Permutation game

lenabantzi 5 months ago

please some help for beginners in game theory!!i can't get into the logic of the problem..i read some solutions from leaderboard but i still can't..I really want to learn solve game theory problems but they look really difficult..

3 | Add Comment Permalink

robinyu 5 months ago

Game theory problems are not so difficult if you undertand the logic. But you need to understand the meaning of "perfect play".

Let's consider first a simpler problem:

Alice and Bob plays a game. They have an integer 10, and each move they can subtract from it 1, 2, or 3, as long as the result is not negative. Alice goes first. Whoever cannot make a move loses. If they play optimally, who will win?

So how to approach it? Let's consider it this way.

If the number is already 0, obviously whoever is playing at the time will lose, since can't make any more moves. So this is a "losing position" to whoever has the turn at the time.

If the number is 1, whoever has the turn can only subtract it by 1. Now the number is 0, and then by our definition the other player will lose. So this is a "winning position" to whoever has the turn at the time.

If the number is 2, whoever has the turn has two choices, subtract by 1 or subtract by 2. If he subtract by 1, then the number becomes 1, which is a "winning position" for the other player. So, the player who has 2 will lose. But wait, if he subtract by 2, then the number becomes 0, which is a "losing position" for the other player. So, since everyone "plays optimally", they will pick the better choice and subtract by 2, causing the player right now to win. So this is a "winning position" to whoever has the turn at the time.

If the number is 3, it's the same, whoever has the turn can subtract 1, 2, or 3. Now it's obvious, that whoever has the turn will subtract by 3 and then he will win. So this is a "winning position" to whoever has the turn at the time.

If the number is 4, whoever has the turn can subtract 1, 2, or 3. It's clear by now that no matter what he does, it will become a "winning position" for the other player, so this position is considered a "losing position". And so on, until 10.

So, for such game theory problems, we can simply calculate the "winning" and "losing" positions. The same can be done for this problem, calculate which sequences are considered "winning" and which ones are considered "losing". If the initial sequence is a "winning" sequence, Alice wins, if not, then Bob wins.

The rule of thumbs for game theory problem: Losing positions lead only to winning positions. Winning positions lead to at least one losing position. So that's the meaning of "perfect play".

The calculation of these positions can be done quite easily by using a recursion with DP memoization, but the implementation details are too specific and will take up lots of space here. So, that's left for you to try :)

16 Add Comment Parent Permalink

lenabantzi 5 months ago

Thank's a lot for your response!It's very useful,but why winning positions lead to at least one losing position and not only to losing potition? Do you have in mind a good tutorial-examples for dp?

2 Add Comment Parent Permalink

robinyu 5 months ago

We define a "losing position" as a position, where, no matter how well the player plays, he will lose if the other one will play optimally.

Likewise, we define a "winning position" as a position, where, if the player plays optimally, he will be guaranteed to win no matter how well the other player plays.

So if we have a "losing position", it should only lead to "winning position". Why? It's because, from there, if he can go to another "losing position", then the other player will lose, which means that it is actually a "winning position", not a losing one.

Now, if we have a "winning position", it should lead to at least one "losing position". It doesn't matter if it's only one or it's all, but there needs to be at least one. Then, the player will play optimally and go to the "losing position", so the other player will lose.

As for DP, it's quite a hard topic to master, I still have lots of troubles with it until now. But there are a lot of tutorials on the internet, like these ones:
- http://www.codechef.com/wiki/tutorial-dynamic-programming
- https://www.topcoder.com/community/data-science/data-science-tutorials/dynamic-programming-from-novice-to-advanced/

But you can't learn DP problems only by reading. It's easiest to learn by practicing it, and that's the reason we have HackerRank.

7 Add Comment Parent Permalink

siva_krishna about a month ago

What is the time limit for this problem?. My solution is accepted but it is taking 9.76s for one of the test cases.

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musazaim Asked to answer about a month ago

Did you try memoization?

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siva_krishna about a month ago

Yes. I have used memoization while solving.

0 | Add Comment Parent Permalink

ASRB7 about a month ago

hmmmm.....

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khannaboy 3 months ago

i understand that this could be solved using the minmax strategy and memoizing the values to avoid unnecessary recursion. Could someone please come up with a working editorial to this? thanx

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khannaboy 3 months ago

i am using recursion, memoization and minimax concept. I know that this works as I get the first test case running. But others get a time-out. What could be a way to circumvent that ?

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rishi2893 4 months ago

Please put up the editorial for this problem!!!

0 | Add Comment Permalink

gauthamk 7 months ago

If the outcome of the game is the largest increasing subsequence, which is "1,4" in second testcase having n = 5, shouldn't the winner by Alice?

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ubiquitousSurge 6 months ago

"For the second example, if 4 is removed then the only way to have an increasing sequence is to only have 1 number left, which would take a total of 4 moves, thus allowing Bob to win." Since Bob is playing optimally, he will recognize this and remove the 4 on his first turn. Thus "1,4" will not be a correct ending to this game.

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