Final Project For N-Body

One possible final project - of course, others are acceptable, just check in with the professor.

Please target early December for the due date. If you need more time, you'll need to arrange for an extension (on which we will be flexible).

Make a 2-D nbody code (3-D if you're feeling awesome) that calculates the forces by computing the gradient of the potential. The potential should be found by gridding the particle positions into a density, and convolving that density with the (softened) potential from a single particle. The acceleration is then found by taking the gradient of the potential. You will probably wish to use a leapfrog solver with fixed timestep.

Part 1: Using this code, show that a single particle starting at rest remains motionless.

Part 2: Next, show that a pair of particles placed in a circular orbit continue to orbit each other, for at least some reasonable length of time.

Part 3: Set up both periodic and non-periodic boundary conditions. Set up a problem where at least hundreds of thousands of particles are initially scattered randomly throughout the domain. Show the evolution with time for both periodic and non-periodic boundary conditions. Track the total energy - how well is it conserved?

Part 4: Switch to an RK4 integrator from a leapfrog. At fixed computational work per unit time in the simulation, which integrator preserves energy better? You may assume the work is dominated by the calls to get forces. Output should be in "rk4 periodic.gif" and "rk4 nonperiodic.gif". Please use the same initial conditions (and starting seeds) as in part 3.