import numpy as np

1.

$$A \; o \; B = \begin{pmatrix} 1 * 0.5 & 2 * 0.1 & 3 * 0.3 \\ 3 * -1 & 2 * -20 & 1 * 1.5 \end{pmatrix}$$

Calculated by python

a = np.array([[1,2,3],[3,2,1]])

b = np.array([[0.5,0.1,0.3],[-1,-20,1.5]])

Q1 =np.multiply(a,b)

print (Q1)

[[0.5 0.2 0.9]

[-3. -40. 1.5]]

2.

$$AB^T = \begin{pmatrix} 1 & 2 & 3 \\ 3 & 2 & 1 \end{pmatrix} \begin{pmatrix} 0.5 & -1 \\ 0.1 & -20 \\ 0.3 & 1.5 \end{pmatrix}$$

$$BA^T = \begin{pmatrix} 0.5 & 0.1 & 0.3 \\ -1 & -20 & 1.5 \end{pmatrix} \begin{pmatrix} 1 & 3 \\ 2 & 2 \\ 3 & 1 \end{pmatrix}$$

Calculated by python

Q2_1 = np.matmul(a, b.T)

Q2_2 = np.matmul(b, a.T)

print (Q2_1)

print (Q2_2)

[[1.6 -36.5]

[2. -41.5]]

[[1.6   2.]

[-36.5 -41.5]]

3.

No, elements are mismatch.

: Input operand 1 has a mismatch in its core dimension 0, with gufunc signature (n?,k),(k,m?)->(n?,m?) (size 2 is different from 3

4.

$f(x) = x + 1, \qquad f(AB^T) = ?$

Calculated by python

Q4 = Q2_1+1

print (Q4)

[[2.6 -35.5]

[3. -40.5]]

5.

$$\frac{\partial E}{\partial w_i} = \frac{\partial(\hat{y} - y)^2}{\partial \hat{y}} \frac{\partial(w^t\mathrm{x})}{\partial w^t\mathrm{x}} \frac{\partial(w^t\mathrm{x})}{\partial w_i} = 2\hat{y} * 1 * x_i = 2x\hat{y}$$

6.

$x = [x_0, x_1, x_{2,} x_3] = [1,0,1,0]^T$

$w = [w_0, w_1, w_{2,} w_3] = [5,4,6,1]^T$

$\text{Ø}(\mathrm{x}) = x^2$

$y = \text{Ø}\,(w^t\mathrm{x})\,, w^t\mathrm{x} = 11\,, \text{Ø}(\mathrm{x}) = x^2\,, \hat{y} = 121$

7.

(1)

$$\frac{\partial E}{\partial x_1} = \frac{\partial(\hat{y} - y)}{\partial x_1} = \frac{\partial((w^t\mathrm{x})^2 - y)}{\partial x_1} = 0$$

(2)

$$\frac{\partial E}{\partial w_1} = \frac{\partial(\hat{y} - y)}{\partial \hat{y}} \frac{\partial \text{Ø}(w^t\mathrm{x})}{\partial w^t\mathrm{x}} \frac{\partial(w^t\mathrm{x})}{\partial w_1}$$

$$\frac{\partial(\hat{y} - y)}{\partial \hat{y}} = 1$$

$$\frac{\partial \text{Ø}(w^t\mathrm{x})}{\partial w^t\mathrm{x}} = 2\,(w^t\mathrm{x}) = 0$$

$$\frac{\partial(w^t\mathrm{x})}{\partial w_1} = x_1\,, x_1 = 0$$

$$\frac{\partial E}{\partial w_1} = 1 * 0 * 0 = 0$$

8.

$$\frac{\partial E}{\partial x} = \frac{\partial(\hat{y} - y)}{\partial x} = \frac{\partial((w^t\mathrm{x})^2 - y)}{\partial x} = \begin{pmatrix} 50 \\ 0 \\ 72 \\ 0 \end{pmatrix}$$

$$\frac{\partial E}{\partial w_i} = \begin{pmatrix} 10 \\ 0 \\ 12 \\ 0 \end{pmatrix}$$