CS 184: FOUNDATIONS OF COMPUTER GRAPHICS

SPRING 2004

PROF. JAMES O'BRIEN

MIDTERM EXAM

Your Name: _____ Your Class Computer Account: cs184-_____

Room: _____ Row: _____ Seat: _____ Your Student ID#: _____

Instructions: *Read them carefully!*

The exam begins at 2:40pm and ends at 4:00pm. You must turn your exam in when time is announced or risk not having it accepted.

Make sure you fill in your name and the above information, and that you sign below. Anonymous tests will not be graded.

Write legibly. If the person grading the test cannot read something, he/she will simply assume that you meant the illegible portion as a note to yourself and they will ignore it. If you lose points because part of your answer could not be read, you will not be given the opportunity to explain what it says.

You may use a calculator (if you think it is needed) and two pages of notes while taking the exam. You may *not* ask questions of other students, look at another student's exam, use a textbook, use a phone, or seek any other form of assistance. In summary: *do not cheat*. Persons caught cheating will be subject to disciplinary action.

Do not ask questions. Most questions are unnecessary and they disturb other students. Figuring out what the exam question is asking is part of the test. If you think you have to make some unusual assumption to answer a problem, note what that assumption is on the test.

The answers to most questions should be short. If you find yourself writing an excessively long response, you may want to think more carefully about the question.

Total Points: 56 You Scored: _____ Extra Credit Points: 7 You Scored: _____

I have read these instructions, I understand them, and I will follow them.

Your Signature: _____

1. Answer the following with true (T) or False(F) *1 point each*

_____ Each of the three types of color receptors in the eye is sensitive to a single frequency of light.

_____ A shear transformation can be decomposed into a series of rotation and scale transformations.

_____ Homogeneous coordinates are useful because 4D spaces include imaginary vectors.

_____ Linear perspective projection keeps straight lines straight.

_____ Every orthonormal matrix defines a rotation.

_____ Surface shading helps reveal the shape of objects.

_____ Z buffers may suffer from quantization errors.

_____ Rotation about an arbitrary axis requires three separate transformation matrices.

_____ The color of some objects results from wave interference.

2. A perspective camera has its center of projection at the origin (0,0,0) and its image plane is defined by z=1.

2.A. What set of lines vanish at the point (2,-1,1)? *5 points*

2.B. Which lines do not vanish at a finite point? *3 points*

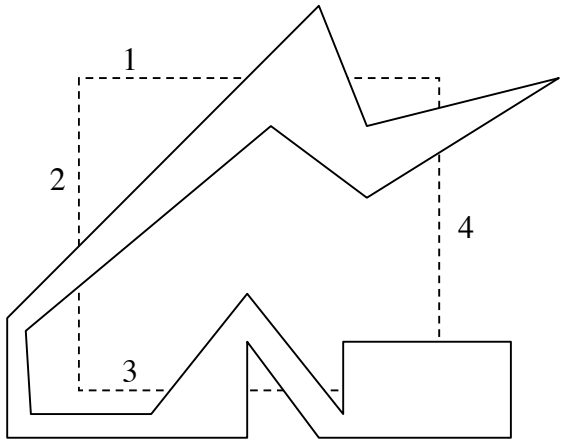
3. THIS QUESTION IS EXTRA CREDIT. If you chose to answer it be precise in your response.

Which of the following are not valid perspective camera matrices? *1 point each*
(place an X over the ones that are not)

$$\begin{bmatrix} 1 & 3 \\ 2 & 4 \end{bmatrix} \qquad \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 7.9 \\ 0 & 0 & 9 & 8 \end{bmatrix} \qquad \begin{bmatrix} 1 & 1 & 0 & 0 \\ 1 & 1 & 0 & 0 \\ 0 & 0 & 1 & 1 \\ 0 & 0 & 1 & 2 \end{bmatrix} \qquad \begin{bmatrix} -1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & 0 & 2 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

For each one that you crossed out, concisely indicate why it is not valid. *3 points*

4. Draw the polygon that will result when this polygon is clipped against the boundary shown in the order shown using the algorithm discussed in class, the Sutherland-Hodgman algorithm. (You should draw the resulting polygon, labeling each vertex to show in which order the vertices appear, and being careful about possible double edges, etc.) *5 points*



Draw result here

5. Given a rotation matrix, how would you determine its axis of rotation? *4 points*

6. Given the following:

location of center of projection	**(c)**
direction of image plane normal	**(n)**
direction of view up vector	**(u)**
right/left and top/bottom distances	**(r/l & t/b)**
near/far distances	**(a/b)**

Describe how do you set up a viewing transformation that will transform the given setup to the canonical configuration? (You can use the variable names given in parenthesis to refer to the named quantities. Also, the question asks for a *description*, not formula. For example if the first step were to rotate the whatever to align with the whateverelse, that is what you should write.) *8 points*

7. The following line segments will be inserted into a BSP Tree in the order indicated. As discussed in class, the polygons themselves will be used to define the split planes. The numbers are on the positive side of each line.

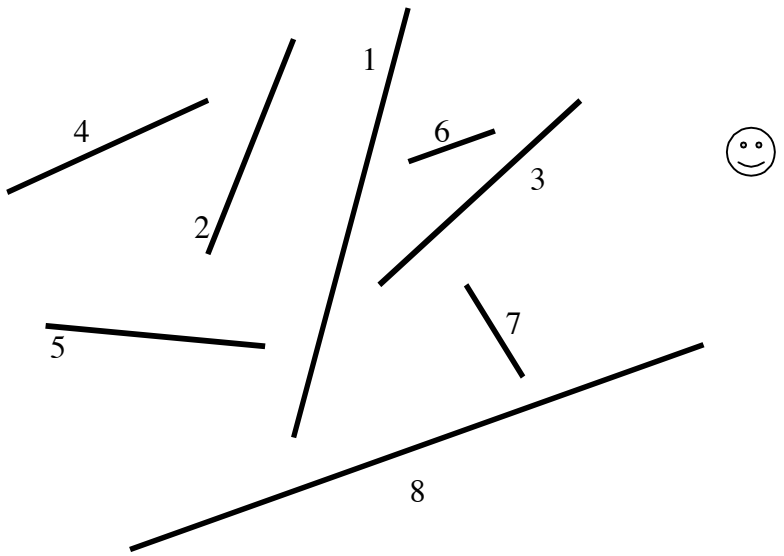
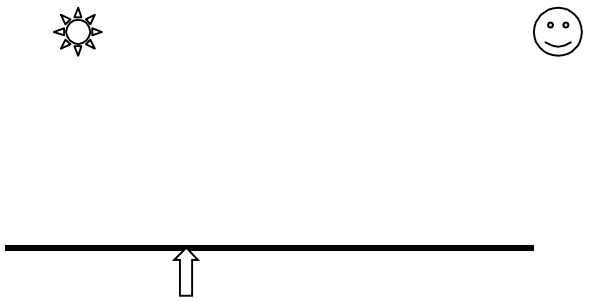


Diagram the resulting tree below. If needed, show where line segments need to be split by marking on the above figure. Also, indicate the names of the split parts by writing labels on the figure above. (For example, if there were a segment 9 and it was to be split, you would draw a mark showing where it would be split and label the resulting pieces 9a and 9b.) *8 points*

List the front to back traversal order that would result for the location indicated by the viewer icon. *3 points*

8. Given the following diagram showing two-dimensional "surface" and the location of the eye, light source, and shading point, annotate the diagram with the *light, view, normal,* and *reflected* vectors. Draw the specular lobe assuming a reasonable value for the specular exponent. (If you are concerned about what "reasonable" means, simply indicate the value you have used.) *3 points*



9. Explain why two colors with very different spectral distributions might still look like the same color when viewed with the human eye. *4 points*

10. In what way is orthographic projection a special case of perspective projection? *4 points*

This portion of the test should only be completed <u>after</u> you have finished the rest of the exam. If you wish, you may remove this sheet and later submit it anonymously by sliding it under Prof. O'Brien's office door.

Are you enjoying this class?

Do you have any suggestions either for the second half of the course or for future offerings of the course?

Do you have any comments specifically about Prof. O'Brien?

Do you have any comments specifically about either of the TA's or the graders?