CMPT385 Midterm Makeup Exam
Closed Book
November 15, 2004 In-Class
50 minutes

Please read all the questions carefully. A portion of the marks awarded will be for the style and the clarity of your answer.

1. **Geometric Transformations (30 marks)**
   a. (20) The following shows the modelview matrix at a particular point in a computer program.

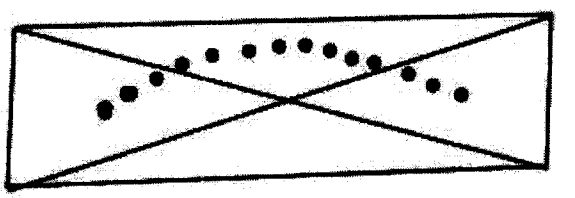
9	-2	3	0
0	-44	7	0
14	0	-3	0
-1	1	-1	1

   Show the translation matrix created by a call to *glTranslated(255, -256, 256)* and show what the modelview matrix looks like afterwards.

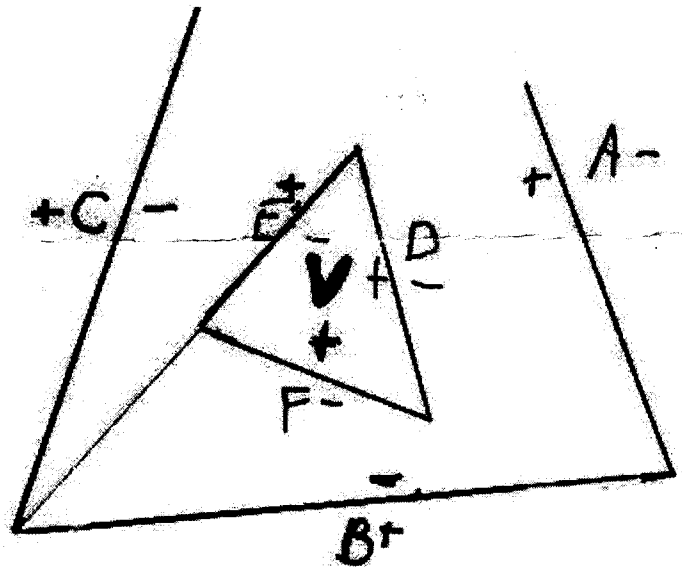
   b. (10) Consider 2D transformation matrices. Do the rotation and scale transformations 1) *always* commute, 2) never commute, or 3)sometimes commute? If your answer is either1 or 2, justify it with a proof. If your answer is 3) justify it with an examples of both cases.

2. **Lighting** (20 marks)
   a. (10) Consider a scene consisting of a just smooth sphere. It is lit in so that the rendered image shows a medium lit sphere with a small but bright highlight. What will change in the image if 1) only the ambient light is turned off, 2) only the diffuse light is turned off, 3) only the specular light is turned off.

   b. (10) Penny Programmer wants to simulate shadows cast by a low flying object traveling over the surface below (consisting of triangles) along the route indicated by the dots. Penny has a Boolean function canSee(P0, Obj, P1). This function returns *true* if the object *Obj* is *not* on the line of sight between *P0* and *P1* and otherwise returns *false.* As a heuristic, she does the following when rendering each triangle of the large surface: For each vertex and point *P*, and for each light at point *L*, she tests whether canSee(P, Obj, L). If at least one call to *canSee()* returns false, she illuminates that triangle with only ambient light. How well does this heuristic work? Make a suggestion to improve it.



3. **Depth** (10 marks)
   a. You are hired by El Cheapo Graphics Cards Ltd. They wish to produce a consumer level graphics card that will sell for less than $10.00. They have found they can do this if, for each pixel, they use a total of 16 bits to represent colour and depth. Their chief engineer, Willard Fleming, believes they should use 5 bits for green, 4 bits for blue, 4 bits for red, and 2 bits for depth information. Suppose that the intended application is animation of simple scenes for games. What advice do you have for Willard?
4. **BSP Trees** (20 marks)
   a. The following polygon is intended to represent a view from the top of a set of equal sized rectangles *A,B,C,D,E,*and *F*. The plus (+) and minus (-) signs indicate the sign of the equation of the plane for the associated rectangle. (The light line is meant to indicate that polygon E is exactly in line with the corner created by C and B.)



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The rectangles arrive at a BSP construction algorithm in the order E A C ~~D~~B F. Show the resulting BSP tree. Label arcs with + and – signs, as in class.

   b. From your BSP tree, show the order the rectangles will be drawn from viewer positions *V*.

5. **Splines** (10 marks:)

   (8) What are the geometric constraints on a Hermite curve?
   (2) What is the main difference between a Bezier and a Hermite curve?

-End of Exam-2 pages