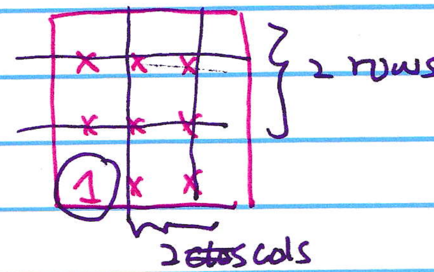
filter $\qquad$ vector

$$(2,-1,1\cancel{3},1) * (1,1,2,1) = 2\times(1,1,2,1,0,0,0)$$
$$+\,-1\times(0,1,1,2,1,0,0)$$
vector $\qquad$ filter
$$+\,1\times(0,0,1,1,2,1,0)$$
$$+\,1\times(0,0,0,1,1,2,1)$$

$$a*(\lambda_1 b+\lambda_2 c) = a*\lambda_1 b + a*\lambda_2 c$$
$$= \lambda_1 a*b + \lambda_2 a*c$$

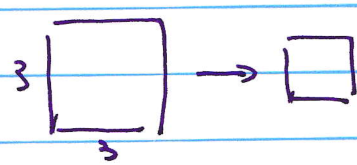
$$\begin{bmatrix}1 & 3 & 1\\ 0 & -1 & 1\\ 2 & 2 & -1\end{bmatrix} \times \underbrace{\begin{bmatrix}x & x\\ 1 & x\end{bmatrix}}_{2\times 2} = 1\times\begin{bmatrix}\otimes & \otimes & \otimes & \otimes\\ 1 & 3 & 1 & \otimes\\ 0 & -1 & 1 & \otimes\\ 2 & 2 & -1 & \otimes\end{bmatrix} = \dots$$

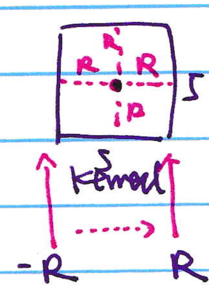


$$M\times M \xrightarrow{*} (M+2)\times(M+2)$$

Given filter of size K^2, input of size M^2 $\longrightarrow M^2 * K^2 = (M+K-1)^2$

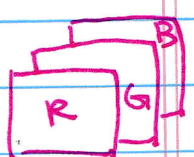
$z_i = w_i\cdot x + b$





$J = 2R+1$

$R = 2\times 2$



$K = 2R+1$; K = dimensionality of kernel

$$y_{i,t} = \sum_{j=1}^{J}\sum_{\tau=-R}^{R} w_{i,j,\tau}\cdot x_{j,t+\tau}$$

ith feature map $\qquad$ location

forward pass

$x \longrightarrow y$ $\qquad \bar{x} = \bar{y} \cdot \frac{\partial y}{\partial x}$ $\qquad x \to y,\ x \to z\ ; \quad \bar{x} = \bar{y} \cdot \frac{\partial y}{\partial x} + \bar{z} \cdot \frac{\partial z}{\partial x}$

x = liner func

$\overline{y_{i,t}}$ = given

comes after input in forward passing

$\bar{x}_2 = \bar{y}_1 \cdot \frac{\partial y_1}{\partial x_2} + \bar{y}_2 \cdot \frac{\partial y_2}{\partial x_2} + \bar{y}_3 \cdot \frac{\partial y_3}{\partial y_2}$

$\underline{\underline{y_{i,t}}} = \sum_{j=1}^{J} \sum_{\tau=-R}^{R} W_{i,j,\tau} \cdot x_{j,t+\tau}$

given.

$\bar{x}_{j,t} = \sum_{\tau} \bar{y}_{i,t-\tau} \cdot \frac{\partial y_{i,t-\tau}}{\partial x_{,t}}$

$\bar{x}_{j,t+\tau} = \sum_{\tau} \bar{y}_{i,t} \cdot \frac{\partial y_{i,t}}{\partial x_{,t+\tau}}$

index for

$\bar{x}_j = \bar{y}_i * W_{i,j}$, j = output feature map

$\bar{x}_{j,t+\tau} = \sum_{\tau} \bar{y}_{i,t} W_{i,j,t}$