MATH 374, Dynamical Systems, Fall 2017

Computer Project #2

Windows in the Orbit Diagram

DUE DATE: Friday, October 27, 5:00 pm

The goal of the project is to compare and contrast the interesting patterns and structures within the orbit diagrams of the Quadratic Family $Q_c(x) = x^2 + c$ and the Logistic Map $F_\lambda(x) = \lambda x(1-x)$. You should do this by completing Experiment 8.3 in the Devaney text, pp. 92 – 94. Use the *Orbit Diagram* java applet available from the Dynamical Systems and Technology Project website at Boston University. You will have to set your security preferences in Java correctly in order to access the applet. You may also want to use Maple (or other software) and the iteration loop from Computer Project #1 to check the periods of certain windows in the orbit diagrams.

It is **required** that you work in a group of two or three people. Any help you receive from a source other than your lab partner(s) should be acknowledged in your report. For example, a textbook, web site, another student, etc. should all be appropriately referenced at the end of your report. The project should be **typed** although you do not have to typeset your mathematical notation. For example, you can leave space for a graph, computations, tables, etc. and then write it in by hand later. You can also include graphs or computations in an appendix at the end of your report. Your presentation is important and I should be able to clearly read and understand what you are saying. Spelling mistakes and sentence fragments, for example, should not occur. Only **one project per group** need be submitted.

Do the **Procedure** part of the experiment for both the quadratic and logistic functions, filling out the given chart for the period-n windows in each generation. Note that you may need to magnify the orbit diagram, by dragging the mouse over the desired region, repeatedly. As you zoom in, you can change the number of iterations as well as the number of points displayed by adjusting the two input boxes on the line directly below the orbit diagram. The orbit diagram is computed by following the orbit of the critical point ($x_0 = 0$ in the case of Q_c and $x_0 = 1/2$ in the case of F_λ.) The reason for this will become clear after we cover Chapter 12.

Once you've completed the procedure part of the experiment, answer **Questions 2 – 5** on page 94. For question #4, delete the phrase "can you" from the first sentence. For Question #5 (this is the hard one!), find explicit formulas for some of the "darker" curves running through the orbit diagrams. Note that this includes the boundary curves that define the top and bottom of the overall orbit diagram. A hint is to examine a histogram plot for a given parameter value and observe the orbit of the critical point visually. You might also take a closer look at a web diagram as well. Both of these tasks can be accomplished with the java applets *The Function Iterator* and *Nonlinear Web*, available at the Dynamical Systems and Technology Project website (linked from the course webpage).