

In the name of God

# Department of Physics Shahid Beheshti University

## COMPUTATIONAL PHYSICS

### Exercise Set 6

(Date Due: 1395/04/05)

1. Linear Boundary value problem: Suppose numerically  $y''(t) + 2y'(t) + y(t) = 0$  with  $y(0) = 1$  and  $y(1) = 3$  and compare it with exact solution.

(For more details see (write exactly below address in your browser to see it):

[http://www.stewartcalculus.com/data/CALCULUS%20Concepts%20and%20Contexts/upfiles/3c3-2ndOrderLinearEqns\\_Stu.pdf](http://www.stewartcalculus.com/data/CALCULUS%20Concepts%20and%20Contexts/upfiles/3c3-2ndOrderLinearEqns_Stu.pdf)

2. Decaying simulation: suppose the probability of decaying are  $p = \lambda\Delta t$  and  $p = \lambda\Delta t/t$ . For both of them write down programs that simulate these phenomena.
3. Using Stone throwing method, compute the value of pi. Check your algorithm for various values N.
4. Logistic map: plot bifurcation, one-cycle, two-cycle, four-cycle and chaotic regime.
5. Chaotic oscillation: suppose the following equation:

$$\frac{d^2\theta}{dt^2} = -\omega_0^2 \sin \theta - \alpha \frac{d\theta}{dt} + f \cos(\omega t)$$

where  $\omega_0 = 1$ ,  $\alpha = 0.2$ ,  $f = 0.52$  and  $\omega = 0.666$ . Plot phase diagram and  $\left| \frac{d\theta}{dt} \right|$  as a function of driving force  $f$ .

6. Lorenz attractor: suppose following coupled equations:

$$\frac{dx}{dt} = 10(y - x)$$

$$\frac{dy}{dt} = -xz + 28x - y$$

$$\frac{dz}{dt} = xy - \frac{8}{3}z$$

Solve them and plot phase diagram of each them.

Good luck, Movahed

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