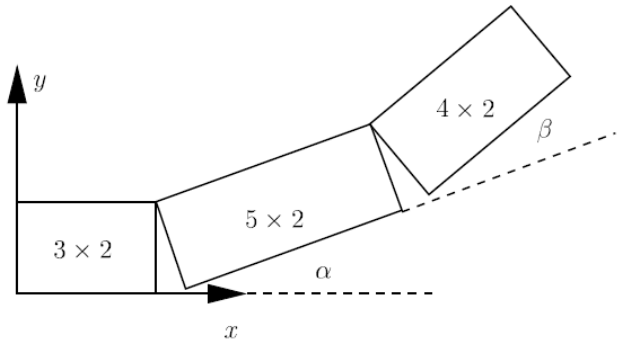
Name _____

CISC 440/640
Midterm
Thursday, March 27, 2014

Only graduate students are required to answer questions Q10 and Q11 of this exam. Point totals will be normalized to a common scale (the exam is worth 20% of your grade). Partial credit will be given in quarter-point gradations. Please use the backs of pages as needed to avoidly overly cramped answers.

Q1 [3 points]



Write OpenGL code, in as few lines as possible, to draw the 3 boxes above (not the arrows, text, or anything else). Assume that you have a function `drawSquare()` that renders a 1 x 1 square with its lower-left corner at the origin, where the *x* and *y* axes meet. Note that α and β indicate the relative angle in degrees of a box to the one to its left.

Q2 [2 points]

What is the ambient term in local lighting models meant to approximate and why is it necessary?

Q3 [2 points]

Define “BRDF” and characterize it for a perfectly *diffuse* material vs. a *mirror-like* material.

Q4 [2 points]

In OpenGL what is the *canonical viewing volume*? What transformation step in the geometry pipeline puts vertices into the coordinate system associated with this volume?

Q5 [2 points]

Suppose you are rasterizing a triangle whose corners in image coordinates are at (1, 1), (5, 1), and (2, 9), and the *z* values of those corners are -22, -29, and -25, respectively. Using the bilinear interpolation scheme of z-buffering, what is the *z* value of the interior point at (3, 5)?

Q6 [2 points]

A 3-D *rigid transformation* is the product of rotation and translation components. Explain what these mean in terms of the change from world coordinates to camera coordinates.

Q7 [2 points]

For the 2-D version of the Cohen-Sutherland line clipping algorithm, what is the meaning of an *outcode*? Given 2-D line endpoints $\mathbf{v}_1$ and $\mathbf{v}_2$, explain which outcodes o($\mathbf{v}_1$) and o($\mathbf{v}_2$) would lead to either *trivial acceptance* (draw the line without clipping it at all) or *trivial rejection* (throw away the entire line).

Q8 [3 points]

When and why does *Gouraud* shading have problems with specular highlights? Why does *Phong* shading not have this problem? What is the trade-off in terms of computational cost?

Q9 [2 points]

Name and briefly explain the 3 behavior forces in Reynolds' original boids flocking algorithm. What other factors besides just *distance* might make the behaviors more realistic?

Q10 [3 points – GRADUATE STUDENTS ONLY]

Suppose you have constructed a *binary space partitioning* (BSP) tree *T* for a 3-D scene consisting solely of triangles. Given an eye position of **e**, write pseudocode for a recursive function `draw_bsp(`*T*`)` to render the scene using the painter's algorithm. What effect does the height of *T* have on the running time of `draw_bsp()`?

Write your answers to Q10 and Q11 on the back of this page

Q11 [3 points – GRADUATE STUDENTS ONLY]

What is the significance of the “midpoint” in the midpoint line rasterization method? Show in detail (preferably with a diagram and a formula) how it is used in the algorithm. Does the basic algorithm work on lines with arbitrary slopes? Explain.