

Indian National Olympiad in Informatics, 2013

Time: 3 hours

19 January, 2013

Instructions

- (a) You will have to return this question paper at the end of the examination with relevant parts filled out.
- (b) There are two questions. You have to write working programs in Pascal, C or C++ to solve each of these questions.
 - *Only your source code will be submitted for evaluation. Your program will be recompiled and run on the evaluation computer.*
 - *Make sure your C/C++ programs compile with the GNU C compiler (`dev-cpp`, `djgpp` or `Code::Blocks` under Windows). Programs written using Turbo C++ may not compile and run in the evaluation environment and may hence lose marks.*
If you work in C/C++, make sure you do not write `#include <conio.h>` in your program or use any functions defined in `conio.h`. If you do so, your program will not compile and you will get no marks.
- (c) At the end of each question, there is a space to indicate the location of the source code file for your solution. Please fill up this information without fail. Otherwise, your solution cannot be evaluated.
- (d) All input for your programs will come from the keyboard. All output from your programs should be written to the screen.
- (e) Please fill out your contact details on the reverse of this page as completely as you can. Use your serial number as reported in the ZIO/ZCO results page as your roll number for INOI. If you qualified under multiple categories, use the ZIO serial number as your roll number. Ask your centre supervisor if you do not know your roll number.
- (f) At the beginning of each program, include a comment with your name, roll number and the problem number. For instance, if your name is Sachin Tendulkar, your roll number is 107 and the problem you are writing a C/C++/Pascal program for is Problem 1, add a comment of the form

```
/* Sachin Tendulkar, 107, Problem 1 */
```

at the top of your file.

This will help us if files accidentally get mixed up when being sent from the exam centres to the evaluation centre.

...P.T.O.

Contact details	
Roll Number:	
Name:	
Home Address:	
	PIN Code
Phone Number(s): (with STD code)	
Email address:	

Question 1 Calvin's game

Calvin wakes up early one morning and finds that all his friends in the hostel are asleep. To amuse himself, he decides to play the following game : he draws a sequence of N squares on the ground, numbered 1 to N , and writes an integer in each square. He starts at square k ($1 \leq k \leq N$). The game consists of one *forward phase* followed by one *backward phase*.

- In the forward phase, Calvin makes zero or more moves of the following type : if his current position is p , he can jump to $p + 1$ or $p + 2$ as long as he stays within the N squares.
- In the backward phase, Calvin makes zero or more moves of the following type : if his current position is p , he can jump to $p - 1$ or $p - 2$ as long as he stays within the N squares.

He plays such that he finally ends up at square 1, and then he stops. He starts with a *score* of 0, and each time he jumps from square i to square j , he adds the integer written in square j to his score. Find the maximum score Calvin can obtain by playing this game. Recall that Calvin must start at square k and end at square 1. The integer on the square where he starts is not included in his score.

For example, suppose $N = 5$ and the numbers in squares are 5, 3, -2, 1, 1. If $k = 2$, Calvin starts on the second square. He can make a forward move to square 4, another to square 5, a backward move to square 4, another to square 2, and another to square 1. His total score is $1 + 1 + 1 + 3 + 5 = 11$. You can check that this is the maximum score possible.

Input format

- Line 1 : Two space-separated integers, N and k , with $1 \leq k \leq N$.
- Line 2 : A space-separated sequence of N integers, the numbers in squares $1, 2, \dots, N$.

Output format

A single line with a single integer, the maximum score Calvin can obtain by playing the game.

Test Data

The testdata is grouped into two subtasks with the following constraints on the inputs.

- Subtask 1 (30 marks) : $1 \leq N \leq 3000$.
- Subtask 2 (70 marks) : $1 \leq N \leq 10^6$.

In all subtasks, the number in each square is between -1000 and 1000 inclusive.

Example

Here is the sample input and output corresponding to the example above.

Sample input

```
5 2
5 3 -2 1 1
```

Sample output

```
11
```

Time and memory limits

The time limit for this task is 4 seconds. The memory limit is 128 MB.

Note: Your program should not print anything other than what is specified in the output format. Please remove all diagnostic print statements before making your final submission. A program with extraneous output will be treated as incorrect!

Important

Indicate the location of the source code file for your solution to Question 1 in the box below. *If you fail to do this, your solution cannot be evaluated!*

Source file:

Question 2 Sequence Land

N people live in Sequence Land. Instead of a name, each person is identified by a sequence of integers, called his or her id. Each id is a sequence with no duplicate elements. Two people are said to be each other's relatives if their ids have at least K elements in common. The *extended family* of a resident of Sequence Land includes herself or himself, all relatives, relatives of relatives, relatives of relatives of relatives, and so on without any limit.

Given the ids of all residents of Sequence Land, including its President, and the number K , find the number of people in the extended family of the President of Sequence Land.

For example, suppose $N = 4$ and $K = 2$. Suppose the President has id $(4, 6, 7, 8)$ and the other three residents have ids $(8, 3, 0, 4)$, $(0, 10)$, and $(1, 2, 3, 0, 5, 8)$. Here, the President is directly related to $(8, 3, 0, 4)$, who in turn is directly related to $(1, 2, 3, 0, 5, 8)$. Thus, the President's extended family consists of everyone other than $(0, 10)$ and so has size 3.

Input format

- Line 1 : Two space-separated integers, N followed by K .
- Lines 2 to $N + 1$: Each line describes an id of one of the residents of Sequence Land, beginning with the President on line 2. Each line consists of an integer p , followed by p distinct integers, the id.

Output format

The output consists of a single integer, the number of people in the extended family of the President.

Test Data

The testdata is grouped into two subtasks. In both subtasks, $1 \leq N \leq 300$ and $1 \leq K \leq 300$. Each number in each id is between 0 and 10^9 inclusive.

- Subtask 1 [30 points] : The number of elements in each id is between 1 and 10 inclusive.
- Subtask 2 [70 points] : The number of elements in each id is between 1 and 300 inclusive.

Example

Here is the sample input and output corresponding to the example above.

Sample input

```
4 2
4 4 6 7 8
4 8 3 0 4
2 0 10
6 1 2 3 0 5 8
```

Sample output

```
3
```

Time and memory limits

The time limit for this task is 2 seconds. The memory limit is 64 MB.

Note: Your program should not print anything other than what is specified in the output format. Please remove all diagnostic print statements before making your final submission. A program with extraneous output will be treated as incorrect!

Important

Indicate the location of the source code file for your solution to Question 2 in the box below. *If you fail to do this, your solution cannot be evaluated!*

Source file: