MODELLING AND SIMULATION OF SYSTEMS

EXERCISE 1: STATISTICS OF A NUMERICAL SEQUENCE

1. EXERCISE

Write a program in C/C++ which, for a given integer $d \geq 1$ and a sequence of integers $x_1, x_2, \ldots, x_n$ $(n \geq 1)$, computes:

(1) the mean value of $x_1, x_2, \ldots, x_n$, i.e. $\frac{1}{n} \sum_{i=1}^{n} x_i$; the result should be given with an accuracy of d decimal places;
(2) the variance of $x_1, x_2, \ldots, x_n$, i.e. $\frac{1}{n} \sum_{i=1}^{n} x_i^2 - (\frac{1}{n} \sum_{i=1}^{n} x_i)^2$; the result should be given with an accuracy of d decimal places;
(3) the period of $x_1, x_2, \ldots, x_n$, i.e. the smallest $p \geq 1$ such that $x_{k+p} = x_k$ for each $k = 1, 2, \ldots, n - p$.

The program should be written within 2 weeks.

2. INPUT AND OUTPUT

The accuracy d will be given as the first command-line argument. Assume that $1 \leq d \leq 2^{16}$.

The sequence $x_1, x_2, \ldots, x_n$ should be read from the standard input. The elements of the sequence will be separated by whitespaces. The length of the sequence will not be given explicitly – the numbers should be read as long as they appear. Assume that $1 \leq n \leq 2^{24}$ and $|x_i| \leq 2^{64}$ for $i = 1, 2, \ldots, n$.

The results should be written on the standard output and separated by newline characters. Leading and trailing zeros must not be a part of the output. The decimal point have to be omitted for results being integers.

3. POINTS

This exercise is worth 20 points. The score depends on the result of the test that will be performed during the laboratory:

(1) programs that do not compile and or end with a runtime error are worth 0 points;
(2) programs that exceed the 60-second time limit or return incorrect results are worth 0 points;
(3) programs that compute properly only one of the three statistics are worth 6 points;
(4) programs that compute properly two out of the three statistics are worth 12 points;
(5) programs that compute properly all of the three statistics are worth 20 points.