Indian Statistical Institute
Semester-I 2023–2024
M.Tech.(CS) - First Year
Lab Test 2 (29 September, 2023)
Subject: Computing Laboratory
Total: 70 marks Maximum marks: 60 Duration: 3 hrs.

INSTRUCTIONS

1. You may consult or use slides / programs provided to you as course material, or programs that you have written yourself as part of classwork / homework for this course, but please **do not** consult or use material from other Internet sources, your classmates, or anyone else.
2. Unless otherwise specified, all programs should take the required inputs from stdin, and print the desired outputs to stdout. Please make sure that your programs adhere strictly to the specified input and output format. **Your program may not pass the test cases provided, if your program violates the input and output requirements.**
3. Submissions from different students having significant match will be **debarred from evaluation**.
4. Test cases (sample inputs and corresponding outputs) may be downloaded from the course page.

Q1. (5 marks)

You are given N integers from the range $[1, 1000)$. The integers are provided via stdin; the value of N is not known in advance. **You are not permitted to store these integers in an array or a file.**

Write a program to construct a histogram for the given integers. The histogram should have 10 equal-sized bins, corresponding to the intervals $[0.5, 99.5), [99.5, 199.5), [199.5, 299.5), \ldots, [799.5, 899.5), [899.5, 999.5)$, respectively. The histogram should be stored in an array of 10 integers. Print the counts stored in the histogram to stdout as a single line, containing 10 space-separated integers.

Q2. (15 marks (+ up to 5 marks extra))

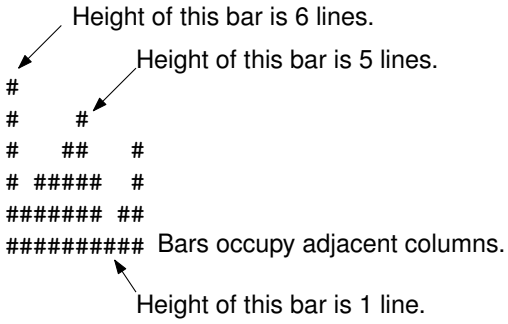
Write a program that takes 10 space-separated integers as input, and "draws" the corresponding bar-diagram on stdout, as shown in the examples below.

- Each bar should be drawn as a column made up using the `#` character.
- The height of each bar (i.e., the number of successive lines occupied by the bar) should be equal to the count stored in the corresponding bin.
- The bars should occupy adjacent columns.

Extra credit: You will get up to 5 extra marks if your program can also handle negative counts. If the input contains negative counts, your diagram should contain a line made up using the `-` character to represent the X-axis. Bars corresponding to negative counts should be drawn below the X-axis.

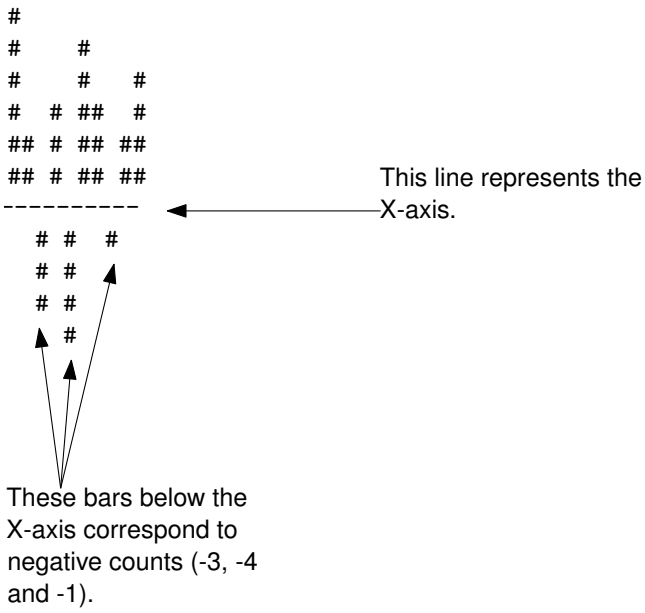
Sample input 1: `6 2 3 3 4 5 3 1 2 4`

Sample output 1:



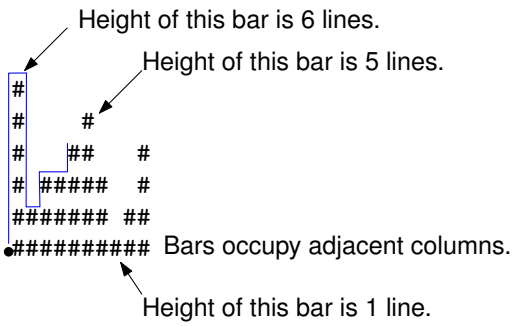
Sample input 2: `6 2 -3 3 -4 5 3 -1 2 4`

Sample output 2:



Q3. (15 marks)

Consider a point that starts at the lower left corner of a bar-diagram drawn by your solution to Q2., and traverses its upper boundary until it reaches the lower right corner (the blue line in the figure below indicates the initial part of the trajectory of the point).



Write a program that computes the distance travelled by the point. You may assume that each line and each column occupy unit height and unit width respectively. **For this problem, you DO NOT need to consider negative counts.**

Input format: 10 space-separated integers (as in Q2.)

Output format: a single integer

Sample input 1: `6 2 3 3 4 5 3 1 2 4` (same as sample input 1 for Q2.; the corresponding bar-diagram is shown in the example above)

Sample output 1: `34`

Q4. (20 marks)

You are given some input text consisting only of blanks, newlines, and the characters `a-z`, `A-Z`. Write a program to print the text in a "*properly formatted*" manner to stdout. By "properly formatted", we mean that your text should satisfy the following.

- A line should not start or end with a blank.
- There should be no empty lines.
- The words (any sequence of letters is regarded as a word) should appear in the output in the same order as in the input.
- Two successive words on the same line should be separated by exactly one blank.
- Each line should contain as many words as possible, but must not be more than 80 characters long (including blanks, but not including the newline).

You may assume that each individual word is no more than 80 characters long.

Sample input 1:

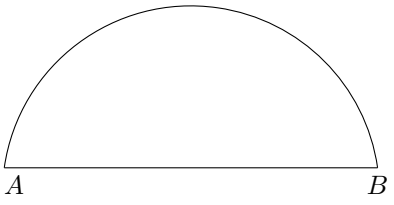
```
  We       always     keep

it         in the  hall  drawer

Ill    go and    see if   its        there now

Poirot   held    up his       hand        with  a faint

smile     No         no           Mr          Cavendish it   is      too
late           now I        am certain
```

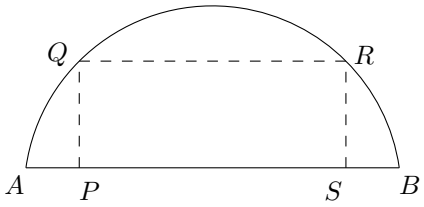
Sample output 1:

```
We always keep it in the hall drawer Ill go and see if its there now Poirot held
up his hand with a faint smile No no Mr Cavendish it is too late now I am
certain
```

Q5. (10 marks)

Let $A(x_a, y_0)$ and $B(x_b, y_0)$ be two points in the X-Y plane. Consider the semicircle that lies above AB and has AB as its diameter. Write a program that takes the coordinates of A and B (x_a, y_0, x_b, y_0) as input, and computes the coordinates of the 4 vertices of the largest rectangle[1] that has one of its sides lying along AB, and which can be fitted inside the semicircle.





Input format: 4 floating point numbers corresponding to the coordinates of A and B, respectively.

Output format: If AB is not parallel to the X-axis, your program should output `INVALID INPUT`. Otherwise, your program should print the coordinates of the 4 vertices of the largest rectangle described above.

- The X and Y coordinates for each point should be printed correct to 3 decimal places, on a single line, and separated by a single space.
- The points should be printed in clockwise order, starting from the lower left vertex. Thus, if $PQRS$ is the required rectangle in the figure above, your program should print 4 lines, corresponding to the coordinates of P, Q, R, and S, in that order.

Sample input 0:

```
-2.0 0
2 0
```

Sample output 0:

```
-1.414 0.000
-1.414 1.414
1.414 1.414
1.414 0.000
```

Sample input 1:

```
1.0 2.5
-1.0 2.0
```

Sample output 1:

```
INVALID INPUT
```

[1] in terms of area