Introduction to Parallel Processing

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Home assignment #3

OpenMP

Write a parallel C code with OpenMP to simulate a naive **2D N-body problem**, $O(n^2)$.
(No Barnes-Hut).

Assume:

1. Each star has a mass equal to $m_{sun} \approx 2x10^{30}kg$
2. A square domain (this is a 2D problem) of size 100ly times100ly (1ly = 1 light year $\approx 9\times10^{12}$km)
3. The Gravitational constant, $G=6.674\times10^{-11}N\cdot m^2/kg^2$
4. v= the average speed ~ 200Km/sec.
5. The number of stars, N=1,000.
6. Generate initial random positions and velocities in the 2D domain (in the range 0.5v<v<1.5v).
7. Choose the time step (1 iteration time).
8. Choose the total number of time steps (=iterations) such that the run will last longer than 1 minute (tmax).
9. Choose the number of grid points in x and y directions.
10. All the physical variables should be in double precision.
11. Conservation of mass: When a star escapes the domain a new star is born at the other edge of the domain (rounded boundary condition). The momentum must also be conserved.
12. Execute the code on one of the “hobbit” nodes.
13. Measure the time using `omp_get_wtime()`.

What to submit?

1) Submit your code.
2) A plot of the speedup (t_2/t_p) vs. number of threads (p=2,4,6 and 8 threads).
3) A plot of $t_N/t_{50,}$ for N=50,100,500,1000 stars vs. number of stars (problem size) N=50, 100, 500,

and 1,000, for a fixed number of 8 threads.

4) For the case of 1,000 stars and 8 threads, generate 3 snapshots of your galaxy (t=0, t=tmax/2 and at t=tmax) and submit map images of the galaxy (in png or jpg format).

5) Your conclusions.

Due: two weeks

Good luck!