6.111 Final Project
Newtonian N-Body Simulator
Checkoff List

Michelle Teh, Michael Witten

22 November 2006

Priorities

The following is a list of priorities we have for this project. They are listed from most important to least important.

1. **Frame Data**
   Our first goal is to produce data for each object according to the laws of physics. This is achieved by using the data available in the current frame as the initial conditions for computing the data in the next frame.

   For our purposes, we will implement a gravitational acceleration simulator.

2. **Draw Circles** (and other graphical elements)
   Each frame of data can be displayed in many meaningful ways. Since each of our objects is a sphere that moves within one plane, we will represent the data as circles in a cartesian coordinate system; the origin will be in the middle of an 800x600 resolution screen.

   If time and resources permit:

   (a) We will allow the scaling and shifting of the cartesian coordinate system, so that different vantage points can be achieved for viewing the scene.

   (b) We will include other graphical data displays to represent the velocities, masses, positions, and other properties of the interacting objects.

3. **Collision Detection**
   The pipelining quirks and resource consumption of the preceding goals relegate collision detection between objects to an if-time-permits goal. Essentially, this is another gigantic pipeline similar to that used for calculating gravitational acceleration; without this capability, the kinds of simulations are simply reduced to those in which objects (circles) do not touch.

4. **User-Specified Data**
   One of the hallmarks of a simulator is the ability to tweak its parameters so that the results of different initial conditions can be computed. At first, we hope to produce results for hard-coded initial conditions. If time permits, we will allow the user to specify object properties such as mass, velocity, position, and radius via switches and buttons or by some more elaborate scheme including a mouse and keyboard; *this goal will probably not be achieved.*

Demonstration

The beauty of this simulator is that hardware is used to perform computations on a representation that is more or less meaningless to humans, and then this data is displayed in a representation that humans can appreciate through their own experience and intuition.

The following list relates the goals give above to their demonstration:

1. We can show that the raw data is being produced properly with the logic analyzer and/or the hex display. In particular, we can show the evolution of a coordinate for a very simple and understandable system of objects like a 2-body system.
2. With drawing capability, we can demonstrate the calculations simply by displaying the data as described above; one should be able to see circles in orbit around other circles.
3. Collision detection will enable richer simulations, easily seen on screen by the proper movement of colliding circles.
4. The specification of user data allow for the simulation to be paused, tweaked, and restarted. Objects can be created and destroyed, and object properties can be reprogrammed.