CS334: Assignment #5 (or Homework #0)

Out: November 17, 2017
Back/Due: November 27, 2015 (*** by 9:30am IN CLASS ***; if turning in late, please arrange handoff to TA)

Objective: This objective of this assignment is to obtain a better understanding of recently covered topics. Please turn-in a legible sheet of paper(s) either handwritten or typed. If >1 sheet, please write your full name and Purdue Student ID on each sheet and also staple them together.

1. (15 points) Please draw a regular grid of 4x4 2D points (i.e., 4 rows of 4 columns of equally spaced points). Then, please draw the line segments that define the Voronoi regions for those points/sites.

2. (10 points) Assume you have a color \( s \) = \( [r \ g \ b]^T \) defined in a standard RGB space. Now assume you have a custom color space. In the custom space color \( c = [cr \ cg \ cb]^T \) can be computed as \( cr = 0.2r + 0.3g + 0.5b \), \( cg = 0.4r + 0.2g + 0.4b \), and \( cb = 0.5r + 0.3g + 0.2b \). If you are given a color \( c_0 \) in custom space, what is the corresponding color \( s \) in a standard RGB space?

3. (15 points) Say you are given a material of color \( a \) and a material of color \( b \) both illuminated by a perfectly white light (e.g., the light produces equal intensity at all frequencies). Now, you illuminate both materials by another light source that shifts color \( a \) by adding \( x \) to it. Please write the mathematical expression that defines what color \( b \) should be in order to keep the colors relatively the same as per the principle of color constancy.

4. (15 points) Assume an L-system with constants \( a \) and \( b \), both corresponding to equal length (short) dashes (e.g., line segments). Let “−” and “+” correspond to 90-degree left and right rotations, respectively. Let \( s(a) \) correspond to a scale operation by \( s \) (e.g., 0.5(\( a \)) means apply a 0.5 scale to whatever is in the parenthesis, in this case one segment ‘\( a \)’). Please draw the result of the first 5 rule applications of the following L-system. Please fully label all the drawn segments.
   \[
   \text{axiom: } b \\
   \text{rules: } b \rightarrow a + 0.9(b) \\
   \text{number of iterations: 5}
   \]

5. (15 points) Please explain, in one short paragraph, what is a Lightfield and what is it useful for?

6. (15 points) Please explain, in one short paragraph, what is Global Illumination and what is it useful for?

7. (15 points) Please write a short paragraph describing a plausible inside-looking-out algorithm to compute per-vertex occlusion factors for an ambient occlusion rendering algorithm.

8. Extra Credit: (20 points) Please describe an adaptive meshing algorithm for improving the quality of rendering soft shadows with a Radiosity algorithm. Assume you have a Manhattan-world model (i.e., any face is exactly in the XZ, XY, or YZ plane). Further, the initial triangulation of the scene is such that all triangles are as large as possible for any planar area of the model (e.g., a very large empty flat wall is modeled as 2 triangles). Thus you need to describe when, where, and how to subdivide triangles so that the resulting radiosity solution is of low-error (e.g., produces about the right shading values). You may use diagrams.