Neural Machine Translation in 10 Slides

EMA Summer School

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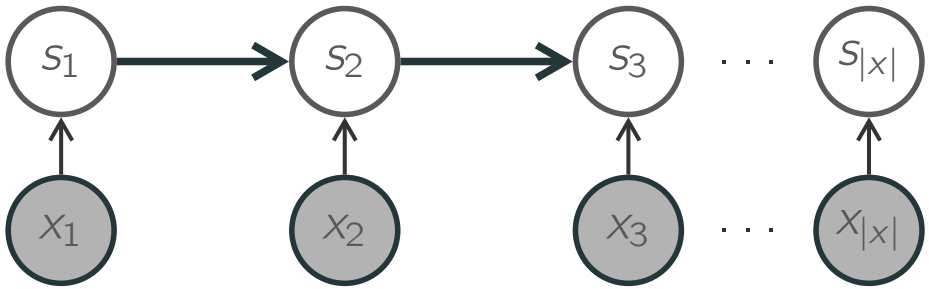
July 11th, 2019

Outline

1. Neural Machine Translation Models

Neural Machine Translation Models

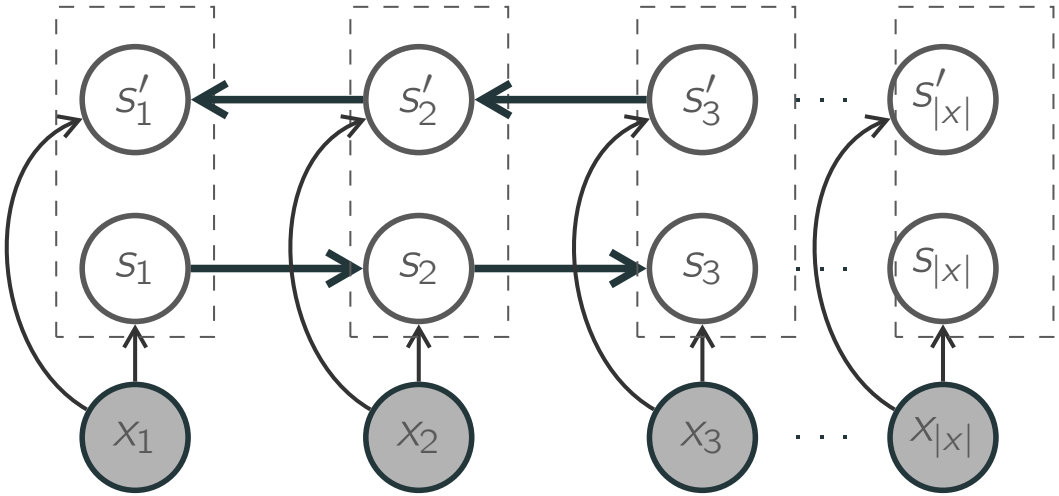
Sequence-to-sequence models | Recurrent networks



Encoder

[Graves, 2013, Sutskever et al., 2014, Cho et al., 2014, Bahdanau et al., 2015]

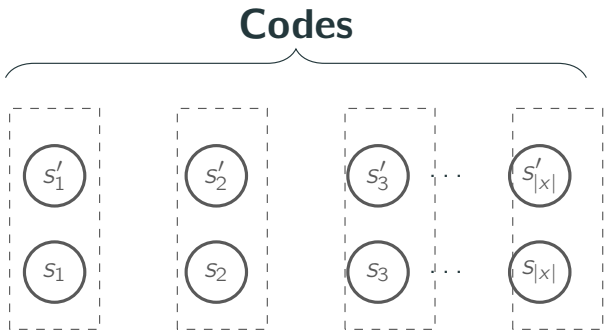
Sequence-to-sequence models | Recurrent networks



Bidirectional encoder

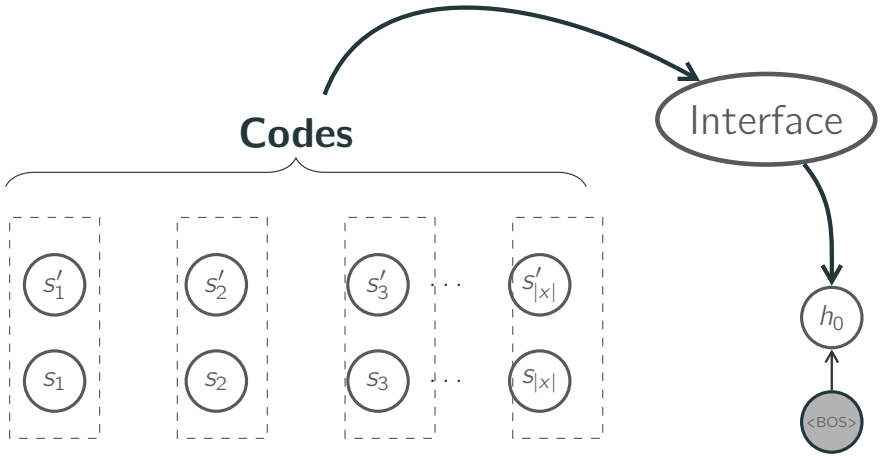
[Graves, 2013, Sutskever et al., 2014, Cho et al., 2014, Bahdanau et al., 2015]

Sequence-to-sequence models | Recurrent networks



[Graves, 2013, Sutskever et al., 2014, Cho et al., 2014, Bahdanau et al., 2015]

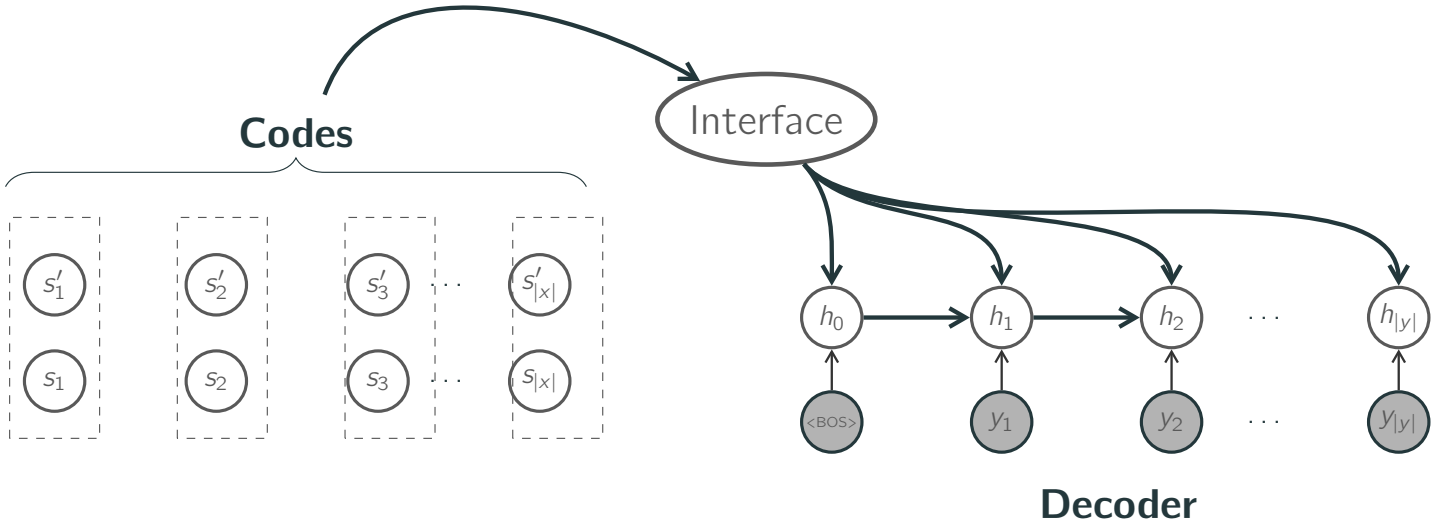
Sequence-to-sequence models | Recurrent networks



Decoder

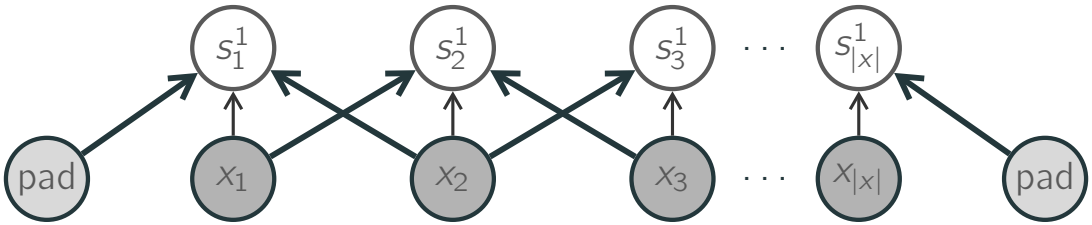
[Graves, 2013, Sutskever et al., 2014, Cho et al., 2014, Bahdanau et al., 2015]

Sequence-to-sequence models | Recurrent networks



[Graves, 2013, Sutskever et al., 2014, Cho et al., 2014, Bahdanau et al., 2015]

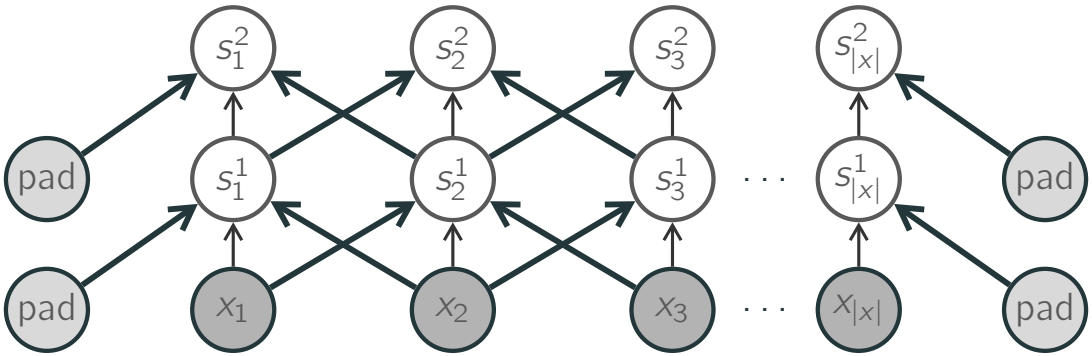
Sequence-to-sequence models | Convolutional networks



Encoder

[Kalchbrenner et al., 2014, Kim, 2014, Gehring et al., 2017]

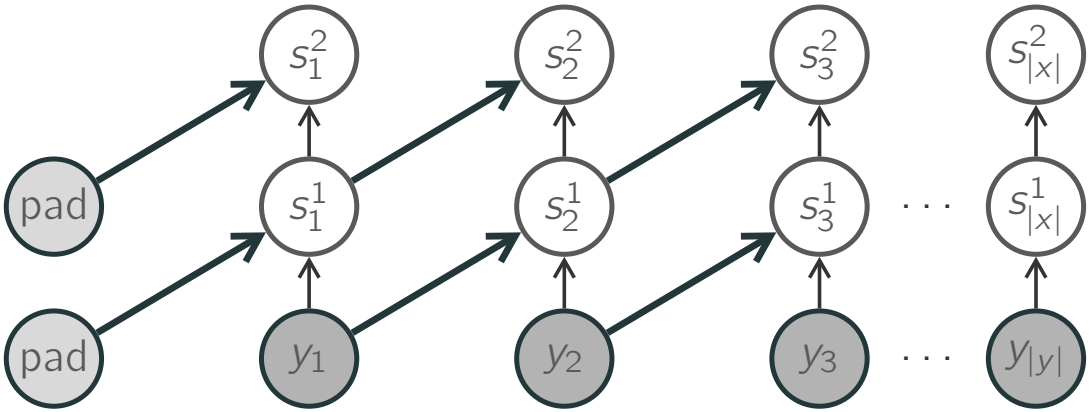
Sequence-to-sequence models | Convolutional networks



Encoder

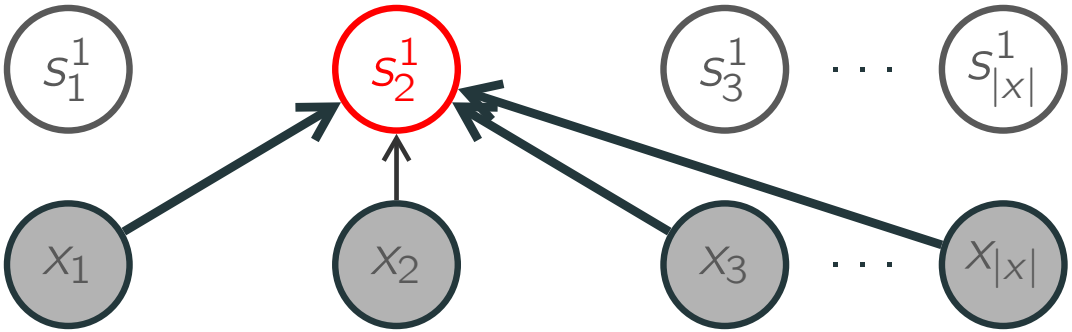
[Kalchbrenner et al., 2014, Kim, 2014, Gehring et al., 2017]

Sequence-to-sequence models | Convolutional networks



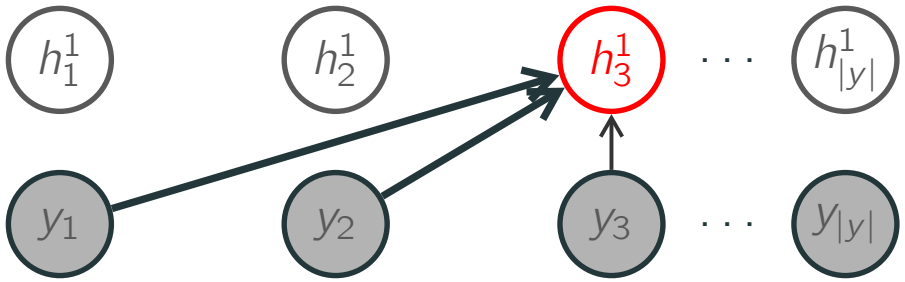
Decoder (Causal convolutions)

[Kalchbrenner et al., 2014, Kim, 2014, Gehring et al., 2017]



Encoder (self-attention)

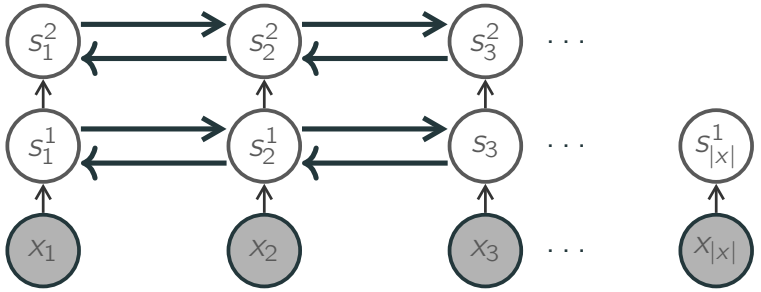
[Vaswani et al., 2017]



Decoder (masked self-attention)

[Vaswani et al., 2017]

Sequence-to-sequence models



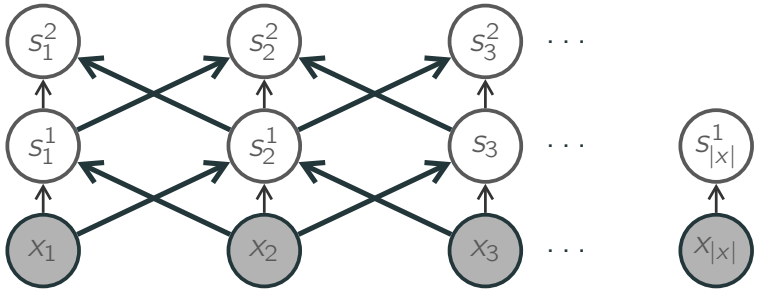
Recurrent

1. Unbounded dependencies.

2. $\mathcal{O}(T)$ sequential steps.

3. Full context.

Sequence-to-sequence models



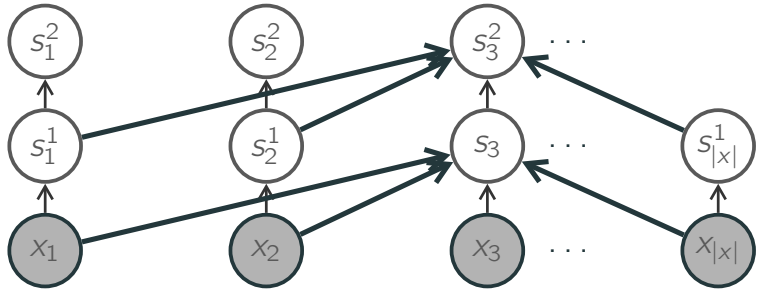
Recurrent

1. Unbounded dependencies.
2. $\mathcal{O}(T)$ sequential steps.
3. Full context.

Convolutional

1. Bounded dependencies.
2. $\mathcal{O}(1)$ sequential steps.
3. Incrementally built context.

Sequence-to-sequence models



Recurrent

1. **Unbounded dependencies.**
2. $\mathcal{O}(T)$ sequential steps.
3. **Full context.**

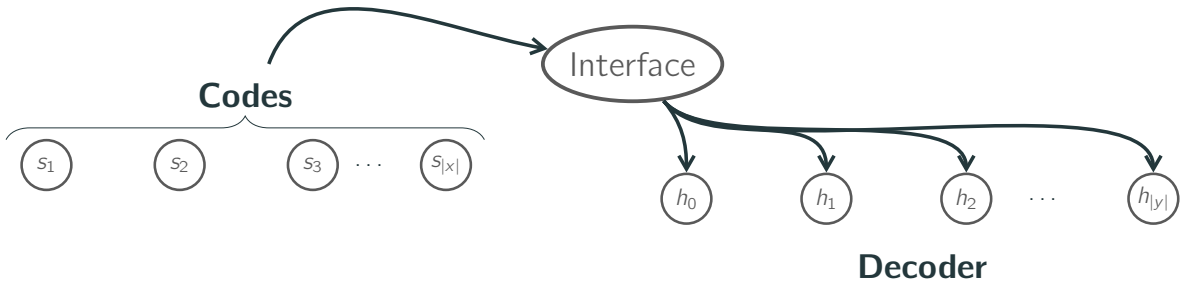
Convolutional

1. Bounded dependencies.
2. $\mathcal{O}(1)$ **sequential steps.**
3. Incrementally built context.

Transformer

1. **Unbounded dependencies.**
2. $\mathcal{O}(1)$ **sequential steps.**
3. **Full context.**

Encoder-decoder interfacing



Single vector:

- context $= s_{|x|}$.
- context $= \frac{1}{|x|} \sum s_i$
- context $= \max s_i$

Only at h_0 or at every time step.

Attention mechanisms:

$$e_i = \text{score}(s_i, h_{t-1}), \forall i$$

$$\alpha = softmax(e_i)_i$$

$$\text{context}_t = \sum_i \alpha_i s_i$$

Illustration: NMT Lab

- You will train your first NMT system using OpenNMT toolkit
- Based on RNNs with attention (but OpenNMT also implements Transformer models)
- Language pair will be French-English (BTEC corpus)
- Training might take a while (be patient)
- Let's start !

References i

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