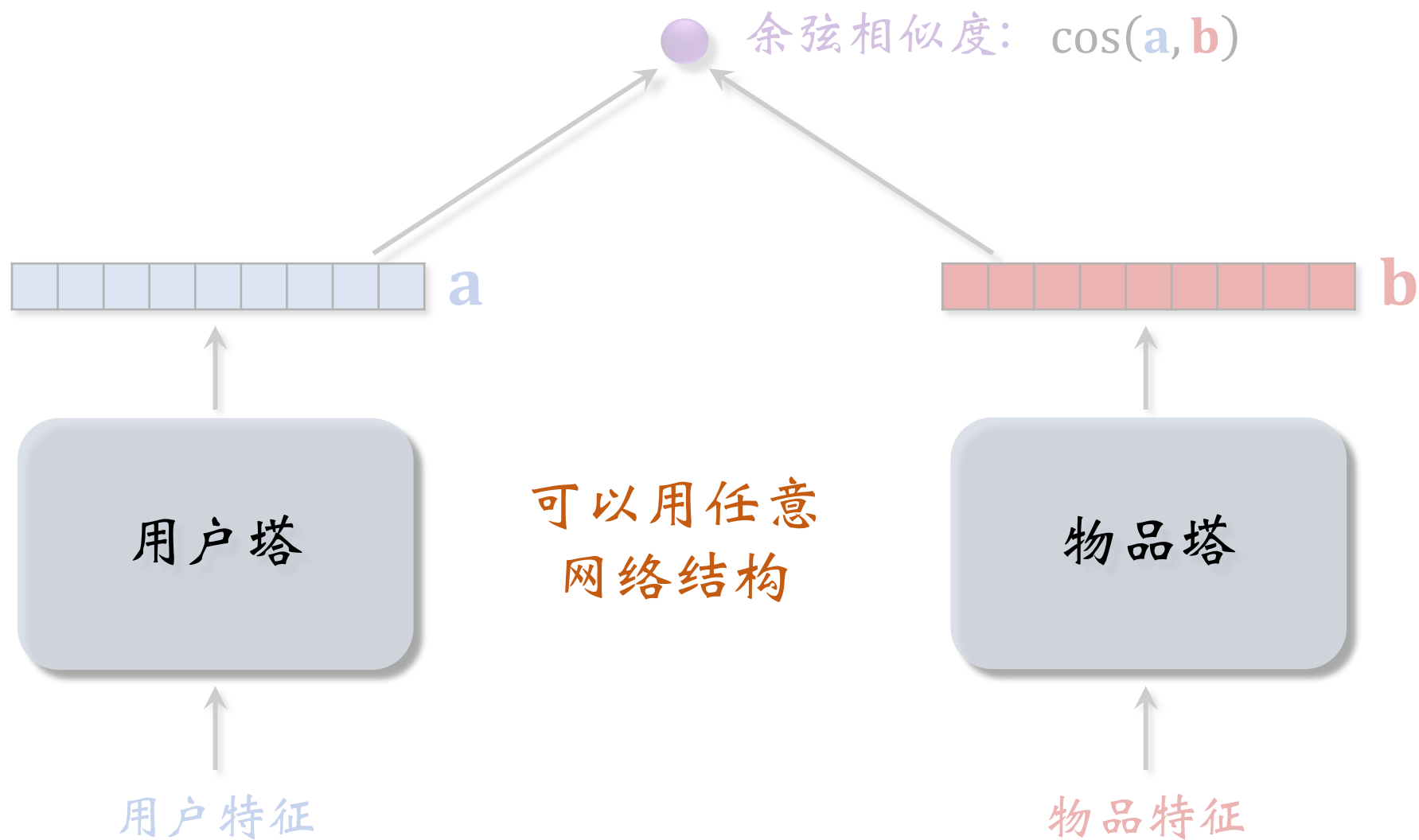
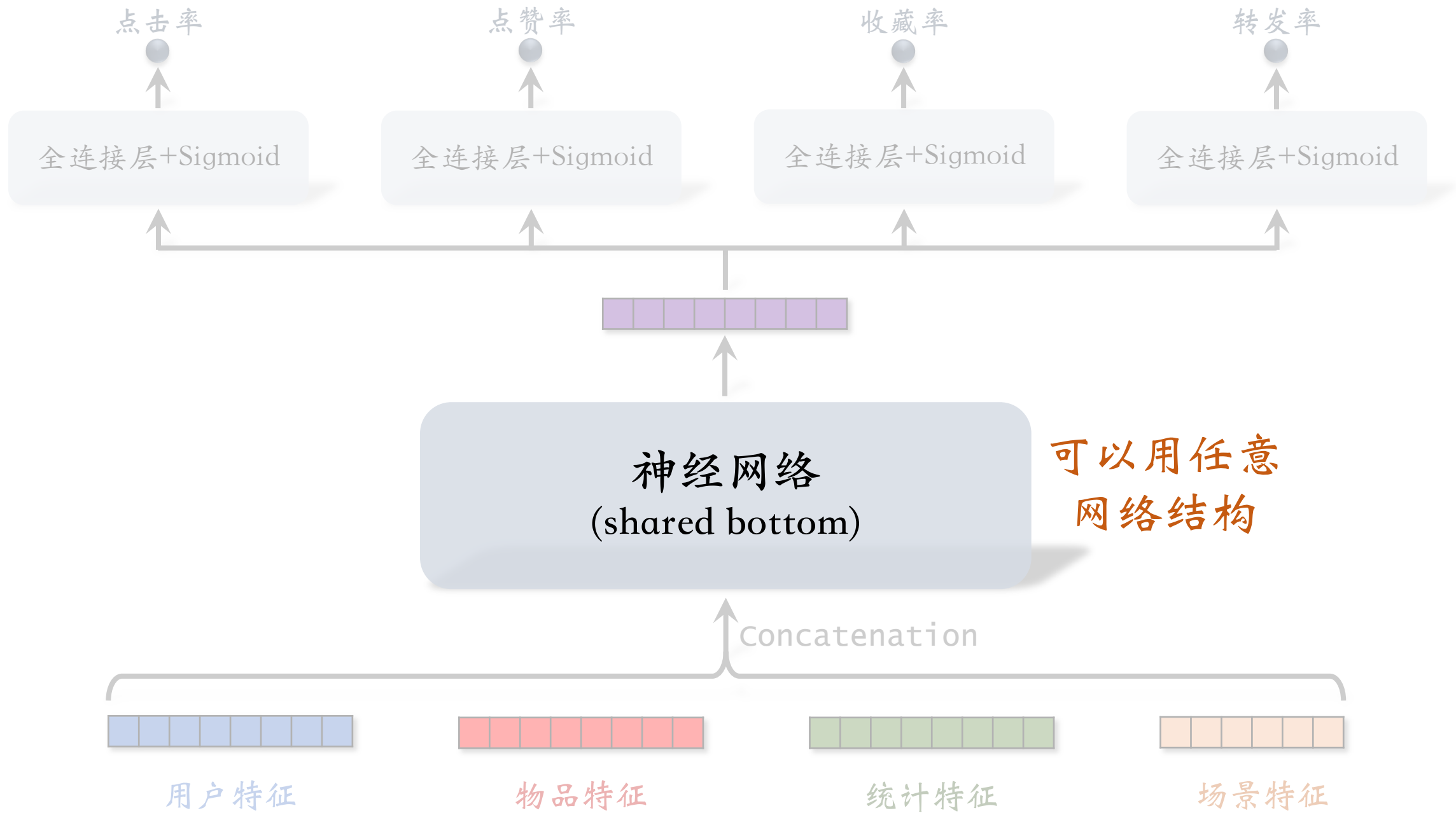
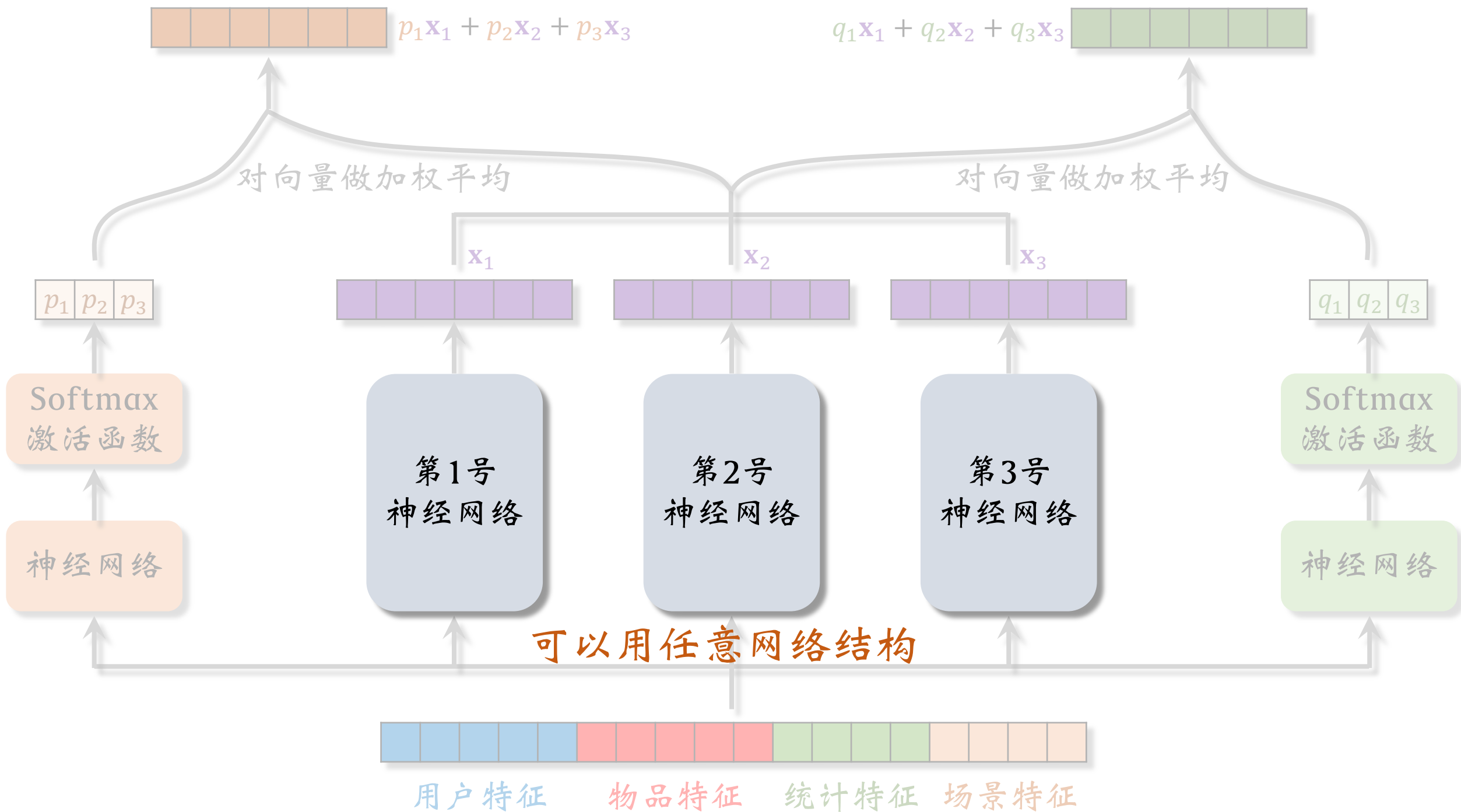


召回、排序模型

双塔模型



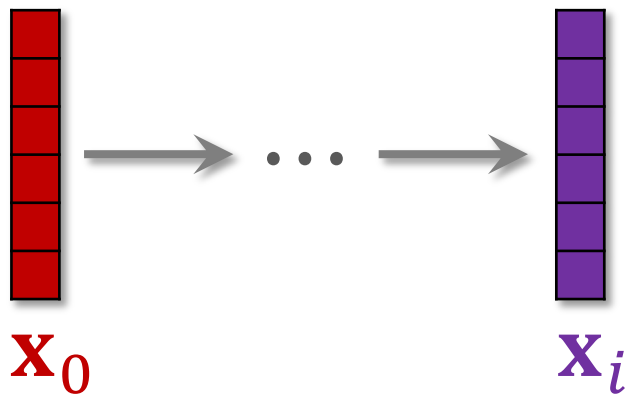




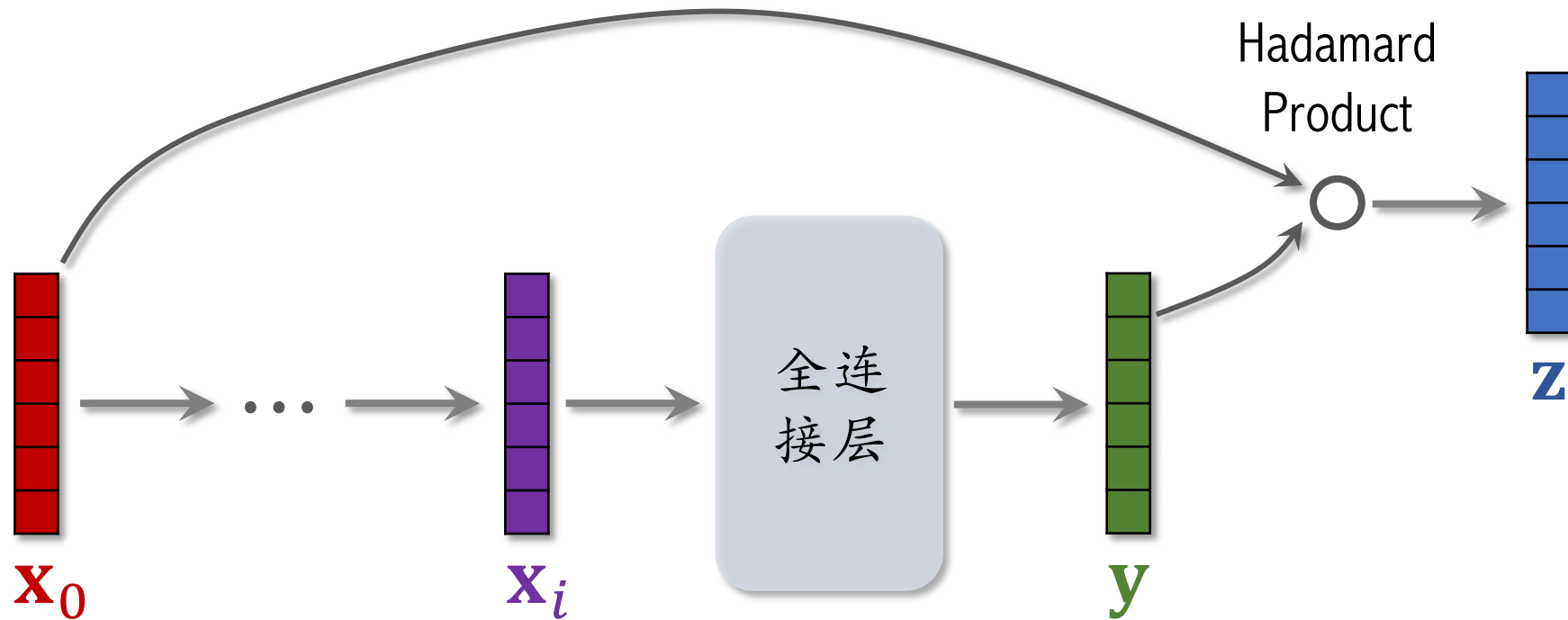
交叉层

(Cross Layer)

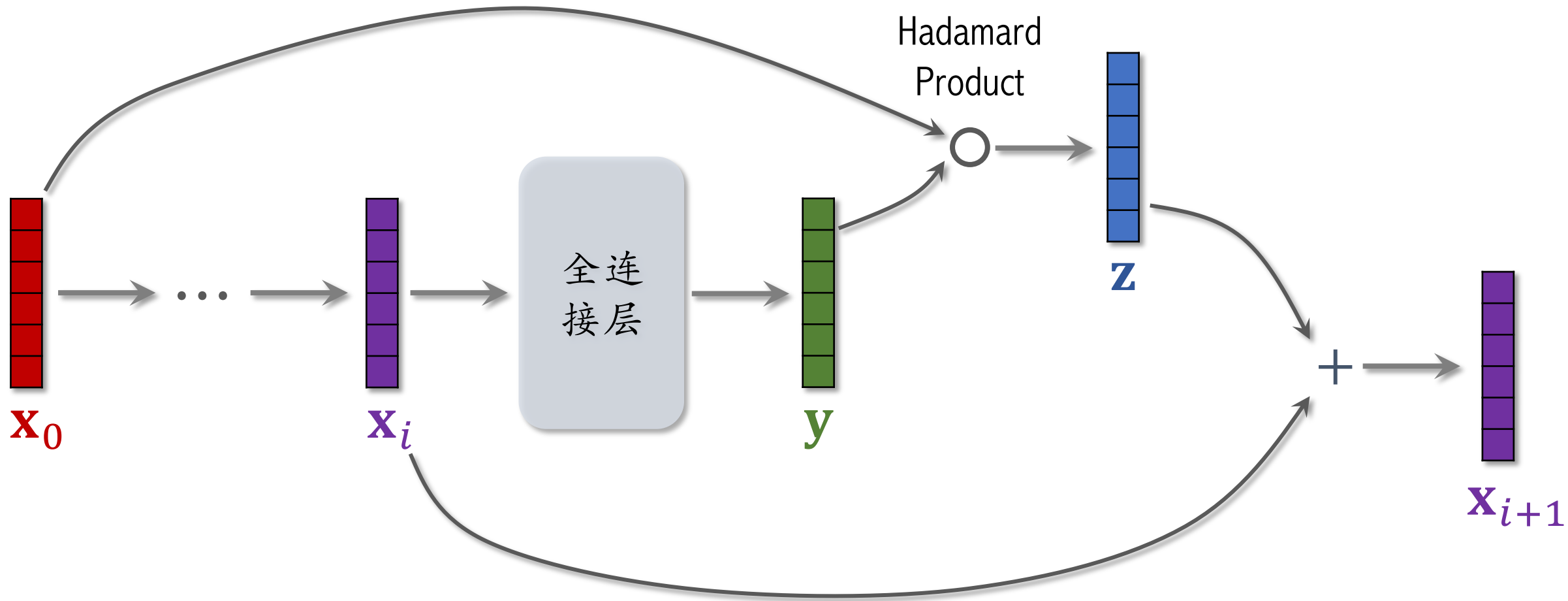
交叉层 (Cross Layer)



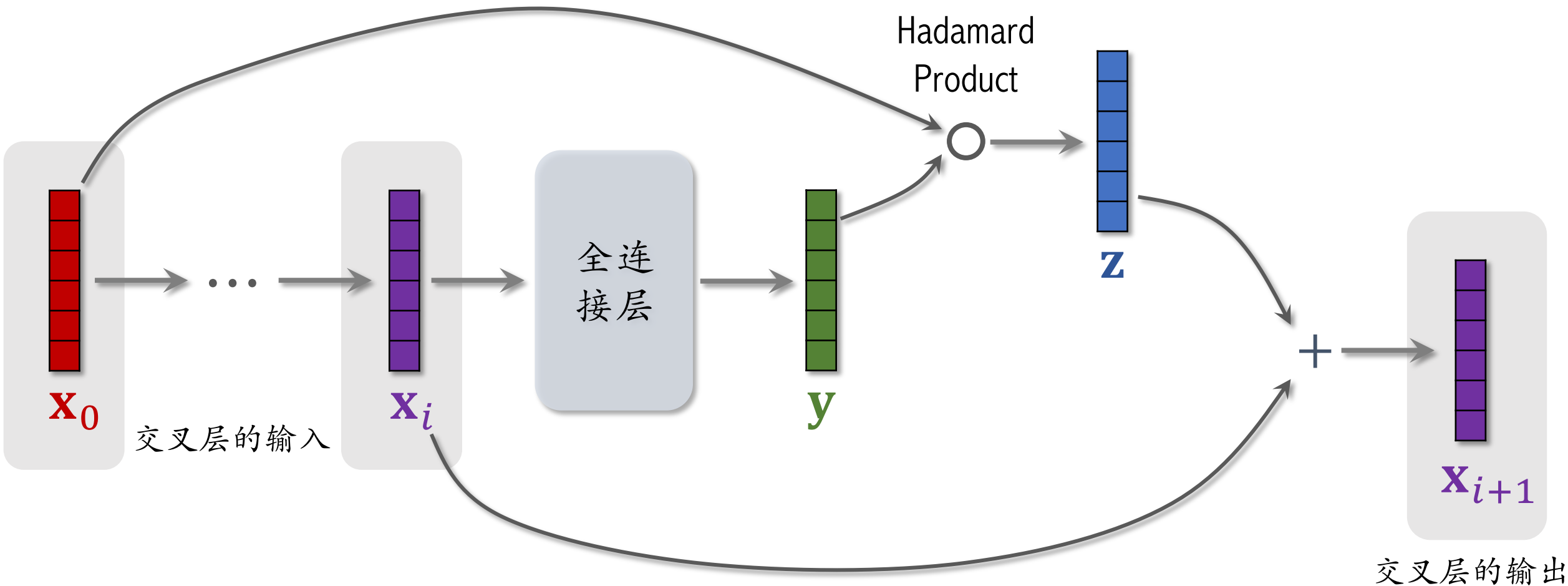
交叉层 (Cross Layer)



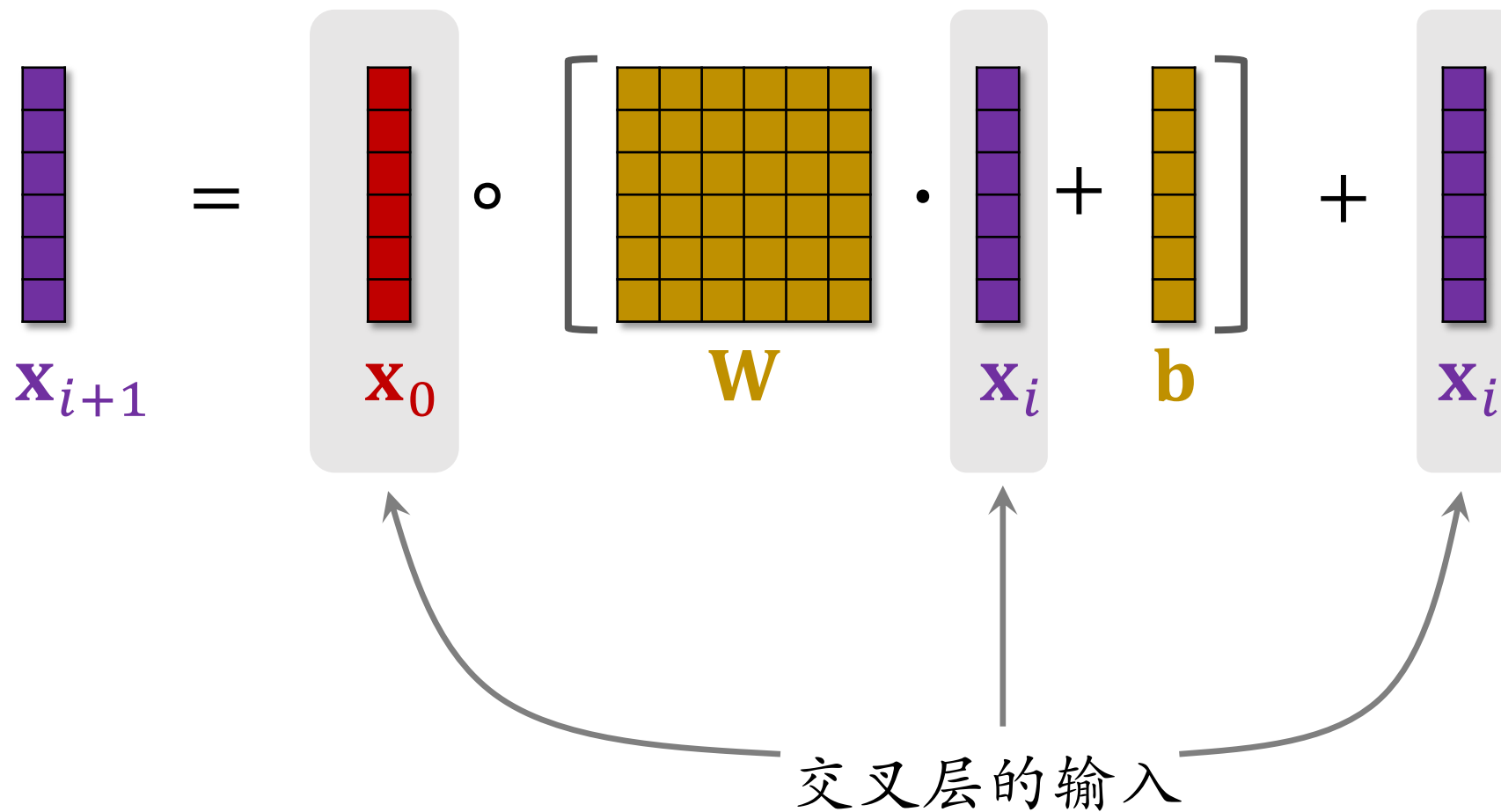
交叉层 (Cross Layer)



交叉层 (Cross Layer)



交叉层 (Cross Layer)



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. To its right is an equals sign. Further right is a red vertical vector x_0 , followed by a circle with a dot (\circ). This is followed by a large light gray rounded rectangle containing a full connection layer. Inside this rectangle, a yellow 6x6 grid labeled W is multiplied (indicated by a dot \cdot) by a purple vertical vector x_i . This result is then added (indicated by a plus sign $+$) to a yellow vertical vector b . The entire expression inside the rectangle is enclosed in large square brackets. To the right of the brackets is a plus sign $+$, followed by another purple vertical vector x_i .

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

全连接层

交叉层 (Cross Layer)

The diagram illustrates the operation of a Cross Layer. It shows the following components and their relationships:

- \mathbf{x}_{i+1} : A purple vertical vector representing the output.
- \mathbf{x}_0 : A red vertical vector representing the input to the Hadamard product.
- W : A yellow grid representing a weight matrix.
- \mathbf{x}_i : A purple vertical vector representing the input to the linear transformation.
- \mathbf{b} : A yellow vertical vector representing a bias.

The operation is defined by the equation:

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

The Hadamard product is indicated by the \circ symbol, and the linear transformation is indicated by the \cdot and $+$ symbols within the brackets.

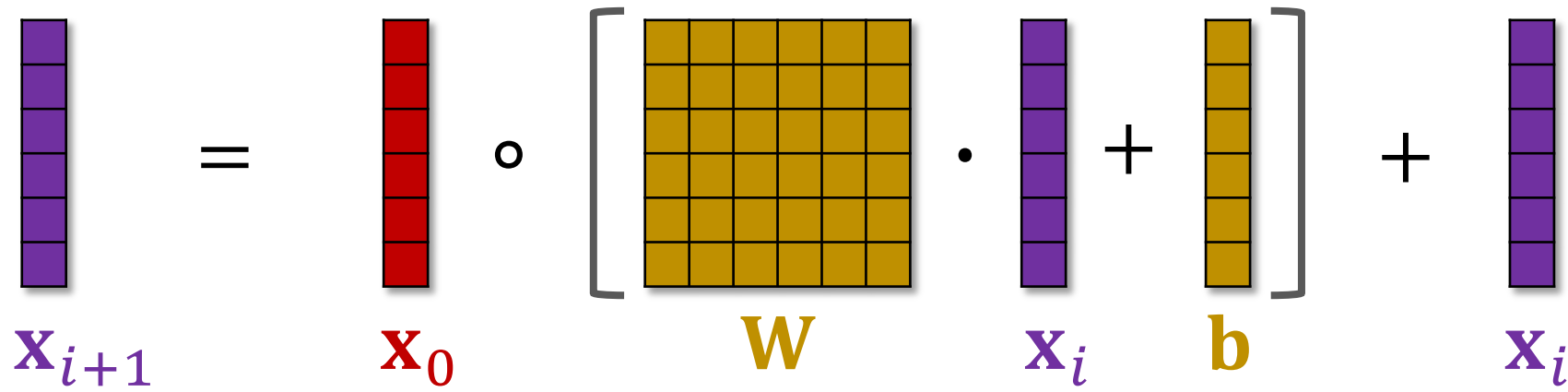
Hadamard Product

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. To its right is an equals sign. Further right is a large light gray rounded rectangle containing the following elements from left to right: a red vertical vector x_0 , a small circle \circ , a yellow grid representing a weight matrix W (6 columns by 6 rows), a dot \cdot , a purple vertical vector x_i , a plus sign $+$, and a yellow vertical vector b (6 rows). These last four elements (x_i , $+$, b , and the closing bracket of the large rectangle) are enclosed in a smaller light gray rounded rectangle. To the right of this large rectangle is a plus sign $+$, followed by a purple vertical vector x_i enclosed in a 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.

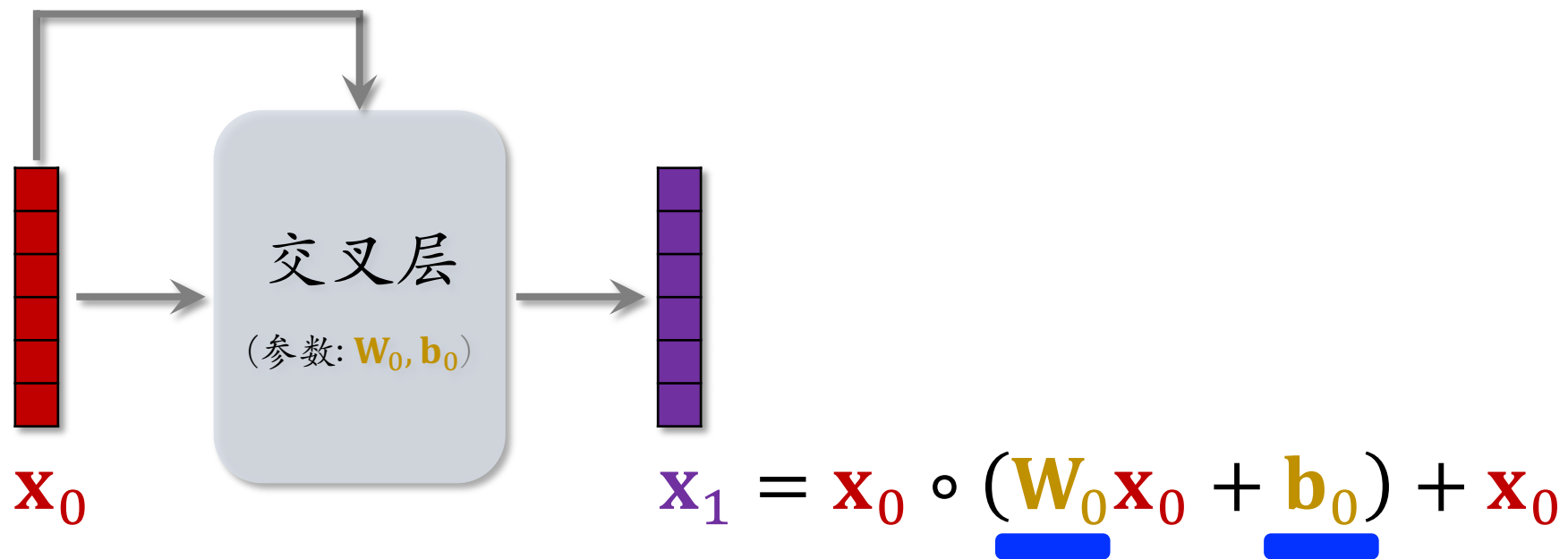
$$\mathbf{x}_{i+1} = \mathbf{x}_0 \circ \left[\mathbf{W} \cdot \mathbf{x}_i + \mathbf{b} \right] + \mathbf{x}_i$$

输出

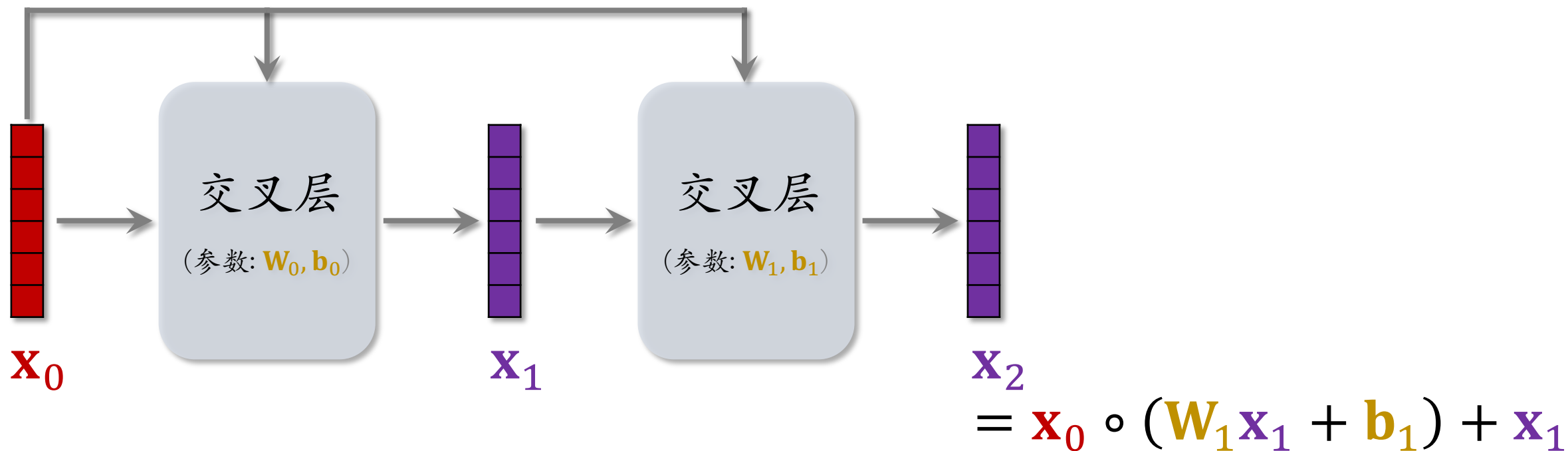
交叉网络

(Cross Network)

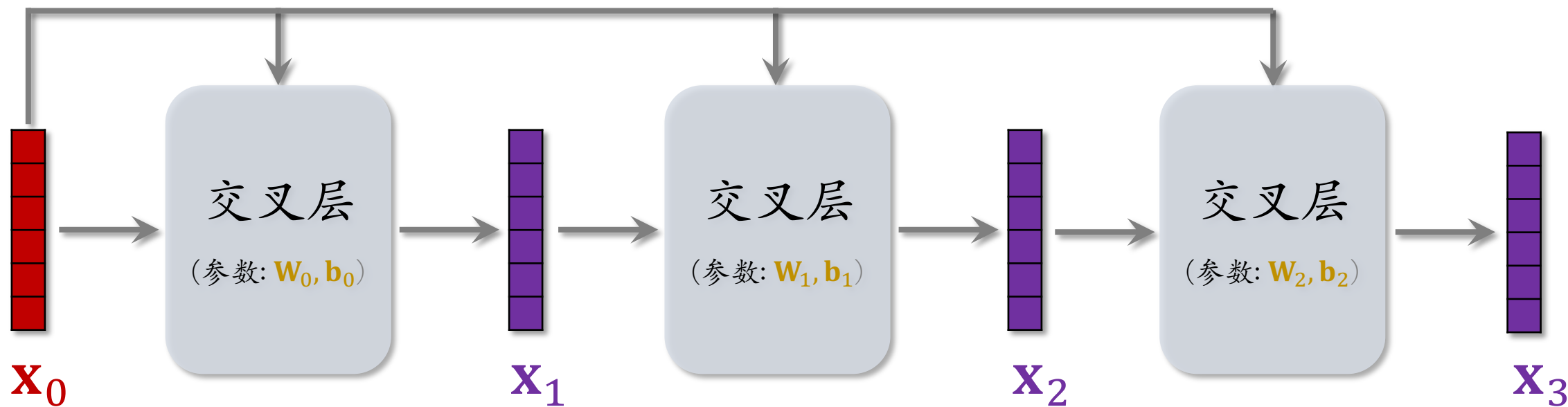
交叉网络 (Cross Network)



交叉网络 (Cross Network)





交叉网络 (Cross Network)



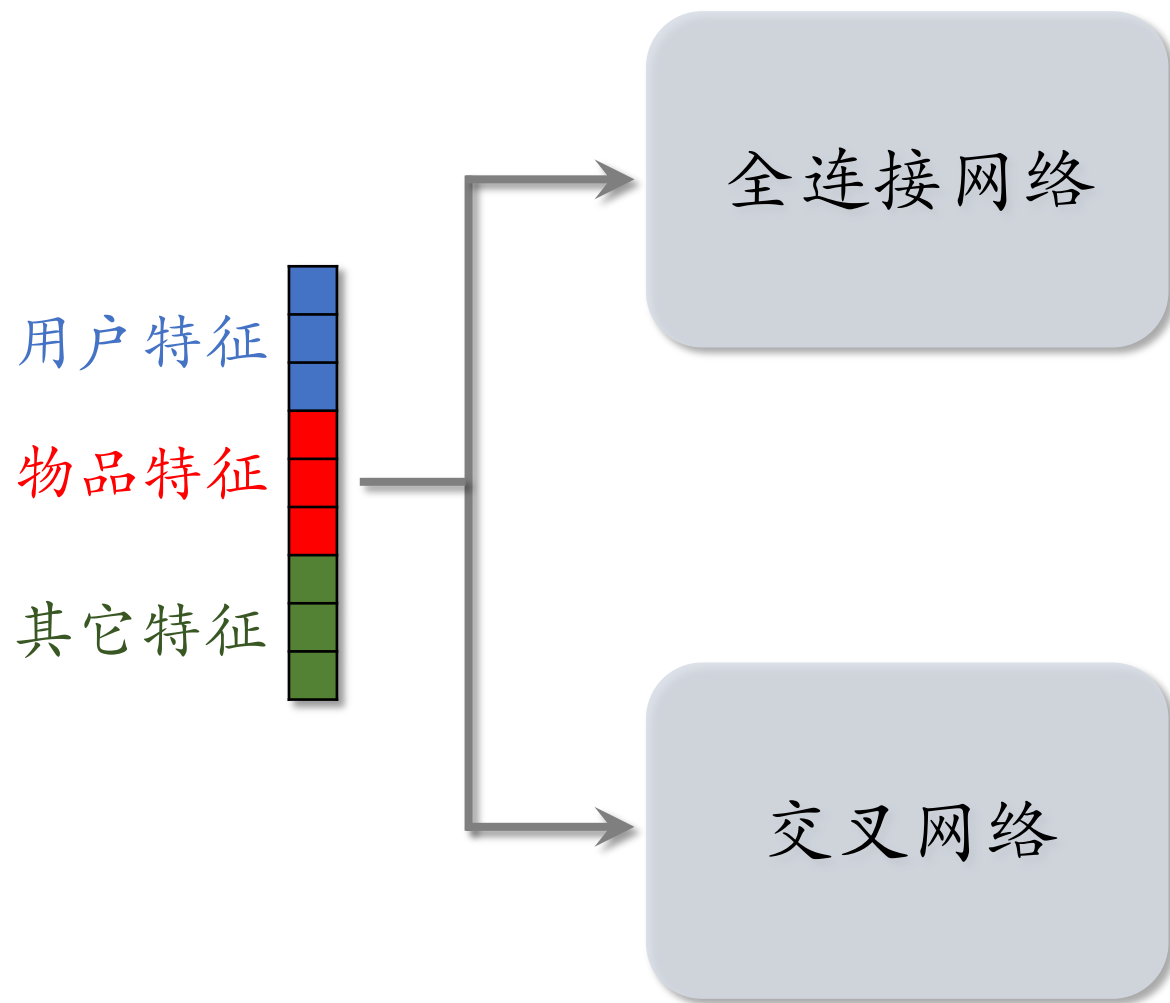
参考文献

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

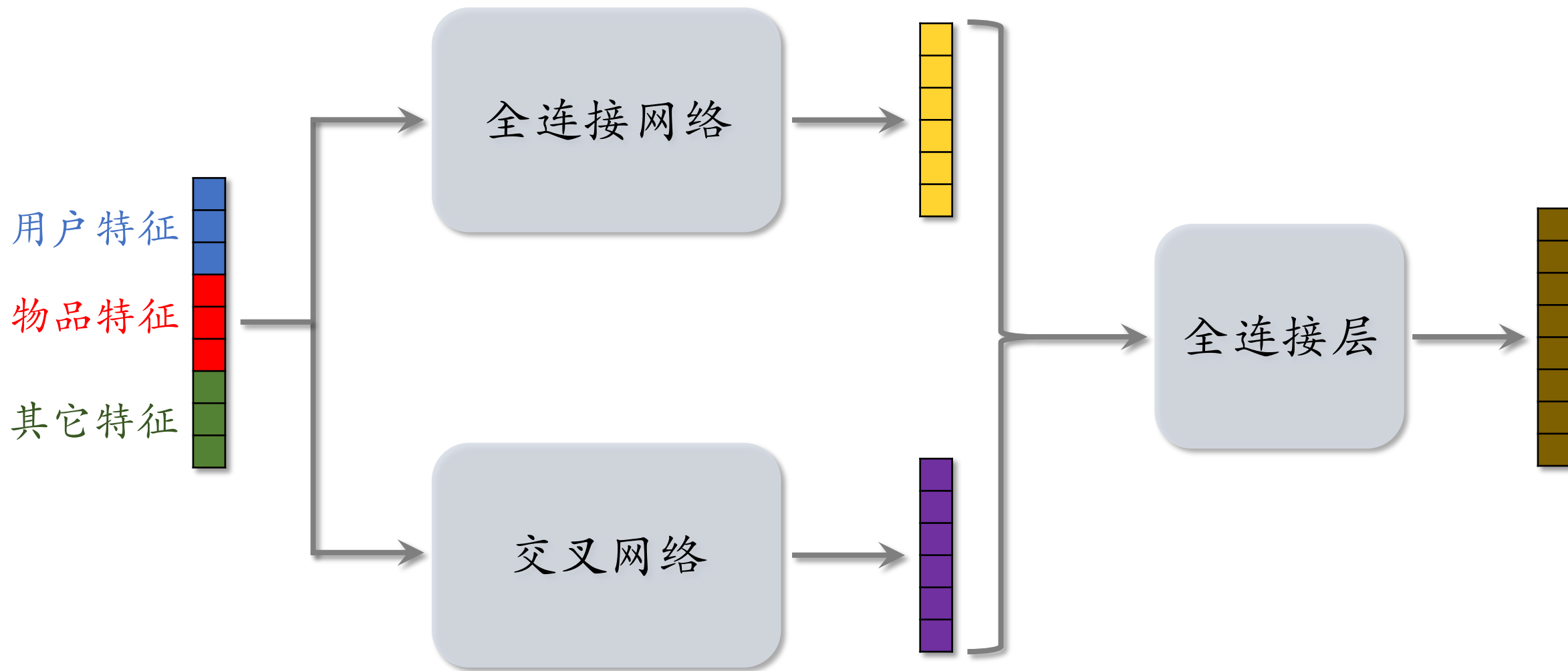
参考文献：

-  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.

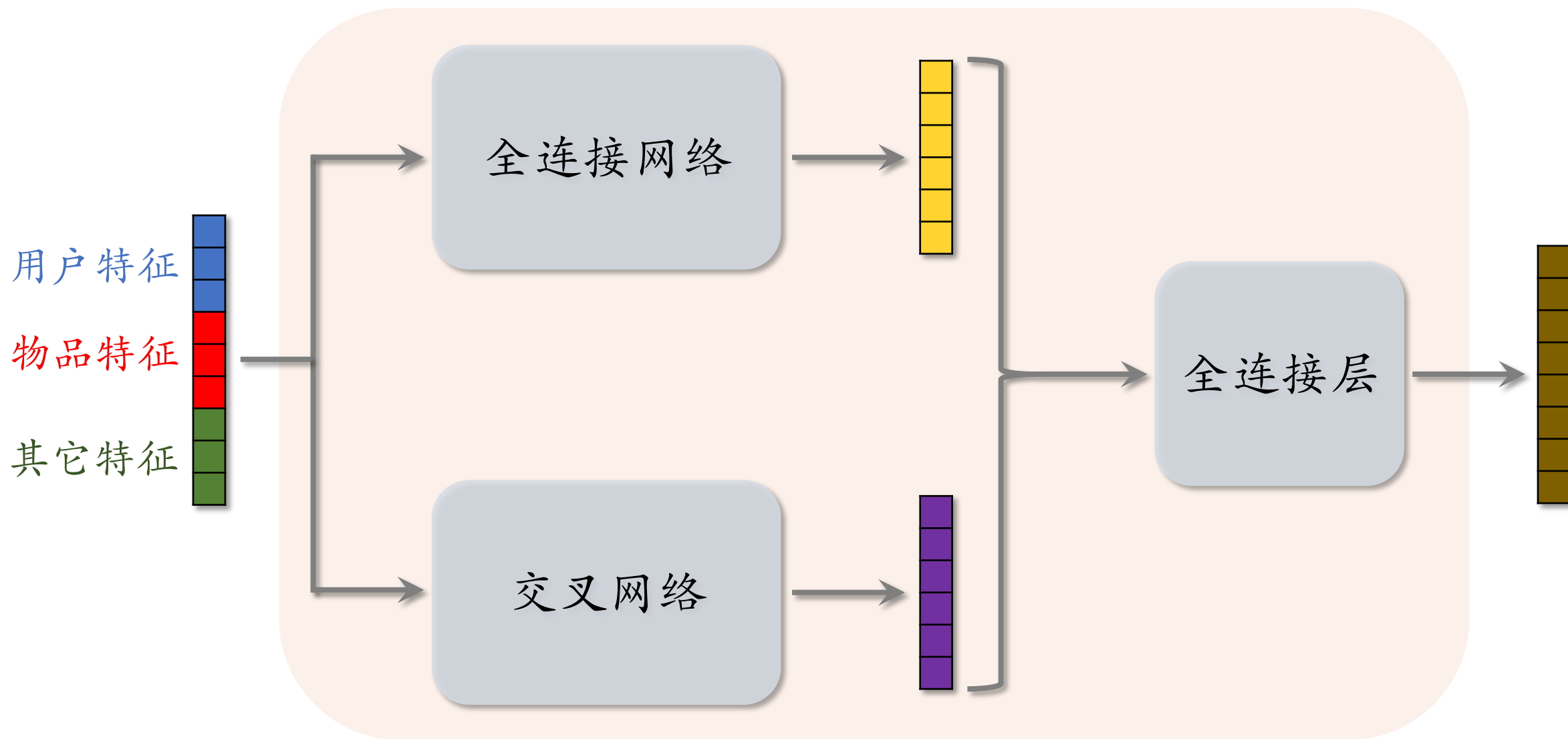
深度交叉网络 (Deep & Cross Network)



深度交叉网络 (Deep & Cross Network)



深度交叉网络 (Deep & Cross Network)



深度交叉网络

Thank You!

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