University of Toronto
Department of Computer Science
CSC 418/2504: Computer Graphics
Midterm Examination
Winter 2008
Duration: 60 minutes
No aids allowed
There are 5 pages (including this page)

First name: ____________________________________

Last name: ____________________________________

Student number: ____________________________________

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1. Answer the following questions without explanation. (7 marks each question)

A. Name three application areas of computer graphics.

_________________________________

_________________________________

_________________________________

B. The color of a pixel with RGB values [1.0,1.0,0.0] is ____________ .

C. The Euclidean coordinates of the midpoint of the two homogeneous vectors (6 12 9 3) and (12 4 14 2) are ________________.

D. True or false: if two straight lines in 3D project under orthographic projection to parallel lines in the image, then the two lines must be parallel in 3D ________________.

E. True or false: the image of a 3D square under perspective projection is always a parallelogram (assuming the square is not projected to a line) ________________.
2. Consider a Lambertian surface satisfying the equation

\[ x^2 + y^2 + z^2 + xy + xz + yz = 6 \]

The surface is illuminated by a distant light source with direction vector \( L = (1, -1, 1)^t / \sqrt{3} \) (\( L \) is the light vector as discussed in class. The incident light is travelling in the \(-L\) direction). The light intensity is 3 and the surface is not absorbing any light.

A. Compute the unit surface normal at point \((1, 1, 1)^t\). (15 marks)

B. Compute the radiance (emitted intensity) at point \((1, 1, 1)^t\). (15 marks)
3. In this question we will examine Bresenham's line drawing algorithm between two pixels $p_1=(x_1,y_1)$ and $p_2=(x_2,y_2)$. Suppose we measure the digital length of a digital line in the following way: as we traverse the pixels from $p_1$ to $p_2$, every step up, down, left or right is counted as 1. Every step in any diagonal direction is counted as 1.414 (approximately $\sqrt{2}$). The digital length is the sum of the lengths of the steps as we go from $p_1$ to $p_2$. What is the digital length of the line from (0,0) to (100,653)? Write a short explanation. (15 marks)
4. Find a 3×3 transformation matrix for transforming homogeneous coordinates in the plane that performs the transformation shown below. (20 marks)