CS 559: Computer Graphics

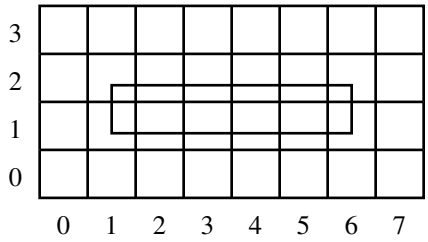
Homework 5

This homework must be done individually. Submission date is Tuesday, November 16, 2004, in class.

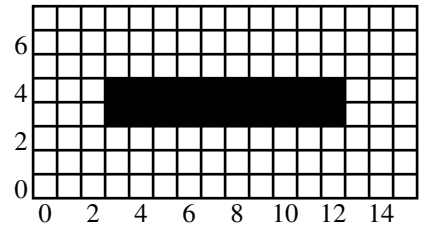
Question 1:

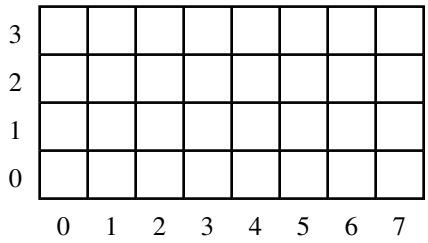
Consider a one pixel wide line from (1,1.33) to (6,1.33), with square endcaps. The outline of the line is shown on the figure below. Integer locations are at the center of each pixel.

a. Assume we are doing area-weighted sampling, with the alpha of each pixel set in proportion to the amount of the pixel covered by the line. Give the alpha values of all the non-zero pixels.



b. Now assume we are doing supersampling. Below is the same line, drawn at twice the resolution using some version of point sampling which fills whole pixels. Halve the size of this image by averaging 2×2 blocks of pixels.



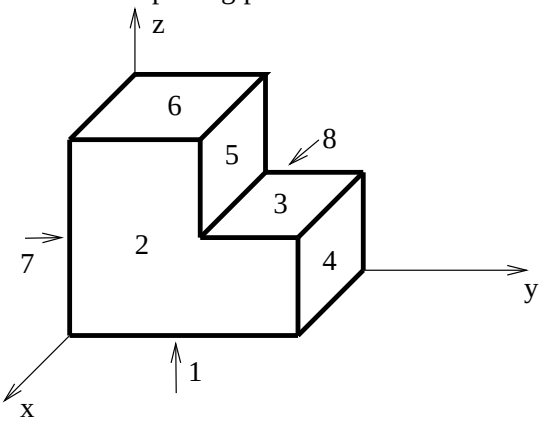


c. Assume you are working with a black line on a white background. Is the result of compositing the area-weighted sample line the same as the result of super-sampling?

Question 2:

This question concerns BSP trees in 3D.

a. Build the BSP tree for the object shown, where faces are used as splitting planes in face number order. If a face is split, label the new faces with sub-letters (if face 1 is split, the pieces would be 1a and 1b). Assume that the positive side of the splitting planes is the side that is "outside" the object.



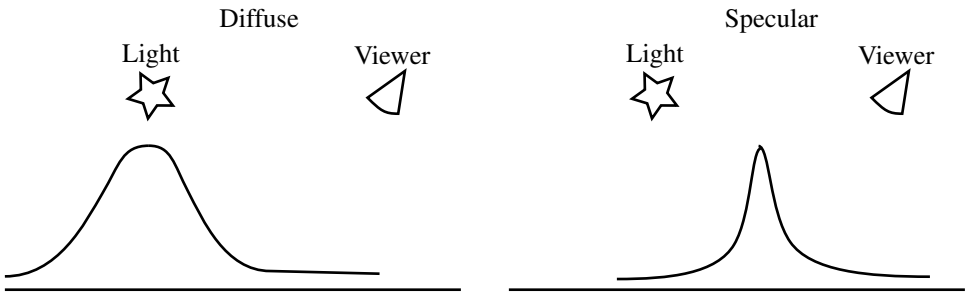
b. Build another BSP tree for the object, this time using an ordering that gives a BSP tree of *lower* height. You do not have to get the minimum height. Label nodes with the face numbers.

c. Show the back-to-front rendering order for your BSP tree of part (b) if the viewer is located at (5,5,5), assuming that the object is 2 units high, 2 units wide and 1 unit deep.

d. Either of the BSP trees could be used to obtain a rendering order. The order might be different, but both will produce a correct result. Which tree is more efficient for rendering, and why?

Question 3:

Below are shown the illumination graphs for the diffuse and specular components of a flat surface lit by a light as shown with a viewer in the position indicated.



a. Draw two more graphs, one for the diffuse and one for the specular component of the same flat surface. However, now make the *distant light assumption*, using a directional light source coming from *vertically above.*

b. Draw two more graphs, but now make the *distant viewer assumption*, assuming that the viewer is looking from a constant direction *vertically down* to the surface. Use the point light from the original example, NOT a directional light.

c. Draw two more graphs, showing the effect of **both** a directional light coming from above and a distant viewer looking from above.