# Homework 1: Complexity Chapters 1-2

**DUE:** Monday, October 4, start of class.

1. Why do you think Aristotle's theories of motion important in the History of Science (even though they turn out to be wrong)?

2. Give an example of a nonlinear system that you encounter in your daily life. What makes it nonlinear?

3. As described in Chapter 2 of the textbook, in the "linear rabbits" population, every year all rabbits pair up to mate and each pair has exactly four offspring and then dies.
   a. Explain why the population in the "linear rabbits" example has the following exponential growth law:
   $$n_t = 2^t n_0$$
   b. Why does the book call this a "linear system"?
   c. Consider a population of rabbits in which every year each pair of rabbits has exactly 8 offspring and then dies. Give the growth law (analogous to that given in part (a) above).

4. In your own words, define "sensitive dependence on initial conditions" and "chaotic system".

5. In the context of the logistic map, define: "fixed-point attractor" and "periodic attractor". Write in your own words a definition of "the period-doubling route to chaos".

6. Define "bifurcation" in the context of the logistic map.

7. As described in the book, what are the two "universal features" of chaotic systems like the logistic map?

8. Explain in your own words (a few sentences) how Feigenbaum's constant is calculated, e.g., with reference to the logistic map.