23-S2-Q4

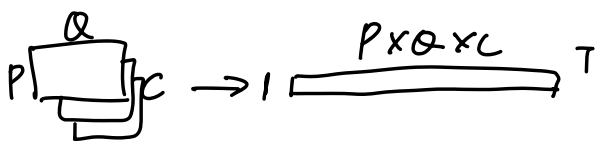
(a)Q: $x_{ijk} \to y_{ijk}$? parameters?

Solution ① understand XIA SONG assistant

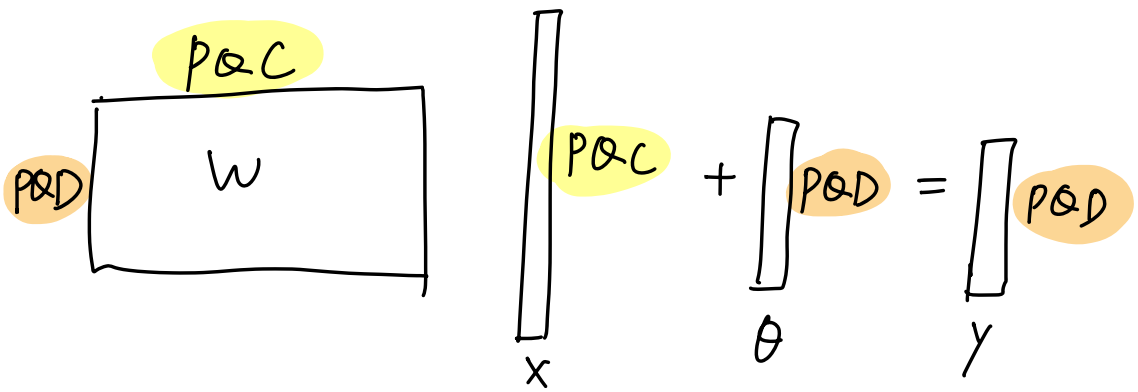
A fully connected layer generally squeezes any input into a one-dimensional vector

So, an image with P×Q×D is turned into a 1×PQD vector, Thus I think the solution PQC PQD +PQD is correct

② 逐行扫描



③ W矩阵 · X列向量

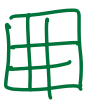


So parameters = PQD x PQC + PQD

④ Scalar form

$$y_{ijk} = \sum_{l=1}^{C} \sum_{m=1}^{P} \sum_{n=1}^{Q} w_{mnlk} x_{mnl} + b_{ijk} \quad , \quad 1 \le k \le D$$

(b) CNN ?



$$y_{i,j,k} = \sum_{u=-1}^{1} \sum_{v=-1}^{1} \sum_{l=1}^{C} w_{u,v,l,k} x_{i-u,j-v,l} + b_k$$

$$3 \times 3 \times C \times D + D = 9 \times C \times D + D$$

(c) $y_{i\,jk} = \sum_{l=1}^{C} w_{l,k} x_{i,j,l} + b_k$

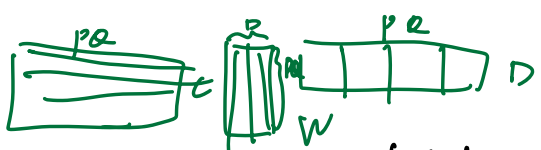
$C \times D + D$ bias

ReLU D个特征图

(d) $y_{i,k} = \sum_{l=1}^{C} w_{l,k} x_{i,l}$

$C \times D$

(e) $Y = XW$

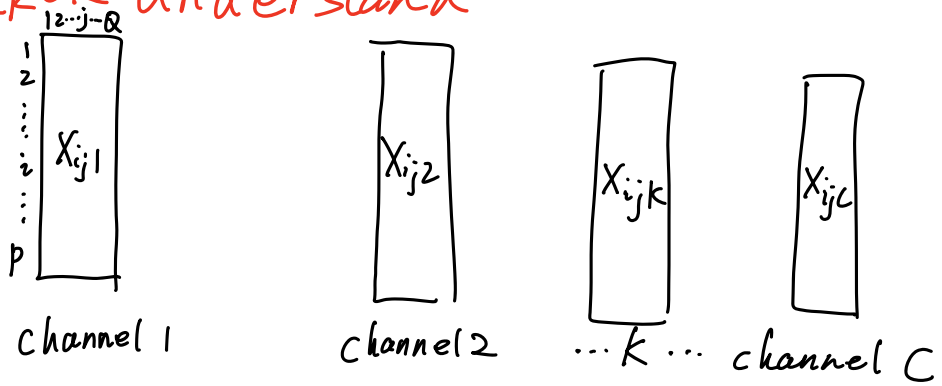


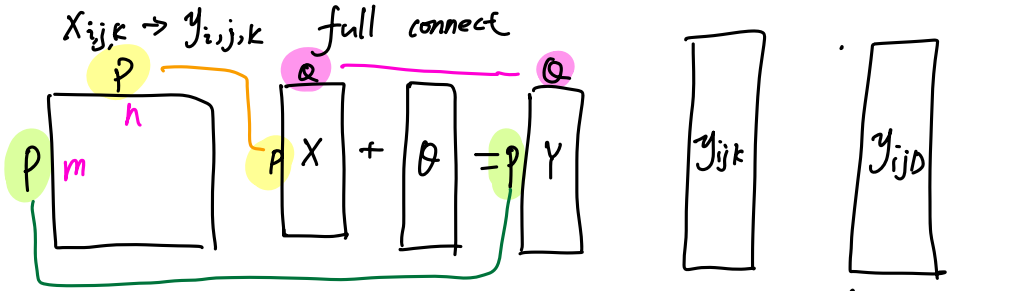
① Both architectures apply matrix multiplications to process input

② $Y = XW$ shows the CNN perform a linear transformation on the input features at each spatial position, identical across all position.

It is similar to the linear layers used in Transformer, where input are transformed via weight matrices

ERROR Understand





$$\sum \begin{bmatrix} w_{11} & w_{12} & \cdots & w_{1n} & \cdots & w_{1p} \\ w_{21} & w_{22} & \cdots & w_{2n} & \cdots & w_{2p} \\ \vdots & \vdots & \ddots & \vdots & \ddots & \vdots \\ w_{m1} & w_{m2} & \cdots & w_{mn} & \cdots & w_{mp} \\ \vdots & \vdots & \ddots & \vdots & \ddots & \vdots \\ w_{p1} & w_{p2} & \cdots & w_{pn} & \cdots & w_{pp} \end{bmatrix} \begin{bmatrix} x_{11} & \cdots & x_{1Q} \\ x_{21} & \cdots & x_{2Q} \\ \vdots & \ddots & \vdots \\ x_{i1} & \cdots & x_{iQ} \\ \vdots & \ddots & \vdots \\ x_{p1} & & x_{pQ} \end{bmatrix} + \begin{bmatrix} b_{11} & \cdots & b_{1Q} \\ b_{21} & \cdots & b_{2Q} \\ \vdots & \ddots & \vdots \\ b_{i1} & \cdots & b_{iQ} \\ \vdots & \ddots & \vdots \\ b_{p1} & \cdots & b_{pQ} \end{bmatrix}$$

$$y_{ijk} = \sum_{l=1}^{C} \sum_{m=1}^{P} \sum_{n=1}^{P} W_{mnlk} X_{ijl} + b_{ijk} \quad (1 \le k \le D)$$

parameters $P \times P \times C \times D + P \times Q \times D$

$P \times P \times C \times D$: 一张W $\to$ C张W生成1张Y $\to$ 生成D张Y

$P \times Q \times D$: 1张bias $\to$ D张bias