

21-51-Q3

(a) (i) SVM

(ii) CNN

(b) graph

Solution (a)(i) SVM

- ① remain the same
- ② In a linear SVM only the support vectors influence the optimisation problem.
- ③ A point that is well outside the margin has a Lagrange multiplier $\alpha = 0$
- ④ Deleting it leaves the quadratic program unchanged
- ⑤ So, weight vector w and bias b are unchanged.

(ii) ① $w_1 : B$ $w_2 : A$
 $w_3 : C$ $w_4 : C$

② $A : +1 / 0 / -1$ vertical edge detector
 detect right edge

$B : -1 / 0 / +1$ ~ detect left edge

$C : \text{identity kernel leave the image unchanged}$

```

0 0 0 0 0 0 0
0 0 1 1 1 0 0
0 0 0 0 1 0 0
0 0 1 1 1 0 0
0 0 0 0 1 0 0
0 0 1 1 1 0 0
0 0 0 0 0 0 0
  
```

white : 0

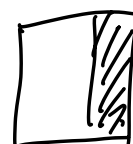
black : 1, 2, 3 ...

padding : 1

A. $\begin{matrix} 1 & 0 & -1 \\ 1 & 0 & -1 \\ 1 & 0 & -1 \end{matrix} \rightarrow \begin{matrix} -1 & -1 & -1 & 1 & 2 \\ -2 & -2 & -1 & 2 & 3 \\ -1 & -1 & -2 & 1 & 3 \\ -2 & -2 & -1 & 2 & 3 \\ -1 & -1 & -1 & 1 & 2 \end{matrix} \xrightarrow{\text{ReLU}}$

```

0 0 0 1 2
0 0 0 2 3
0 0 0 1 3
0 0 0 2 3
0 0 0 1 2
  
```

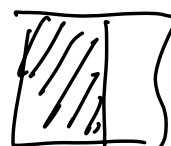


right edge

B. $\begin{matrix} -1 & 0 & 1 \\ -1 & 0 & 1 \\ -1 & 0 & 1 \end{matrix} \rightarrow \begin{matrix} 1 & 1 & 1 & -1 & -2 \\ 2 & 2 & 1 & -2 & -3 \\ 1 & 1 & 2 & -1 & -3 \\ 2 & 2 & 1 & -2 & -3 \\ 1 & 1 & 1 & -1 & -2 \end{matrix} \xrightarrow{\text{ReLU}}$

```

1 1 1 0 0
2 2 1 0 0
1 1 2 0 0
2 2 1 0 0
1 1 1 0 0
  
```



left edge

$$\begin{aligned}
 \text{(iii) output size} &= \frac{N - \text{filter size} + 2 \times \text{padding}}{\text{stride}} + 1 \\
 &= \frac{100 - 7 + 2 \times 0}{1} + 1 \\
 &= 94
 \end{aligned}$$

output : $94 \times 94 \times 1$

(b) (i) ① bias lower

② variance higher

(ii) ① bias stays roughly the same or grow slightly

② Because model capacity cannot fit more data

③ variance lower

④ Because model can improve generalization performance in the test set