CPSC 314 Homework 3

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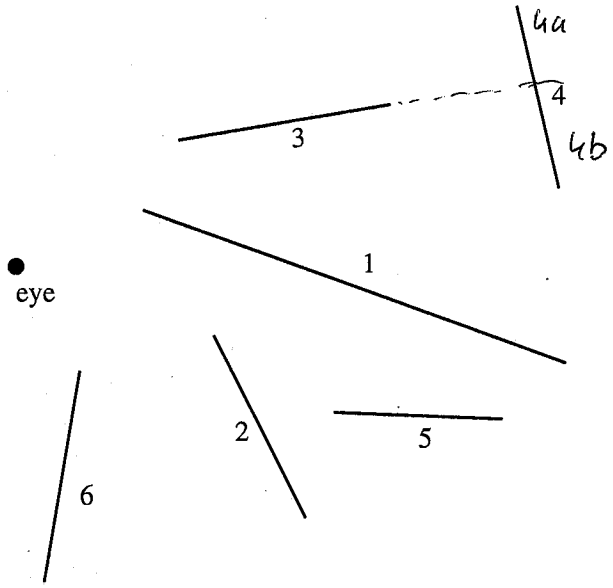
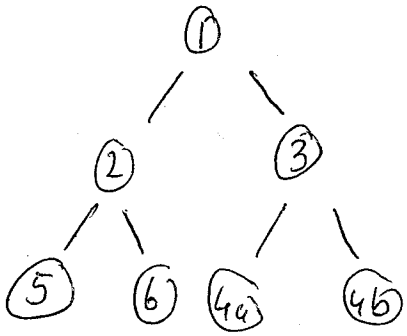
NOTE: These homework problems are not graded. **However**, I strongly encourage you to take them seriously as a preparation for the second quiz and the final exam.
This problem sheet deals with BSP trees and shading/lighting. Solutions will be discussed in the labs in the week of February 9-13.

1 BSP Trees

a) The diagram below shows a top-down-view of vertical walls in a "maze". Construct the BSP tree that results from inserting the individual walls in numerical order. Draw the tree such that the right subtree (child) is located on the side that the normal points to. The positive halfspace of a wall is indicated by the side on which the number is located. Make sure to indicate how walls are split.





b) What is the traversal order for the indicated eye position?

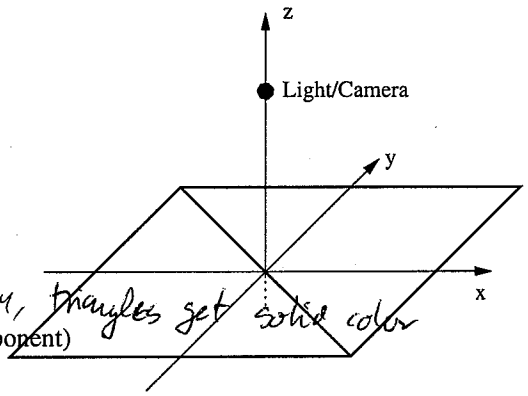
6, 2, 5, 1, 4b, 3, 4a

2 Shading and Lighting

Consider a square with corners located at $(-1,-1,0)^T$, $(+1,-1,0)^T$, $(+1,+1,0)^T$, and $(-1,+1,0)^T$, and a single point light source positioned at $(0,0,1)^T$, as depicted in the figure below. Let the shading normals in the vertices correspond to the z direction (i.e. the actual geometric normal of the square).

The camera is positioned where the light is, and looks down on the square. You can assume that the square has been subdivided into two triangles along one of the diagonals. **The point light source has a quadratic falloff.**

For each of the following combinations of shading and lighting models, describe the intensity distribution across the square.



a) Purely diffuse material with flat shading

uniform grey rectangle

(Lighting is computed at vertices only, triangles get solid color

b) Phong material with flat shading (no diffuse component)

uniform black / very dark:

same as a), but the viewer is outside the specular lobe

c) Purely diffuse material with Gouraud shading

Same as a)!

(geometry is symmetric, so the values computed at each vertex are the same

=) Gouraud shading degenerates to flat shading)

d) Phong material with Gouraud shading (no diffuse component)

Same as b)

(Symmetry)

e) Purely diffuse material with Phong shading

a slow intensity falloff from the center to the edges / corners

falloff corresponds to $1/r^2$ term

d) Phong material with Phong shading (no diffuse component)

bright spot in the center, quickly falls off to black at corners / edges