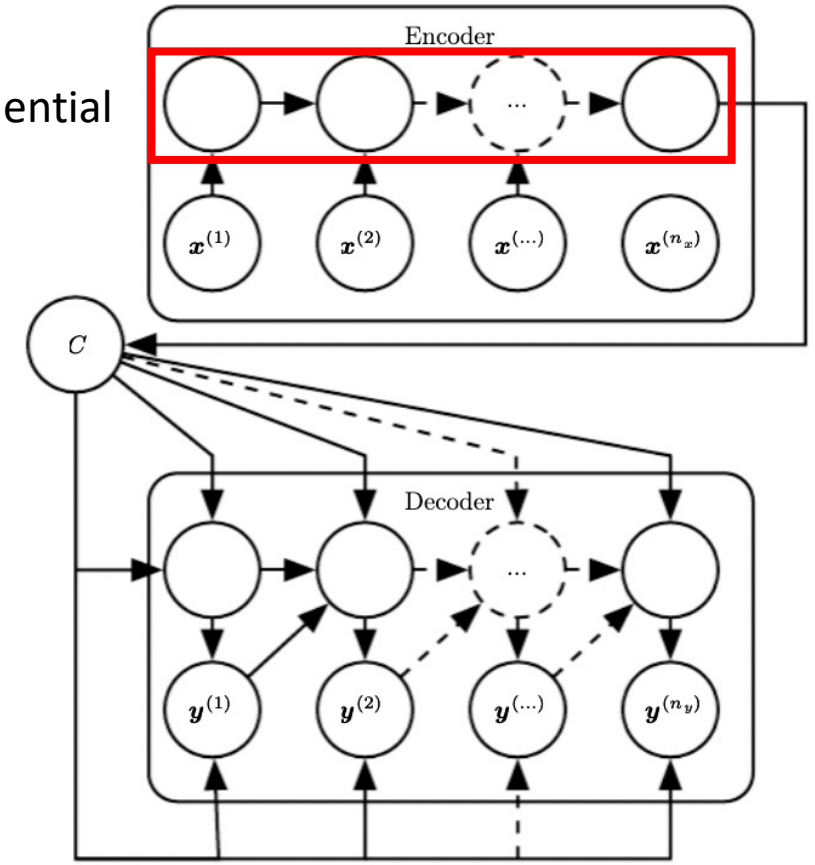
Attention

Neural Networks Design And Application

Encoder-decoder

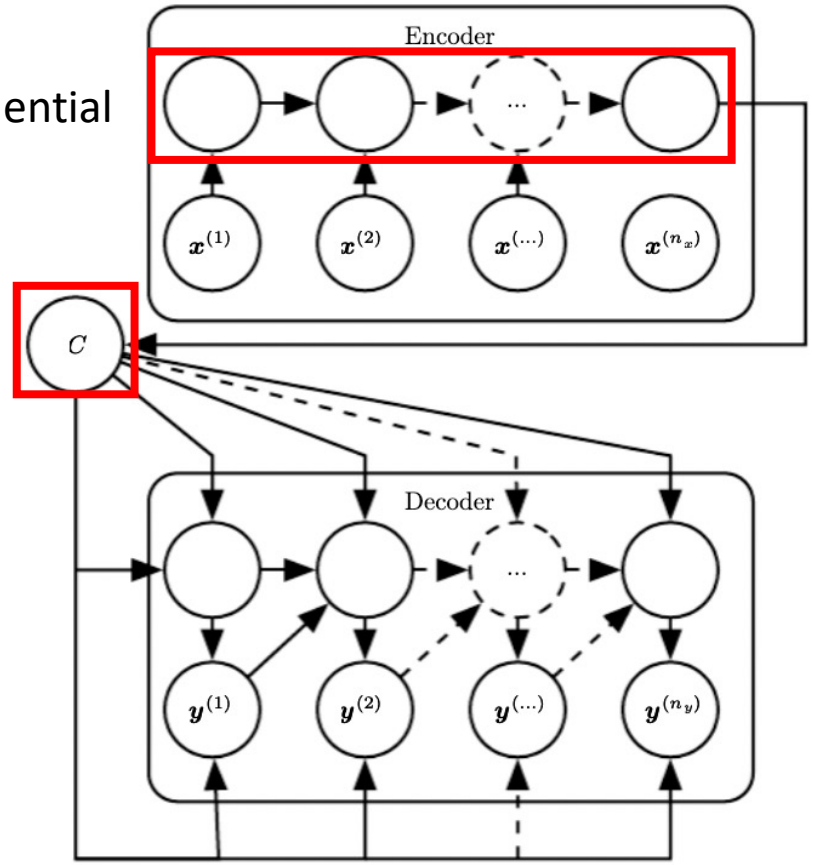
sequential



Encoder-decoder

sequential

summary: context feature



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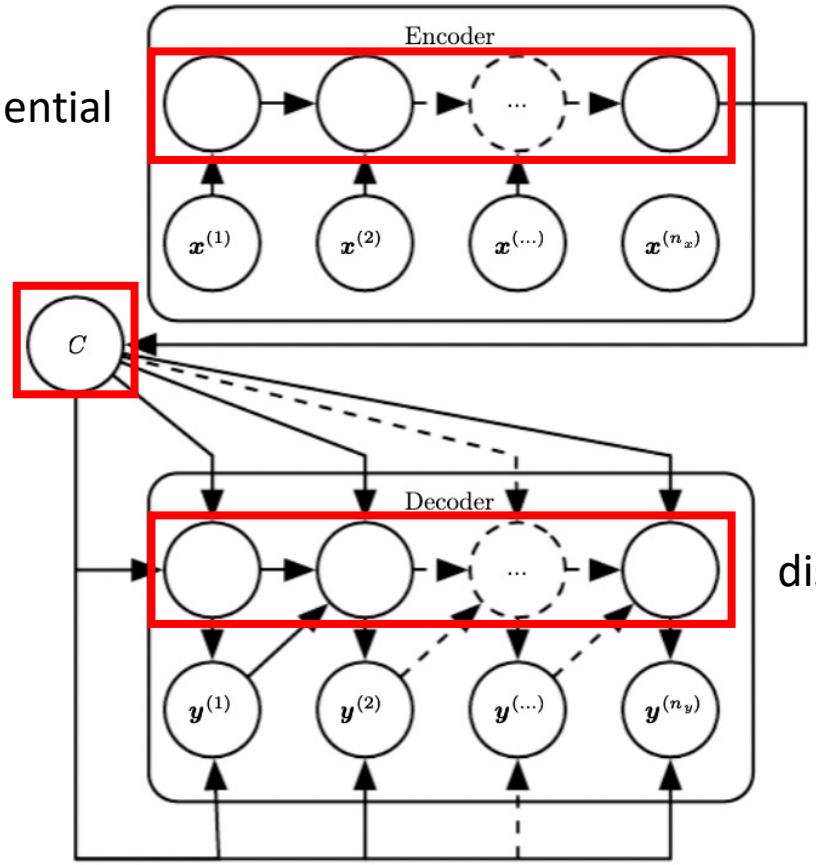
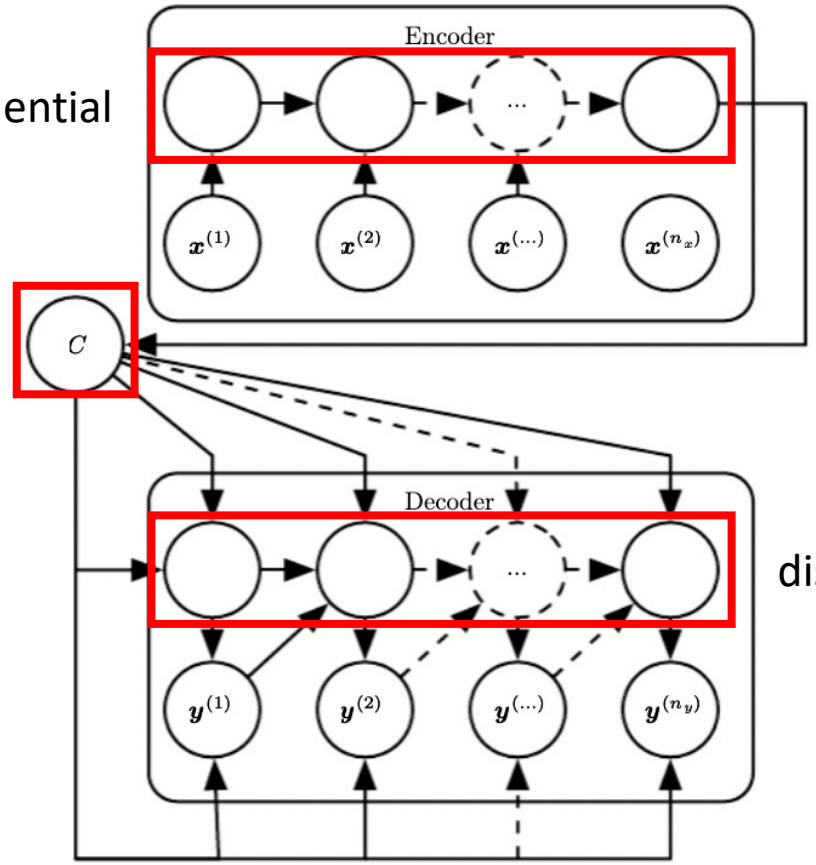


distribute information

Encoder-decoder

sequential

summary: context feature



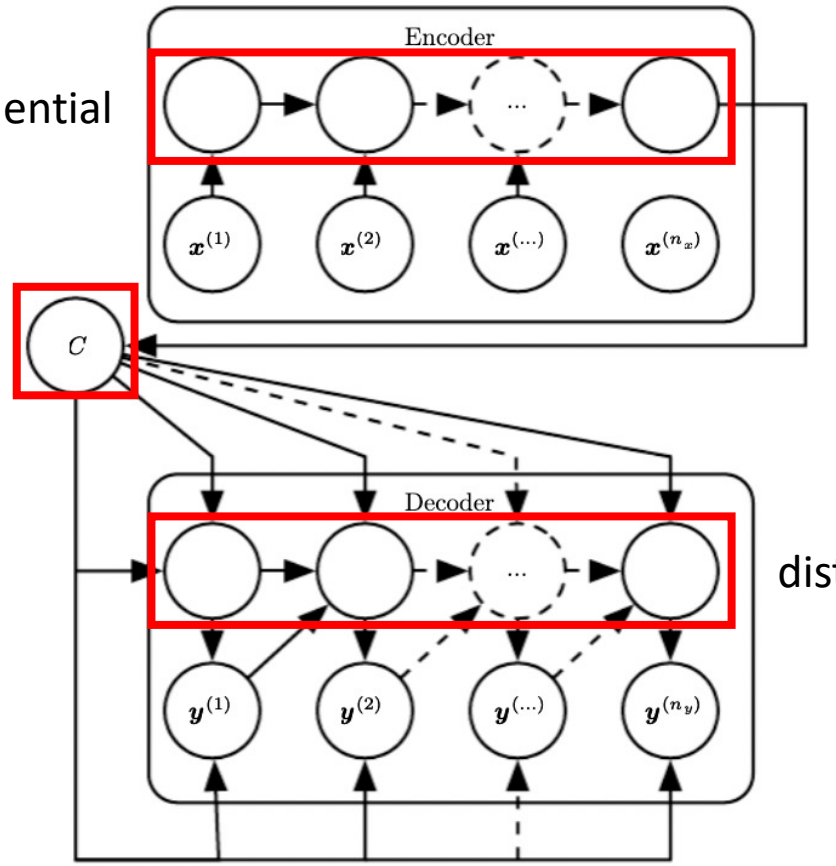
distribute information

Q: can we use bi-directional RNN for input?

Encoder-decoder

sequential

summary: context feature



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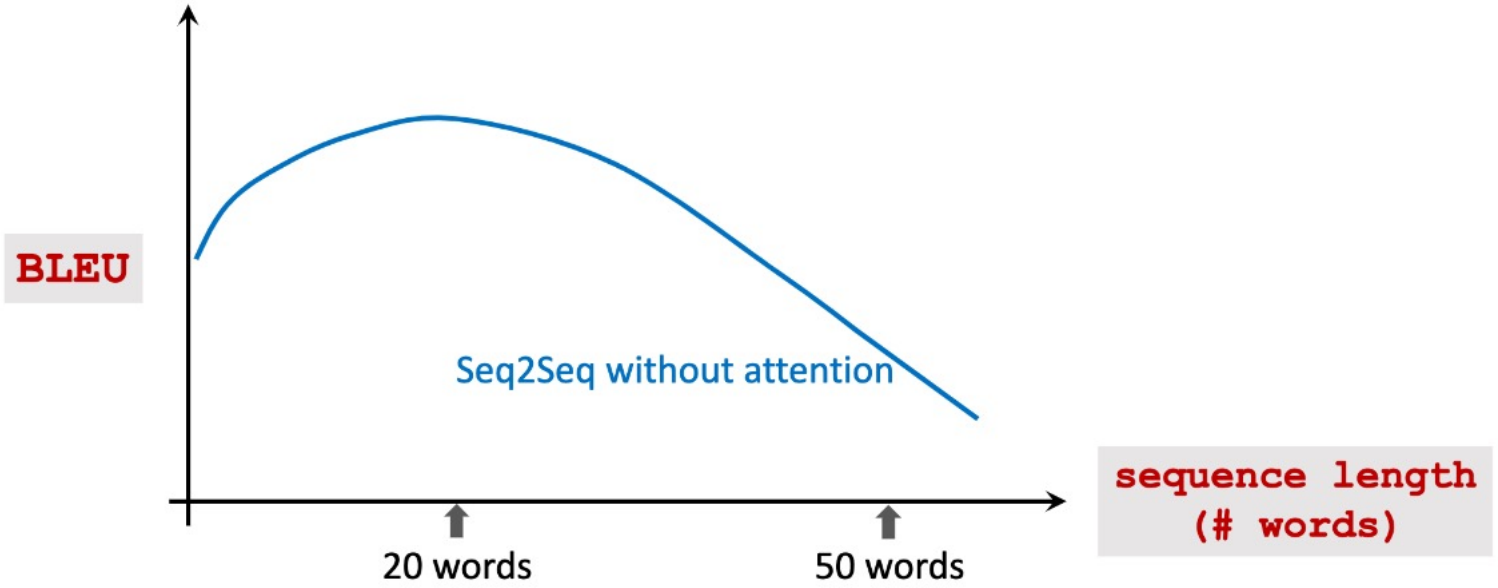
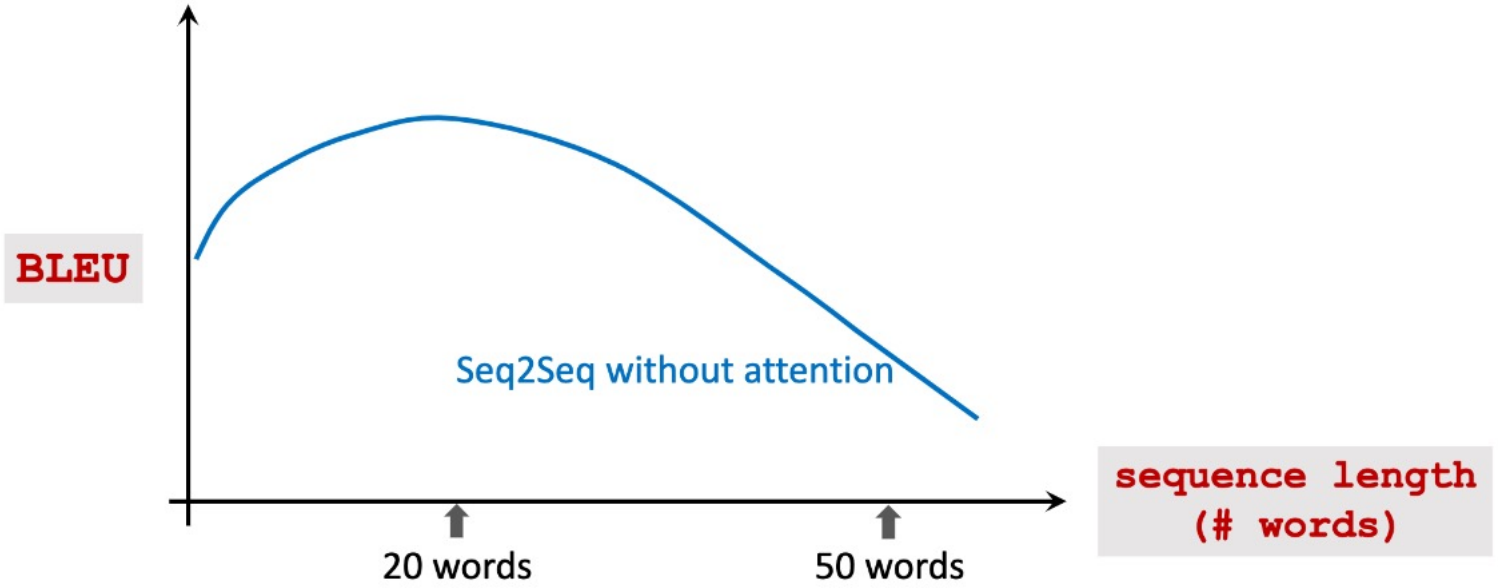
Seq2seq model performance



the clouds are in the sky

Seq2seq model performance



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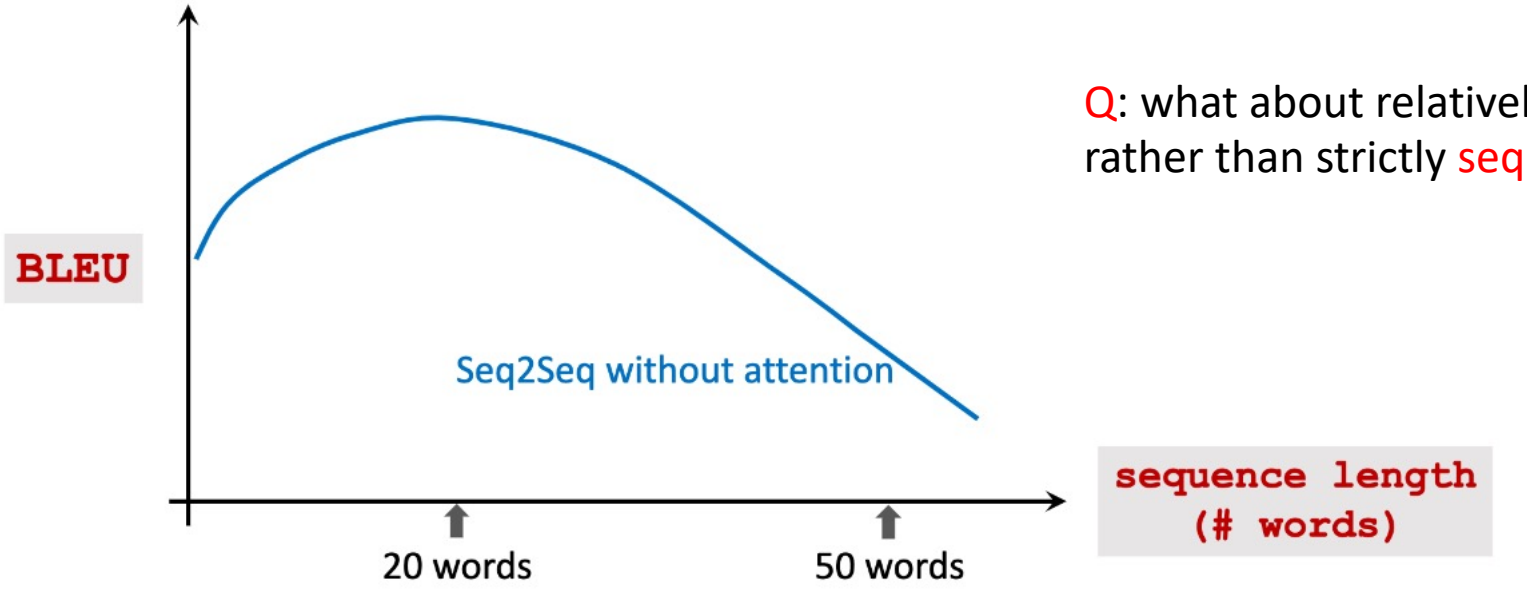

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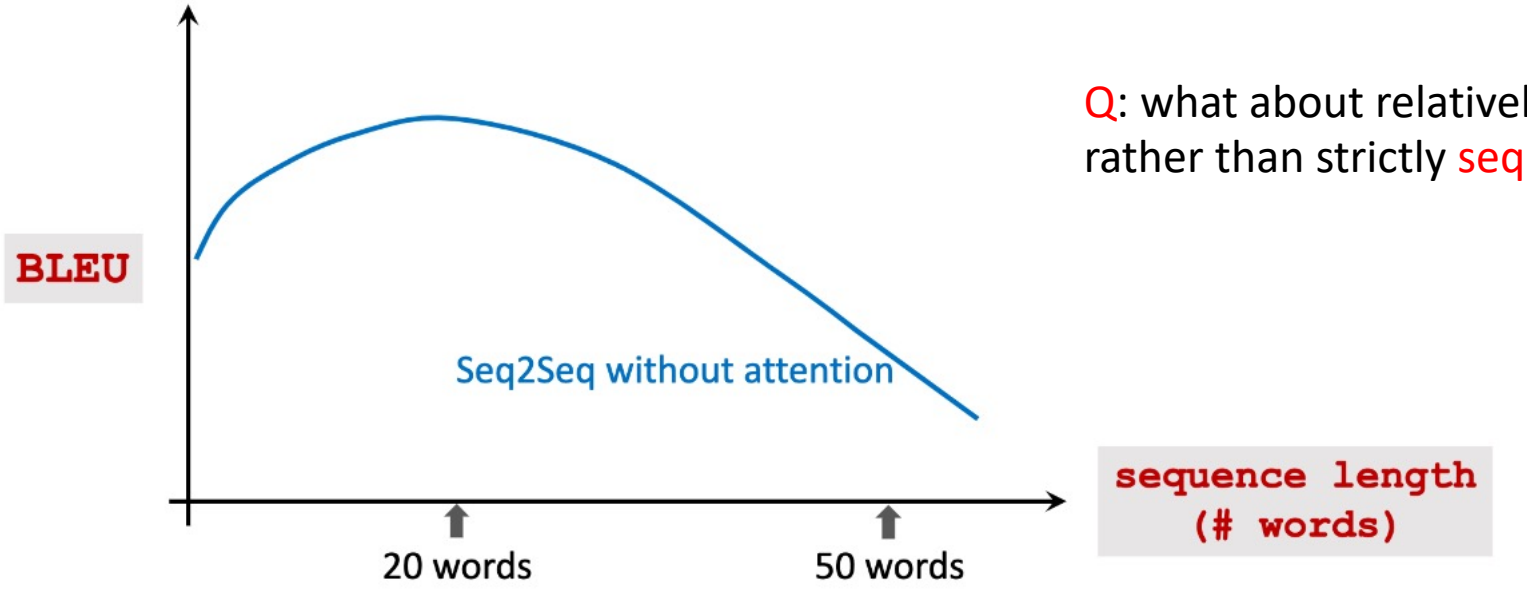

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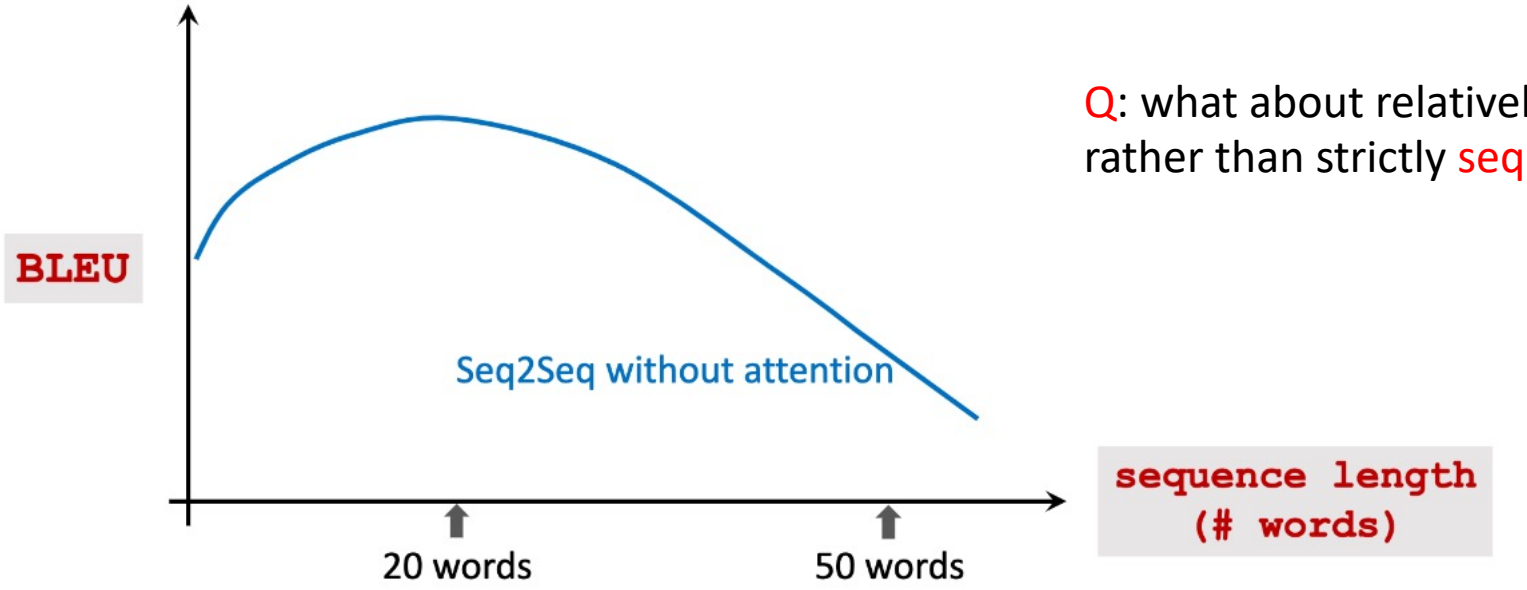

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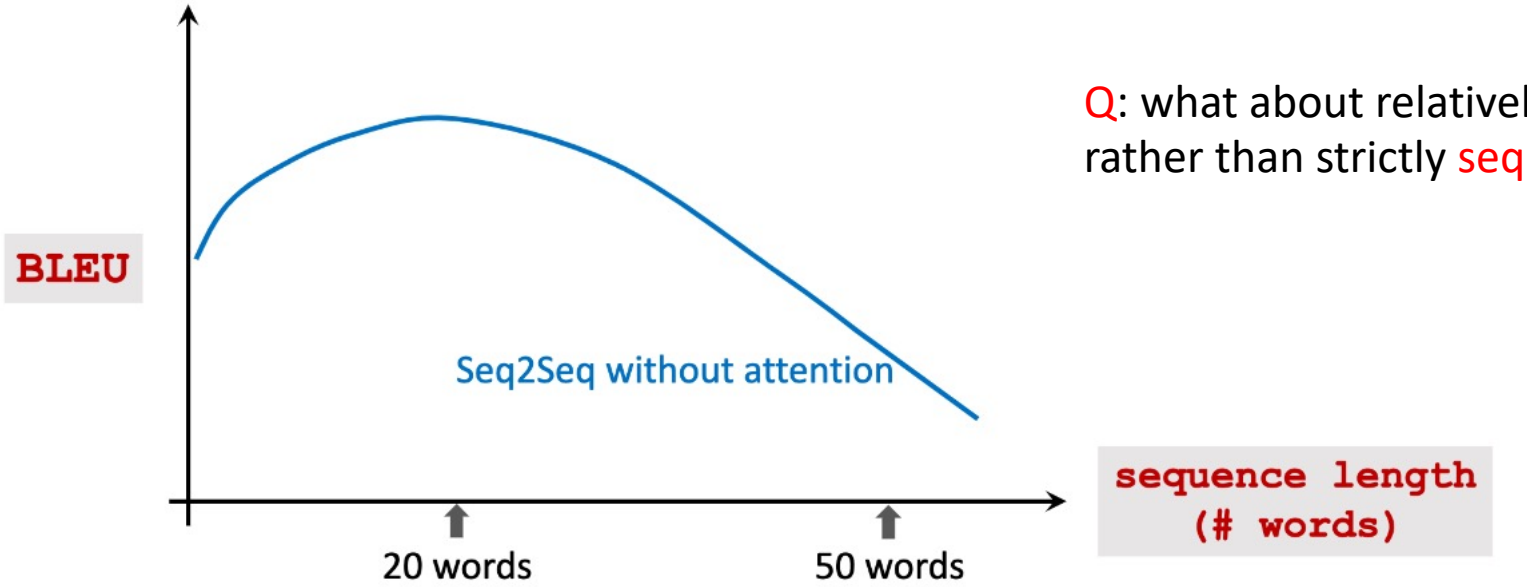

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We need to summarize all context

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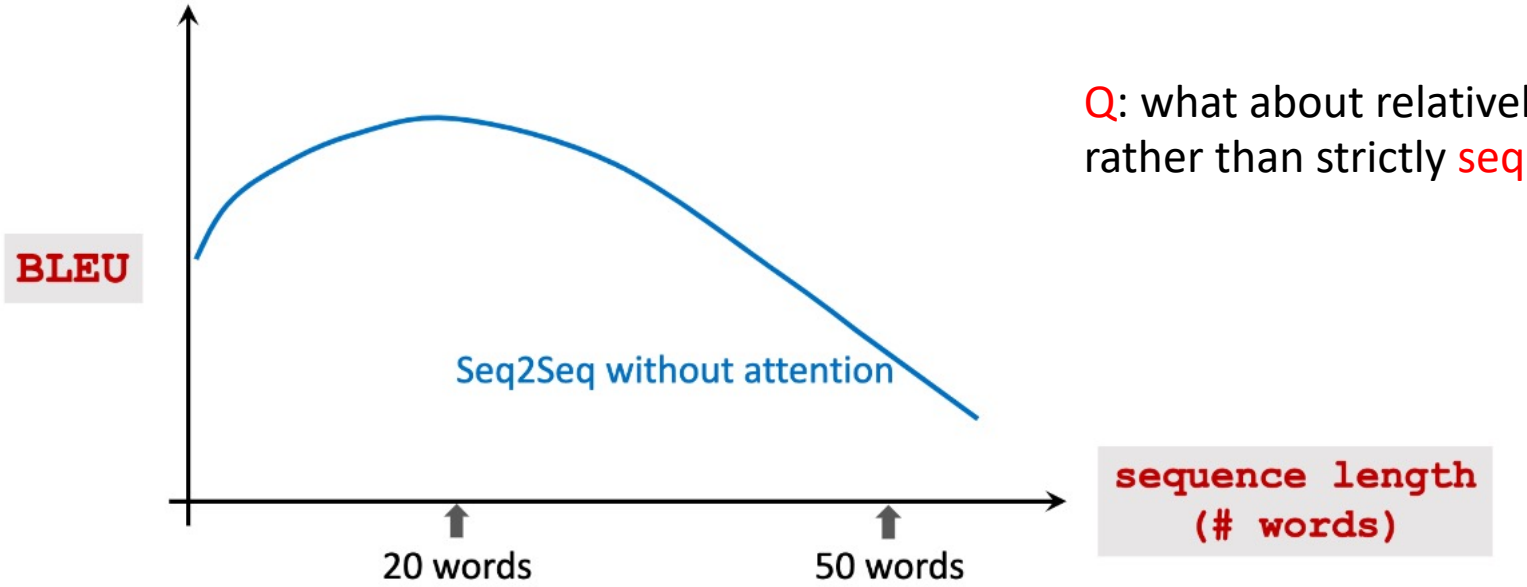

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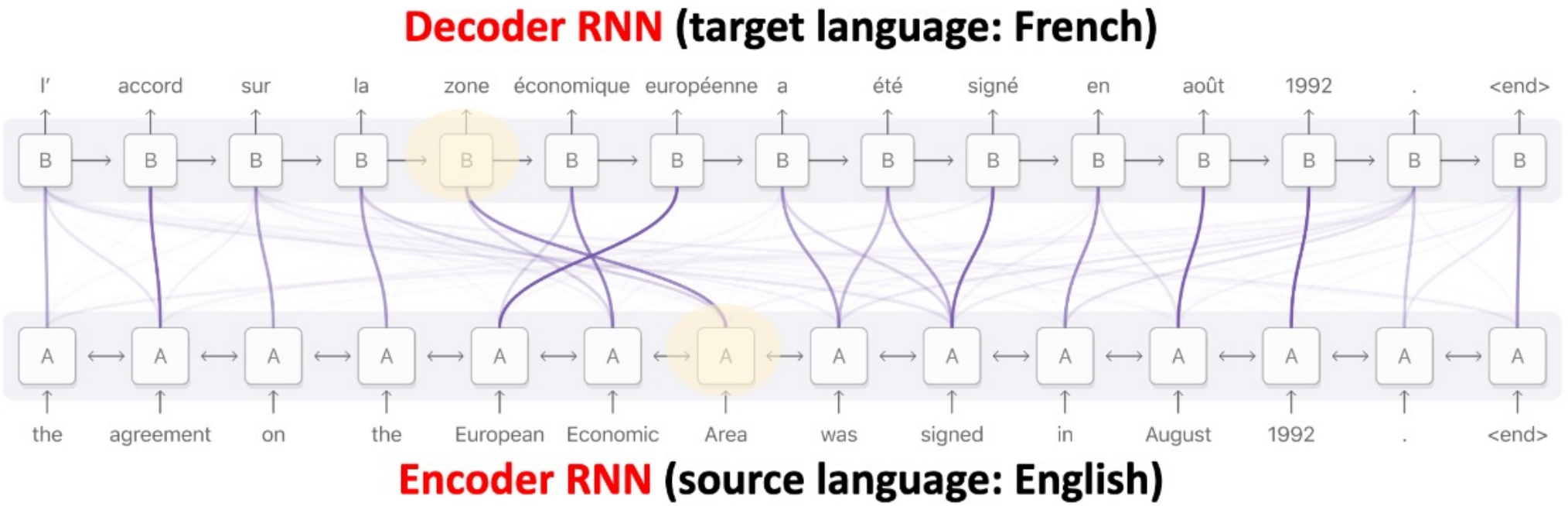
Input-output correlation



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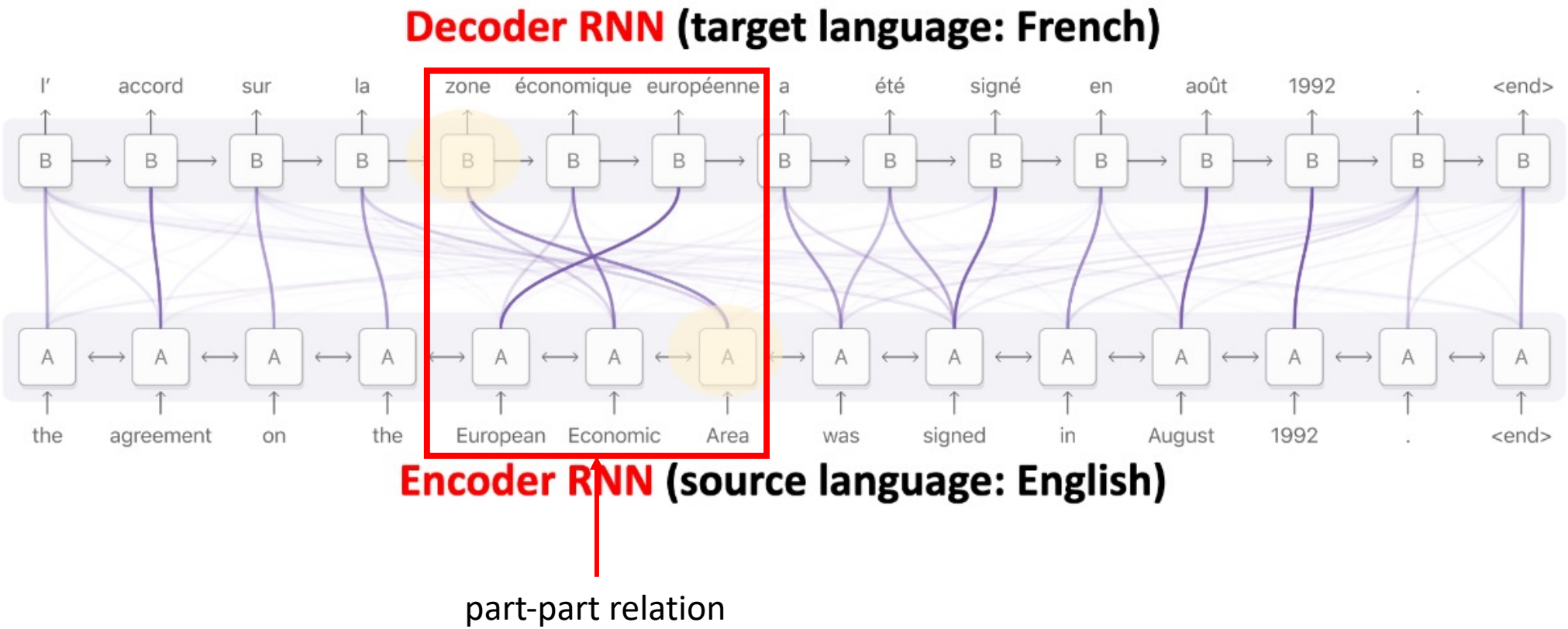

Encoder-decoder

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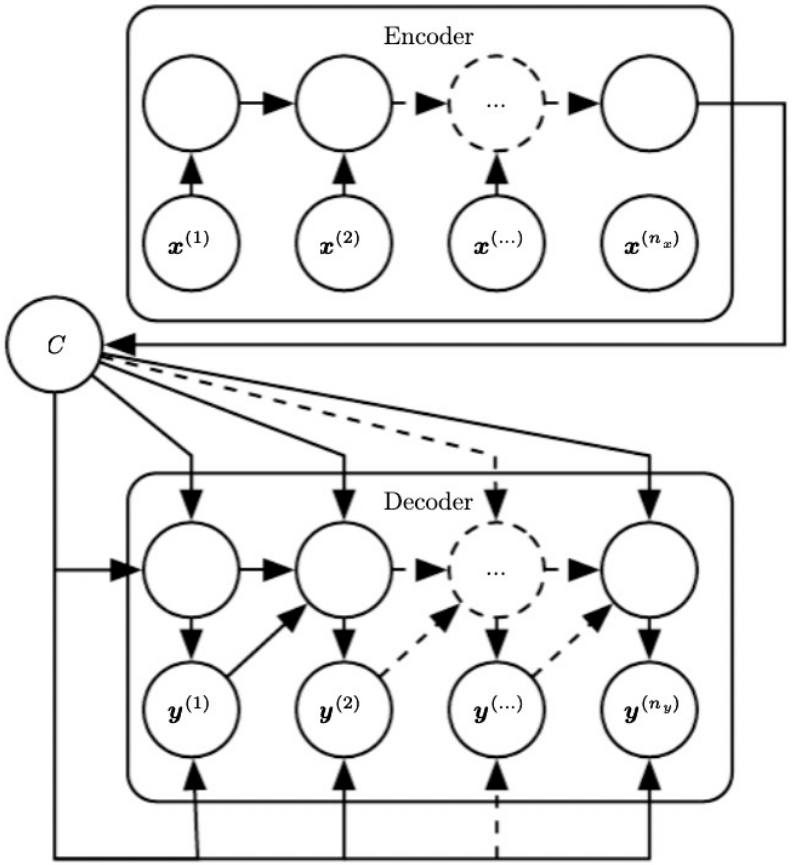

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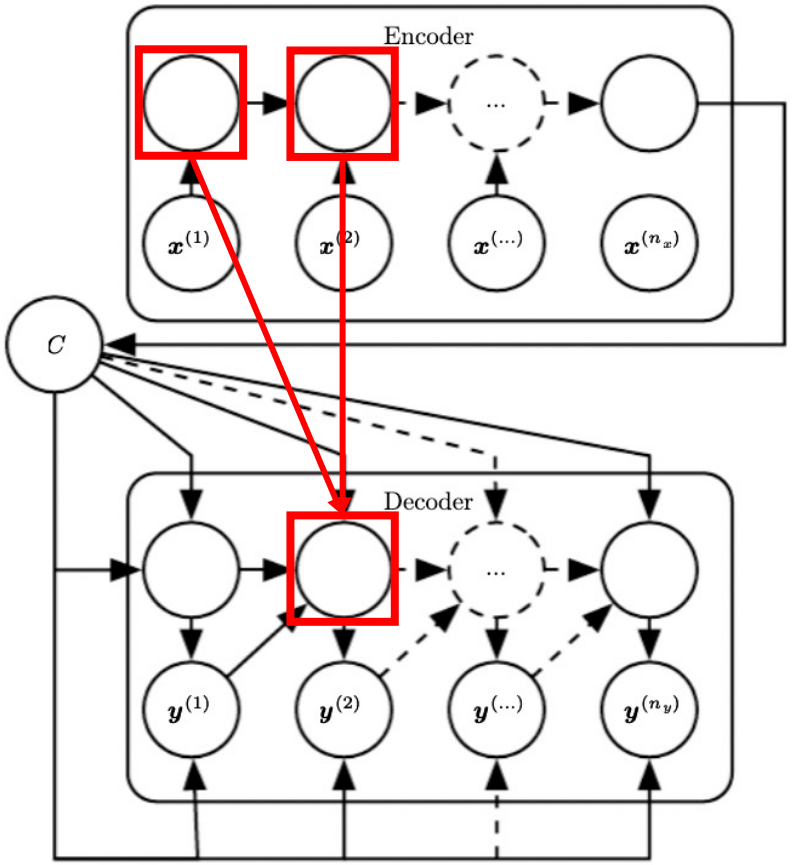


Attention mechanism

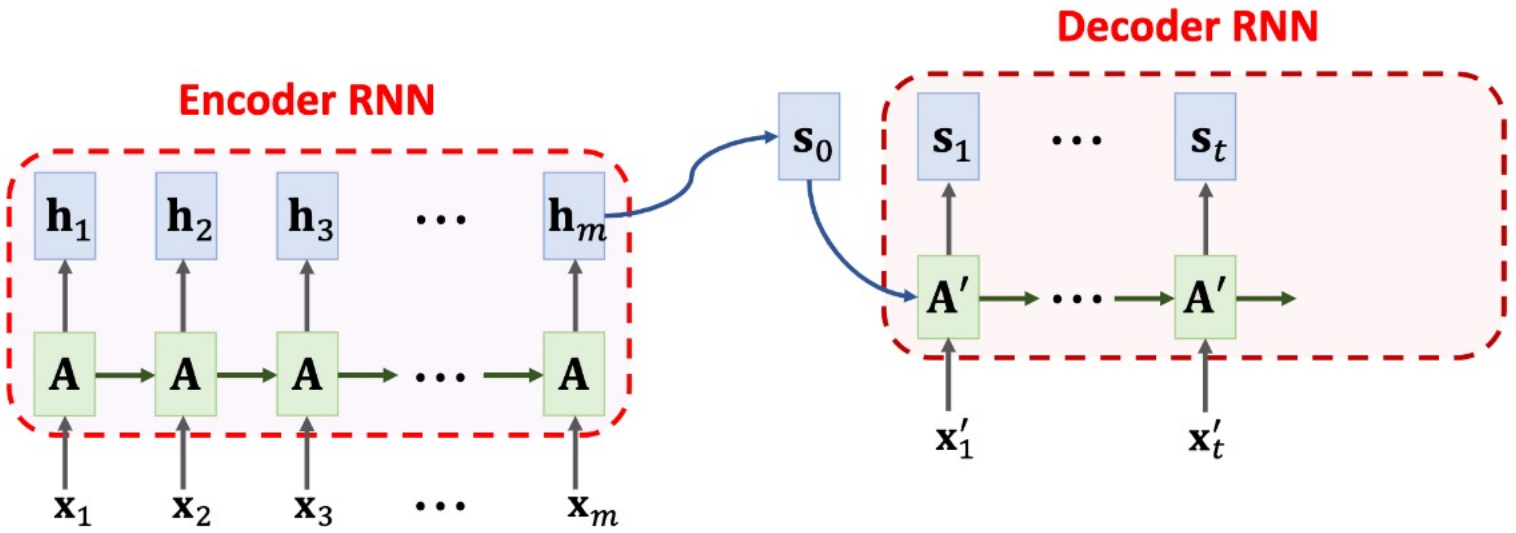
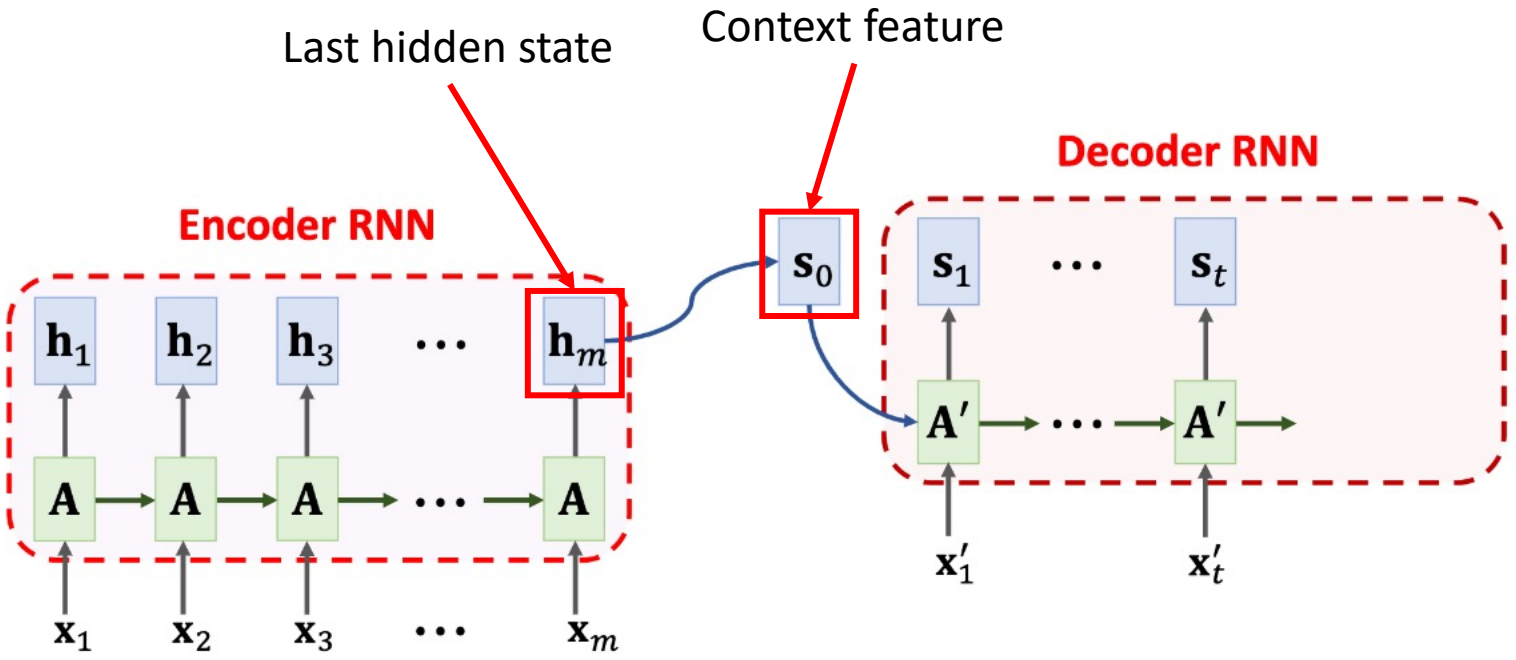


Image from https://github.com/wangshusen/DeepLearning/blob/master/Slides/9_RNN_8.pdf

Attention mechanism



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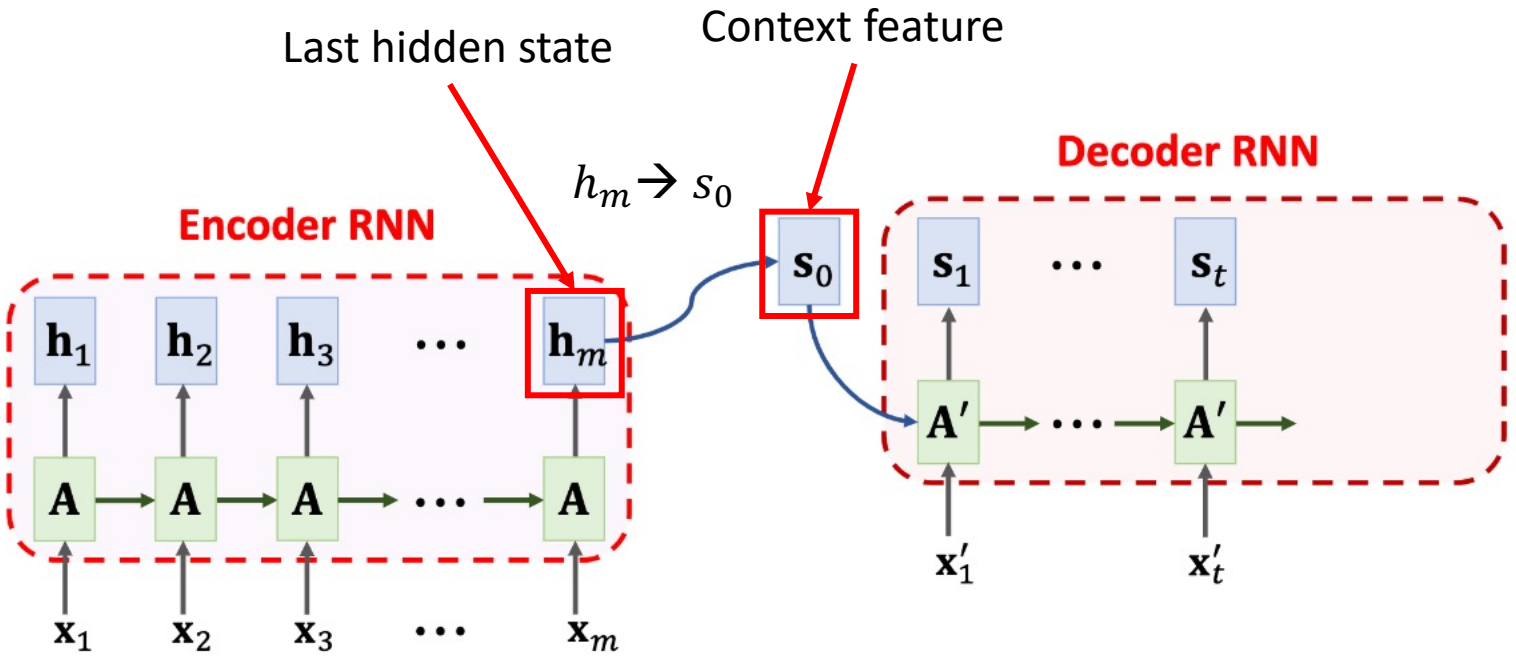

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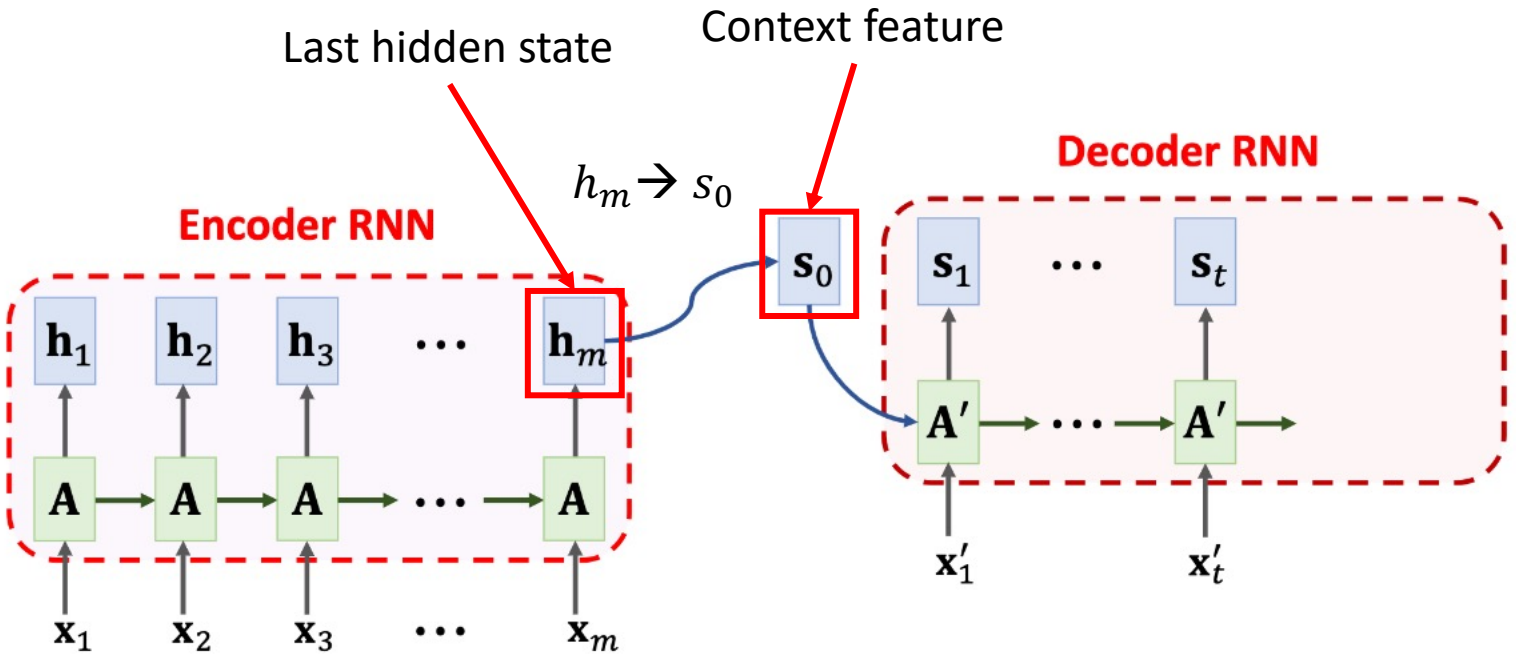

No direct connection between hidden states of encoder and decoder

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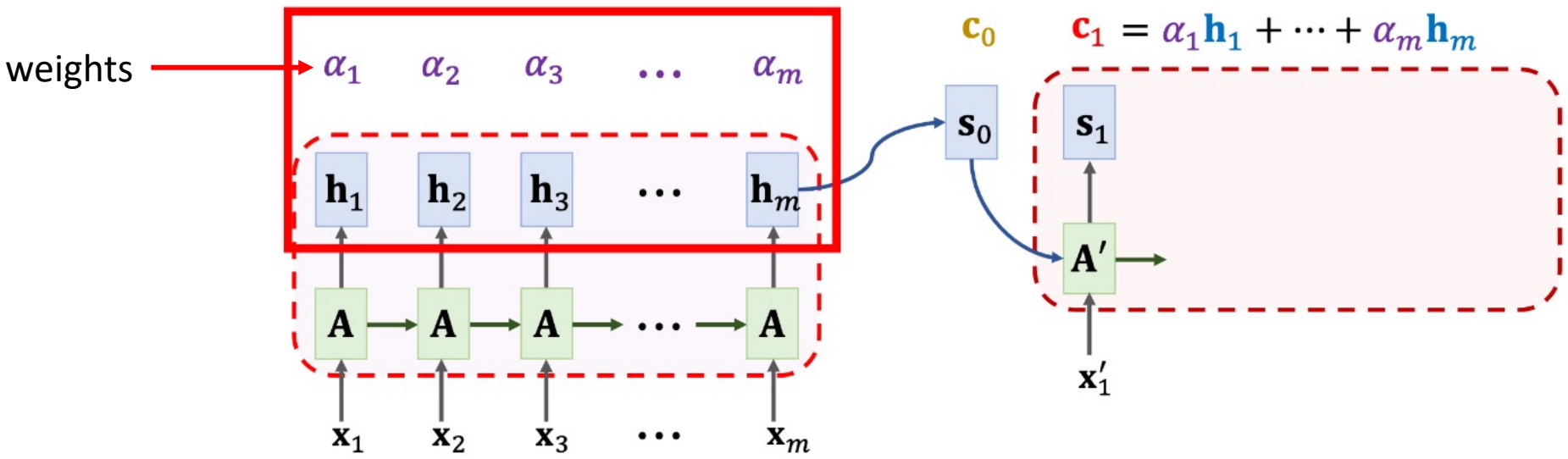

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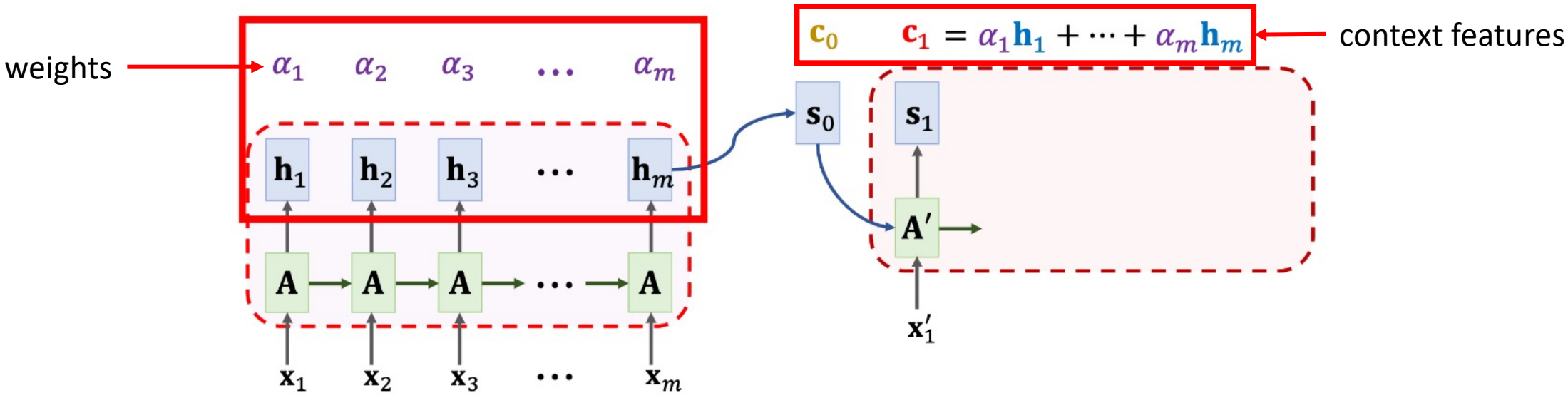

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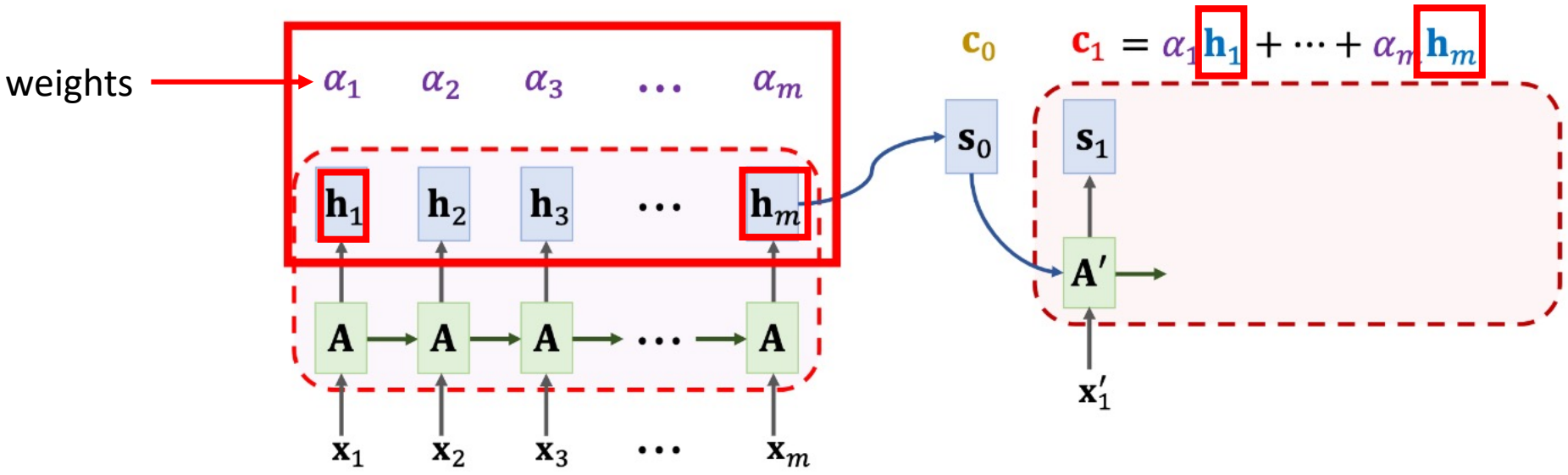

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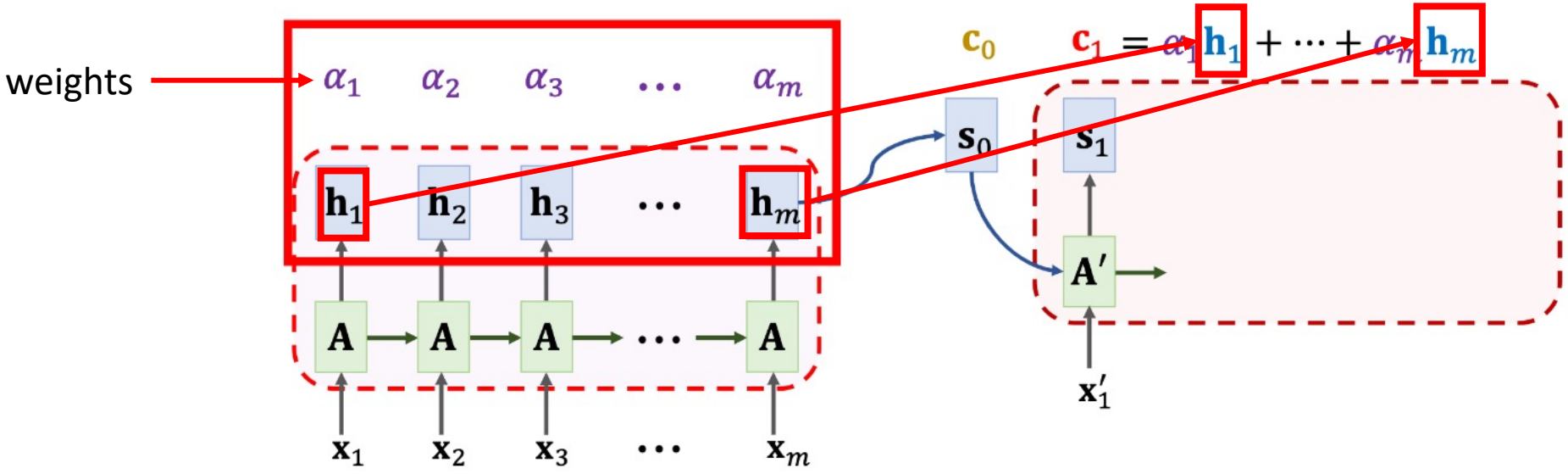

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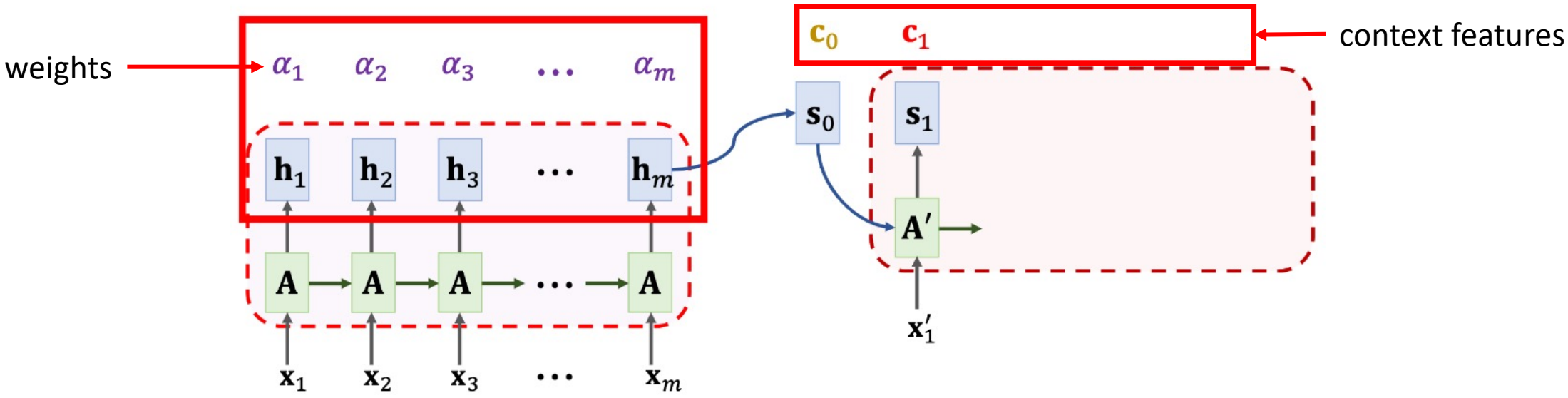

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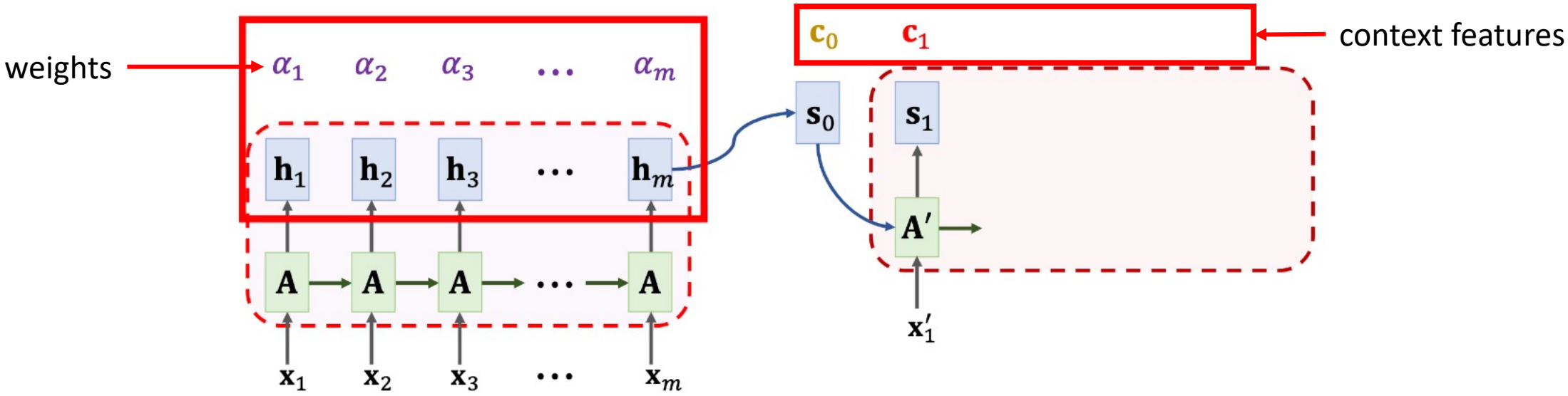
Attention mechanism

How to use the two variables to build information flow?



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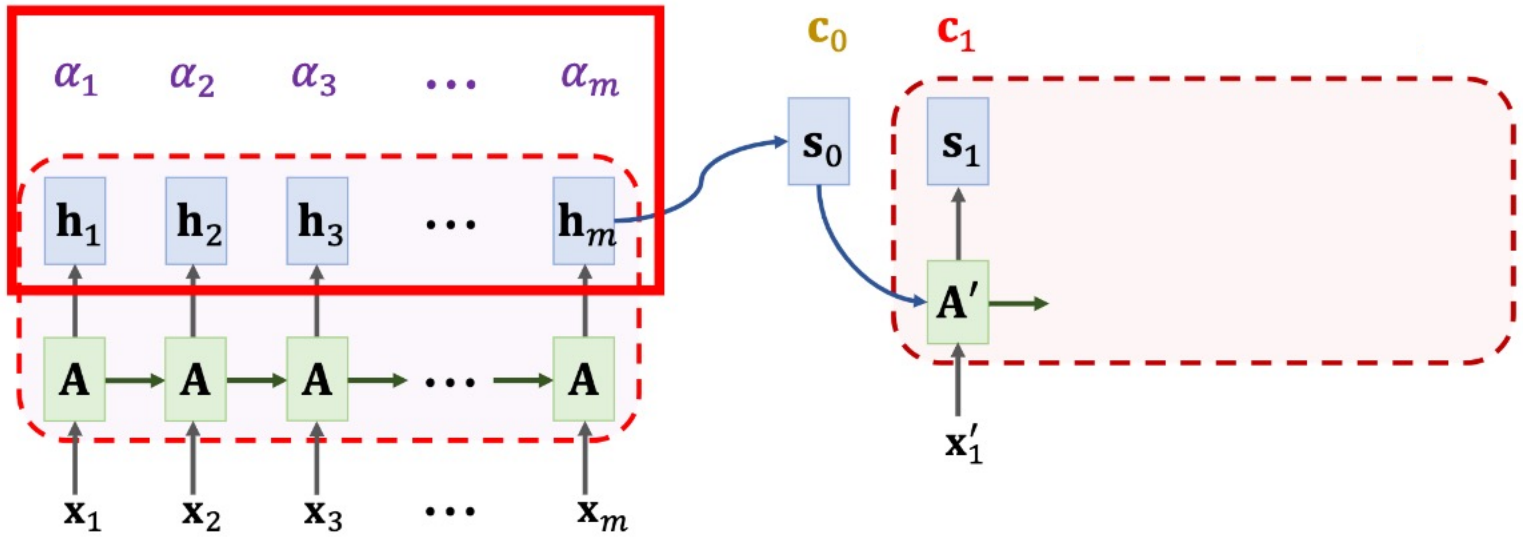
Attention mechanism

Weight: $\alpha_i = \text{align}(\mathbf{h}_i, \mathbf{s}_0)$.



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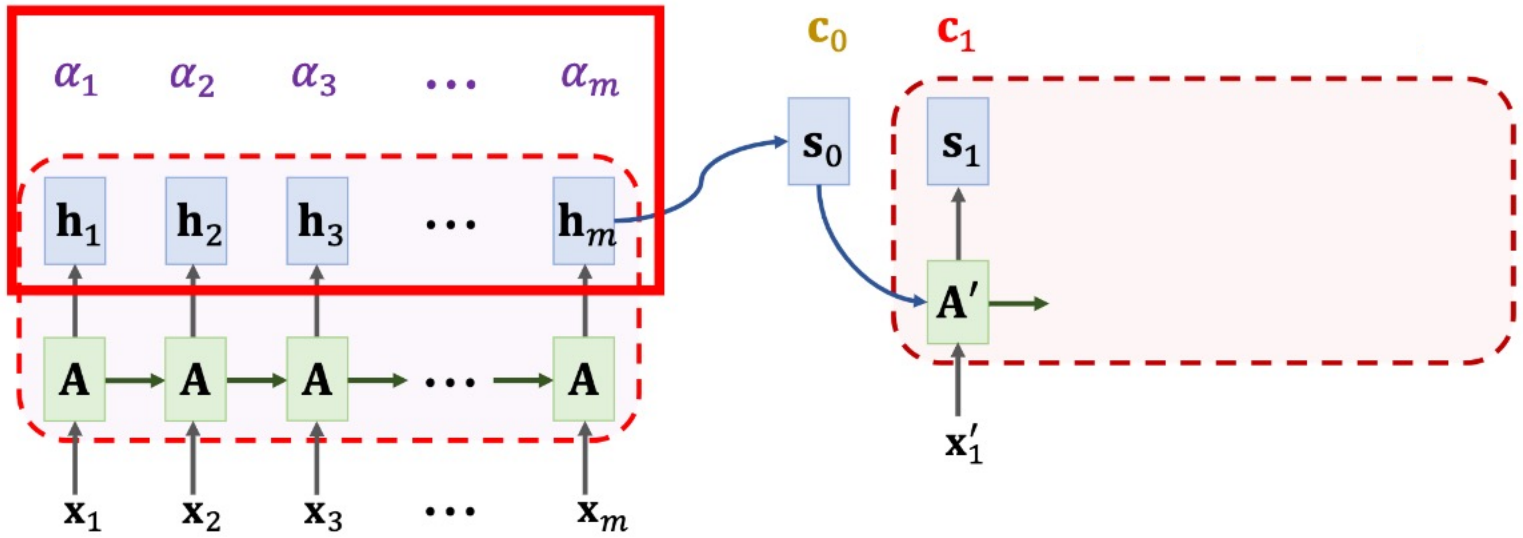

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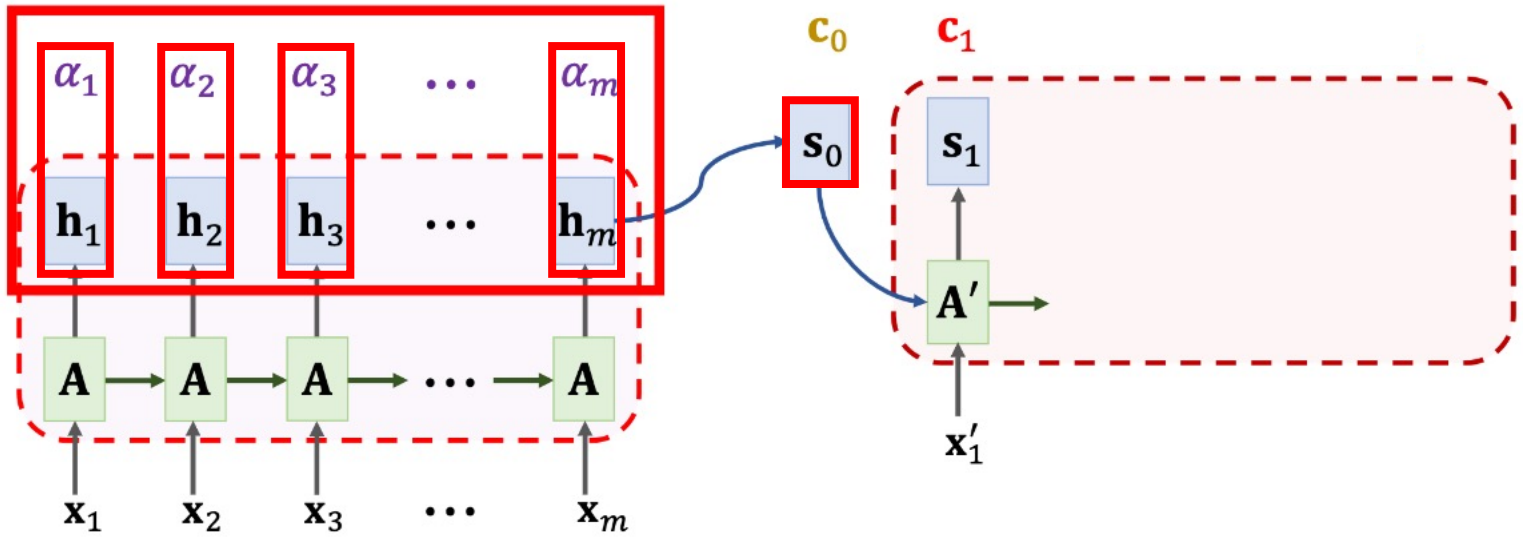

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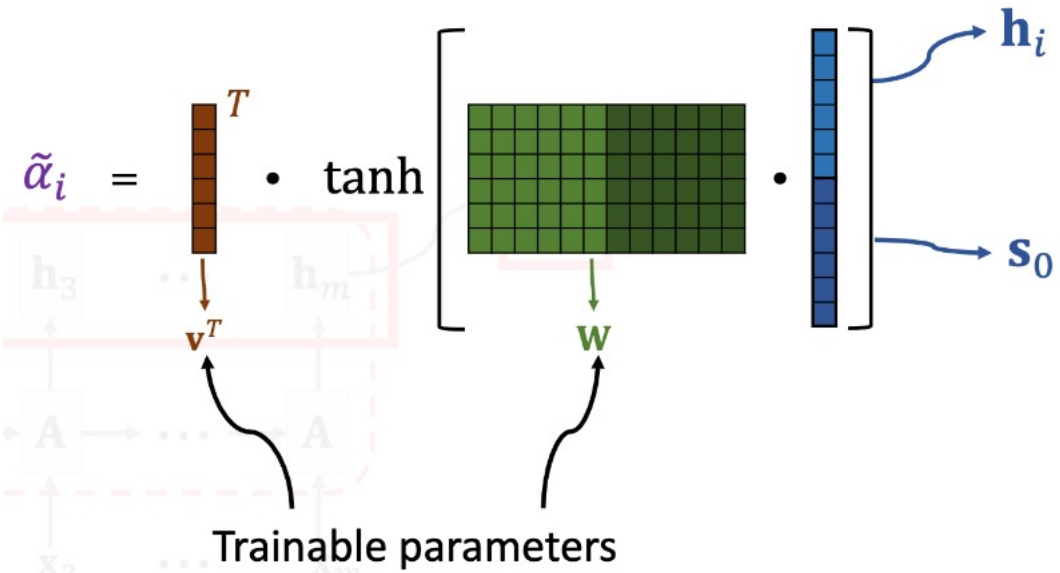

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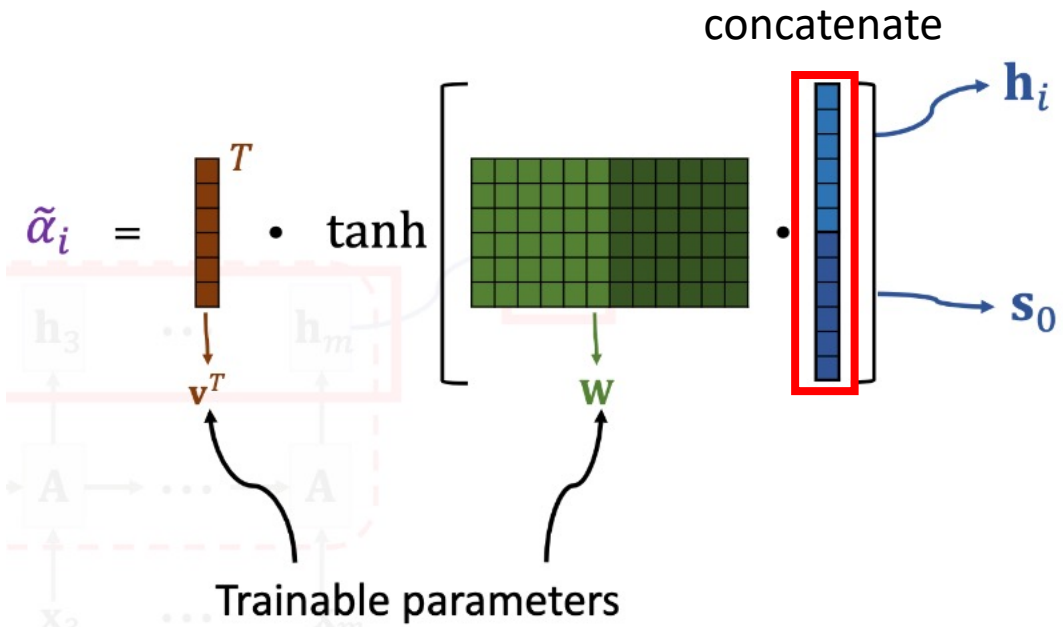

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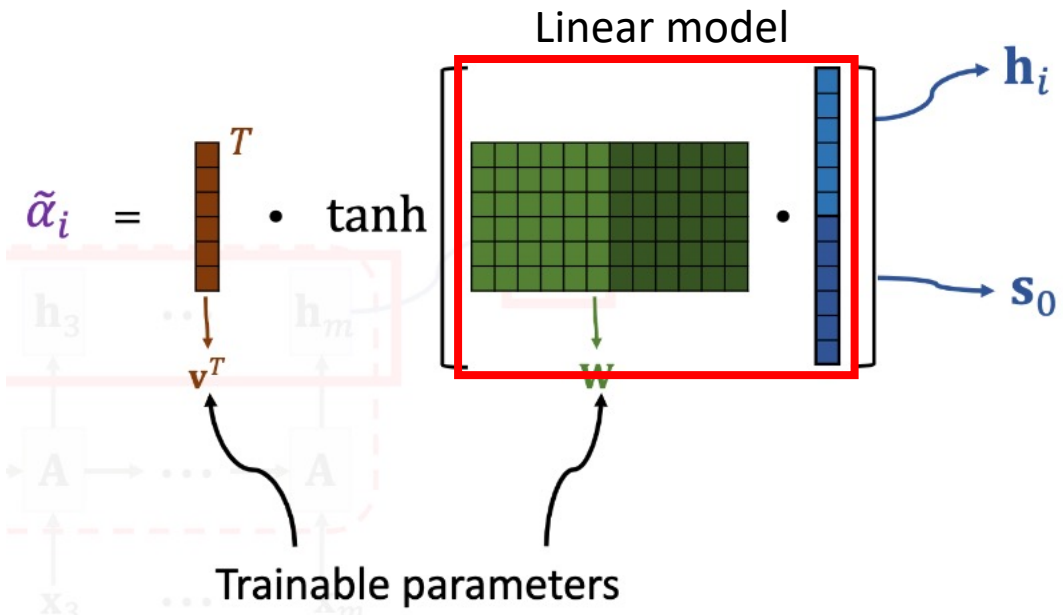

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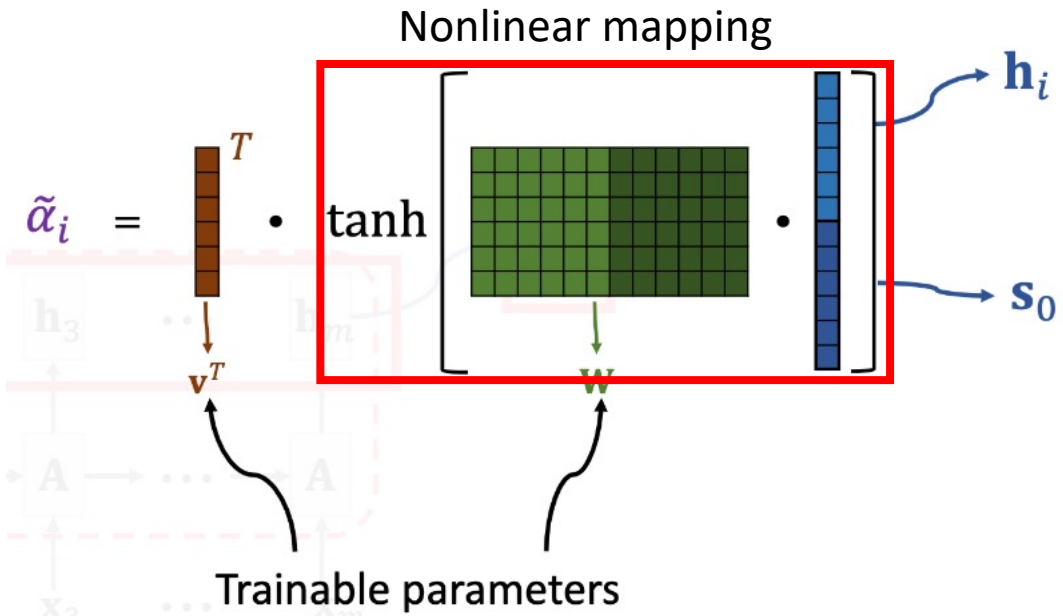

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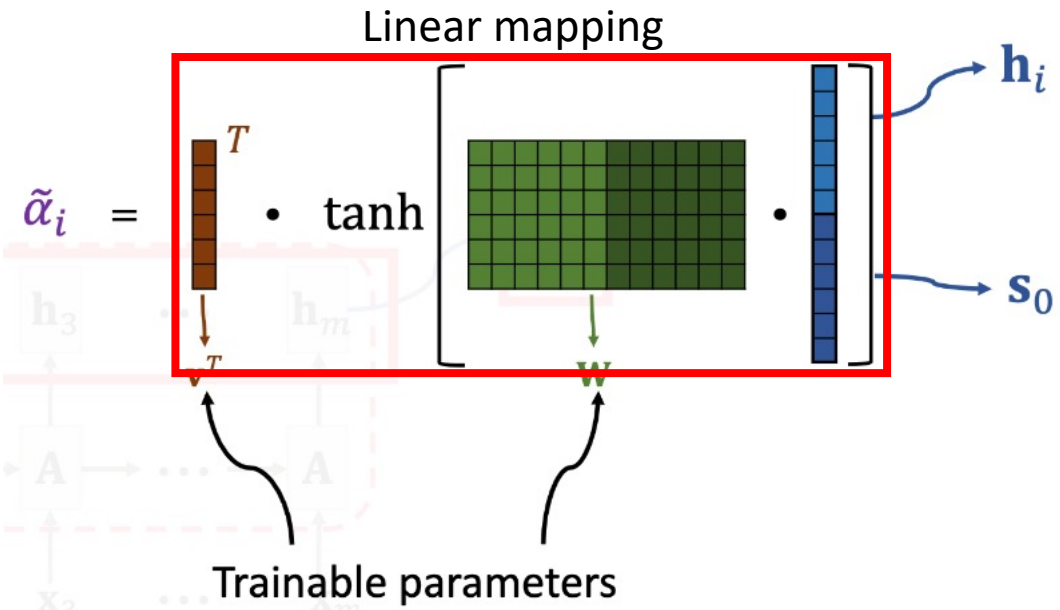

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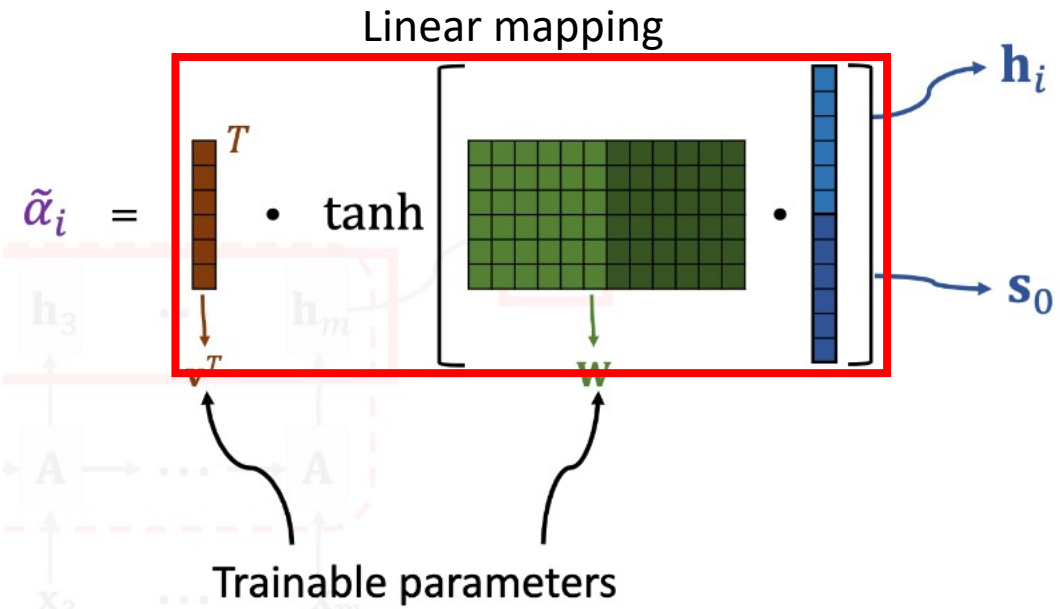

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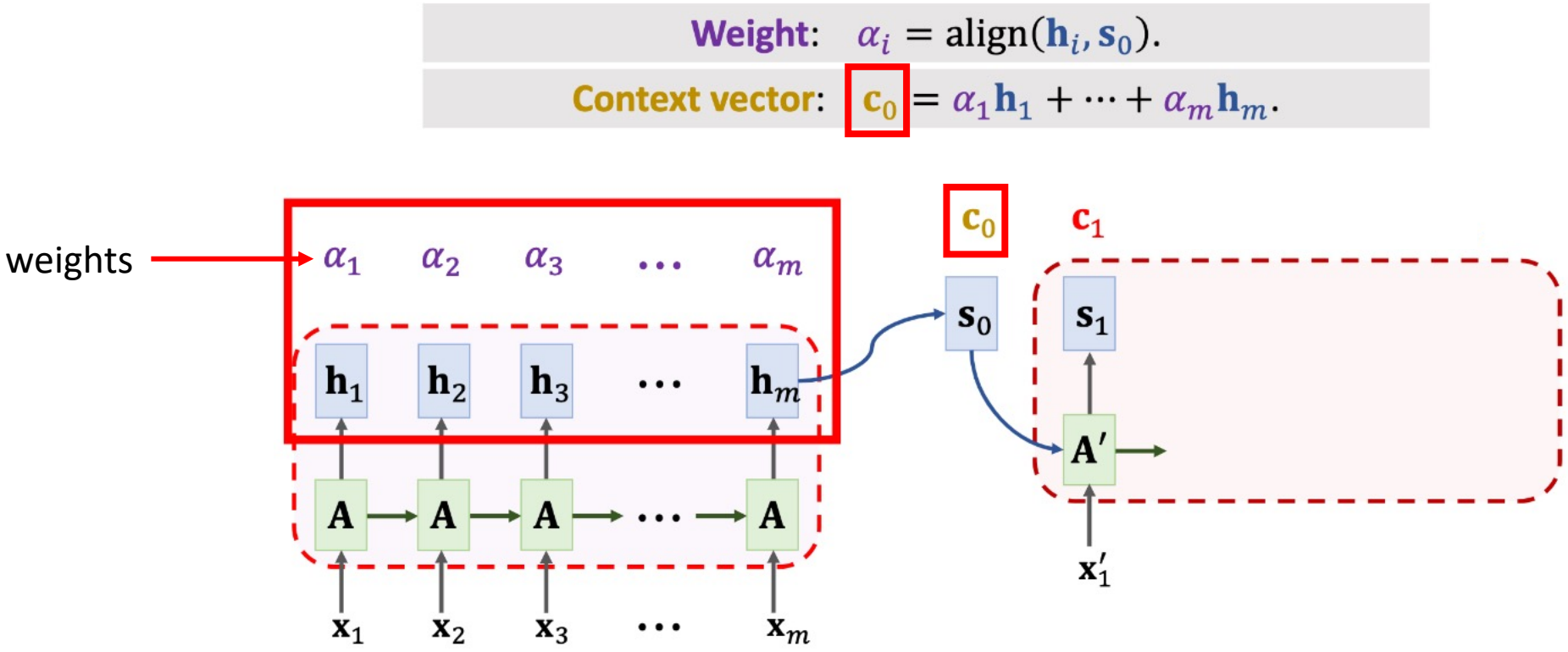
Image from https://github.com/wangshusen/DeepLearning/blob/master/Slides/9_RNN_8.pdf

Attention mechanism



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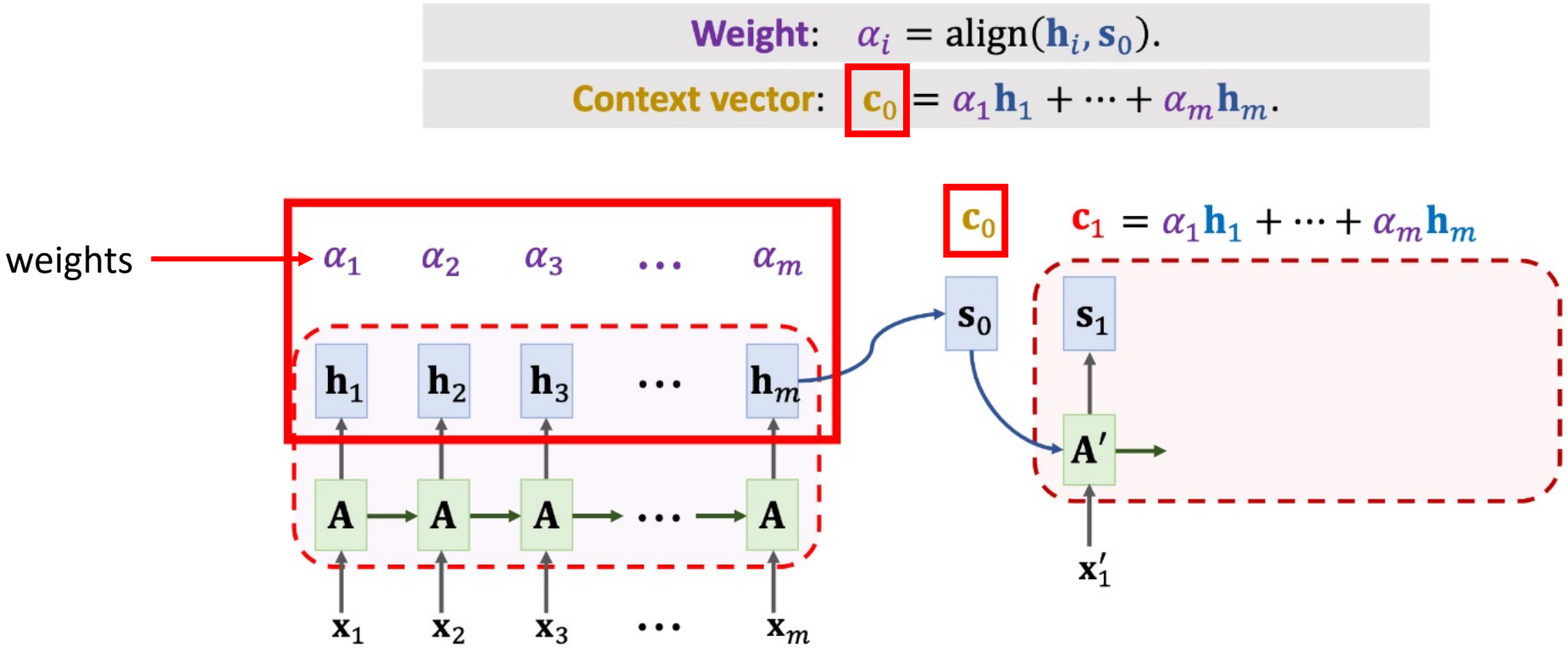
Attention mechanism



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Attention mechanism

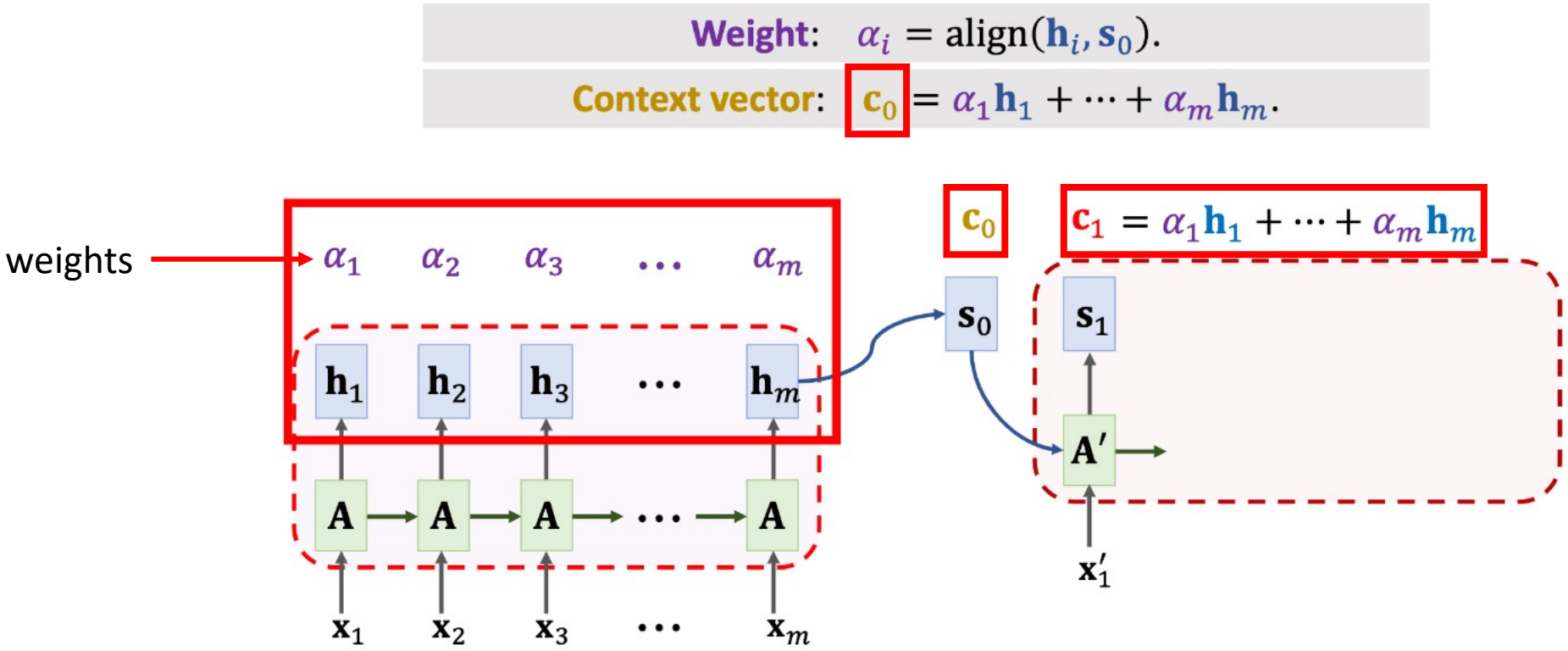


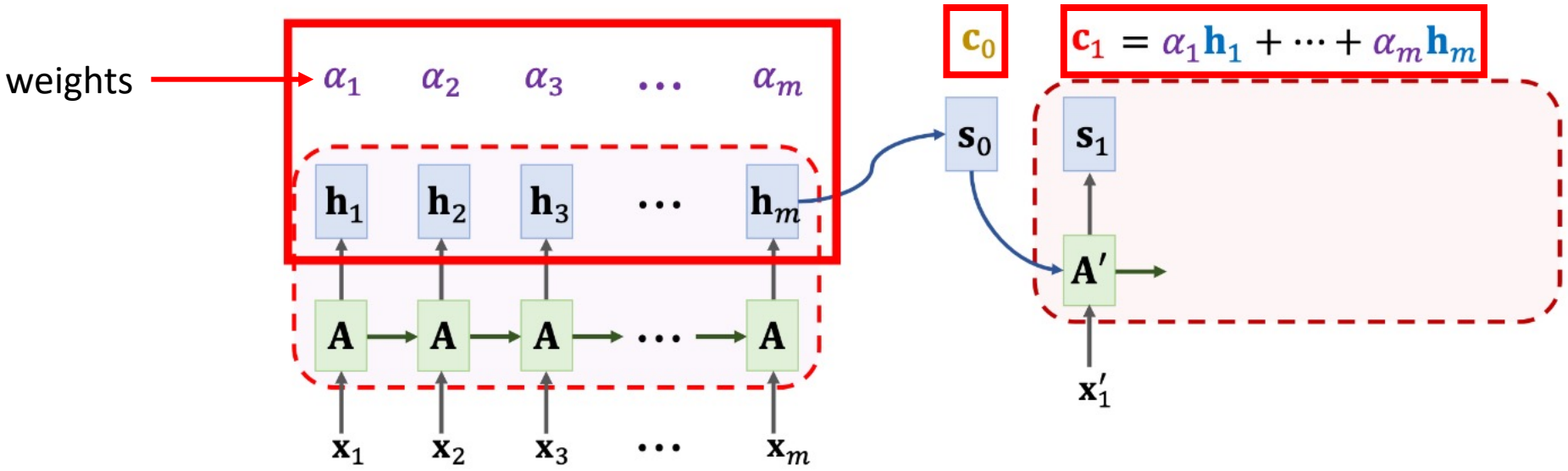
Image from https://github.com/wangshusen/DeepLearning/blob/master/Slides/9_RNN_8.pdf

Attention mechanism

Weight: $\alpha_i = \text{align}(\mathbf{h}_i, \mathbf{s}_0)$.

Context vector: $\mathbf{c}_0 = \alpha_1 \mathbf{h}_1 + \cdots + \alpha_m \mathbf{h}_m$.

Q: should we use different $\alpha's$ for different c_t?



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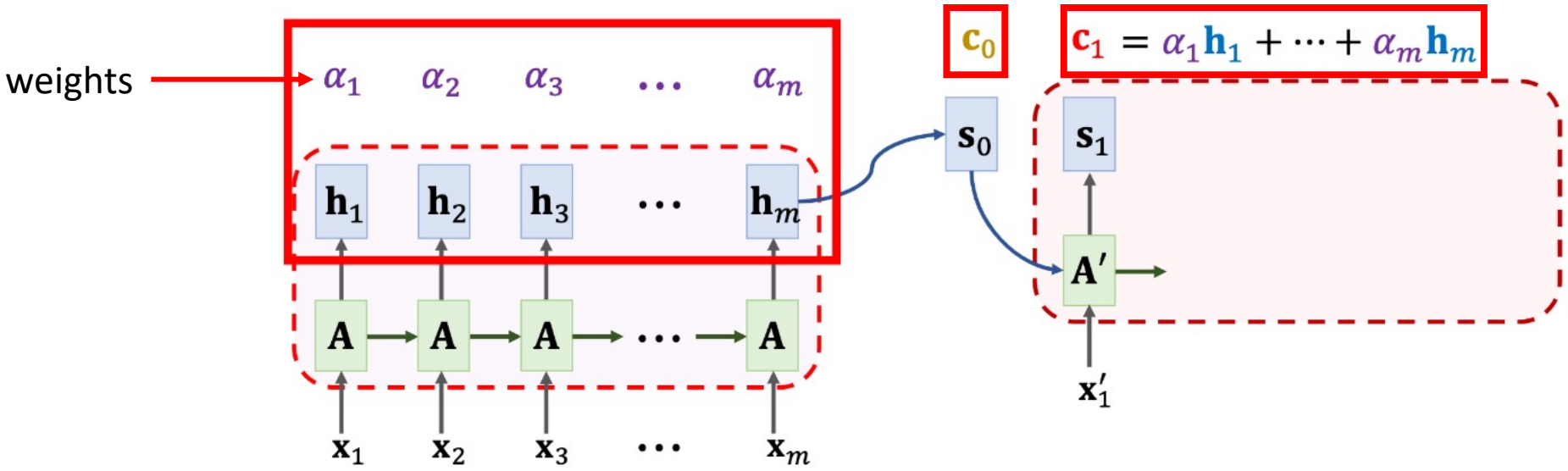

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Attention mechanism

$$c_i = \sum_{j=1}^{T_x} \alpha_{ij} h_j.$$

In the original paper

Weight: $\alpha_i = \text{align}(\mathbf{h}_i, \mathbf{s}_0)$.

Context vector: $\mathbf{c}_0 = \alpha_1 \mathbf{h}_1 + \cdots + \alpha_m \mathbf{h}_m$.

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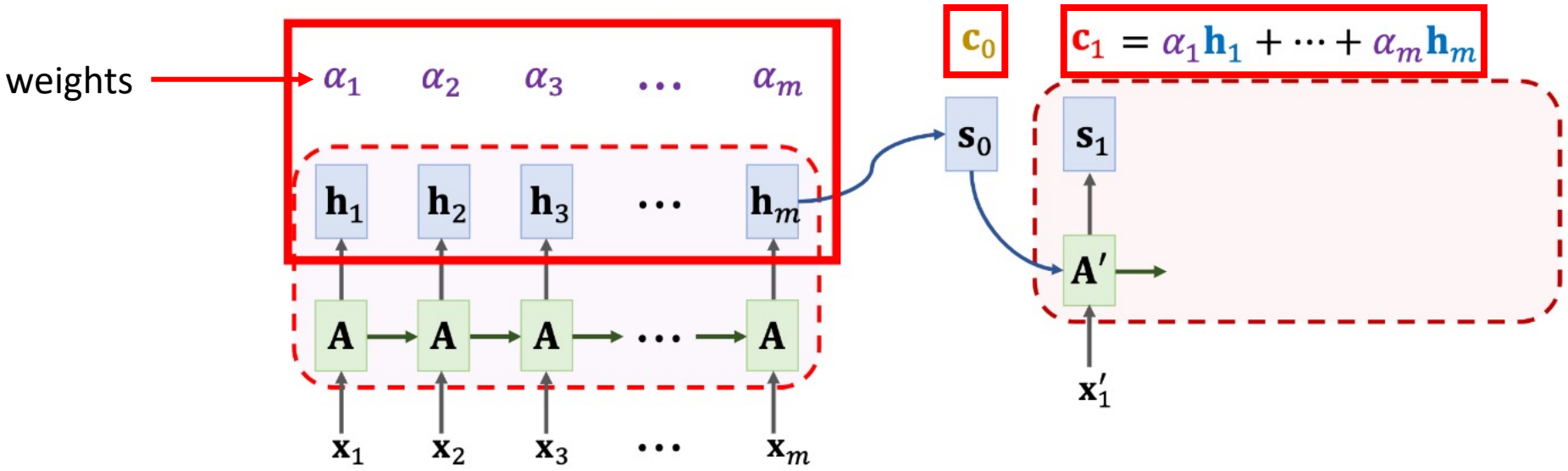

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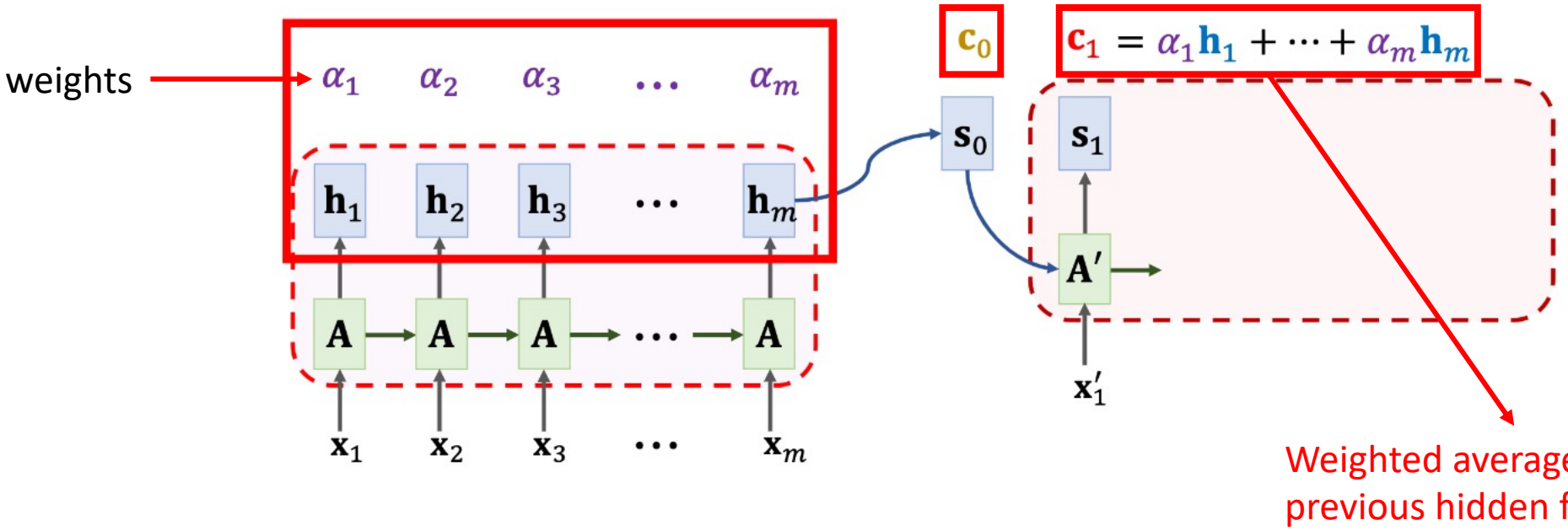

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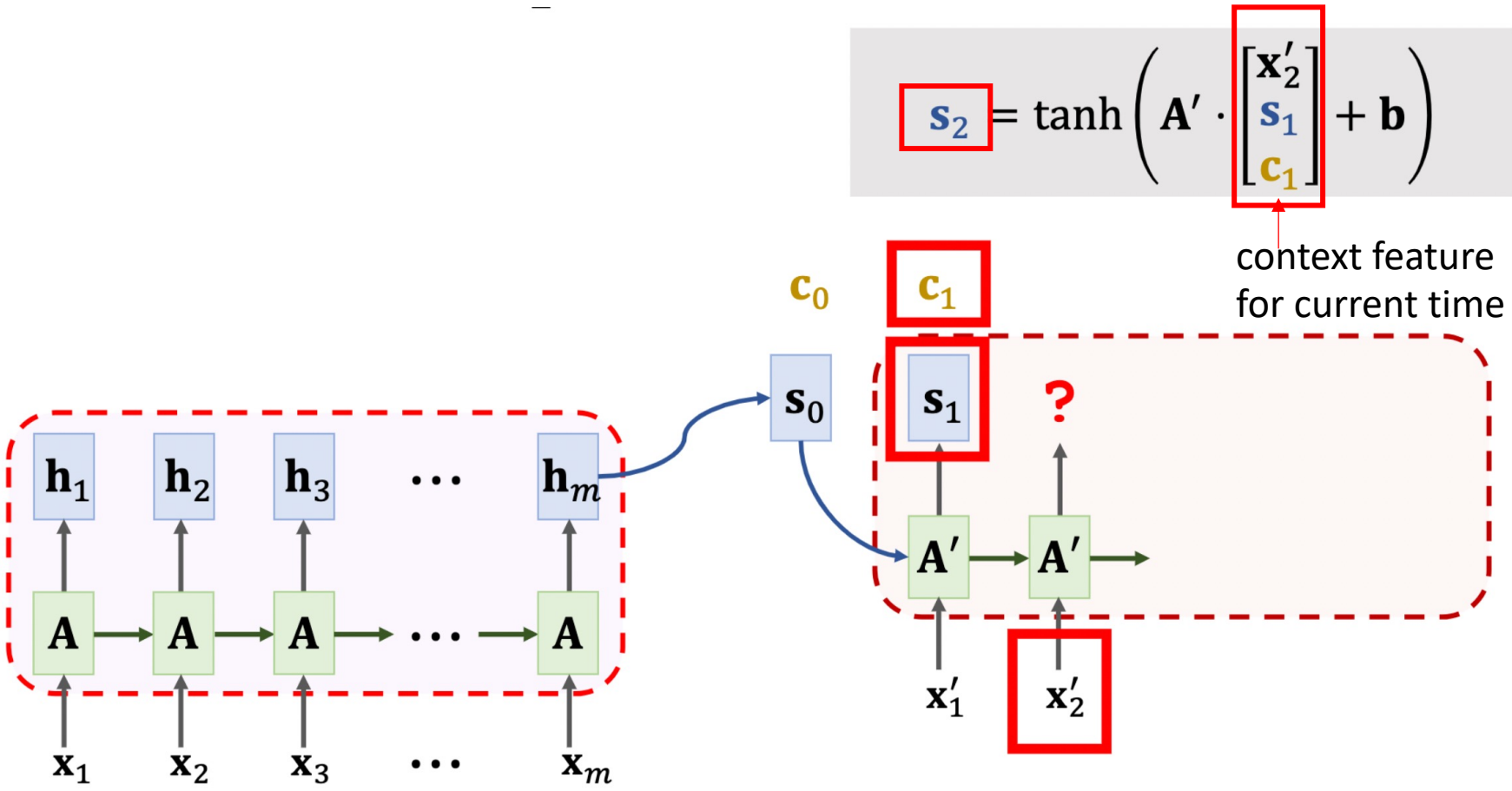
Attention mechanism



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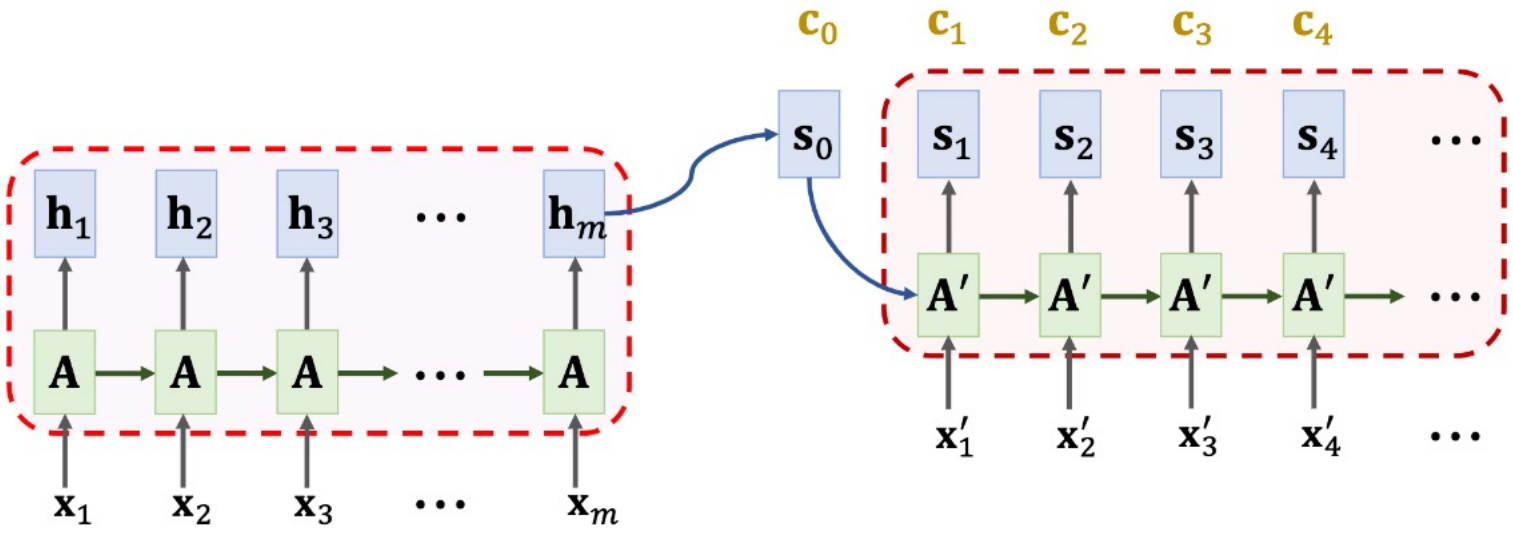
Attention mechanism



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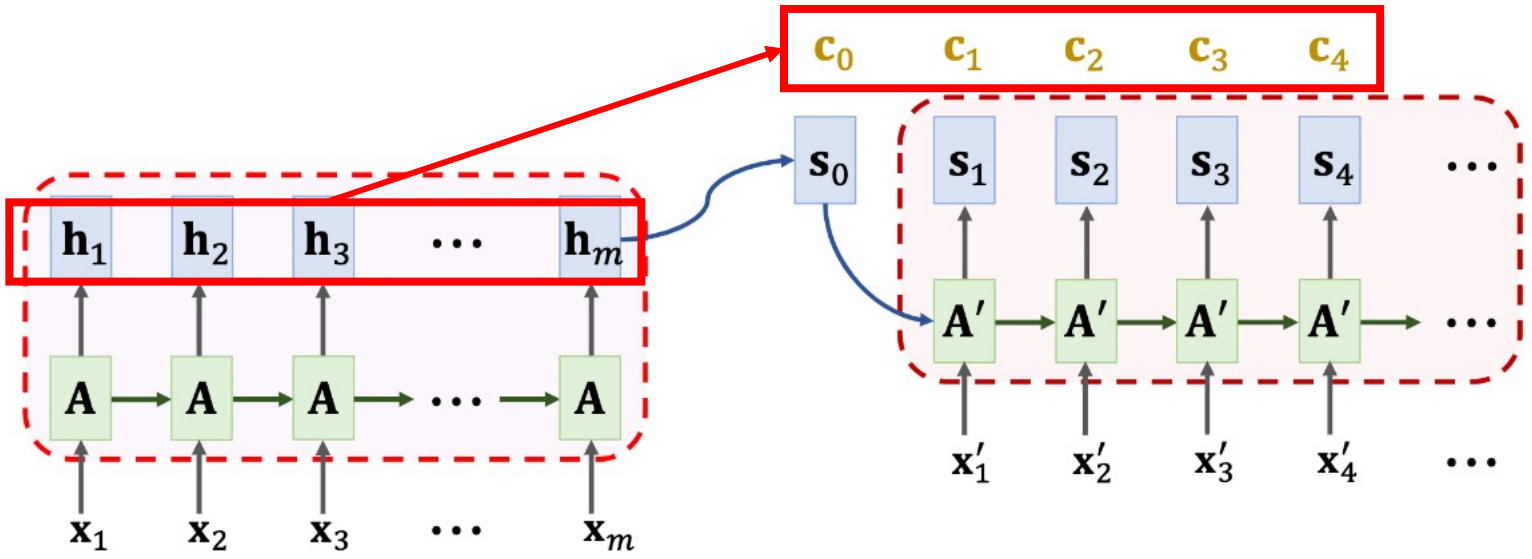
Attention mechanism



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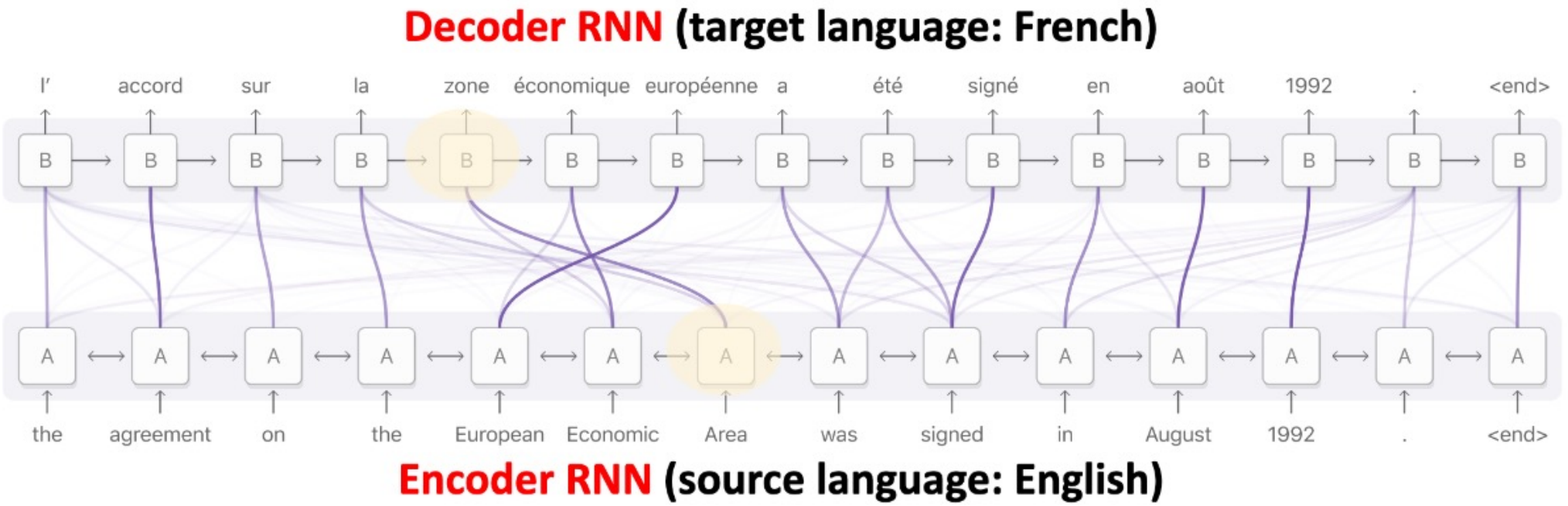
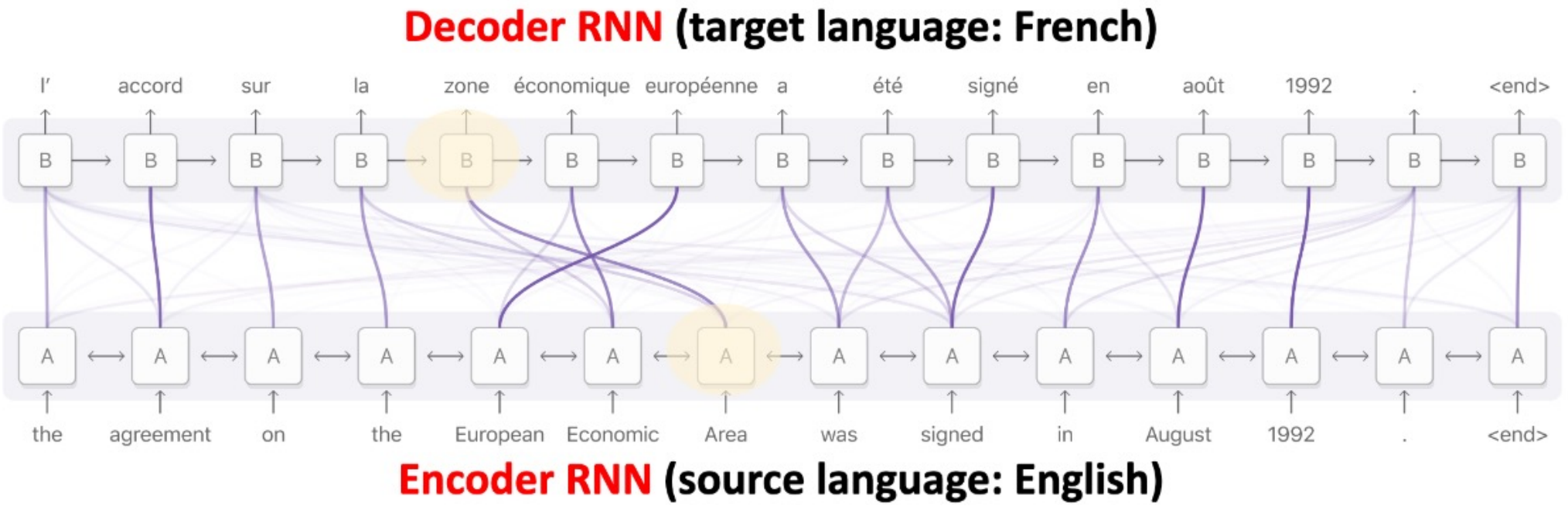
Input-output correlation



Input-output correlation



Q: can we build attention mechanism in a single RNN (e.g., the encoder)?

Self-attention (intra-attention)

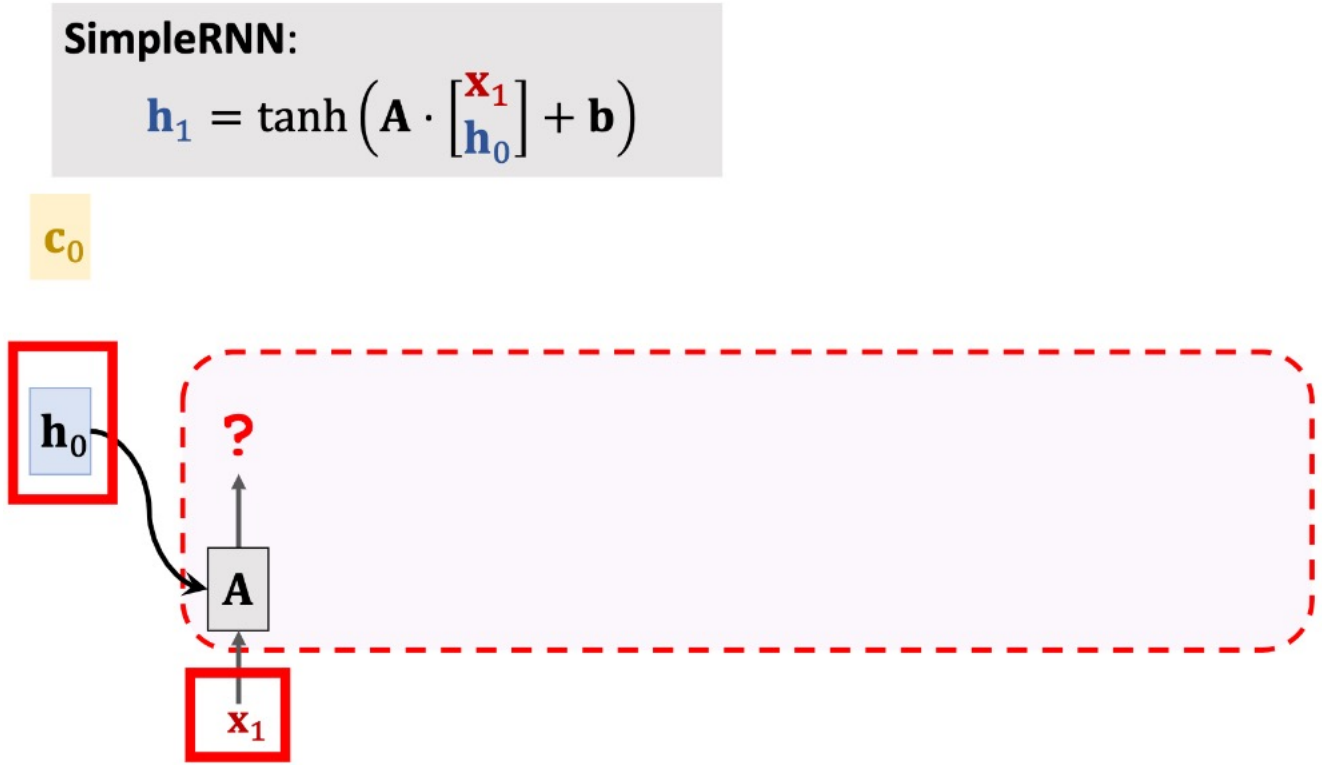


Image from https://github.com/wangshusen/DeepLearning/blob/master/Slides/9_RNN_9.pdf

Self-attention (intra-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:

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

Image from https://github.com/wangshusen/DeepLearning/blob/master/Slides/9_RNN_9.pdf

Self-attention (intra-attention)

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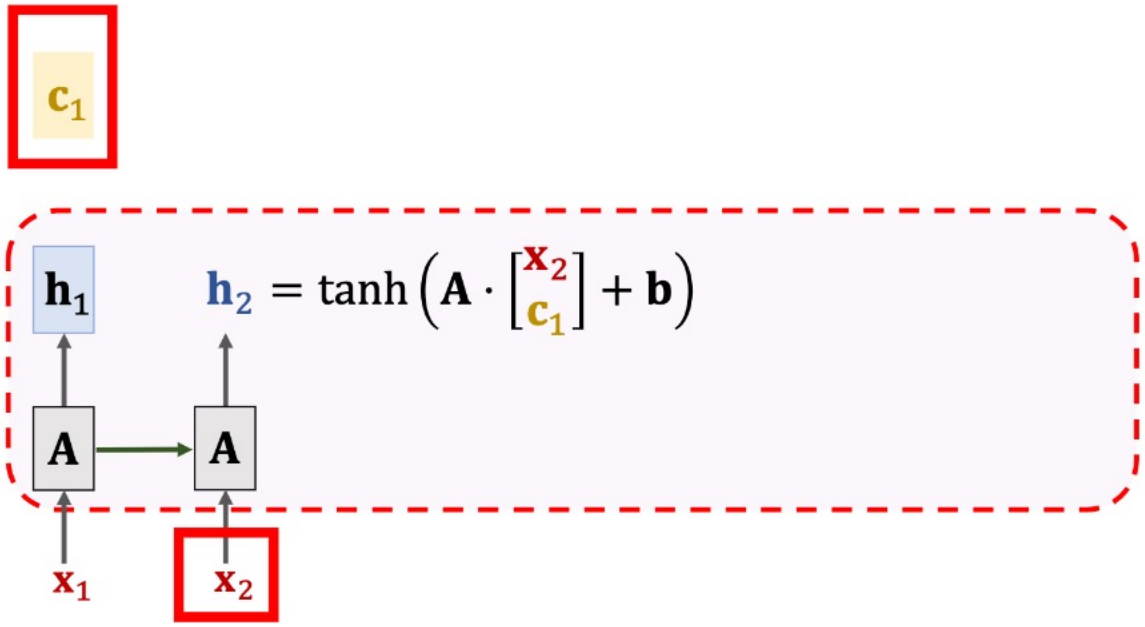
Self-attention (intra-attention)



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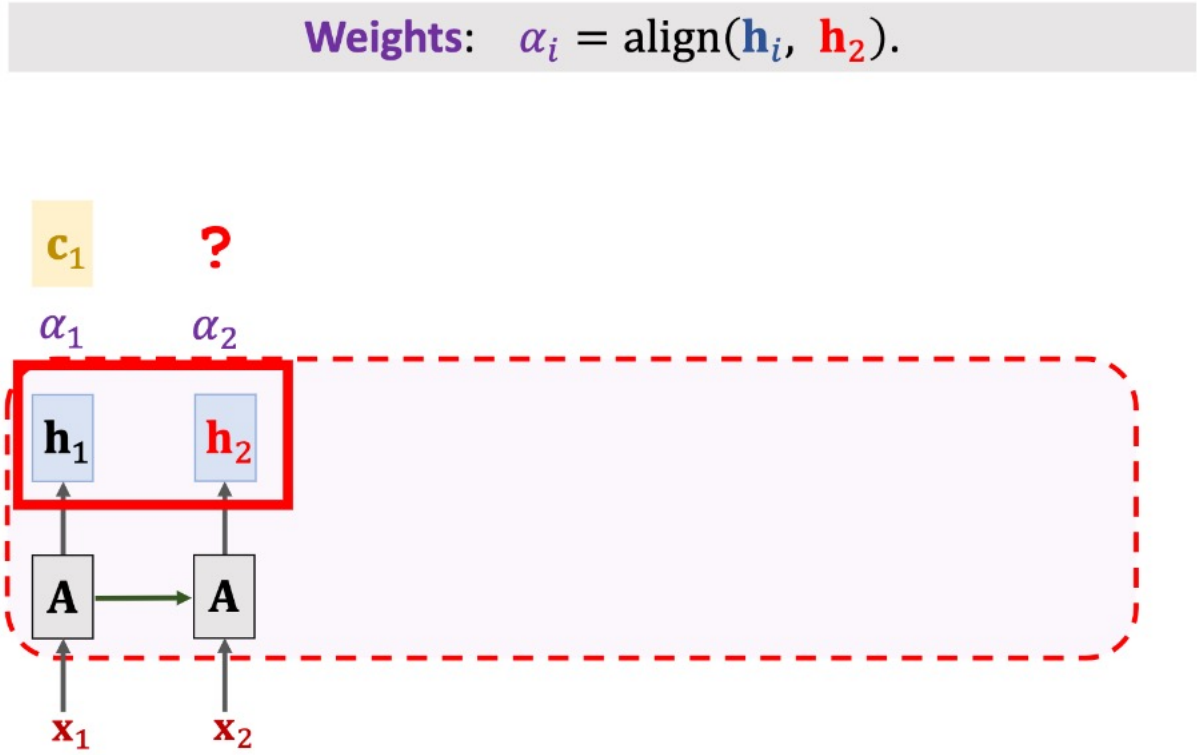

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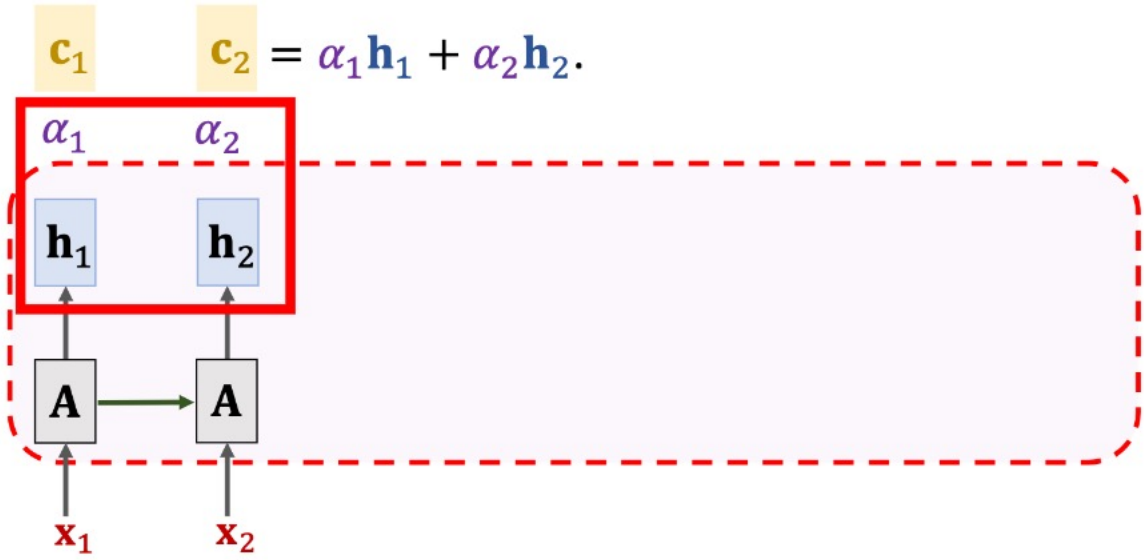

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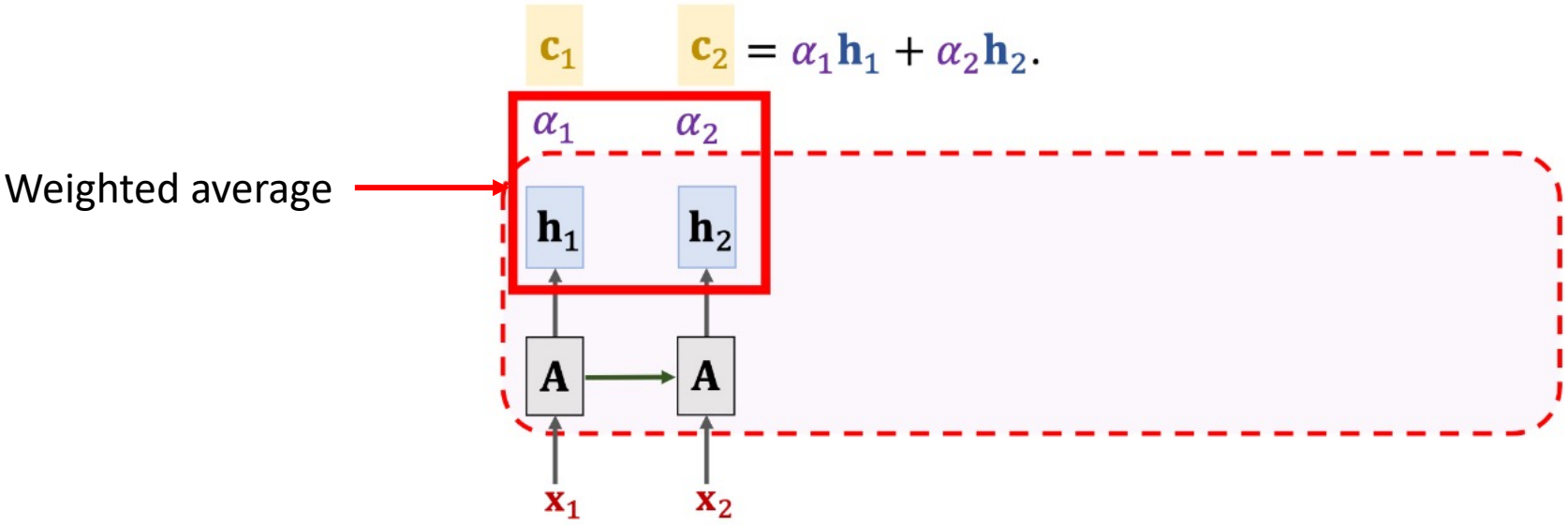

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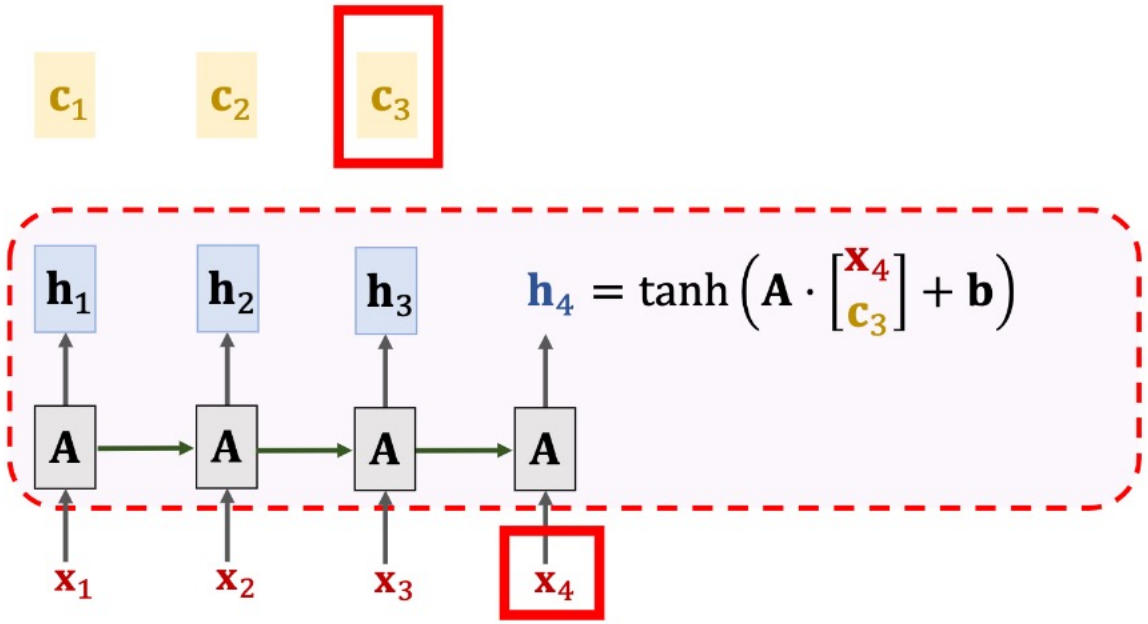

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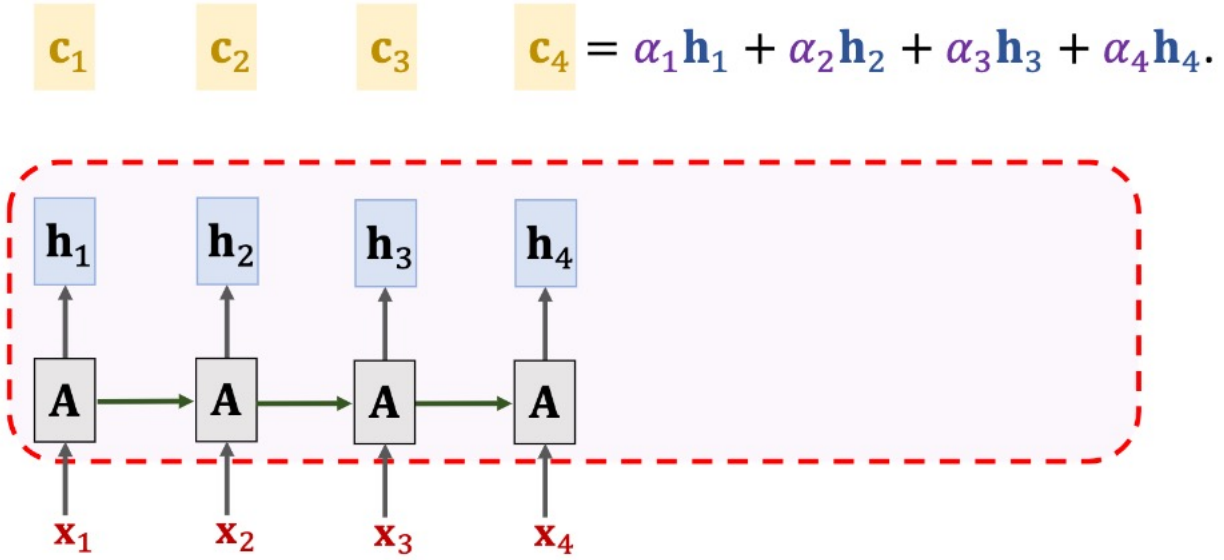
Self-attention (intra-attention)



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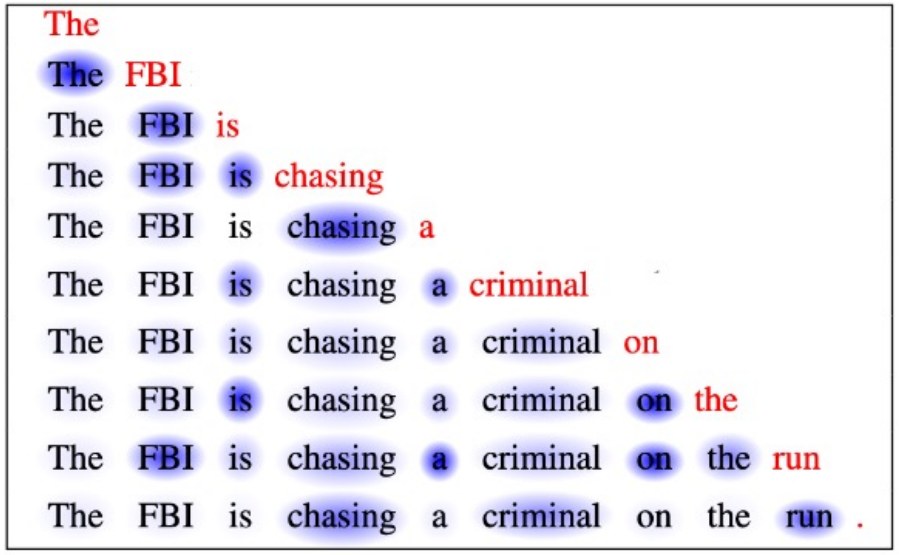
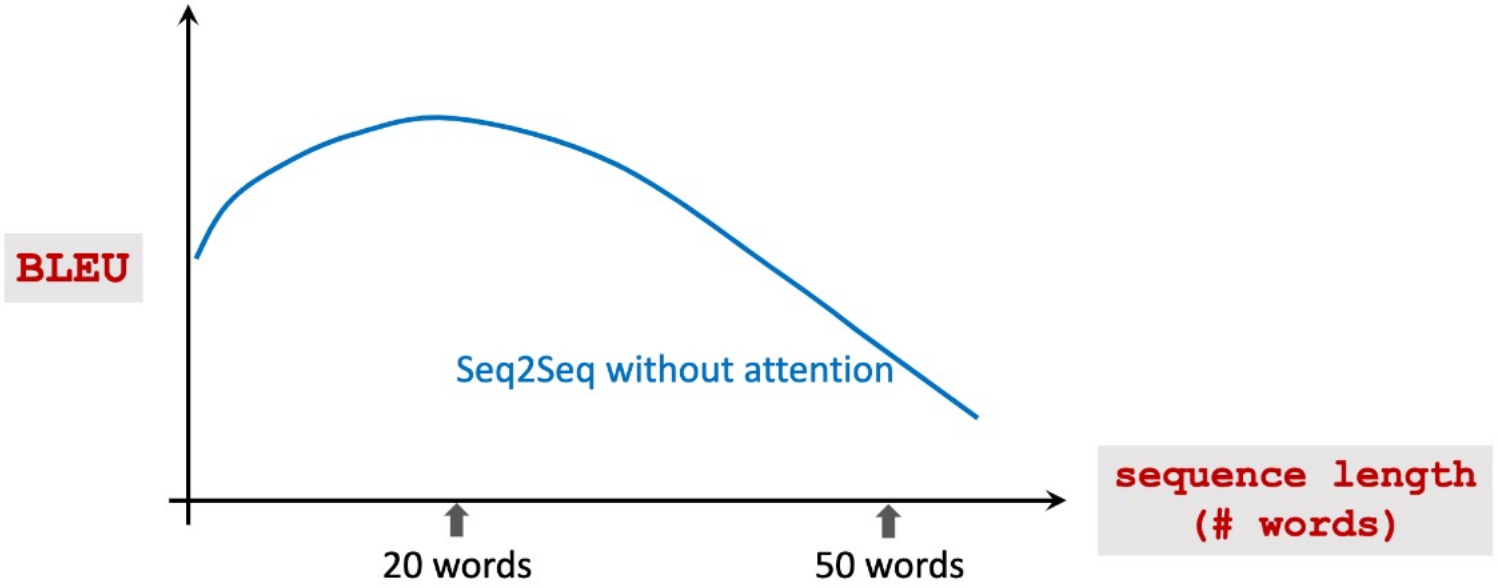


Figure is from the paper " Long Short-Term Memory-Networks for Machine Reading."

Pay attention to the context relevant to the new input

Seq2seq model performance



Seq2seq model performance