Lunds Universitet
Institutionen för Datavetenskap

Exam – Computer Graphics

29 March 2005, 8-13

1 (a) What is a *rigid body transform*? Given an as exact answer as you can. Also give one or more examples of transforms which are not rigid body transforms. *(0.4)*
(b) Give an expression for the *projection* of a vector ***a*** on another vector ***b***. *(0.6)*

2 (a) How do you distinguish between the front side and the back side of a triangle? *(0.4)*
(b) Explain the notion of *tesselation*. *(0.4)*
(c) What is the so called *minification* problem? (0.2)

3 (a) How is the specular reflection computed in Blinn's reflection model? *(0.3)*
(b) What is a *BRDF*? *(0.4)*
(c) What is *light mapping* and what is it useful for*? (0.3)*

4 (a) What is the fundamental difference between *ray-tracing* and *radiosity*? *(0.3)*
(b) Describe how each of the algorithms work. *(0.5)*
(c) What is *image based lighting*? *(0.2)*

5 Compute ***T****(1,1,1) where ***T*** is defined as the matrix product

T* = *M1**R1**S**M2**R2

where each term is the matrix for a two-dimensional transform in homogenous coordinates as given below:

M1: translation by the vector (-1,-1)
R1: rotation 45 degrees clockwise
S: scaling by the factor 2
M2: translation by the vector (1,1)
R2: rotation 90 degrees anti-clockwise

6 (a) Compute the shading of a triangle surface defined by vertex positions P_0-P_2 with flat shading, and Phong's reflection model, given a point light source with the attenuation function f(r) and light intensity at the light source I_l and given that a point on the surface has incident light angle θ, viewer angle Ω and the material properties given below. *(0.6)*

Material properties	Vertex positions	Light source	Viewer
$k_a = 0.2$ $k_d = 0.3$ $k_s = 0.5$ $\alpha = 4$	$P_0 = \begin{bmatrix} -1 \\ -1 \\ 1 \end{bmatrix}$ $P_1 = \begin{bmatrix} 1 \\ -1 \\ -1 \end{bmatrix}$ $P_2 = \begin{bmatrix} 0 \\ 1 \\ -2 \end{bmatrix}$	$I_l = 0.8$ $f(r) = 1$ $\theta = 30^\circ$	$\Omega = 45^\circ$

(a) Now change to a somewhat artificial light model where you find the color of a surface point by doing a lookup with its normal in a cube map. Which color would the triangle get if the cube map is defined as below? *(0.4)*

Side	**RGB value**
positive X-direction:	(1,0,0)
negative X- direction:	(0,1,1)
positive Y- direction:	(0,1,0)
negative Y- direction:	(1,0,1)
positive Z- direction:	(0,0,1)
negative Z- direction:	(1,1,0)

THE END!