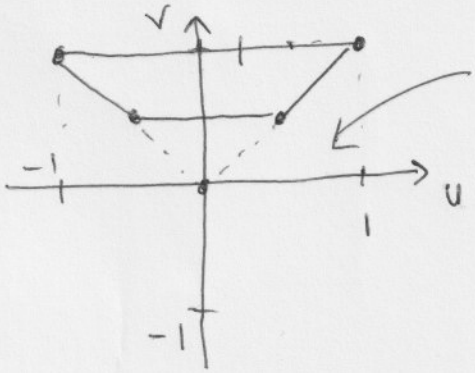
Q7

$$s\begin{bmatrix} u \\ v \\ 1 \end{bmatrix} = \begin{bmatrix} 1 & 1 & -1 & -1 \\ 1 & 1 & 1 & 1 \\ 1 & a & 1 & a \end{bmatrix} = \begin{bmatrix} su \\ sv \\ s \end{bmatrix}$$

$$\begin{bmatrix} u \\ v \end{bmatrix} = \begin{bmatrix} 1 & 1/a & -1 & -1/a \\ 1 & 1/a & 1 & 1/a \end{bmatrix} = \begin{bmatrix} 1 & 1/2 & -1 & -1/2 \\ 1 & 1/2 & 1 & 1/2 \end{bmatrix} \quad \text{if } a=2$$



as $a \to \infty$ projections of 2nd + 4th points meet at a vanishing point 0,0

as $a \to \infty$ $\begin{bmatrix} u \\ v \end{bmatrix} \to \begin{bmatrix} 1 & 0 & -1 & 0 \\ 1 & 0 & 1 & 0 \end{bmatrix}$

Q9.

$$\begin{array}{|ccc|ccc|} \hline 0 & 0 & 0 & 1 & 1 & 1 \\ 0 & 0 & 0 & 1 & 1 & 1 \\ 0 & 0 & 0 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 \\ \hline 1 & 1 & 1 & 1 & 1 & 1 \end{array} \quad * \begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 0 & 4 & 4 & 0 \\ 0 & 3 & 3 & 0 \\ 0 & 1 & 1 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

$$\begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 \\ 2 \\ 1 \end{bmatrix} \begin{bmatrix} -1 & 0 & 1 \end{bmatrix}$$

↖ centred x derivative

↑ vertical smooth

This is a ~~horizontal~~ edge filter, with ~~smoothing~~ applied in the y direction.

Q11 b)

$$H = \begin{bmatrix} 1 & 2 \\ 2 & 4 \end{bmatrix}$$

Recall: $SSD(\Delta x) = \Delta x^T H \Delta x$

Must be large for any $\Delta x \Rightarrow$ corner

$\therefore$ both eigval of H are large

$$|H - \lambda I| = (1-\lambda)(4-\lambda) - 4$$

$$= \lambda^2 - 5\lambda + 4 - 4 = 0$$

$$= \lambda^2 - 5\lambda = \lambda(\lambda - 5) = 0$$

$\lambda_1 = 5, \ \lambda_2 = 0$

→ not a corner, as one of the eigenvalues is 0

likely to be an edge.