<CS 184 Midterm (Fall 1990)

UNIVERSITY OF CALIFORNIA

College of Engineering

Department of Electrical Engineering

and Computer Sciences

Computer Science Division

Fall 1990 | CS 184 | Professor Brian A. Barsky

16 October 1990 | Foundations of Computer Graphics

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NAME:
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CS184 MIDTERM EXAMINATION

Enclosed is your very own personal copy of the Computer Science 184 Midterm Examination (one copy per person, please). In the ensuing two hours, you should answer all the questions to the best of your ability. Feel free to use the back of each page for additional answer space. Do not panic. You will have time. Pay attention to the point values listed by each problem, so that you don't spend lots of time on the lower-valued problems.

Good Luck!

Problem	Possible	Score
1	20	
2	20	
3	20	

4	20	
5	20	
Total Score	100	

Question #1: **Raster Memory Requirements**

For a raster display of resolution 1280 x 1024 pixels that uses a *color mapped display*, find the amount of total memory required for each of the following configurations:

a) 4096 possible colors, 256 entry color map. (8 Points)

b) 4 bit planes each for Red, Green and Blue primaries, a 1 bit overlay plane and 1 color map for each primary color that can display 256 possible shades of each primary color. (12 Points)

Question #2: **Balanced Colortable**

If a colortable contains 256 entries, each of which is a triple (R,G,B) where R,G, & B are floating point numbers between 0 and 1 (inclusive), describe a method of setting up and using the lookup table with the goal of covering the *entire* color spectrum as uniformly as possible. Include Pseudo-code of two routines:

a) One to initialize the entries in the colortable with appropriate floating point representation of color values. Use the routine set_ct_index(ind, R, G, B) to set an index (ind) to correspond to the color triple [R,G,B]. (10 Points)

b) A second routine used to find the index into the colortable which most closely matches the requested color vector. For example,

int color_index(float red, grn, blu)
would return as its result the index in your lookup table which is *closest* to the requested value [red,grn,blu]. Aim for efficiency! (10 Points)

Question #3: **Video Display Technology**

Assuming a non-interlaced video display measuring 12" x 14" with 640 scanlines per frame, a frame rate of 60Hz, and horizontal and vertical retrace times of 7 microsec. and 1250 microsec. respectively, and that the vertical velocity of the elctron gun is constant *except during vertical retrace*, determine the angle from the horizontal that the electron gun's beam makes as it travels from one side of the screen to the other during:

(a) actual drawing of each scanline. (10 Points)

(b) horizontal retrace. (10 Points)

Question #4: **Rigid Body Transformations**

If points are represented in homogenous co-ordinates, 2-dimensional transformations can be represnted using 3 X 3 matrices. A composition of 2-dimensional rotations and translations can be represented as a matrix of the form:

$$M = \begin{bmatrix} R_{11} & R_{12} & 0 \\ R_{21} & R_{22} & 0 \\ T_x & T_y & 1 \end{bmatrix}$$

Consider the upper 2 X 2 matrix consisting entirely of rotations. Assume it to be an orthogonal matrix. This means that if each of the rows is taken as a vector then:
(i) Each is a unit vector.
(ii) Each is perpendicular to the other (their dot product = 0)
The same properties are also true for the 2 columns of the submatrix.

(a) Prove that a transformation of this type (M) preservers lengths (i.e. the dimensions of the object being transformed remain the same after transformation). (15 Points)

(b) Why is it useful that lengths are preserved? (5 Points)