Homework Assignment #5: Programming Exercise #1

Due Date & Time

5:00PM Thursday, April 14, 2016. Late submission will be penalized by 20% for each working day overdue.

Problem Description

Solve Problem A "Amalgamated Artichokes" of the 2015 Annual ACM International Collegiate Programming Contest World Finals (see the appended).

Notes

This assignment constitutes 4% of your grade. You may discuss the problem with others, but copying code is strictly forbidden. **Some of you may be requested to demonstrate your program.**

Submission Guidelines

- Pack everything, excluding compiler-generated files, in a .zip file, named with the pattern "`b037050xx-alg2016-hw5.zip`".
- Upload the .zip file to the Ceiba course site for Algorithms 2016:

  `https://ceiba.ntu.edu.tw/1042algorithms`.
- If you use a Makefile, make sure that it outputs "`hw5`". Otherwise, make sure that the whole application can be compiled by a single command like "`gcc hw5.c`", "`g++ hw5.cpp`", or "`javac hw5.java`".

Grading

Your work will be graded according to its correctness and presentation. Before submission, you should have tested your program on several input cases. You should organize and document your program in such a way that other programmers, for example your classmates, can understand it. In the documentation, you may also want to explain how you have applied the algorithmic techniques, particularly design by induction and reduction, learned in class.

Below is a more specific grading policy:

Criteria	Score
incomplete or doesn't compile	≤ 20
complete, compiles, but with major errors	≤ 40
correct but with little documentation	≤ 80
correct and with good documentation	≤ 100
explanation of algorithmic techniques applied	$+10$

Problem A
Amalgamated Artichokes
Time limit: 5 seconds

Fatima Cynara is an analyst at Amalgamated Artichokes (AA). As with any company, AA has had some very good times as well as some bad ones. Fatima does trending analysis of the stock prices for AA, and she wants to determine the largest decline in stock prices over various time spans. For example, if over a span of time the stock prices were 19, 12, 13, 11, 20 and 14, then the largest decline would be 8 between the first and fourth price. If the last price had been 10 instead of 14, then the largest decline would have been 10 between the last two prices.

Picture by Hans Hillewaert via Wikimedia Commons

Fatima has done some previous analyses and has found that the stock price over any period of time can be modelled reasonably accurately with the following equation:

$$\text{price}(k) = p \cdot (\sin(a \cdot k + b) + \cos(c \cdot k + d) + 2)$$

where p, a, b, c and d are constants. Fatima would like you to write a program to determine the largest price decline over a given sequence of prices. Figure A.1 illustrates the price function for Sample Input 1. You have to consider the prices only for integer values of k.

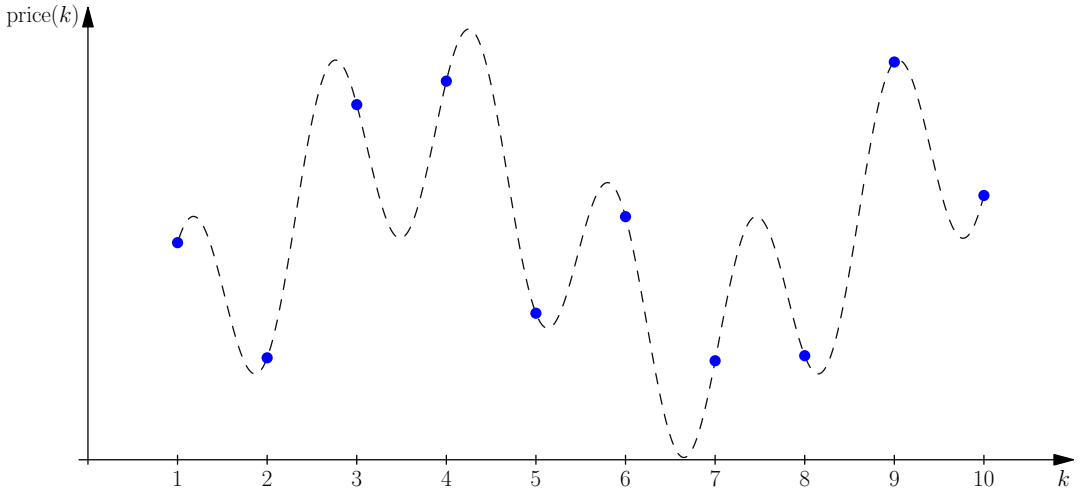

Figure A.1: Sample Input 1. The largest decline occurs from the fourth to the seventh price.

Input

The input consists of a single line containing 6 integers p ($1 \leq p \leq 1\,000$), a, b, c, d ($0 \leq a, b, c, d \leq 1\,000$) and n ($1 \leq n \leq 10^6$). The first 5 integers are described above. The sequence of stock prices to consider is $\text{price}(1), \text{price}(2), \ldots, \text{price}(n)$.

Output

Display the maximum decline in the stock prices. If there is no decline, display the number 0. Your output should have an absolute or relative error of at most 10^{-6}.

Sample Input 1	Sample Output 1
42 1 23 4 8 10	104.855110477

Sample Input 2	Sample Output 2
100 7 615 998 801 3	0.00

Sample Input 3	Sample Output 3
100 432 406 867 60 1000	399.303813