OpenMP Assignment #3

You need to provide the OpenMP implementation of the **many-body problem** as stated below. Generate the trajectory of the many-body system during the simulation using the concept of classical mechanics. The detailed procedure is mentioned in the following steps:-

1) Consider 1000 *spherical* bodies. The mass and radius of each body are *1Kg* and *0.5m* respectively.

2) Assume that the bodies are placed inside a container which is a rectangular cuboid. The dimension (length×width×depth) of the container is *100m×200m×400m*. If during motion, a body reaches the container wall, then the body will get reflected from the rigid boundary and will be positioned accordingly.

3) The initial 3D coordinates of the bodies are provided, and initially, they all are at rest.

4) You can calculate the forces acting on the bodies using the gravitational force equation proposed by Newton's theory of gravitation which is

   $$F = (G \times M_1 \times M_2)/r^2$$

   where M_1 and M_2 are the masses of the interacting bodies and r is the Euclidean distance between their center of masses. The gravitational constant (G) is $6.67 \times 10^{-11} m^3 kg^{-1} s^{-2}$.

5) From the initial coordinates and the calculated forces on the bodies, you can compute the velocity of the bodies and their position at the next time instant using the Velocity-Verlet algorithm[1], a numerical method used to integrate Newton's equations of motion. Assume that the time step of the Verlet integrator (Δt) as *0.005s*.

6) Run the OpenMP version of the many-body simulation system for *1 hour* on the given input file. Record the positions of the bodies (trajectory.txt) at each iteration/time step in an output file separated by a line "TERMINATE". Maintain the log of your simulation (log.txt) in another file with the following details:

   a. System specification (CPU, #Processor, Clock Speed, #Threads used)
   b. Time required for each step.
   c. Total simulation time.
   d. Any other information.

7) Create a folder with your roll no as the folder name. Place your OpenMP code and output file in the folder. Zip it and upload in Moodle.

[1]http://www.compsoc.man.ac.uk/~lucky/Democritus/Theory/verlet.html#velver