Introduction to Parallel Scientific Computing

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Parallel integration of an ordinary differential equation

We consider the problem of computing the trajectories of planets or stars using Newton's law of gravitation. There is a sequential program available for this problem which uses the explicit Euler method.. The trajectories are written to file and can viewed with the program "gnuplot": (`gnuplot planets.gpd`).

Structure of the input file:

<Number of planets n>
mass_1
x_1
y_1
z_1
u_1
v_1
w_1
.
.
.
.
mass_n
x_n
y_n
z_n
u_n
v_n
w_n
<max. time>
<delta t>

Implement a parallel version of this program! You should simulate a large number of planets. It is probably better to generate the initial data randomly, than to read them from a file. Similarly, it is not necessary to write the trajectories to a file.

1. Measure the speedup for varying numbers of planets and processors.
2. Verify that there is a critical value for Δt, above which the integration is no longer stable. (This can be done with a small sequential computation.)