IOI Training Camp 2010 – Test 1, 16 June, 2010

Problem 2 Radio telescope[1]

An astronomer is trying to analyze data reported by a radio telescope. The data from the radio telescope is a relentless stream of values that the astronomer must make sense of. The values that occur most frequently in any given interval are specially significant to the astronomer, so he wants to record them. His problem is that he is searching for an event of enormous significance, but is not sure exactly when it will occur, so he has to scan all possible intervals in the data reported by the radio telescope.

More precisely, the data from the telescope is a sequence of N values, each in the range $\{0, 1, \ldots, R-1\}$. The astronomer is interested in intervals of length K—that is all possible segments of length K in the input sequence. For each of these segments, he wants to identify the value that occurs most frequently in that segment, and the number of times that this value occurs. If more than one value occurs with the same frequency in a segment, he records any one.

For instance, suppose the data sequence is `[1 3 3 5 3 5 5]` and the astronomer is looking at intervals of length 5, then he will find that the most frequent value in the first segment of length 5, `[1 3 3 5 3]`, is 3, with frequency 3, the most frequent value in the next segment of length 5, `[3 3 5 3 5]`, is 3, with frequency 3, and the most frequent value in the last segment of length 5, `[3 5 3 5 5]`, is 5, with frequency 3.

Your task is to help the astronomer analyze his data efficiently.

Input format

The first line of input will contain three integers N, K and R, where N is the total number of events in the sequence, K is the length of the segments to be analyzed and R gives the range of values reported by the radio telescope. This is followed by N lines of inputs, each containing an integer in the range $[0..R-1]$ reported by the radio telescope.

[1] Problem formulated by Kshitij Bansal.

Output format

The output should consist of $N-K+1$ lines. Line i consists of two integers: the value that occurs most frequently in the segment $i, i+1, \ldots, i+K-1$ of the input and the number of times this value occurs in this segment. If more than one value appears with maximum frequency in an interval, report any one.

Test Data

You may assume that $1 \leq N \leq 6 \times 10^6$, $1 \leq K \leq 5 \times 10^5$ and $1 \leq R \leq 4 \times 10^4$. In 50% of the inputs, $1 \leq N \leq 5 \times 10^5$.

Example

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

Sample input

```
7 5 6
1
3
3
5
3
5
5
```

Sample output

```
3 3
3 3
5 3
```

Time and memory limits

The time limit for this task is 6 seconds, taking into account the large amount of input/output. The memory limit is 20 MB (actual limit 8 MB, plus 12 MB buffer for 64-bit compilation).