INFO 4150E– HW4
Singular Value Decomposition (SVD)

Application - Image Compression using SVD

Images are made up of pixels and higher the resolution larger the size of the image. An image is nothing but a large matrix of rows and columns and hence can be decomposed using SVD. This also gives us the opportunity to compress the image by taking only that many number of components (number of singular values) to reconstruct the image without compromising too much on what you see in the image. Compressed images make the model building process in ML efficient or even sharing / distributing data more feasible and economical.

Tasks in this HW

In this HW you are provided a color image ('portrait.jpg') and your task is as follows:

1. Read in the image using the PIL library, store the width and height of the image in a variable and compute the size of the original image as w*h*3.
2. Convert it into a NumPy array.
3. Split it into its R, G, B components.
4. You can plot the individual images if you like.
5. Apply SVD on the individual channels to get the u,s,v matrices for each channel.
6. Compress each of the channels by choosing 'k' components of the singular values (start with 1 or 2).
7. Merge the 3 channels to get back the color image and compare it visually with the original.
8. Increase k may be in steps of 10 or 20 (trial) till you find that the compressed image is good enough to represent the original. This your judgement.
9. Then calculate the size of the final compressed image using the formula:
    a. compressed_size = k*(original width +1.0 + original height).
10. Calculate the compression achieved in percentage and print it.

Your deliverable will be a single Jupyter Notebook with the naming convention of "First_Last_Name.ipynb" while submitting. **The homework is due no later than Aug 3rd, 2022, by midnight.**