1)

$\underline{a} \in \mathbb{R}^n \qquad \underline{a} = [a_1, a_2, a_3, \dots, a_n] \qquad \underline{a}^T = \begin{bmatrix} a_1 \\ a_2 \\ \vdots \\ a_n \end{bmatrix}$

$\underline{b} \in \mathbb{R}^n \qquad \underline{b} = [b_1, b_2, b_3, \dots, b_n]$

$$\underline{\underline{X}} = \begin{array}{cc} & \\ i=1 \rightarrow & \\ M & \begin{bmatrix} x_{11} & x_{12} & x_{13} & \cdots & x_{1N} \\ x_{21} & & \vdots & & \\ x_{31} & & \vdots & & \\ \vdots & & & & \\ x_{M1} & & x_{M3} & & x_{MN} \end{bmatrix} \\ & N \end{array} \quad X_{1k}$$

$\sum X_{1k} \cdot a_k$

$\dim(\underline{\underline{x}}) = M \times N$

$$\underline{y} = \underline{\underline{X}} \cdot \underline{a} = \begin{pmatrix} x_{11} \cdot a_1 + x_{12} \cdot a_2 \cdots + \\ \vdots \\ x_{M1} a_1 + x_{M2} a_2 \cdots \end{pmatrix}$$

fall

1b) $y = \sum_{i=1}^{N} a_i b_i = a_1 b_1 + a_2 b_2 + a_3 b_3 + \dots + a_N \cdot b_N = \underline{a} \cdot \underline{b}$

1d)
```
for i=1:M
    for k=1:N
        y_i += x_ik · a_k
```

1c) $\underline{a} \cdot \underline{b}$

Numpy $a @ b$

$\underline{\underline{X}} \cdot \underline{b}$ OK

$3 \times 2 \quad 2 \times 1$

Ehs:

$$\begin{array}{c} \\ 3 \end{array} \begin{pmatrix} 1 & 2 \\ 3 & 4 \\ 5 & 6 \end{pmatrix}_{2} \cdot \begin{pmatrix} 7 & 8 \\ 9 & 10 \end{pmatrix}_{2}^{2}$$

$$3 \times \cancel{2} \cdot \cancel{2} \times 2 = 3 \times 2$$

$$= \begin{pmatrix} \underbrace{1 \cdot 7 + 2 \cdot 9}_{y_{11}} & 0 \\ \underbrace{3 \cdot 7 + 4 \cdot 9}_{y_{21}} & 0 \\ 0 & \underbrace{5 \cdot 8 + 6 \cdot 10}_{y_{32}} \end{pmatrix}$$

1e) for $i = 1 : M$

for $j = 1 : N$

$y \mathrel{+}= X_{ik} a_k$

1) $y = X @ a$

2) $y = y.\mathrm{sum}()$

$$\underline{y} = \underline{\underline{X}} \cdot \underline{a}$$

$\underline{X} \in \mathbb{R}^{M \times N}$

1f) $$\underline{\underline{Z}} = \begin{pmatrix} Z_{11} & Z_{12} & \cdots & Z_{1M} \\ \vdots & & & \\ Z_{P1} & Z_{P2} & \cdots & Z_{PM} \end{pmatrix}$$

$Z \in \mathbb{R}^{P \times M}$

$$\underset{P \times M}{Z} \cdot \underset{M \times N}{X} = \underset{P \times N}{Y}$$

Transpose

$$\underset{=}{X} = \begin{pmatrix} 1 & 4 \\ 2 & 5 \\ 3 & 6 \end{pmatrix} \qquad \underset{=}{X}^T = \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{pmatrix}$$