Programming Design, Spring 2014
Lab Exam 1

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Submission and grading. In this exam, there are two problems. You need to write a C++ program for each problem. 100% of your grades will be based on the correctness of your outputs. The online grading system will input in total 50 lines of testing data and then check your outputs. These 50 lines count for 100 points, i.e., 2 points for each set. Before the due time of the exam, you may upload your programs multiple times. Only the last one you upload will be graded. Unlike what happens with your homework, you will not see your scores during the exam.

To submit your work, please upload the two .cpp files, one for each problem, to the online grading system at http://lckung.im.ntu.edu.tw/PD/.

Just a reminder: Talking to any other person online, directly or indirectly, is definitely cheating.

Problem 1

(50 points) Given n values within 0 and 100, we would like to generate a frequency distribution for them. To do so, we first split the range $[0, 100]$ into ten intervals $[0, 10)$, $[10, 20)$, ..., and $[90, 100]$. Then we count the frequency of each interval, i.e., the number of values within an interval. Finally, we output the frequencies from the lowest interval to the highest interval. As an example, suppose you are give fifteen values

$$42, 42, 60, 70, 3, 11, 12, 41, 42, 85, 1, 2, 42, 90, 99,$$

then the frequencies can be summarized in the following table.

Interval	$[0, 10)$	$[10, 20)$	$[20, 30)$	$[30, 40)$	$[40, 50)$
Frequency	3	2	0	0	5
Interval	$[50, 60)$	$[60, 70)$	$[70, 80)$	$[80, 90)$	$[90, 100]$
Frequency	0	1	1	1	2

Input/output formats

The input consists of 25 lines. In each line, there are $n+1$ integers n, x_1, x_2, ..., and x_n, where $n \leq 1000$ and $0 \leq x_i \leq 100$ for all $i = 1, ..., n$. Two consecutive integers are separated by one white space. Your program should read these integers, prepare the frequency distribution, and then output the frequencies from the lowest interval $[0, 10)$ to the highest interval $[90, 100]$. Two consecutive integers in the output should be separated by a white space. After the last integer there should be a new line character.

For example, suppose we have

```
15 1 2 3 11 12 41 42 42 42 42 60 70 85 90 99
```

as a line of input, the output should be

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3 2 0 0 5 0 1 1 1 2
```

with a new line character appended at the end.

Problem 2

(50 points) Given a 7×7 matrix of integers $\{1, 2, 3, 4, 5\}$, we would like to find (1) the frequency of the most frequent integer and (2) the length of the longest vertical or horizontal consecutive sequence of identical integers. For example, for a matrix

$$
\begin{bmatrix}
1 & 1 & 2 & 2 & 3 & 3 & 4 \\
4 & 5 & 5 & 1 & 1 & 2 & 2 \\
3 & 3 & 3 & 3 & 1 & 1 & 1 \\
5 & 4 & 3 & 2 & 1 & 2 & 3 \\
4 & 5 & 1 & 2 & 1 & 4 & 3 \\
5 & 5 & 5 & 4 & 1 & 2 & 3 \\
4 & 3 & 2 & 3 & 3 & 3 & 5
\end{bmatrix},
$$

the most frequent integer is 3 with frequency 14. Moreover, the longest horizontal consecutive sequence is composed by the four 3s in the third row while the longest vertical one is composed by the five 1s in the fifth row. As the latter is the longest, the answers to this matrix are 14 (the frequency of the most frequent integer) and 5 (the length of the longest consecutive sequence).

Input/output formats

The input consists of 25 lines. In each line, there are exactly 49 integers x_1, x_2, ..., and x_{49}, where $x_i \in \{1, 2, 3, 4, 5\}$ for all $i = 1, ..., 49$. Two consecutive integers are separated by one white space. Your program should read these integers, prepare the matrix as

$$
\begin{bmatrix}
x_1 & x_2 & x_3 & x_4 & x_5 & x_6 & x_7 \\
x_8 & x_9 & x_{10} & x_{11} & x_{12} & x_{13} & x_{14} \\
x_{15} & x_{16} & x_{17} & x_{18} & x_{19} & x_{20} & x_{21} \\
x_{22} & x_{23} & x_{24} & x_{25} & x_{26} & x_{27} & x_{28} \\
x_{29} & x_{30} & x_{31} & x_{32} & x_{33} & x_{34} & x_{35} \\
x_{36} & x_{37} & x_{38} & x_{39} & x_{40} & x_{41} & x_{42} \\
x_{43} & x_{44} & x_{45} & x_{46} & x_{47} & x_{48} & x_{49}
\end{bmatrix},
$$

and then output the length of the longest consecutive sequence and a new line character.

For example, suppose we have[1]

$$1\ 1\ 1\ 1\ 1\ 1\ 1\ 2\ 2\ 2\ 2\ 3\ 3\ 3\ 4\ 4\ 4\ 4\ 5\ 5\ 5\ 1\ 1\ 1\ 1\ 2\ 2\ 2$$
$$3\ 3\ 3\ 4\ 4\ 4\ 4\ 1\ 2\ 3\ 4\ 5\ 1\ 2\ 3\ 4\ 5\ 1\ 2\ 3\ 4$$

as a line of input, the output should be[2]

$$14\ 7$$

with a new line character appended at the end.

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[1] Please imagine that these 49 integers are put in a single line.
[2] The most frequent integer is 1 and the longest consecutive sequence is in the first row.