

EE 7700-1, GPU Microarchitecture

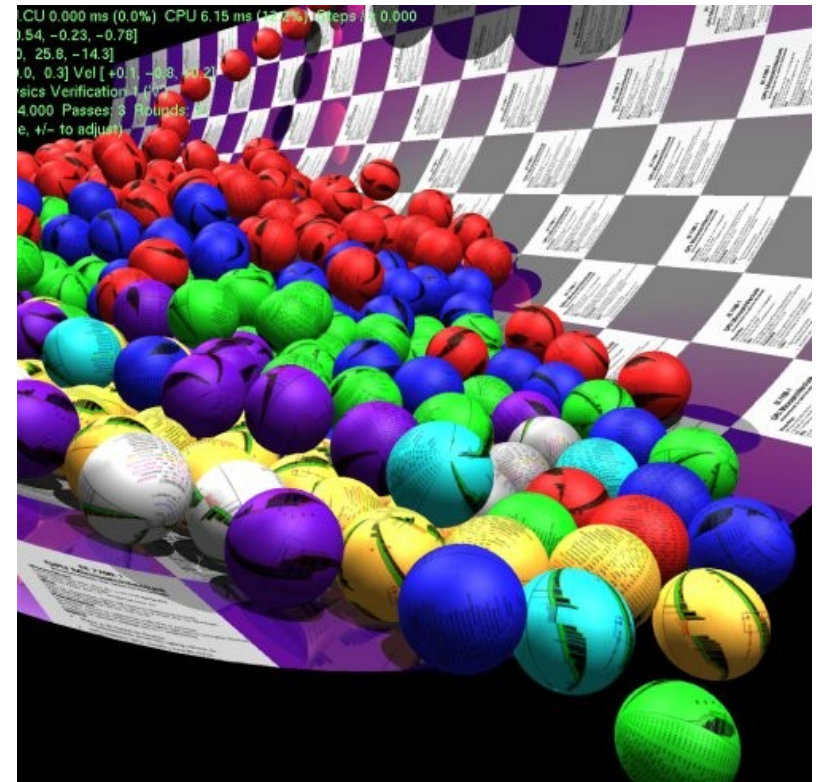
When / Where

- Here (218 Tureaud Hall)
- MWF 11:40-12:30 Spring 2010
- <http://www.ece.lsu.edu/koppel/gp/>

Offered By David M. Koppelman

- Room 349 EE Building
- Office Hours: Monday-Friday 14:00-15:00

Prerequisites by topic: C++, digital logic, computer organization.



EE 7700-1, GPU Microarchitecture

Grading

- 35% Midterm Exam
- 35% Final Exam
- 30% Homework and Projects

AVATAR

LSU AVATAR

- *AVATAR*: Arts, Visualization, Advanced Technologies and Research
- <http://www.avatar.lsu.edu>
- AVATAR includes several initiatives in the area of digital media.
- Includes research and instructional components.
- First product is a minor in Digital Media.
- This course, and others, will count toward that minor.

Balls Demonstration

Balls Program

- Shows balls bouncing on half cylinder.
- Code developed for GPU programming class.

Execution of Program

- Makes heavy use of GPU
- Would be slower or less detailed without GPU.

Ball Reflections

- Slows down execution substantially.
- Why? By end of course we will know.

GPU Definition

GPU: Graphics Processing Unit

- Like a CPU (runs programs that read and write storage) ...
... but does 3D graphics and certain other computation ...
... much faster than CPU.

GPU Placement

Main component of video card (higher-performance systems).

On motherboard along side CPU (lower-cost systems).

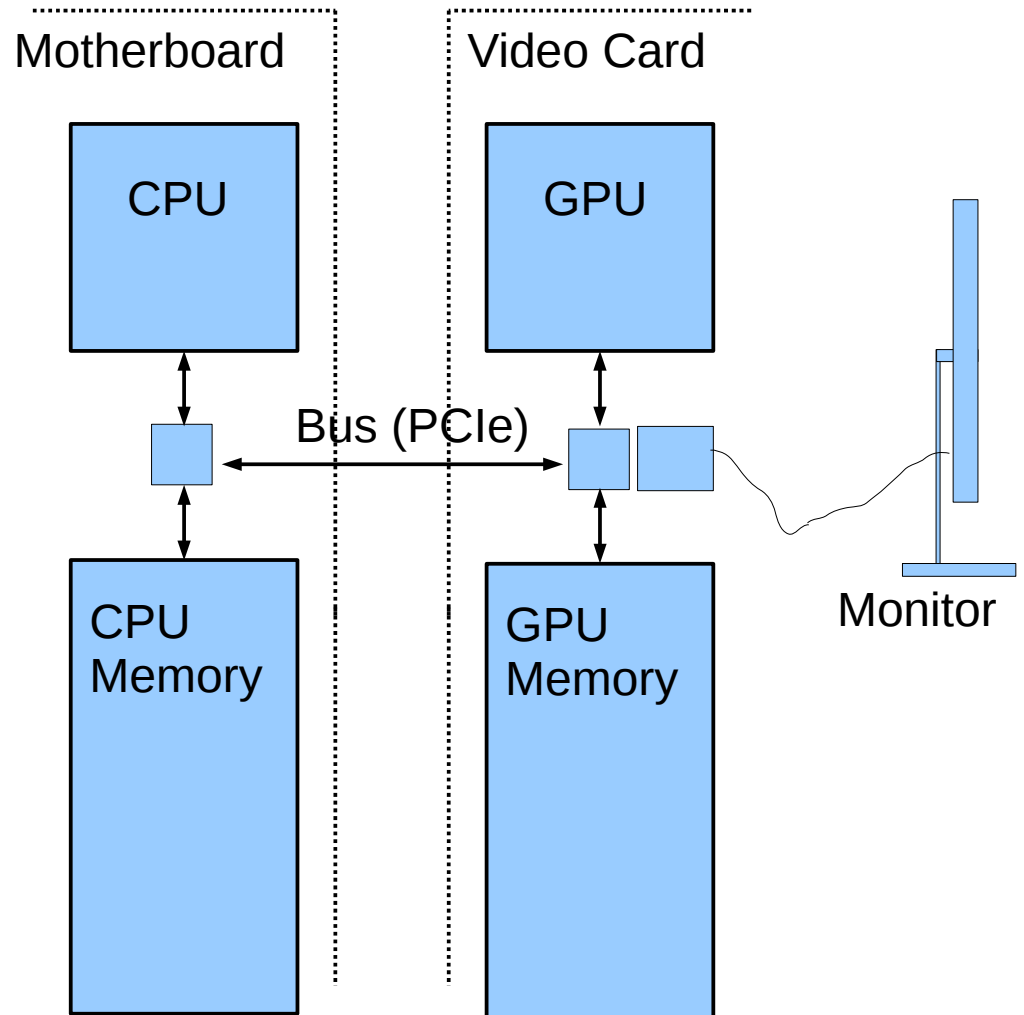
Major Companies and Brands

- NVIDIA
- ATI (Compaq)
- Intel

System Overview: Hardware

Typical Hardware

- On Computer motherboard: CPU, CPU Memory
- On Video Card GPU, GPU Memory
- Connection between CPU/GPU via Bus, e.g., PCI Express (PCIe).
- Connection from video card to monitor.



This Course

Design of GPUs

- *Case studies* of current products, NVIDIA 8000/200/Fermi
- Case studies of important past designs, NVIDIA 3 series.
- Look at proposed and research designs, Intel Larrabee.

Will Examine Key CPU / GPU Differences

- Why have GPUs succeeded where other special-purpose designs failed?

Use of GPUs

- Coding in OpenGL, shader languages.
- Coding for graphics and GPGPU applications.

System Overview: Frame Buffer

Frame Buffer

- Area of memory continuously converted to a video signal.
- Simple mapping from memory address to pixel coordinate.

Older Systems

- Frame buffer in CPU memory.
- Application programs wrote frame buffer directly.

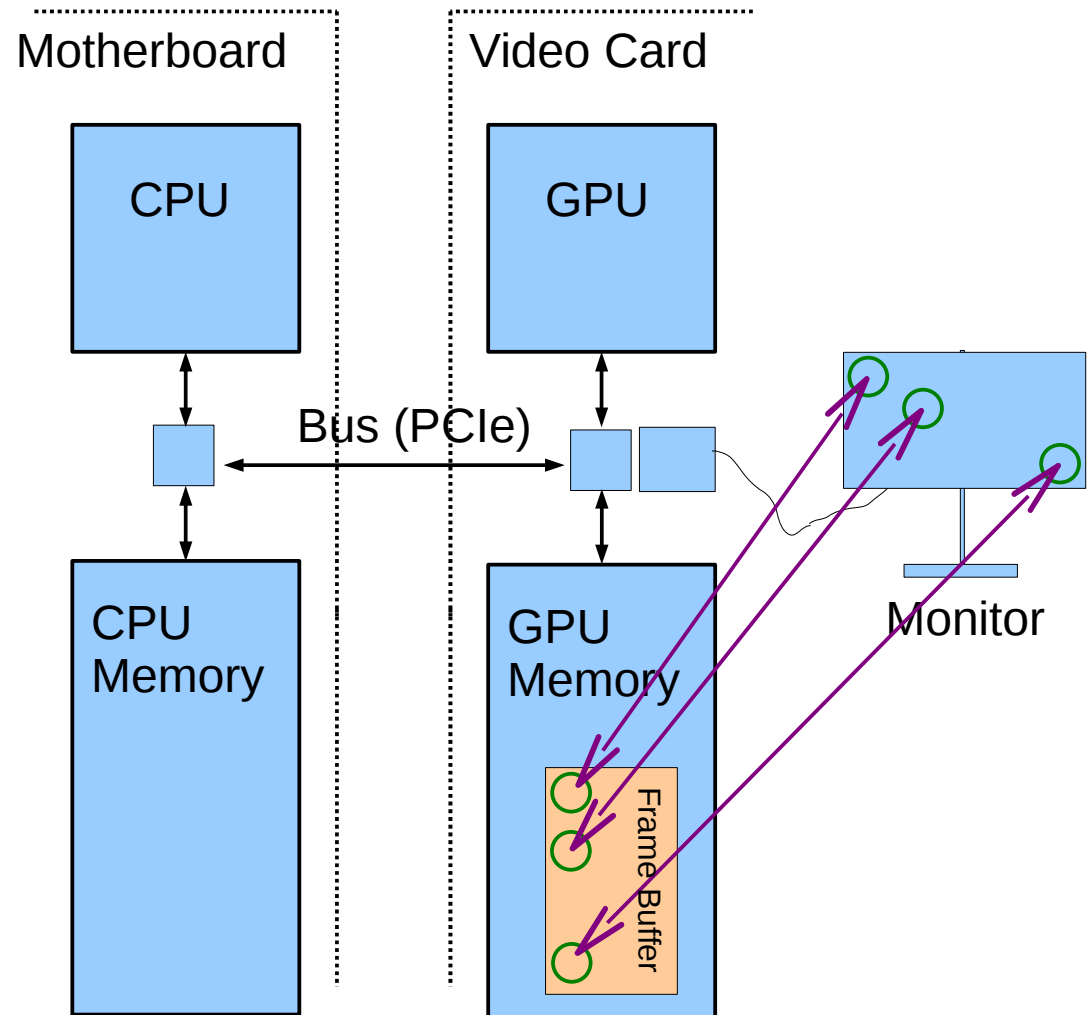
Typical Current Systems

- Frame buffer in GPU memory.
- Frame buffer written by GPU hardware (typical)...
... at end of long chain of events initiated by application.

System Overview: Frame Buffer

Frame Buffer Contents

- Position in FB corresponds to particular pixel on display.
- In illustration, first FB element is upper-left pixel.
- A common FB element size is 32 bits.
- Frame buffer format varies with video mode and of course system.



System Overview: Graphical Computations

Steps for balls demo.

- Compute ball locations (freshman physics, junior CS)
- Compute location of triangles on ball surface (grade school geometry).
- Compute lighting at each triangle vertex.
- Compute pixel location of each vertex using a *projection*.
- Compute location of all pixels covered by triangle.
- Find texture (image) color at each pixel.
- Write to frame buffer.

System Overview: Graphical Computations

On Blackboard

- Some details on steps from last slide.
- Estimate of amount of computation needed.