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CS700

Fall 2016, Assignment #0

The *Logistic Map*

$$f_r : [0;1] \ni x \mapsto r \cdot x \cdot (1-x) \in [0;1], \qquad 1 < r < 4 \qquad (1)$$

is a dynamical system well-known for its chaotic behaviour for many values of the parameter r.

PROBLEM 0 (1+2+2+1+1+2+1P):

a) Prove that (iterating) the function is well-defined.

b) Write, run, and record both output and execution time of a C++ program printing the

> (i) $m = 30$th, (ii) $m = 40$th, (iii) 85th, (iv) 100th, (v) 200th,
> (vi) 500th, (vii) 1000th, (viii) 10 000th, (ix) 100 000th, and (x) 500 000th

iterated value $x_{m+1} = f_r(x_m)$ up to six decimal places
for $r := 15/4 = 3.75$ and start value $x_0 := 1/2 = 0.5$ using the data type `float`.

c) Repeat using `double`. Compare.

d) Repeat using `long double` or quadruple precision.

e) Repeat with data type `RATIONAL` after adding these lines to your code:
   ```
   #include "iRRAM.h"
   using namespace iRRAM;
   ```
   Also, rename `int main(int argc, char **argv)` to `void compute()`

f) Repeat with data type `REAL`.

g) Explain the above findings!

Feel free to peruse our virtual compute server `irram.zieg.de` accessible via `SSH` and your individual login. A C++ source file named `logistic.cc` can be compiled, linked, and executed on the shell prompt with the commands `make logistic` and `./logistic`

Alternatively, as root on a linux machine of your choice,
install the library from `http://irram.uni-trier.de`

Send your solutions via email to `cs700@theoryofcomputation.asia`
latest on the evening of Monday, September 19.

Earn 3 points extra credit by signing your email message
with a private PGP key assigned to your (KAIST) email address(es)
and the corresponding public key uploaded to `http://pgp.mit.edu/`