

# Math 4973 - Dynamical Systems

## Homework #2

Assigned - 2011.06.13

Name: \_\_\_\_\_

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1. Remember our friend the doubling function  $D(x) = 2x \bmod 1$ , for  $x \in [0, 1)$ .

(a) Find all periodic orbits of period less than 4.

(b) Classify each of these periodic orbits as stable, unstable, or unknown.

2. Sketch the phase portrait for each of the following functions.

(a)  $F(x) = -x^2$

(b)  $F(x) = x^2 + \frac{1}{4}$

(c)  $F(x) = x^2 + \frac{3}{8}$

3. If  $x_0$  is a fixed point of the map  $D^n(x)$ , i.e. on an orbit of period  $n$ , for  $n \in \mathbb{N}$ , compute the stability of the orbit. Your answer should agree with part (b) of problem 1.

4. Each of the following functions has a neutral fixed point ( $|F'(x_0)| = 1$ ). Find these points, and using graphical analysis, classify them as weakly attracting, weakly repelling or neither.

(a)  $F(x) = x + x^2$

(b)  $F(x) = x + x^3$

(c)  $F(x) = x - x^3$