CS 559: Computer Graphics

Detailed Syllabus Part 2: Topics for the Final Exam

This document outlines the set of things you should know or be able to do for the final exam on May 14. Things you needed to know for the midterm that are not explicitly listed here will not be explicitly tested again, but may be implicitly tested as part of other questions.

As for the midterm, you are allowed one double-sided 8.5x11 page containing anything (notes, diagrams). Items are listed roughly by topic.

Visibility:

- Understand the distinction between object-precision and image-precision algorithms.
- Be familiar with several visibility algorithms: painters, z-buffer, a-buffer, scan-line z buffer, depth sorting, Warnok's algorithm, BSP-Trees.
- Be able to identify the relative strengths and weaknesses of the various visibility algorithms.
- Be able to construct a BSP tree for a simple 2D environment. Understand the rules for traversing the tree to obtain a back-to-front or front-to-back rendering order.

The Standard Lighting Model:

- Know what the diffuse lighting component is, how it is calculated, and what sort of shading effects it gives. For instance, be able to identify the brightest and darkest spots on a surface that is diffusely lit.
- Know what the specular lighting component is, how it is calculated, and what sort of shading effects it gives. You should understand the impact of the exponent in determining the size of the highlight. You should be able to identify which spot on a surface will be brightest when it is specularly lit.
- Know what the ambient term is, why it exists, and what impact it has on the appearance of the scene.
- Know how color is typically dealt with.
- Know what the distant viewer and distant light assumptions are, and be able to reason about their impact.
- Know the difference between flat shading, Gouraud interpolation and Phong normal interpolation, and how the different techniques impact the appearance of an object. You should be able to identify where shading discontinuities will appear with each model (if they appear at all) and how specularities are impacted.
- Know the basic definition of a point light source, a directional light source, and a spotlight. Be able to say, for instance, how each would illuminate a flat plane.

Texture Mapping:

- Know what texture mapping is.
- Know how texture coordinates are found, and how they are used to decide on which texture image value is used for shading a given point. Understand the distinction between clamping and repeating texture.
- Know what mipmapping is, and why it is used. You do not need to know the mipmap selection equations.

Modeling in General:

- Know what some of the issues are in modeling objects and how the various techniques rate.
- Be able to design a polygonal data structure given a set of operations to be supported.
- Know what parametric instancing is, why it's useful, and what sorts of thing it is good for modeling.
- Understand the basic idea of hierarchical modeling and why it's useful.
- Understand the basic principles of sweep objects. Be familiar with some common sweep paths and the types of shapes that result. For instance, surfaces of revolution arise when a curve is swept about an axis.
- Know what an implicit function object is.

Parametric Curves and Surface Patches:

- Understand the basic idea behind a parametric curve.
- Know what is meant by parametric (derivative) and geometric continuity.
- Know how a Hermite curve is specified. You DO NOT need to know the exact formulas for Hermite basis functions.
- Know how Bezier curves are specified.
- Know the properties of Bezier curves, and be able to sketch curves using these properties, and identify curves that cannot be Bezier because they don't satisfy the properties.
- Know how to achieve C^0, C^1 and G^1 joins with Bezier curves, and which vertices are involved in C^2 and G^2 joins.
- Know how to subdivide a Bezier curve into two pieces.
- Know how to use de Casteljau's algorithm to find the point on a Bezier curve corresponding to a given parameter value.
- Know the options for rendering Bezier curves and be able to give reasons to prefer one option over another.
- Know what uniform B-spline curves are and their basic properties. You DO NOT need to know the exact blending functions for B-spline curves.
- Know what happens when control points are repeated with uniform B-spline curves. Be able to identify how many times each control point is repeated by looking at a curve and the locations of control points. For instance, if a B-spline curve interpolates its endpoint, then the end control point must be repeated three times.
- Know what a rational curve is and why you might care to use one.
- Understand the basic form for parametric surface patches.
- Know what a Bezier surface patch is, its properties and how to join them together to achieve certain degrees of continuity.

Subdivision Techniques:

- Understand the basic principle of subdivision.
- Know how to subdivide an octahedron to obtain a sphere.
- Know how to subdivide a triangular mesh to get a fractal terrain.
- Know what is meant by extraordinary vertices in a subdivision scheme.

Animation:

- Know the three basic approaches to animation and be able to suggest situations in which each would be appropriate.
- Understand what a particle system is and be able to give some examples of their use.

Global Illumination:

- Know what it means for a surface to be perfectly diffuse or perfectly specular, and be able to give an example of such surfaces.
- Know how to classify simple light paths using the $L(S|D)^*E$ path system. Be able to sketch cases in which a particular light path is important. Be able to identify the light paths present in an image.
- Know how basic raytracing works and which light paths it can capture. Also be able to identify light paths that ray-tracing cannot capture.
- Understand the basic principle of a light caching algorithm and which light paths it can and can't capture. Be able to sketch cases where basic raytracing and light caching algorithm will give different answers.
- Know the radiosity assumptions and the types of light paths the radiosity can capture. Be able to sketch situations in which radiosity will give different answers compared to both raytracing and light caching.