1. (a) Let $\mathbf{A} = \begin{bmatrix} 1 & d \\ d & d \end{bmatrix}$ be a matrix. Let $\mathbf{v}_1$ be the eigenvector corresponding to λ_1 and let $\mathbf{v}_2$ be the eigenvector corresponding to λ_2. Find the value of the quantity $4\mathbf{v}_1^\top \mathbf{v}_2$. Here, d represents the number of characters in your first name. [8 **Marks**]

Ans: 0

2. (a) Is the filter F1 separable? If yes, then what are the constituent filters of F1? If not, remove any 1 row and 1 column to make it separable. [1 Mark]

$$F1 = \begin{bmatrix} 1 & -1 & -1 & -1 & 5 \\ -1 & 0 & -2 & 0 & -3 \\ -1 & 0 & -2 & 0 & -3 \\ -1 & 0 & -2 & 0 & -3 \\ 5 & -1 & -1 & -1 & 1 \end{bmatrix} \quad F2 = \begin{bmatrix} 0 & 0 & 0 \\ 1 & 0 & -1 \\ 0 & 0 & 0 \end{bmatrix}$$

(b) Apply the 2D filter F2, to the filter F1 using correlation. While doing so, if you cannot fit the F2 filter around any element/pixel of F1 without going outside the boundary of F1, then ignore those elements/pixels in the output.

What is the output? Is the output separable? If yes, then what are the constituent filters of the output? If not, remove any 1 row and 1 column to make it separable. [You can ask for clarifications. No assumptions will be considered] [5 **Marks**]

Ans:

a) Total Marks of Part a) Updated to 1 Mark

Is F1 separable? No [1 Mark]

If not, remove any 1 row and 1 column to make it separable. **[Non Graded]**

b)

Output of F2 applied to F1 [2 Marks]

$$Output = \begin{bmatrix} 1 & 0 & 1 \\ 1 & 0 & 1 \\ 1 & 0 & 1 \end{bmatrix}$$

Is the output separable? Yes [1 Mark]

If yes, then what are the constituent filters of the output? [2 Marks]

The output is separable into a column vector $\begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$ and a row vector $\begin{bmatrix} 1 & 0 & 1 \end{bmatrix}$,