CS 447/547: Computer Graphics

This document outlines what you should know for the final exam. For the final exam you are allowed to bring one double-sided 8.5x11 page containing anything. Items are listed roughly by topic.

Rasterizing:

- Understand the features of Bresenham's algorithm, although there is no need to know the equations.
- Understand triangle filling, including the basic rules for deciding whether a pixel is inside or outside a triangle.

Visibility:
- Be familiar with several visibility algorithms: painters, Z-buffer, A-buffer, BSP-Trees.
- Understand how to correctly render transparent objects in each algorithm.
- Understand how to achieve anti-aliasing operations with each algorithm.
- Understand the cases for which each method will perform well, and cases for which it will perform badly.
- For the Z-buffer algorithm, be able to show the state of the depth buffer and color buffer as polygons are processed by the algorithm.
- For the A-buffer algorithm, be able to show the state of the list associated with a pixel as polygons are processed by the algorithm.
- Be able to construct a BSP tree for a set of line segments in 2D or polygons in 3D. Understand the rules for traversing the tree to obtain a back-to-front or front-to-back rendering order.
- Understand how the Cell-Portal visibility algorithm works for 2D environments. Be able to show the frustum(s) used for rendering a particular cell given a viewpoint.

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 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 spot-light. 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. You should be able to specify texture coordinates to achieve a particular effect, and also be able to draw a texture if given a set of coordinates and a textured polygon.
- Know what mipmapping is, and why it is used. You need to understand, but do not need to remember the mipmap selection equations.

Modeling in General:

- Know what some of the issues are in modeling objects.
- 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:
- 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 remember 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 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.

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.