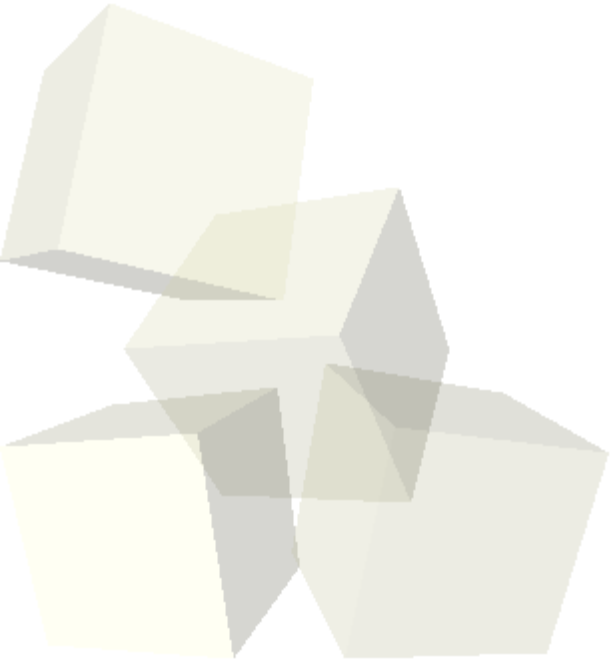
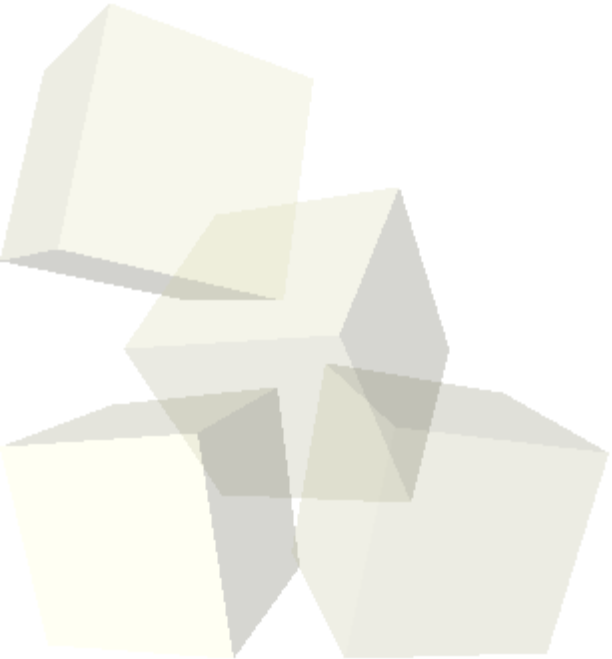
10-4-2006



Opening Discussion

- What did we talk about last class?
- Do you have any questions about the assignment?



Gravity

- Last time we started working on a function to do a system of mutually attracting massive bodies.
- We ran into a problem with specifying the masses of the bodies and I asked you to think about how to get around that. We certainly don't want to have to hard code it.
- My hint was the you should think of how you would do this in a functional language. To be more specific, we need to make a curried function.
- Let's go try that out and see if we can finish this N-body integrator.

Real Gravity Simulations

- Real simulations of gravitational systems would never be done this way. The lack of energy conservation is a serious problem for long term integrations.
- Small systems have to go a long time normally so a symplectic integrator would be used.
- Large systems would have problems with the $O(n^2)$ nature of what we have written. Tree codes can improve this to O(n log n). Multipole methods can run in O(n) time. The coefficients and complexity go up with each of these.

Other N-body/Multibody Systems

- Other common N-body type systems include collisional systems, molecular dynamics, granular flows, etc.
- Collisions can be handled through either hard or soft sphere means. Hard sphere doesn't work with an integrator, but soft sphere does, assuming the integrator is advanced enough.
- Boundary conditions can also complicate things. These are reasons why a large system likely wouldn't be integrated with something like ode45.

Writing a Leapfrog Method

- The simplest type of symplectic integrator is a first order method called the leapfrog method. Let's go ahead and work on a T+V leapfrog method.
- This method looks almost like Euler's method. We just have to be careful to separate some things. To see what we need to do we should discuss a little Hamiltonian dynamics as well.
- This is worth discussing because MD simulations also typically need to be symplectic so this might work better than using ode45 for your project.

Reminders

- Assignment #5 is due today.
- Quiz #3 will be next class. We'll spend the rest of the time next class talking about the project so that you can work on it during next week while I'm out of town.