10-5-2005

- Do you have any questions about the quiz?
- What did we talk about last class?
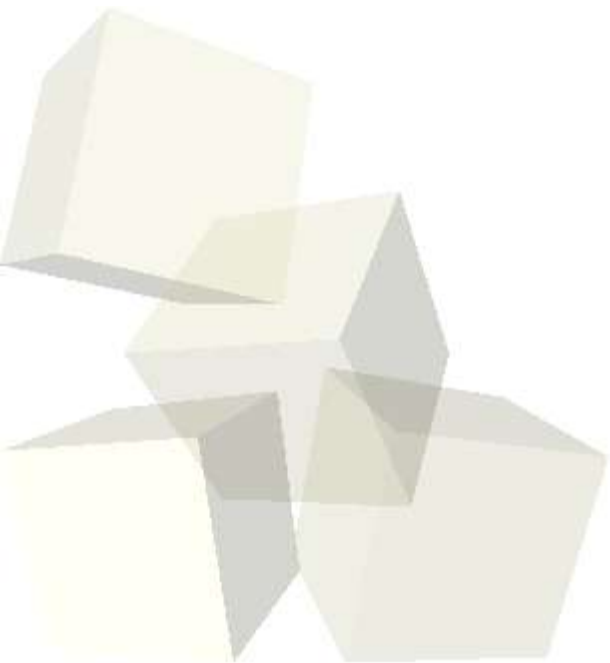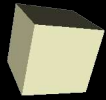- Let's look at the document that Dr. Ugolini sent me about the project. That way you can start thinking about it. It will also be significant for today's lecture.

- Last time we talked about the logistic map ($x_{n+1} = rx_n(1-x_n)$) and wrote code to draw a cobweb diagram. We saw from those that the behavior of the system changes as r is increased.
- We want to write code that can plot a bifurcation diagram so that we can see the impact of increasing r more clearly.
- A bifurcation diagram plots the "steady state" values of the iteration. We simply iterate 200 times, but only plot the last 100.
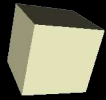
- So far almost every method that we have talked about using in Matlab has been deterministic. That is to say that given the same initial conditions we always get the same result.
- Some problems are better described in a statistical sense. For these methods you often want to sample random numbers and perform actions based on the values you get.
- These types of methods are generally called Monte Carlo methods and they are extremely useful for a fairly large number of different systems. Many of these systems have "uncorrelated events".
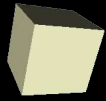
- To see how these work we can play with some simple toy problems.
- Work out the percentage chances of getting different numbers when you roll a certain number if dice.
- Estimate π by "throwing darts" at the unit square in the first quadrant.
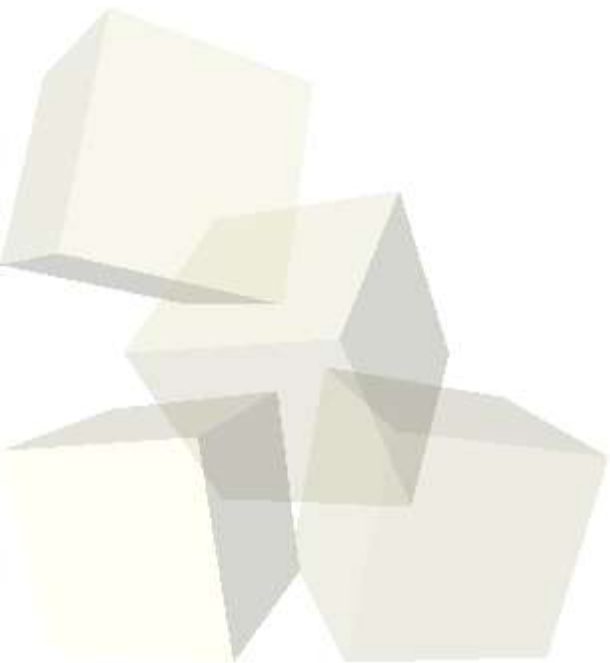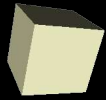
- Some systems are too complex to treat deterministically, or they truly have a probabilistic nature to them.
- Light scattering in a medium like a cloud. Photons can be considered independently and we pull random numbers to determine how far they go between scattering events and when they scatter a random number tells us what direction they go in.
- In cells these types of methods can be used to model the gating of ion-channels as a stochastic process.
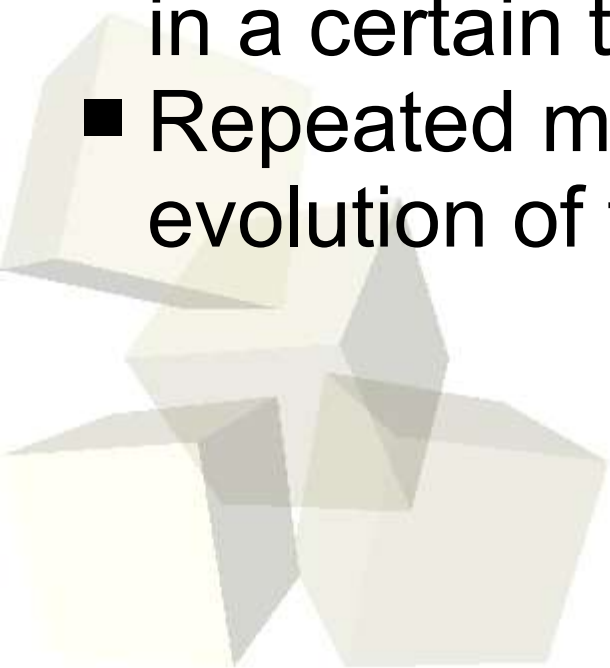
- The project that you have chosen involves stochastic processes. The flipping of the electron spins is a probabilistic function of temperature.
- In reality electrons can flip in a parallel way based on the thermal energy delivered to their atom. The individual flips are largely uncorrelated though so you can model them as independent events that happen in serial.
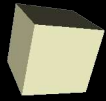
- Another method is can be very useful for simulating probabilistic systems is that of the Markov chain.
- In this method you have a number of states and each state has a certain population associated with it. There is a transition matrix that tells you how much stuff moves from one state to another in a certain time period.
- Repeated multiplication by the matrix tracks the evolution of the system.

- The midterm is next Wednesday.