ESS201 – C++ Programming
International Institute of Information Technology

C++ Classes
Announcement on Oct 07, 2020 (Wednesday), at 1:30 pm IST
Submission by Oct 16, 2020 (Friday), at 11:59 pm IST, on Domjudge and LMS

Highlight:
Write a C++ program which does the following:

- Uses classes with member data variables and methods to instantiate objects
- Reads from std input, a sequence of positive real numbers
- Computes statistical descriptors and a histogram
- Writes in std output, the computed results

Details:
Input: The input has to provide the following information – size of the sequence, the sequence values, number of bins for the histogram (N_b). The input sequence must be in the following order: sequence-size, -1, comma-spaced values of the sequence, followed by -1, and then followed by a positive inger greater than 0 for number of histogram bins, and terminated by -1. Example:
4 -1 3.4,1.3,2.51,3.24 -1 10 -1

Following inputs are examples of incorrect ones with missing delimiters, additional characters, space instead of comma, non-positive values in the sequence, invalid number of bins;
~~4 -1 3.4,1.3,2.51,3.24 -1 10 -1~~
4 3.4,1.3,2.51,3.24 10 -1
-1 4 -1 3.4,1.3,2.51,3.24 -1 10 -1
4 -1 3.4 1.3 2.51 3.24 -1 10 -1
4 -1 3.4,1.3,2.51,-3.24 -1 10 -1
4 -1 3.4,1.3,2.51,0.00 -1 10 -1
4 -1 3.4,1.3,2.51,3.24 -1
4 -1 3.4,1.3,2.51,3.24 -1 0 -1
4 -1 3.4,1.3,2.51,3.24 -1 -0.5 -1

If the input is incorrect, the output must be -1, without any additional punctuation marks. Example of an incorrect input and output:
$ ./a.out < 4 -1 3.4,1.3,2.51,-3.24 -1 10 -1
$ -1

Output: The output must provide the following values computed using the input sequence, in the following order, with "<space>-1<space>" as the separator:
<minimum> -1 <mean> -1 <median> -1 <maximum> -1 <comma-separated-(N_b+1)-bin-values> -1 <comma-separated-N_b-bin-frequencies> -1

Median is the middle number of the sorted sequence, or the average of middle numbers, if there are two middle numbers of the sorted sequence.
Minimum, mean, median, and maximum values can be written upto 4 decimal points of precision.
In the histogram, all bins includes the minimum bin value, and all except the last bin excludes the maximum bin value.

Example:
4 -1 3.4,1.3,2.51,3.24 -1 10 -1
~~$ 1.3 -1 2.6125 -1 2.875 -1 3.4 -1 1.3,1.51,1.72,1.93,2.14,2.35,2.56,2.77,2.98,3.19,3.4 -1 1,0,0,0,0,1,0,0,0,2 -1~~
$ 1.3000 -1 2.6125 -1 2.8750 -1 3.4000 -1
1.3000,1.5100,1.7200,1.9300,2.1400,2.3500,2.5600,2.7700,2.9800,3.1900,3.4000 -1
1,0,0,0,0,1,0,0,0,2 -1

Code – Classes:

1. Create a class for "DataSequence". The class must have a data member of float pointer type, which has to be allocated in the constructor.
2. Create a class for "Histogram" which stores both bin-values, and bin-frequencies. Use pointers for the data members for bin-values and bin-frequencies.
3. Implement a sorting algorithm as a member function in DataSequence to find the minimum, median, and maximum.
4. Write separate header files for both classes, and separate source files for class implementation and main function.
5. Start creating a skeleton code for all classes you would create starting forward. This is a good time to get into the habit.
   a) Each class must have a constructor, destructor, and a copy constructor for performing deep copy.
   b) Each class must have accessors and manipulators (get/set methods).
6. Objects instantiated by DataSequence and Histogram must be kept independent, wherein the Histogram header file is included in the DataSequence header and the Histogram is only used as output type for the member function of DataSequence for creating the histogram.
7. Use std::cin and std::cout for input/output (I/O) operations.
8. std:: vector or any other containers from the Standard Template Library (STL) shall not be used in this assignment. Using pointers is mandatory with appropriate usage of "new" and "delete" for allocating and deallocating memory.
