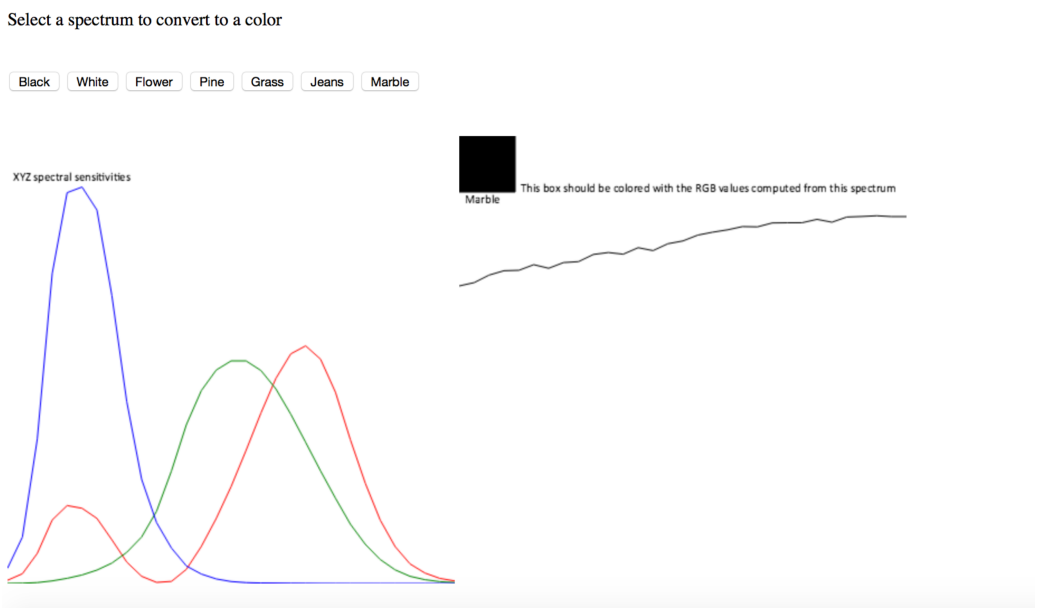
CPSC 478/578
HW #4
Due Oct 16, 2017, 11:59pm

Note that the requirements for each question may vary depending on whether you are registered for 478 or for 578. The areas addressed in this assignment are color and shading.

Turn-in Procedure

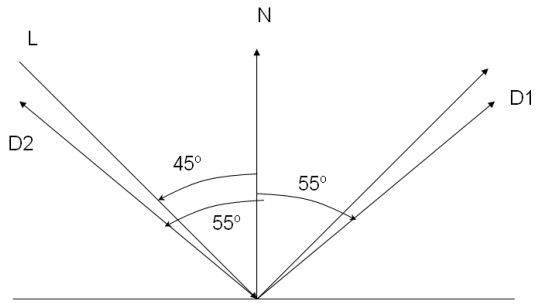
You should submit your work as a zip file using the classesv2 server. Please name your file as LastNameFirstName-Assignment4.zip
When your file is unzipped there should be subdirectories for each question named q1, q2, etc. Name your files as directed in each question. In each directory you should have:
1. The HTML and Javascript programs you have written, or pdf's of your written response (either typed directly or scanned in). For code, you should use files in the form of the samples given, rather than producing files from scratch. This will help us follow your code.
2. If the question asks you to write code to make images, provide sample images created by your program. You can save these by clicking and saving results in your browser, or by taking a screenshot.
3. A readme.{txt, doc} that lists the input used to create the images you include, as well as answering any questions posed in the problem. You should also list the operating system (e.g. Linux, Windows 7, 8.1, 10, Mac OS 10.4.4) and browser (e.g. Firefox 40.0.2, Safari, IExplorer, Edge) that you used. If you programs fail on the machines used for grading, you may be asked to bring in your system to demonstrate that the files you submitted functioned in the environment you worked in.

1. (478 and 578) Using the color.html file provided, compute *relative* X, Y and Z values of the materials Pine, Flower, Marble, Grass and Jeans. Include the values you compute in your readme file for this question. Compute the values of R, G, and B for these materials using the values of XY and Z for RG and B in the slides for Oct 1 lecture, and display them in a modified version of color_new.html.In order to scale the values to 0 to 255, use the scaling values necessary for the given white spectrum to be mapped to R=G=B=255.



2. **(478 and 578)**
a. A glass sphere of radius 1 is sitting in clear air at the center of a coordinate system (i.e. the sphere center is at 0,0,0). A ray starting from point (5,5,4) in the direction of the point (0,0,.5) intersects the sphere. The index of refraction for the glass is 1.5.
i. What is the direction of the ray reflected from the intersection point?
ii. Where does the refracted ray exit the sphere?

b. Consider a surface with diffuse reflectance $K_d = 0.1$ and specular reflectance $K_s = 0.5$. Using the simple shading model described in class, find the exponent for the Phong specular reflectance such that for light incident from a direction L of 45 degrees to the surface normal the intensity of light reflected in the direction D1 that is 55 degrees from the surface normal is twice the intensity of the light that is reflected in direction D2, also 55 degrees from the surface normal, as shown. L, the surface normal, D1 and D2 all lie in the same plane. The surface does not emit light itself, and the rest of the environment is black. For the same case, find the exponent for the Blinn-Phong variant of Phong reflectance.



3. a. **(478 and 578)** Modify chapter6/illumination_models/illumination_models.html so that when you hit the letter L repeatedly the light position and color changes somewhat as it would through a typical day. It starts out to the right nearly perpendicular to the surface the car sits on and is dark and the sun color you expect for sunrise. It then increases in elevation and increases in intensity and to a color you expect for high noon, and then decreases in elevation, takes on a sunset color and finally goes dark as it goes to the left of the car.

b. **(578)** Add a new shader type that is the sum of the Cook-Torrance and Oren-Nayar shaders. Scale the result so that it does not look too bright.

4. **(478 and 578)** Write a javascript program to read in an image and then use the intensity of the image as a bump map to shade the web page canvas as a surface with its normal pointing to the user.