**SVD**

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## CO21BTECH11001

Let A be a matrix. Then A can be written as –

where is a diagonal matrix, and U and V are unitary matrices of dimensions and respectively.

We are trying to find out a set of orthonormal vectors in rowspace of A which when multiplied by A (along with some constant) gives a set of orthonormal vectors in columnspace of A.

i.e.

where r is the number of positive eigen values of the matrix   
Now   
Since is also a diagonal matrix.  
 Columns of V are eigen vectors of the matrix   
Similarly columns of U are eigen vectors of the matrix

It can be proved that non-zero eigen values of and are same (with the same multiplicity).

If are +ve eigenvalues of in decreasing order, then

∑jj= for   
   
 and all other elements are zero.

**Questions –**

1. SVD decomposition is possible for   
   (a) Square matrices  
   (b) Rectangular matrices  
   (c) Positive definite matrices  
   (d) Any matrix  
   **Ans.** (d)
2. What does U, ∑ and V signifies in SVD transform technique?  
   (a) Stretching, Rotation, Stretching  
   (b) Rotation, Stretching, Rotation  
   (c) Stretching, Stretching, Rotation  
   (d) Rotation, Rotation, Stretching  
   **Ans.** (b)
3. Which of the following expressions is/are correct?  
   (a)   
   (b)   
   (c) ∑  
   (d)   
   **Ans.** a,c
4. What does the value of (singular values) signify?  
   **Ans.** The singular values go down with each dimension, which tells us that each dimension is adding less and less value. Our goal is to stop adding dimensions to our approximation when the singular values become relatively negligible.
5. How is SVD used in machine learning?  
   **Ans.** It is used as data reduction method in machine learning. It can also be used in image compression and denoising data.