CS663, Assignment 4 **Yash Sanghvi, Pradyot Prakash**
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Question 4: Singular Value Decomposition

Problem Statement

Given a matrix A of size m n, write a MATLAB routine called MySVD which takes this matrix as input and outputs the left and right singular vectors (i.e. column vectors of U and V under usual notation) and the singular values (i.e. diagonal entries of S) of A. You are not allowed to use the svd or svds functions of MATLAB directly. You should use only the eigenvalue decomposition routines eig or eigs for this task. Cross-check your answer by verifying that A = USVT based on your computation. **[10 points]**

Implementation Details

The Singular Value Decomposition of matrix was done in the following steps:

1. Obtain the left eigenvector matrix U, of AA^T using *eig(A*A')* and the right eigenvector matrix V of A^TA using *eig(A'*A)*.

2. Since *eig* function of MATLAB returns the eigenvectors in increasing order of the corresponding eigenvalues, we sort the columns of both U and V to get them the eigenvalues in decreasing order.

3. We take the the eigenvalue matrix of either AA^T or A^TA, whose ever dimension is smaller and obtain the diagonal matrix S from the square root of that matrix and then concatenate a zero submatrix so that S has the same dimension as A.

4. There might be sign inconsistencies in U and V as eigenvectors are same up to a scaling constant. So to fix that, we compute $T1 = A * V$ and $T2 = U * S$. From the definition of SVD, $T1 = T2$. Now we iterate over the columns of both $T1$ and $T2$ and check for sign inconsistencies. If the signs differ, then we negate the corresponding column of V. These are the final matrices.