EECE 478 Computer Graphics 2013 Midterm Examination

Department of Electrical and Computer Engineering

University of British Columbia

Dr. G. Miller

1400 Tuesday 26th February 2013

Print Name: _____ **Signature**: _____

Student Number: _____

Exam instructions (read carefully):

1. **Print** your name, **sign** this cover page and enter your **student number** in the space provided **immediately.**
2. Continue reading the instructions, but **do not open the exam booklet** until told to do so by an invigilator.
3. Cheating is an academic offense. Your signature on the exam indicates that you **understand** and **agree** to the University's policies regarding cheating on exams.
4. Write **all** of your answers on these pages. If you need more space, you may ask an invigilator for more paper. Be sure to indicate when a question is continued, **both** on the page for that question and on the continuation page.
5. The exam is **closed book**. There are **no aids permitted (including calculators)**.
6. You have **1 hour** in which to work. **Budget your time wisely**.
7. No one will be permitted to leave the exam room during **the first 30 minutes** (per University regulations) and **the last 30 minutes**.
8. Most marks are given for demonstrating your thought processes. Ma**ke sure you show all the steps you use for each of your answers**. If you do not know the answer to a question, **write down the process** by which you think it could be answered.

Question	Marks Available	Marks Received
1	8	
2	7	
3	10	
Total	25	

Question 1

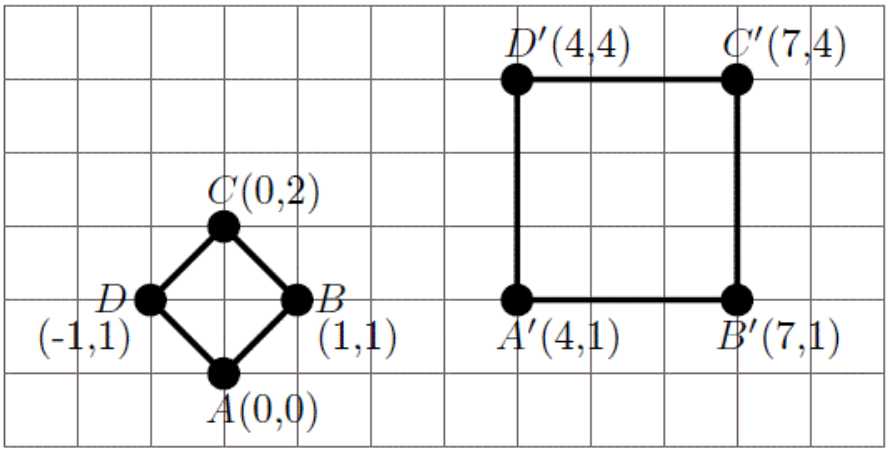
Derive perspective projection equations for 2D values of x and y, assuming that the centre of projection is at $(0, 0, d)$ and the projection plane is at $z = 0$.

Start by drawing diagrams to illustrate your approach, then describe each step you take (*most marks are given for the work you show – no marks are given for writing down the equations with no work shown*).

[8 marks]

Question 2

Consider the following figure:



Assuming an OpenGL-like system (post-multiplication), and using the notation:

R(ø) - rotate clockwise by ø degrees
S(*x*) - scale uniformly by *x*
T(*x*, *y*) - translate horizontally by *x* and vertically by *y*

(a) Provide the sequence of matrices with associated values that will transform the square *ABCD* into the square *A'B'C'D'*. **[5 marks]**

(b) Provide the sequence of matrices with associated values that will transform the square *A'B'C'D'* into the square *ABCD*. **[2 marks]**

Question 3

(a) Explain how to convert points **and** vectors in standard 3D coordinates, (x, y, z), to homogeneous coordinates. **[2 marks]**

(b) Explain how to convert points **and** vectors in homogeneous coordinates to standard 3D coordinates. **[2 marks]**

$$\begin{bmatrix} x'_H \\ y'_H \\ z'_H \\ w'_H \end{bmatrix} = \begin{bmatrix} a_{11} & a_{12} & a_{13} & b_1 \\ a_{21} & a_{22} & a_{23} & b_2 \\ a_{31} & a_{32} & a_{33} & b_3 \\ c_1 & c_2 & c_3 & d \end{bmatrix} \begin{bmatrix} x_H \\ y_H \\ z_H \\ w_H \end{bmatrix}$$

(c) From the matrix equation above, describe the types of transformations provided by each of the two blocks (a_{11} ... a_{33}) and (b_1, b_2, b_3); Also, provide a use in computer graphics for the block (c_1, c_2, c_3, d) **[4 marks]**

(d) Is it possible to construct a translation matrix for 3D objects using a 3x3 matrix? Give an explanation for your answer. **[2 marks]**