

# CPSC 314

## Assignment 4

due: Friday Dec, 2nd 2016, in class

Answer the questions in the spaces provided on the question sheets. If you run out of room for an answer, continue on the back of the page.

Name: \_\_\_\_\_

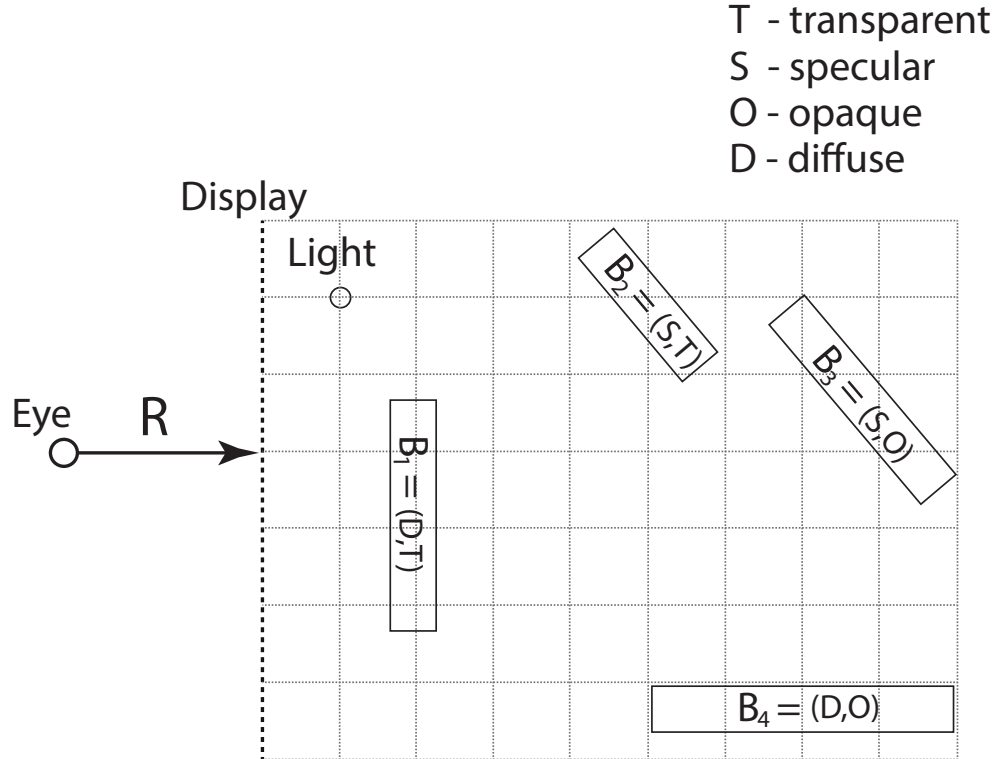
Student Number: \_\_\_\_\_

Question 1	/ 5
Question 2	/ 5
Question 3	/ 5
TOTAL	/ 15

1. (5 points) Ray Intersections with an Ellipse: Given a ray originating at  $C = (1, 1)$  with a direction  $v = (-1, -1)$ , determine whether it will intersect an ellipse given by the implicit equation  $x^2 + \frac{y^2}{4} = 1$ . If it does intersect the ellipse, find the coordinates of the intersection(s) and the normal(s) to the ellipse at these points. If there are two intersections identify the one closest to the origin of the ray. Reminder: use parametric ray equation:  $\mathbf{P}(t) = \mathbf{C} + t\mathbf{v}, t \geq 0$

2. Ray-Tracing

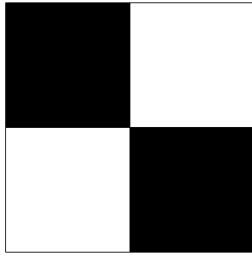
- (a) (3 points) Draw the ray tree for the ray  $R$  shown below. Assume index of refraction  $c_1$  for air is 1 and index of refraction for all the transparent objects in the scene is  $c_2 = 1.2$ . Use Snell's law to obtain (approximate) refraction angles.



- (b) (2 points) Assume the transparency coefficient  $\alpha$  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  $k_d^1 = (0, 0, 1), k_s^1 = (0, 0, 0), k_d^2 = (0, 0, 0), k_s^2 = (1, 1, 1), k_d^3 = (0, 0, 0), k_s^3 = (1, 1, 1), k_d^4 = (1, 0, 0), k_s^4 = (0, 0, 0)$ . What is the color returned by the ray tracing algorithm for ray  $R$ ?

## 3. Texture Mapping.

- (a) (3 points) Given the following texture defined over a unit
- $u,v$
- square.



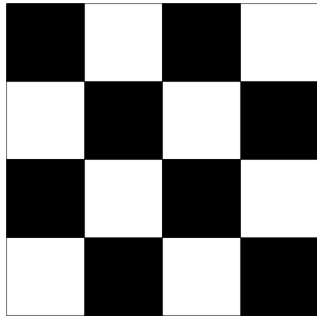
draw the textured triangle with the following vertex and texture coordinates

$$P_0 = (0, 0, 0); UV_0 = (0, 0);$$

$$P_1 = (2, 0, 0); UV_1 = (1, 1);$$

$$P_2 = (0, 2, 0); UV_2 = (0, 1);$$

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



How will this texture look when mapped to a square of  $3 \times 3$  pixels with no mipmapping or other antialiasing techniques used? Draw and explain.