ACM 11: Solar System Project

This is one possible topic for the ACM11 Mathematica project. Difficulty rating: easy to medium. 100 points. 11/27/08.

Simulate the dynamics of the three body system consisting of the Sun, Moon, and Earth using Mathematica.

You will need initial conditions for your simulation: the distances of the Earth from the Sun and the Moon from Earth, as well as the orbital velocity of the Earth relative to the Sun and that of the Moon relative to Earth. Of course you will also need the mass of these bodies. All of this information is available on the Internet- use the most accurate information you can find, but don't worry excessively about that (the simulation is insensitive to reasonable variations in the initial values). I suggest that for simplicity, you use a collinear initial configuration of the three bodies and use NDSolve.

Animate the orbits of these three bodies over the span of 5 years. Be sure to avoid flickering by explicitly setting the PlotRange on your graphic. If we simply used a 1-1 scale in the graphic, the orbit of the moon would be indistinguishable from that of the Earth, since the Earth-Moon distance is miniscule compared to the Sun-Earth and Sun-Moon distances, and the motion of the Sun would be unnoticable, because the Sun is so massive that compared to the other two bodies, it barely moves. Use your discretion to find felicitous rescalings of the orbits– e.g. we should be able to see the movement of the Sun, the movement of the Earth, and the fact that the Moon's orbit is not a simple geometric figure. Plot the Sun as an orange point, its path as an orange dashed line, the Earth as a (smaller) green point with a green dashed orbit, and the Moon as a (even smaller) gray point with a gray dashed orbit.

Document every stage in your program with text cells, or comments.

If you want, add even more solar bodies! (Take this as a challenge to write your program in such a way that adding more bodies to the simulation is trivial, perhaps as simple as extending a few lists containing the initial conditions– this is, of course, not a requirement)

