# 4

Given a 2D operator defined by a matrix $G \in R^{n \times n}$, using SVD decomposition we can write it as:

$$G = \sum_{i=1}^{n} \sigma_i u_i v_i^T \tag{1}$$

Clearly, G is separable iff $\forall i > 1, \sigma_i = 0$. Hence the number of non-zero singular values should be equal to 1. Since that is equal to the rank of the matrix, the rank of the matrix should be 1.

(a) Given Matrix, $\begin{bmatrix} 0 & 1 & 0 \\ 1 & -4 & 1 \\ 0 & 1 & 0 \end{bmatrix}$ ,clearly has rank 2. Hence it is not separable.

(b) Since the Matrix is not separable, it cannot be written as an outer product of 2,1-D vectors and hence it can not be implemented using 1-D convolution.