GPU Programming and Architecture: Course Overview

Patrick Cozzi
University of Pennsylvania
CIS 565 - Spring 2012

Lectures

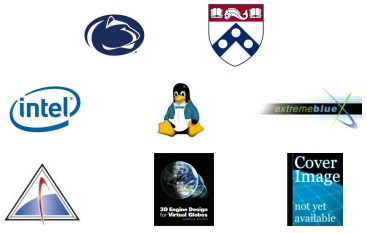
- Monday and Wednesday
- 9-10:30am
- Moore 212

- Lectures will be recorded

Image from http://pinoytutorial.com/techtorial/geforce-gtx-580-vs-amd-radeon-hd-6870-review-and-comparison-conclusion/

Instructor

- Patrick Cozzi: pjcozzi@siggraph.org



If you are curious, see http://www.seas.upenn.edu/~pcozzi/

Instructor

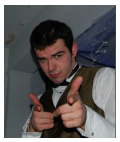
- Include "[CIS565]" in email subject line
- Office Hours
  - SIG Lab
  - Monday and Wednesday, 10:30-11:00am
- Just see me after class

Teaching Assistant

- Varun Sampath: vsampath@seas.upenn.edu
- Office Hours
  - SIG Lab
  - Tuesday, 5-6pm
  - Thursday, 3-4pm
- Starting at NVIDIA this summer

If you are curious, see http://vsampath.com/

CIS 565 Hall of Fame



Jon McCaffrey

Krishnan Ramachandran

Varun Sampath

- Are you next?

Course Website

- http://www.seas.upenn.edu/~cis565/
- Schedule, reading, slides, audio, homework, etc.

Google Group

- cis565-s2012@googlegroups.com
- Signup:
  - http://groups.google.com/group/cis565-s2012
- Be active; let's build a course community

GitHub

- Used for course materials, homeworks, and the final project
- Create an account:
  - https://github.com/signup/free
- Join our GitHub organization:
  - https://github.com/CIS565-Spring-2012
- Who is new to source control?

Prerequisites

- CIS 460/560
- CIS 371 or CIS 501
- Strong C or C++

Books

Programming Massively Parallel Processors

2010, David Kirk and Wen-mei Hwu

Old draft: http://courses.engr.illinois.edu/ece498/al/Syllabus.html

OpenGL Insights

2012, Patrick Cozzi and Christophe Riccio, Editors

Selected readings handed out in class

Course Contents

- *GPU* – *G*raphics *P*rocessing *U*nit
- Is it still just for graphics?

Images from http://www.ngohq.com/news/18784-nvidia-launches-geforce-gtx-580-a.html and http://gs7.blogspot.com/2011/09/amd-radeon-hd-6990-worlds-fastest.html

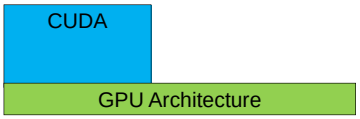
Course Contents

- *New*: Start with GPU architecture

Not to scale

Course Contents

- *CUDA* programming model for *GPU Compute*



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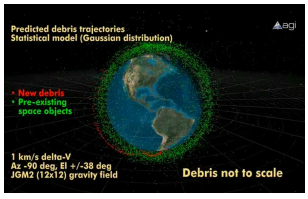
Course Contents

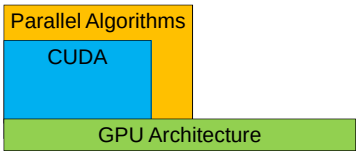
- GPU Compute example: conjunction analysis



http://www.youtube.com/watch?v=dtT3pTh_g-8

Course Contents

- Parallel algorithms that form building blocks



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Course Contents

- Parallel Algorithms example: *Scan*
  - Given:

3	1	7	0	4	1	6	3

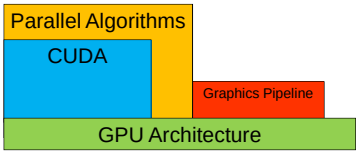
  - Compute:

0	3	4	11	11	15	16	22

  - In parallel!

Course Contents

- Historical and modern graphics pipeline



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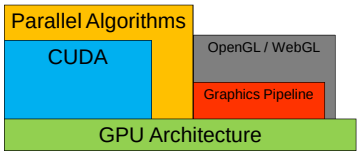
Course Contents

- *New*: WebGL



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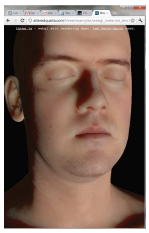
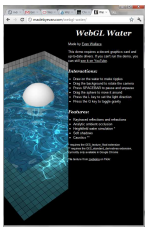
Course Contents

- WebGL Demos



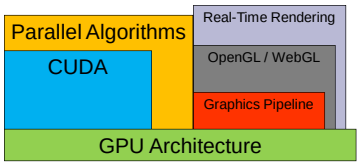
WebGL Skin
http://alteredqualia.com/three/examples/webgl_materials_skin.html



WebGL Water
http://madebyevan.com/webgl-water/

Course Contents

- Real-Time Rendering



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Course Contents

- Real-Time Rendering

http://www.geforce.com/Hardware/GPUs/geforce-gtx-590/videos

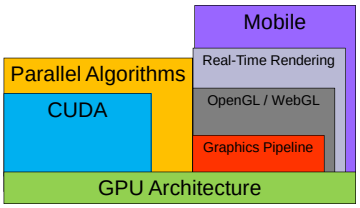
Course Contents

- GPU Compute + Real-Time Rendering

http://www.nvidia.com/object/GTX_400_games_demos.html

Course Contents

- *New*: Mobile



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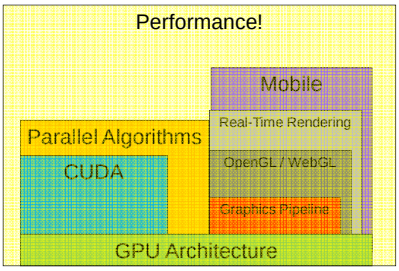
Course Contents



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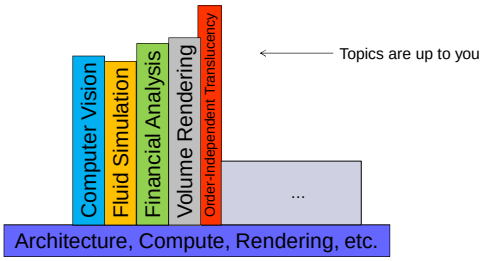
Course Contents

- Student Presentations. Examples:



Grading

- Homeworks (5) 40%
- Student Presentation 10%
- Final Project 40%
- Final 10%

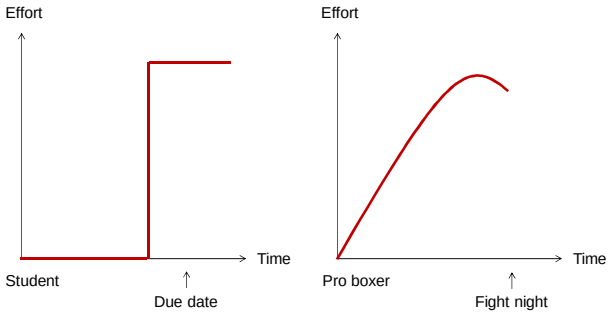
Homework Submission

- *Push* your submission to GitHub by midnight on the due date
- *Bonus Days*:
  - Five per person
  - Homework only; not for presentation or project

Homework Submission

- *Late Policy*:
  - One second to one week late: 50% deduction
  - More than one week late: no credit

Homework Submission



Academic Integrity

- http://www.upenn.edu/academicintegrity/

GPU Requirements

- Homework and the project require an *NVIDIA GeForce 8* series or higher
- Update your drivers:
  - http://www.nvidia.com/Download/index.aspx
- What GPU do I have?
- What OpenGL/OpenCL/CUDA version:
  - http://www.ozone3d.net/gpu_caps_viewer/

GPU Requirements

- Lab Resources
  - *Moore 100b* - NVIDIA GeForce 9800s
  - *SIG Lab* - Most machines have at least NVIDIA GeForce 8800s. Two machines have a GeForce 480, and one machine has a Fermi Tesla card
- Contact Varun

CPU and GPU Trends

- *FLOPS* – *FL*oating-point *OP*erations per *S*econd
- *GFLOPS* - One billion (10^9) FLOPS
- *TFLOPS* – 1,000 GFLOPS

CPU and GPU Trends

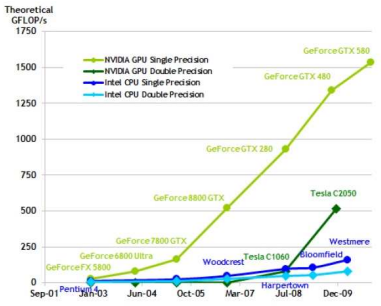


Chart from: http://proteneer.com/blog/?p=263

CPU and GPU Trends

- Compute
  - Intel Core i7 – 4 cores – 100 GFLOP
  - NVIDIA GTX280 – 240 cores – 1 TFLOP
- Memory Bandwidth
  - System Memory – 60 GB/s
  - NVIDIA GT200 – 150 GB/s
- Install Base
  - Over 200 million NVIDIA G80s shipped

Class Exercise

- Parallel sorting

Reminders

- Include “[CIS565]” in email subject line.
- Signup for our google group:
  - http://groups.google.com/group/cis565-s2012
- Join our GitHub organization:
  - Signup: https://github.com/signup/free
  - Organization: https://github.com/CIS565-Spring-2012
- No class or office hours Monday, 01/16.