

CSC 226: Summer 2018: Lab 8

July 11, 2018

1 Coins-in-a-line

Rules of the game:

- It is a two person game.
- There would be n coins in a line, where n is an even number. Each coin has a value.
- Each player can take one coin, but from either end.
- At the end, the player who has more money wins.

1.1 Play the Game

Let's divide in pairs and play the game. If you don't have coins, you can draw coins on a paper and assign values to them.

1.2 Play to Win

- Suppose you are player 1. Think of an algorithm/strategy so that you can always win. How about a greedy algorithm? **Ans:** A greedy strategy would be to choose the maximum value coin from the two end coins.
- Can you find an example where the greedy strategy won't work? **Ans:** 7, 3, 13, 19, 17, 5, 23, 11.
- What about a dynamic programming algorithm? Apply your algorithm to a line of coins with the following values from left to right: 6, 5, 2, 7, 3, 5.
Ans: Suppose $M_{i,j}$ be the maximum total value of coins taken by Player 1 from the coins numbered from i to j , assuming Player 2 plays optimally. Then Player 1 is looking for $M_{1,n}$.

Let the values of the coins numbered $1, 2, \dots, n$ be $V[1], V[2], \dots, V[n]$.

$$M_{i,j} = \begin{cases} V[i] & \text{if } i = j; \\ \max\{V[i], V[i+1]\} & \text{if } j = i+1; \\ \max\{\min\{M_{i+1,j-1}, M[i+2, j]\} + V[i], \min\{M_{i+1,j-1}, M[i, j-2]\} + V[j]\} & \text{otherwise} \end{cases}$$

The table for the sequence 6, 5, 2, 7, 3, 5 is given below.

i/j	1	2	3	4	5	6
1	6	6	8	11	11	18
2		5	5	9	12	10
3			2	7	5	12
4				7	7	10
5					3	5
6						5