Nonlinear Dynamics

PHYS 750

Problem Set # 5
Distributed February 1, 2005
Due February 10, 2005

Undergraduates: Do problems 1 and 2.
Graduates: Do problems 1, 2, and 3.

Systematics of Periodic Orbits

1. Finding Periodic Orbits: Construct a data base of 10000 points for the logistic map $x' = \lambda x(1 - x)$ for $\lambda = 4$. Extract periodic orbits of periods $p = 1, 2, 3, 4, 5$ from this data base. How many distinct orbits of period $p$ (a) exist? (b) did you find? Write a short essay ($\geq 10$ words) that describes how you found these orbits and how you verified that lower period orbits are not masquerading as higher period orbits.

2. Kneading Invariant: Compute the kneading invariant for the period-$p$ orbits $0^{p-2}11$ for $p = 3, 4, 5, \cdots$. In what order are they created in the logistic map?

3. Kneading Invariant: Compute the kneading invariant for the period-$p$ orbits $0^{p-4}14$ for $p = 5, 6, 7, \cdots$. In what order are they created in the logistic map? How do they interleave the formation of the orbits of the type $0^{p-2}12$? Write a short essay ($\geq 20$ words) that describes how you determined the order of creation of the orbits in these two classes of orbits.