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Parallel and Distributed Computing REU

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Dear Sir or Madam,

I'm largely interested in Computational Mathematics, specifically in the pursuit of optimizing the algorithms for these types of problems. Therefore, fields such as Numerical Linear Algebra, Computational Number Theory, Cryptography, and Numerical Optimization are very attractive to me. In addition, I have a substantial interest in the methods to accomplish such tasks, such as compilers, and methods of high performance computing, notably distributed and parallel computation.

I realized this when recently I worked on a course project that could have benefited from parallelization. In my graduate Geometric Modeling course, which was a cross between computer graphics and discrete differential geometry, my final project was to implement a paper *Algebraic Point Set Surfaces* by Gunnebaud and Gross. Roughly speaking, in graphics when we want to turn a point cloud, read by some kind of scanner, into a triangularized mesh, we do an optimization on algebraically fit planes to the point cloud, minimizing distances. But, this paper proposed a fast method to fit spheres to the data using an interesting "linear under certain circumstances" approximation, which was advantageous in regions of high curvature.

What really plagued me in this project wasn't the actual graphics theory. Rather I spent days spinning my wheels in the implementation, trying to reduce the bottleneck in the eigenvalue system construction and solve, trying various different sparsity arguments and decompositions. Later I realized, that I could have seriously improved performance using a library like OpenMP to parallelize the construction of the matrix and the actual solve. That's when I began to look into parallel computation.

Next semester, I'm taking a HPC course on this with the hopes of improving my finite field polynomial library with it, and I hope to be able to apply my new abilities in this REU with any professor looking into parallel numerical methods or similar. I'm very interested in this field, as I consider it the next step in numerical methods.

Sincerely yours, Abhijit Chowdhary.