Assignment 3: Merge

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a. What is the difference between the MATLAB operators .* and * ? Demonstrate the difference on the basis of two simple examples.

The operator * performs matrix multiplication, while the operator .* performs element-wise multiplication.

E.g. M*V compared to M.*V

if V is a scalar, the result is the same, each element of M will be multiplied by V.
However if V is a matrix (or a vector as the special case of a matrix), then the operation will be quite different.

Suppose M consists of three 3D column vectors A, B, C. and V is a 3D column vector with values x, y, z.

Then the M*V will be A*x + B*y + C*z, which is matrix multiplication, or linear combination of the vectors in the left matrix with the values (scale factors) in the right matrix. Note that here on the right side since x, y, z, are scalars * performs scalar multiplication. This matrix multiplication would also apply if V was a matrix of multiple column vectors, then the linear combination would be carried out for each of its vectors which supply the scale factors for the vectors of the left matrix.

M.*V would not work, since for elementwise multiplication the matrix dimensions must agree. If we had two matrices of same dimension than each value at position i,j in the first matrix would be multiplied with the value at position i.j in the second matrix.

b. What needs to be removed in the HSV color space, to eliminate the color information (to compute an image that contains only shades of gray)?

The HSV color space is defined via the three dimensions Hue, Saturation and Value. It is based on the RGB color model, and thus is not a photometric model, i.e. it does not try to accurately model color perception as it would be subjectively described in human observers, like the CIE color models. Rather, like the RGB model, it is used to intuitively select and describe colors of same output in a display (but not necessarily same perception in humans) in human computer interfaces and similar.

Value corresponds to the dimension spanned between the extremes of the black to the white corner of the RGB color cube. It corresponds to lightness, i.e. how bright a color is perceived as opposed to another color.

Hue models color, as an interpolated value of the coloredcorners ot the RGB color cube: red, green, blue, cyan, magenta, yellow. The advantage of having color as a separate dimenion is that users can intuitively select the color first and then adapt it by the other two dimenions. This dimension is often modeled as an interpolated circles through the colored corners of the RGB cube, and perpendicular to the Value dimensions. Hue is the angle on such circle in any slice along the Value dimension.

Saturation models how much of the brightness is perceived as color, as opposed to a mixture of all colors, i.e. grayscale. In the HSV model this corresponds to the distance from the Value dimension (line from black corner to white corner) towards the colored corners / the colored circle.

From this it follows that we need to have Saturation of zero to have an image of shades of gray. Note however that the hue information will still be stored in HSV, as we can not remove this information in HSV (there is always an hue angle defined), just that this angle doesnt matter if Saturation is zero.