

# 深度交叉网络 (DCN)

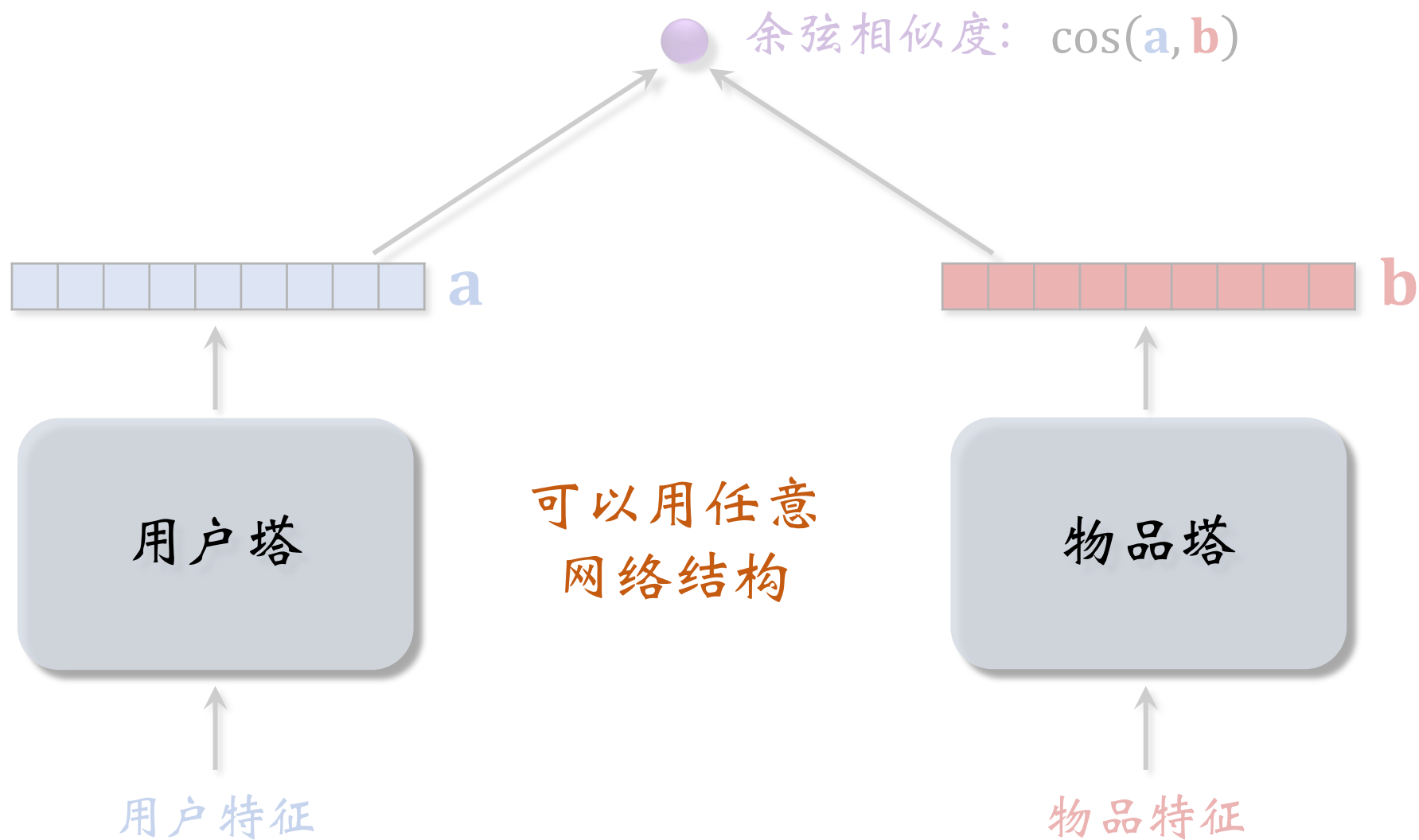
王树森

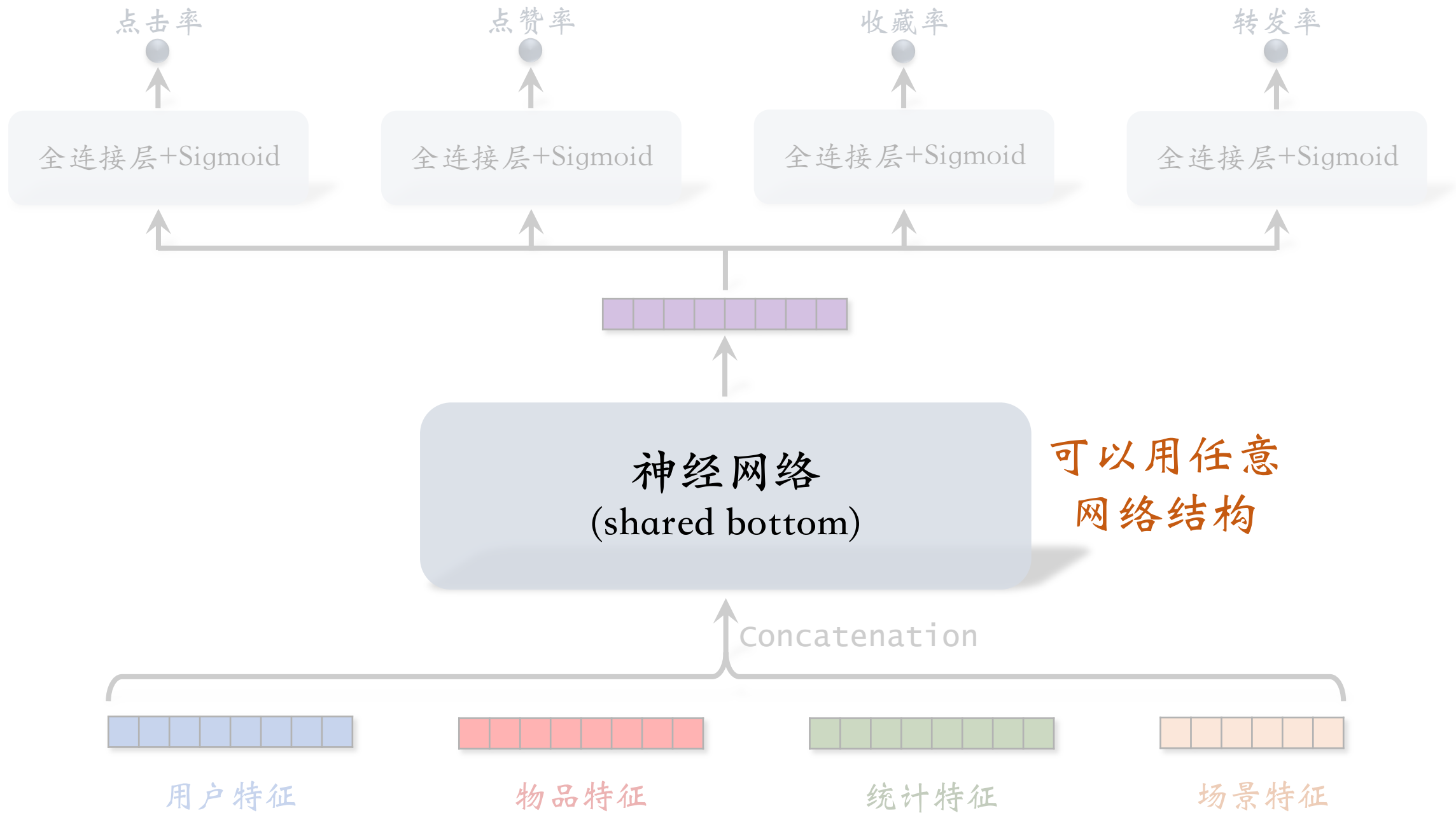
<http://wangshusen.github.io/>

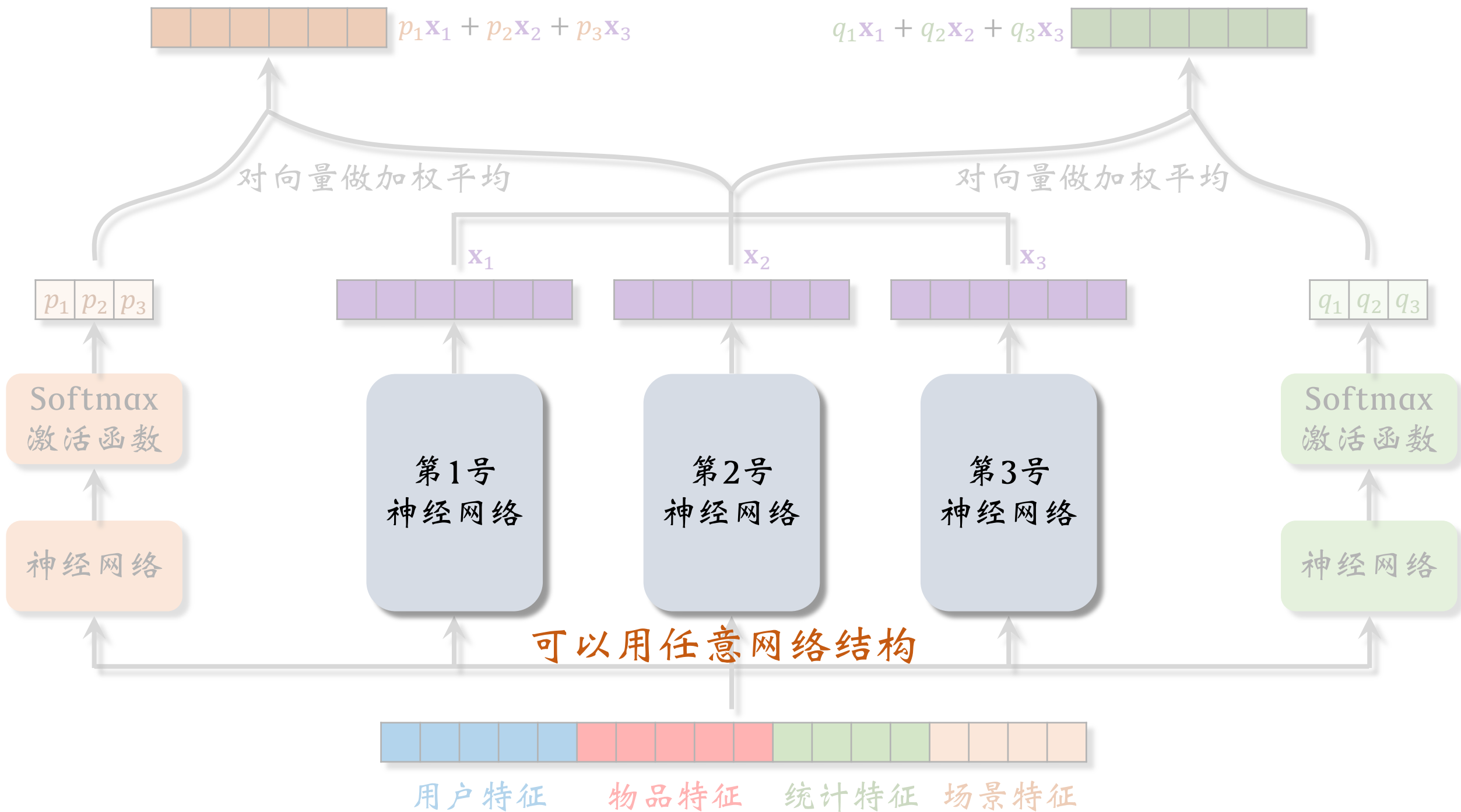


# 召回、排序模型

# 双塔模型



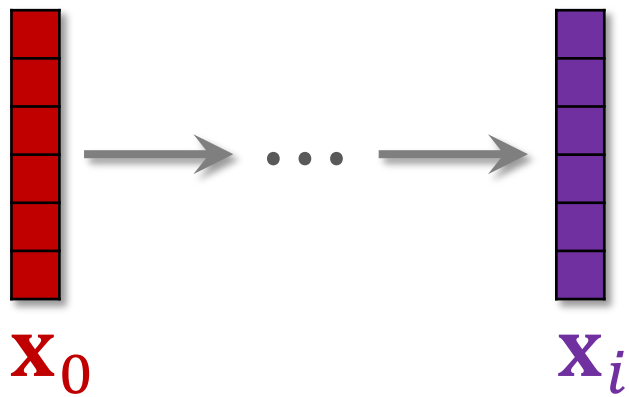




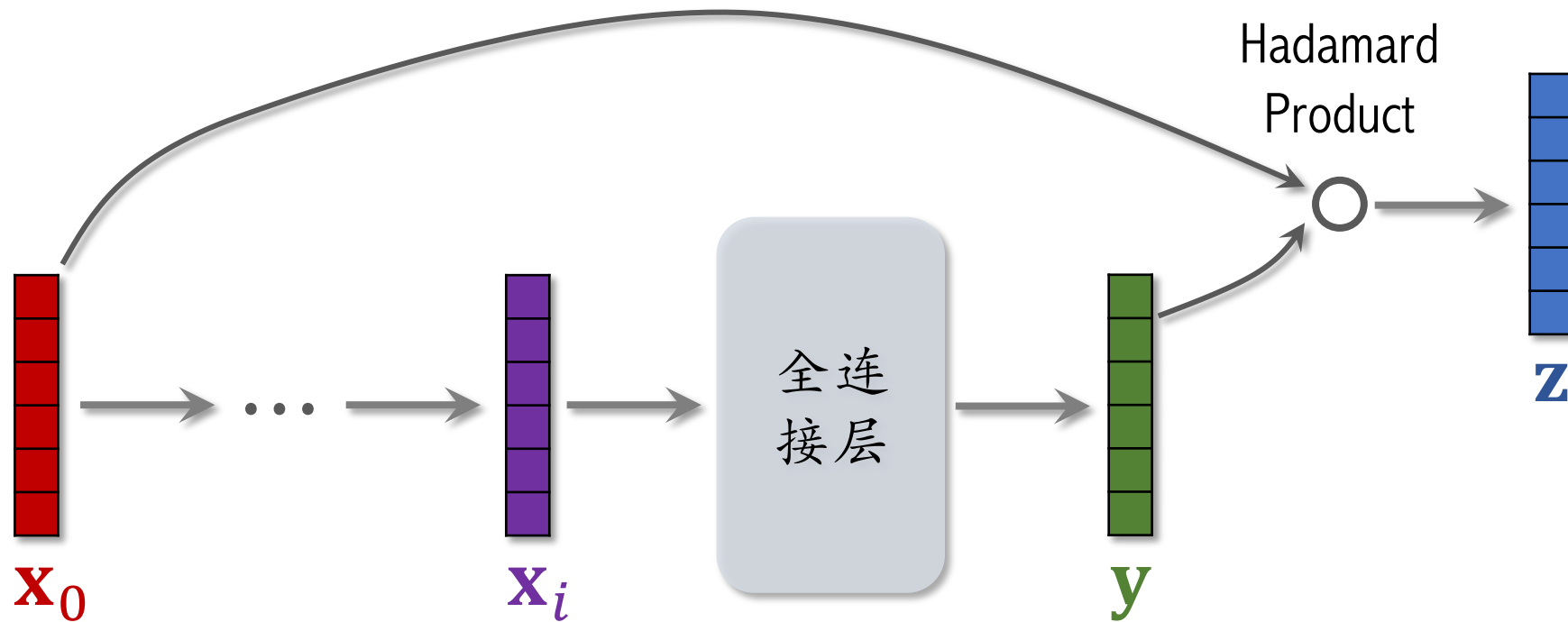
# 交叉层

(Cross Layer)

# 交叉层 (Cross Layer)

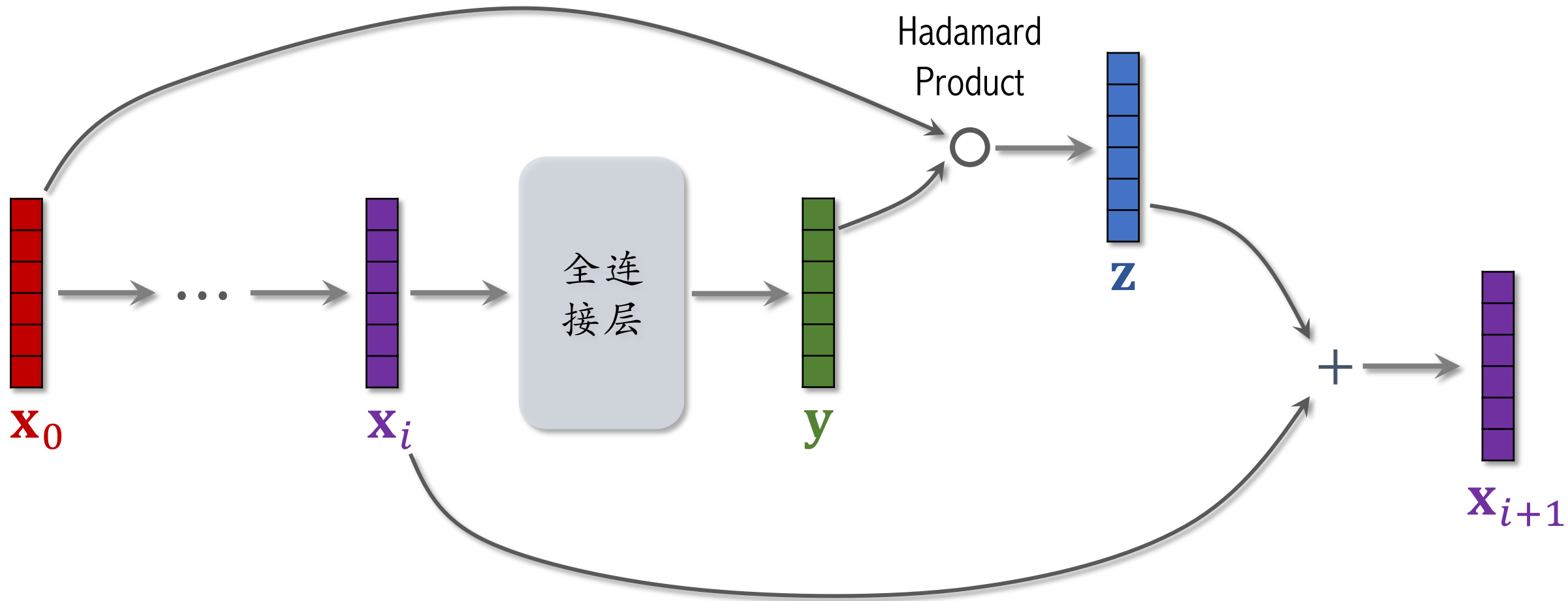


# 交叉层 (Cross Layer)

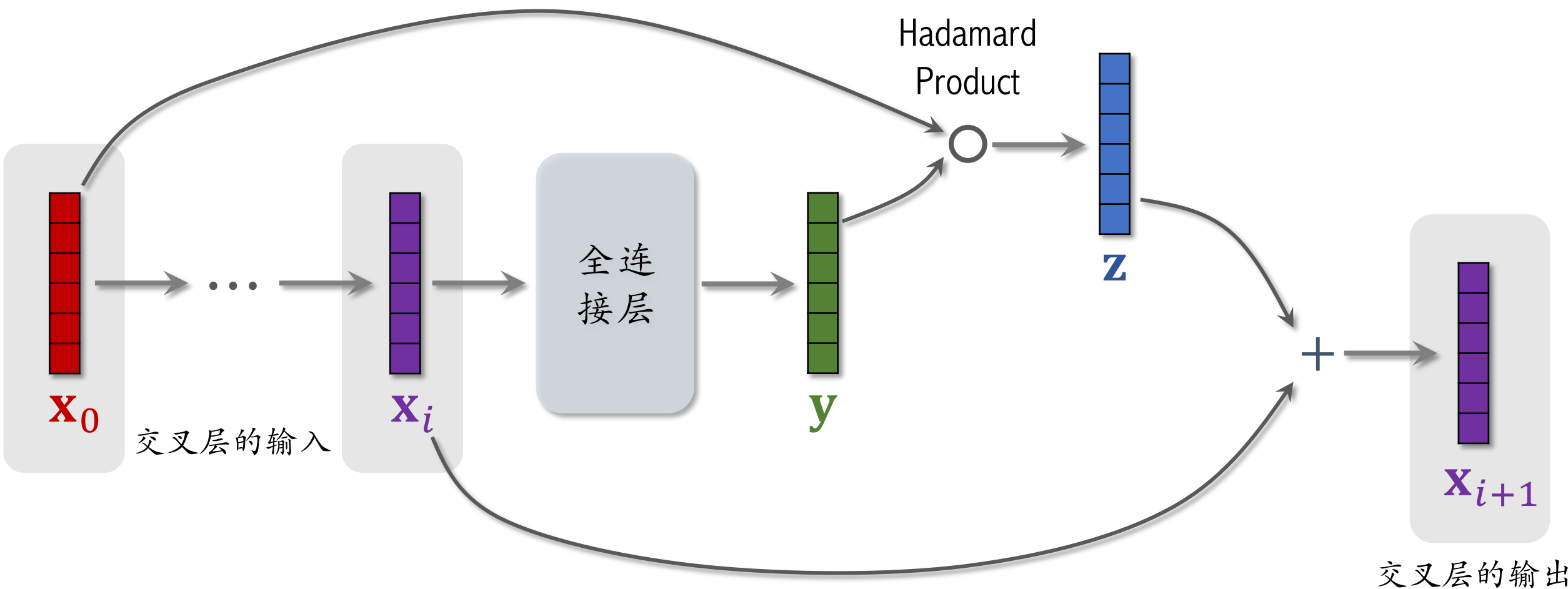




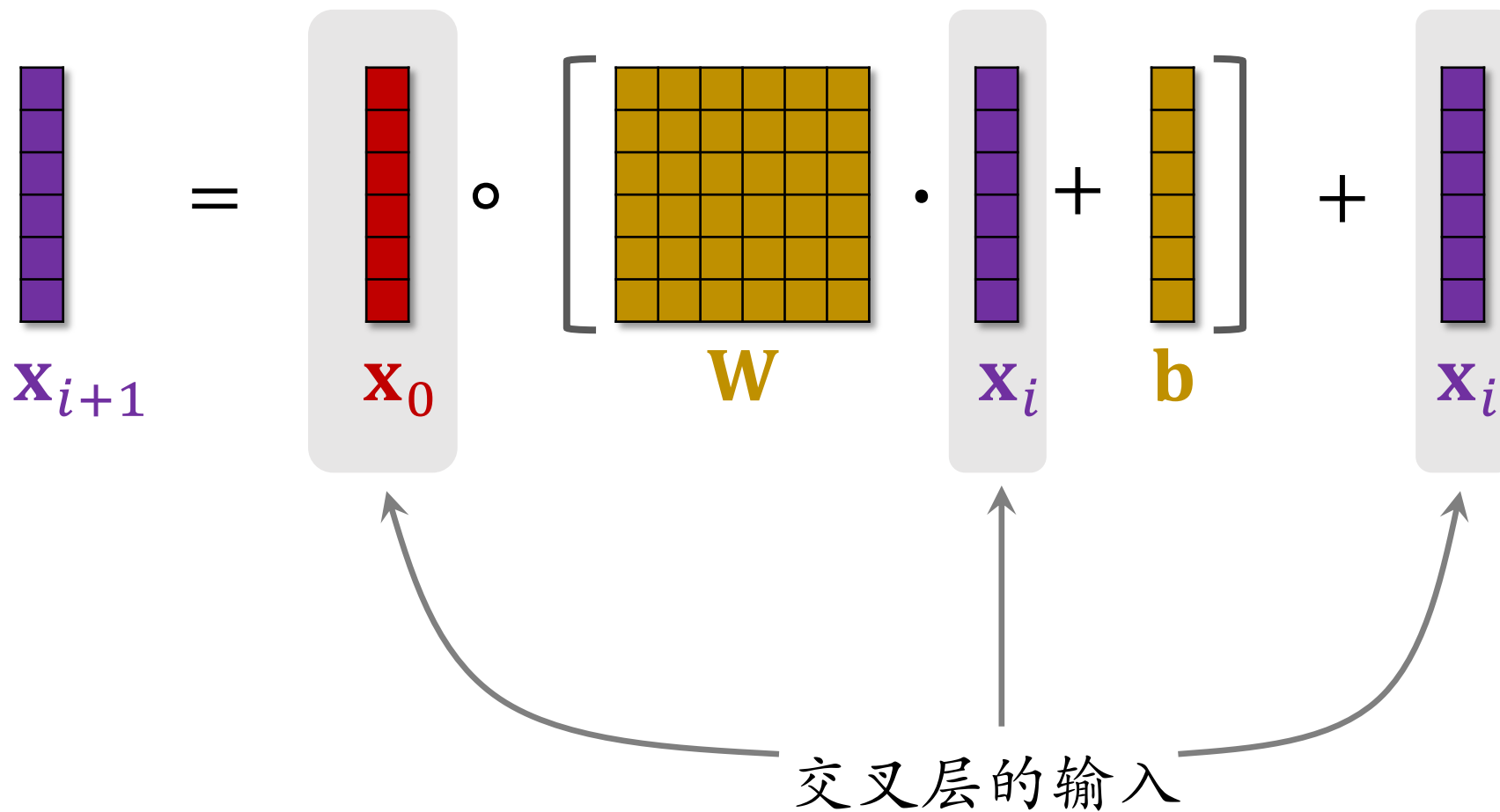
# 交叉层 (Cross Layer)



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# 交叉层 (Cross Layer)



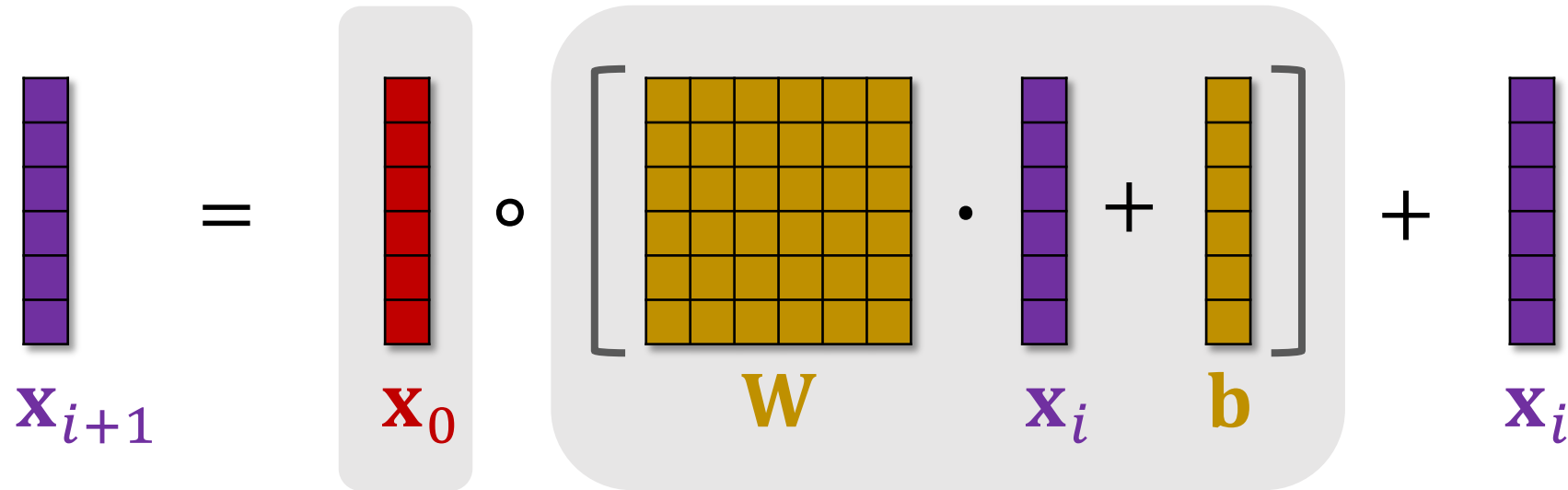
# 交叉层 (Cross Layer)

The diagram illustrates the operation of a Cross Layer. It shows the calculation of the output vector  $x_{i+1}$  as the sum of the input vector  $x_0$  and the output of a fully connected layer. The fully connected layer takes the input vector  $x_i$  and applies a weight matrix  $W$  and a bias vector  $b$ . The result is then added to  $x_i$  to produce the final output  $x_{i+1}$ .

$$x_{i+1} = x_0 \circ \left[ W \cdot x_i + b \right] + x_i$$

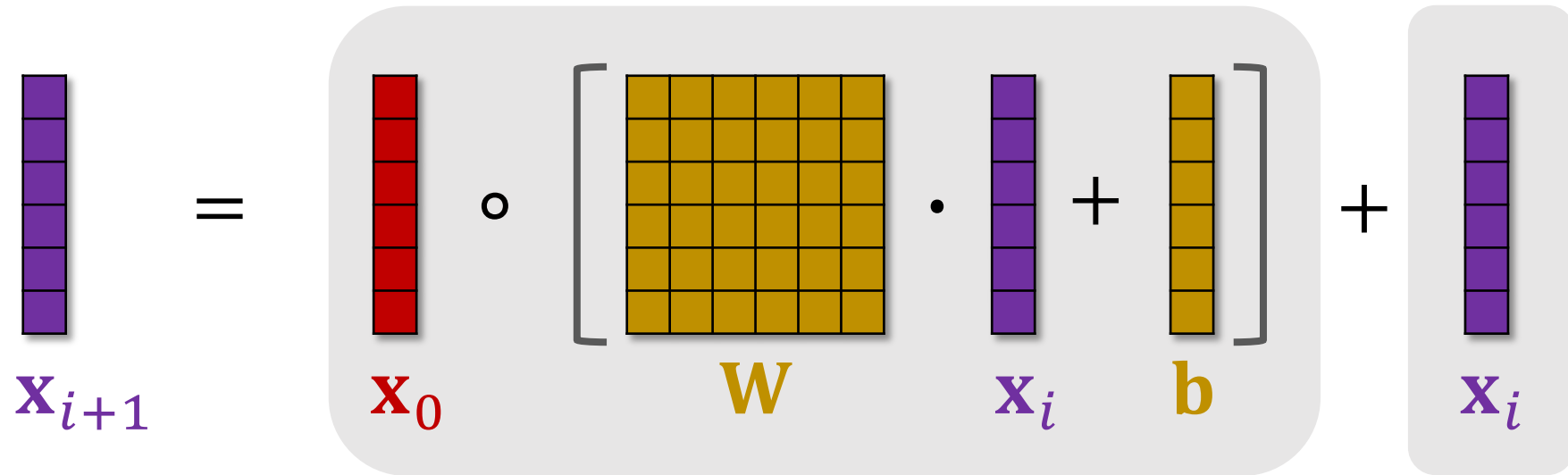
全连接层

# 交叉层 (Cross Layer)



Hadamard Product

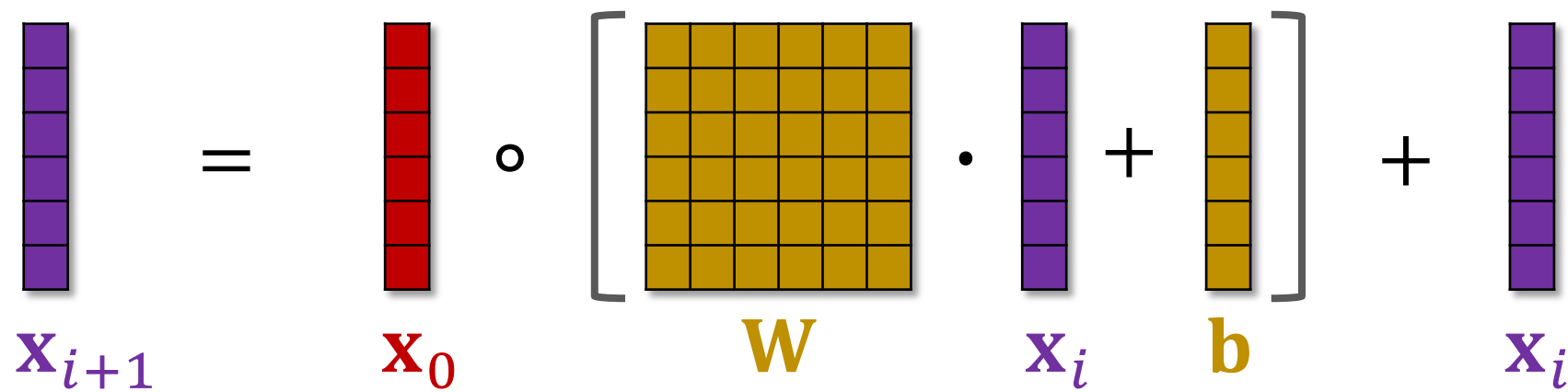
# 交叉层 (Cross Layer)



The diagram illustrates the operation of a Cross Layer. On the left, a purple vertical vector  $x_{i+1}$  is shown. This is followed by an equals sign. To the right of the equals sign is a large light gray rounded rectangle containing the main operation. Inside this rectangle, a red vertical vector  $x_0$  is followed by a circle with a dot ( $\circ$ ). This is followed by a large square bracket containing a 6x6 yellow grid representing a weight matrix  $W$ . To the right of the grid is a purple vertical vector  $x_i$ , followed by a dot ( $\cdot$ ), then a yellow vertical vector  $b$ , and finally a plus sign ( $+$ ). The entire expression within the square bracket is enclosed in a large square bracket. To the right of this large square bracket is a plus sign ( $+$ ), followed by a purple vertical vector  $x_i$  which is enclosed in its own light gray rounded rectangle.

$$x_{i+1} = x_0 \circ \left[ W \cdot x_i + b \right] + x_i$$

# 交叉层 (Cross Layer)



The diagram illustrates the operation of a Cross Layer. It shows the output vector  $\mathbf{x}_{i+1}$  (purple) is equal to the element-wise product of the input vector  $\mathbf{x}_0$  (red) and a bracketed expression, plus the input vector  $\mathbf{x}_i$  (purple). The bracketed expression is the sum of a matrix multiplication and a bias vector. The matrix multiplication is between a weight matrix  $\mathbf{W}$  (yellow grid) and the input vector  $\mathbf{x}_i$  (purple). The bias vector  $\mathbf{b}$  (yellow) is added to the result of the matrix multiplication.

$$\mathbf{x}_{i+1} = \mathbf{x}_0 \circ \left[ \mathbf{W} \cdot \mathbf{x}_i + \mathbf{b} \right] + \mathbf{x}_i$$

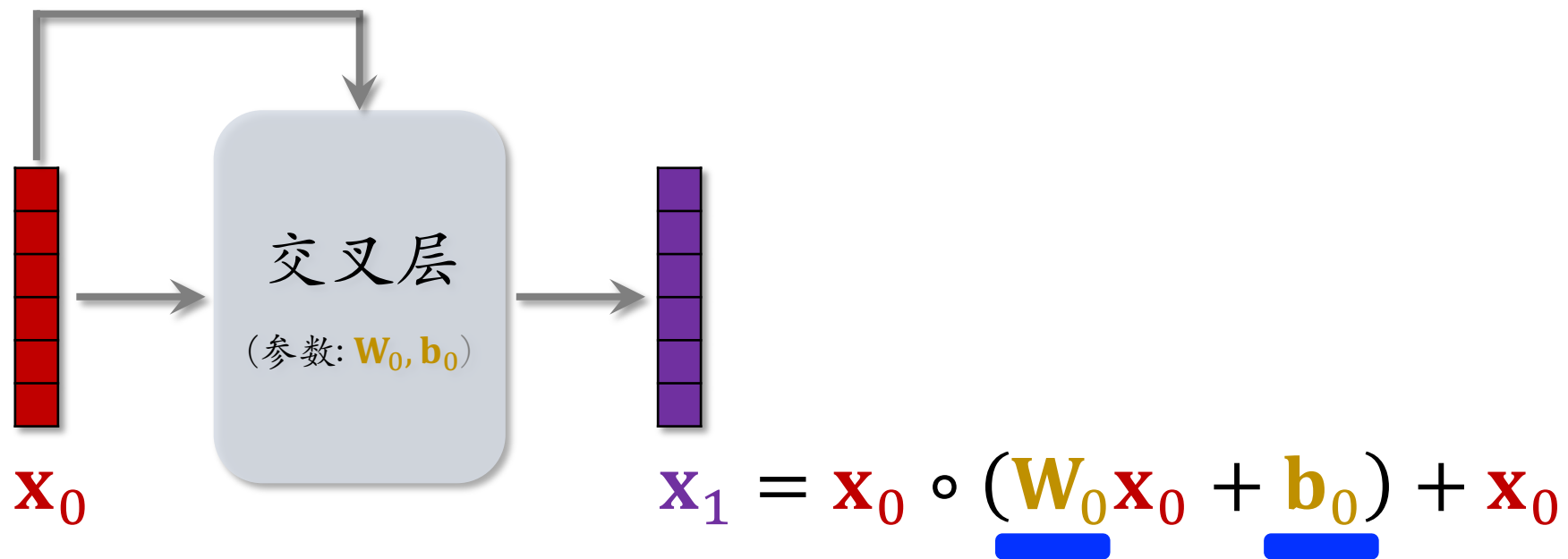
输出

# 交叉网络

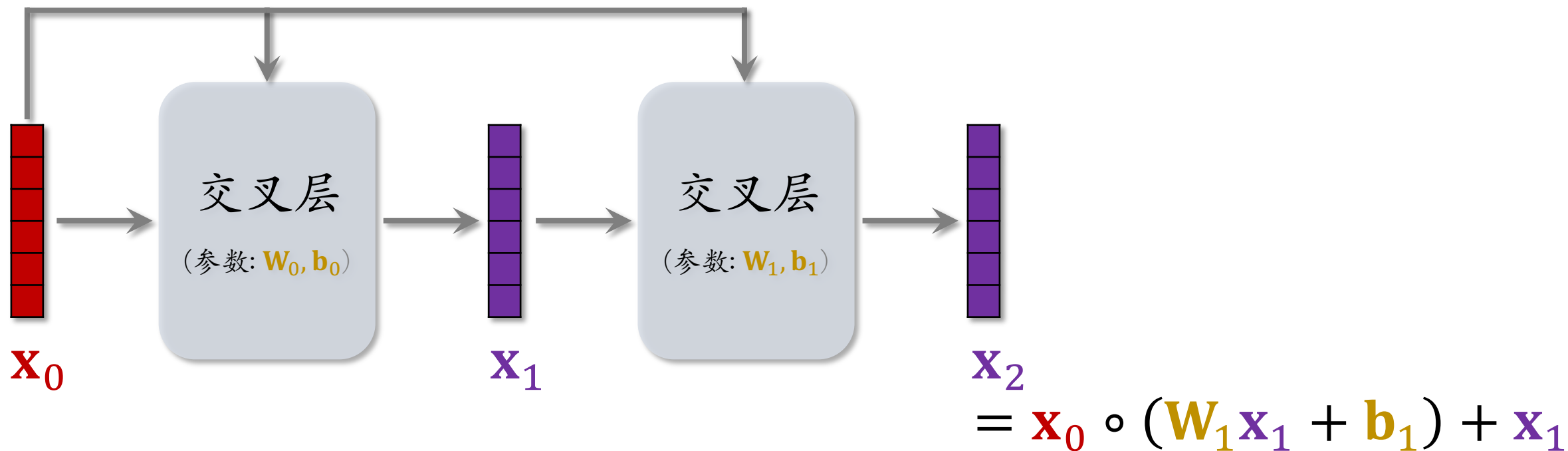
(Cross Network)



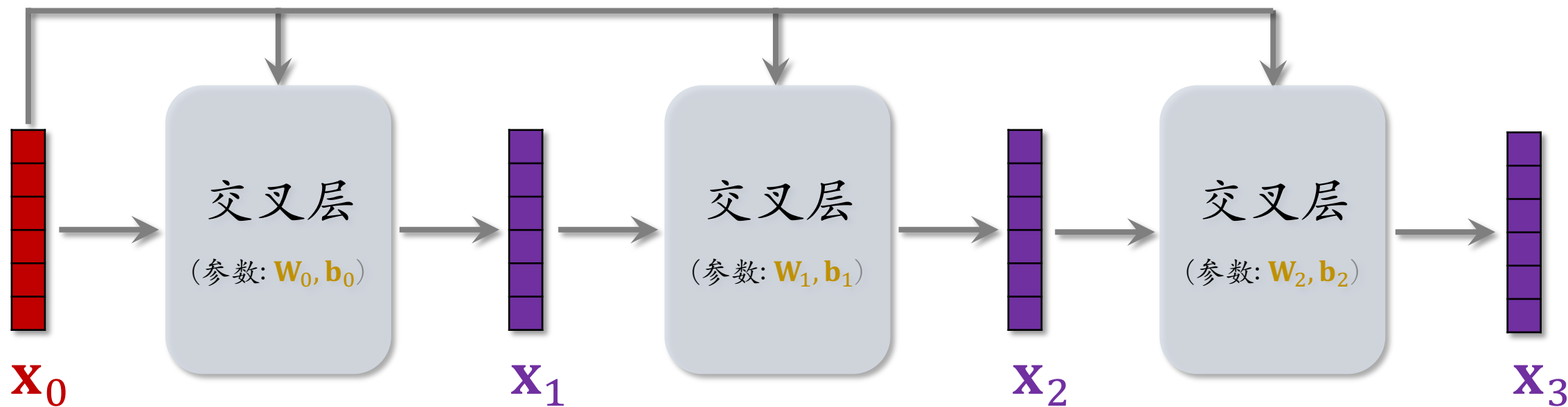
# 交叉网络 (Cross Network)



# 交叉网络 (Cross Network)





# 交叉网络 (Cross Network)



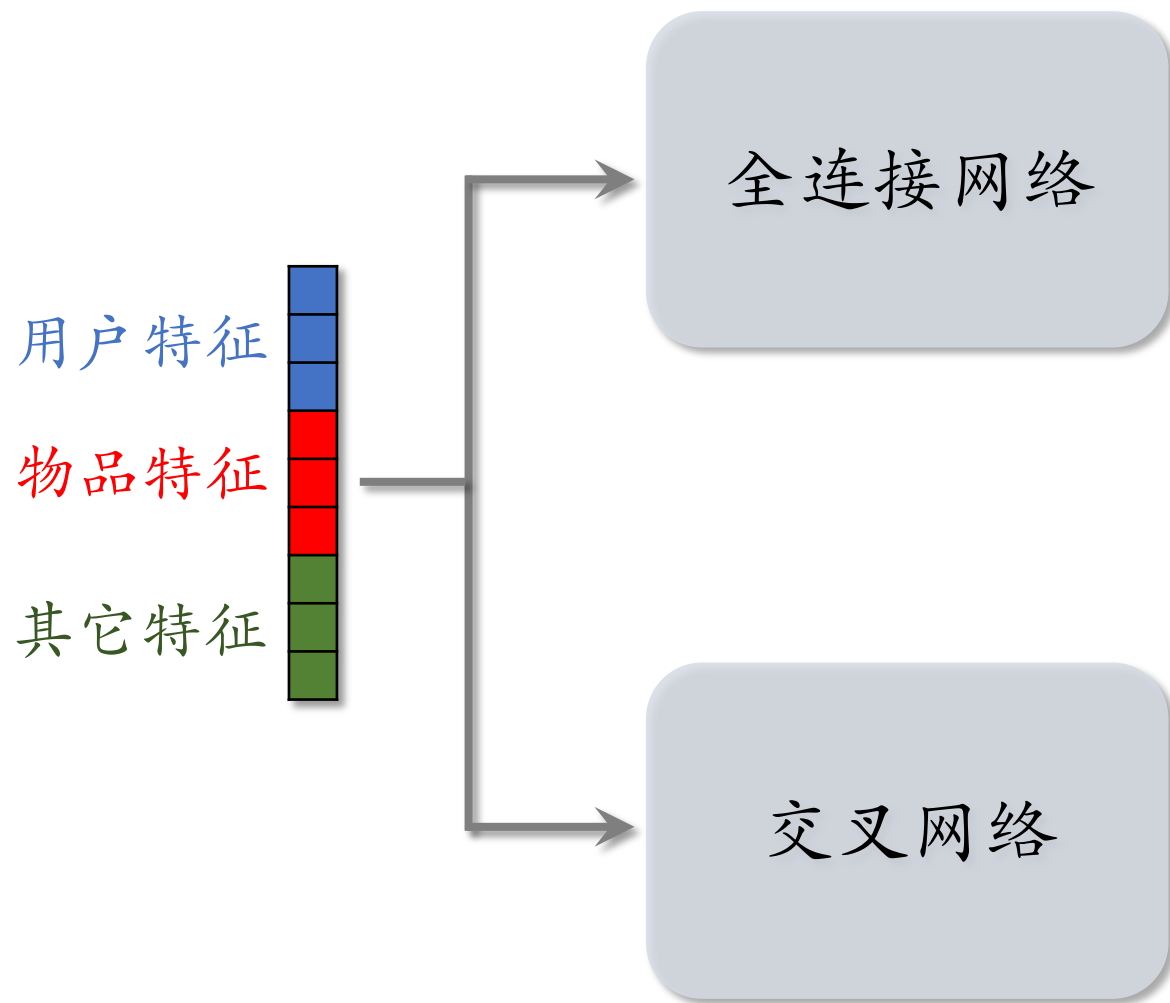
# 参考文献

- 这节课介绍的是 Cross Network V2 [1]。
- 老版本的 Cross Network 在论文 [2] 中提出。

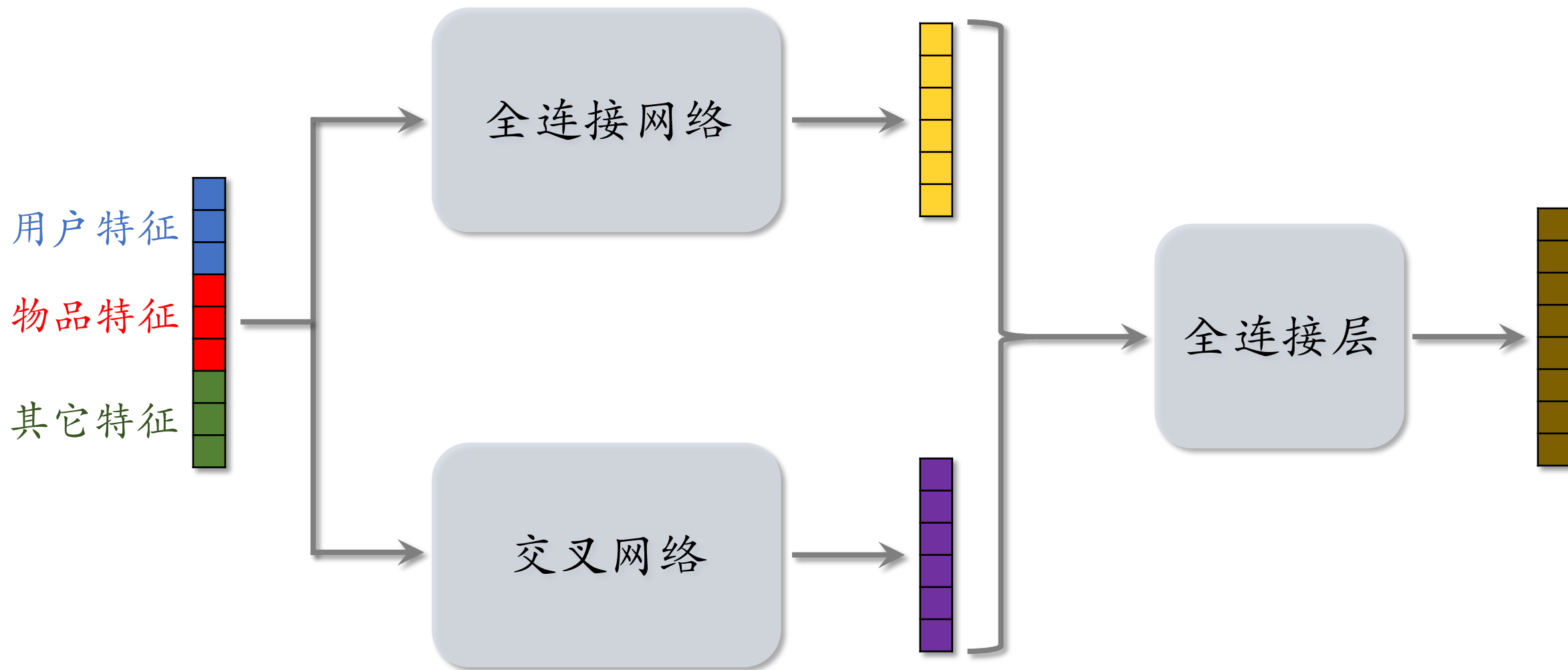
参考文献：

-  1. Ruoxi Wang et al. [DCN V2: Improved Deep & Cross Network and Practical Lessons for Web-scale Learning to Rank Systems](#). In *WWW*, 2021.
-  2. Ruoxi Wang et al. [Deep & Cross Network for Ad Click Predictions](#). In *ADKDD*, 2017.

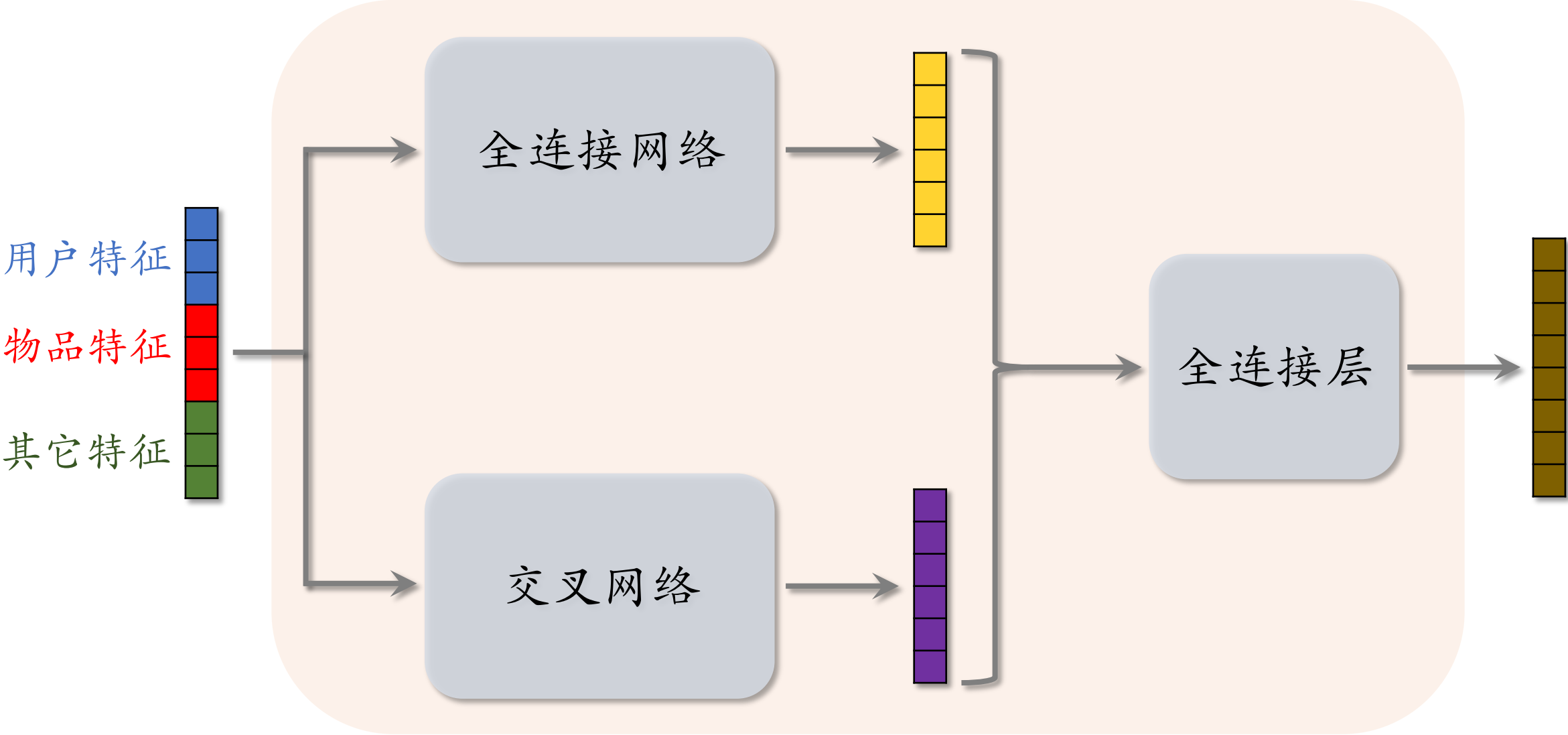
# 深度交叉网络 (Deep & Cross Network)



# 深度交叉网络 (Deep & Cross Network)



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深度交叉网络

**Thank You!**

<http://wangshusen.github.io/>