

$$\begin{bmatrix} X \\ x_1 \\ x_2 \\ x_3 \\ x_4 \\ \vdots \\ x_N \\ N \times d \end{bmatrix} \times \begin{bmatrix} W^Q \\ d \times d_k \end{bmatrix} = \begin{bmatrix} Q \\ q_1 \\ q_2 \\ q_3 \\ q_4 \\ \vdots \\ q_N \\ N \times d_k \end{bmatrix}$$

The diagram illustrates the matrix multiplication of X and W^Q to produce Q .

Matrix X is of size $N \times d$ and contains rows $x_1, x_2, x_3, x_4, \dots, x_N$.

Matrix W^Q is of size $d \times d_k$.

The resulting matrix Q is of size $N \times d_k$ and contains rows $q_1, q_2, q_3, q_4, \dots, q_N$.