

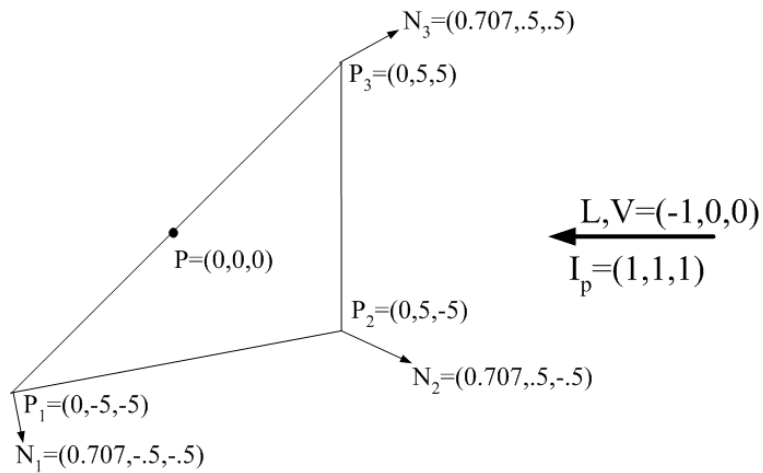
CPSC 314

Assignment 4

1. Light and shading

- (a) Given a scene with two non specular objects, one yellow ($k_a = k_d = (1, 1, 0)$) and one red ($k_a = k_d = (1, 0, 0)$), classify the following statement as true or false. Explain.
 - i. (1 point) Given a single point light source with intensity $I_p = (1, 0, 0)$ the objects will have the same shading.
 - ii. (1 point) Given a single ambient light source with intensity $I_a = (1, 0, 0)$ the objects will have the same shading.
- (b) (1 point) Write the openGL code for defining the following lighting scenario with three light sources: ambient light source with intensity $I_a = (0.3, 0, 0)$; directional light with direction $(1, 0, 0)$ and intensity $(0.6, 0.6, 0.6)$; point light at $(10, 0, 0)$.
- (c) (1 point) In openGL define the material properties for a triangle with $k_a = (1, .5, .5)$, $k_d = (1, .5, .5)$, $k_s = (.5, .5, .5)$ and specular coefficient $n = 16$.

- (d) In the scene below there is one directional light source at infinity $(\infty, 0, 0)$ with direction $(-1, 0, 0)$. The view direction is the same as light direction $(-1, 0, 0)$. The shading coefficients for the triangle are $k_a = k_d = (1, 0, 0)$, $k_s = (0, 1, 0)$ and the specular coefficient is $n = \infty$.

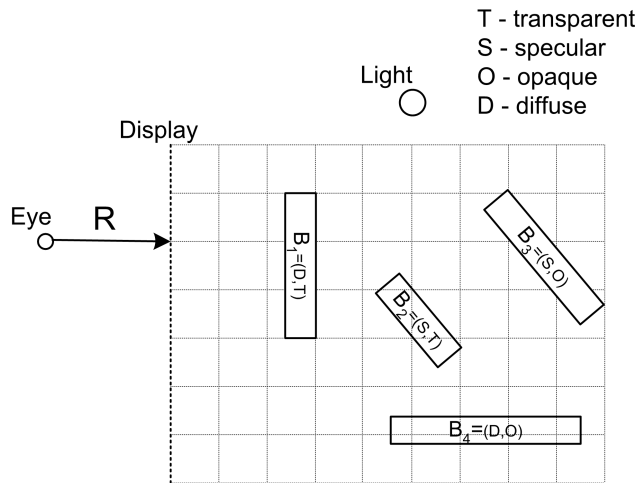


Compute the color at point P on the triangle using the following shading algorithms (use per-face or per-vertex normals as necessary):

- i. (2 points) Flat shading,
- ii. (2 points) Gourard shading,
- iii. (2 points) Phong shading.

2. Ray-Tracing

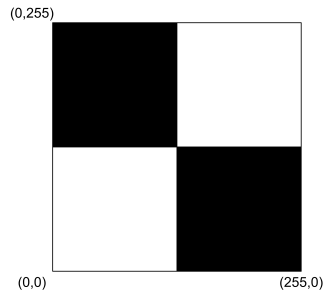
- (a) (3 points) Draw the ray tree for the ray R shown below. Assume index of refraction c_1 for air is 1 and index of refraction for all the transparent objects in the scene is $c_2 = \frac{1}{\sqrt{2}}$. Use Snell's law to obtain refraction angles.



- (b) (2 points) Assume the transparency coefficient α for the transparent objects is .5, the light intensity is $I_p = (1, 1, 1)$ (no other lights), and the diffuse/specular coefficients for the objects are $k_d^1 = (1, 0, 0)$, $k_s^1 = (0, 0, 0)$, $k_d^2 = (0, 0, 0)$, $k_s^2 = (1, 1, 1)$, $k_d^3 = (0, 0, 0)$, $k_s^3 = (1, 1, 1)$, $k_d^4 = (0, 1, 0)$, $k_s^4 = (0, 0, 0)$. What is the color returned by the ray tracing algorithm for ray R ?

3. Texture Mapping.

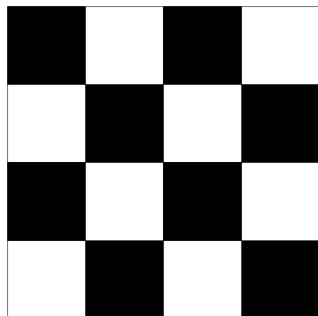
- (a) (3 points) The following texture is stored in the array *image* of size $imgx \times imgy$ (256×256).



Draw the textured triangle produced by the following code:

```
glTexParameteri(GL_TEXTURE_2D, GL_TEXTURE_WRAP_S, GL_REPEAT);
glTexParameteri(GL_TEXTURE_2D, GL_TEXTURE_WRAP_T, GL_REPEAT);
glTexImage2D(GL_TEXTURE_2D, 0, GL_RGBA, imgx, imgy, 0,
             GL_RGBA, GL_UNSIGNED_BYTE, image);
glEnable(GL_TEXTURE_2D);
glBegin(GL_POLYGON);
glTexCoord2f( 0, 0);
glVertex3d( 0 , 0, 0 );
glTexCoord2f( 1, 1);
glVertex3d( 1, 0, 0 );
glTexCoord2f( 0, 1);
glVertex3d( 1, 1, 0 );
glEnd();
```

- (b) (2 points) The texture below is stored in a 4×4 “texel” array.



How will this texture look when mapped to a square of 3×3 pixels? Draw and explain.