High School Programming Competition

Saint Anselm College

2006.04.29

Contest Rules

0. Any questions and requests for clarification should be directed at one of the competition supervisors.

1. Each participant is allowed to use any hard-copy/offline references desired (books, old texts, prior program printouts, etc.).

2. Programs may be written in C, C++, or Java. Visual C++ 2005, Visual C++ 6.0, and GCC 3.x will be provided for C and C++. Sun's JDK 1.5 will be provided for Java. Each contestant should use choose a single combination of language and toolset and use it for all problems.

3. Each program should read from console input (the keyboard) and write to console output (the monitor).

4. Each program should be a command-line application (non-graphical).

5. Each program solution should be named *problemX.ext* where *X* is the problem number (1-4) and *ext* is the file extension associated with the chosen programming language (.c for C, .cpp for C++, and .java for Java).

6. Participants may submit work as many times as desired as long as all files are submitted before the deadline. Each completed program (both source code and compiled executable/bytecode) should be deposited in the X:\My Documents\CONTEST_DROPBOX directory if using MS Windows or ~/My Documents/CONTEST_DROPBOX if using OpenBSD.

7. At the end of the allocated time, the winner of the competition will be the contestant who completes the most problems correctly. In the event of a tie, the winner will be the contestant who submits said solutions earliest as determined by the system timestamps.

1 The Moving X

Write a program that, given a single line input of a single string of $1 - 100$ characters (with no whitespace between them), prints the string with an 'x' character inserted at the earliest position, another string with an 'x' inserted at the second earliest position, and so forth until the original string with an 'x' postfixed is printed.

Example Input:

```
abcd
```

Example Output:

```
xabcd
axbcd
abxcd
abcxd
abcdx
```

2 Palindromes

A palindrome is a sequence that reads the same in forward order and in reverse order. Write a program that, given a single line input of no more than 100 characters, determines whether the input is a valid palindrome and prints "TRUE" or "FALSE" as the case may be. Your program should ignore punctuation marks and capitalization in making this determination.

Example Input 1:

```
noon
```

Example Output 1:

```
TRUE
```

Example Input 2:

```
Babel loaded.
```

Example Output 2:

```
FALSE
```

Example Input 3:

```
A man, a plan, a canal, Panama!
```

Example Output 3:

```
TRUE
```

3 Locked Lockers

A school has n closed lockers and n students. The first student opens each and every locker. The second student then closes every second locker (starting with the second locker). After that, the third student examines every third locker (starting with the third locker) and closes each that is open and opens each that is closed. This continues for the remaining students, with student n closing or opening every nth locker. Write a program that, given a single line input of a single positive integer, n, determines the number of lockers that will be open after the above procedure has been run.

Example Input:

```
5
```

Example Output:

```
2
```

4 Statistics - from CCSCNE 2006

Let $x_1, \ldots, x_n$ be numbers. We define their *average* $\overline{x}$ and *standard deviation* σ by

$$\overline{x} = \frac{1}{n}(x_1 + \cdots + x_n), \sigma = \sqrt{\frac{1}{n}((x_1 - \overline{x})^2 + \cdots + (x_n - \overline{x})^2)}$$

Write a program that, given a single line input of no more than 20 whitespace-separated, double-precision floating point numbers, determines and prints the number of numbers read, their average, and their standard deviation in the indicated format.

Example Input:

```
123.45 -678.901 0 3.14159 -2.71828
```

Example Output:

```
5 numbers read, average = -111.006, standard deviation = 287.942
```