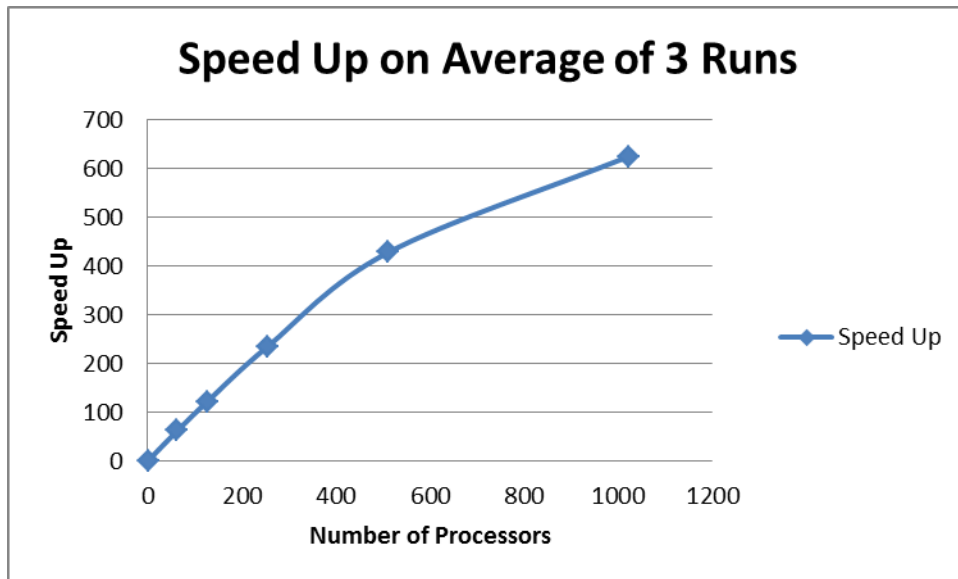


Homework 7: Particle Interaction

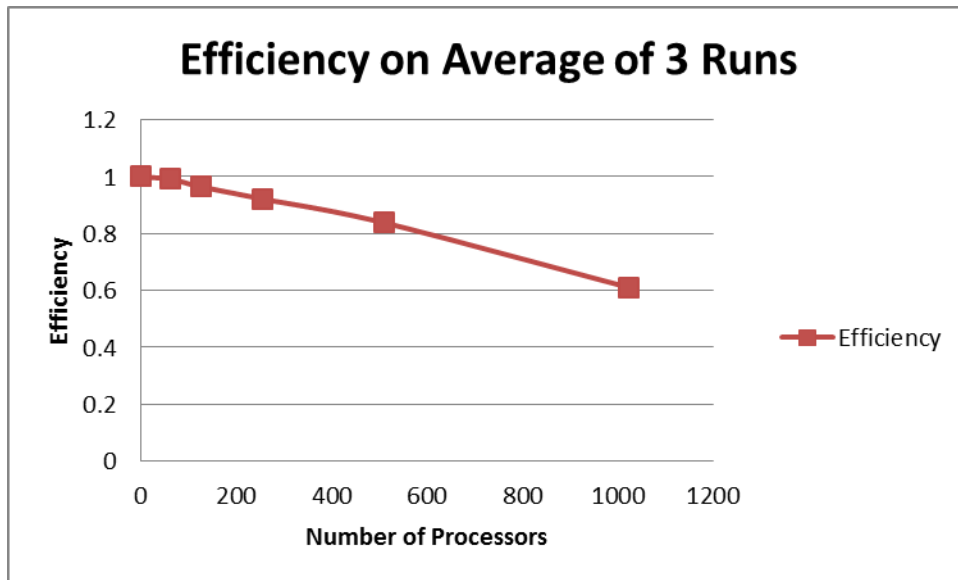
Introduction to High Performance Computing CS 1645

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- 1) General Parallelization effort for this problem was a Ring algorithm using MPI. Rather than one processor computing the interactions between every single particle the particles are split evenly over the processors. Each processor will pass along its section of the particles and then compute the forces between its set and the set of particles it just received. This is done with a ring topology and after traveling half way around the ring the passed set of particles will have the sum of forces with the particles in the sets it has passed by. While this set has been moving around the ring the other half of the sets have passed by the original copy of the set, this means that set has the sum of forces between the other half of the particles. The copy of the set is passed back to its original processor and the forces are computed which combines the halves of the ring so that the total forces are calculated. This is faster because this happens to each set (that are on different processors) of particles at the same time.
- 2) This is a graph of the speed up of the program averaged over 3 executions.



- 3) This is a graph of the efficiency of the program averaged over 3 executions.



- 4) The biggest bottlenecks are the communication times. As you use more and more processors more and more messages must be sent and on computers that do not have an underlining ring topology (like stampede and its Fat Tree Topology) more and more complicated routing is needed and often messages will have to travel farther and farther to reach its destination. These longer times mean that the speed up will decrease with more processers so the efficiency will go down over all.