

CPSC 314 2013W T2 Midterm 2 Review Questions

March 18, 2014

These are some questions to help you review class material. They don't constitute a "practice exam". The exam format will be very similar to midterm 1, with answers to many questions given in the lecture notes and textbook. So the most important study preparation is to read and understand those two sources.

1 Lighting/Shading

For the following, assume vectors at point \tilde{p} are defined in Fig. 14.3 of the textbook.

1. If a point light source is at position \tilde{p}_l , what is \vec{l} ? If the surface was a perfect mirror, in what direction \vec{r} would the surface look like the light source?

$$\vec{l} = \frac{\tilde{p}_l - \tilde{p}}{\|\tilde{p}_l - \tilde{p}\|}$$

$$\vec{r} = 2(\vec{l} \cdot \vec{n})\vec{n} - \vec{l}$$

2. Define the Blinn-Phong model and state how it differs from the Phong model.

$$I_{spec} = k_s I_s (\vec{n} \cdot \vec{h})^{shininess}$$

Blinn-Phong model replaces $\vec{v} \cdot \vec{r}$ with $\vec{n} \cdot \vec{h}$ for the specular component, where \vec{h} is the half-way vector.

3. Compute the half-way vector \vec{h} in the Blinn-Phong model from the data in the figure.

$$\vec{h} = \frac{\vec{v} + \vec{l}}{\|\vec{v} + \vec{l}\|}$$

4. The color L_c of a point light is $(0.9, 0.9, 0.9)$. Its location is $(0, 3, 0)$. The eye point \tilde{e} is at $(3, 1, 0)$. The specular coefficient k_s is $(0.8, 0.8, 0.1)$, and shininess σ is 5. Compute the specular color of the surface at point $\tilde{p} = (3, 3, 0)$ with the normal $(-\frac{\sqrt{2}}{2}, \frac{\sqrt{2}}{2}, 0)$. Use the Blinn-Phong model.

$$\text{light vector towards the source: } l = \frac{\tilde{p}_l - \tilde{p}}{\|\tilde{p}_l - \tilde{p}\|} = (-1, 0, 0)$$

$$\text{eye vector towards the eye: } e = \frac{\tilde{e} - \tilde{p}}{\|\tilde{e} - \tilde{p}\|} = (0, -1, 0)$$

$$\text{half-way vector: } \frac{\tilde{e} + \tilde{p}_l}{\|\tilde{e} + \tilde{p}_l\|} = (-\frac{1}{\sqrt{2}}, -\frac{1}{\sqrt{2}}, 0)$$

$$(0.9, 0.9, 0.9)(0.8, 0.8, 0.1)((-\frac{1}{\sqrt{2}}, -\frac{1}{\sqrt{2}}, 0) \cdot (-\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}, 0))^5 = (0.72, 0.72, 0.09)(\frac{1}{2^5}, -\frac{1}{2^5}, 0) \approx (0, 0, 0)$$

5. Compute the normal for the triangle whose vertices are at $(2, 4, 1)$, $(0, 5, -2)$, $(-1, 2, 3)$. If the triangle is rotated 180 around the x -axis, and then scaled by 2 along the x -axis, what is its new normal?

$$\vec{a} = \begin{bmatrix} 0 \\ 5 \\ -2 \end{bmatrix} - \begin{bmatrix} 2 \\ 4 \\ 1 \end{bmatrix} = \begin{bmatrix} -2 \\ 1 \\ -3 \end{bmatrix}$$

$$\vec{b} = \begin{bmatrix} -1 \\ 2 \\ 3 \end{bmatrix} - \begin{bmatrix} 2 \\ 4 \\ 1 \end{bmatrix} = \begin{bmatrix} -3 \\ -2 \\ 2 \end{bmatrix}$$

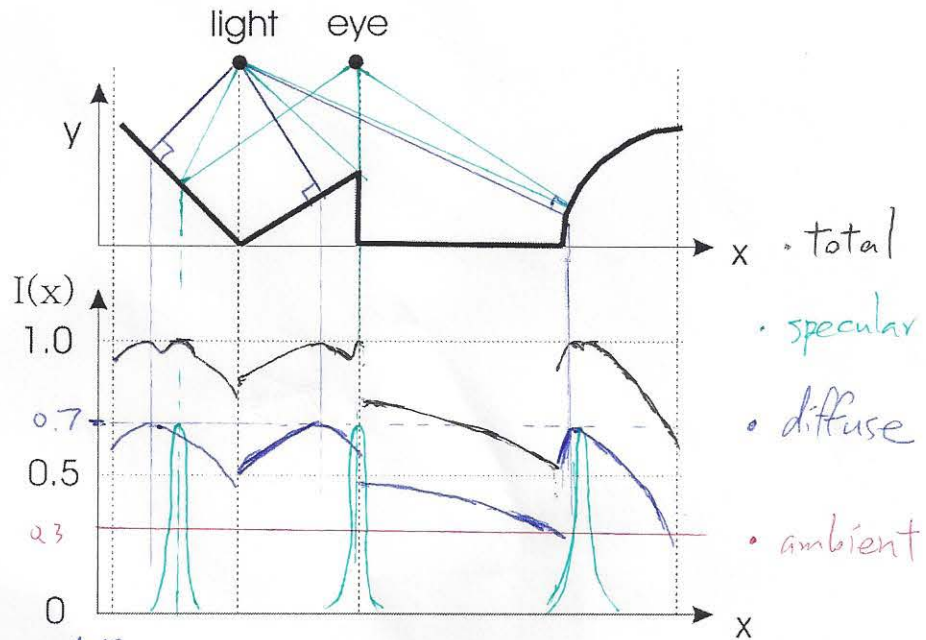
$$\vec{n} = \frac{\vec{a} \times \vec{b}}{\|\vec{a} \times \vec{b}\|} \approx \begin{bmatrix} -0.26 \\ 0.85 \\ 0.46 \end{bmatrix}$$

$$A = \begin{bmatrix} 2 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & -1 \end{bmatrix} = \begin{bmatrix} 2 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & -1 \end{bmatrix}$$

$$(A^{-1})^T = \begin{bmatrix} \frac{1}{2} & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & -1 \end{bmatrix}$$

$$\vec{n}^{\rightarrow} = \begin{bmatrix} \frac{1}{2} & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & -1 \end{bmatrix} \begin{bmatrix} -0.26 \\ 0.85 \\ 0.46 \end{bmatrix} = \begin{bmatrix} -0.13 \\ -0.85 \\ -0.46 \end{bmatrix}$$

6. Sketch the ambient, diffuse, specular, and total illumination for the following scene as a function of x . Assume the Phong lighting model, i.e. $I = k_a I_a + k_d I_d (\vec{n} \cdot \vec{l}) + k_s I_s (\vec{r} \cdot \vec{v})^n$ where $k_a = 0.3$, $k_d = 0.7$, $k_s = 0.7$, $I_a = I_d = I_s = 1$, $n = 100$



diffuse max : $0.7 \cdot 1 = 0.7$

@ $\vec{l} \parallel \vec{n}$ ($\vec{n} \cdot \vec{l} = 1$)

and changes smoothly when the angle changes continuously

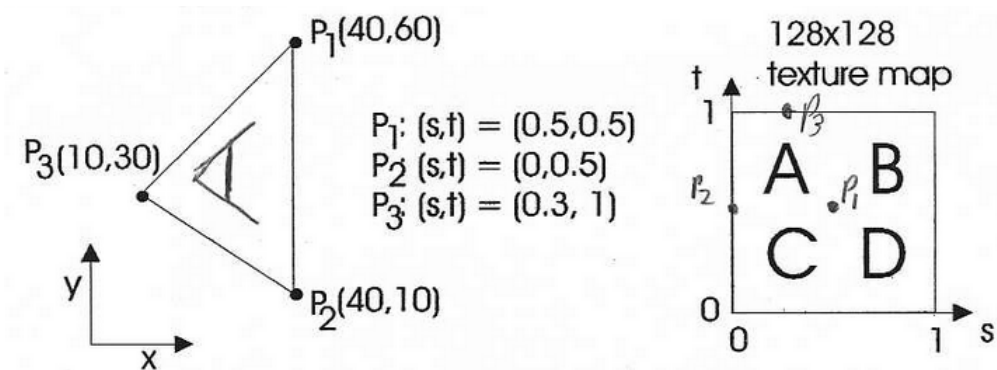
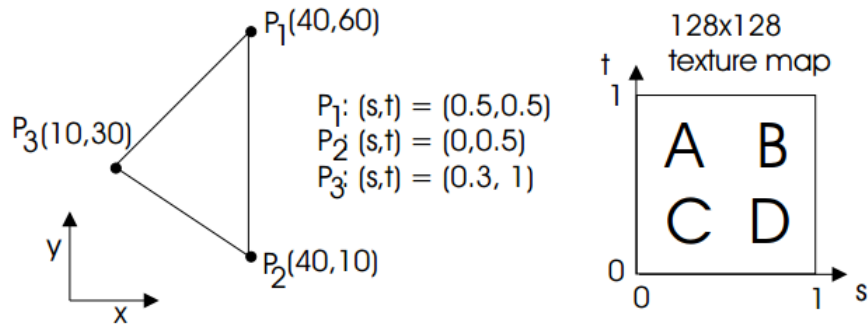
ambient : $0.3 \cdot 1 = 0.3$

specular max : $0.7 \cdot 1 = 0.7$

@ locations where the eye is in the bounce direction

2 Texture mapping

1. A texture map with the letters "ABCD" is mapped onto the given triangle. Draw the texture map as they would appear on the triangle.



2. A unit sphere is placed at $(0,0,0)$ and the eye is at $(0,0,5)$ looking at the origin. Environment cube map is used to create the texture for the sphere. The colors of the cube are: top: green, bottom: yellow, left: magenta, right: red, front & back: blue. Please describe qualitatively (or draw) how the sphere will appear on the screen.

