Homework – Week 2

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## Question 1

We need to use CIE-Luv color space whenever we need to mimic human perception of colour. The Luv color space is useful when we are discussing generated light, for example from a monitor. The Luv color space is used to decide on the colour being generated a monitor screen to best match a human perceived notion of a certain object (say, a rose).

## Question 2

The UV representation of signals are actually colour difference signals. In other words, the U and V signals tell the TV to shift the colour of a certain spot without altering its brightness. The UV signals tell the monitor to make one colour brighter at the cost of another and by how much it should be shifted. The higher the values of U or V are the more saturated (colourful) a spot gets. The closer U and V values get to zero, the lesser it shifts the colour meaning the red, green and blue lights will be equally bright producing a greyer spot.

This is the benefit of using colour difference signals. Instead of telling how much red is there, it tells how much more red is there as compared to green and blue. So basically, if U and V components were absent, the resultant would simply be a greyscale image.

If the regular RGB channel were to be used , these would have to be used even for grey scale images. This was crucial because TVs originally only supported the Y (luma or luminance). So the new system for colour TVs needed to be backward compatible with all the existing TVs. And the new colour TVs could either use all three signals or only display B/W images.

So U = B – Y  
Y = R + G  
U tells us how much more of Blue should be there than Red and Green.  
V = R – Cyan  
Cyan = G + B  
V tells us how much more of Red should be there as compared to Green and Blue.

## Question 3

Yes there is a connection between the human visual definition and the definition of UV. As mentioned in the previous question, U and V represent difference in colour signal rather than values of colours itself.

The human eye has fairly little spatial sensitivity to colour as compared to luminance. The accuracy has a far greater impact on the quality of the image as compared to the other two channels. Most human perception relevant image information is actually reconstructed from luminance, which is black and white images are just as understandable as colour images.  
Moreover, human eyes don’t perceive colour as a sum of three numbers. It rather sees colours as lighter or darker shades of colours. Therefore expressing colours as a difference separate from the luminance not only makes it easier for broadcast and storage(through compression of chroma channels) but also has a bigger gamut of colours.

## Question 4

A CNN uses 2D or 3D (in case of multi-channel input image) matrices as filters to learn features of the image.   
The individual numbers inside the filters are what act as weights and these are the learnable parameters.  
Multiple filters are used to learn different features of an image.   
So based on this knowledge we require 16 filters of size 5 by 5 for an input image with 3 channels. So the total number of learnable parameters are:  
number of weights = 3 x 5 x 5 x 16 = **1200**

## Question 5

The same logic as the previous question applies except this time there are 16 input channels instead of 3 and the 2D size of each filter would be 3 by 3. So the total number of learnable parameters between second and third layer would be given by:

Number of weights = 16 x 3 x 3 x 32 = **4608**

## Question 6

1. Dimensions of a histogram: 1D, 2D or 3D histogram.
2. Chromaticity coordinates we wish to use: rg, xy, UV, HS
3. Number of bins: How many levels are dividing the colours into?
4. Method to compare histograms: sum-squared distance or intersection distance?
5. Histograms for regions: single histogram for entire image, separate histogram for focus and background, separate histogram for top and bottom half of image, etc

## Question 7



Figure : Image 1 - TIFF

A blue and black background with a black and red triangle

AI-generated content may be incorrect.

Figure : Image 1 - HISTOGRAM

A blue and black background

AI-generated content may be incorrect.

Figure : Image 2 - Histogram

A shadow of a person on a street

AI-generated content may be incorrect.

Figure : Image 2 – TIFF