

# Exam – Computer Graphics

20 december 2003, 8-13

- 1 (a) What is the most important advantage of representing transforms with matrices? (0.3)  
(b) How is this utilized in the design of a renderer? (0.4)  
(c) How is the transformation of normals different from the transformation of vectors? (0.3)
  
- 2 (a) What is *Catmull-Rom-interpolation*? (0.6)  
(b) What is *back face culling*, and how is it done? (0.4)
  
3. (a) What is a *cube map* and what is it used for? (0.2)  
(b) How do you do lookup in a cube map? (0.8)
  
- 4 (a) What are *barycentric coordinates*? (0.3)  
(b) Explain how barycentric coordinates can be used for rasterization and shading of triangle meshes. (0.7)
  
- 5 (a) Describe what a call to the function `draw()` below will draw on the screen. (0.8)

```
def draw():
    glColor(1,0,0)
    glPushMatrix()
    glScale(3,3,3)
    glTranslate(2,0,0)
    glRotate(90, 0,0,1)
    glPushMatrix()
    glTranslate(1,0,0)
    drawSquare()

    glColor(0,1,0)
    glPopMatrix()
    glPushMatrix()
    glTranslate(4,0,0)
    glScale(0.5,0.5,0.5)
    glRotate(270, 0,0,1)
    drawSquare()

def drawSquare():
    glBegin(GL_QUADS)
    glVertex(0,0,0)
    glVertex(0,1,0)
    glVertex(1,1,0)
    glVertex(1,0,0)
    glEnd()
```

- (b) What is a *vertex array*? And what are its advantages? (0.2)
- 6 (a) A triangle surface with vertices  $P_0, P_1, P_2$  is lit by a point light source with transmittance  $L$  and positioned in  $P_L$ . There is no ambient light in the scene. Use Phong's reflection model to determine the light reflection reaching the point  $P_V$  from each of the vertices. (0.7)

Material parameters	Vertex positions	Light source	Viewer position
$k_a = 0.1$ $k_d = 0.5$ $k_s = 0.2$ $\alpha = 3$	$P_0 = \begin{bmatrix} 2 \\ 0 \\ 0 \end{bmatrix}$ $P_1 = \begin{bmatrix} 0 \\ 4 \\ 0 \end{bmatrix}$ $P_2 = \begin{bmatrix} 0 \\ 0 \\ 8 \end{bmatrix}$	$L = 1.0$ $P_L = \begin{bmatrix} 5 \\ 3 \\ 1 \end{bmatrix}$	$P_V = \begin{bmatrix} 8 \\ 1 \\ 8 \end{bmatrix}$

- (b) Determine the light reflection from the point  $P=(2/3, 2/3, 4)$  by interpolation over the triangle surface. (0.3)

SLUT!