CS 663 : Digital Image Processing : Assignment 4

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Due Date :- 16rd October, 2019

Question 6

Implementation of SVD in mySVD.m:

For $\boldsymbol{A} = \boldsymbol{U}\boldsymbol{S}\boldsymbol{V}^T$, we know that $\boldsymbol{U}$ contains the eigenvectors of $\boldsymbol{A}\boldsymbol{A}^T$ and singular values are square roots of eigenvalues of $\boldsymbol{A}\boldsymbol{A}^T$. We use this information to first calculate $\boldsymbol{U}\&\boldsymbol{S}$ using the `eigs()` function on the given matrix $\boldsymbol{A}\boldsymbol{A}^T$.

To calculate the right singular vectors, we initially tried using the fact that $\boldsymbol{V}$ contains eigenvectors of $\boldsymbol{A}^T\boldsymbol{A}$, but this resulted in a poor reconstruction. Later, taking inspiration from the approach used to define SVD in Q6, where right singular vectors are defined by multiplying $\boldsymbol{A}^T$ with $\boldsymbol{U}$ and then dividing column-wise by the norm of respective columns. Although this yielded $\boldsymbol{V}$ of size $n \times m$ instead of $n \times n$, this is not really an issue because we know that the eigenvalues corresponding to the missed vectors are 0, and hence, those eigenvectors do not play a role in the reconstruction as well.