

## CS 170 Homework 5

Due 3/1/2022, at 10:00 pm (grace period until 11:59pm)

### 1 Study Group

List the names and SIDs of the members in your study group. If you have no collaborators, you must explicitly write “none”.

### 2 Copper Pipes

Bubbles has a copper pipe of length  $n$  inches and an array of nonnegative integers that contains prices of all pieces of size smaller than  $n$ . He wants to find the maximum value he can make by cutting up the pipe and selling the pieces. For example, if length of the pipe is 8 and the values of different pieces are given as following, then the maximum obtainable value is 22 (by cutting in two pieces of lengths 2 and 6).

length	1	2	3	4	5	6	7	8
price	1	5	8	9	10	17	17	20

Give a dynamic programming algorithm so Bubbles can find the maximum obtainable value given any pipe length and set of prices. Clearly describe your algorithm, prove its correctness and runtime.

### 3 Egg Drop

You are given  $k$  identical eggs and an  $n$  story building. You need to figure out the highest floor  $\ell \in \{0, 1, 2, \dots, n\}$  that you can drop an egg from without breaking it. Each egg will never break when dropped from floor  $\ell$  or lower, and always breaks if dropped from floor  $\ell + 1$  or higher. ( $\ell = 0$  means the egg always breaks). Once an egg breaks, you cannot use it any more. However, if an egg does not break, you can reuse it.

Let  $f(n, k)$  be the minimum number of egg drops that are needed to find  $\ell$  (regardless of the value of  $\ell$ ).

- (a) Find  $f(1, k)$ ,  $f(0, k)$ ,  $f(n, 1)$ , and  $f(n, 0)$ .
- (b) Find a recurrence relation for  $f(n, k)$ . *Hint: Whenever you drop an egg, call whichever of the egg breaking/not breaking leads to more drops the “worst-case event”. Since we need to find  $\ell$  regardless of its value, you should assume the worst-case event always happens.*