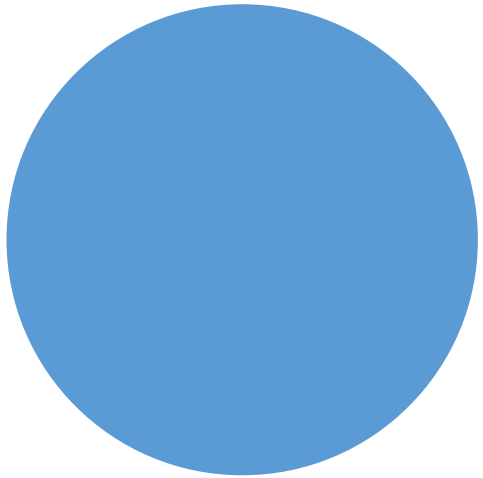
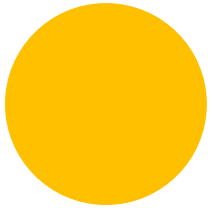



Attention Please!

Attention Mechanisms in Neural Networks

Patrick Michl
www.frootlab.org

PyData Heidelberg #4
2019-11-21

Milestones in Attention Research

Visual Attention in Human Perception

Visual attention in human perception is based on the dynamics between **Recognition** and **Selection**

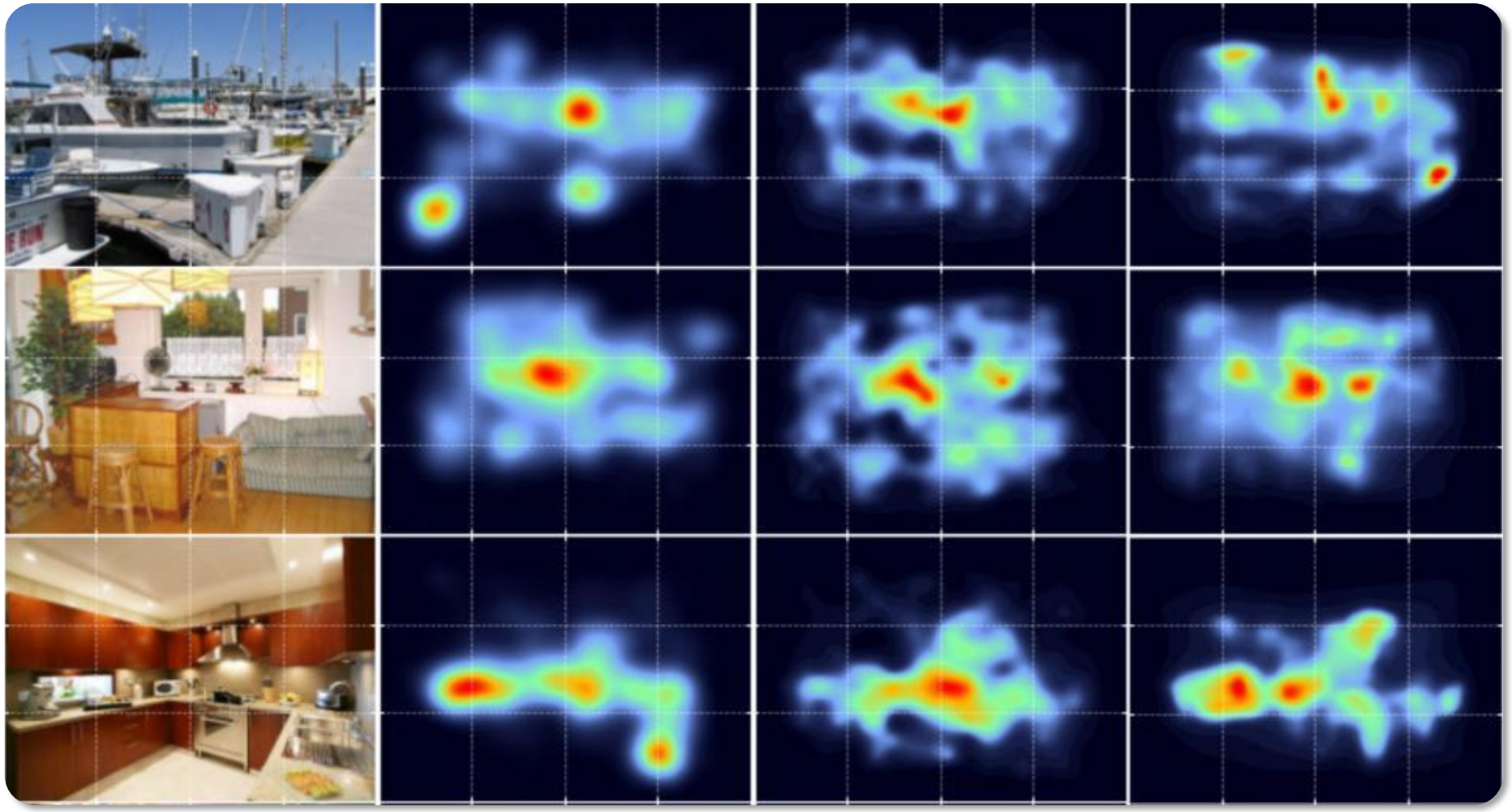
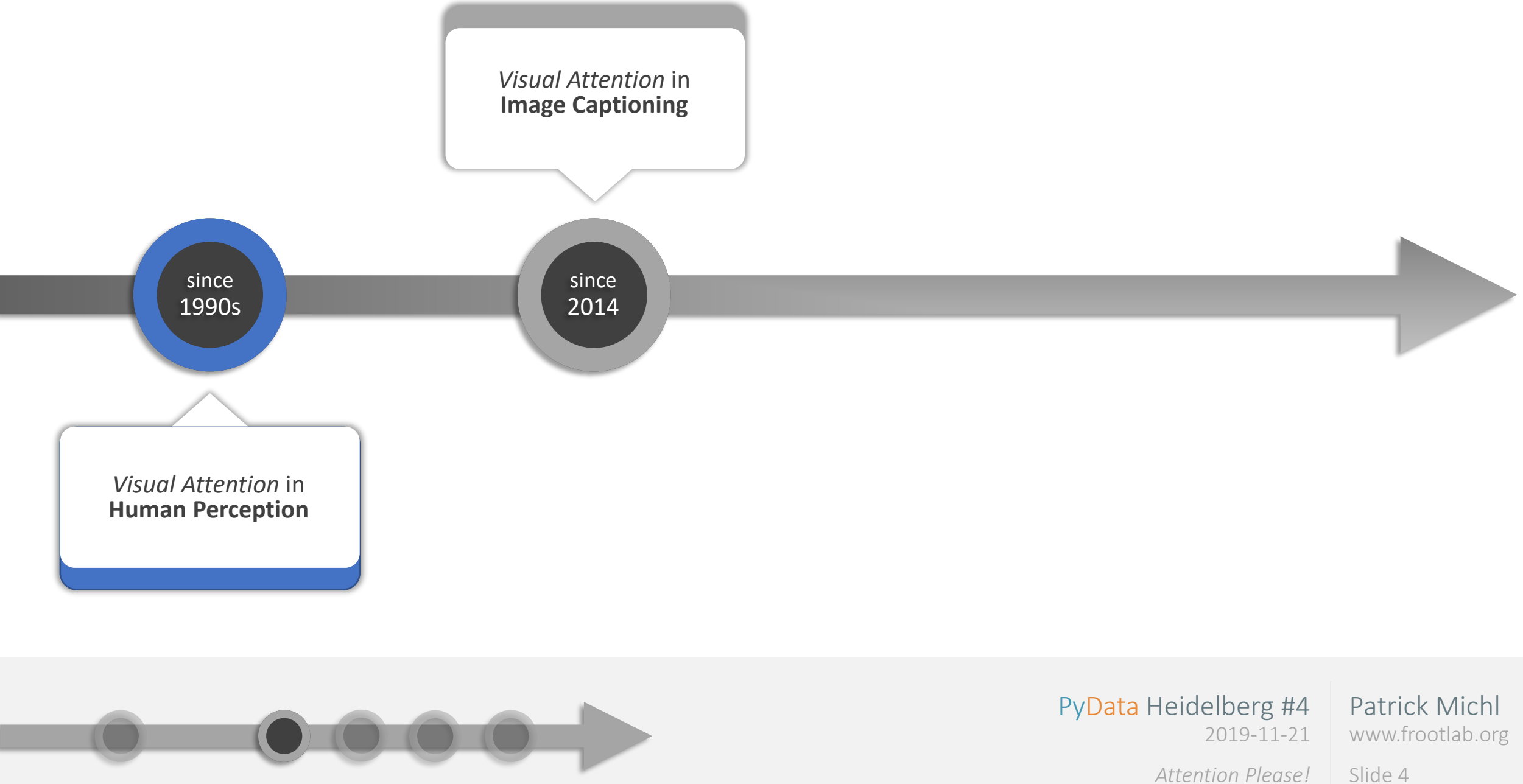


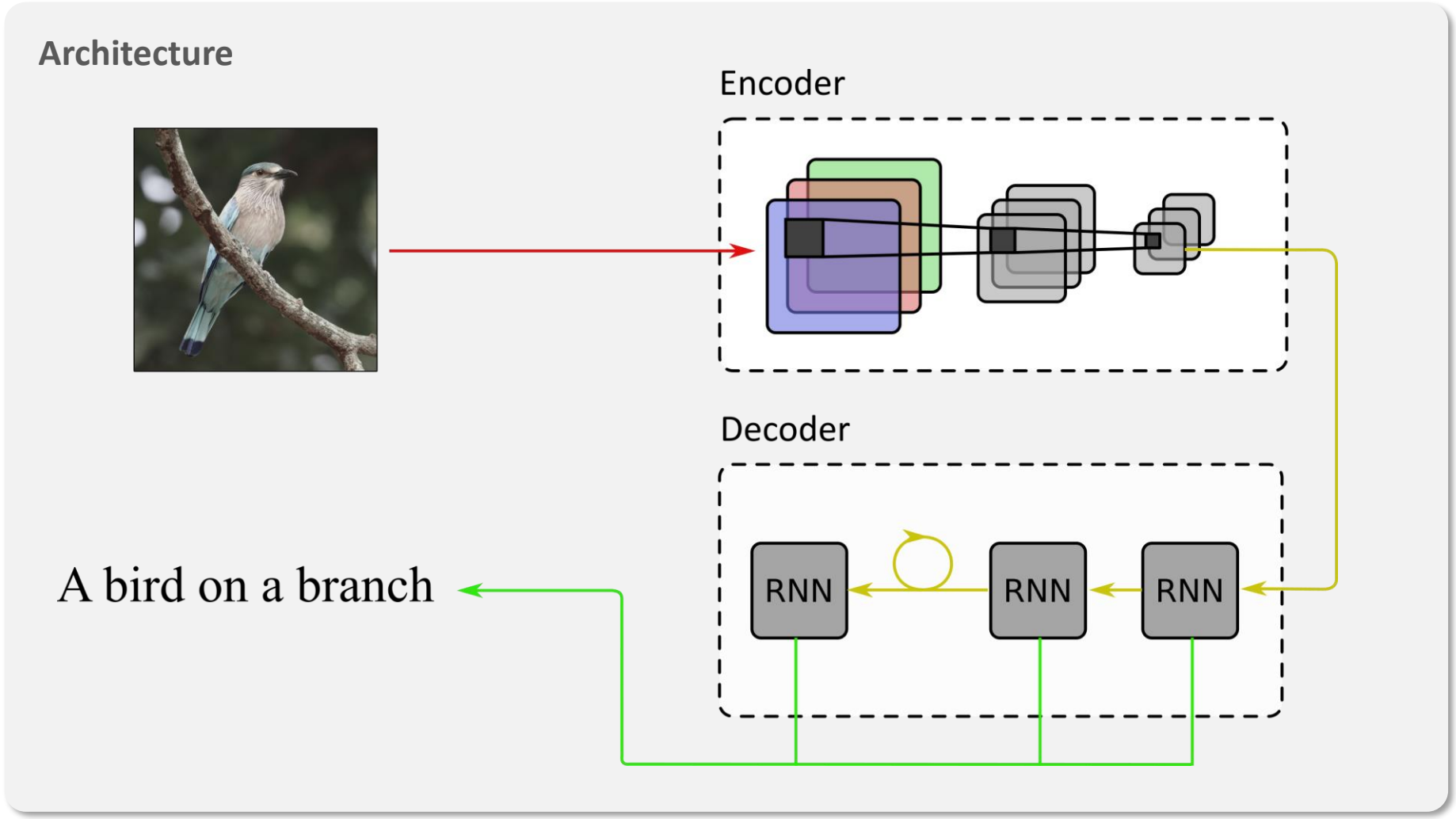
Image source*: John Henderson* and *Taylor Hayes*, UC Davis


Visual Attention in
Image Captioning
since
2014
since
1990s
Visual Attention in
Human Perception

Visual Attention in Image Captioning

Encoder: CNN

Decoder: RNN



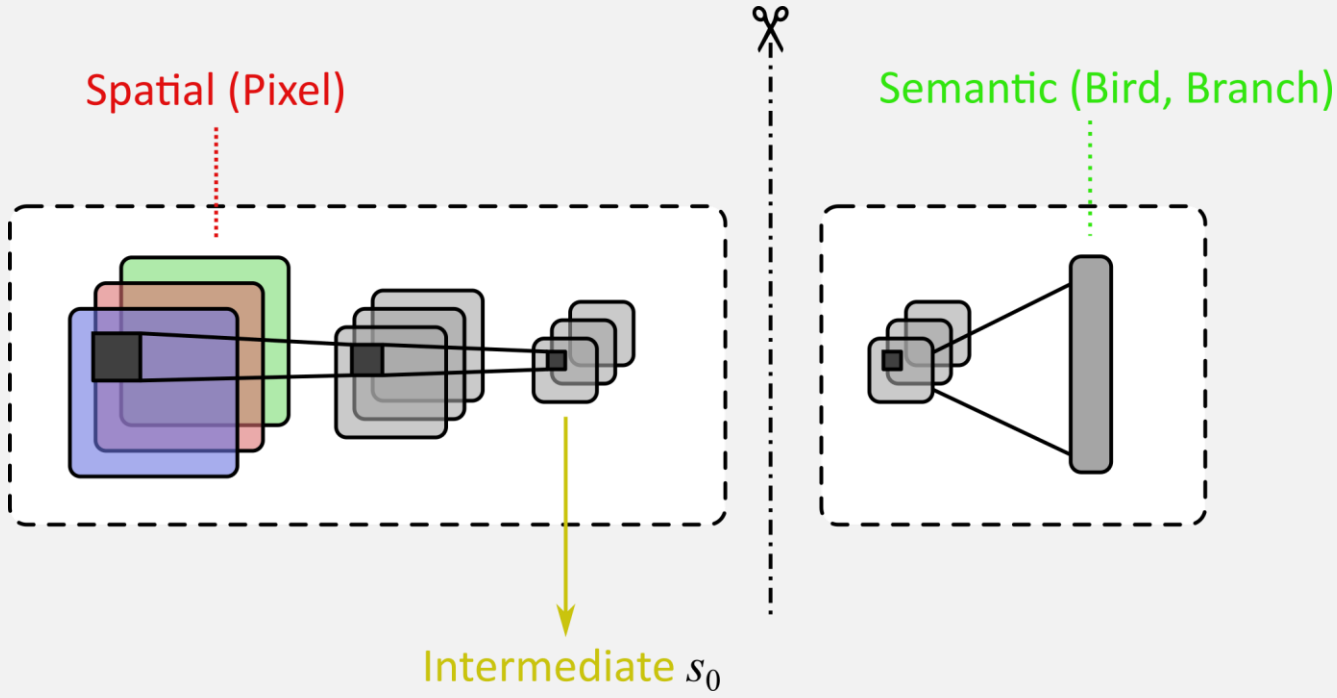
Visual Attention in Image Captioning

Encoder: CNN

Convolutional features entangle spatial with semantic information

Decoder: RNN

Encoder



Visual Attention in Image Captioning

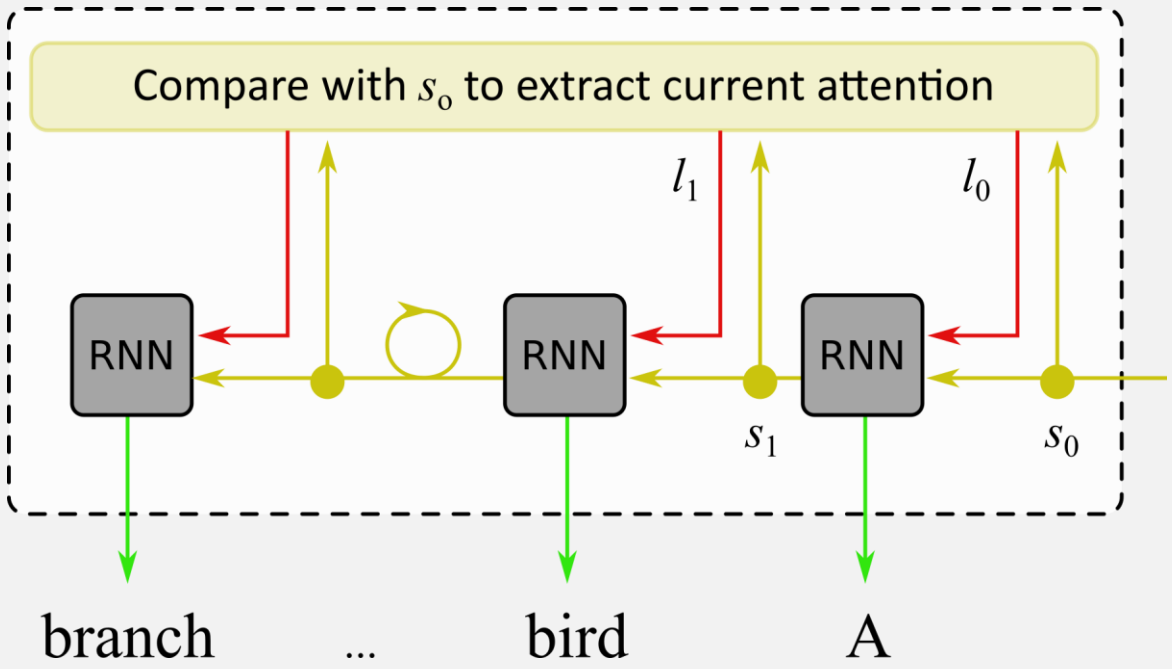
Encoder: CNN

Convolutional features
entangle spatial with semantic information

Decoder: RNN

Visual Attention
allows to recover spatial relations of current outputs

Decoder



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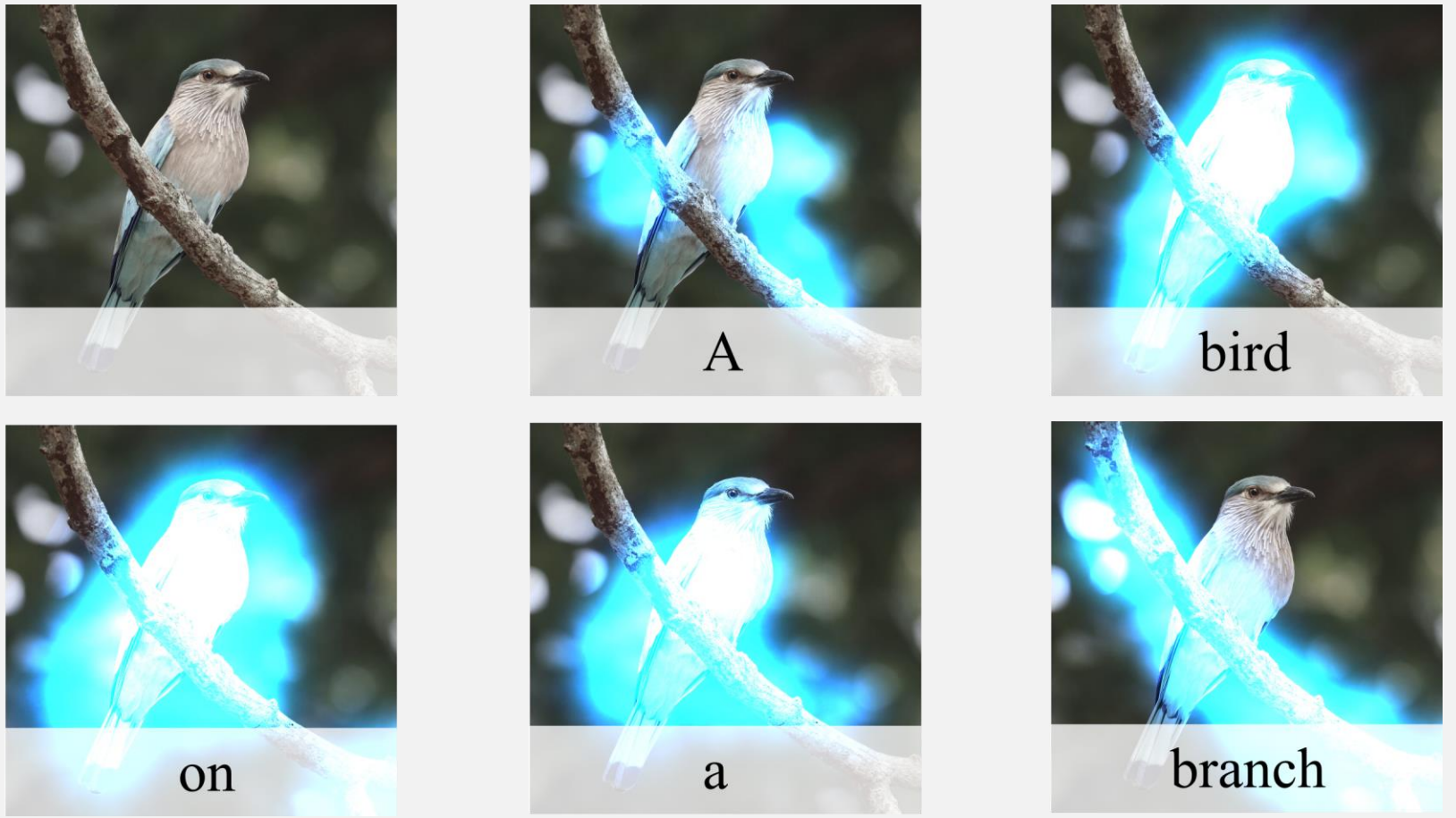
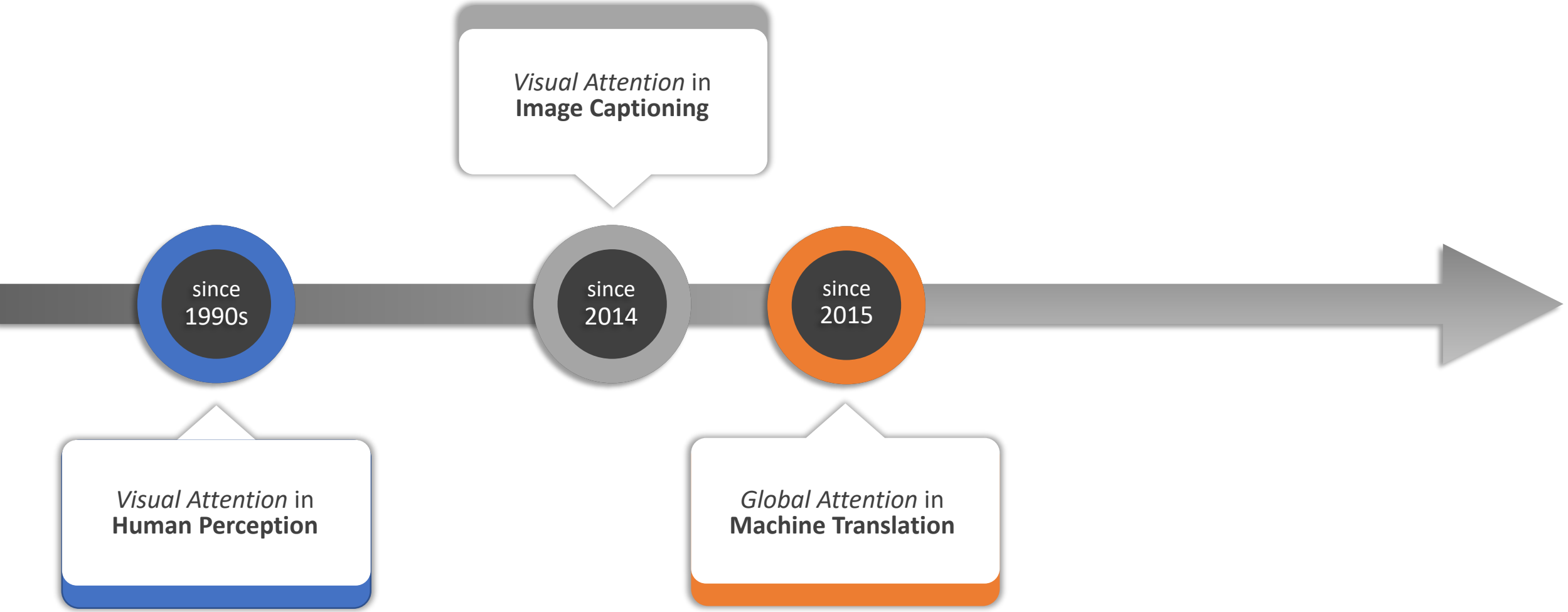


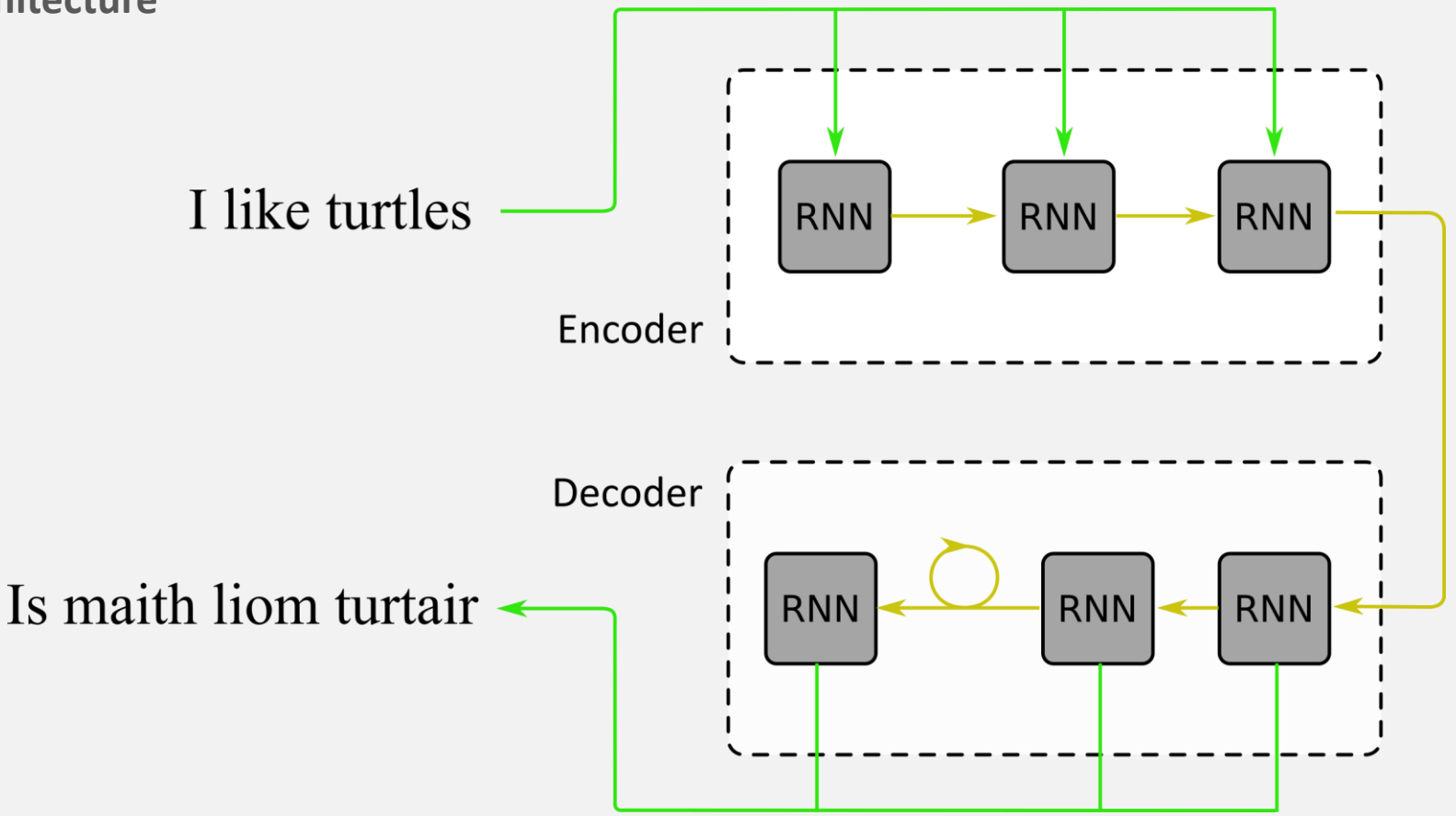

Visual Attention in
Image Captioning
since
1990s
since
2014
since
2015
Visual Attention in
Human Perception
Global Attention in
Machine Translation

Global Attention in Machine Translation

Encoder: RNN

Decoder: RNN

Architecture



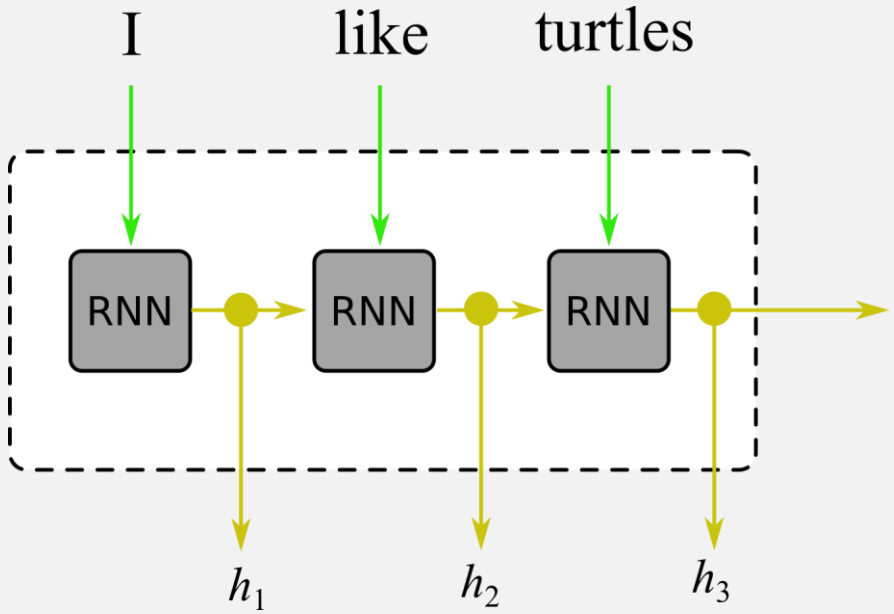
Global Attention in Machine Translation

Encoder: RNN

Sequence of hidden states encodes the context building stack

Decoder: RNN

Encoder



Global Attention in Machine Translation

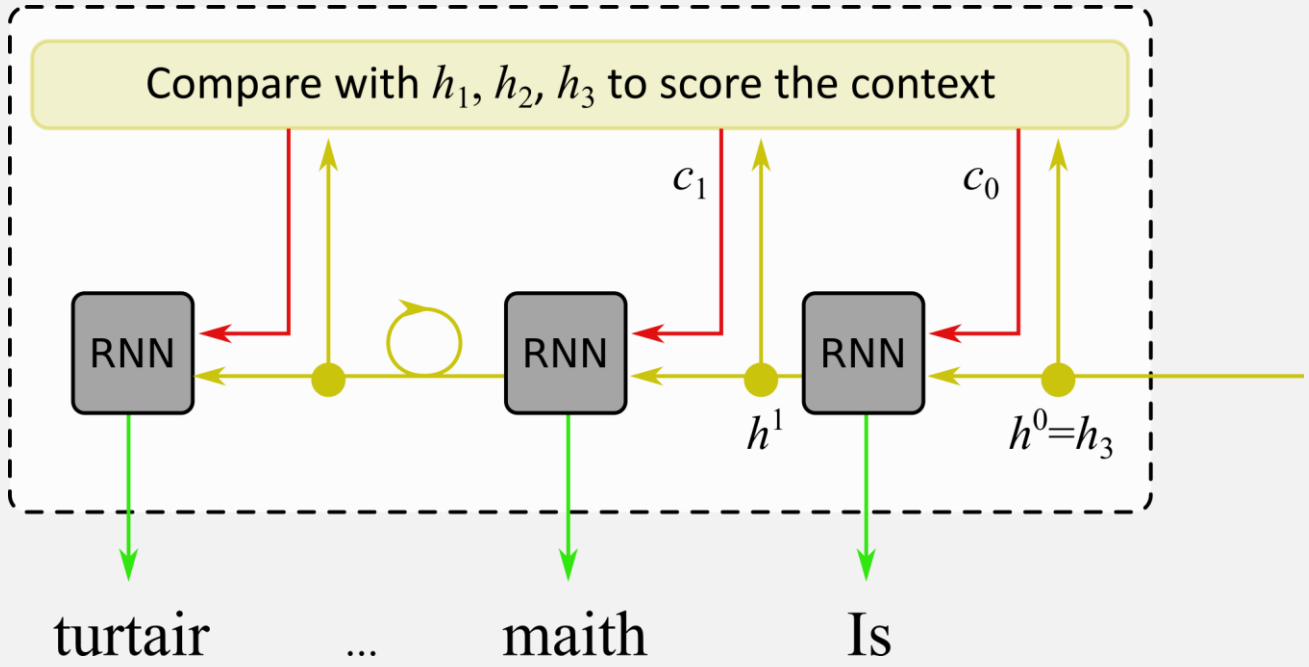
Encoder: RNN

Sequence of hidden states
encodes the context building stack

Decoder: RNN

Global Attention
allows to recover the context of current outputs

Decoder



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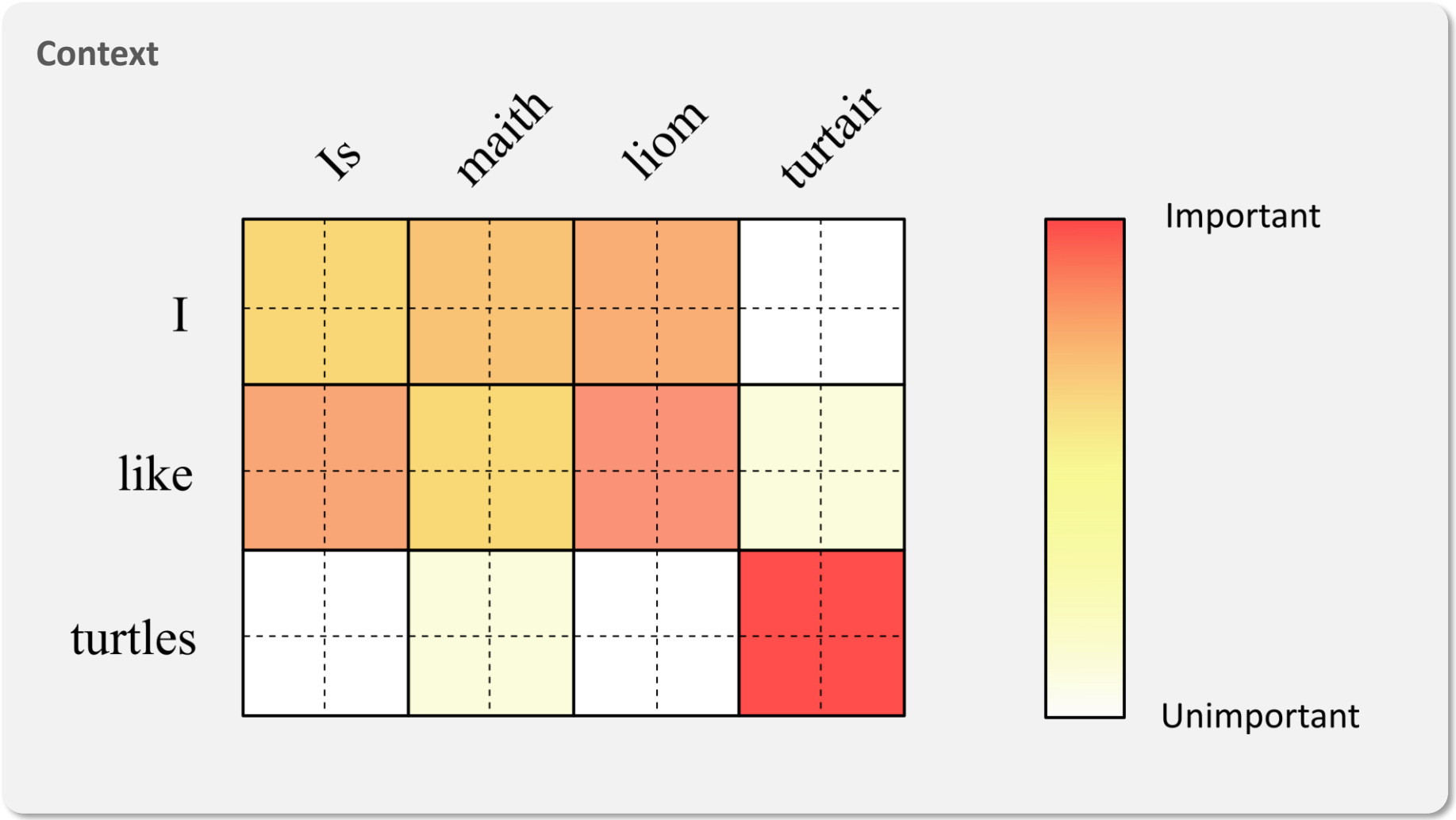

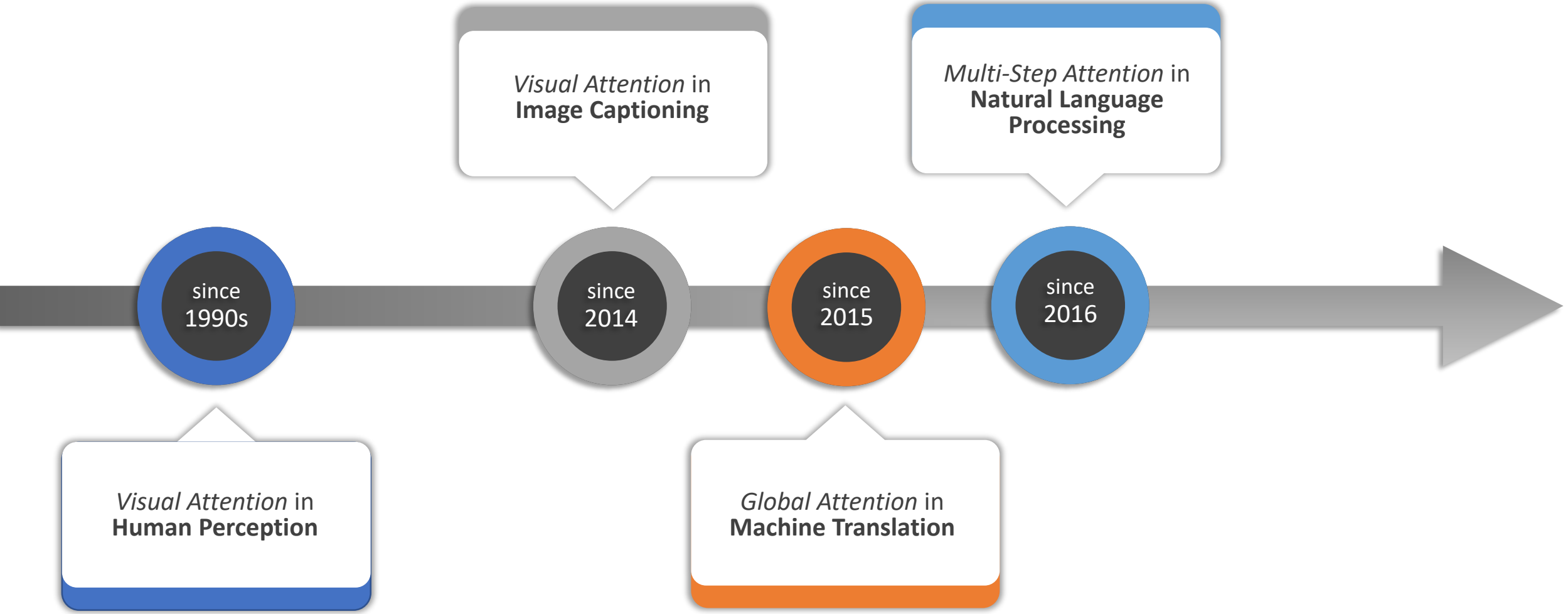
Visual Attention in
Image Captioning
Multi-Step Attention in
Natural Language Processing
since
1990s
since
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2016
Visual Attention in
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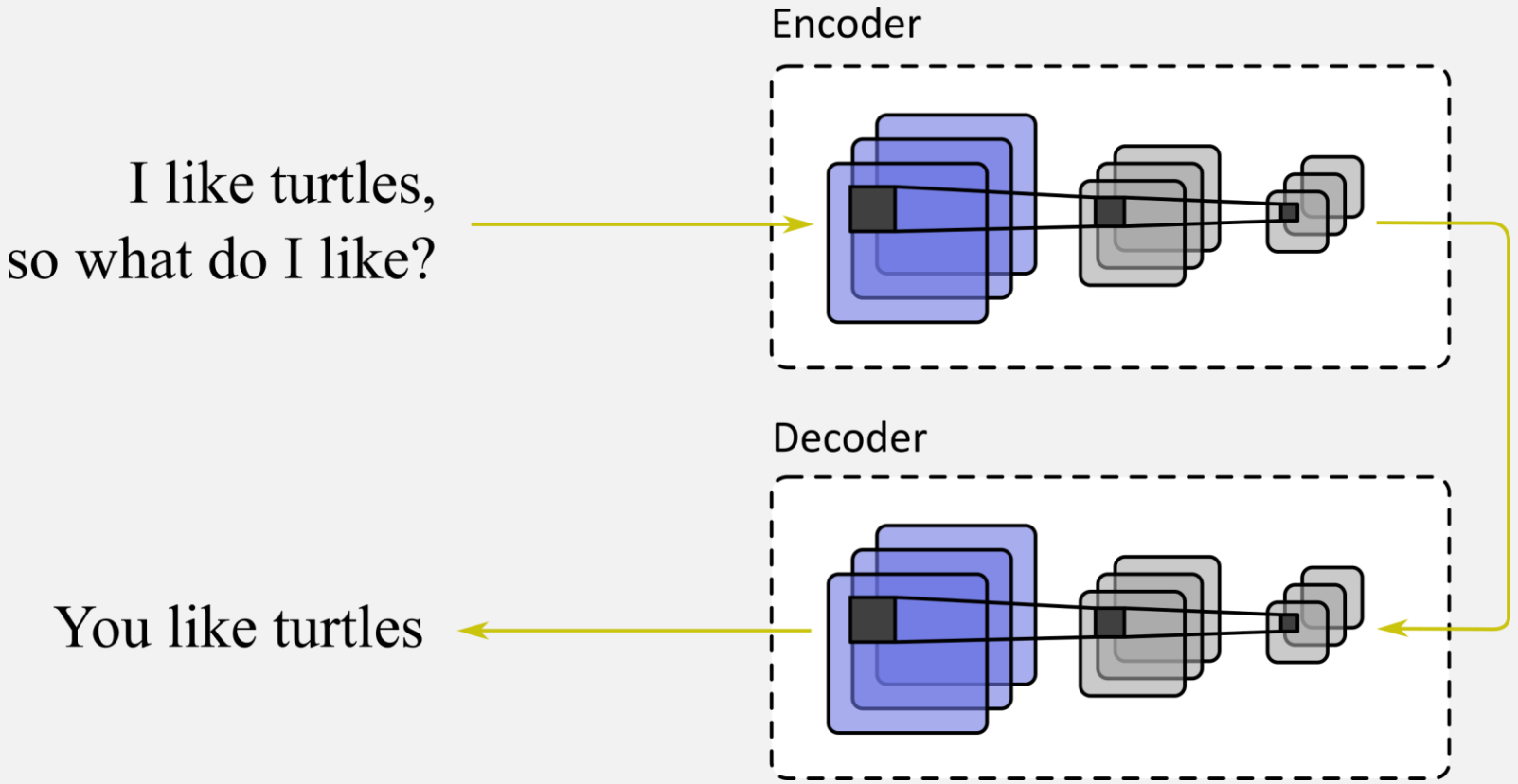
Multi-Step Attention
in **Natural Language Processing**

Encoder: CNN

Decoder: CNN

Architecture

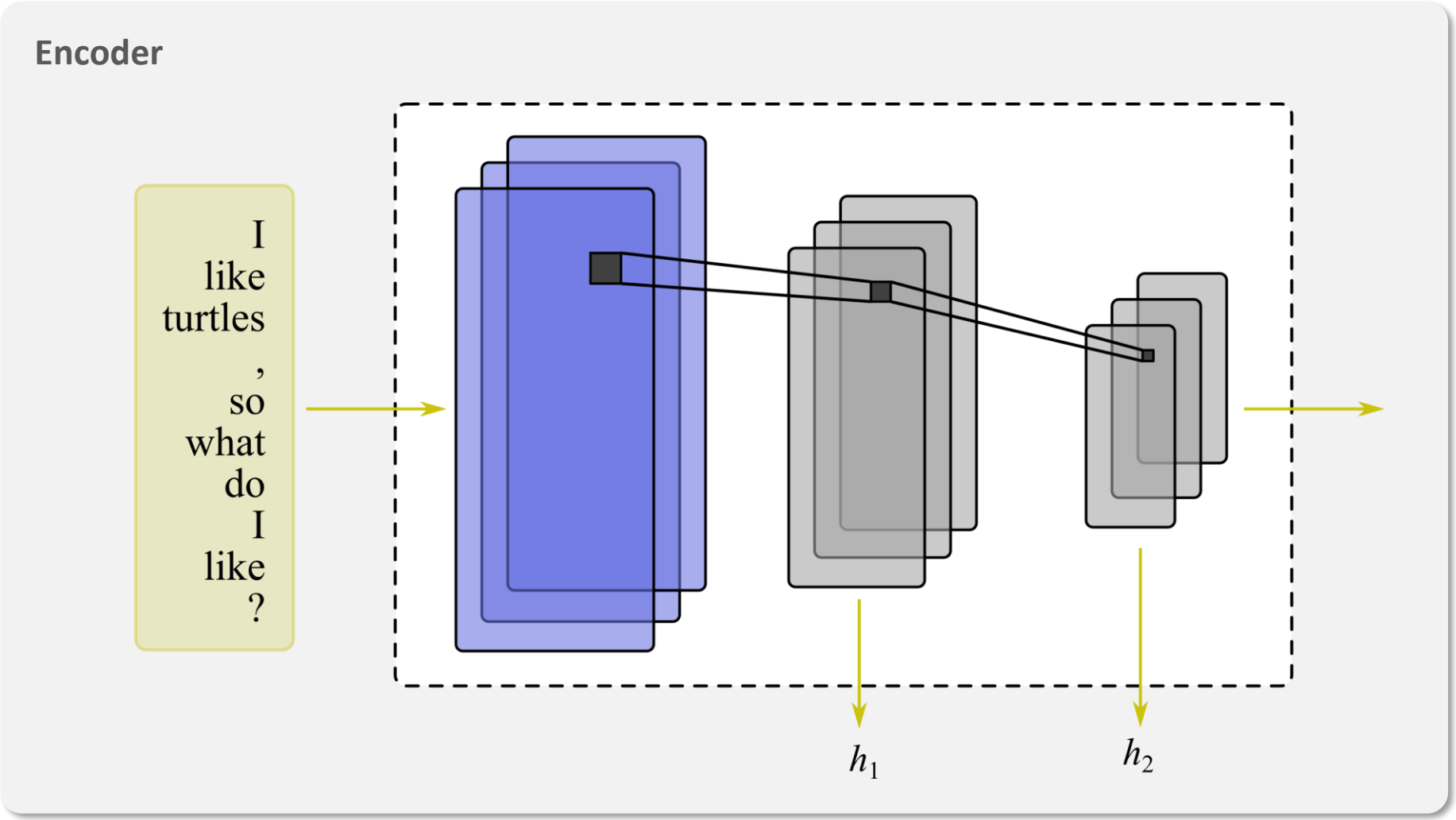


Multi-Step Attention
in **Natural Language Processing**

Encoder: CNN

Sequence of convolutional features encodes the context building stack

Decoder: CNN



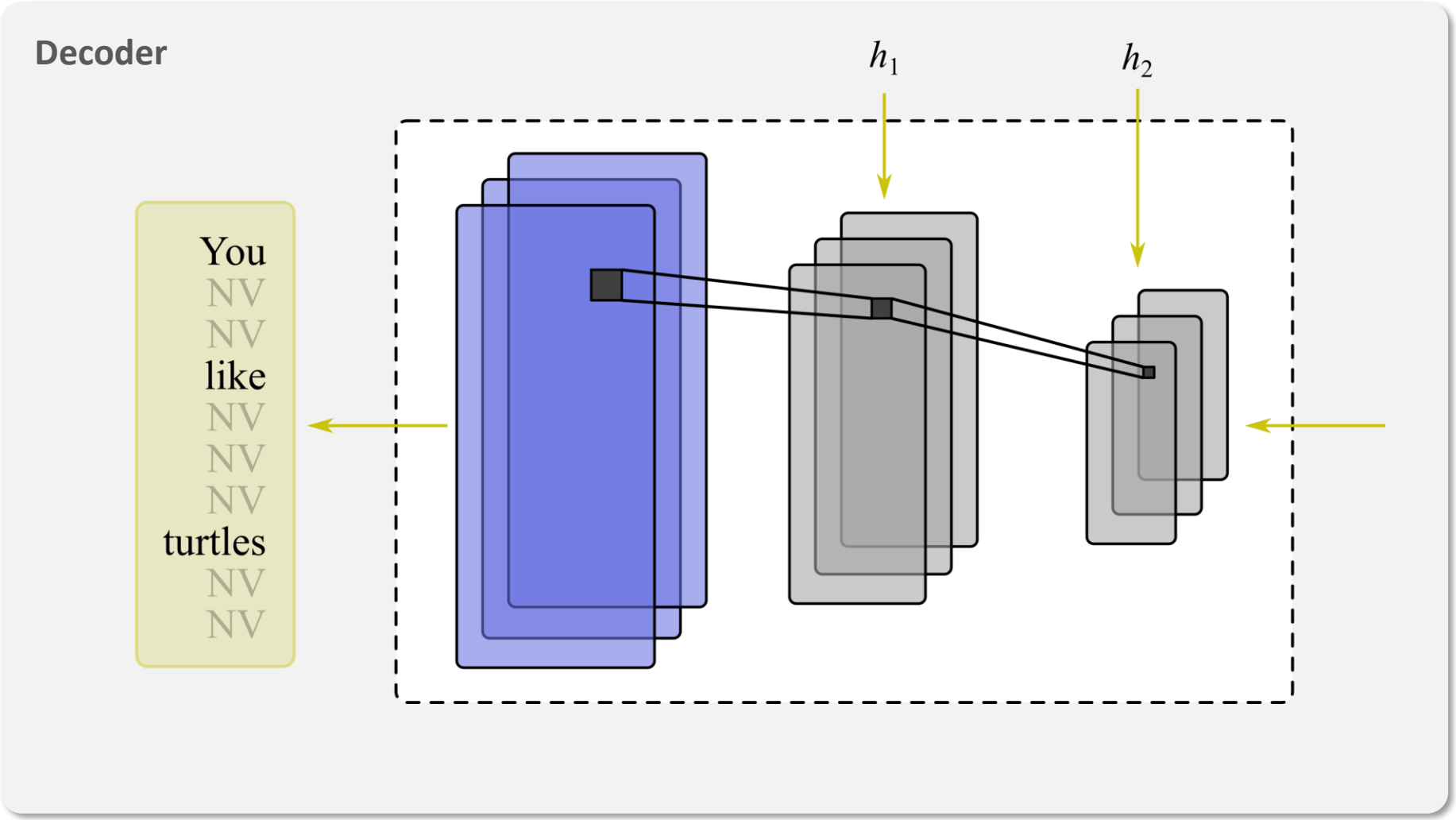
Multi-Step Attention in Natural Language Processing

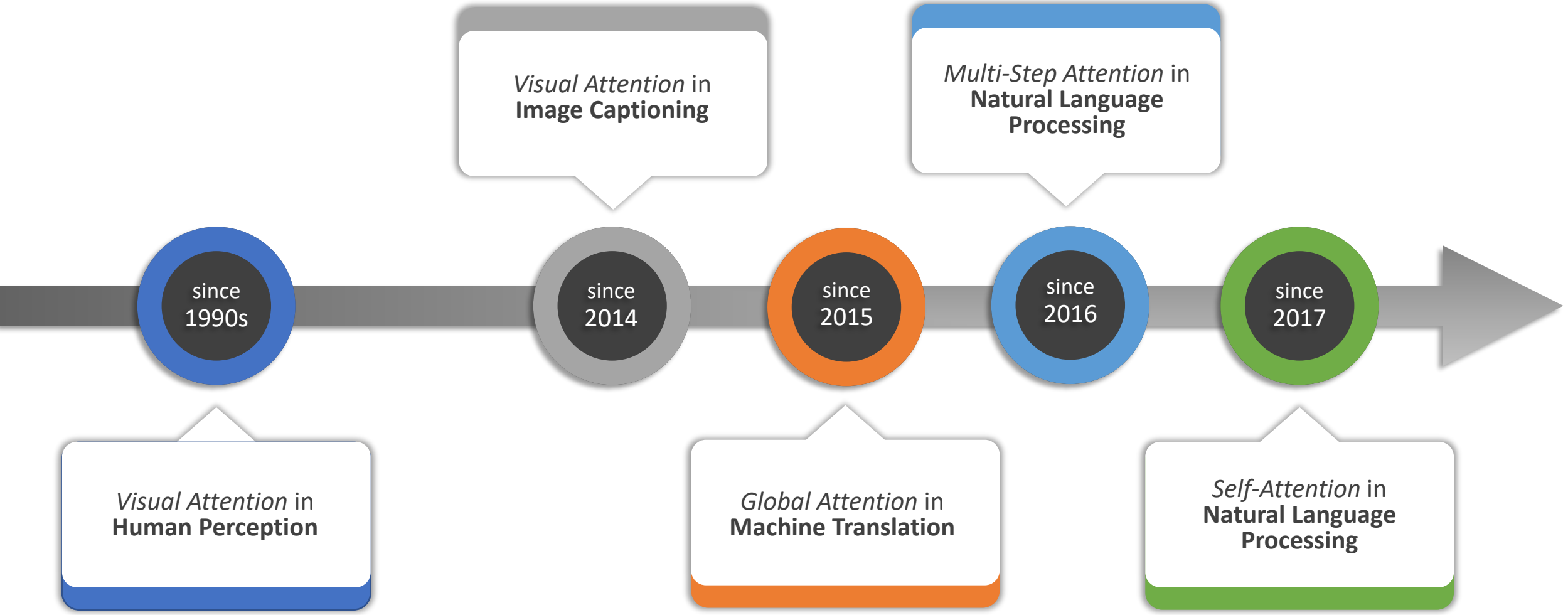
Encoder: CNN

Sequence of convolutional features encodes the context building stack

Decoder: CNN

Multi-Step Attention allows to recover the current context of current deconvolutional steps




since 1990s
Visual Attention in Human Perception
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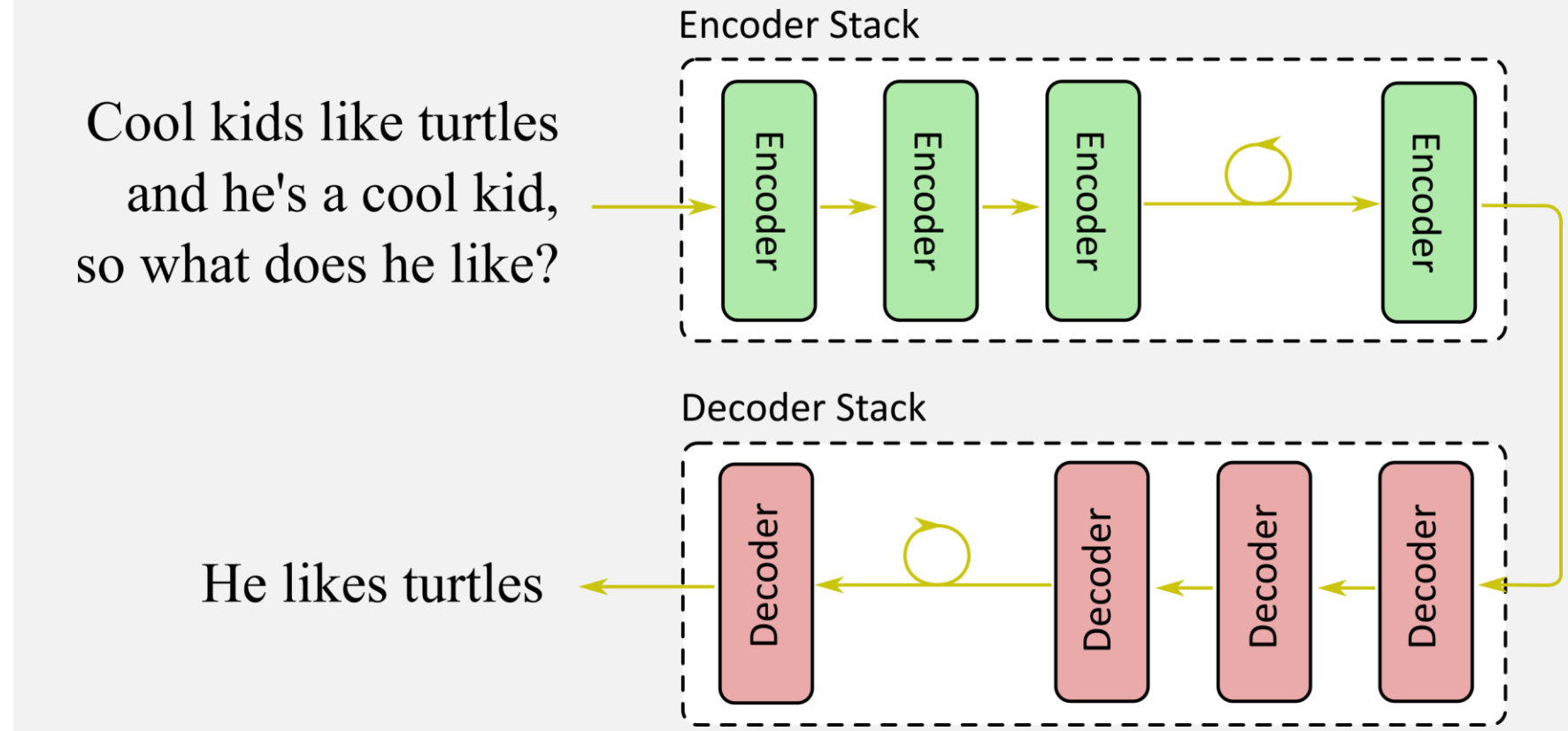
Visual Attention in Image Captioning
since 2015
Global Attention in Machine Translation
since 2016
Multi-Step Attention in Natural Language Processing
since 2017
Self-Attention in Natural Language Processing

Self-Attention in Natural Language Processing

Encoder: Stacked ANN

Decoder: Stacked ANN

Architecture

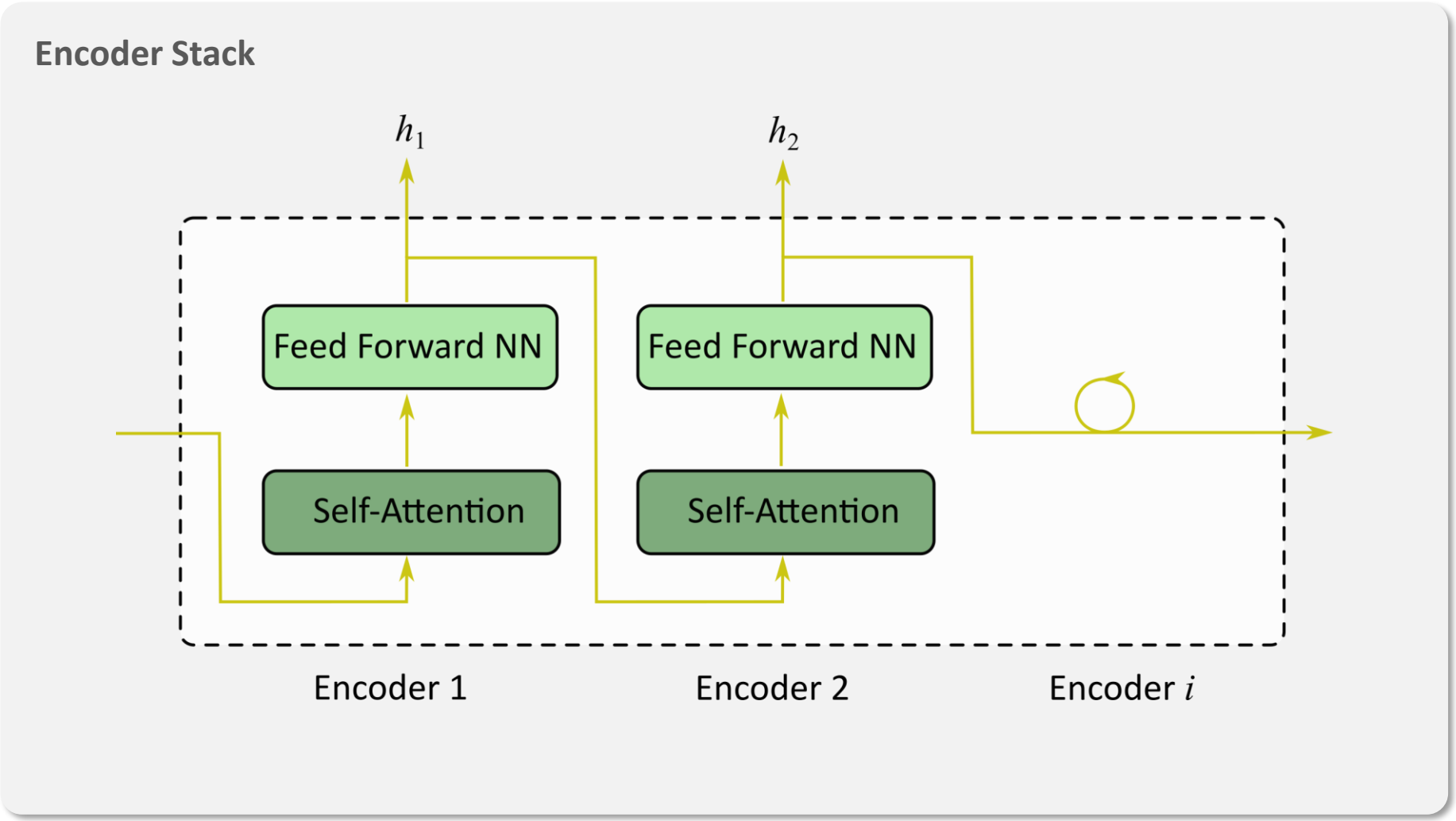


Self-Attention in Natural Language Processing

Encoder: Stacked ANN

Sequence of hidden features captures the encoder context building stack

Decoder: Stacked ANN



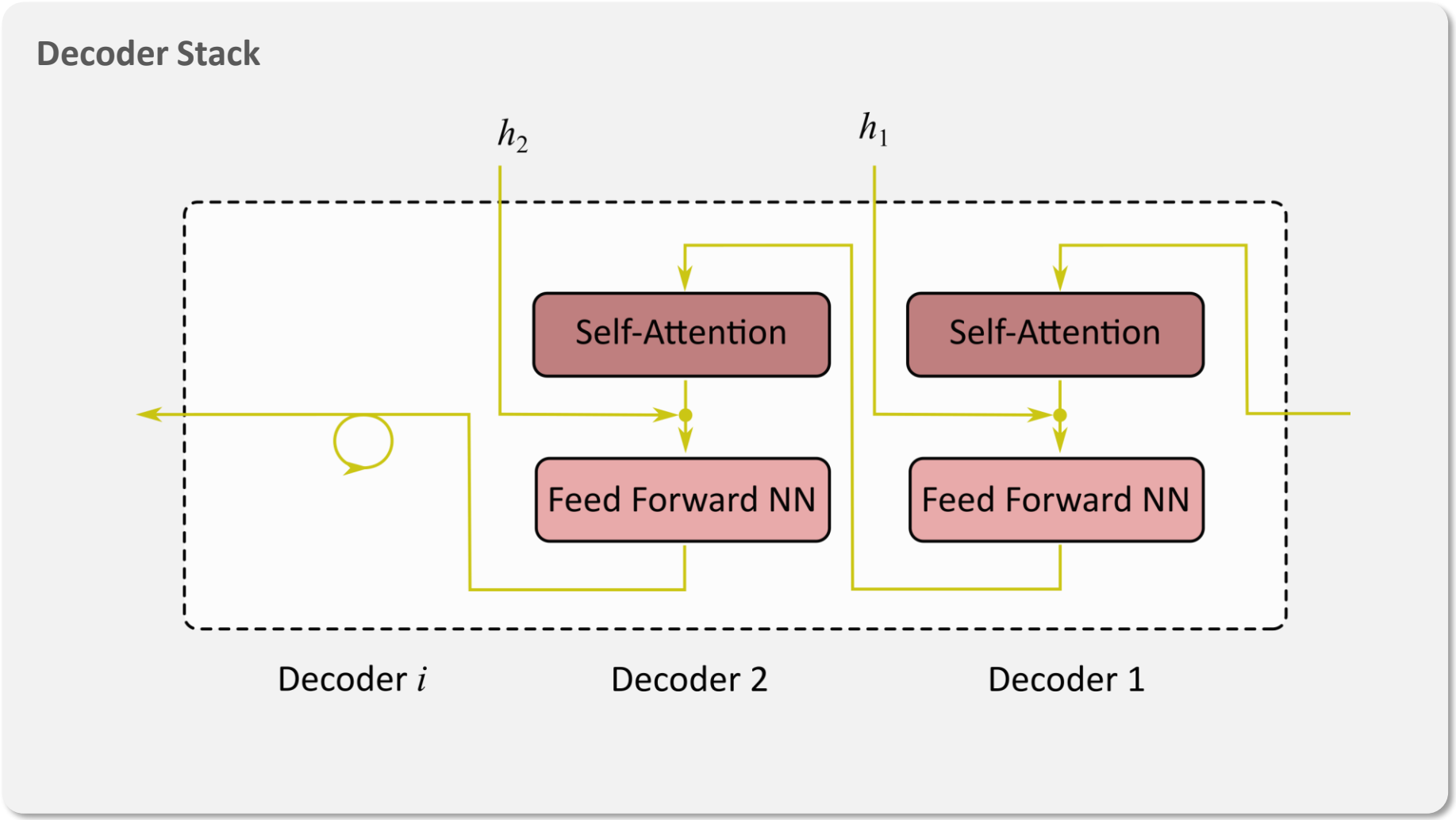
Self-Attention in Natural Language Processing

Encoder: Stacked ANN

Sequence of hidden features captures the encoder context building stack

Decoder: Stacked ANN

Multi-Step Attention unrolls the context stack to the decoder



Self-Attention in Natural Language Processing

Encoder: Stacked ANN

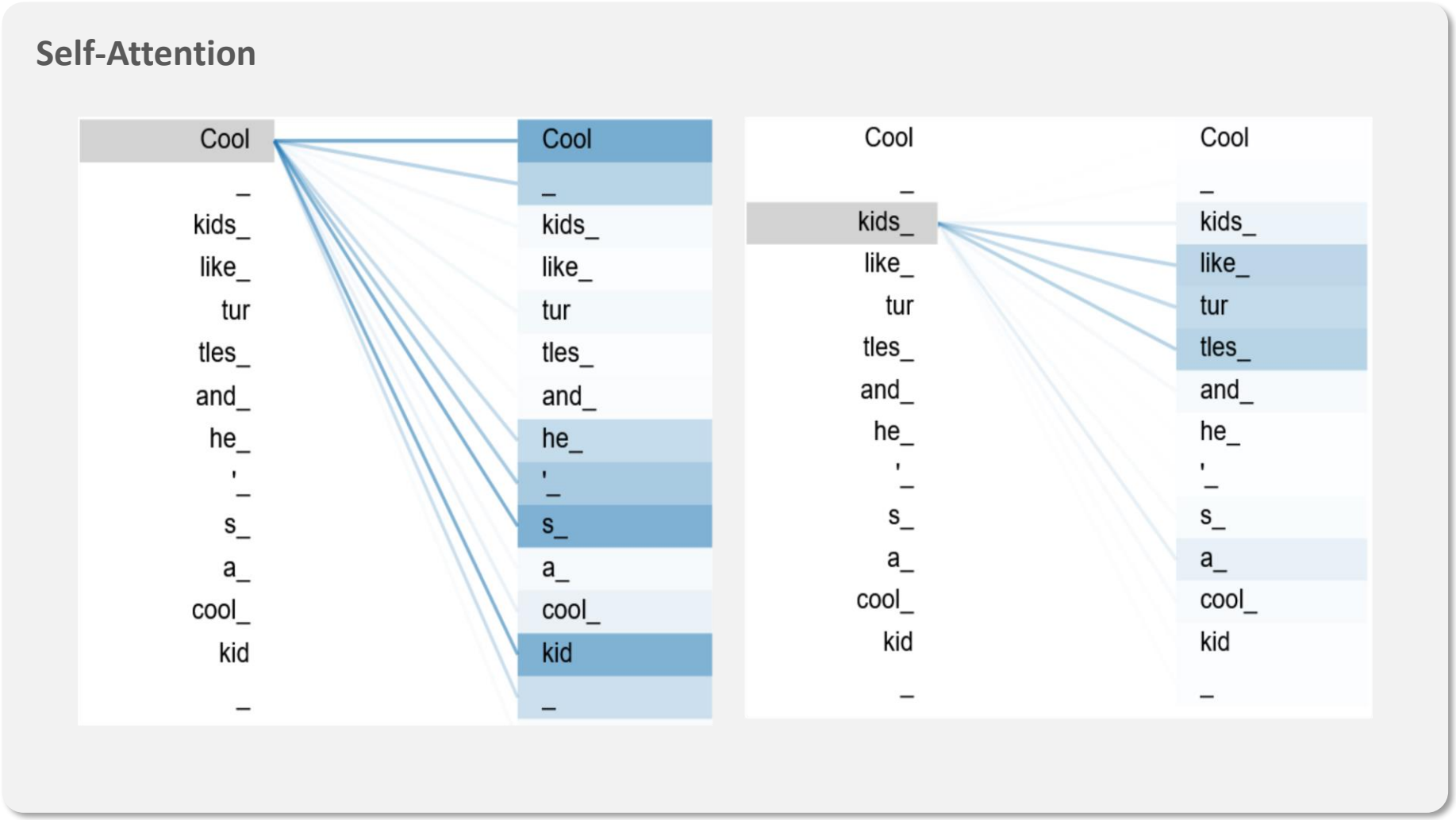
Sequence of hidden features captures the encoder context building stack

Decoder: Stacked ANN

Multi-Step Attention unrolls the context stack to the decoder

---

Self-attention aggregates context dependencies within the inputs



Summary

#1

Human Perception is based on the dynamics between ***selection*** and ***recognition***

#2

Attention machanisms immitate this behaviour by using intermediate states, that entangle *context* with *semantic* information

#3

The incorporation of context provides **dynamic features** that are context specific and therefore improve the model perfomance

#4

After all - attention mechanisms can also help to **understand the decisions** of deep networks

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Thank you for your attention!