CS 559: Computer Graphics - Midterm Exam

March 21, 2002

Name: ____________________

ID: ____________________

Login: ____________________

- You have 1 hour and 10 minutes to complete the exam.
- Before beginning, write your name, ID number and login on the front page, and your login on every page.
- On your desk you may have something to write with, one double-sided piece of paper with anything on it, an optional ruler, and nothing else.
- Do all your work on the pages provided, going to the back side if necessary. If you do use the back, indicate on the front side that there is something on the back.
- If you need to make assumptions in order to answer a question, say what they are. However, all the questions should be unambiguous.

Question 1: ____/6

Question 2: ____/3

Question 3: ____/3

Question 4: ____/4

Question 5: ____/4

Question 6: ____/7

Question 7: ____/4

Question 8: ____/4

Question 9: ____/9

Question 10: ____/6

Total: ____/50

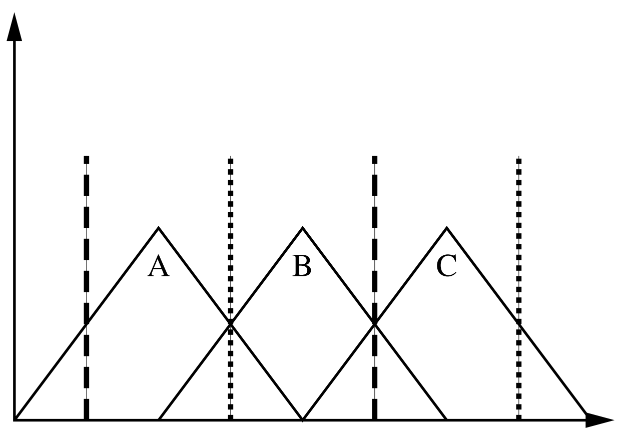
Question 1: (6 points)

Answer each of the following questions about color with one or two sentences.

a. The monitors showing departures and arrivals at airports sometimes fail. In correct operation, they show white text on a cyan background. When they fail, they show magenta text on a blue background. What had happened to the failed monitors?

b. You have a digital camera in which the red sensors have failed. Give two different real world colors that will appear identical in an photograph taken with your broken camera.

c. The figure below shows the response curves for three color sensors, A, B and C. Each response curve is a triangular hat function. Also shown are two color spectra, one consisting of two spikes shown as dashed lines, and one consisting of two other spikes shown with dotted lines. Can you distinguish the two spectra using data from the sensors? Explain your answer.



Question 2: (3 points)

Match the color quantization algorithm to the application. Draw lines to indicate your matching.

An animation application in which speed is critical	Uniform quantization
	Populosity
An application producing images for a book on flower gardens	
	Median-cut
An application converting images of forests	

Question 3: (3 points)

When working with animation, temporal coherence is important. In other words, a video of a slow moving scene should show small changes from frame to frame, without excess noise.

a. Which dithering algorithm would perform poorly on animation sequences with respect to temporal coherence? Why?

b. What dithering algorithm is both fast and provides good temporal coherence?

Question 4: (4 points, points off for incorrect responses)

Consider a situation in which you resize an image and then apply the inverse resizing operation, giving an image that is the same size as the original. For each of the operations below, indicate whether it is possible to perform the pair of operations and get the same image as the original, or whether sampling theory says you must have a different result.

Operation Pair	Same	Different
Double then half	__________	__________
Multiply by 1.6 then reduce by 0.525	__________	__________
Reduce by 0.525 then multiply by 1.6	__________	__________
Half then double	__________	__________

Question 5: (4 points, points off for an incorrect response)

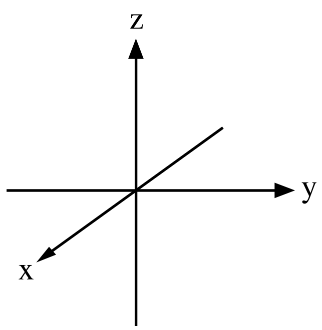
For each of the lines below indicate *true* if the transformation commutes with a **rotation about the z-axis**, or *false* if the ordering of the transformations is important.

Translate in the x direction	__________
Translate in the z direction	__________
Rotate about the y axis	__________
Rotate about the z axis	__________

Question 6: (7 points)

We wish to specify a view that has the image plane centered at the point $(0, 0, 0)$ with the viewer looking along the y axis toward the point $(0, 5, 0)$. The z axis should appear up in the image.

a. Mark the points above and the "up" vector on the diagram.



b. What is the view plane normal vector, **n**, in world coordinates?

c. What vector is to the right in the image plane, **u**?

d. What vector is up in the image plane, **v**?

e. What transformation matrix can we use to transform from world space into view space? Recall that in view space, the z axis should point toward the viewer, the x axis should point to the right and the y axis should point up. (We are *not* talking about canonical screen space.)

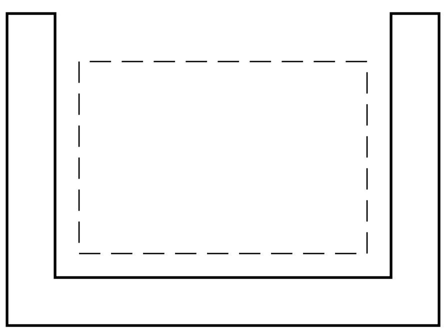
f. About what axis do we rotate to go from world to view space, and by how much?

Question 7: (4 points)

You are shown a picture of a scene that you recognize. Give two cues that you could use to determine if the picture was taken with orthographic or perspective projection.

Question 8: (4 points)

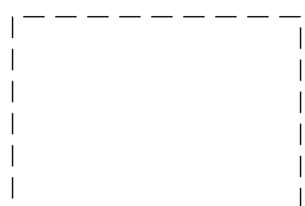
Perform Sutherland-Hodgman clipping on the polygon below, with the clip region indicated with the dashed rectangle. Show the result of clipping to the top edge; the top and right edges; the top, right and bottom edges; and all the edges.



Top edge

Top and right edges

Top, right and bottom edges



All edges

Question 9: (9 points)

For each of the following features, indicate the hidden surface removal (visibility) algorithms that support the feature. Your choices of algorithm for this question are: Z-buffer, A-buffer, Depth sorting, Scanline HSR, and Warnock's area subdivision.

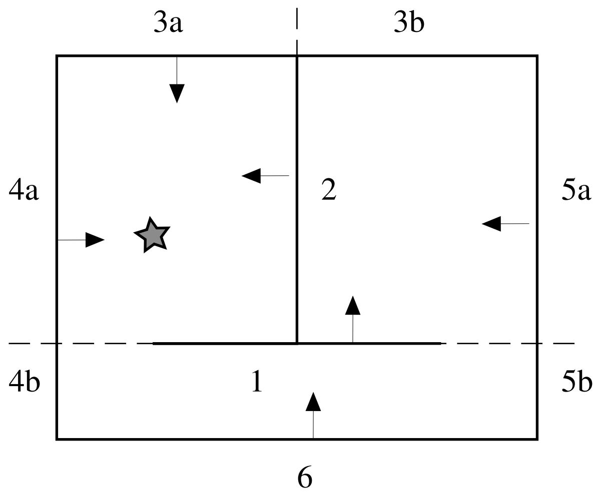
a. Which algorithms require knowledge of all the polygons before they can begin?

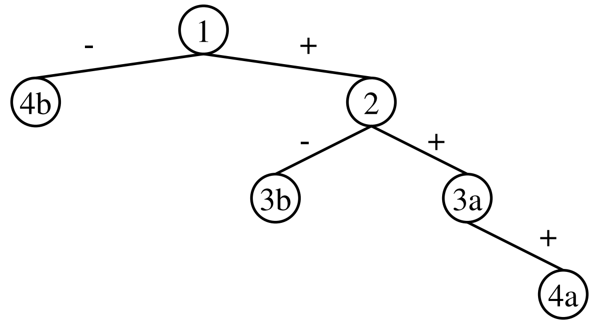
b. Which algorithms write each pixel only once?

c. Which algorithms handle transparency without explicit user help?

Question 10: (6 points)

Consider the partially built BSP tree for the scene below. Arrows on the edges point to the "inside."





a. Complete the tree by adding nodes for 5a, 5b and 6.

b. Give the rendering order for back-to-front rendering if the viewer is located at the star on the image.