

NAME:
Login name:

Computer Science 426 Exam 1 4 Mar 2003

This test has 6 questions. Do all of your work on these pages, giving the answer in the spaces provided and using the backs of the pages for scratch space. Wherever possible, use concise answers (long, rambling, unfocused answers will be penalized). This is a closed-book exam, but you may use one page of notes with writing on both sides during the exam.

Put your name on every page, and write out and sign the Honor Code pledge before turning in the exam.

"I pledge my honor that I have not violated the Honor Code during this examination."

Question	Score
1	
2	
3	
4	
5	
6	
Total:	(72 possible)

NAME:

Q1: Colors

- (a) [3 pts] You are watching TV with your friend Zapog who is from planet Zooglo. A commercial advertising bananas is shown. Seeing the commercial, Zapog comments: "That's not a banana! That is a reddish, greenish, banana-shaped thing!" But it looks to you like an ordinary banana. Provide an explanation based on possible differences between Zapog's and your visual systems. (One to three brief sentences.)

For optional extra credit, provide another (different) explanation based on the visual systems.

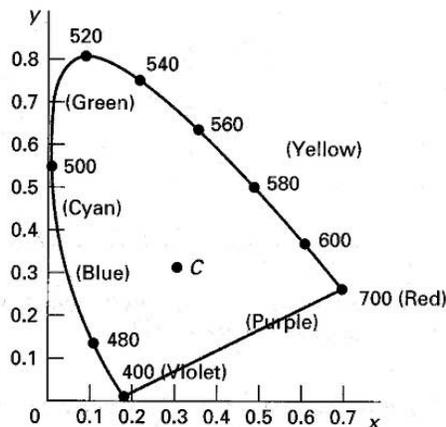
- (b) [6 pts] Draw (i) the RGB color cube, (ii) the CMY color cube, and (iii) the HSV color model, labeling the 8 locations R, G, B, C, M, Y, white, and black (label all 8 on each of the figures).

RGB:

CMY:

HSV:

- (c) [3 pts] Draw a narrow loop around the spectral colors on the CIE chromaticity diagram below.



NAME:

Q2: Compositing

(a) [4 pts] List two different possible physical interpretations for the alpha channel in a 4-channel pixel (R,G,B,A).

i)

ii)

(b) [2 pts] Representing colors with 4-channel pixels (R, G, B, A), what color do we get if we composite (0.0, 0.5, 0.25, 0.5) OVER (1.0, 0.5, 0.5, 1.0)?

(c) [2 pts] What is a drawback of using a fixed-precision representation for a 4-channel pixel (R,G,B,A) when using pre-multiplied alpha?

(d) [4 pts] Describe two different properties of a foreground object that would not be described well in an image that uses blue-screen matting to separate foreground from background.

i)

ii)

NAME:

Q3: Lighting

The Phong lighting model is given by the equation:

$$I = I_E + K_A I_{AL} + \sum_i (K_D (N \cdot L_i) I_i + K_S (V \cdot R_i)^n I_i)$$

where K_D is the material constant for diffuse lighting and K_S is for specular lighting.

- (a) [2 pts] In this lighting model, what visual property is controlled by the exponent n ?

- (b) [2 pts] The constant K_A adjusts how the material responds to ambient light I_{AL} . What is the purpose of including the term $K_A I_{AL}$ in the lighting model?

- (c) [2 pts] Give one example of a real object or material whose appearance is well approximated using this lighting model and an entirely diffuse material (no specular component).

- (d) [2 pts] Give one example of a real object or material whose appearance is well approximated using this lighting model and an entirely specular material (no diffuse component).

- (e) [2 pts] Give one example of a real object or material whose appearance is well approximated using this lighting model and a material with both diffuse and specular components.

- (f) [2 pts] Give one example of a real object or material whose appearance cannot be well approximated using this lighting model.

NAME:

Q4: Projection

(a) [4 pts] You are using a program that allows you to view a cube in 3D. The program provides controls that allow you to specify the position and orientation of the cube. However, you are not sure whether the program uses an orthographic or perspective projection of the cube. Describe two ways you can determine which type of projection is used in the program. (In each case, say how you would use the program and/or what you would look for on the screen.)

i)

ii)

(b) [3 pts] Draw pictures of a cube in each of the three forms of perspective listed below.

1-point:

2-point:

3-point:

(c) [2 pts] List an advantage and a disadvantage of using cabinet projection instead of perspective.

Advantage:

Disadvantage:

(d) [3 pts] Write out the 16 entries of the projection matrix that transforms a point from 3D camera coordinates to 2D screen coordinates for an orthographic camera.

$$\begin{bmatrix} x_s \\ y_s \\ z_s \\ w_s \end{bmatrix} = \begin{bmatrix} & & & \\ & & & \\ & & & \\ & & & \end{bmatrix} \begin{bmatrix} x_c \\ y_c \\ z_c \\ 1 \end{bmatrix}$$

NAME:

Q5: Transformations

(a) [4 pts] Homogeneous coordinates (x,y,z,w) are commonly used in computer graphics for representing 3D geometry (x,y,z) . One reason is that they permit non-linear transformations called *homogeneous transformations* represented by 4x4 matrices. List two different types of transformations that are not linear yet can be represented using homogeneous transformations.

i)

ii)

(b) [2 pts] Give an example of an object transformation that cannot be represented using a homogeneous transformation matrix.

(c) [3 pts] Some scenes are represented using a *transformation hierarchy* (for example, a model of an office building with many offices and several instances of a chair model in each office). When ray casting into a scene represented by a transformation hierarchy, we may choose to transform the rays from world space into model space and find intersections there (rather than in world space). Provide an explanation of why we might choose to do this.

For optional extra credit, provide a second (different) reason.

(d) [3 pts] List the steps necessary to transform the rays as described in (c) when rendering an image in a ray tracer.

NAME:

Q6: Miscellaneous

(a) [2 pts] Smith argues that a pixel is not a little square. What is it? (*1 to 3 words will suffice.*)

(b) [2 pts] Define the term *convex* as it applies to polygons

(c) [2 pts] What are features lines used for in a Beier & Neely morph?

(d) [2 pts] How many different gray levels can be represented by a 6x6 dither matrix?

(e) [2 pts] A matrix M is convolved with an image in order to blur the image. Why is it important to “normalize” the entries of a M so that they sum to 1.0?

(f) [2 pts] List two properties of a spot light that are not properties of a directional light.

i)

ii)