Homework 2

Should be submitted to the course Moodle site by 5pm on Monday, February 6. Your assignment should be submitted as a single Jupyter notebook. If you draw any diagrams by hand, please take a picture of them and insert it into the document rather than submitting it separately on paper.

1. Use the principles of light and the formulae that you were given in class to make a quantitative argument for each of the following. **Your argument should integrate calculation and written explanation of your reasoning**.
    a. How much more sunlight does Jupiter intercept from the sun relative to earth? (hint: You should consider distance to AND size of the planets. A picture will help)
    b. The speed of light in any material is equal to its wavelength times its frequency, but the frequency of a light wave is constant regardless of medium. How, therefore, is the wavelength of light affected by refraction? To support your argument, look up the index of refraction of a few materials and calculate the wavelength of 400nm (blue) light inside those materials. How much does the color change when it enters the medium?
    c. In most materials, including glass, the index of refraction decreases with decreasing wavelength. Use this principle and the formula for the index of refraction to make an argument about what happens to white light when it enters glass. Then, explain why prisms are generally triangular in shape (will help to draw a diagram).
2. Use the diff_int function for the intensity of the double slit diffraction pattern (available as a .py file on the GitHub repository in the Homework folder) to do the following:
    a. Make plots that show what happens to the intensity pattern when you modify the wavelength, slit width, and distance to the screen. In each case, explain what about the intensity pattern changes and why. Change only one parameter at a time. Your explanation of each effect should include a markdown cell with a heading, at least two plots, and a paragraph of explanatory text. *Hint: start with small iterations around the values provided. As you increase them, you may wish to modify the range of theta values to see what is happening when the spread of light becomes much larger or smaller.*
    b. Overplot the single and double slit diffraction patterns together with the total intensity pattern on the same graph. *Hint: do this by adding additional plot commands inside the function. Note that i_single is the single slit intensity and i_double is the double slit intensity. To change the color of the line (so that you can see what's what), use the optional keyword "color" for plot (e.g. plot(x,y, color='red').*
    c. Modify the function so that it returns the intensity as a variable. Then store intensity functions for 400, 500, 600, 700 and 800nm light in separate variables. Make a single plot showing both the individual intensity patterns and their sum and use it to explain why white light doesn't display a diffraction pattern.

Don't forget to stop the kernel and clear output before submitting.