CSCI 580

Topic 1: Intro to class and Computer Graphics Rendering
2D Graphics, 3D Graphics, Image Synthesis

Topic 2: Graphics transforms and HW2 intro - flat-shaded z-buf triangle teapot
Explicit geometry (tris, patches) vs implicit description via function
Transforms and vertices with implied edges.
Notation and linear algebra

Topic 3: Spaces to coordinate modeling, animation, viewing, rendering.
Spaces: model, world, image, perspective (NDC), screen
How to manage transforms
Effect of transforms in each space
What about Z? What do we do with it in screen space?
Setup and manage matrices in renderer.

Topic 4: Rasterizing and Hidden Surface Removal - scan line method
Image order rasterization -- ray tracing/casting
Object order rasterization – object by object
Linear Expression Evaluation
Scan line renderer - DDA
Hidden surfaces: Painters algorithm, Warnock algorithm
BSP tree, Z-buffer, …

Topic 5: Parameter Interpolation
Z interpolation

Topic 6: Illumination and Shading
Light sources
Propagation through media
Interaction with surfaces
Ideal specular and diffuse reflection
Color, absorption, and mix of specular and diffuse components
Shading models

Topic 7: Lighting and shading
Shading Equation
Spaces for shading
Normals and transformations

Topic 8: Screen-Space Interpolation with Perspective Correction
Understanding the problem - interpolation under perspective
Perspective warping and proper interpolation
Phong shading

Topic 9: Textures and Hierarchy of detail
- Geometry, textures, lighting model -- a wide range of scales
- Mapping 2D surface location to image texture.
- U, V coords
- Texture space and Tangent Space
- Color, bump, shadow, reflection textures
- Procedural textures - Mandelbrot / Julia sets

Topic 10: Compositing and Volume Slices
- Alpha channel
- Film applications
- General compositing equations
- Compositing as approximation for translucent or transparent materials.

Topic 11: Antialiasing Introduction and Basic Signals
- Images as continuous functions
- Aliasing errors/sources
- Nyquist Theorem
- Signals as functions of time and space
- Impulse, Step, Box, Comb or Shah, Sinc, Gaussian functions

Topic 12: Antialiasing - convolution
- Linear time-invariant systems
- Frequency domain/Fourier transforms
- Dual and inverse relationships
- Multiplication Property
- Prealiasing/Postaliasing

Topic 13: Textures and Filtering
- Filtering image textures
- MIPMAPs and scale
- Weaknesses in perspective
- Summed-Area Tables
- Environment Mapping

Topic 14: Visibility
- BSP Trees
- Survey of Shadow Algorithms

Topic 15: Basics of Radiosity Lighting
- Linear systems
- Summing methods
- Shooting method

Topic 16: Volume Rendering

Compositing and Opacity computations
Data Organization - grid structures
Lighting and Shading
Opacity and Color Mappings
Resampling in 2D vs 3D
Ray Casting vs Splatting vs Texture Planes
Algorithm fidelity and aliasing

Topic 17: Hair Modeling and Rendering
Problems with traditional pipeline
Deep Shadows with Opacity
Visibility with Opacity

Topic 18: Faces and Caricature
Face Space and norms
Feature emphasis
Stylized Rendering and Style Emulation

Grading Components:
Six programming HWs x 10 each = 60 points
Two midterm exams x 10 each = 20 points
Final team project = 20 points