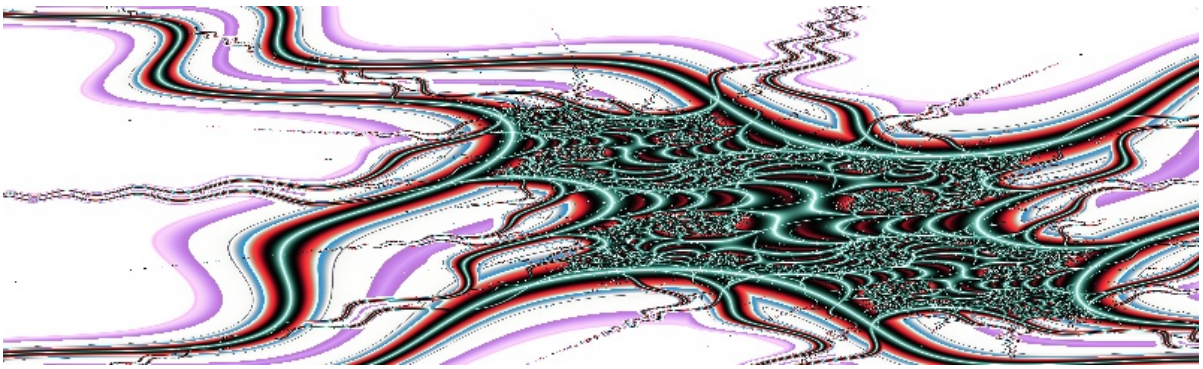

Classroom Chaos 6

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0. Period Doubling Route to Chaos

Use a spreadsheet to determine the first four bifurcation values of the parameter appearing in the logistic, sine, and quadratic maps:

$$P_{t+1} = rP_t(1 - P_t)$$
$$P_{t+1} = r\sin(P_t)$$
$$x_{t+1} = x_t^2 + c$$

Defining λ_n as the nth bifurcation value, calculate the following ratio for each map:

$$\frac{\lambda_n - \lambda_{n-1}}{\lambda_{n+1} - \lambda_n}$$

With 4 bifurcation values you will be able to find two ratios for each map. Do your ratios approach the universal scaling # of 4.6692016… found by Feigenbaum?

Use the Feigenbaum value to predict λ_∞ for each map. This value is effectively where chaos begins.

Logistic _____

Sine _____

Quadratic _____

1. BifLAB and The Period-3 Window

Use BIFLab to investigate the maps. How many period doublings can you spot? How does the BifLAB λ_∞ compare with your predicted one?

Can you find period 3, 5, 7, etc. windows?

Play around with different maps. In particular, check out the Sine, Quadratic and Tent map