

intensity values are -

③ Laplacian of an Image

$$\nabla^2 f = \frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2}$$

$$= f(x+1, y) + f(x-1, y) + f(x, y-1) + f(x, y+1) - 4f(x, y)$$

Part(a) Laplacian Mask with -8 in center

To check if Mask is separable, we need to determine whether it can be expressed as outer product of two 1D filters.

Let f_1, f_2 be two 1D filters st.

$$f_1^T \cdot f_2 = \begin{bmatrix} 1 & 1 & 1 \\ 1 & -8 & 1 \\ 1 & 1 & 1 \end{bmatrix} \quad \text{--- (1)}$$

\Rightarrow There is no possibility to find f_1 and f_2 st. eqⁿ (1) is true; we can't find;

\Rightarrow Disproved
Hence ∇

③ Part ⑥ Laplacian mask with -4 in center

$$\begin{bmatrix} 0 & 1 & 0 \\ 1 & -4 & 1 \\ 0 & 1 & 0 \end{bmatrix}$$

to check whether this filter can be implemented using 1D convolutions; we need to check its separability:

Consider f_1, f_2 be two 1D filters;

$$\text{let } f_1^T \times f_2 = \begin{bmatrix} 0 & 1 & 0 \\ 1 & -4 & 1 \\ 0 & 1 & 0 \end{bmatrix} \quad \text{--- ①}$$

→ there is no real valued filters possible f_1 and f_2 st. eqn ① is true.

⇒ this mask cannot be implemented as 1D convolution.

→ Hence disproved.