C++ Programming

1D Arrays Homework 2

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Teaching, Training and Coaching since more than a decade!

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Homework 9: Recamán's sequence

- Sequence is a series of numbers. The first terms are 0, 1, 3, 6, 2, **7**, …
  - So last term **value** is 7 and its **index** is 5 (zero based)
  - The next value is either:
    - **Last value-last index-1** if 2 conditions satisfied
      - It is > 0
      - It did not appear before
      - E.g. 7 (last value) - last index (5) - 1 = 7-5-1 = 1 (> 0 but already exists
    - Or last **value+last index+1** = 7+5+1 = 13
- Read integer index ([0, 200]) and print the value of this index
  - E.g. (6 ⇒ 13), (9 ⇒ 21), (17 ⇒ 25)
- Don’t use nested loops
- The series is: 0, 1, 3, 6, 2, 7, **13**, 20, 12, **21**, 11, 22, 10, 23, 9, 24, 8, **25**, 43

Homework 10: Fixed sliding window

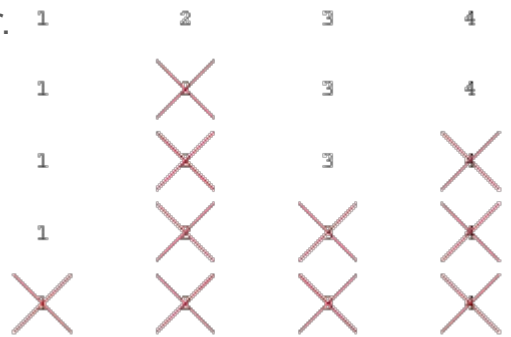
- Read Integers K and N, (where K <= N). then read N <= 200 integers. Then find a sub-array of K elements that has maximum sum.
- Input 3 7 1 0 3 -4 2 -6 9
  - Let's list all sub-arrays of length 3
  - 1 0 3 ⇒ sum = 4
  - 0 3 -4 ⇒ sum = -1
  - 3 -4 2 ⇒ sum = 1
  - -4 2 -6 ⇒ sum = -8
  - 2 -6 9 ⇒ sum = 5
- Output: 4 6 5 (Sub-array from indices 4 to 6 has maximum sum of 5)
- Hard: Can you do without nested loops? There are 2 ways.

Homework 11: Count increasing subarrays

- Read an Integer N, then read N <= 200 integers. Count how many sub-arrays are increasing in the array. A sub-array is set of consecutive numbers in array
- E.g. If array is 1 2 3 4
  - We can find all sub-arrays of length 1 ⇒ 1 / 2 / 3 / 4
  - All sub-arrays of length 2 ⇒ 1, 2 / 2, 3 / 3, 4
  - All sub-arrays of length 3 ⇒ 1, 2, 3 / 2, 3, 4
  - All sub-arrays of length 4 ⇒ 1, 2, 3, 4
- Inputs ⇒ Outputs
  - 4 1 2 3 4 ⇒ 10 [10 sub-arrays from previous example, all are increasing]
  - 4 4 3 2 1 ⇒ 4 [only sub-arrays of length 1 can be considered]
  - 4 10 20 1 5 ⇒ 6
- Easy using 3 nested loops. Medium using 2 loops. Can you do it with 1 loop?

Homework 12: Josephus problem

- Read integers N (<= 200) and K (<= 1000000). Find the game winner for following game:
- We have a group of N people in Circle. They are numbered 1, 2, …. N
  - Someone is the master of the game.
  - He starts from Person #1. Count K. Then remove this person from the circle.
  - He keeps doing so till only 1 person remains. This is the winner.
- Input 4 2
  - Means we have people: 1, 2, 3, 4. Master starts at 1
  - Count 2 persons (2 removed), start from 3
  - Count 2 persons (4 removed), start from 1
  - Count 2 persons (3 removed), 1 is winner
- Output
  - People removed in order: 2 4 3 1 [same answer for 10 2 why?]



Homework 13: longest subarray

- Read integers N (<= 1000) then N numbers each is either 0 or 1. Find longest **subarray** with number of zeros = numbers of ones
  - You can easily implement it using 3 loops
  - Or with little thinking using 2 loops (even with no extra arrays)
  - Hard: You can implement it without any nested loops
- Inputs ⇒ outputs
  - 7 1 0 0 0 1 1 1 ⇒ 6 (e.g. 100011 or 000111)
  - 19 1 0 0 0 0 0 1 0 1 1 0 1 0 0 0 0 0 0 1 ⇒ 8 (e.g. 00101101)
- Reduction
  - How may this problem be reduced to another problem: longest subarray of zero sum?

"Acquire knowledge and impart it to the people."

"Seek knowledge from the Cradle to the Grave."