the true distance between two points will not decrease definitely, instead, it will only increase ~~¥~~. in some cases. So h remains $0 \leq h \leq h^*$, where h^* is the true distance, which means h is admissible.

h. No. When links are added between ~~a~~ nonadjacent states, their actual distance decreases and therefore, it can be less than h.

Problem 4

Solutions:

a. Obviously, there are 9! possible games of tic-tac-toe

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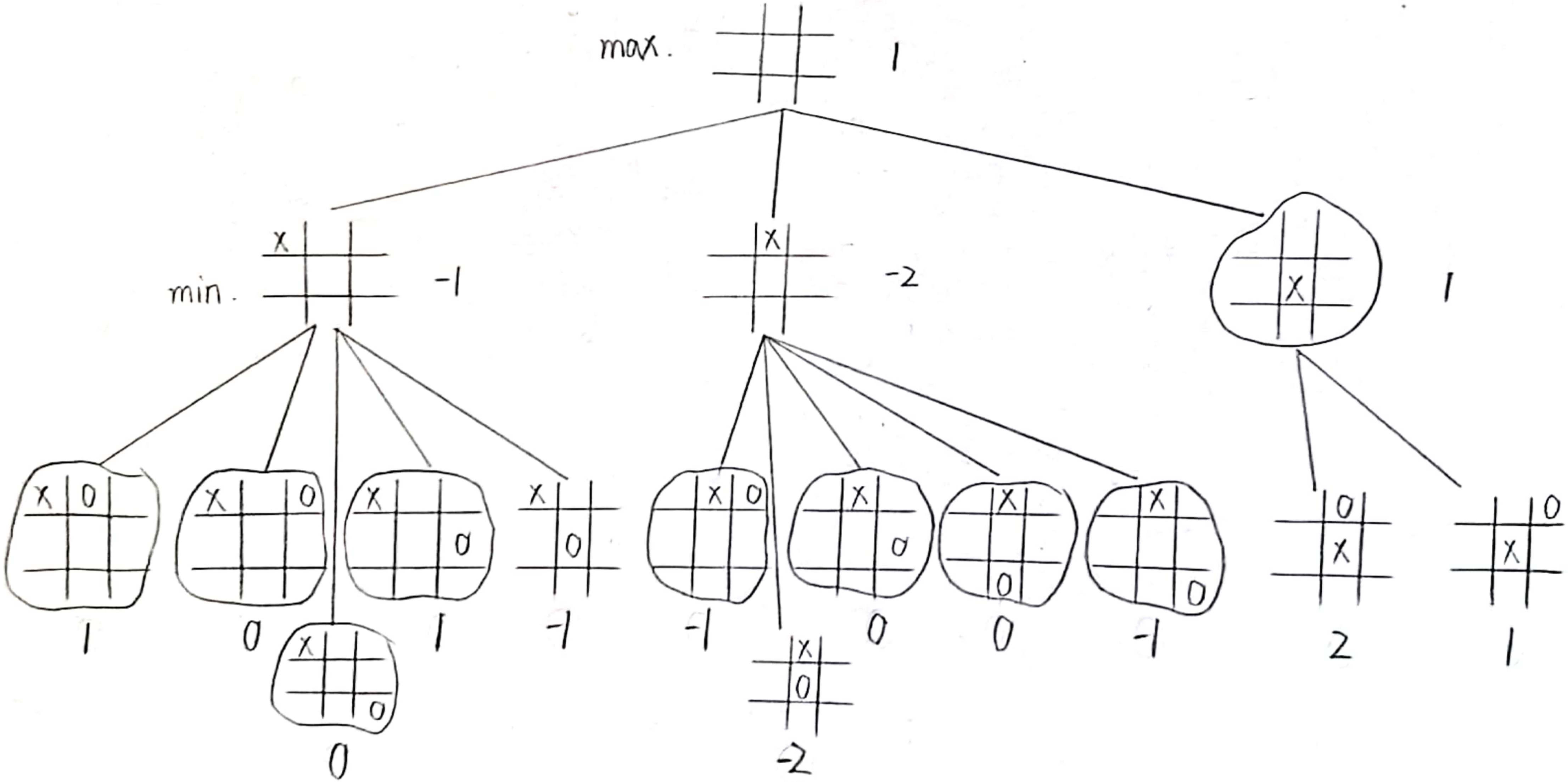
b. Taking symmetry into account, the tree can be:

c. $\because \text{Eval}(s) = 3X_2(s) + X_1(s) - (3O_2(s) + O_1(s))$

and the values are marked on the tree in (b).

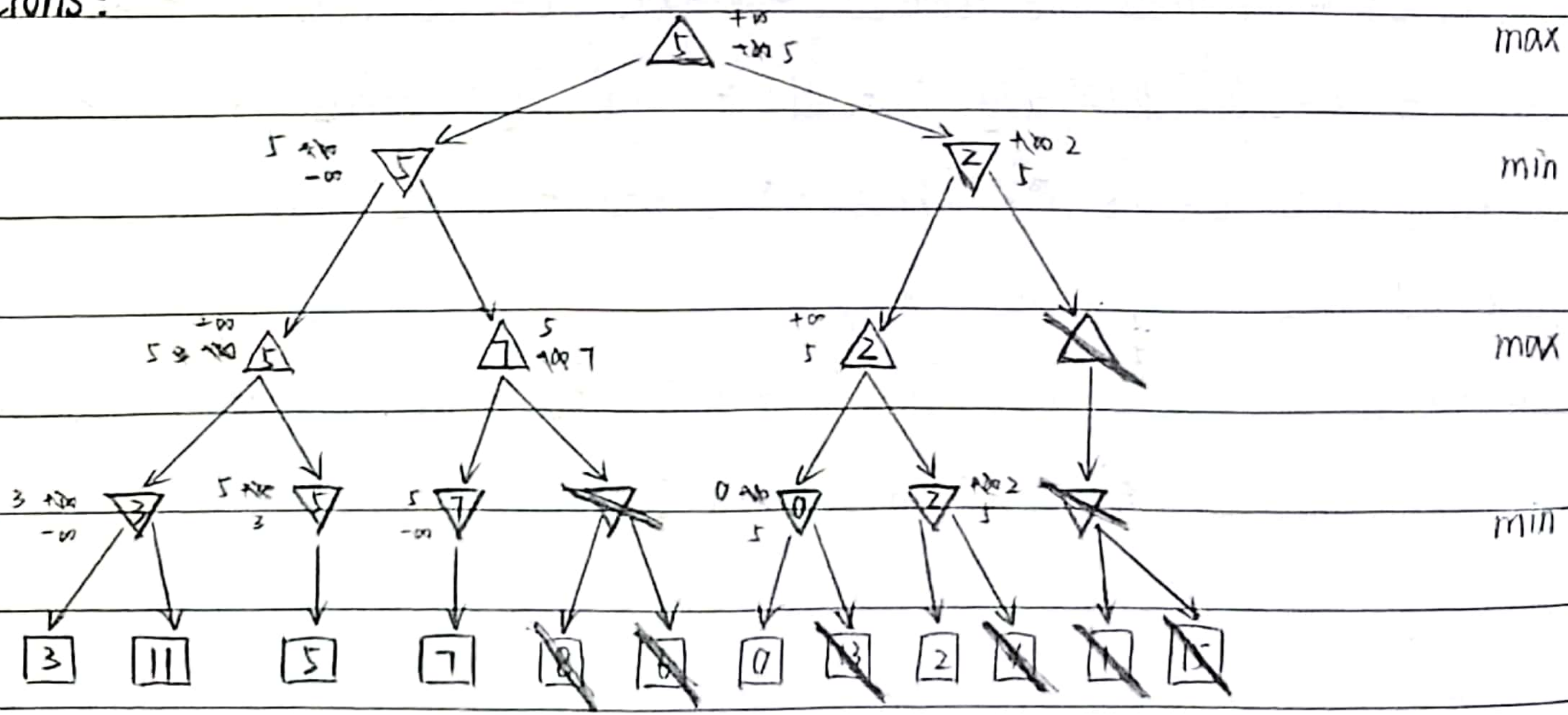
d. As ~~show~~ is shown in the tree, the best starting move is circled at depth ~~1. at right.~~ 1 on the right.

e. When applying alpha-beta pruning, the pruned nodes are shown in the tree at depth 2 if the nodes are generated in the optimal order.


max.
1
min.
-1
-2
1
1
0
0
1
-1
-1
-2
0
0
-1
2
1

Problem 5.

Solutions:



The pruned nodes are crossed out as above.