Problem 3562: Maximum Profit from Trading Stocks with Discounts

Problem Information

Difficulty: Hard
Acceptance Rate: 21.80%
Paid Only: No
Tags: Array, Dynamic Programming, Tree, Depth-First Search

Problem Description

You are given an integer `n`, representing the number of employees in a company. Each employee is assigned a unique ID from 1 to `n`, and employee 1 is the CEO. You are given two **1-based** integer arrays, `present` and `future`, each of length `n`, where:

* `present[i]` represents the **current** price at which the `ith` employee can buy a stock today. * `future[i]` represents the **expected** price at which the `ith` employee can sell the stock tomorrow.

The company's hierarchy is represented by a 2D integer array `hierarchy`, where `hierarchy[i] = [ui, vi]` means that employee `ui` is the direct boss of employee `vi`.

Additionally, you have an integer `budget` representing the total funds available for investment.

However, the company has a discount policy: if an employee's direct boss purchases their own stock, then the employee can buy their stock at **half** the original price (`floor(present[v] / 2)`).

Return the **maximum** profit that can be achieved without exceeding the given budget.

Note:

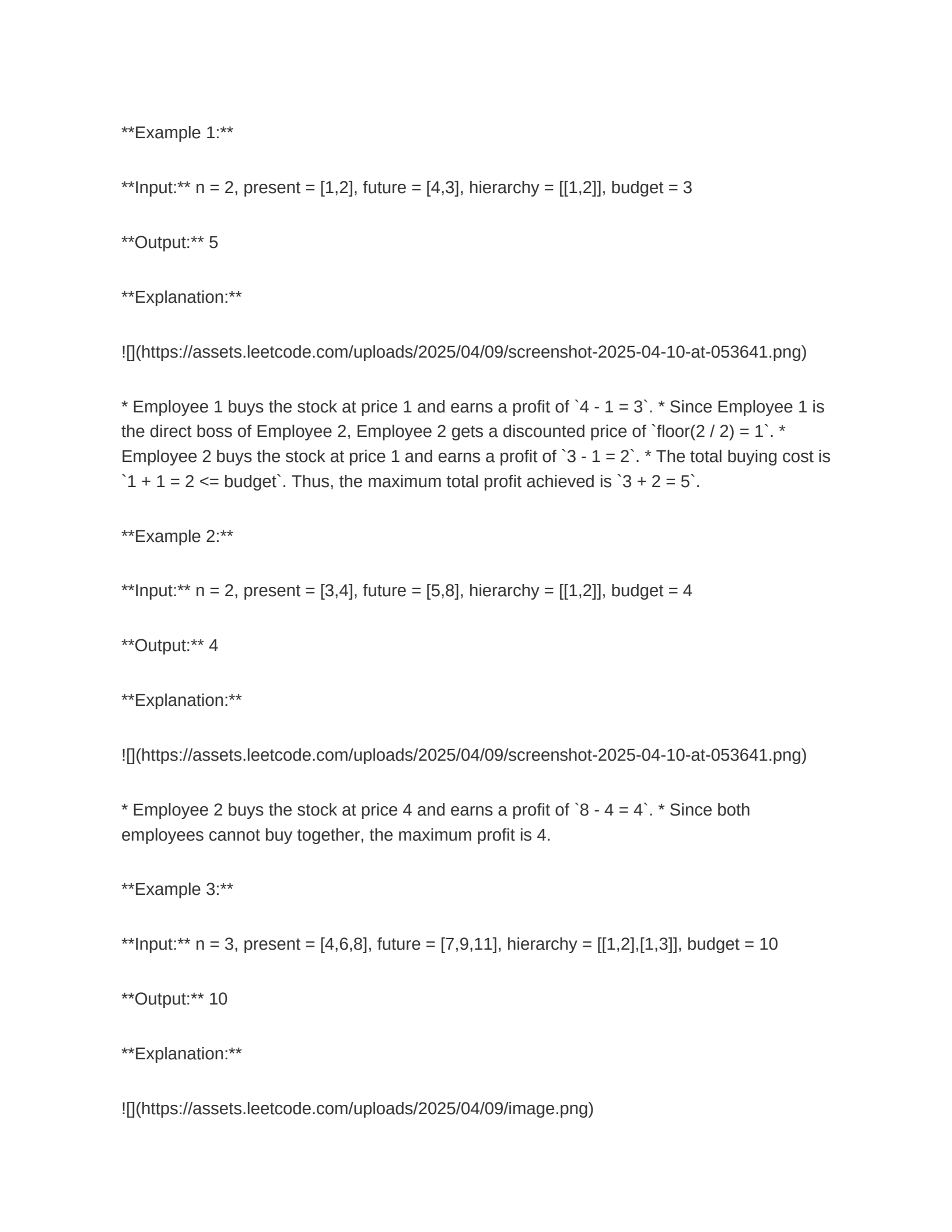
* You may buy each stock at most **once**. * You **cannot** use any profit earned from future stock prices to fund additional investments and must buy only from `budget`.

Example 1:

Input: n = 2, present = [1,2], future = [4,3], hierarchy = [[1,2]], budget = 3

Output: 5

Explanation:



* Employee 1 buys the stock at price 1 and earns a profit of `4 - 1 = 3`. * Since Employee 1 is the direct boss of Employee 2, Employee 2 gets a discounted price of `floor(2 / 2) = 1`. * Employee 2 buys the stock at price 1 and earns a profit of `3 - 1 = 2`. * The total buying cost is `1 + 1 = 2 <= budget`. Thus, the maximum total profit achieved is `3 + 2 = 5`.

Example 2:

Input: n = 2, present = [3,4], future = [5,8], hierarchy = [[1,2]], budget = 4

Output: 4

Explanation:

* Employee 2 buys the stock at price 4 and earns a profit of `8 - 4 = 4`. * Since both employees cannot buy together, the maximum profit is 4.

Example 3:

Input: n = 3, present = [4,6,8], future = [7,9,11], hierarchy = [[1,2],[1,3]], budget = 10

Output: 10

Explanation:

* Employee 1 buys the stock at price 4 and earns a profit of `7 - 4 = 3`. * Employee 3 would get a discounted price of `floor(8 / 2) = 4` and earns a profit of `11 - 4 = 7`. * Employee 1 and Employee 3 buy their stocks at a total cost of `4 + 4 = 8 <= budget`. Thus, the maximum total profit achieved is `3 + 7 = 10`.

Example 4:

Input: n = 3, present = [5,2,3], future = [8,5,6], hierarchy = [[1,2],[2,3]], budget = 7

Output: 12

Explanation:

* Employee 1 buys the stock at price 5 and earns a profit of `8 - 5 = 3`. * Employee 2 would get a discounted price of `floor(2 / 2) = 1` and earns a profit of `5 - 1 = 4`. * Employee 3 would get a discounted price of `floor(3 / 2) = 1` and earns a profit of `6 - 1 = 5`. * The total cost becomes `5 + 1 + 1 = 7 <= budget`. Thus, the maximum total profit achieved is `3 + 4 + 5 = 12`.

Constraints:

* `1 <= n <= 160` * `present.length, future.length == n` * `1 <= present[i], future[i] <= 50` * `hierarchy.length == n - 1` * `hierarchy[i] == [ui, vi]` * `1 <= ui, vi <= n` * `ui != vi` * `1 <= budget <= 160` * There are no duplicate edges. * Employee 1 is the direct or indirect boss of every employee. * The input graph `hierarchy `is **guaranteed** to have no cycles.

Code Snippets

C++:

```
class Solution {
public:
int maxProfit(int n, vector<int>& present, vector<int>& future,
vector<vector<int>>& hierarchy, int budget) {

}
};
```

Java:

```
class Solution {
public int maxProfit(int n, int[] present, int[] future, int[][] hierarchy,
int budget) {

}
}
```

Python3:

```
class Solution:
def maxProfit(self, n: int, present: List[int], future: List[int], hierarchy:
List[List[int]], budget: int) -> int:
```