HW4 Data Visualization

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1) Short answers about the human visual system (HVS): a) (10 words or less) Where specifically, in the anatomy of the HVS, is color reduced from an infinite-dimensional space of spectra, to three dimensions?
The cones in the retina (rods can not tell color)

b) Between luminance, saturation, and hue, which dimension of color offers the highest spatial resolution?
Luminance

c) True or false, for each of the three sub-parts: opponent color channels respond to (i) luminance (light versus dark) **True**
(ii) red versus blue **False**
(ii) green versus yellow **False**

d) True or false: In the CIE chromaticity diagram, there is a whole region that might be named "white", depending on visual context, rather than a single point.
True e) True or false: fundamental limits in the HVS mean that color can be used to visualize only one (scalar, univariate) variable at a time.
False

2) a) Either by writing some javascript code, or by using either http://people.cs.uchicago.edu/ glk/cspace determine the "L" coordinate in HCL space for the following RGB colors that define the typical "rainbow colormap":
red: (255,0,0) = 53.24
yellow: (255,255,0) = 97.14
green: (0,255,0) = 87.73
cyan: (0,255,255) = 91.11
blue: (0,0,255) = 32.30
magenta: (255,0,255) = 60.27

b) Suppose you fixed the luminance variation in the rainbow colormap (one of the problems noted in [Borland-Rainbow-2007]) by choosing colors (in RGB space) that have the same HCL hue as the six rainbow colors (above) but with constant luminance (say, by fixing the L value to be the average L for the six rainbow colors above). What would be one drawback of your new isoluminant rainbow colormap? (55 words or less)
One negative of this color map is it still has 4 color regions (corners) not two. This means there is still no obvious ordering when presented with colors from this colorspace. This is

different from greyspace which has only grey and white.
3) Suppose you have 7 categories that you need to visually identify in a visualization. Someone suggests using 7 different gray levels, varying from black to white with 6 equal-sized steps in brightness. What are two reasons why this a bad idea? Identify what part of what reading supports your answer. (60 words or less)
One such reason is that grayscale has been shown to be harder to read values from a key. Therefore differentiating the values with a key will be harder(Ware Chapter 4). Second research shows that 4 grayscale categories is liekly the limit (Ware chapter 4 pg 122

4) A bioinformatician wants to create a graph visualization of genetic information wherein nodes identify genes, with links showing patterns of conservation across different species. The node color is supposed to identify the gene, with luminance variation used for other purposes. The bioinformatician has learned that the human eye is capable of discriminating thousands of different iso-luminant colors (true!), and tells you "no problem, I only have 90 different genes to show."
a) Why will things go poorly for the bioinformatician?
While the human eye can discrimenate colors upon inspection it can not do so very quickly. Using 90 colors will make the visual very hard to read. This is espically true when we hold luminance constant. b) Incredulous, the bioinformatician says "[citation needed]". What published paper, or what page in which book chapter, do you refer the bioinformatician to? Limit yourself to assigned readings, or the things in their citations/bibliographies.
Read the following sentance Ms. Bioinformatican: "the human visual system uses luminance variation for the determination of object segmentation, shape, motion, and stereo depth [Borland, Rainbow, page 3 Color map on a surface].