TRAINING COMPETITION OF THE BULGARIAN EXTENDED NATIONAL TEAM
Bankya, 17 June 2025
group G

Task GT3. TRICK

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Another year, another magic show from Harry the magician. The trick starts with a deck consisting of N identical cards that are numbered from 1 to N. The cards are initially with their backs on a table (their numbers are not visible). Harry marks the cards by also writing numbers from 1 to N on the backs. An assistant comes to the stage and the show begins in the following way:

- Harry puts the cards in B boxes and in each K cards are put ($N = B \times K$). (without flipping the cards)
- The assistant shuffles the cards in each box in random order.
- The assistant shuffles the boxes in random order.
- Harry asks the assistant what the order of the cards is now. The assistant checks all of them and writes down the real numbers of the cards in the first box, then the real numbers of the cards in the second box and so on.
- Finally the cards are returned with their backs on the table and Harry can repeat the process.

After some questions, Harry always guesses the cards.

Task

Write the program **`trick`** that helps Harry make the trick as fast as possible. After more than Q questions the crowd would get bored and will boo him, so there can be no more than Q questions.

Implementation details

Your function `trick` must have the following format:

```
std::vector <int> trick (int N, int B, int K);
```

It will be called once by the jury's program with three parameters - the number of cards, the number of boxes and the number of cards in each box. The function should return a list of numbers describing the real numbers of the cards in the order that Harry marked them from 1 to N.

The function for asking questions to the assistant has the following format:

```
std::vector <std::vector <int> > shuffle (std::vector
<std::vector <int> > boxes);
```

The parameter `boxes` describes the Harry's grouping of the N cards into B boxes with K cards. The result will be the real numbers of the cards in the boxes after the two shuffles by the assistant.

If the parameter `boxes` is not a valid grouping of the numbers from 1 ot N, you will get `Wrong answer` for the test and `Invalid question` verdict. You can call this function at most Q times (depending on the subtask), otherwise you will get `Wrong answer` and `Too many questions` verdict.

Your program **`trick.cpp`** must implement the function `trick`. It can also contain other code, functions, and global variables, but it must not contain the `main` function. Also, you should not read from the standard input or print to the standard output. Your program must include the header file `trick.h` by instruction to the preprocessor:

```
#include "trick.h"
```

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Constraints

- $6 \leq N \leq 1\,000$;
- $2 \leq B, K$ and $N = B \times K$.

Subtasks

Subtask	Points	N	B	K	Q	Other constraints
0	0	–	–	–	$= 2000$	The cards from the sample communication.
1	2	$= 6$	$= 2$	$= 3$	$= 100$	–
2	3		$= 3$	$= 2$	$= 100$	–
3	12	$\leq 1\,000$	–	–	$= 12$	The assistant won't shuffle the boxes.
4	16		$\frac{N}{2}$	$= 2$	$= 4$	–
5	15		$= 2$	$\frac{N}{2}$	$= 12$	–
6	52		> 2	> 2	$= 2000$	–

*The points for a subtask are given only if all tests for it are passed **successfully**, and the points are equal to the minimum test score in it multiplied by the points of the subtask.*

Scoring

Each test receives a score that is a fractional number between 0 and 1 inclusive. If a test has a positive score, it is considered **successful** for your solution. A test has a positive score if you successfully find the real numbers of the cards.

If cnt is the number of calls to the function `shuffle` for a particular test, then the score of the test is calculated in the following way:

- Subtasks $0 - 5$.
  - If $cnt \leq Q$, then the score is equal to 1.
  - If $Q < cnt$, then the score is equal to 0.
- Subtask 6.
  - If $cnt \leq 9$, then the score is equal to 1.
  - If $9 < q \leq 50$, then the score is equal to $\frac{22+30\times\left(\frac{50-q}{41}\right)^2}{52}$.
  - If $50 < q \leq 500$, then the score is equal to $\frac{17}{52}$.
  - If $500 < q \leq 2\,000$, then the score is equal to $\frac{8}{52}$.
  - If $2\,000 < q$, then the score is equal to 0.

Sample communication

Let we have 6 cards with real numbers $3, 1, 4, 5, 2, 6$ (in the order of 1 to N according to the markings on the backs), $B = 3$, $K = 2$ and $Q = 2000$.

Actions of your program	Actions and answers of the jury
	`trick(6,3,2)`
`shuffle({{1, 2}, {3, 4}, {5, 6}})`	`return {{6, 2}, {5, 4}, {3, 1}}`
`shuffle({{1, 3}, {2, 4}, {6, 5}})`	`return {{3, 4}, {5, 1}, {6, 2}}`
`return {3, 1, 4, 5, 2, 6}`	

Local testing

For local testing the following files are provided: `trick.h`, `Lgrader.cpp`, sample file `trick.cpp` for your program and the cards from the sample communication. When the provided files are in the same folder, you can compile together your program `trick.cpp` and `Lgrader.cpp`. This will make a program to check the correctness of your function.

The program will require from the standard input the following sequence of numbers:

- on the first line: five positive integers – the number of cards N, the number of boxes B, the number of cards in each box K, the maximum number of questions Q, and the subtask number S;
- on the second line: N positive integers which describe the real numbers of the cards in the order from 1 to N (by the marking of Harry).

If you don't follow the protocol for communication, you will get an appropriate error message. Otherwise, if the program is successful, you will get the message "Correctly guessed cards.".