Problem 1 Solution: Bamboozling Big Oil

By Sacheth Sathyanarayanan

The main idea to solve this problem is to use dynamic programming. For those unfamiliar with the concept, the idea is that we will come up with a general problem that can be indexed by some number (where a smaller index means an "easier" problem) and then use the answer to "easier" problems to calculate the answer to "harder" problems. If you're familiar with recursion, you can think of dynamic programming as recursion, but storing the answers to each recursive call so you never make the same call twice.

In this problem, for every index i, we keep track of $\texttt{maxCost}[i]$, the maximal cost we can attain assuming the existence of only the first i oil sites. We claim that the following always holds:

$$\texttt{maxCost}[i] = \max\left(\texttt{maxCost}[i-1], \texttt{maxCost}[i-2] + \texttt{cost}[i]\right)$$

This recursive function comes from the fact that if we drill at site $i-1$, then we cannot drill at site i and so the maximum total cost is $\texttt{maxCost}[i-1]$. On the other hand, if we do not drill at site $i-1$, then we can drill at site i and the maximum we could have is $\texttt{maxCost}[i-2] + \texttt{cost}[i]$. This recursion, combined with the fact that $\texttt{maxCost}[0] = \texttt{cost}[0]$ and $\texttt{maxCost}[1] = \max\left(\texttt{cost}[0], \texttt{cost}[1]\right)$ gives us a technique to find $\texttt{maxCost}[n-1]$, the desired quantity.

Time Complexity: If we start calculating `maxCost` starting from index zero, then each calculation takes constant time. Thus, the runtime of the algorithm is $O(n)$.

Space Complexity: We need space linear in n to store the `maxCost` array.

Plaudits

- Congrats to Alex Zhang (COS '24), Bill Ao (COS '24), and Eric Ahn (ORF '24) for submitting a solution in a lightning-fast 8 minutes and 22 seconds! This submission won them the prize for the overall fastest solution.
- Ian Henriques '25/Minjae Kwon '25/Anna Krokhine (MAT '24), Kevin Chen (COS '24)/Darius Jankauskas (COS '24)/Ben Shi (COS '24), Arya Maheshwari (MAT '25)/Rebecca Zhu (COS '25)/Ijay Narang (COS '25), and Samyak Gupta (grad) for also submitting extremely fast solutions (under fifteen minutes)!

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