

College Of IT
CSCI103 : Algorithms and problem solving

Assignment 2

Date: 18/11/06
Max marks: 10

Submission Date: 4/12/06
Weighting: 5%

General Instructions:

This assignment is to be done individually. You may share ideas, but the final solution should be your own. You are encouraged to discuss your difficulties in completing the assignment with your lecturer or tutor *before* the submission date.

Submission Instructions:

- Please attach the cover sheet along with your assignment.
- Submit your assignments to your lecturer/tutor personally.
- Do not submit loose sheets.

Objectives:

Develop algorithm to solve some of the standard problems in Mathematics and Statistics. Analyze the complexity of the algorithm and improve efficiency of the algorithm if possible.

Task 1: Understand the ‘brute-force’ approach and determine the complexity of the algorithm written using ‘brute-force’ approach.

Suppose there are three numbers given to you: x_0, x_1, x_2 . The *Harmonic Mean* of these

three numbers is defined as $\frac{1}{H} = \frac{\left(\frac{1}{x_0} + \frac{1}{x_1} + \frac{1}{x_2} \right)}{3}$

One simple algorithm to calculate this value is as given below:

```
Harmonic(X[0..3])
1. Set i=0
2. Sum=0
3. While(i<3)
   3.1 sum=sum+(1/X[i])
   3.2 i=i+1
4. end while
5. H=3/sum
6. Return H
```

- (A) Write one advantage and one dis-advantage of this *approach* in general. [½ mark]
- (B) Will the above algorithm work for all types of numbers? If no, write the case(s) where the algorithm will not work. [½ mark]
- (C) How can you make this algorithm work on 10 numbers instead of only 3? [½ mark]
- (D) Determine the running expression of this algorithm when it is applied on a group of n numbers. [½ mark]

Task 2:

This algorithm will always produce a number that is not an integer. Suppose we want the answer in the form of a fraction and not a decimal number.

Example:

Let the three numbers be 2,4, and 5. Their harmonic mean is $\frac{3}{\left(\frac{1}{2} + \frac{1}{4} + \frac{1}{5}\right)} = \frac{3}{0.95} = \frac{300}{95} = \frac{100}{19}$ where as the above algorithm will only produce the answer as 3.15789.. .

- (A) Re-write the algorithm so that it gives the answer as two numbers, which form the numerator and the denominator of the Harmonic Mean of given n numbers. [2 marks]
- (B) Find the running time expression and the big-oh expression of your algorithm. [1 mark]

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Task 3:

Standard deviation is an important concept in Statistics. Suppose you have a group of observations $x_0, x_1, \dots, x_n$. The standard deviation of these numbers is calculated using the following formula:

$$\sqrt{\frac{\sum_{i=0}^{n-1} (x_i - \bar{x})^2}{n}} \quad \text{where } \bar{x} \text{ is the average of the given numbers.}$$

(A) Write an algorithm that returns the standard deviation of the given array of n numbers. [2 marks]

(B) Determine its running-time expression and the big-oh expression.

[1 mark]

(C) Did you use Brute-force approach in solving this problem? If yes, then suggest at least one way of improving the efficiency of your algorithm. If not, then justify that your approach is better than the Brute-force approach.

[1 mark]

Bonus mark: One bonus mark is awarded for the work that is 100% correct. If your score is 9/9 then you will get one mark as the bonus.
