MAT 332, Fall 2018. Assignment 4. Due on Nov 29th, in class.

**1.** Find an example of a chaotic attractor in 3D which is **NOT** covered in Chapter 7 of the textbook (either in other literature, or on the Internet). Give a brief description of your example, and illustrate its properties with a Maple worksheet (**Caution:** identical answers may be considered cheating).

**2.** Investigate what happens with the Lorentz system (7.1) on p. 297 of the text when parameters are changed. For $\sigma = 10$, $b = 8/3$, and $r = 28$ we observe chaos. With the same values of $\sigma$ and $b$, use Maple to determine what happens for $r = 10$, $r = 22$, and $r = 100$. In the last case you will need to start with a very large range of $x$, $y$, $z$ values, so the trajectory fits in your plot. To make sure you are seeing the true long-term behaviour of the trajectories, use large values of $t$ (starting at least from $t = 200$).

**3.** Consider the function

$$f(x) = 3x - x^3$$

a) Find all the fixed points and classify their stability. Use Maple to iterate graphically starting at the points $x_0 = 1.9$ and $x_0 = 2.1$. Try to explain the dramatic difference between the two orbits.

b) Find a single orbit of period 2 (use Maple if necessary). Classify its stability.