Final Project For N-Body

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

Make a 3-D nbody code that calculates the forces by computing the potential, where the potential is found by convolving the 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 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: In cosmology, we start the universe with a scale-invariant power spectrum, so mass fluctuations are proportional to k^{-3}. Start with the particles on a grid, but with masses derived from a realization of k^{-3} and use periodic boundary conditions. How does your universe look now?