

Supercomputing in High Schools

Accelerating Science Program

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Mission

“The Accelerating Science Group studies ways to accelerate computation to increase the pace of scientific discovery and technological innovation.”



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Scientific Computing Process

- Data Collection
- Computation
- Interpreting Results



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Example: [Hirsch-Fye Quantum Monte Carlo Algorithm](#)
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Example: [Hirsch-Fye Quantum Monte Carlo Algorithm](#)
Scientific Computing Process

- Data Collection
- Computation ([Large Dense Matrix Multiplication](#))
- Interpreting Results

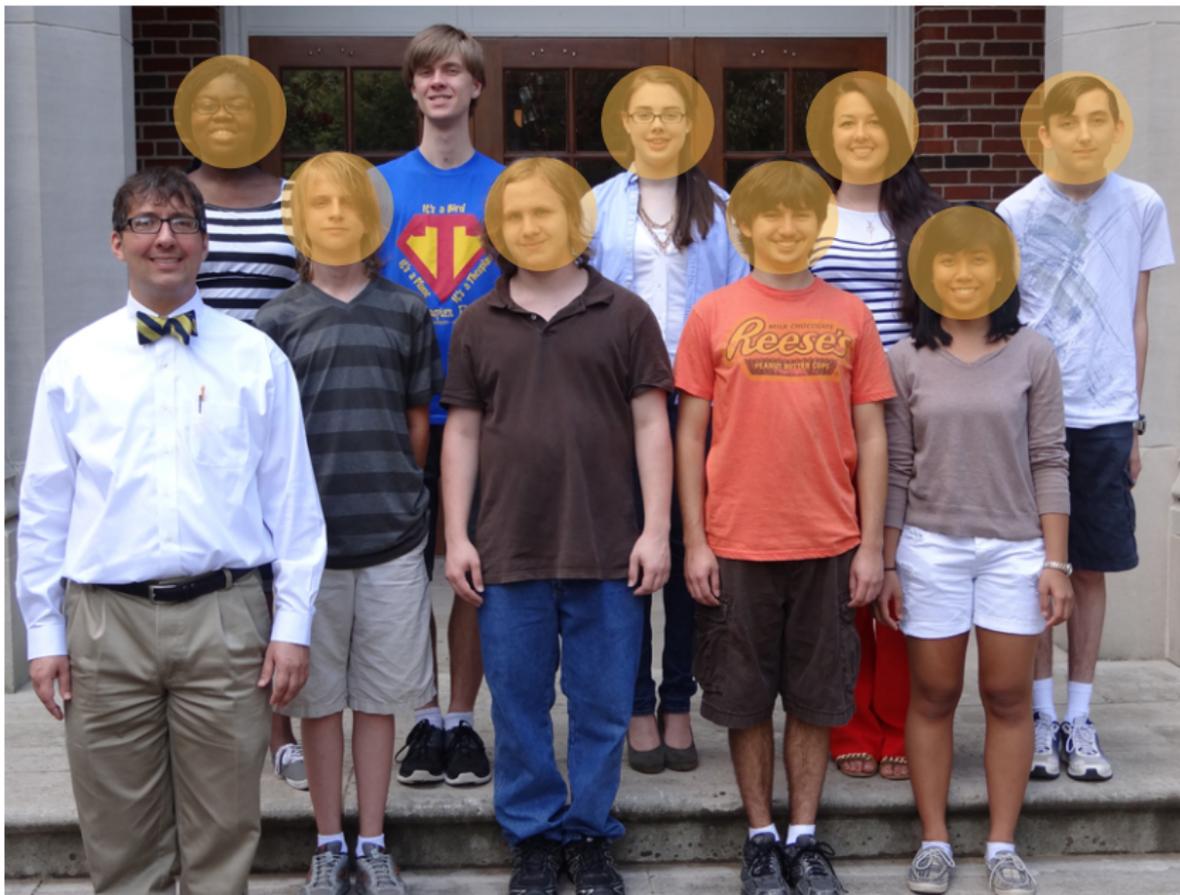


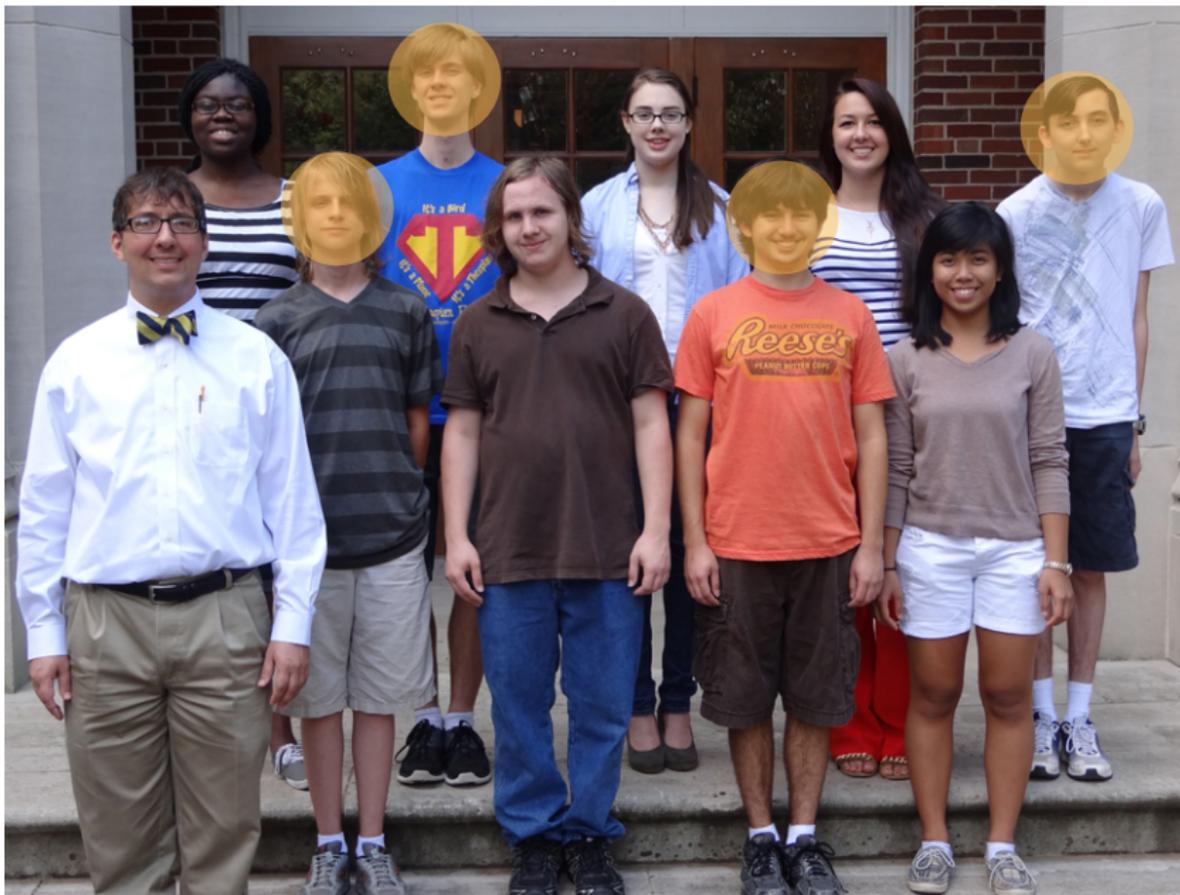


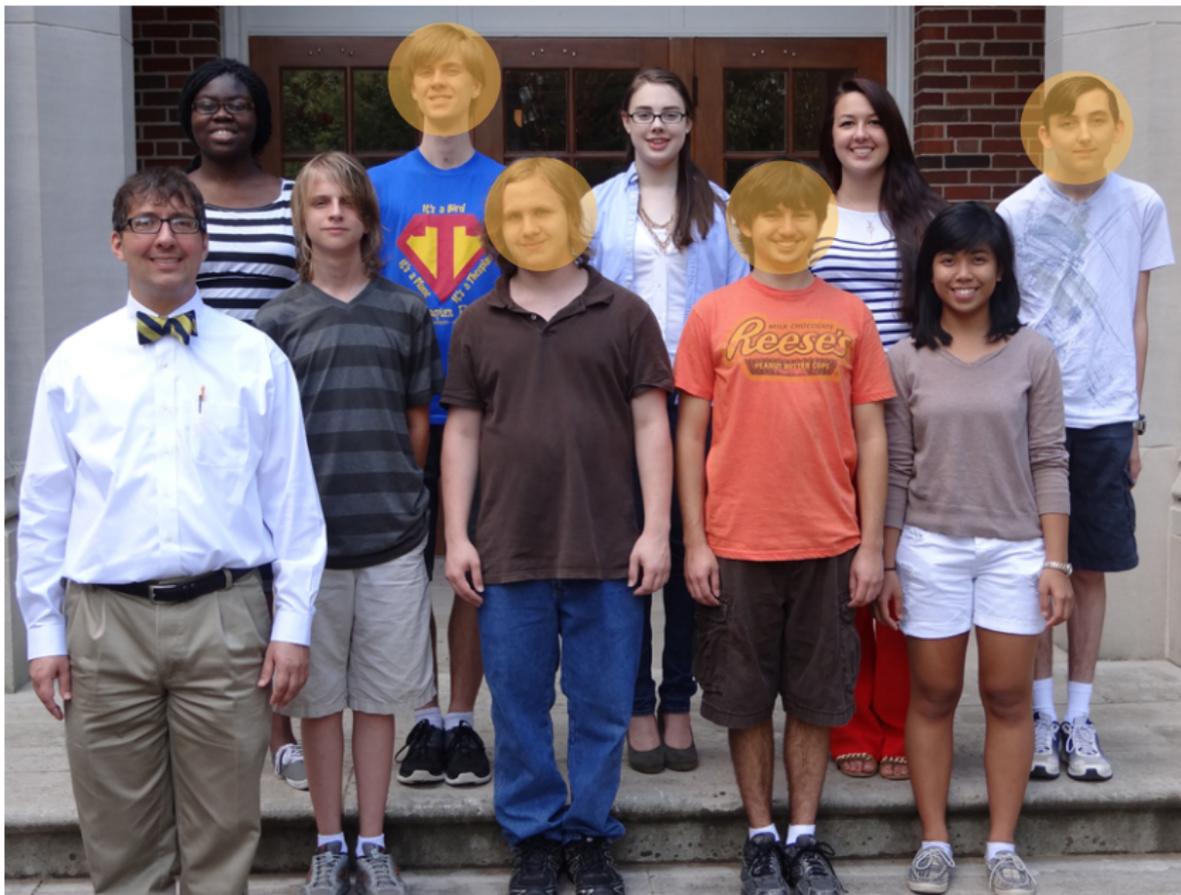


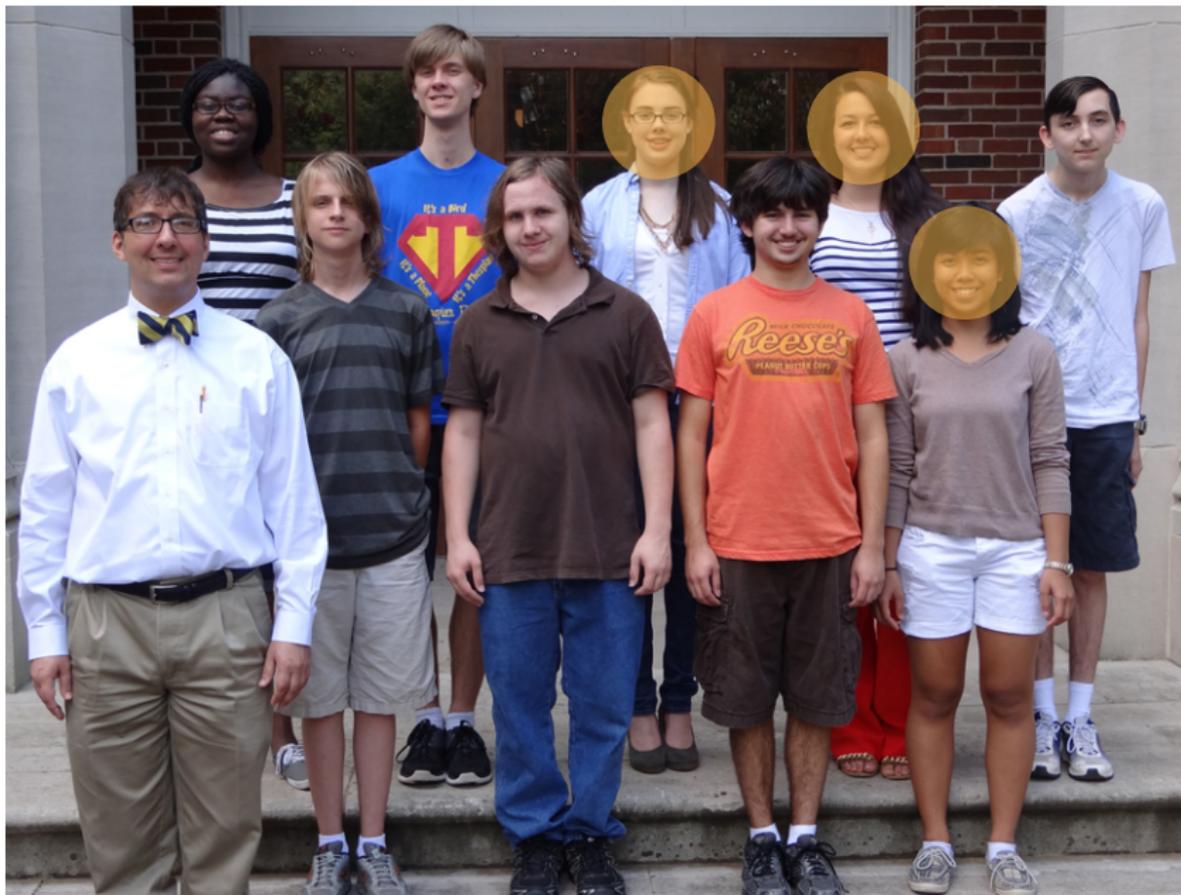














So, Why Are We Doing This?



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- Experience with High Performance Computing



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- Experience working in teams



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So, Why Are We Doing This?

- Experience with High Performance Computing
- Experience working in teams
- Experience with public speaking
- Boost us into summer research



Our Master Plan

- Accelerating Science Group during junior year
- Research during the summer after junior year
- Accelerating Science Group during senior year
- Graduation with Distinction
- Research Experience for Undergraduates after graduation



Progress to Date

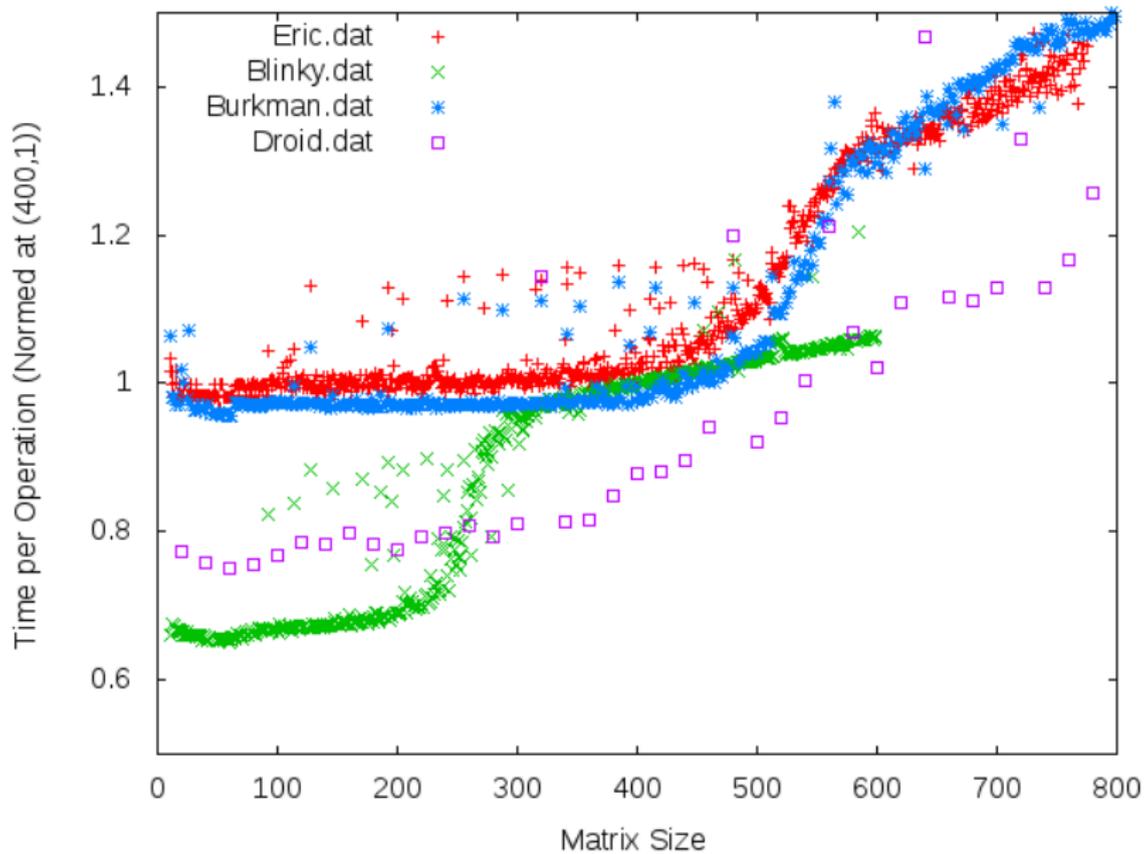
- Understood the challenge
- Ran tests of simple cases



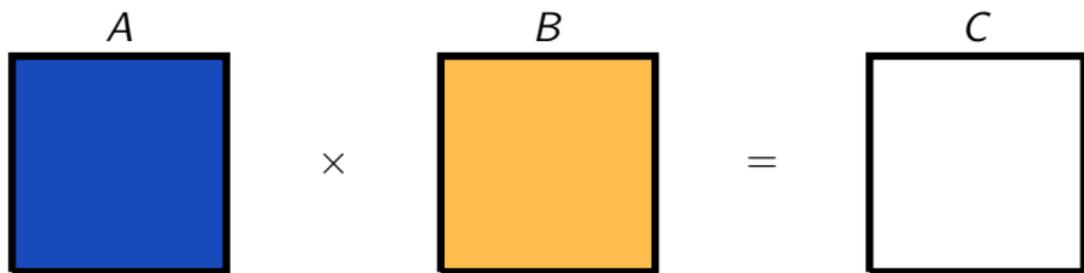
How Large is Large?

For our purposes, it's a matrix whose size pushes the limits of our computer's memory, whose multiplication pushes the limits of our software, and whose multiplication can be significantly accelerated with ingenuity and cleverness.

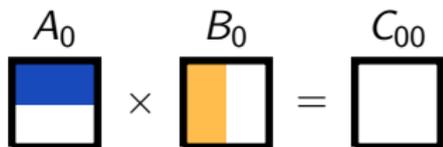


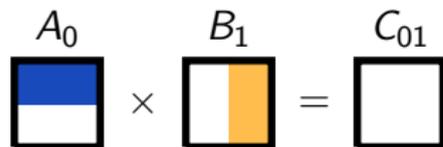


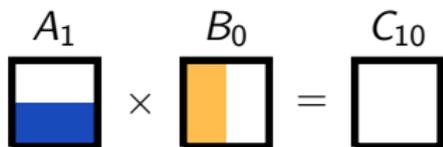
Tiling Algorithm

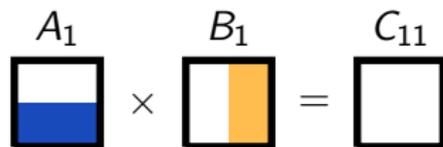


Tiling Algorithm

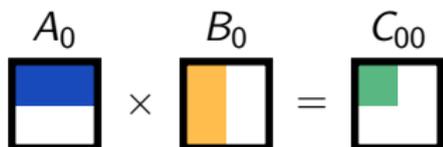
$$A_0 \times B_0 = C_{00}$$


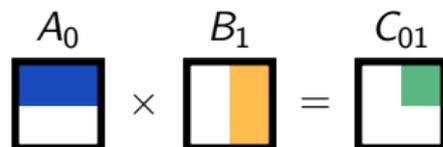
$$A_0 \times B_1 = C_{01}$$


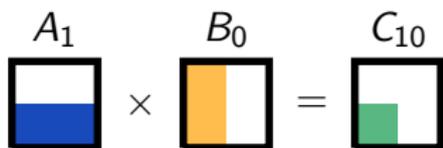
$$A_1 \times B_0 = C_{10}$$


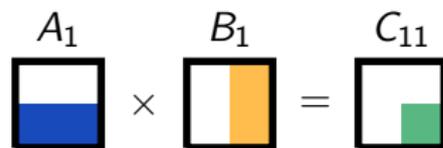
$$A_1 \times B_1 = C_{11}$$


Tiling Algorithm

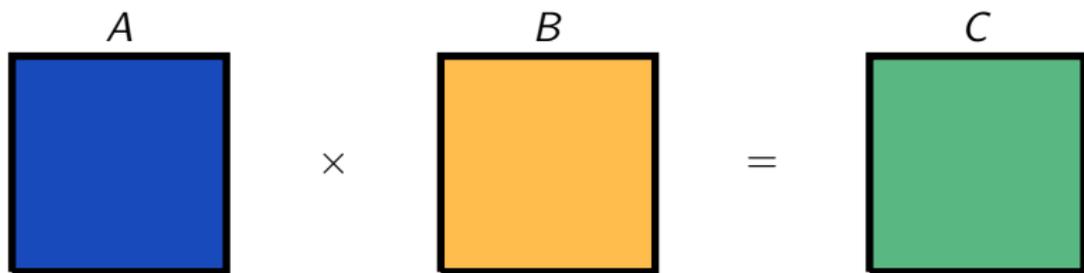
$$A_0 \times B_0 = C_{00}$$


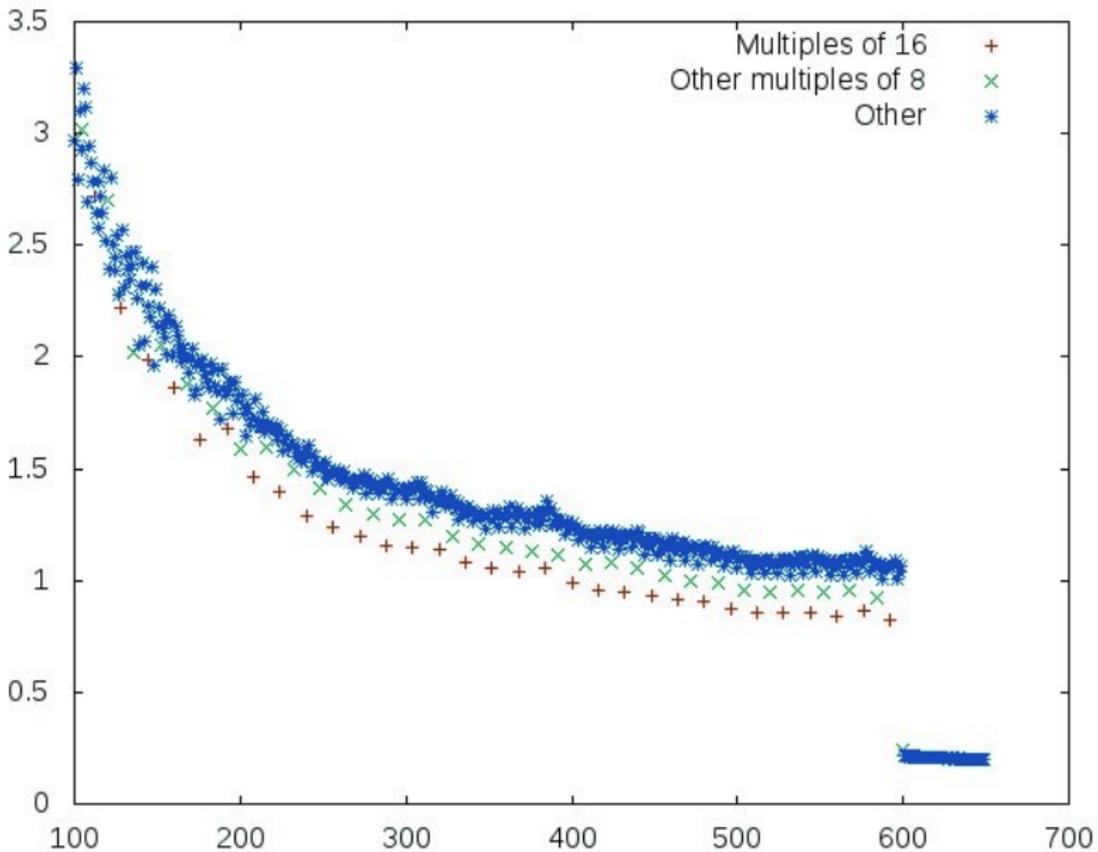
$$A_0 \times B_1 = C_{01}$$


$$A_1 \times B_0 = C_{10}$$


$$A_1 \times B_1 = C_{11}$$


Tiling Algorithm





What's Next?



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- Split into teams to work on:
 - Parallelizing code
 - Tiling matrices
 - Reindexing matrices
 - Optimize code for different architectures



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- Split into teams to work on:
 - Parallelizing code
 - Tiling matrices
 - Reindexing matrices
 - Optimize code for different architectures
- Commissionless commission projects
 - LSU: Hirsch-Fye Quantum Monte Carlo Algorithm



Hirsch-Fye Quantum Monte Carlo Algorithm

- Libraries good for simple cases of large matrices, but aren't so good for thin matrices
- Work with LSU grad students to optimize for their specific case



XSEDE

Extreme Science and Engineering
Discovery Environment



July 2013, San Diego, CA



Speakers

We're looking for people who are willing to speak to us about their applications of matrix multiplication.



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How about you?

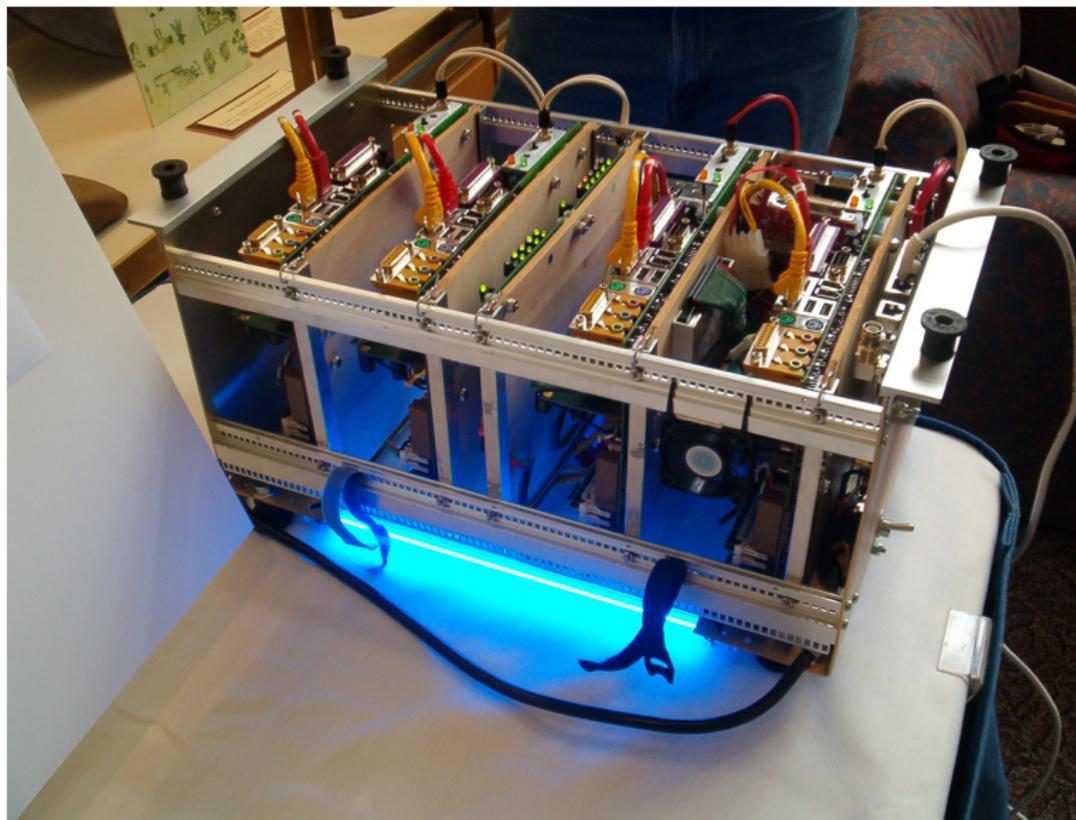


Special Thanks

Mr. Brad Burkman
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La-SIGMA
SHODOR
LSMSA Foundation
Mrs. Kristal Fults



Feedback?



Questions?

