# Assignment 2

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**Exercise 2**

a) What is the Helmholtz-Kohlrausch effect?

**Answer.** An experiment was conducted to see, if an user was able to find out the luminance match between bipartite fields. The user was presented with two fields,one where two chromatic fields are optically superimposed and the other with doubly intensified white field. Then according to the equation for a given $V(\lambda)$, L signifies:

$$L = K_m \int_\lambda L_e \lambda V(\lambda) d\lambda \tag{1}$$

where:
$L_e\lambda$ is the spectral concentration of the radiance
$K_m$ is a constant with vaule 638lm/W
$S_d$ damage level and $v(\lambda)$ is the luminance efficiency function

First field will have equal luminance as the brighter white field, but the experiment showed that the first field appears dull (less bright) due to their additive chromaticity which leads them to appear with an out of proportion brightness. This is called Helmholtz-Kohlrausch effect.

b) Why are the authors proposing to use images of faces?

**Answer.** The authors have suggested a technique for luminance matching using faces because human brain is highly trained when it comes to recognizing faces and our brain has circuitry specially designed to analyze faces.

c) To what alternative method do the authors compare their newly proposed one in the user study?

**Answer.** The authors have proposed a new method which was double face luminance matching method which was compared against an alternative method called Minimally Distinct Boundary (MDB).The user study that they have conducted showed that luminance matching can be more precisely obtained by the face based method.

d) Based on the result of the user study, what is the advantage of the newly proposed method?

**Answer.** The two methods, face and MDB were conducted under same experimental setup where the face method showed more precise result of luminance matching. They have analyzed the standard deviation of the user results and came to the conclusion that the face based method showed a more precise way of adjusting luminance than MDB method although they have similar quantitative output values.

e) Why do the authors have to know the monitor gamma while creating a colormap based on the result of the user study?

**Answer.** From the user study, they did not require to to know the gamma of the monitor to create an isoluminant colour map, but if they wanted to produce a continuous range of hues in between colors with the help of interpolation, the knowledge of gamma of the monitor was required.

## Question 3

b) In Section 2.2 of the lecture slides, equations are provided to convert from RGB to HSV color space. Derive the inverse mapping, which should convert from HSV to RGB. Please specify intermediate steps.

**Answer.** When $0 \leq H \leq 360, 0 \leq S \leq 1, 0 \leq V \leq 1$ :
$C = V * S$
$X = C(1 - |(H/60) mod 2 - 1|)$
$m = V - C$
$(R^{'},G^{'},B^{'})$ =

$$\begin{cases} (C, X, O) & 0^\circ \leq H < 60^\circ \\ (C, X, 0) & 0^\circ \leq H < 60^\circ \\ (X, C, 0) & 60^\circ \leq H < 120^\circ \\ (0, C, X) & 120^\circ \leq H < 180^\circ \\ (0, X, C) & 180^\circ \leq H < 240^\circ \\ (X, 0, C) & 240^\circ \leq H < 300^\circ \\ (C, 0, X) & 300^\circ \leq H < 360^\circ \end{cases} \tag{2}$$

(R,G,B) = (($R^{'}$+m)255, ($G^{'}$+m)255, ($B^{'}$+m)255)

a) Design a color map for different files on a computer. Each file should be represented by a color that conveys both the file type (text / image / audio / video / other file) and the file size (amount of memory). Decide on a suitable color scheme and create a color legend that illustrates it. Justify your choices.

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**Answer.** The color chosen for different type of files in the system are - Blue for text files, Pink for images, Green for Audio, A shade of yellow for Video, Red for Others. For each type of file, the shade of that color will vary according to the size of that file. We can see that in the following picture.


Figure 1: Color Legend

c) Name an application for which you would prefer HSV color space over CIEluv, and one for which you would prefer CIEluv over HSV. Briefly justify why.

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**Answer.** Photo editing softwares/applications should have HSV color space over CIEluv. Since CIEluv color spaces are closer to human vision applications like monitors or screens preferably should use CIEluv.

## Question 4

a) What is an advantage of stripplots over swarmplots? What is an advantage of swarmplots over stripplots?

**Answer.** The advantage of using swarmplot over stripplot is that in swarmplot, the points are adjusted along the categorical axis avoiding the existing problem of points overlapping in stripplot. This property of swarmplots give a better representation of the distribution of values. but it does not scale well to large numbers of observations.

The advantage of stripplot against swarmplot is that it can be scaled to large number of observations because of point overlapping (jitter) property.

b) What is meant by IQR?

**Answer.** IQR stands for Inter-quartile range, it is a measure of variability based on dividing a data set into different quartiles. Quartiles divide a rank-ordered data set into four equal parts. The values that divide each part are called the first, second, and third quartiles; and they are denoted by Q1, Q2, and Q3, respectively.

1. Q1 is the "middle" value in the first half of the rank-ordered data set.
2. Q2 is the median value in the set.
3. Q3 is the "middle" value in the second half of the rank-ordered data set.

For above case, the inter-quartile range is as follows :

$$\text{IQR} = (\text{Q3-Q1})$$

c) What would be a reason to use violinplots instead of, or in addition to boxplots?

**Answer.** In a box plot, all of the plot components correspond to actual data points, whereas in violin plot - a kernel density estimation of the underlying distribution in depicted. This can be an effective and attractive way to show multiple distributions of data at once, keeping in mind that the estimation procedure is influenced by the sample size, and violins for relatively small samples might look misleadingly smooth.

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