CMSC 401 – Fall 2023

Assignment 4
(due Tue, 12/12 – 11:59pm)

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CMSC 401- Algorithm Analysis with Advanced Data Structures

Minimum Cost Rod Cutting

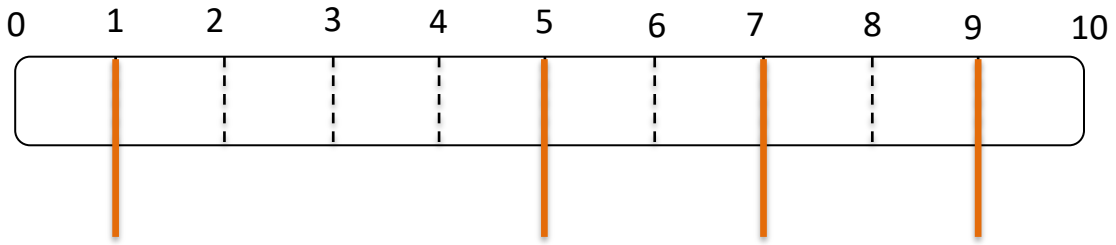
- You are given a rod that is N inches long and a set of M cutting points on the rod.
- You will need to cut the rod from these M points.
  - You can **only cut from** these points.
- You can perform the cuts in any order of these points.
- After a cut, rod gets divided into two smaller sub-rods.
- The **cost** of making a cut is the **length of the current sub-rod in which you are making a cut on**.
- Your goal is to **minimize** the total cost of cutting.
- Output will show only the minimum cost.

Assignment 4

- Write a program CMSC401_A4.java that reads the size of the rod and cutting points in the format below:

- The size of the rod, N, in the first line. N>=2, N<=100
- The number of cutting points, M, in the second line. M>=1, M<=N-1
- The location of each of M distinct cutting points (will be >0 and <N)
  - Only integer values (will be given in increasing order)

```
10
4
1
5
7
9
```



Cutting points

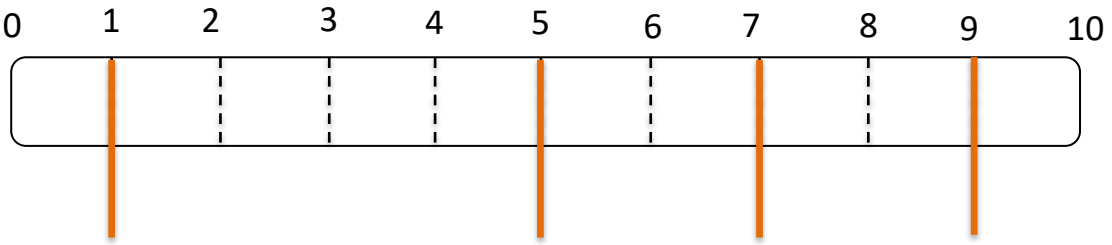
Example

Input in correct format

```
10
4
1
5
7
9
```

Correct output

23



Cutting points

Order	Cost
1) Cutting at 5:	10
2) Cutting at 1:	5
3) Cutting at 7:	5
4) Cutting at 9:	3
Total Cost:	23

An order of cutting points that gives the min cost is 5,1,7,9 (there are also others giving the same minimum, e.g., 5,7,9,1)

Bad cut example: Cutting in the order of 1,5,7,9 which has cost 10+9+5+3=27.

Hint

- Define the problem in terms of cutting the rod from one cutting point to another one
  - C(i,j) = cost of cutting the rod from point i to point j
- Find the **recursive formula**
- Apply a dynamic programming method
- Algorithm should have $O(M^3)$ complexity
  - M: number of cutting points
  - Complexity should NOT depend on N, the length of rod.
    - You will get lower grade if it does or if you have a larger complexity in general.
  - **Solutions** like finding the cutting point closest to middle of the rod or selecting the median of cutting of points etc. will not work always (Do not use these!!!).
    - Ex: with points 3,5,6 on a rod of size 10. Selecting in order of 5,3,6 yields 10+5+5=20 cost, while optimal is obtained with order 6,3,5 which gives 10+6+3=19.

Submission

- Date due: Tue, Dec 12th, 11:59 pm

- Submission through Canvas
  - Just submit the single Java source code file CMSC401_A4.java
    - **No need to zip. Don't worry about "-1", "-2" added to your file by Canvas for new versions.**
    - The file should have *your name* in a comment in the first line
    - Remember: in Java, class name should match the file name, and is case sensitive

- Please do NOT create your own packages
- Use standard I/O to read input (System.in, System.out) and output
- Make sure the **program compiles and WORKS!**
- Late submissions are accepted up to 2 days only with penalties!

(If you have a special accommodation, let me know if you will use it at least 24 hours before the deadline)