CS 447/547: Computer Graphics

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

Color:

- From a physics point of view, color is specified by a spectrum.
- Be able to describe some of the things that affect color perception.
- Understand the experimental evidence for and mathematical implications of the principle of trichromacy.
- Understand how sensors work, particular color sensors.
- Understand color matching.
- Understand the idea of a color space.
- Be familiar with RGB color space. There is no need to know the wavelengths of the primaries.
- Be familiar with CIE-XYZ and CIE-xy color space.
- Know how to go from one linear color space to another.
- Know how subtractive color spaces (printer inks) work.
- Understand the problems with perceptually non-uniform color spaces.
- Be familiar with HSV color space.

Color Quantization:

- Understand how indexed color works.
- Understand the issues involved in color quantization algorithms, including perceptual issues, Mach bands, and quantization error.
- Know how uniform quantization and populosity work.

Dithering:

- Understand why dithering is important.
- Know how to go from color to grayscale.
- Know how threshold dithering, constant brightness threshold, random dithering, ordered dithering and Floyd-Steinberg dithering work, and their relative strengths and weaknesses.

Signal Processing:

- Know that an image can be represented in the spatial domain or the frequency domain.
- Know how certain features in the spatial domain manifest themselves in the frequency domain, and vice-versa. For example, what do high frequencies look like in the spatial domain?
- Know the representations for various common functions in the spatial and frequency domain: box & sinc, delta & constant, Gaussian & Gaussian.
- Know that knowing one direction also gives you the other direction. For example a box in spatial is a sinc in frequency, and a box in frequency is a sinc in spatial.
- Understand what it means for a function to be band-limited.
- Know what the Nyquist frequency is and what its implications are for graphics.

Filtering:

- Know the basic shapes of some common filters (box, Gaussian, Bartlett, edge detection, enhancement) and the results of applying them to an image.
- Understand how to construct a 2D filter from a 1D filter.
- Understand the principles of re-sampling and reconstruction
- Know how to filter in color.

Compositing:

- Understand what α represents.
- Understand what is meant by pre-multiplied α colors.
- Know the basic compositing equation, $c_o = Fc_f + Gc_g$, and be able to use the F and G values for the common compositing operations.
- Know a couple of ways to get α values for an image.

Transformations:

- Understand the basics of coordinate systems and transformations.
- Know what an affine transformation is.
- Understand the idea of homogeneous coordinates, and how to go from regular to homogeneous coordinates and back.
- Know the basic form of the transformation matrices for common transformations, in both regular and homogeneous form, in both 2D and 3D.
- Know how to rotate about an arbitrary point or axis, and scale about an arbitrary point.

Viewing Transformations:

- Know the coordinate systems employed in a typical graphics pipeline, and be familiar with the transformations that take points from one end of the pipeline to the other. That means all the transformations from object space right through to window coordinates, including perspective transformations. You don't need to know what the values in the matrices are, but you should know, for instance, what the view volume looks like in each space.
- Understand the distinction between orthographic and perspective views, and the general properties of each.
- Know which parameters are required to specify a view, including the viewing volume and the viewport, and how they influence what is seen and how it looks. (For both orthographic and perspective projection.)

Clipping:

- Know how Sutherland-Hodgman clipping works, and be able to do an example.
- Understand how to do inside/outside testing, and find intersection points.
- Know how Cohen-Sutherland and Liang-Barsky line clipping works, and be able to do examples.