CS 374 HW 5 Problem 1

quddus2, Aldo Sanjoto, Hieu Huynh

TOTAL POINTS

77.5 / 100

QUESTION 1

1 1A 70 / 70

✓ - 0 pts Correct

- 5 pts Incorrect description of the memoization data structure
- 15 pts [BASE CASE] Incorrect base case(s)
- 5 pts [BASE CASE] Minor mistake in base case, like a typo or an off-by-one error
- 20 pts [ORDER] Incorrect evaluation order; a clear picture is usually sufficient. If you use nested loops, be sure to specify the nesting order.
- 5 pts [ORDER] Minor mistake in order, like a typo or an off-by-one error
- 20 pts [UPDATE] Incorrect update in the loop
- 5 pts [UPDATE] Minor mistake in updates.
- 10 pts [UPDATE] Major mistake in updates.
- 5 pts Missing or incorrect description of RETURN statement to get the final answer.
- 5 pts Incorrect time analysis
- + 5 pts BONUS: For CORRECT algorithms FASTER than those in the solutions
- 5 pts For CORRECT algorithms SLOWER than those in the solutions
- 70 pts We are unable to follow the logic of the answer, or the answer is just way too long. In the future, you might want to consider using "IDK"
- 70 pts The answer is unreadable
- 52.5 pts IDK
- 10 pts For minor mistake
- 20 pts For major mistake
- 30 pts We are unable to follow the logic of the answer, or the answer is just way too long. In the future, you might want to consider using "IDK"
- 30 pts The answer is unreadable

✓ - 22.5 pts IDK

QUESTION 2

2 1B 7.5 / 30

- 0 pts Correct
- 30 pts Incorrect modification to the dynamic programming solution
- 5 pts For printing unnecessary content

(Q1)

a) Let $Opt(i,j)$ denote the total minimum energy to break a pile of book $[\![i \dots j]\!]$. This function obeys the following recurrence:

$$Opt(i,j) = \begin{cases} 0 & \text{if } i \geq j \\ \sum_{l=i}^{j} we + \min_{i \leq k < j} \{ Opt(i,k) + Opt(k+1,j) \}, & \text{otherwise} \end{cases}$$

- Let define $F(i,j) = \sum_{l=i}^{j} we$.

$$\Rightarrow F(i,j) = \begin{cases} wi, & \text{if } i = j \\ F(i,j-1) + wj & \text{; otherwise} \end{cases}$$

It takes $O(n^2)$ to compute all posible values of $F(i,j)$.

```
Init F(W[w1 ... wn]){        // where W is the array with the weight
    for i ← 1 to n:
        F[i, i-1] ← 0
        for k ← i to n:
            F[i,k] ← F[i, k-1] + W[k]
}
```

After calculation all possible values of $F(i,j)$, we have:

$$Opt(i,j) = \begin{cases} 0 & \text{if } i \geq j \\ F(i,j) + \min_{i \leq k < j} \{ Opt(i,k) + Opt(k+1,j) \}, & \text{Otherwise} \end{cases}$$

- We need to calculate $Opt(1,n)$
- We can memorize the function $Opt(i,j)$ into an array $A[1 \ldots n, 1 \ldots n]$. Each entry $A[i,j]$ is the minimum energy to break a pile of book $[i,j]$.
- We have $A[i,j]$ depend on entries below it and entries on the left of it. We can fill the array row by row from the bottom up, traversing each row from right to left.

```
Calculate_min_energy(W[w1 ... wn])
    Init F(W[w1 ... wn])
    A[1..n, 1..n]                          // Base cases
    For i ← 1 to n {
        For j ← 1 to i {
            A[i,j] = 0
        }
    }
    For i ← n-1 to 1 {
        For j ← n to i+1 {
            A[i,j] ← ∞
            For k ← i to (j-1) {
                A[i,j] = min(A[i,j], A[i,k] + A[k+1,j]);
            }
        }
        A[i,j] = A[i,j] + F[i,j];
    }
    return A[1,n];
}
```

• Running time Analysis:

- Initialize F takes $O(n^2)$ time
- Initialize base cases takes $O(n^2)$ time
- To calculate each entry $A[i,j]$, it take $O(n)$ time.

We have n^2 entries $\Rightarrow$ Fill all entries take $O(n^3)$ time

$\Rightarrow$ Total running time take $O(n^3)$.

1 1A 70 / 70

✓ - 0 pts Correct

- 5 pts Incorrect description of the memoization data structure
- 15 pts [BASE CASE] Incorrect base case(s)
- 5 pts [BASE CASE] Minor mistake in base case, like a typo or an off-by-one error
- 20 pts [ORDER] Incorrect evaluation order; a clear picture is usually sufficient. If you use nested loops, be sure to specify the nesting order.
- 5 pts [ORDER] Minor mistake in order, like a typo or an off-by-one error
- 20 pts [UPDATE] Incorrect update in the loop
- 5 pts [UPDATE] Minor mistake in updates.
- 10 pts [UPDATE] Major mistake in updates.
- 5 pts Missing or incorrect description of RETURN statement to get the final answer.
- 5 pts Incorrect time analysis
+ 5 pts BONUS: For CORRECT algorithms FASTER than those in the solutions
- 5 pts For CORRECT algorithms SLOWER than those in the solutions
- 70 pts We are unable to follow the logic of the answer, or the answer is just way too long. In the future, you might want to consider using "IDK"
- 70 pts The answer is unreadable
- 52.5 pts IDK

Q1b.

IDK

2 1B **7.5 / 30**

- **0 pts** Correct
- **30 pts** Incorrect modification to the dynamic programming solution
- **5 pts** For printing unnecessary content
- **10 pts** For minor mistake
- **20 pts** For major mistake
- **30 pts** We are unable to follow the logic of the answer, or the answer is just way too long. In the future, you might want to consider using "IDK"
- **30 pts** The answer is unreadable

✓ - **22.5 pts** **IDK**