Final 2021 Fall

(202050817 TAN SIN HONG)

1) According to the Taylor Series

$$f(x) = \lim_{\Delta \to 0} f(x+\Delta)$$

$$= \lim_{\Delta \to 0}\left(f(x) + f'(x)\Delta + \frac{f''(x)}{2}\Delta^2 + \frac{f'''(x)}{3}\Delta^3 + \dots + \frac{f^{(k)}(x)}{k}\Delta^k + \dots\right)$$

$$= \lim_{\Delta \to 0}\left(f(x) + f'(x)\Delta\right)$$

When $\Delta \to 0$, it will easily get $f(x+\Delta) = f(x) + f'(x)\Delta$

In the example 2-11, $f(x) = \frac{1}{2}x^2$, $f'(x) = x$, $\Delta = 0.2, 0.1, 0.01, 0.001$

| $\Delta$ | $f(x+\Delta)$ | $f(x)+f'(x)\Delta$ | $\lvert f(x+\Delta) - f(x) + f'(x)\Delta \rvert$ |
|---|---|---|---|
| $\Delta = 0.2$ | 0.72 | 0.7 | 0.02 |
| $\Delta = 0.1$ | 0.605 | 0.6 | 0.005 |
| $\Delta = 0.01$ | 0.5101 | 0.51 | 0.0001 |
| $\Delta$ 0.001 | 0.501 | 0.501 | 0 |

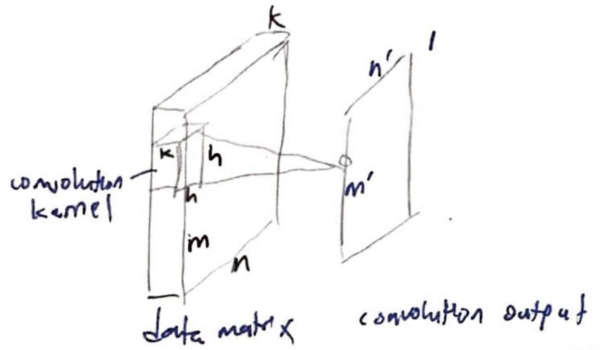
$\therefore$ From here, we deduce that the lesser the $\Delta$, the lesser the error.

Q2) For Figure 4.15(a), 4.15(b), both are data with three-dimensional structure.

For Figure 4.15(a), it is 2D convolution on multiple frames

the data matrix is $Z \in \mathbb{R}^{k\times m\times n}$, convolutio kernel is $U \in \mathbb{R}^{k\times h\times h}$,

the convolution output is $S \in \mathbb{R}^{1\times m'\times n'}$, which resulted from the sliding of the convolution kernel $U$ on the data matrix $Z$ and calculate the element $s(j,i)$ of $S$




data matrix

in_height × in_width × n_channels.

( m × n × k )

convolution kernel

filter_height × filter_width × in_channel × out_channel.

( h × h × k × 1 )

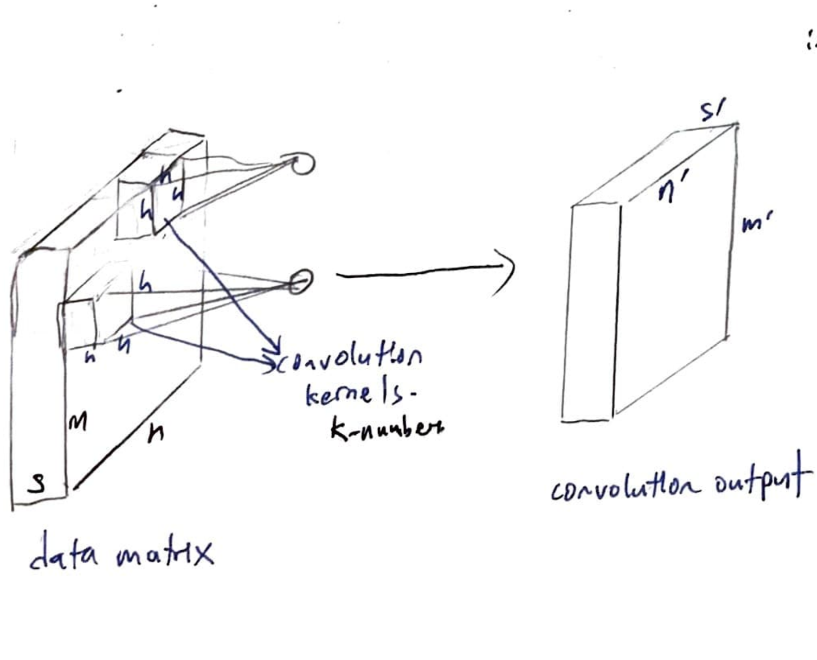
Convolution output

out_height × out_width × out_channel.

( m' × n' × 1 )

$$s(j,i) = Z \circledast U = \sum_{w=1}^{k} \sum_{y=-1(h-1)/2}^{(h-1)/2} \sum_{x=-1(h-1)/2}^{(h-1)/2} z(j+y, i+x, w)\, u(y,x,w)$$

For Figure 4.15(b) the data matrix is $Z \in \mathbb{R}^{k\times s\times m\times n}$, convolution kernel is $U \in \mathbb{R}^{k\times h\times h\times h}$, the convolution output is $S \in \mathbb{R}^{s'\times m'\times n'}$, which resulted from the sliding of the convolutio kernel $U$ on the data matrix $Z$. and calculate the element $s(j,i,l)$ of $S$.




data matrix

in_channel, in_depth × in_height × in_width

( k × s × m × n )

convolution kernel

filter_depth × filter_height × filter_width × in_channels × out_channel

( h × h × h × k × s' )

convolution output

out_depth × out_height × out_width × out_channel

( s' × m' × n' × k )

element $s(j,i,l)$ of $S$

$$s(j,i,l) = z \circledast u$$

$$= \sum_{w=1}^{k} \sum_{y=-(h-1)/2}^{(h-1)/2} \sum_{x=-(h-1)/2}^{(h-1)/2} \sum_{v=-(h-1)/2}^{(h-1)/2} z(j+y, i+x, l+v, w)\, u(y, x, v, w)$$