Assignment – 1

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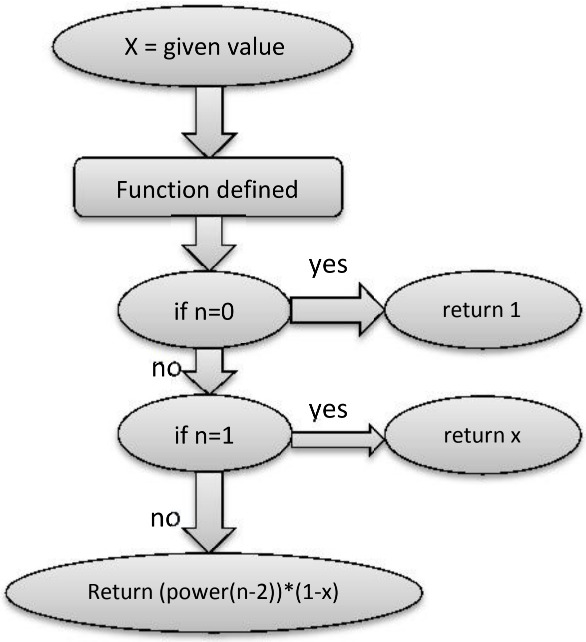
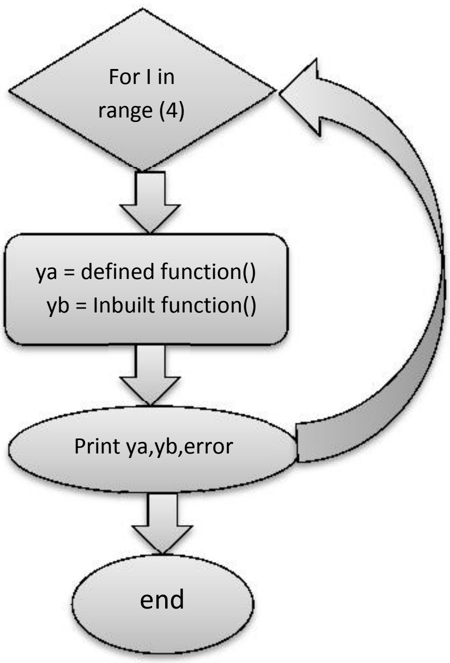
Problem : 3

It is desired to calculate all integral powers of the number
$x = (\sqrt{5.0} - 1.0) / 2.0$.
It turns out that the integral powers of x satisfy a recursive relation:
$x^{n+1} = x^{n-1} - x^{n}$.
Show that the above recurrence relation is unstable by calculating x^{16}, x^{30}, x^{40} and x^{50} from the recurrence relation and comparing with the actual values obtained by using inbuilt function e.g., pow(a,b) in C.

Method :





Result :

We run the program and got following output.

From recursive function	From inbuilt function	error
0.0004531038537848216	0.00045310385378482274	-2.5124753885902884e-15
5.374904998555692e-07	5.374904998555718e-07	-4.727709312900816e-15
4.3701303391810556e-09	4.370130339181083e-09	-6.246257684699876e-15
3.553186370096331e-11	3.5531863700963593e-11	-8.002488638314576e-15

Discussion :

In the 10th line if we use the subtraction of two functions then it takes too much time to compile the file so instead of doing that we took the common factor out this way it’s too easy to compile the file and will not take much time.

Problem 4(a) :

Consider the logistic map

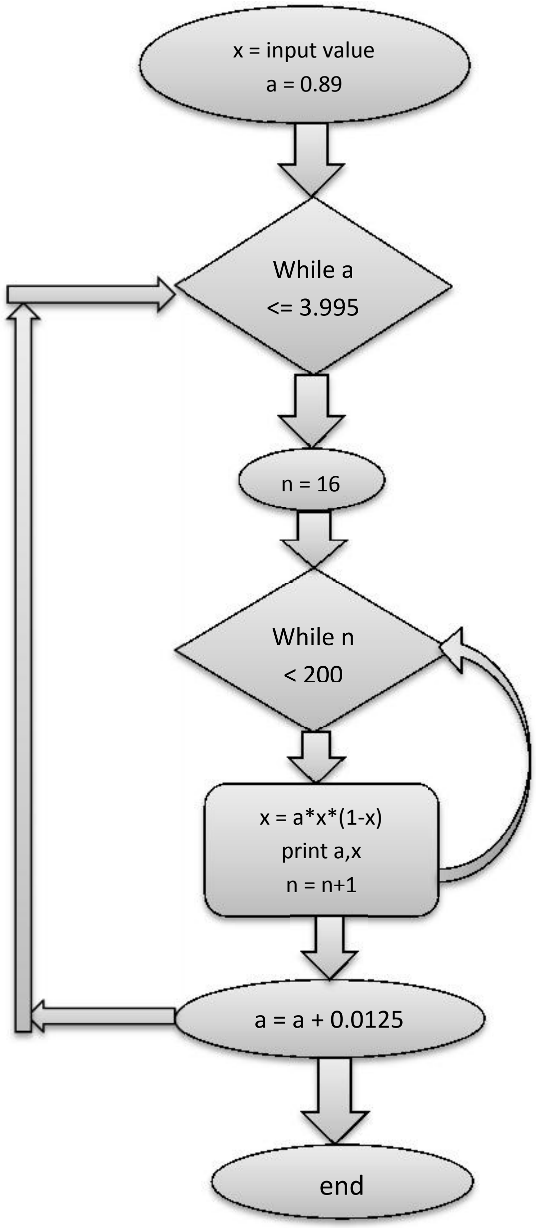
$x_{n+1} = A\, x_n\, (1 - x_n)$

where, x_n is the n^{th} iteration for $0 \leq x \leq 1$. Here A is a constant. Vary the value of A from 0.89 to 3.995 in an interval of 0.0125 in each step.

(a) For each value of A, note the values of x_n for $15 < n < 200$, then make a plot of x_n vs. A and see the bifurcation and chaos.

(b) For A = 4.0, choose two points x and x' where, x' = x + 0.01 and iterate. Plot $\log(|x_n - x'_n| / 0.01)$ as a function of n. See if it is approaching a straight line.

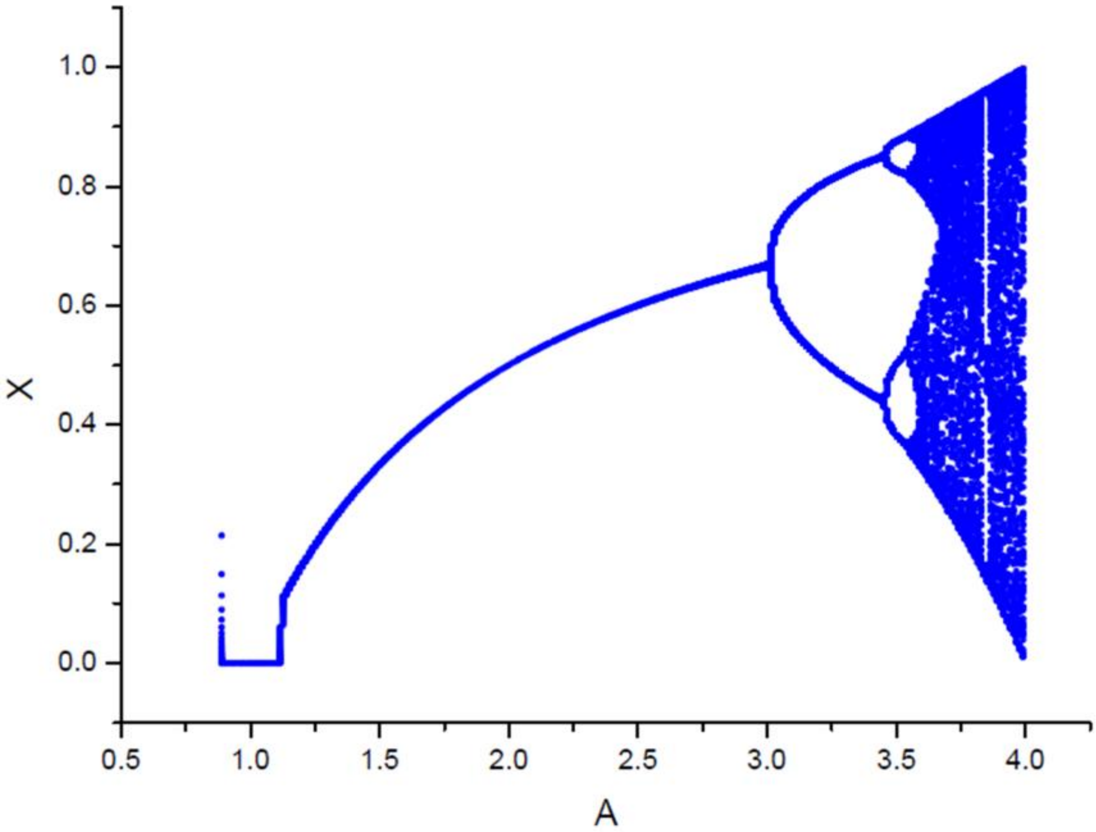
Method :



Result :

We run the program, it asks for the value of x and print corresponding output .

Graph for x = 0.6

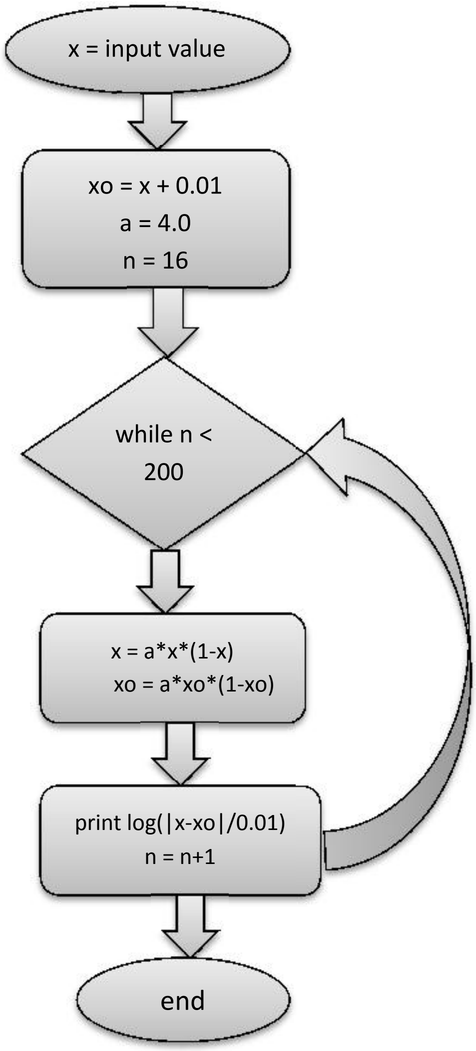


Discussion :

We increased “a” in step of 0.0125 and for each a there is 200 – 15 values of x. So in the graph it looks like filthy. When the value of “a” is low x is almost constant, but for high value of “a” it varies almost in whole range.

Problem 4(b) :

Method :



Result :

We run the program, it asks for the value of x and print corresponding output.

Discussion :

We divided the value of log(|x-x0|) by 0.01 so that the significant numbers increased and consequently error decreased.