$\boxed{\text{fun sub}}$

1. sub

$$A = \left[\begin{pmatrix} 1 & 4 \\ 2 & 5 \\ 3 & 6 \end{pmatrix}, \begin{pmatrix} 11 & 14 \\ 12 & 15 \\ 13 & 16 \end{pmatrix} \right]$$

① Tensor & $B = A.\text{sub}((1),(2,3),(1,2))$

$= A.\text{sub}(\dim 1=(1), \dim 2=(2,3), \dim 3=(1,2))$

$= \left[\begin{pmatrix} 2 & 5 \\ 3 & 6 \end{pmatrix} \right]$

② Vector & $B = A.\text{sub}\left(\begin{pmatrix} 1 & 2 & 1 \\ 2 & 1 & 1 \\ 2 & 2 & 2 \end{pmatrix} \right) = \begin{pmatrix} 2 \\ 11 \\ 15 \end{pmatrix}$

③ Vector & $B = A.\text{sub}\left(\begin{pmatrix} 3 \\ 3 \\ 1 \end{pmatrix} \right) = \begin{pmatrix} 2 \\ 2 \\ 11 \end{pmatrix}$

1.2 $y = f(x, \text{index}) = x.\text{sub}(\text{index})$

e.x., $x = \begin{pmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{pmatrix}$, $y = \text{sub}\left(x, \begin{pmatrix} 1 \\ 2 \\ 2 \end{pmatrix}\right) = x.\text{sub}\begin{pmatrix} 1 \\ 2 \\ 2 \end{pmatrix}$

$\therefore y = \begin{pmatrix} x_1 \\ x_2 \\ x_2 \end{pmatrix}$

1.3 $dy \Rightarrow dx$

$x \xrightarrow{\text{sub}} y$: $y = x.\text{sub}(\text{index})$

$dx \leftarrow dy$: $dx = 0$, $dx.\text{sub}(\text{index}) += dy$ (must use +=, not =)

$ddx \xrightarrow{\text{sub}} ddy$: $ddy = ddx.\text{sub}(\text{index})$

2. Index (see numpy indexing ndarrays)

$y = f(x, \text{index}) = \text{Index}(x, \text{index}) = x.\text{sub}(\text{index})$

2.3 $dy \Rightarrow dx$: $dx = dy.\text{new}(x.\text{shape}).\text{zero}$, $dx.\text{sub}(\text{index}) += dy$

$\left(dx := \frac{dL}{dx} := \left(\frac{\partial L}{\partial x}\right).\text{reshape}(x.\text{shape})\right.$, see 01025)

3. $y = f(x, \text{dims}) = \text{transpose}(x, \text{dims}) = x.\text{trans}(\text{dims})$

3.3 $dx = dy.\text{trans}(\text{dims})$, here dims.size $= 2$

4. $y = f(x, \text{shape} = d) = \text{reshape}(x, d) = x.\text{reshape}(d)$

4.3 $dx = dy.\text{reshape}(x.\text{shape})$

5. $y = f(x, \text{type}) = \text{copy}(x, \text{type})$

5.3 $dx \Leftarrow dy$: $dx = \text{copy}(dy, x.\text{type})$