Self-Attention

自注意力机制
发表于2016年
用在了LSTM上

Shusen Wang

Self-Attention

- Self-Attention [2]: attention [1] beyond Seq2Seq models.
- The original self-attention paper uses LSTM.
- To make teaching easy, I replace LSTM by SimpleRNN.

Original paper:

1. Bahdanau, Cho, & Bengio. Neural machine translation by jointly learning to align and translate. In *ICLR*, 2015.
2. Cheng, Dong, & Lapata. Long Short-Term Memory-Networks for Machine Reading. In *EMNLP*, 2016.

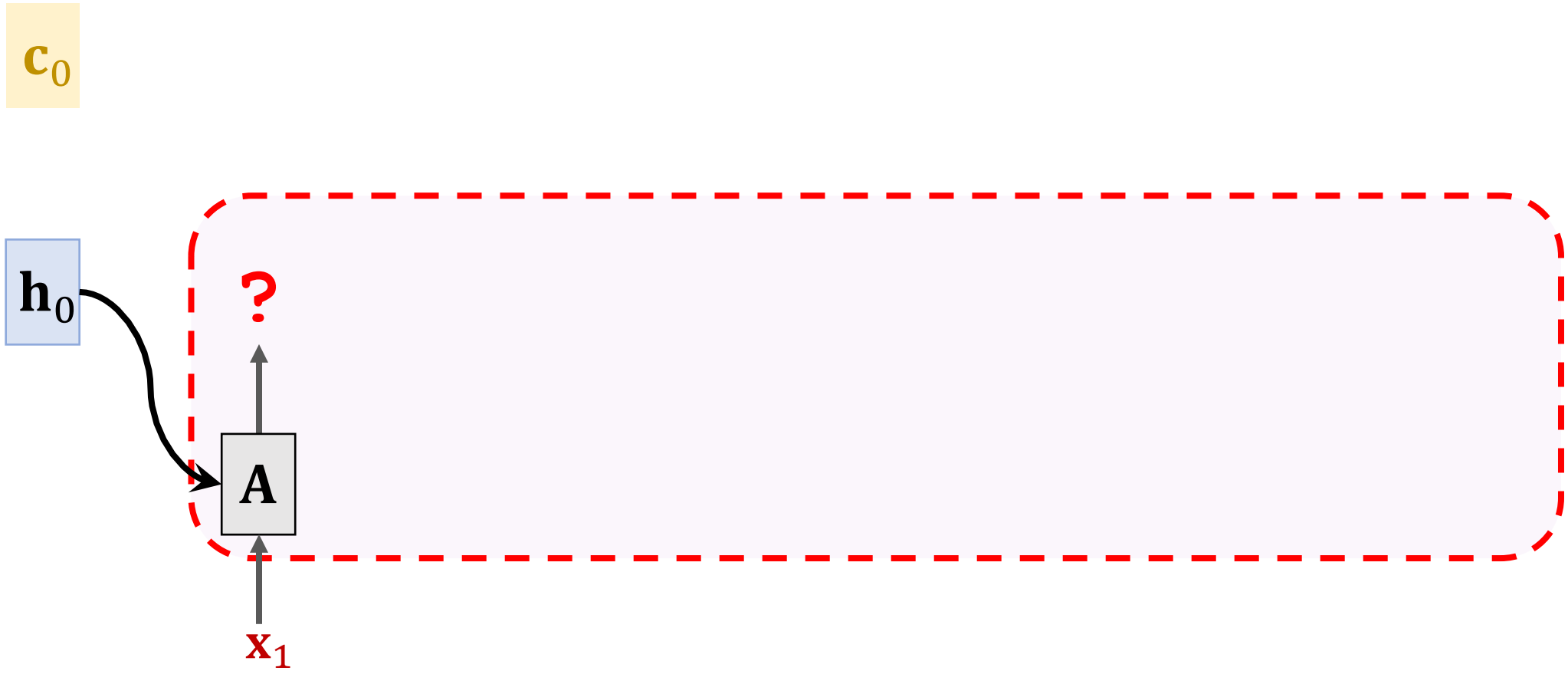
SimpleRNN + Self-Attention

初始条件

$\mathbf{c}_0 = \mathbf{0}$

$\mathbf{h}_0 = \mathbf{0}$

SimpleRNN + Self-Attention



SimpleRNN + Self-Attention

SimpleRNN:

$$\mathbf{h}_1 = \tanh\left(\mathbf{A} \cdot \begin{bmatrix} \mathbf{x}_1 \\ \mathbf{h}_0 \end{bmatrix} + \mathbf{b}\right)$$

$\mathbf{c}_0$

SimpleRNN + Self-Attention

SimpleRNN:

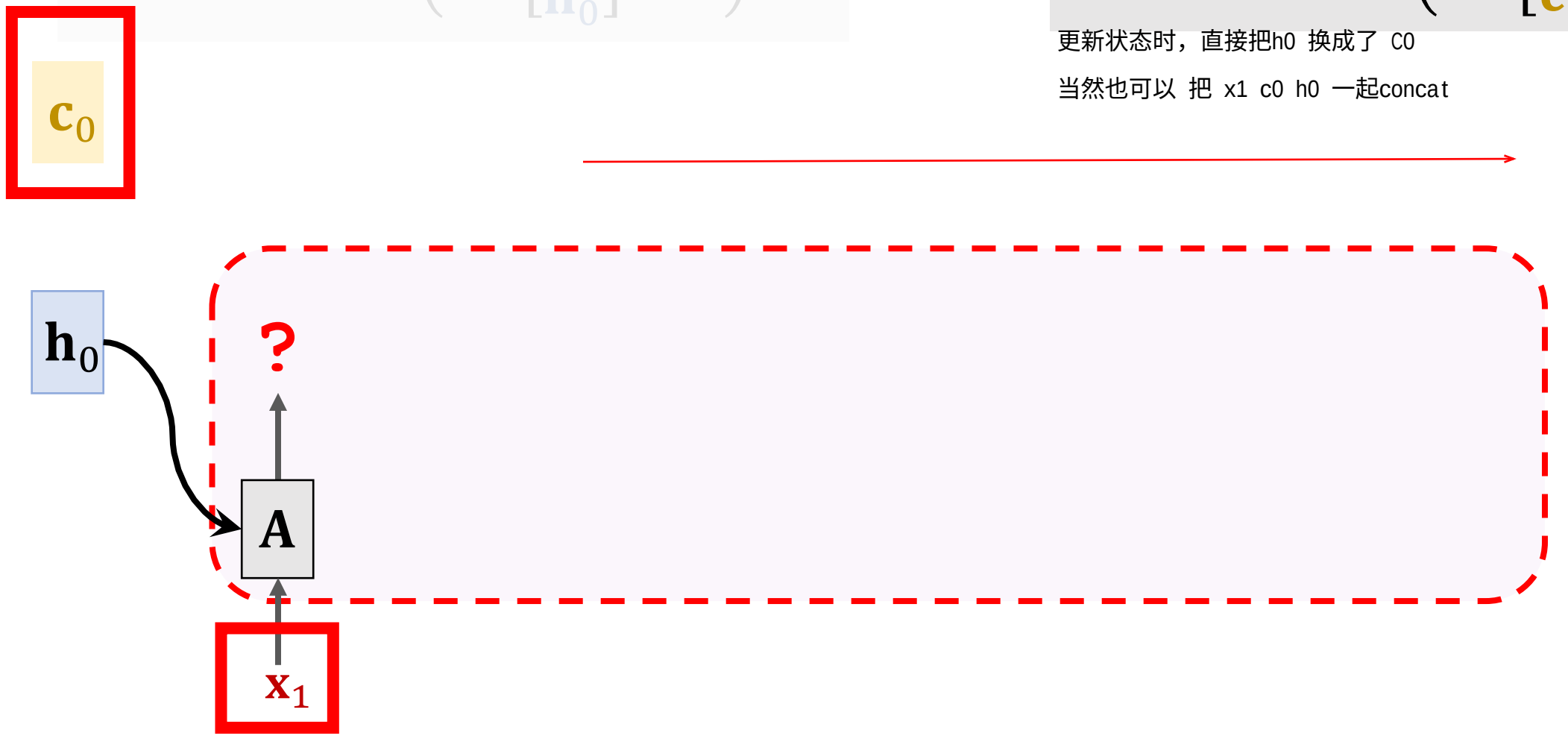
$$\mathbf{h}_1 = \tanh\left(\mathbf{A} \cdot \begin{bmatrix} \mathbf{x}_1 \\ \mathbf{h}_0 \end{bmatrix} + \mathbf{b}\right)$$

SimpleRNN + Self-Attention:

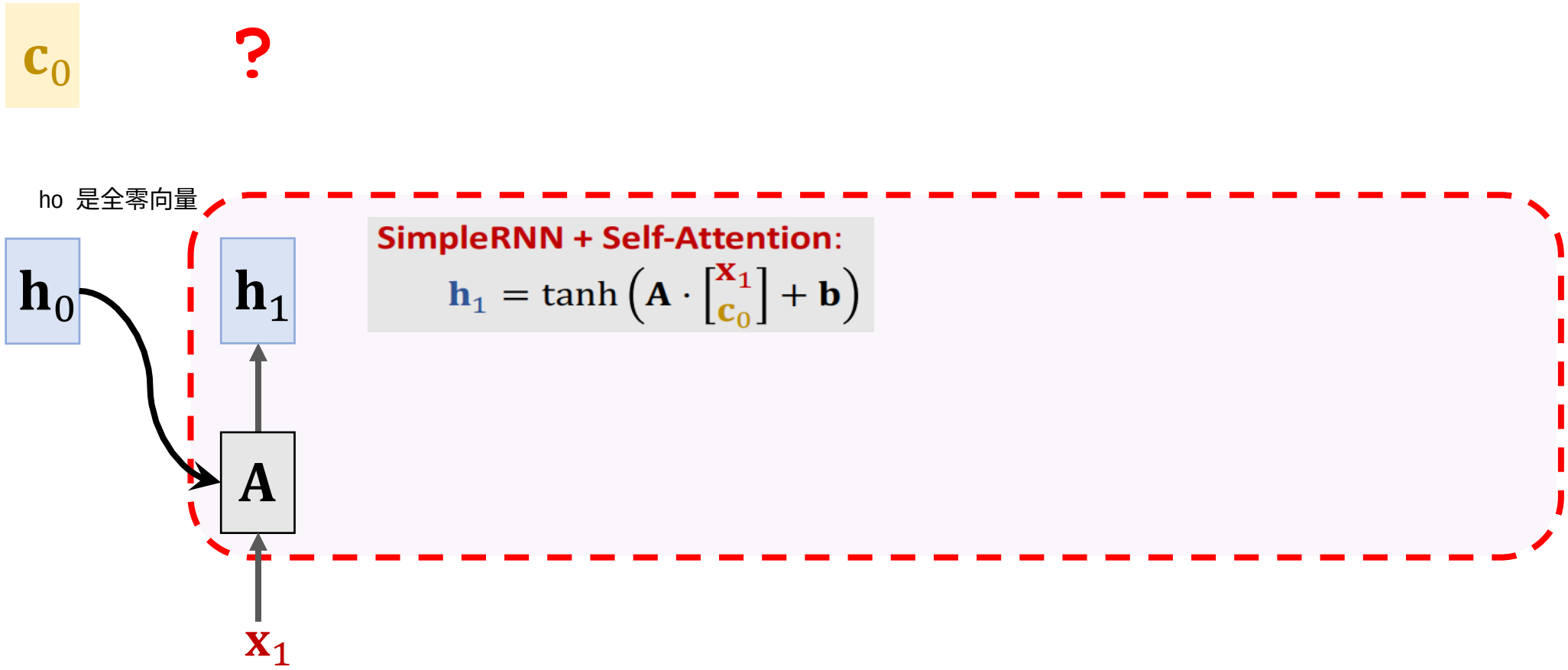
$$\mathbf{h}_1 = \tanh\left(\mathbf{A} \cdot \begin{bmatrix} \mathbf{x}_1 \\ \mathbf{c}_0 \end{bmatrix} + \mathbf{b}\right)$$

更新状态时，直接把h0 换成了 C0

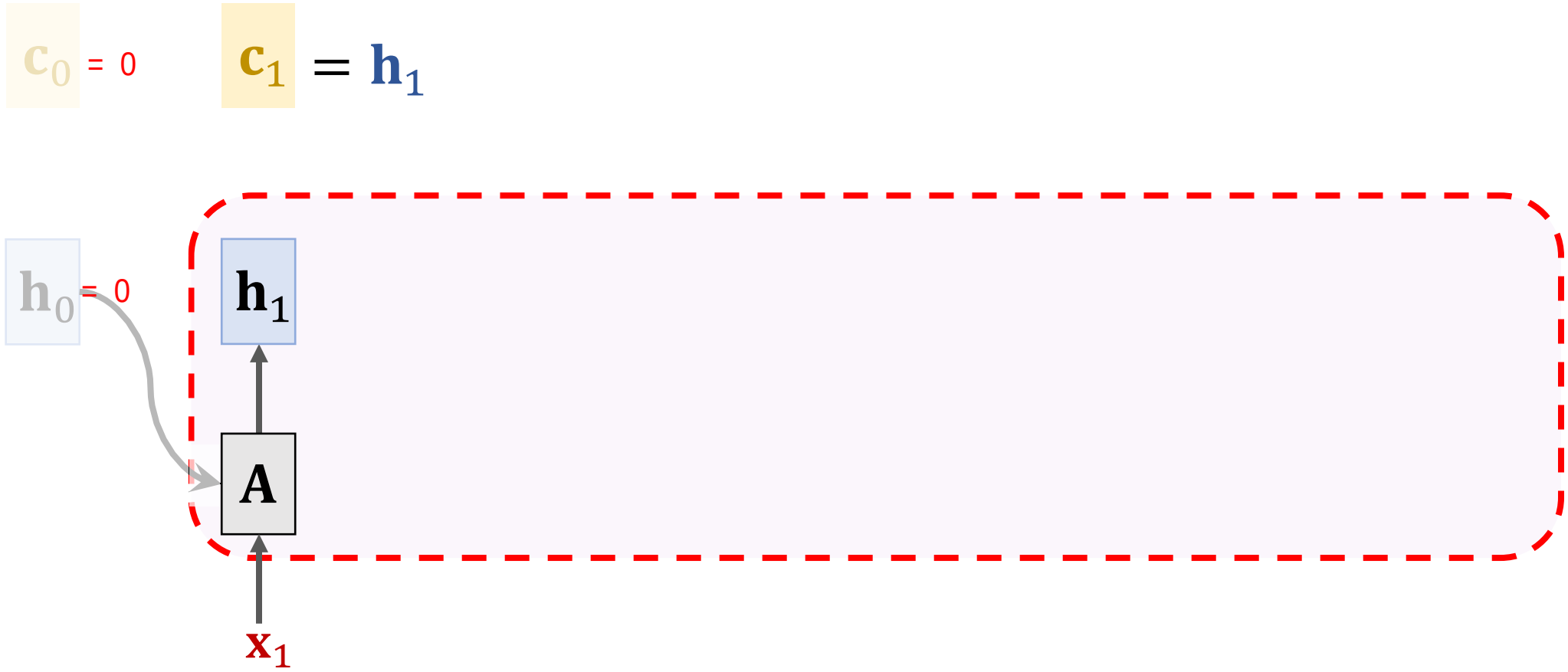
当然也可以 把 x1 c0 h0 一起concat



SimpleRNN + Self-Attention



SimpleRNN + Self-Attention



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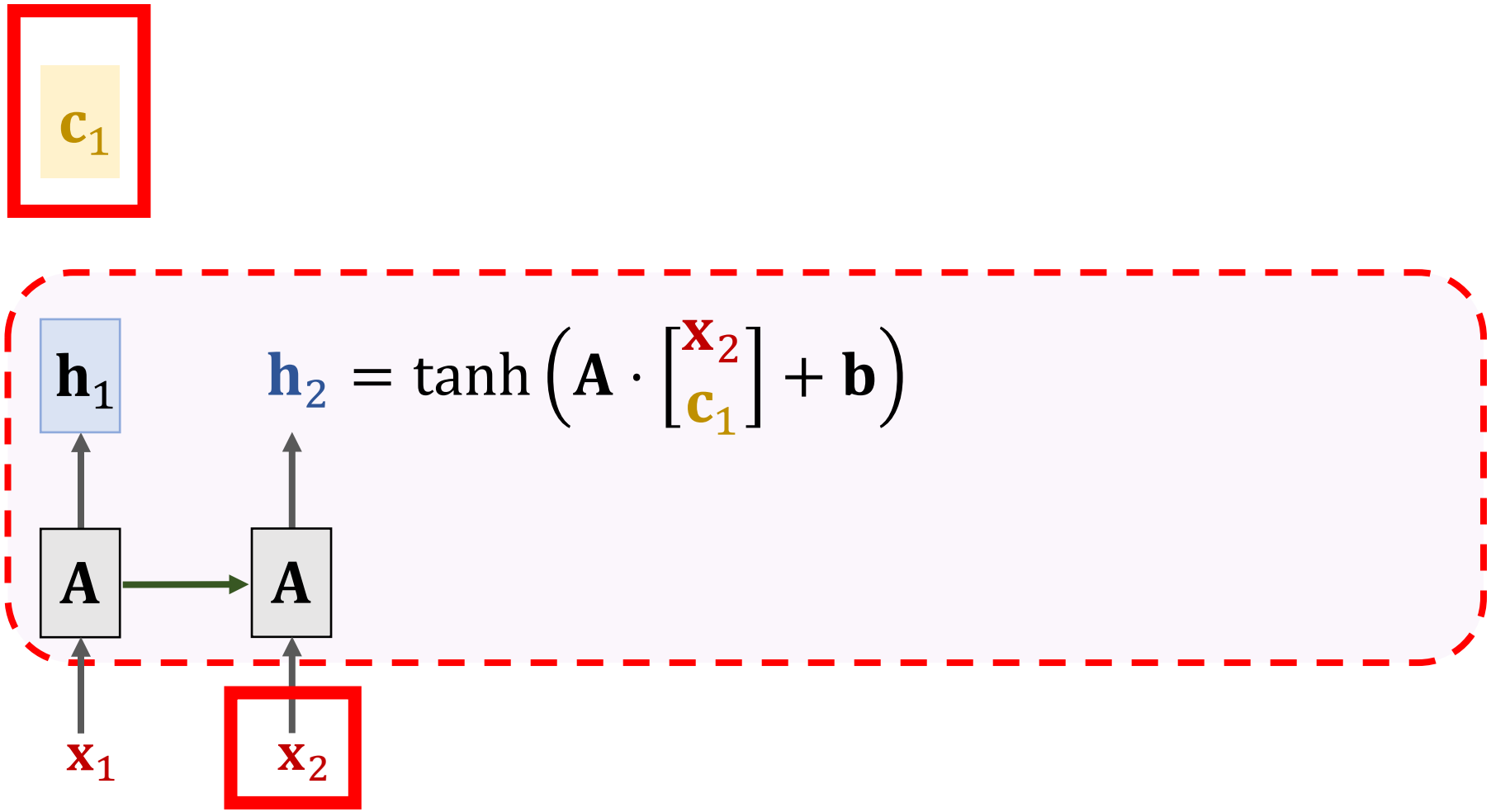


SimpleRNN + Self-Attention

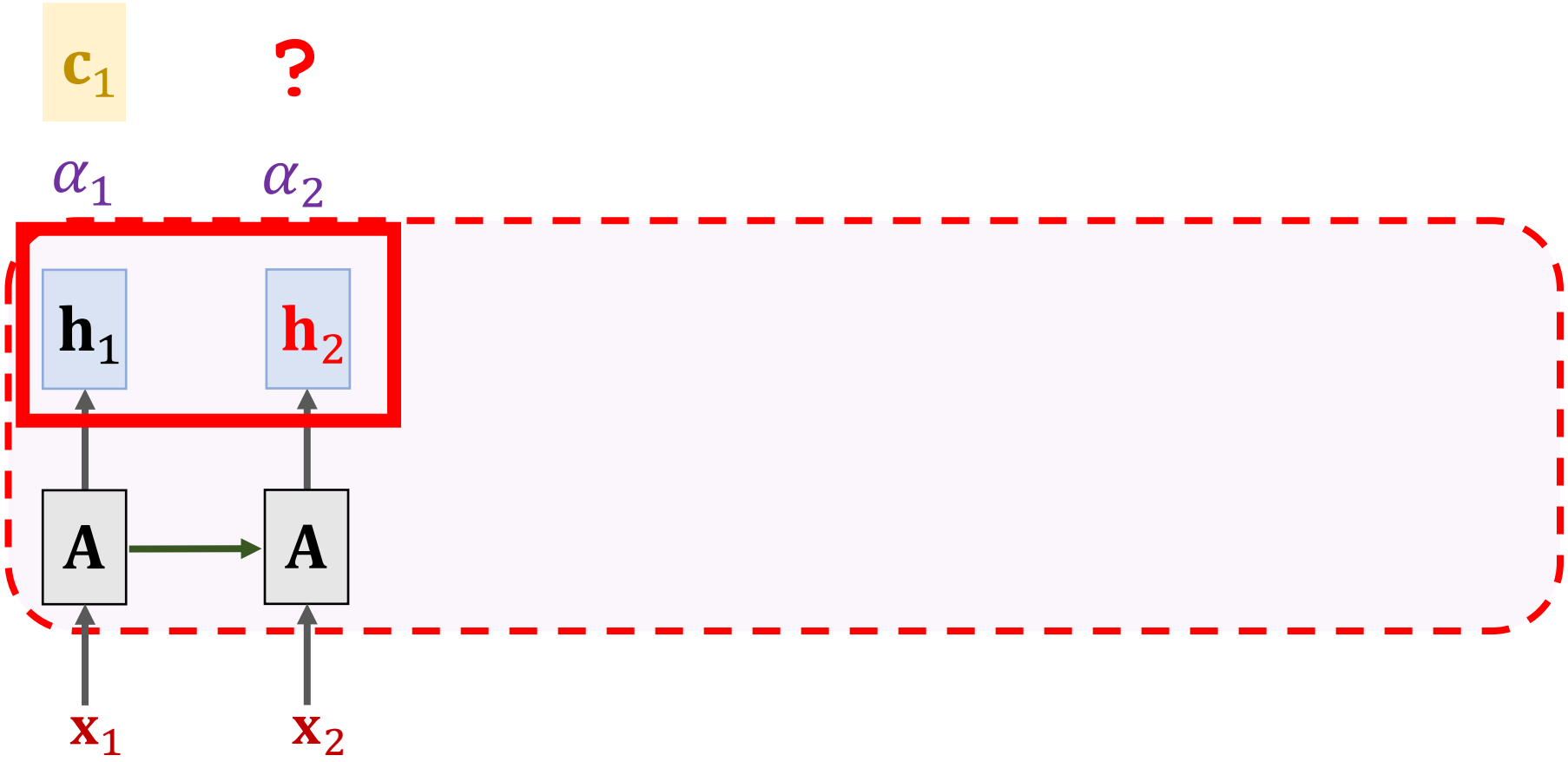
SimpleRNN + Self-Attention

Weights: $\alpha_i = \text{align}(\mathbf{h}_i, \mathbf{h}_2)$.

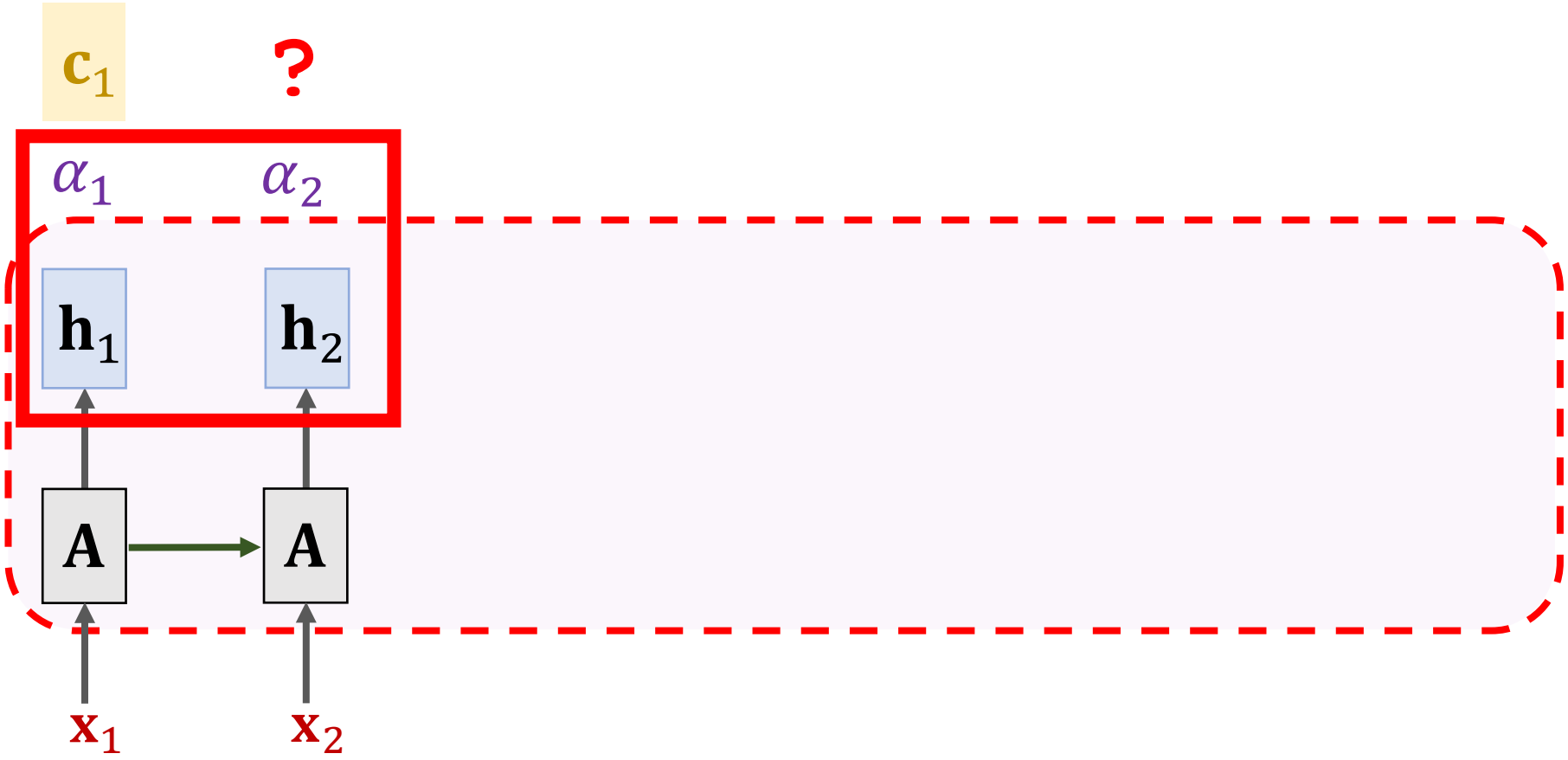
参照第9_8中的内容

计算出结果

这里可以看到 ：
注意力机制是添加在编码器上的
align 中标红的 h 是和相同的状态进行比较



SimpleRNN + Self-Attention



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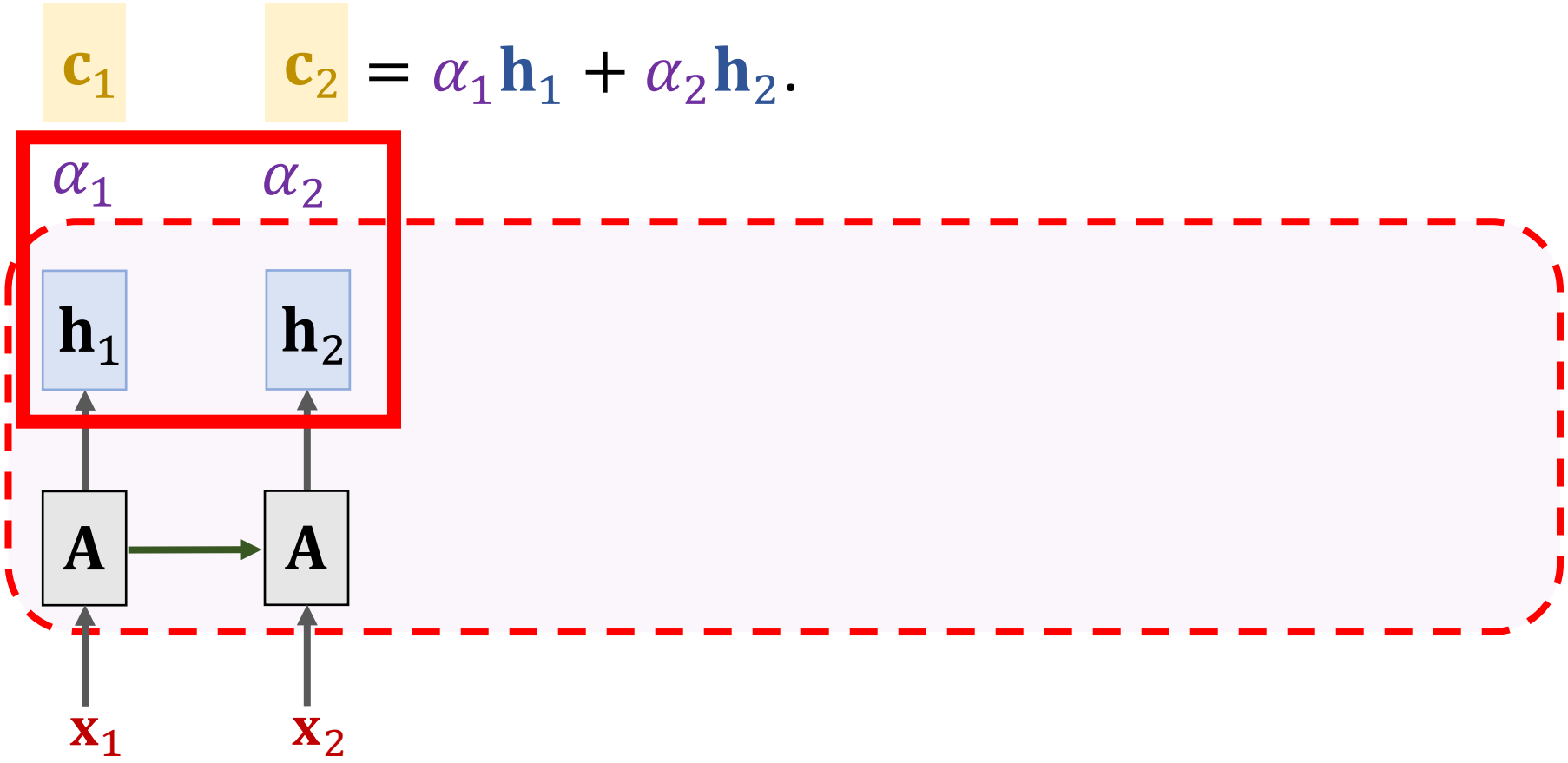

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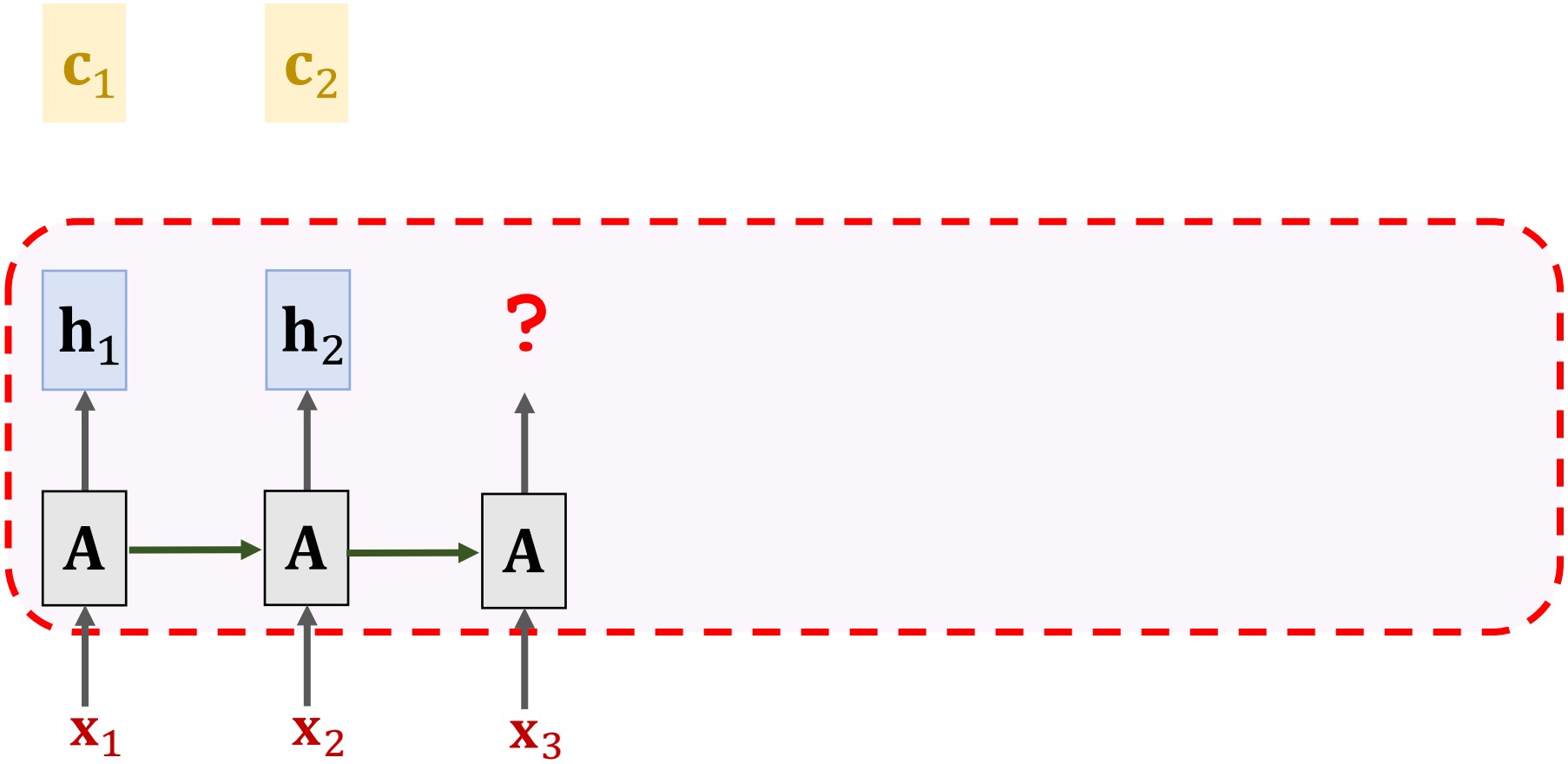

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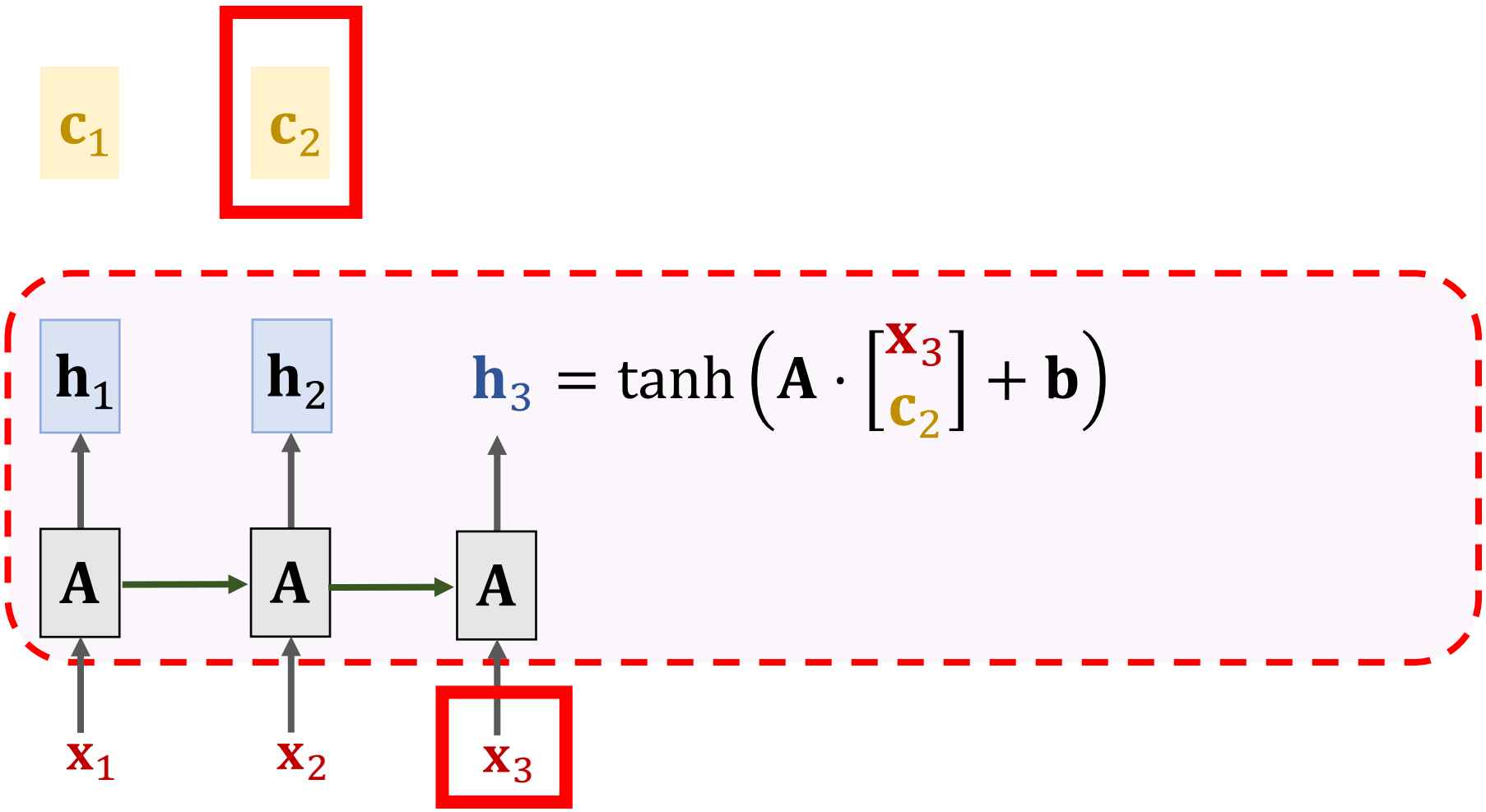
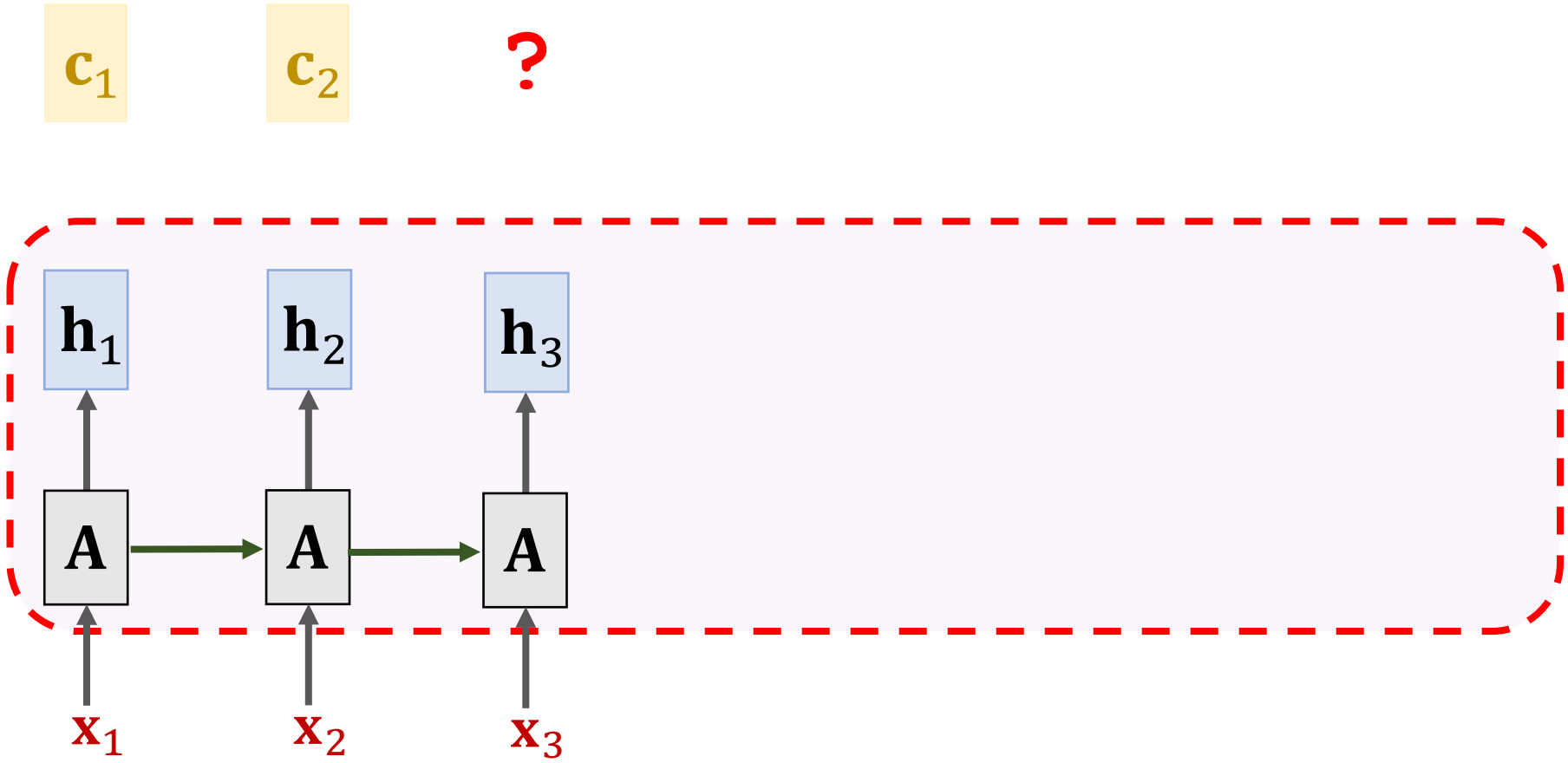
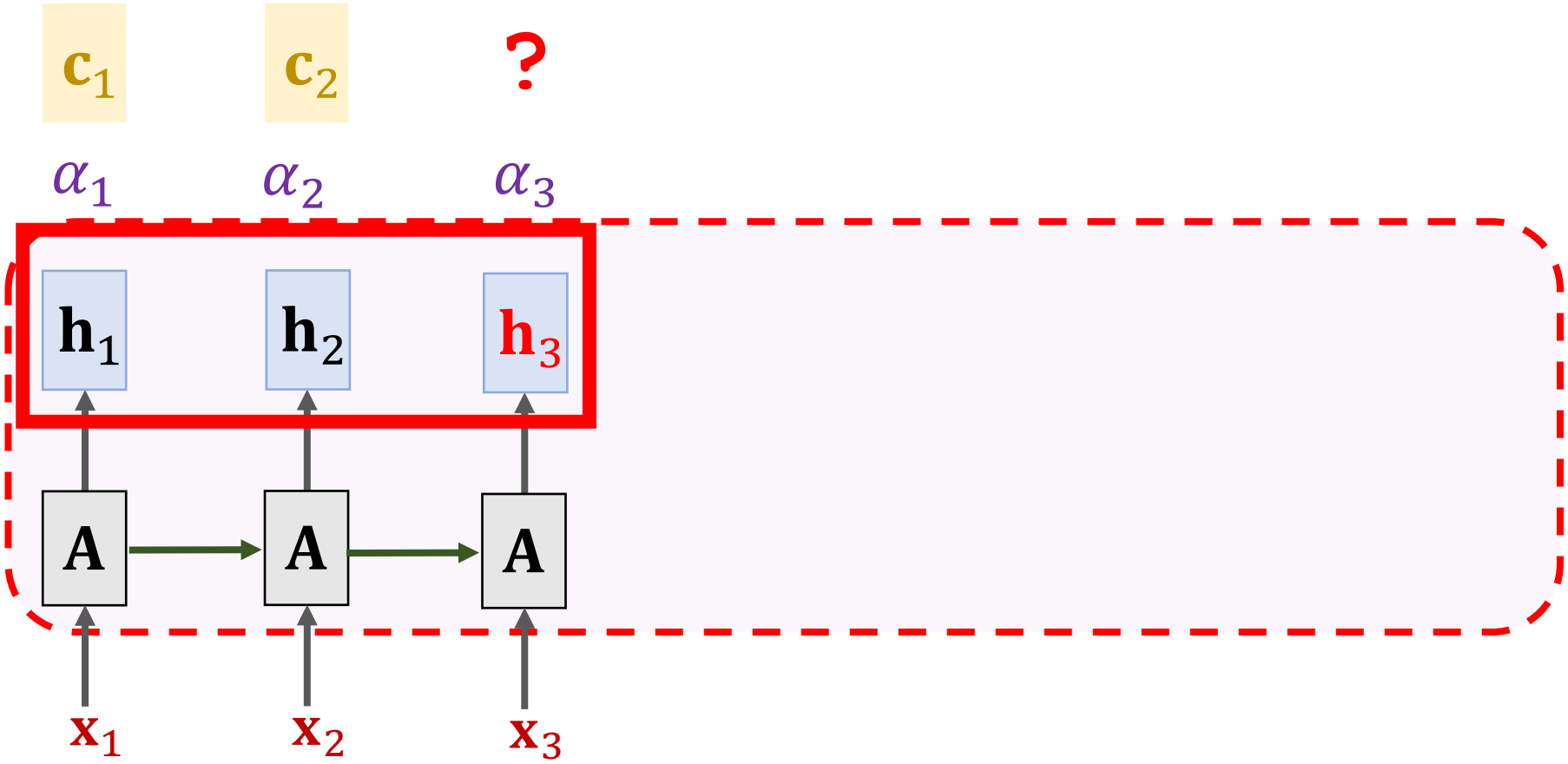


SimpleRNN + Self-Attention

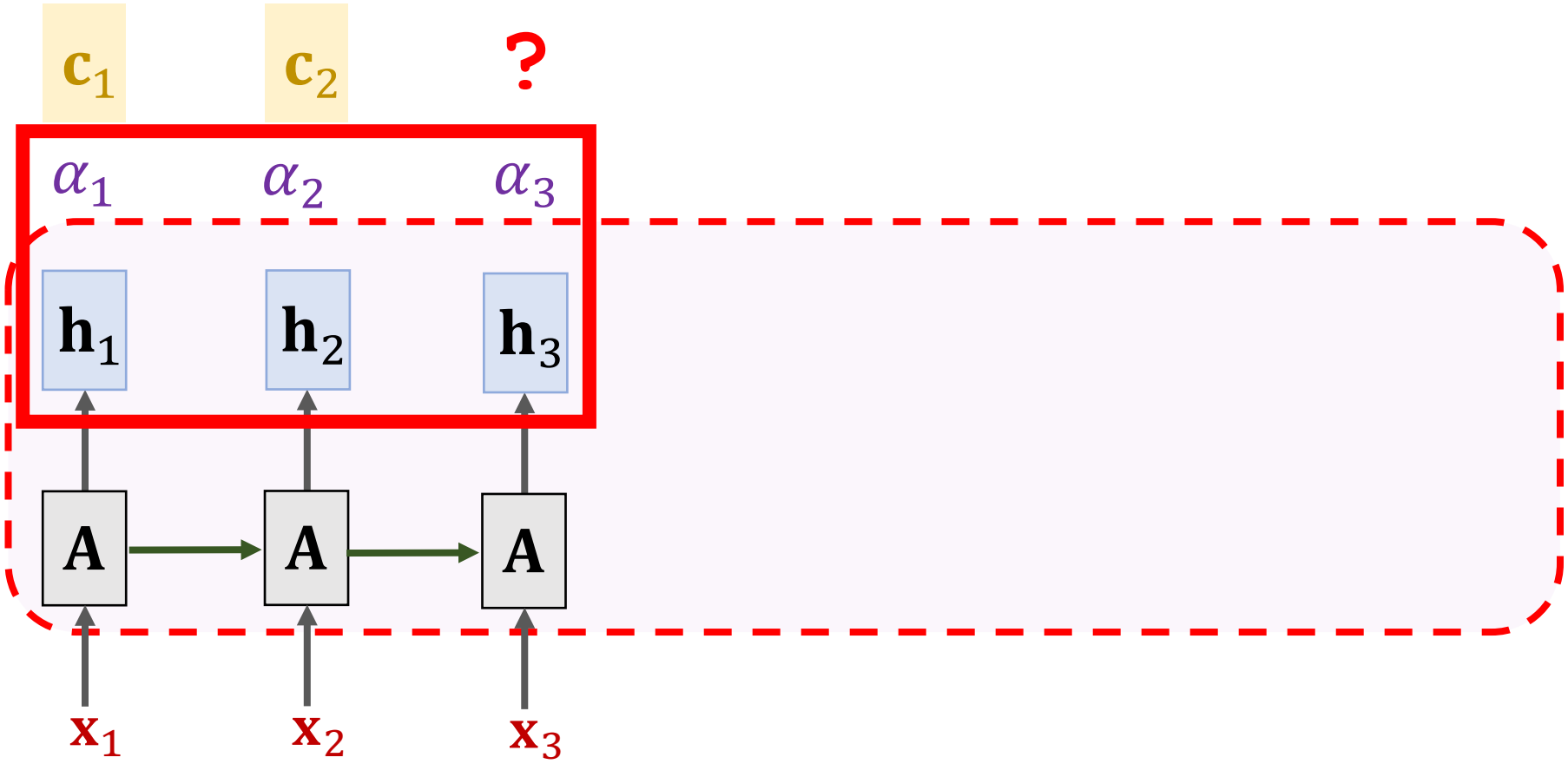


SimpleRNN + Self-Attention

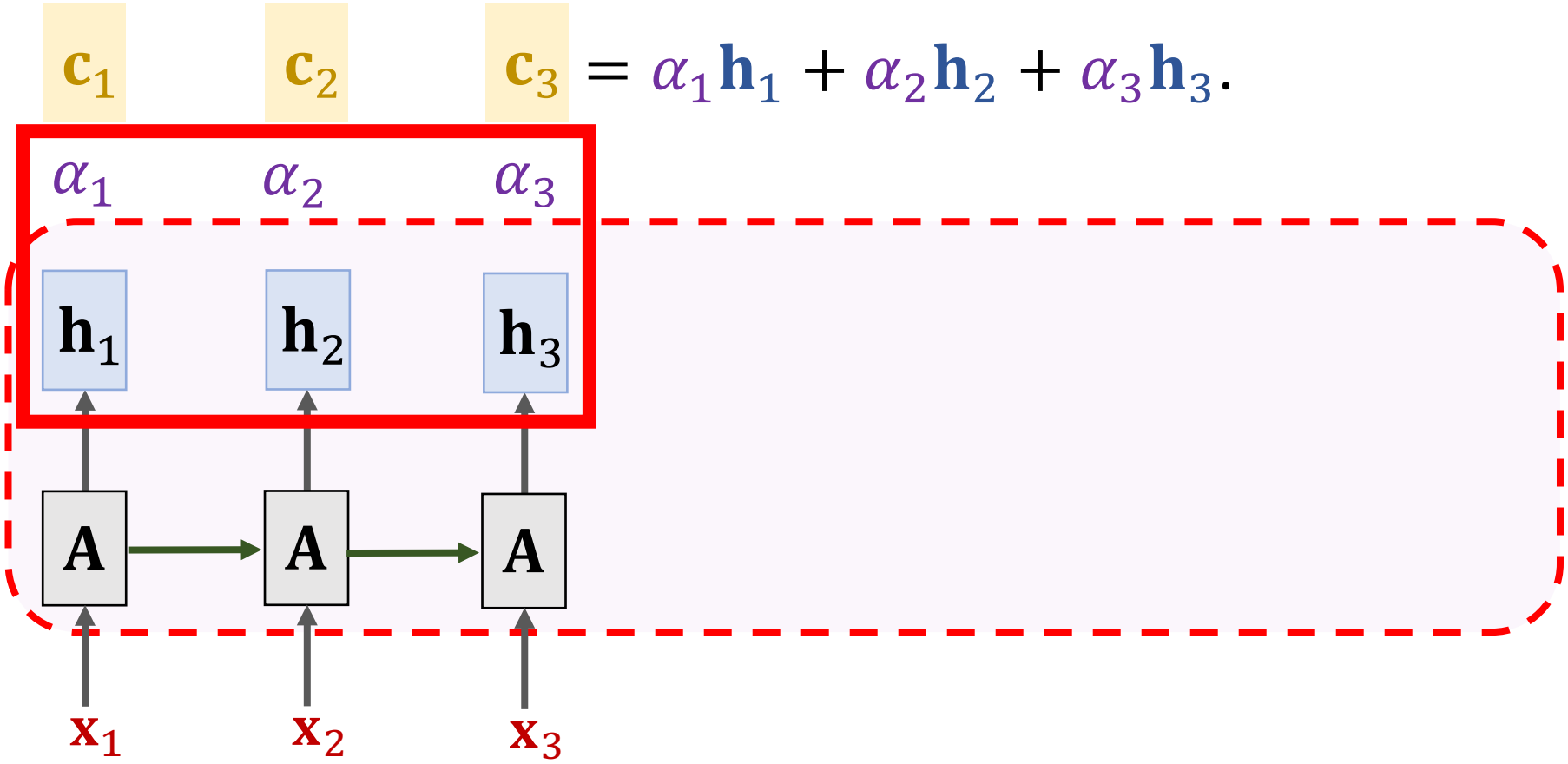
Weights: $\alpha_i = \text{align}(\mathbf{h}_i, \mathbf{h}_3)$.



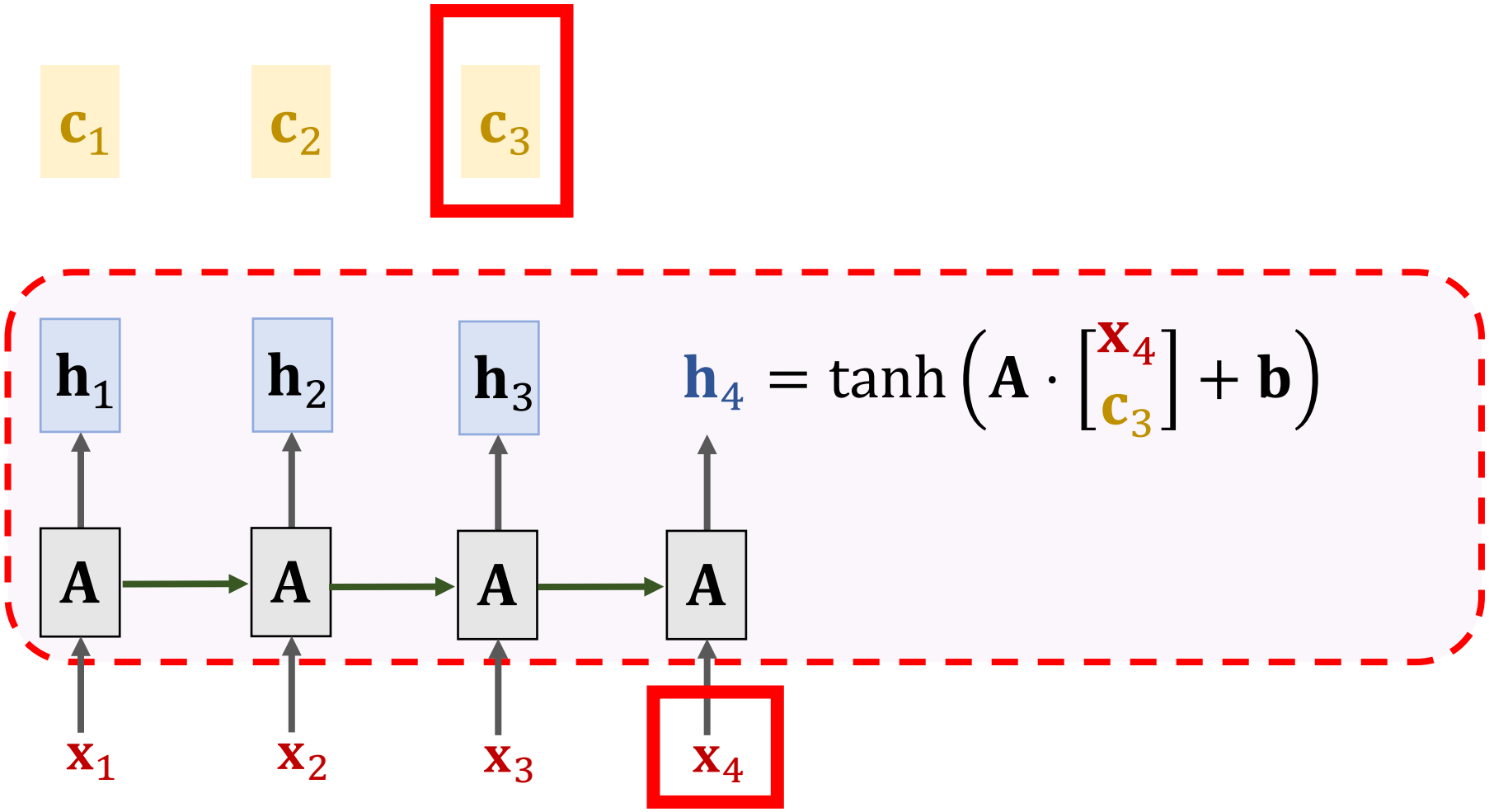
SimpleRNN + Self-Attention



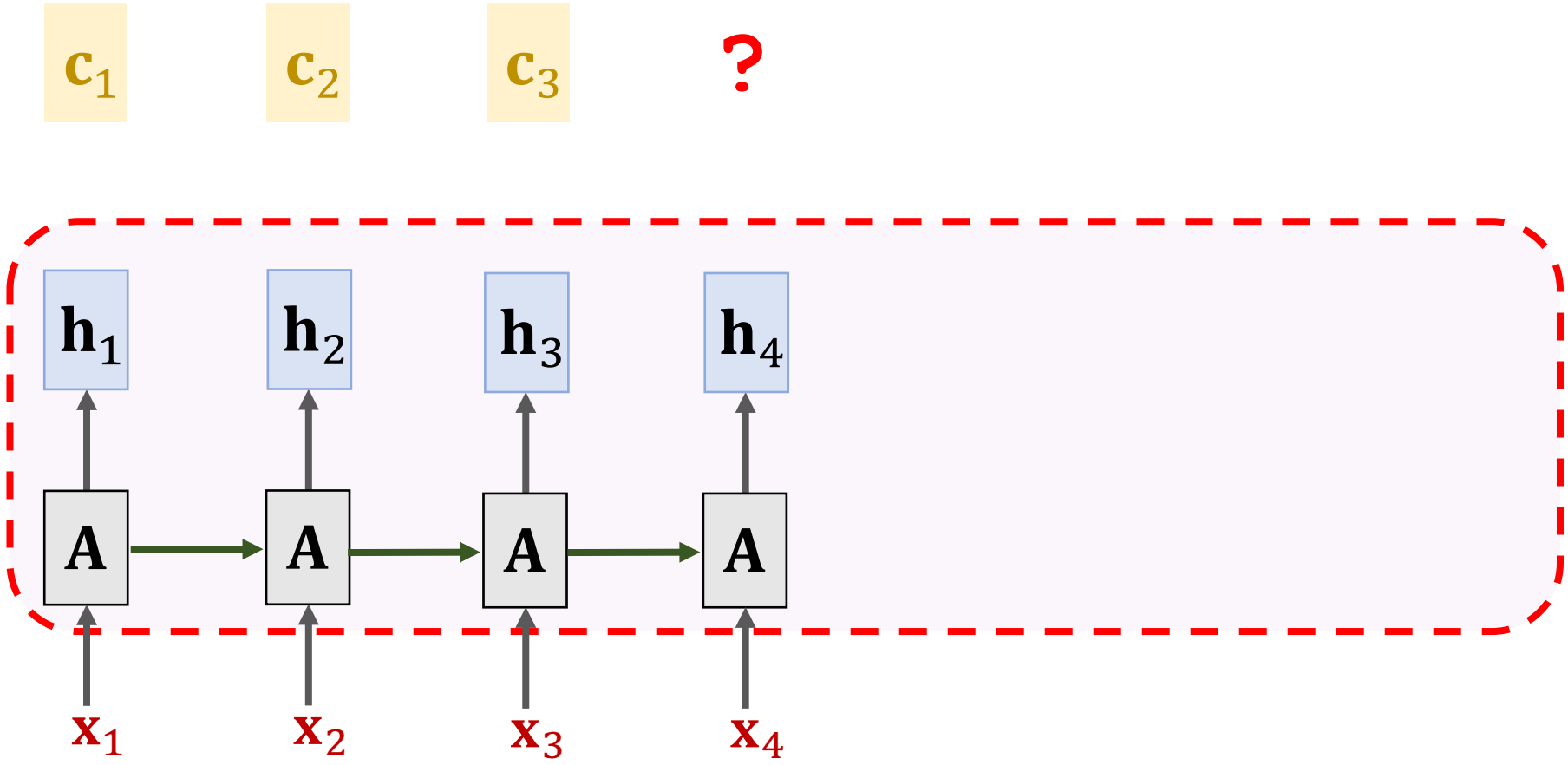
SimpleRNN + Self-Attention



SimpleRNN + Self-Attention



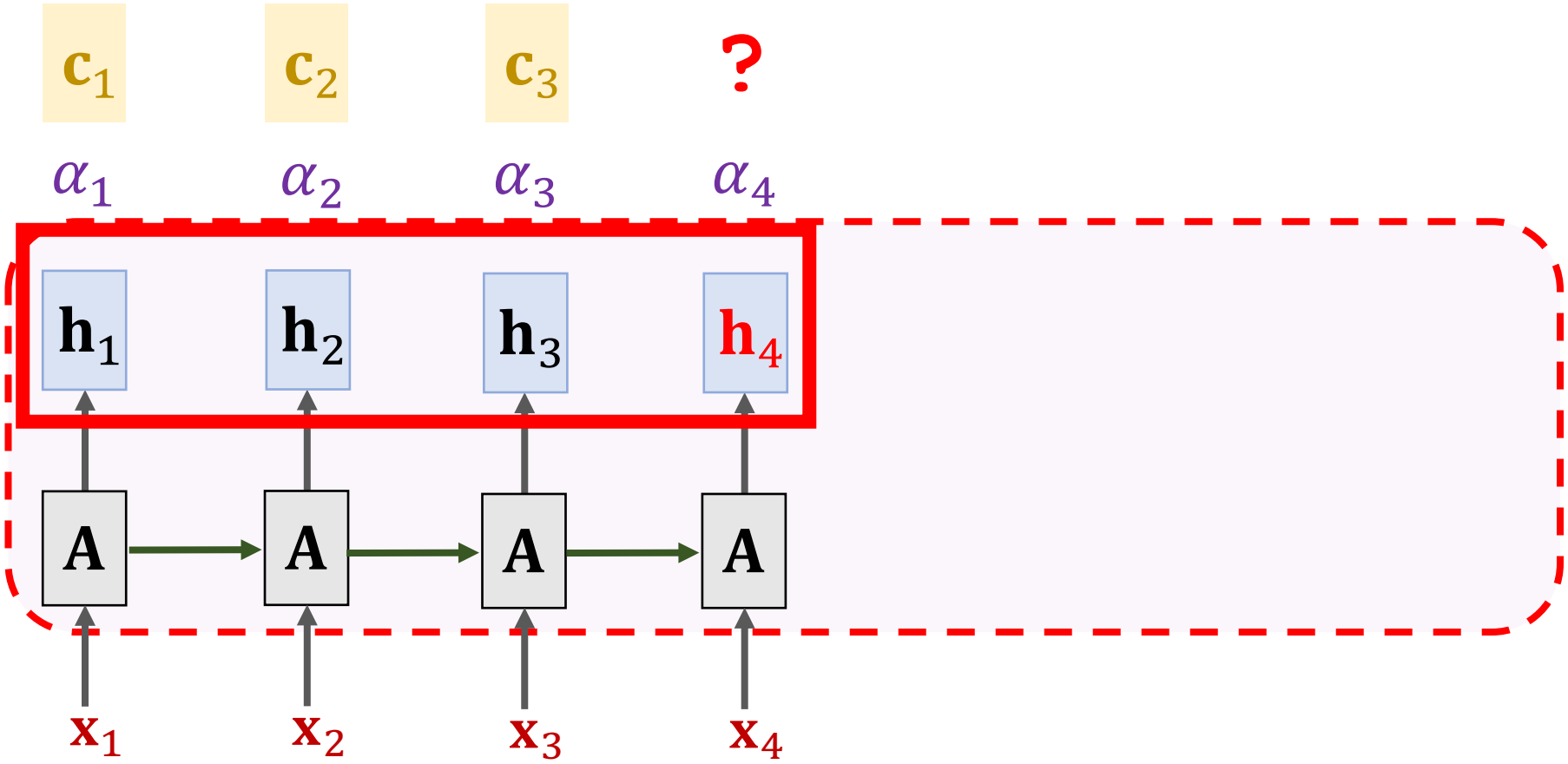
SimpleRNN + Self-Attention



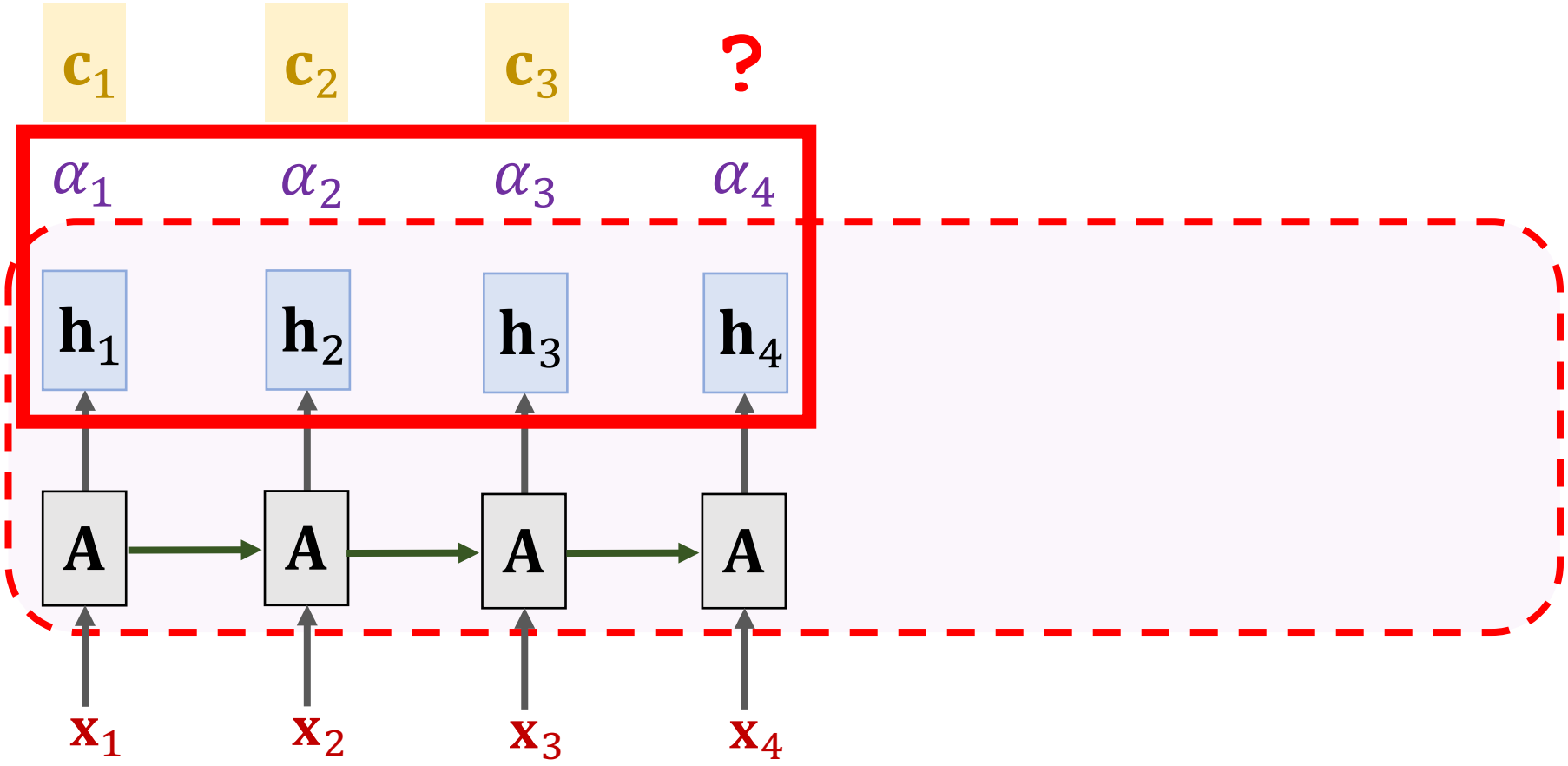
SimpleRNN + Self-Attention

Weights: $\alpha_i = \text{align}(\mathbf{h}_i, \mathbf{h}_4)$.

状态之间 算相关性权重

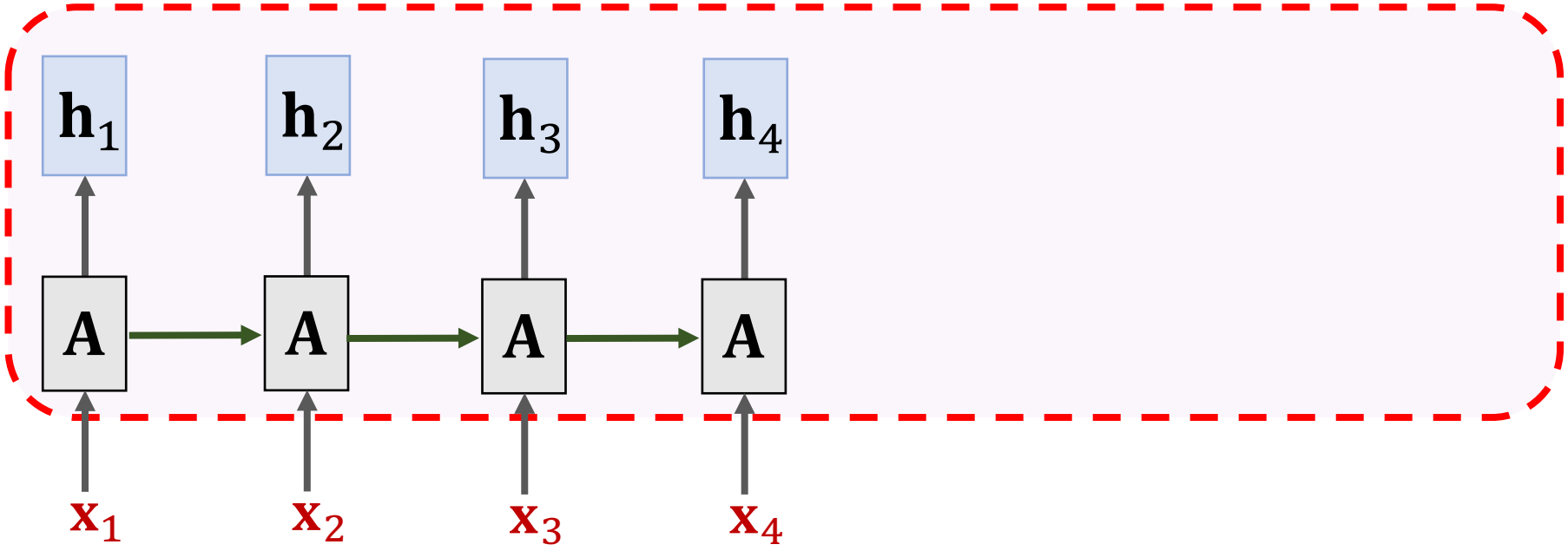


SimpleRNN + Self-Attention



SimpleRNN + Self-Attention

$\mathbf{c}_1$ $\mathbf{c}_2$ $\mathbf{c}_3$ $\mathbf{c}_4 = \alpha_1\mathbf{h}_1 + \alpha_2\mathbf{h}_2 + \alpha_3\mathbf{h}_3 + \alpha_4\mathbf{h}_4.$



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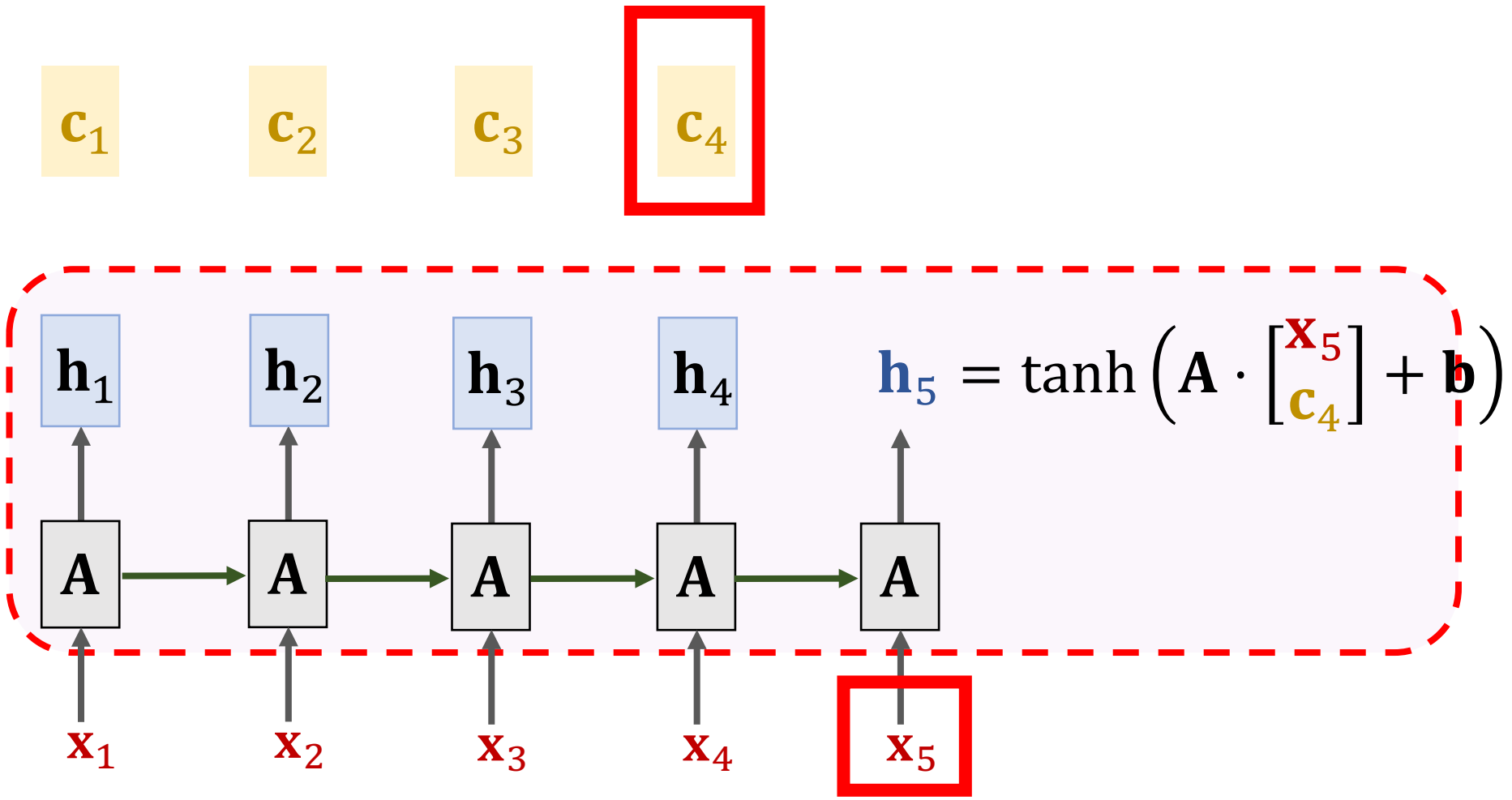
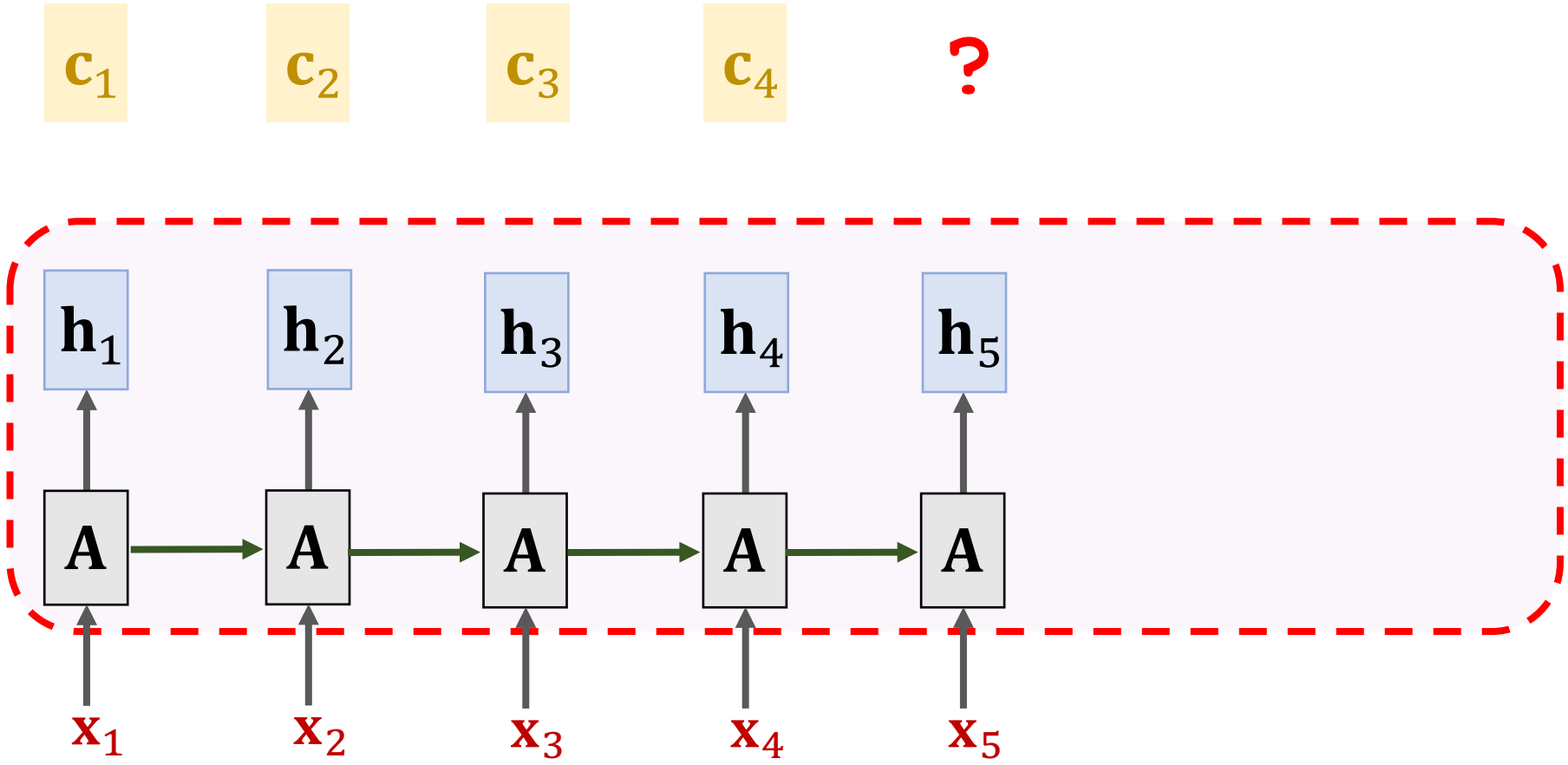
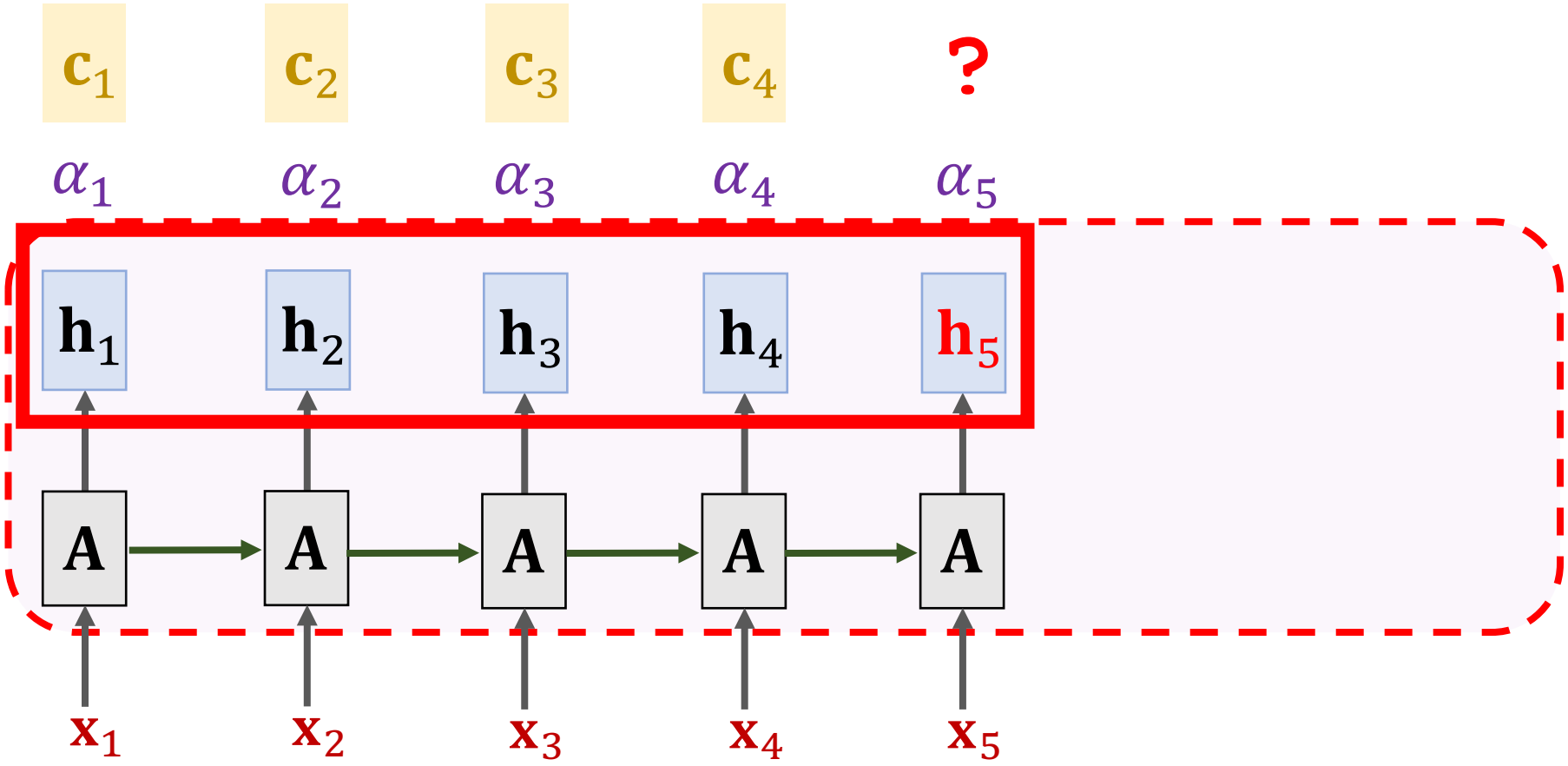


SimpleRNN + Self-Attention

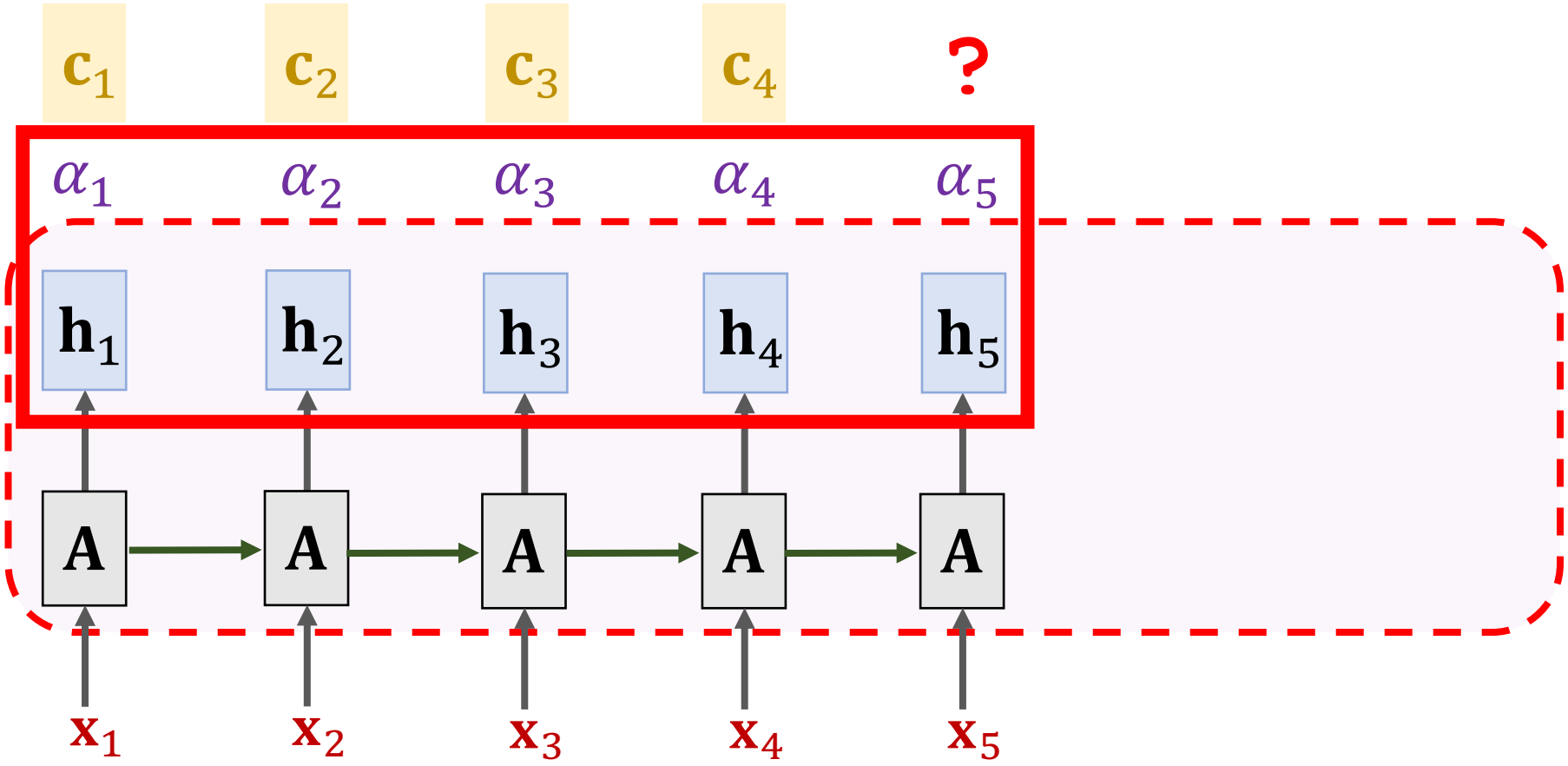


SimpleRNN + Self-Attention

Weights: $\alpha_i = \text{align}(\mathbf{h}_i, \mathbf{h}_5)$.

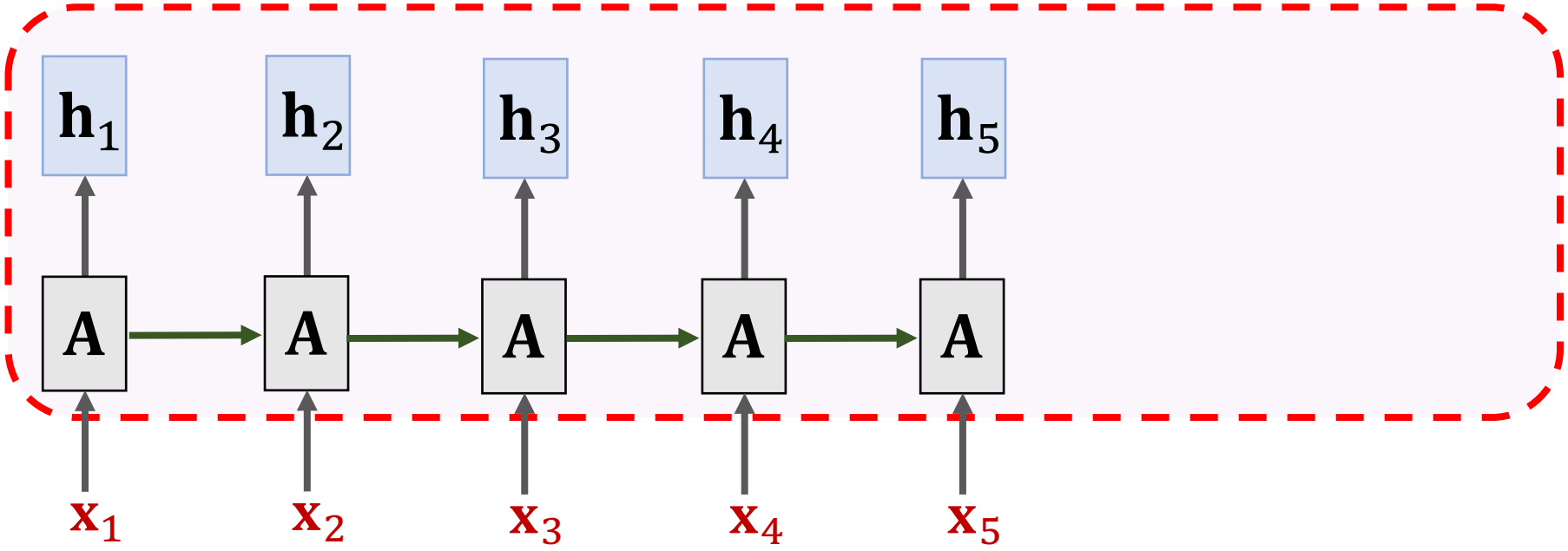


SimpleRNN + Self-Attention

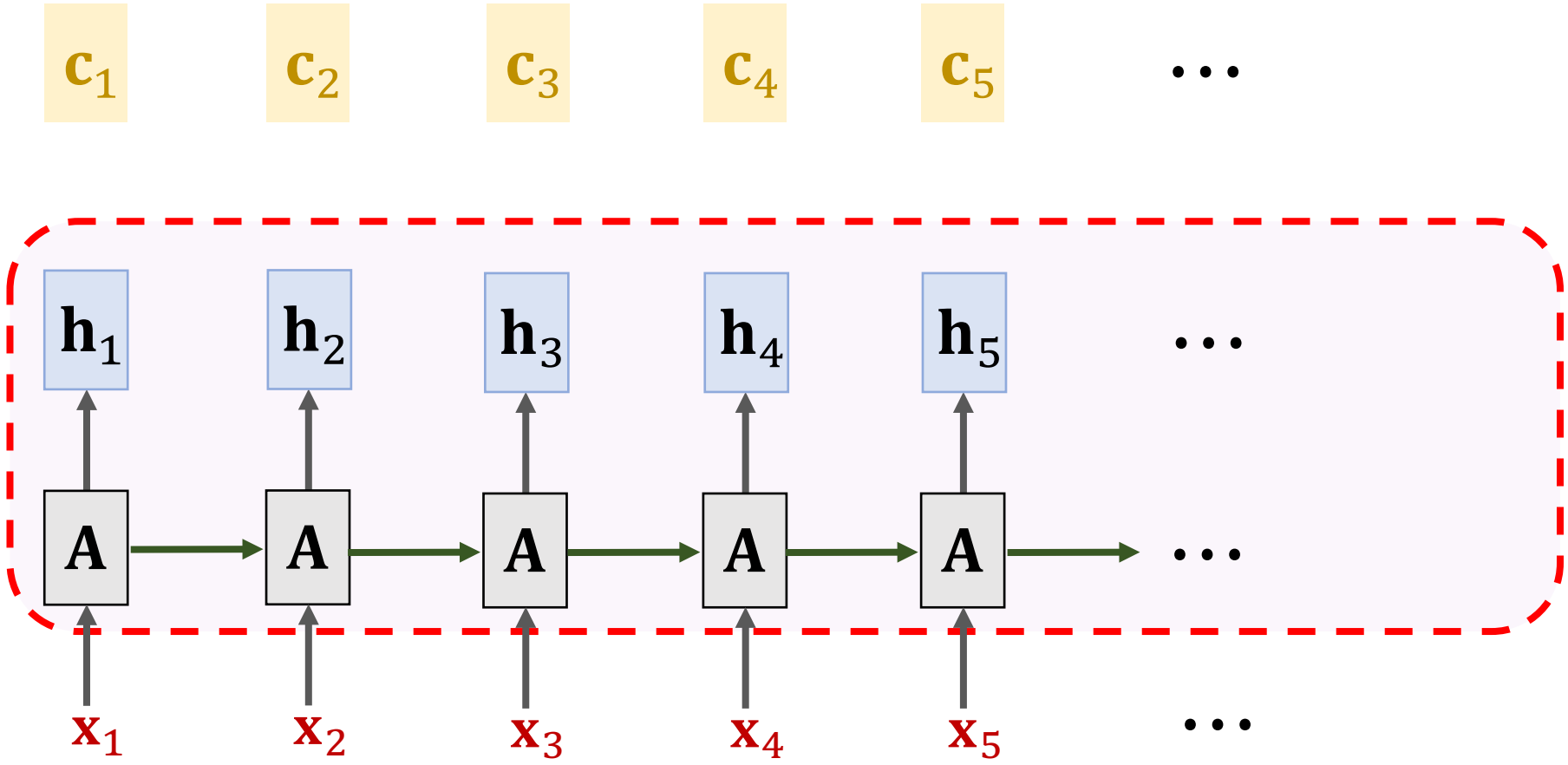


SimpleRNN + Self-Attention

$\mathbf{c}_1$ $\mathbf{c}_2$ $\mathbf{c}_3$ $\mathbf{c}_4$ $\mathbf{c}_5 = \alpha_1 \mathbf{h}_1 + \alpha_2 \mathbf{h}_2 + \cdots + \alpha_5 \mathbf{h}_5.$



SimpleRNN + Self-Attention



Summary

- With self-attention, RNN is less likely to forget.

Summary

- With self-attention, RNN is less likely to forget. 有了自我关注，RNN就不太可能忘记了
- Pay attention to the context relevant to the new input. 注意与新输入相关的上下文

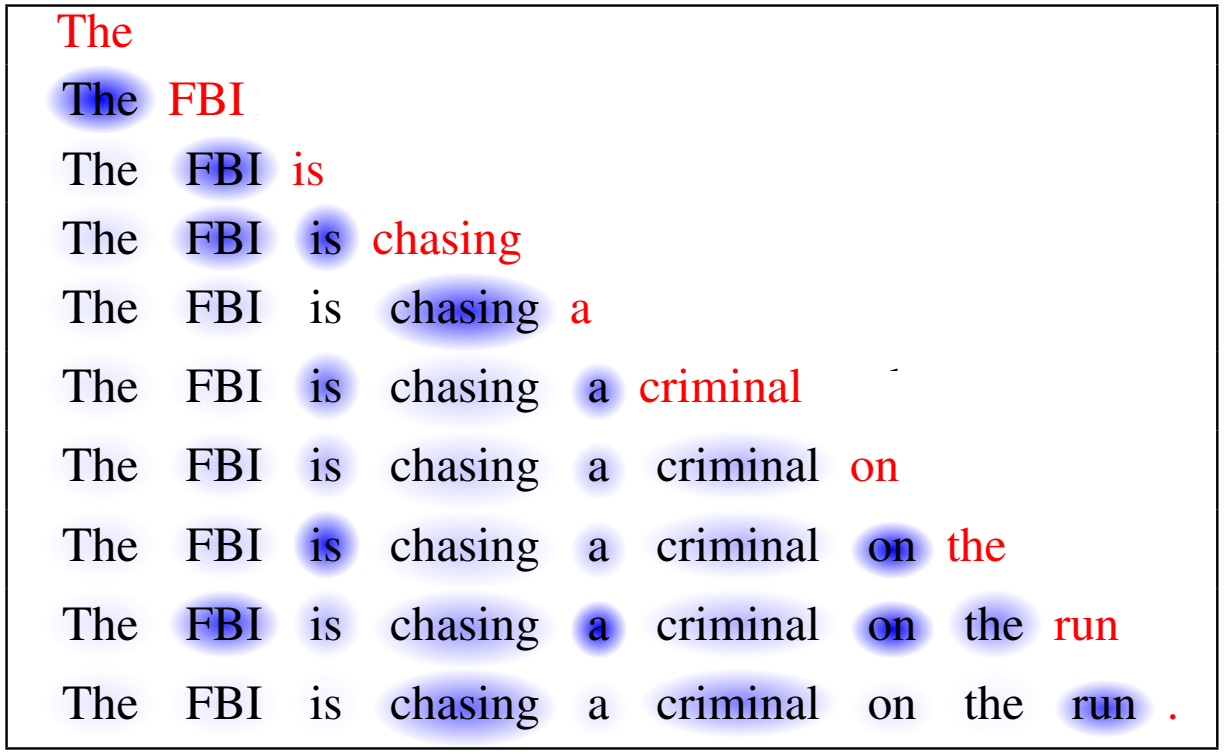


Figure is from the paper " Long Short-Term Memory-Networks for Machine Reading."

Thank you!