Midterm Exam

CS 184: Foundations of Computer Graphics
Fall 2008
Prof. James O'Brien

Student Name: **Class Account Username:**

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.*

***Be clear and concise**. 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. Long rambling answers generally get fewer points that short ones do because there are more opportunities to mark something wrong.*

You may use one page 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 calculator, 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 during the exam.** 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.*

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

Your Signature: _____

Date: _____

Student ID: _____

Total Points: XX You Scored: _____

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1. Please fill in each of the blanks with an appropriate answer. *2 points each blank, 64 Total*

Visible light roughly corresponds to wavelengths between _____ and _____ nanometers.

Spectral colors have a very _____ appearance.

The human eye contains receptor cells, called _____, that are sensitive to color and function well under bright lighting.

A typical person has this many _____ types of receptor cell at are sensitive to color and function well under bright lighting.

The human eye contains an additional type of receptor cell, called _____, that are used under low-light conditions.

Given a set of three primary colors, the color gamut for linear mixing is defined by the _____ of the colors plotted as points in the CIE color space.

The "H" in HSV color space stands for _____.

A phenomenon called _____ creates "rainbow colors" by means of wave interference.

The term _____ refers to energy emitted by hot objects.

The _____ describes how light is reflected from the surface of a material.

A _____ shading model focuses only on how light interacts with a single surface and does not account for paths containing multiple bounces of light.

_____ is a phenomena that plays a key role in the appearances of milk and the sky.

Ideal _____ materials reflect light uniformly in all directions.

The exponent in the Phong specular model controls the appearance of the _____.

Directional lights behave like lights located _____.

_____ shading is relatively cheap and generally works reasonably well for diffuse objects. However it performs quite poorly at producing correct specular highlights.

By commonly used convention, rotations in the plane are measured so that positive rotations are in a _____ direction.

Rotation matrices have determinant of _____.

Any arbitrary matrix can be decomposed into a series of rotations and _____.

Among other benefits, _____ coordinates allow translation to be expressed using matrix multiplication.

The parameterization of rotations know as _____ suffers from problems with gimbal-lock.

_____ can be well approximated using several stochastically distributed point-lights.

Computing the intersection of a ray with a sphere requires solving a _____ equation.

_____ is a data structure that recursively partitions space in a binary fashion.

Orthographic viewing is a special case of _____ where the center of projection is moved to be "infinitely far away."

In linear perspective projection, straight lines project to a geometric shape know as _____.

_____ is common office device produces color output by mixing colors in an **additive** way.

_____ is common office device produces color output by mixing colors in an **subtractive** way.

CS 184 is absolutely the most _____ class ever.

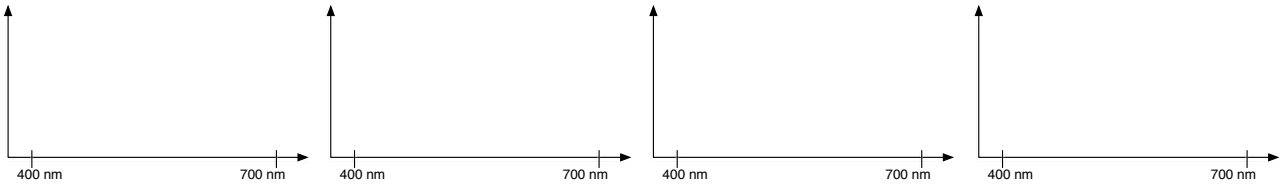
The mnemonic _____ reminds people of order of colors in the spectrum.

The word _____ describes two colors that appear the same to the human eye but that have different specular distributions.

Bresenham's line drawing algorithm uses _____ only arithmetic.

2. **You have two pieces of opaque ***orange*** plastic, pieces "A" and "B." When viewed under light source "X" they look identical in color, but when viewed under sunlight (light source "Y") they look different. Draw a set of curves showing the spectral reflectance for A and B and spectral emissions for X and Y that could provide a reasonable explanation for this situation.** **10 points**

   Note: Makes sure the curves you draw show plausible distributions. In other words, if you tried to draw a curve for "blue" by making a hump centered at 700 nm, it would be wrong.



A **B** **X** **Y**

3. **A perspective camera has its center of projection at** $[9,\sqrt{2},-5]$**, and it's image plane is defined by** $z = +7$**. What set of lines vanish at the same point in the image plane as does the line** $x(t) = [3,0,1] + t\,[1,1,-1]$ **?** *5 points*

   Be precise and concise.

   What lines do not vanish to any finite point in the image? *3 points*

   Be precise and concise.

4. **Circle the types of transformations that to be expressed in matrix form require homogenized coordinates.** *8 points*

Translation

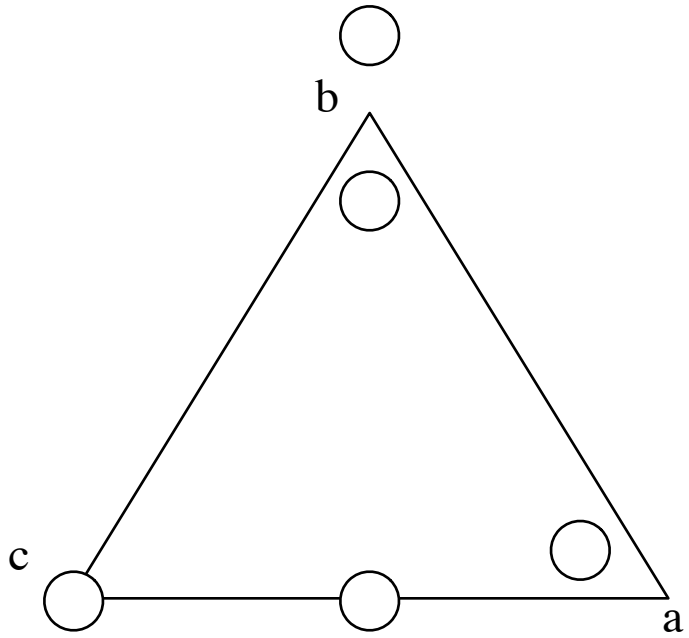
Scale

Rotation

Shear

Perspective

5. This diagram shows a triangle with vertices labeled a, b, **and** c. **Several locations have been indicated with circles. The list of numbers to the right contains triples of numbers representing the barycentric coordinates of these circles. Draw a line connecting each triple with the correct circle. Cross out the triple that does not match any circle.** *12 points*



[0.5, 0.0, 0.5]

[0.0, 0.0, 1.0]

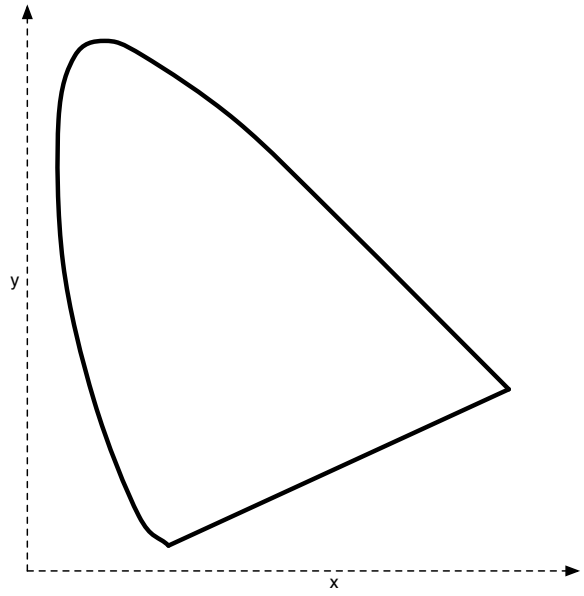
[0.8, 0.1, 0.1]

[0.1, 0.8, 0.1]

[-0.1, 1.2, -0.1]

[0.1, -0.2, 0.1]

6. The following diagram shows the the x-y plane of the CIE color space. Mark and label the approximate locations of spectral orange, spectral yellow, spectral violet, spectral green, sky-blue, and white. *12 points*



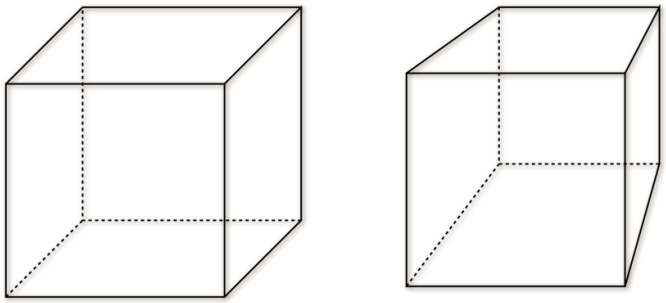
7. **Given a rotation encoded as a length-3 vector (*e.g.* axis-angle, a.k.a. exponential map), in general how is the rotation changed when the representation is negated?** *3 points*

8. **Given a rotation encoded as a quaternion, in general how is the rotation changed when the representation is negated?** *3 points*

9. **Name a physical phenomena that causes the appearance of color on a surface, and that typically causes the perceived color to change dramatically as the location of the viewer is changed.** *4 points*

10. **Assume that I want to ray trace an image, and I decide that each time a ray strikes a surface I will send out K number of rays to sample the light coming in to that surface. How will my rendering time grow as I increase recursion depth?** *4 points*

11. **One of the diagrams below shows a cube under orthographic projection, the other under perspective projection. Label which is which.** *3 points*



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

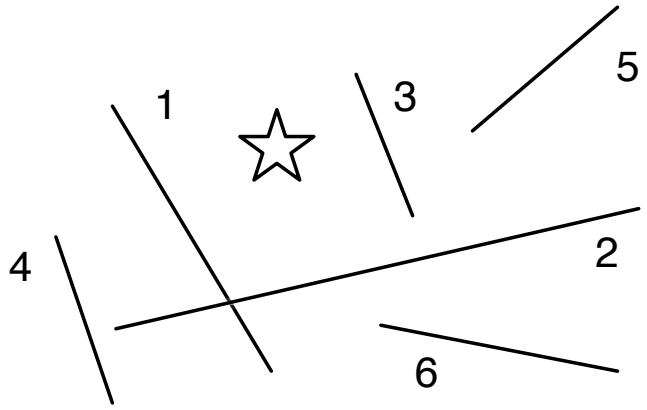
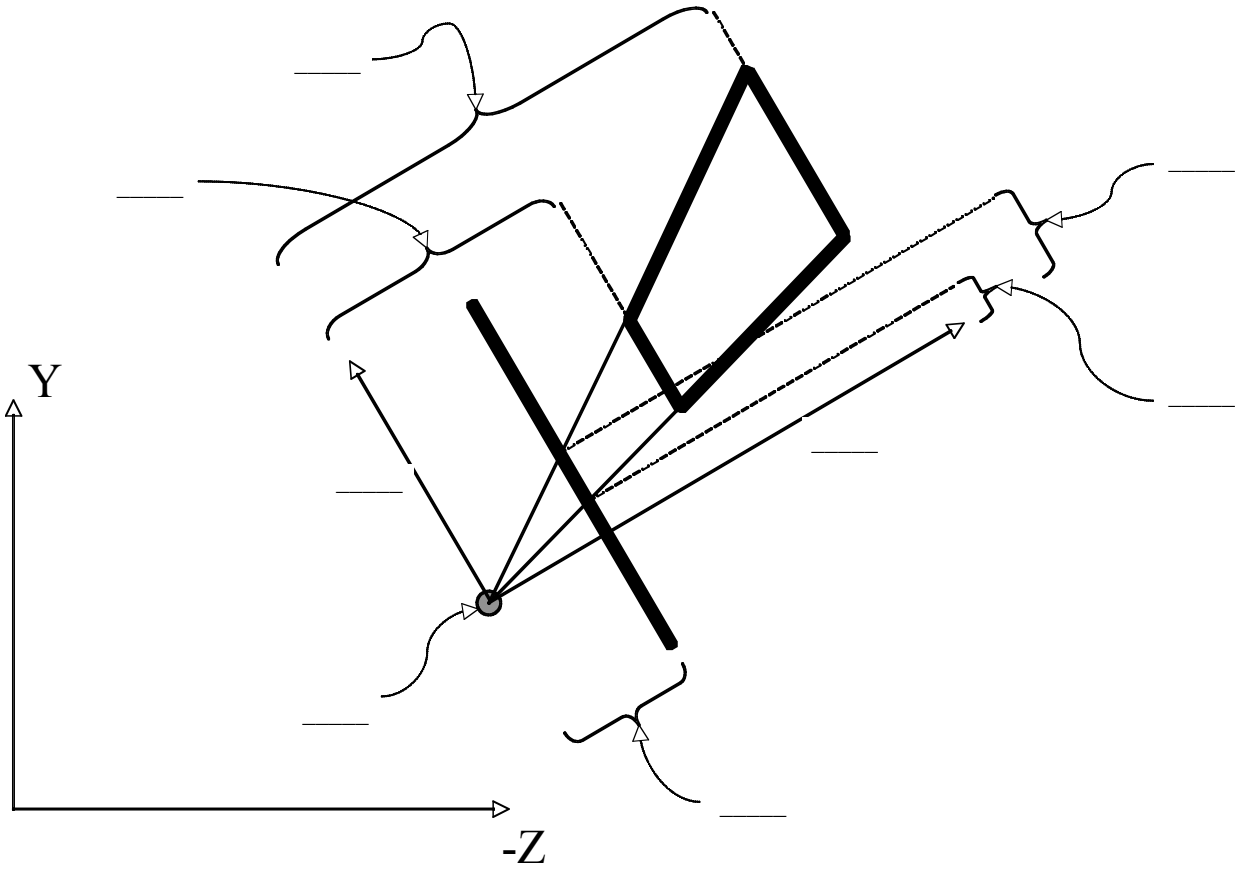


Diagram the resulting tree below. If needed, show where line segments need to be split by marking on the above figure. Also, indicate the names of the split parts by writing labels on the figure above. (For example, if there were a segment 9 and it was to be split, you would draw a mark showing where it would be split and label the resulting pieces 9a and 9b.) *15 points*

List the <u>front-to-back</u> traversal order that would result for the location indicated by the viewer icon (the star). *6 points*

13. On the figure below write the appropriate letter in each of the blanks to label the diagram properly. Some of the letters are just there to confuse you. *15 points*



A	Center of Projection	I	Zero point
B	Small blind	J	Bottom clipping plane distance
C	Top clipping plane distance	K	Big blind
D	View up vector	L	Star power
E	View plane normal	M	Far clipping plane distance
F	Main tank	N	Right clipping plane distance
G	Near clipping plane distance	O	Left clipping plane distance
H	Distance to image plane	P	Distance to a higher plane