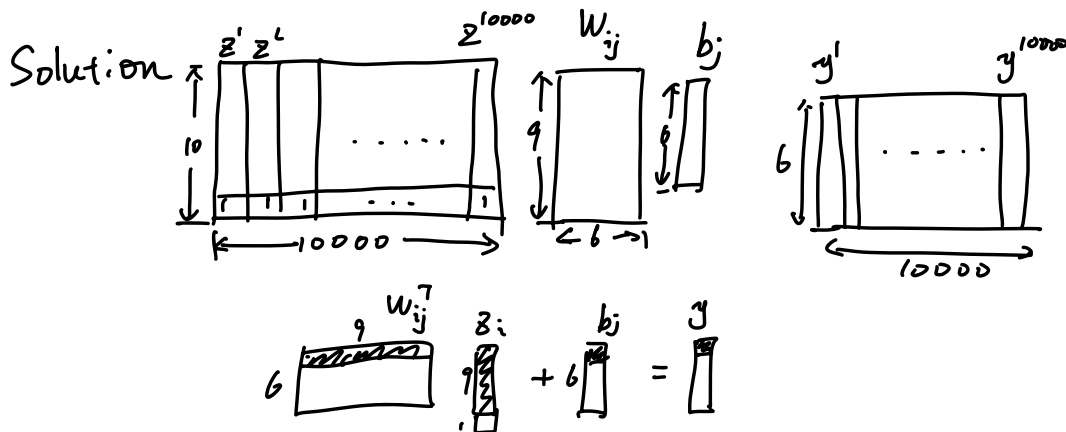


23-52-Q2

Q:  $3 \times 3 \rightarrow 100 \times 100 \rightarrow 10000$   $z^k = (z_1^k, z_2^k, \dots, z_9^k, 1)^T, k=1 \sim 10000$

$y^k = (y_1^k, \dots, y_6^k)^T$   $w_{ij}$  and  $b_j$

(a)  $z_i^k \rightarrow y_j^k$  ?



$$y_j^k = \sum_{i=1}^9 w_{ij} z_i^k + b_j$$

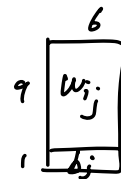
(b)  $W$ ?  $z^k \rightarrow y^k$

Solution

we can construct the weight matrix  $W$  of size  $10 \times 6$  where each column corresponds to the weight  $w_{ij}$  and the last one is bias  $b_j$

$$W^T = [w_{ij} | b_j]$$

$$y^k = W^T z^k$$



$$(c) \quad w_j = \begin{bmatrix} w_{1j} & w_{2j} & w_{3j} \\ w_{4j} & w_{5j} & w_{6j} \\ w_{7j} & w_{8j} & w_{9j} \end{bmatrix}$$

$$Y_j(u, v) = \sum_{s=-1}^1 \sum_{t=-1}^1 w_j(s+1, t+1) \cdot X(u-s, v-t) + b_j$$

$$Y_j = X * w_j + b_j$$

\* mean convolution operation

(d) Each of the 100 training image of size  $100 \times 100$  provide 10000 samples

Therefore ,

$$\begin{aligned} \text{Number of training sample} &= 100 \text{ images} \times 10000 \text{ sample/image} \\ &= 1,000,000 \end{aligned}$$