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Artificial intelligence Homework2

1 Problem 3.9

The representation can be a three-tuple of integers which listing the number of missionaries, cannibals and boats on the begin side. The presentation can be written as:

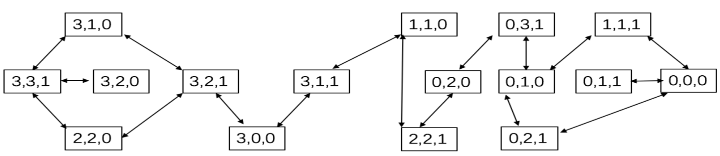
$$[\boldsymbol{m_1}, \boldsymbol{c_1}, \boldsymbol{b_1}]$$

Where $\boldsymbol{m_1}$ represents the number of missionaries, $\boldsymbol{c_1}$ represents the number of cannibals and $\boldsymbol{b_1}$ is the number of boats on the begin side.

It's obvious that:

- initial state: $[\mathbf{3}, \mathbf{3}, \mathbf{1}]$
- goal state: $[\mathbf{0}, \mathbf{0}, \mathbf{0}]$
- The cost function is 1 for each step
- The successors of a state are all the states that 1 or 2 people and 1 boat leave from one side to another

The complete state space can be show as follow:



The complete state space for this problem

2 Problem 3.21

a

When all step costs are equal, $g(n) \propto depth(n)$, so uniform-cost search reproduces breadth-first search.

b

- Breadth-first is best-first search with $f(n) = depth(n)$
- Depth-first search is best -first search with $f(n) = -depth(n)$
- Uniform-first search is best-first search with $f(n) = g(n)$

c

Uniform-cost search is A^* search with $h(n) = 0$

3 Problem 3.26

a. The branching factor is 4.

b.The state at depth k form a square rotated at 45 degrees to the grid. So the answer is $4k$

c. WIthout repeated state checking, BFS expands exponentially many nodes, we can computed the exact number :

$$\frac{4^{x+y+1}-4}{3}$$

d.There are quadratically many states within the square for depth $x+y$, the answer is :

$$2(x+y)(x+y+1)-1$$

e.The statement is true, because it's manhattan distance metric.

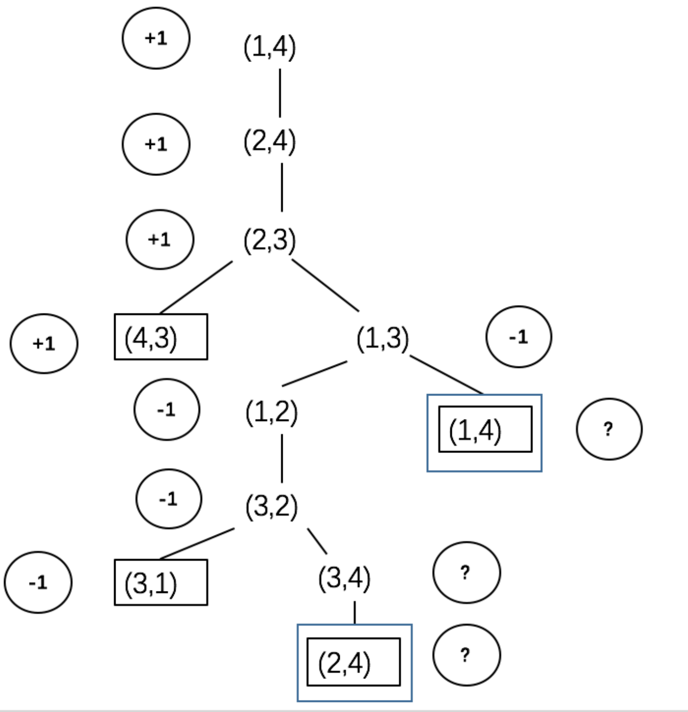
f.When $h(n) = 0$, since all steps costs are equal, A^* graph search and breadth-first graph search are equal, there are $2(x+y)(x+y+1)-1$ nodes.

g.Removing links may induce detours, which require more steps, so h is an underestimate. So h is still admissible.

h.Nonlocal links can reduce the actual path length below the Manhattan distance, so h is may not admissible.

4 Problem 5.8

a. The complete game tree based on the principle can be draw as :



The complete game tree

b. The "?" values are handed by assuming that an agent with a choice between winning the game and entering a "?" state. We will always choose to win. So $\mathbf{min}(-1, ?) = -1$ In the same way, we can get that $\mathbf{max}(+1, ?) = +1$

c. Standard minimax is depth-first and will go into an infinite loop. It can be fixed by comparing the current state against the stack and if the state is repeated, then return a "?" value, just as drawed in the figure in a.

d. When n = 3, it's a loss for A, and the case for n=4 is a win for A.

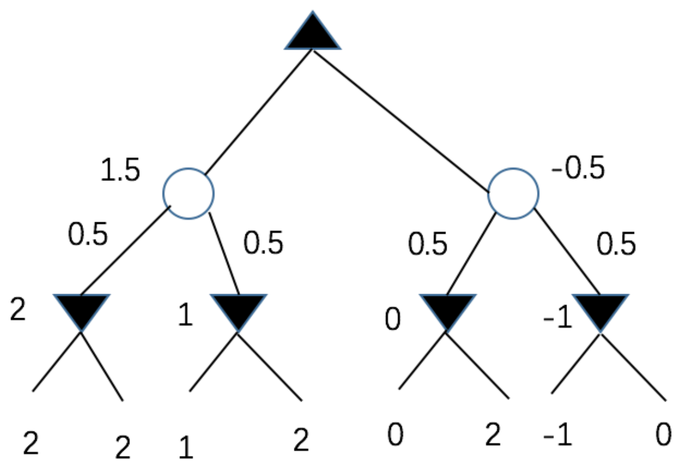
For any $n > 4$, the problem can be engaged in a subgame if n-2 on the square $[2, \ldots, n-1]$. It's clear that if n-2 is win for A, then the game n is also win for A. By the same line of reasoning, if n-2 is win for B ,then the game n is also win for B.

It's obvious that the player who slated to win the subgame n-2 will never move back to his home square. So we can see that a subgame of $n - 2k$ is played on step closer to the loser's home square. All the problem can be turned into the situation for $n = 3$ and $n = 4$

So we can prove that A wins if n is even and loses if n is odd.

5 Problem 5.16

a. The complete game tree for trivial game can be draw as follow:



The complete game tree for trivial game

b.

- Given nodes 1 6, we would need to look at 7 and 8. If they are both $+\infty$ then the values of the min node and chance node above would be $+\infty$ and the best move will change.
- Given nodes 1 7, we do not need to look at 8, even if it is $+\infty$, the min node can not be worth more than -1. So the chance node above can not be worth more than -0.5, the best move will not change.

c.

- The worst case is if either of the third and fourth leaves is -2, in which case, chance node above is 0.
- The best case is where they are both 2, the chance node has value 2. So it must lie between 0 and 2.

d. See the figure in a