1.1(a) $(h, w) = (10, 11)$

$k = 3$

$s = 2$

$h' = (h + 2P - f)/s + 1$

$= (10 - 3)/2 + 1$

$= 4$

$w' = (11 - 3)/2 + 1 = 5$

$\boxed{(h', w') = (4, 5)}$

(b) $C' = F$

$$H' = \frac{(H + 2P - D(k-1) - 1)}{S} + 1$$

$$W' = \frac{(W + 2P - D(k-1) - 1)}{S} + 1$$

$(C', H', W')$ w

(c) $x \in R^{5\times 2}$ $\quad w \in \mathbb{R}^{1\times 2\times 3}$ ← one kernel of size '3'.

output size $= \underline{5-3}+1 = 3 \equiv (1\times 3)$

$$w = \begin{bmatrix} w_{11} & w_{2} & w_{13} \\ w_{21} & w_{22} & w_{23} \end{bmatrix} \qquad x = \begin{bmatrix} x_{11} & x_{12} & x_{13} & x_{14} & x_{15} \\ x_{21} & x_{22} & x_{23} & x_{24} & x_{25} \end{bmatrix}$$

(i) $o_1 = w_{11}x_{11} + w_{12}x_{12} + w_{13}x_{13} + w_{21}x_{21} + w_{22}x_{22} + w_{23}x_{23}$

$$= \sum_{c=1}^{2}\sum_{i=1}^{3} w_{ci}x_{ci}$$

or, $$o_j = \sum_{c=1}^{2}\sum_{i=j}^{j+2} w_{c(j-i+1)}x_{ci}$$

$f_w(x) = \text{output} = [o_1, o_2, o_3] \in R^{1\times 3}$

(ii) $\frac{\partial \text{output}}{\partial w} \in \mathbb{R}^{1\times 2\times 3}$

$$\frac{do_1}{dw_{ij}} = x_{ij}, \quad \frac{do_2}{dw_{ij}} = x_{i(j+1)}, \quad \frac{do_3}{dw_{ij}} = x_{i(j+2)}$$

$\frac{\partial o}{\partial w} \in R^{1\times 3 \times 2\times 3}$, omit dim = 1

(iii) $\frac{do_1}{dx_{ij}} = w_{ij}$, $\quad \frac{do_2}{dx_{ij}} = w_{i(j-1)}$, $\quad \frac{do_3}{dx_{ij}} = w_{i(j-2)}$

else 0

$\frac{\partial o}{\partial x} \in R^{1\times 3\times 5\times 2}$ omit dim = 1

(iv) $\frac{dl}{dw} \in R^{1\times 2\times 3}$

$$\frac{dl}{dw} = \underbrace{\frac{dl}{d\text{output}}}_{\text{given}} \times \frac{dout}{dw}$$

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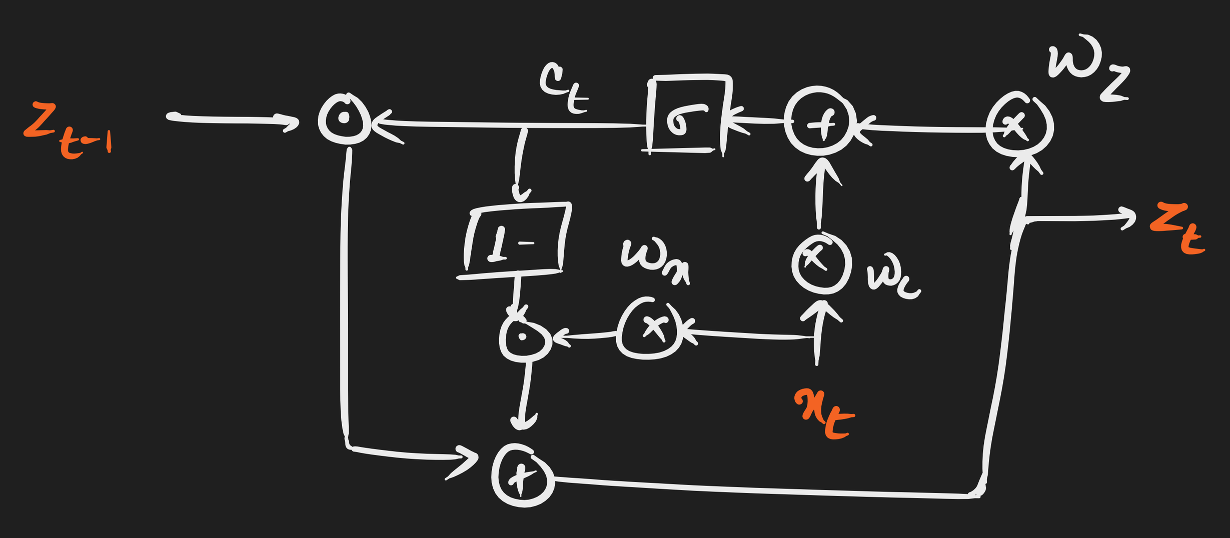
1.2(a)




(b) $c_t \in R^m$

(c) $\frac{dl}{dw_x} \in R^{m\times n}$

(d) Probably not.