Today’s Outline

- OpenGL introduction
  - OpenGL primitives
- Demos / code
- Rasterization rules
- The OpenGL graphics pipeline
- Graphics hardware

Colored pixels on screen
shapes, lines, points
images, text
Demonstrations

OpenGL Shape Primitives
Pixel Coordinates

OpenGL: Pixel centers correspond to non-integer coordinates
Rasterization Rules: Area Primitives

Output fragment if pixel center is \textit{inside} area

Fragments vs. Pixels

Combine fragment color with pixel color and store in framebuffer
Rasterization Rules: Lines

Output fragment if line intersects diamond

OpenGL Drawing Primitives

Geometric Shapes

Bitmaps

Images
OpenGL Architecture

Simplified Pipeline
Modern PC

3.0 Ghz Intel Core2 Duo
Core 1
Core 2
4MB L2 Cache

1GB main memory (DDR2)

NVIDIA GeForce 8800 GTX (575 MHz)
(16 cores)

512MB video Memory (GDDR3)

4MB L2 Cache

12.8 GB/sec

PCIe Bus (max 4 GB/sec)

NVIDIA 8800GTX

Game Machines – Xbox 360

3.2 Ghz PowerPC CPU
Core 1
Core 2
Core 3
L2 Cache

500 Mhz ATI GPU
48 3D Cores

Frame buffer
Video out

512 MB memory

Display (TV)

controllers/ethernet/audio/DVD/etc.
Game Machines – PS3

3.2 Ghz Cell
PPC Core
L2 Cache

IO Chip
256 MB Memory (XDR)

550 Mhz NVIDIA RSX GPU
Multiple 3D cores
256 MB video Memory (GDDR3)

Video out
Display (TV)

controllers/ethernet/audio/DVD/etc.

Modern Hardware Pipeline

OpenGL commands

Cmd

Rasterizer

Frame buffer ops

Programmable processing cores
(runs vertex and fragment programs)

Texturing

Frame buffer

Memory

Textures
Summary

Graphics state stores attributes
Graphics commands output primitives
   Shapes (points, lines, triangles, quads, etc.)
   Bitmaps (fonts)
   Images
Different coordinate systems
   User coordinates
   Pixel coordinates
Graphics system produces fragments from primitives
Demos: use simple GL commands and use GLUT for windowing/interaction