Applied Parallel Computing

Chris Lupo
Spring 2011

Background

- Over a year in the making!

- Last Summer, Cal Poly became one of the first NVIDIA CUDA Teaching Centers

- Developed the lab infrastructure to support course

- Developed the curriculum and course materials

- Came up with cool projects

Equipment

- Massively parallel compute server
  - 4 Tesla C2050 cards, 1800 cores

- Workstations
  - Each lab machine equipped with GeForce GTX 470, 448 cores

- Latest development tools
  - Compilers, debuggers, profilers

Curriculum

- Course based roughly on material from UIUC.
  - Emphasize performance
  - Memory model
  - Thread model
  - Control-flow model

- Excellent online resources from NVIDIA and developer forums.

- TA funding provided
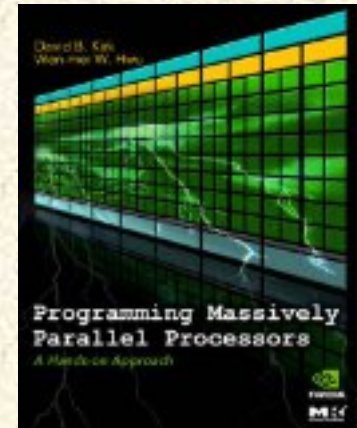
Projects

- Project 1 - Matrix Multiplication
  - Straightforward to conceptualize
  - Impact of parallelization is easily seen in performance
  - Operation forms basis for many other scientific applications
- Three parts:
  - Sequential
  - OpenMP
  - GPU

Project 1 Results

**Matrix Multiply - 1234x1234 Square Matrices**
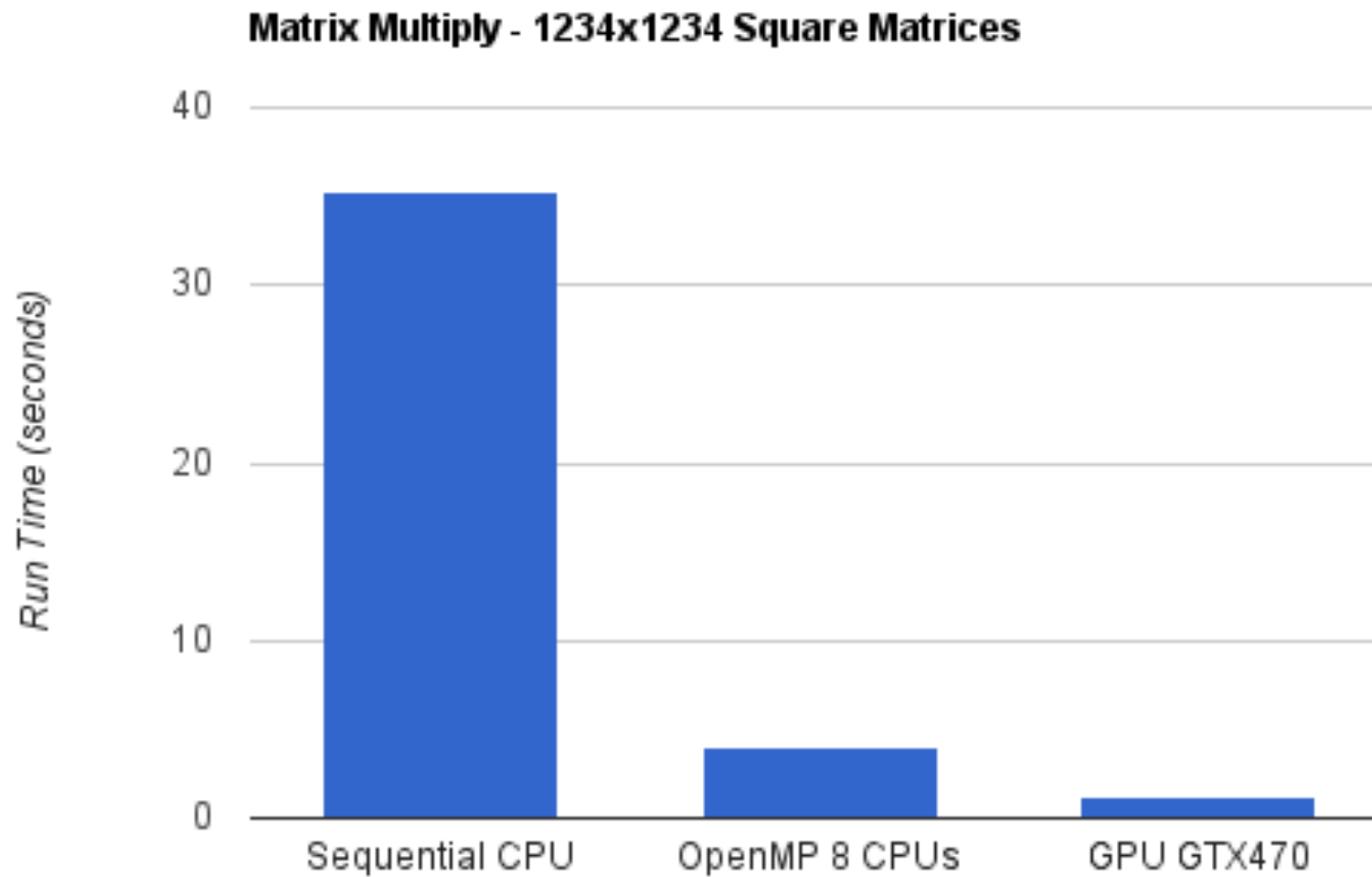
Projects

- Project 2 - Ray Tracing
  - Course integrated with Zoe Wood's Advanced Rendering Course (CPE 473) for 3 weeks
  - Teams formed such that students from each course were on every team
  - Awesome software engineering experiment
    - Rendering students had to share existing code base
    - CUDA students tasked with parallelizing that code

Project 2 Results

- Render the bunny!
- 36K spheres

- Average class speedup over CPU implementation is 170X
  - Best team had 780X (!!!)
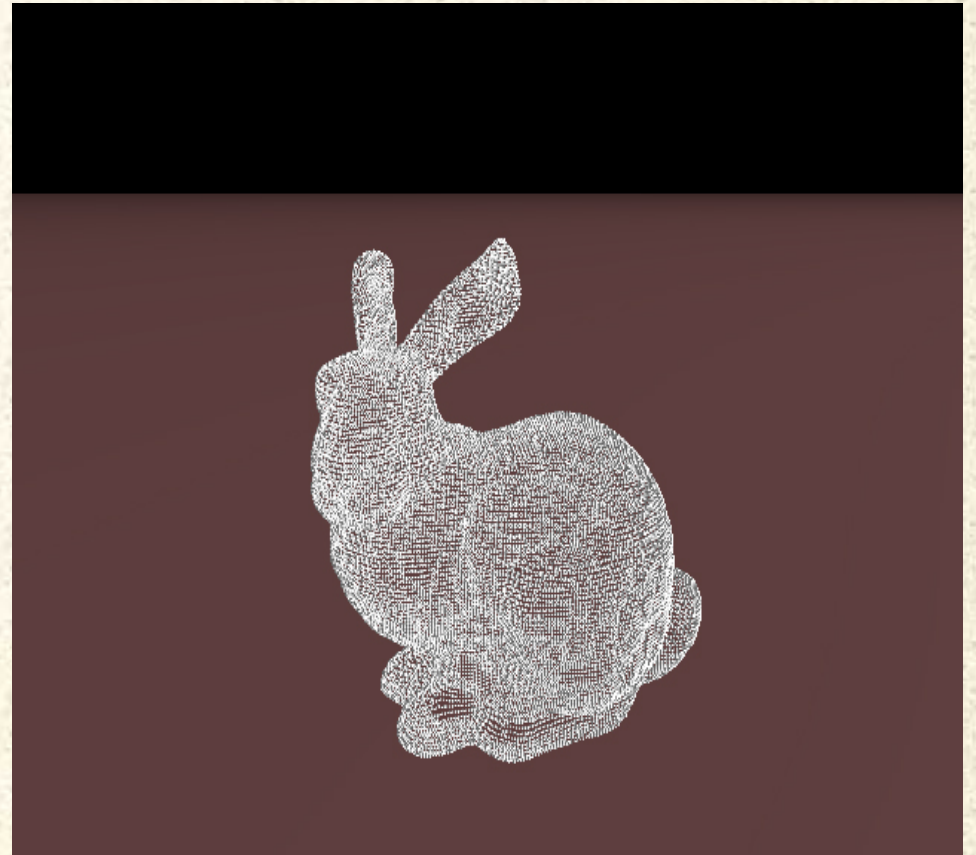
Projects

- Project 3 - Student/Team choice
  - More advanced ray tracers
    - Monte carlo, reflection/refraction, etc.
  - Game simulation
  - Financial modeling
  - Image compression (WebP)
  - WebGL
  - Data Mining (Wikipedia)
  - OpenCL

Projects

- Sandbagging actively discouraged!
- Performance was emphasized, rewards for best

Challenges

- Building and administering the lab
  - New hardware
    - big, power hungry, special connectors
  - New version of OS required
  - Proprietary drivers
- Tool-chain version different from text
  - Differences are significant
- Merging two classes for three weeks
  - Zoe was Great! Cal Poly logistics weren't...
    - Big room, colliding enrollment, ...
- Only having 10 weeks to do *everything*

The Last Slide

I can't wait to teach this again!

State Grant

Student Demand

Student Research
   paper submitted