Computer Graphics
CSC 418/2504
Patricio Simari
Topics

• Overview:
  • Computer Graphics
  • Images
  • Color
  • Line rasterization
• Course overview (dates, req’s, etc.)
What is Computer Graphics?

• “Any use of computers to create or manipulate images” – Peter Shirley

• Computational modeling: Data structures and algorithms

• Mathematics: Linear algebra, geometry, vector calculus...

• Physics: optics, dynamics, materials

• Perception: color theory, psychophysics
What is *not* in CSC 418

Image manipulation in Photoshop
What is *not* in CSC 418

How to use 3D software, e.g. Maya
What is *not* in CSC 418

How to design and create GUIs
CG application domains
CG application domains

Film: visual quality
CG application domains

**Games:** Visual quality and real-time performance
CG application domains

Industrial design: modeling precision
CG application domains

Scientific/medical visualization:
real world data, abstraction, large datasets
Areas of CG

- **Modeling**: defining the geometric form of 3D objects
- **Rendering**: math. modeling the appearance of 3D objects, converting generating 2D images
- **Animation**: modeling the motion and behavior of 3D objects over time.
Graphics Pipeline

Modeling → 3D scene → Animation → 3D scene in motion → Rendering → Image Sequence
Modeling

Point Sets
Polygon Meshes
Surface Patches
Textures
Curves
Modeling

Implicit Surfaces

Voxel Data

Subdivision Surfaces
Animation

Motion capture

Keyframes

Behavior modeling
Animation

Procedural

Physical simulation
Rendering

Camera & Perspective
Projection
Visibility

Clipping
Rasterization/Scan Conversion
Texture Mapping
Light Transport

Material Models
Illumination
Transparency
Reflectance
Shadows
What is an image?

- A distribution of wavelength-dependent light energy stored on film or emitted by a display.
- Raster displays discretize this distribution using a 3 dimensional color space and a grid of color samples called **pixels**.
- **Pixel**: “picture element”
What is a pixel

- Color represented in (typically) three-dimensional color space
- RGB: red, green, blue.
Storing Color

In an image: 24-bit color

```
8 bits  8 bits  8 bits
```

\[ r, g, b \in [0, 255] \]

In software:

```java
class RGBColor {
    float r;
    float g;
    float b;
};
```

\[ r, g, b \in [0, 1] \]
Conceptual display architecture

What happens while we write to the frame buffer?
Double buffering
Color correction & calibration

Getting the display colors right
Color correction & calibration
Line drawing

Jaggies
Line drawing

Make a thicker line...
Line drawing

... and set intensity to frac. value based on coverage
Course Topics: Subset of...

• Foundations: geometric primitives, rasterization, transformations
• 3D viewing: cameras, projection, perspective
• Rendering: Radiometry, Light Transport, Illumination, Ray Tracing
• Animation: Keyframe animation, physical models, behavior
• Modeling: curves, polygons, surface patches, subdivision surfaces, implicit surfaces
Requirements

- Course webpage for specifics
- Linear algebra
- Calculus
- Vector/Matrix operations
- Algorithms and data structures
- Basic C++ programming
Course Info

• Announcements Section: Check twice/week
• Bulletin board (link on webpage)
• psimari@cs.toronto.edu
• Tutorials: W6, required for assignments, Math, C++, OpenGL, ...
Assignments/Midterm

- Assignment 1 (10\%): October 5
- Assignment 2 (15\%): November 2
- Assignment 3 (25\%): November 30
- Midterm (15\%): October 19
- Exam (35\%): Period December 9–20
Marking Policies

- CDF Unix Machines
- Starter code
- Minimum of 35% on final exam
- Re-mark in writing within one week
- Late penalties: 15% per day, 3 day max
- Written part: 7pm, start of class
- Programming part: 11:59pm
Academic Offense

- Submit only your own work
- Acceptable to talk about general ideas
- Not acceptable to communicate about solutions
- A3 in pairs