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For the OpenMP mini project, I plan to center my work on recent readings I have been doing regarding the N-Body problem. The N-Body problem is the classic orbital dynamics problem derived from Newton’s Second Law of Motion as well as Newton’s law of universal gravitation. The algorithm itself is well defined and understood. Additionally, there are existing methods to parallelize the work - these center around dividing the three dimensional space in question into octrees or quadtrees <https://en.wikipedia.org/wiki/Octree>.

Once the space is divided, the tree can be constructed, and the tree is traversed to a set depth - the more in depth the traversal, the heavier workload and the finer degree of accuracy. The algorithm operates on the premise that as objects further out from the center object are considered, their gravitational force on the object in question can be combined into one single gravitational force from the collective center of their mass. This allows for the parallelization of the algorithm, in that for each node, the calculations can be parallelized to determine the net gravitational effect. This is the section in which openMP can be employed.

From https://scala-blitz.github.io/home/documentation/examples//barneshut.html

To summarize – the Barnes-Hut simulation proceeds in steps, and each step consists of several phases:

1. In each step, bounds on all the positions have to be calculated first.
2. A quadtree is then constructed based on the positions of all the bodies and their bounds.
3. At this point the net force on all the bodies can be calculated by traversing the quadtree for each of the bodies.
4. Finally, we remove the bodies that are too far away and unlikely to affect the simulation anymore.

The end goal will be to simulate either a small solar system, the formation of a planetoid from stellar dust, or other such gravitationally driven events.