Grid Computing

"Many hands make light work."

University of Hawaii at Hilo - Robert R. Puckett - 2006

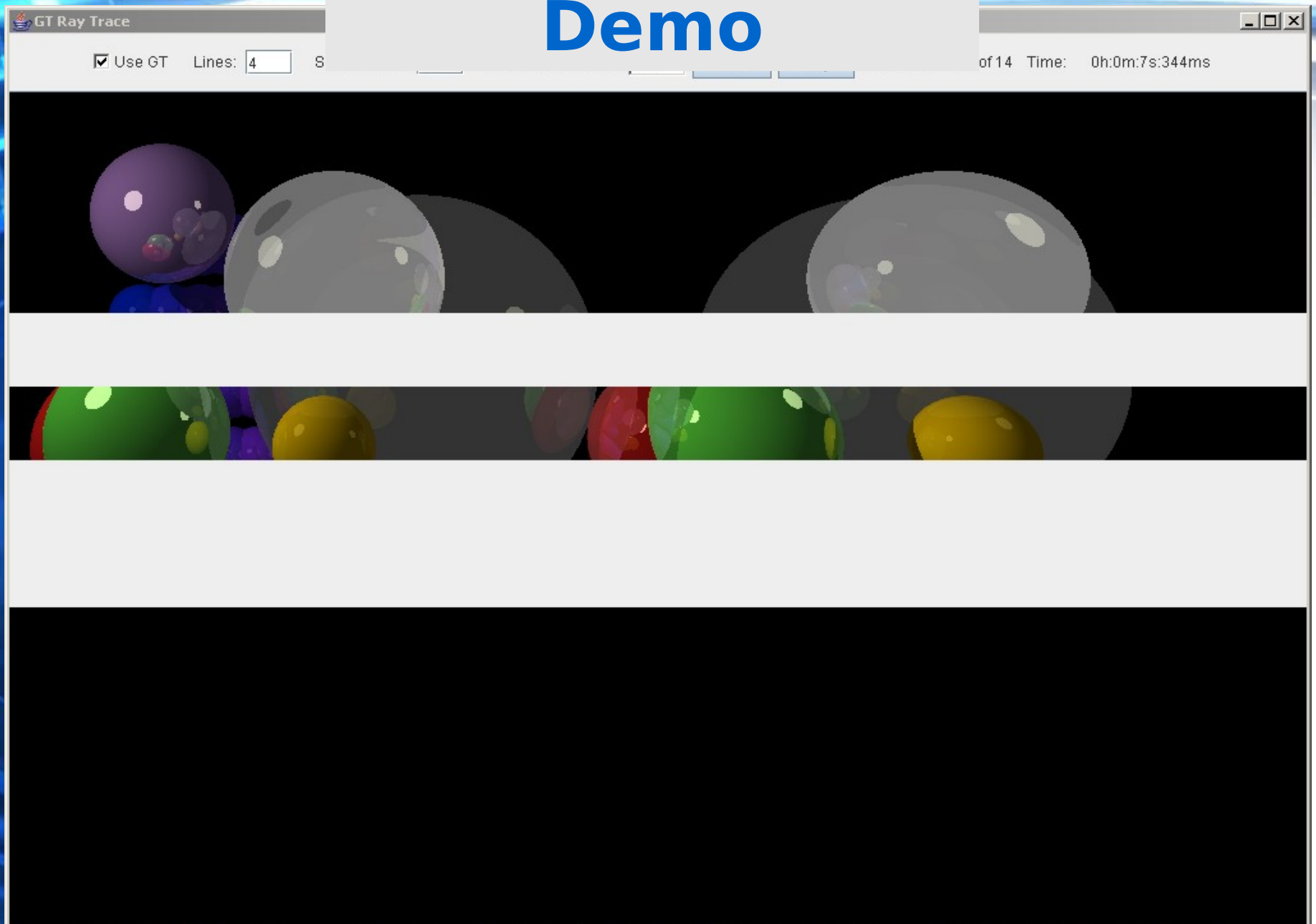
GreenTea™

- Java-based
- Permits grid computing, distributed computing, peer to peer
- ~15-20% overhead
- Demo package for benchmarks

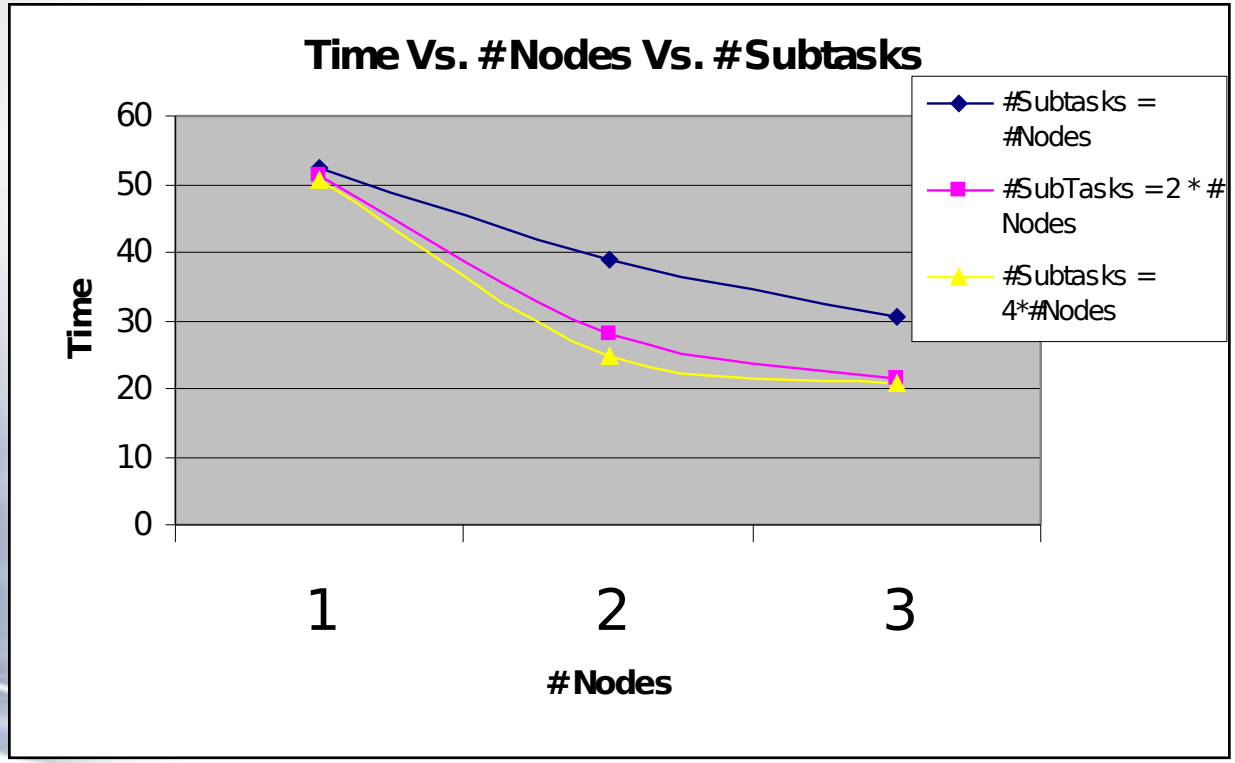
Software Components

- Resource Management
  - Allocating existing resources to jobs
- Resource Discovery & Monitoring
- Integrity & Security
  - Application Layer
- Transmission
  - TCP/IP

Ray Tracing Demo



Ray Tracing Demo



Primes

- Brute force search for factors
- Work Nodes
  - Returns True or False for Relatively Prime to their Interval
- Operated too quick for benchmarking

Application Window

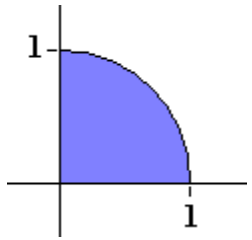
GreenTea Console

Monte Carlo

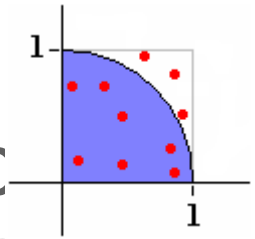
(not just for gambling)

- An Integration Approximation to:

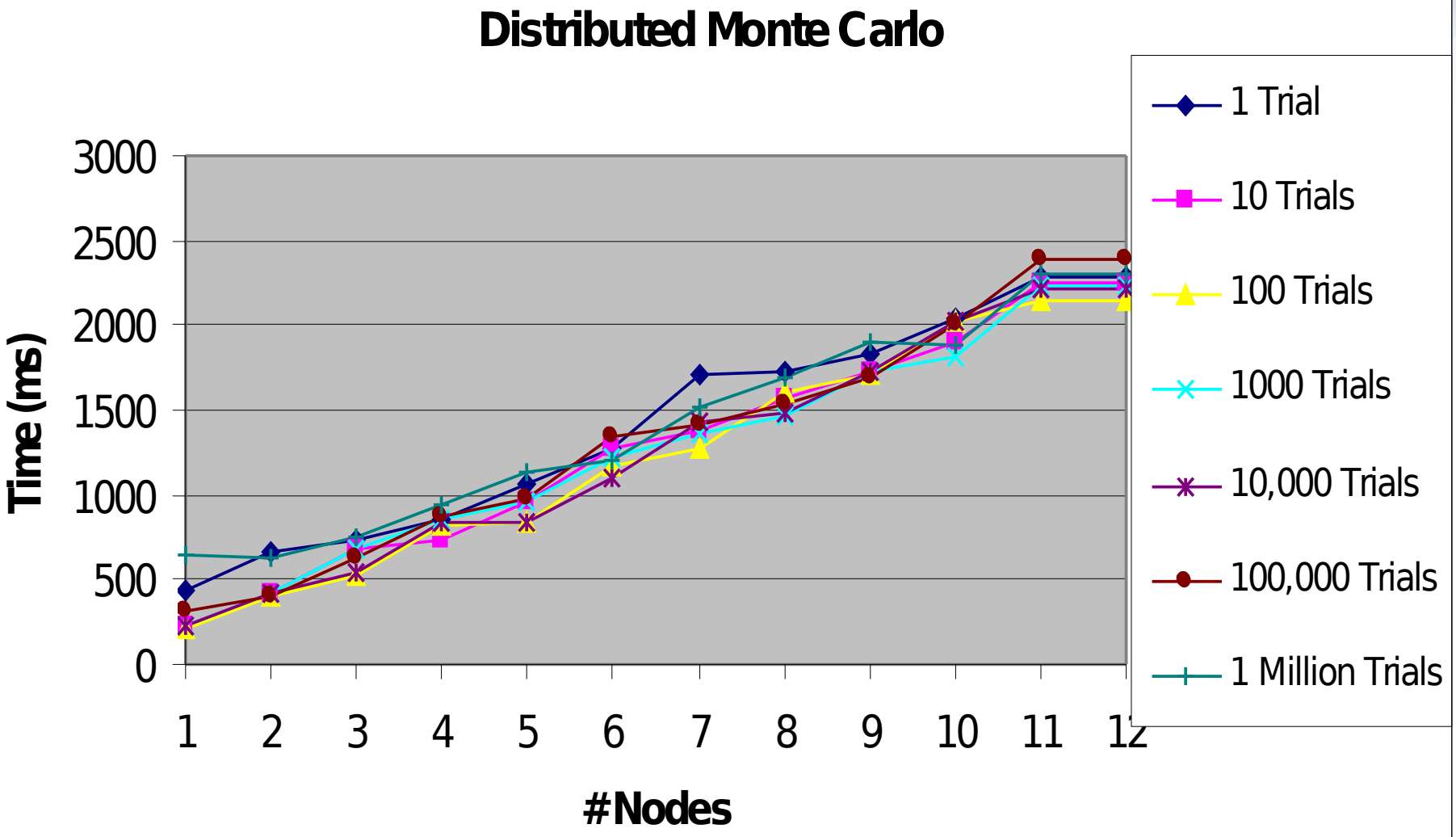
$$\int_0^1 \sqrt{1-x^2}$$



- Random number generation for points
- Ratio of points inside to tc points gives integral value



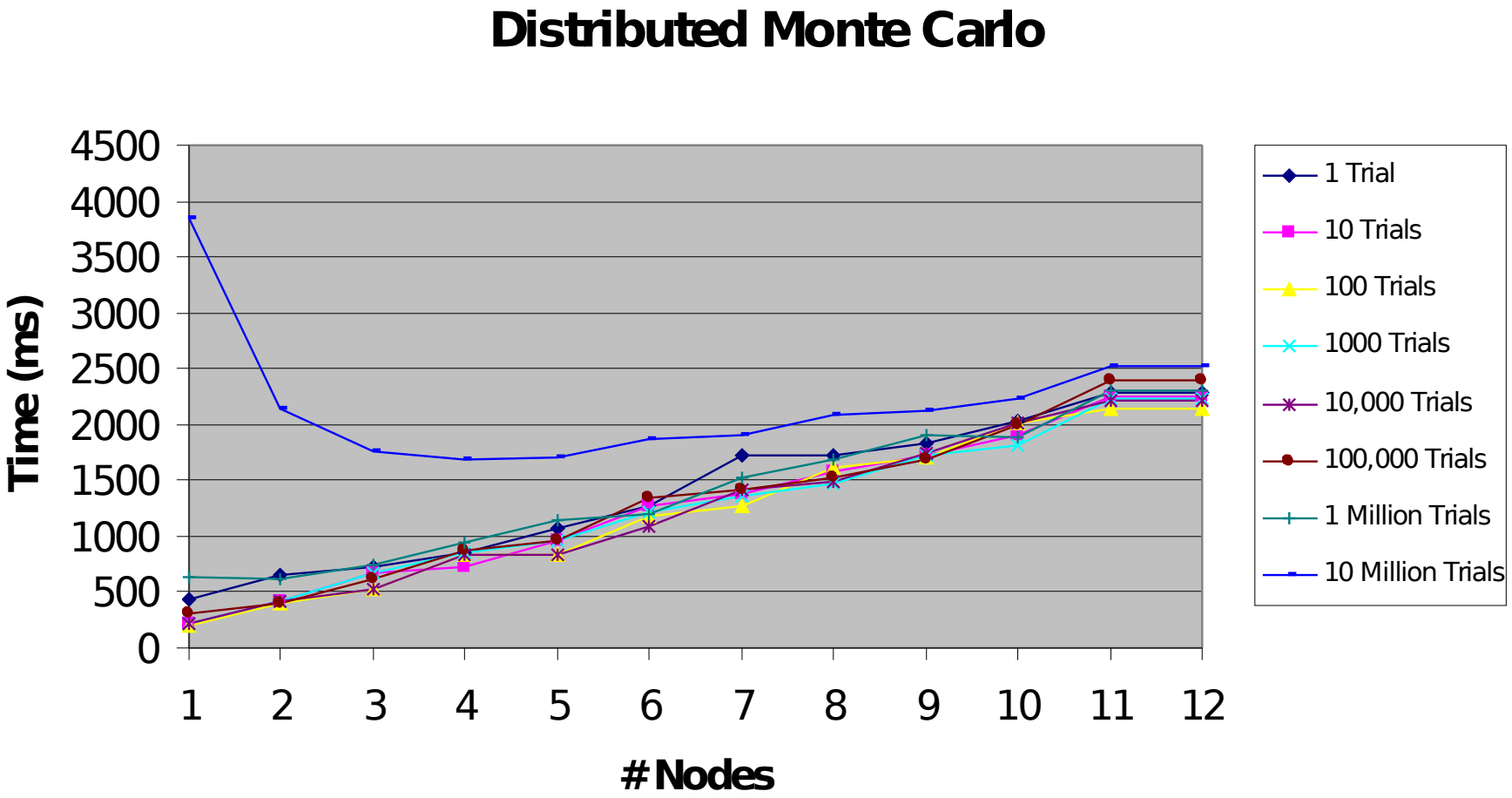
Something is not right…



What went wrong?

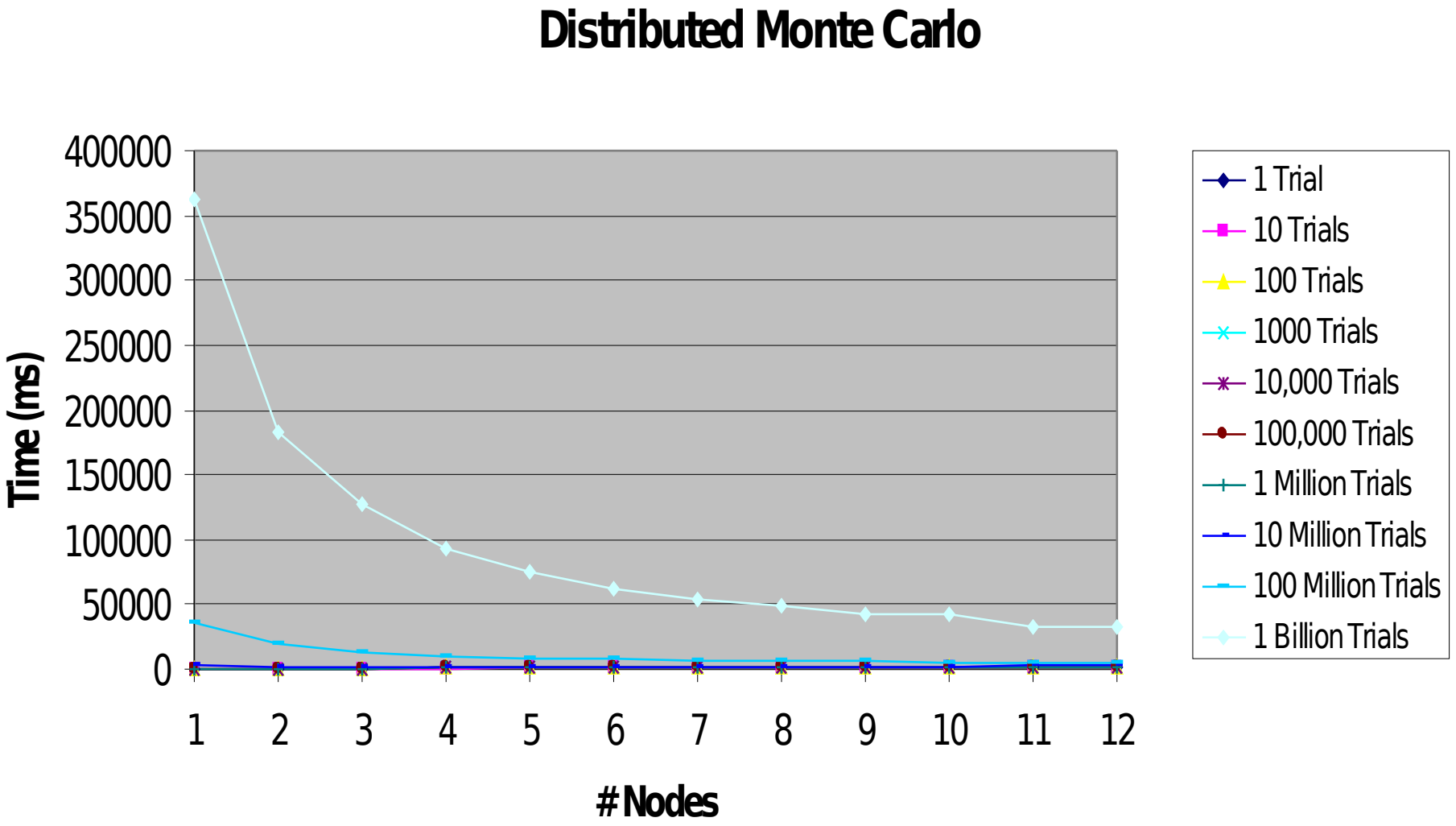
- Overhead from work division and transmission
- Other possible factors:
  - Random number generation overhead?
  - Competition for resources?

Interesting…



Breakeven point about 10 Million Trials

Much better…


Distributed Monte Carlo
Time (ms)
400000
350000
300000
250000
200000
150000
100000
50000
0
1
2
3
4
5
6
7
8
9
10
11
12
#Nodes
1 Trial
10 Trials
100 Trials
1000 Trials
10,000 Trials
100,000 Trials
1 Million Trials
10 Million Trials
100 Million Trials
1 Billion Trials

Conclusions

- Algorithms need to be optimized for grid
  - Division into local & distributed work
- Division of work overhead may outweigh benefits from distributed workload
- Increased communication between will likely add additional overhead
- GreenTea is useful tool for implementing site grid
- GreenTea might benefit from additional automation of resource allocation and monitoring

Amdahl's Law

- Allows estimate for maximum speed up
- Ignores communication/application overhead
- F is % serial code

$$\frac{1}{F+(1-F)/N}$$

References

Koch, Lewis E. 2004. A Quiet Time Bomb. The Raw Story. Retrieved February 23, 2006 from: http://www.rawstory.com/exclusives/koch/vulnerable_computer_grid.h

Levinson, Meridith. 2005. Who's Afraid of Grid Computing? CIO.com. Retrieved February 25, 2006 from: http://comment.cio.com/soundoff/042505.html.

Peel, Roger M. Grid Computing. Retrieved February 26, 2006 from: http://www.computing.surrey.ac.uk/personal/st/R.Peel/csm23/parallel-

GreenTea Technologies, Inc. GreenTea User Manual. Retrieved January 25, 2006 from: http://www.geocities.com/gtusaus/current/docs/readme.html

Foster, I. & Kesselman C. 1997. Globus: A metacomputing infrastructure toolkit.

Gustafson, John L. Reevaluating Amdahl's Law. Retrieved February 20, 2006 from http://www.scl.ameslab.gov/Publications/Gus/AmdahlsLaw/Amdahls.h

Bell, Gordon & Gray, Jim. 2002. What's Next in High-Performance Computing? Communications of the ACM, Volume 45 Issue 2. ACM Press. February.

Kahan, W. & DARCY, J. 1998. How JAVA's Floating-Point Hurts Everyone Everywhere. ACM 1998 Workshop on Java for High–Performance Network Computing. Retrieved February 26, 2006 from: http://www.cs.berkeley.edu/~wkahan/JAVAhurt.pdf.

Park, S. and Miller, K. 1988. Random Number Generators: Good Ones are Hard to Find. Comm. ACM 31, 1192-1201, 1988.