The Illustrated Transformer

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Visualizing machine learning one concept at a time.
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Artificial Intelligence

Creating the Future

Dong-A University

Division of Computer Engineering & Artificial Intelligence

References

Main

- https://jalammar.github.io/illustrated-transformer/

Illustrated Transformer

Transformer

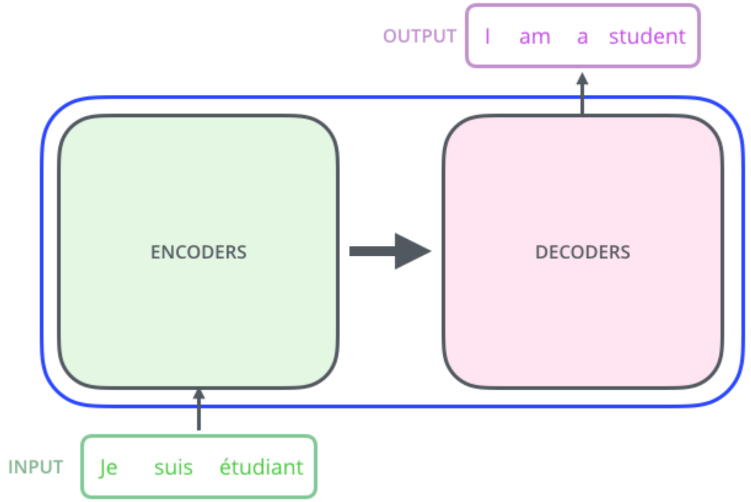
- A model that uses **attention** to boost the speed with which these models can be trained.
- The Transformers outperforms the Google Neural Machine Translation model in specific tasks.
- The biggest benefit, however, comes from how The Transformer lends itself to **parallelization**. It is in fact Google Cloud's recommendation to use The Transformer as a reference model to use their Cloud TPU offering.

- A TensorFlow implementation of it is available as a part of the Tensor2Tensor package.
- Harvard's NLP group created a guide annotating the paper with PyTorch implementation.

A High-Level Look

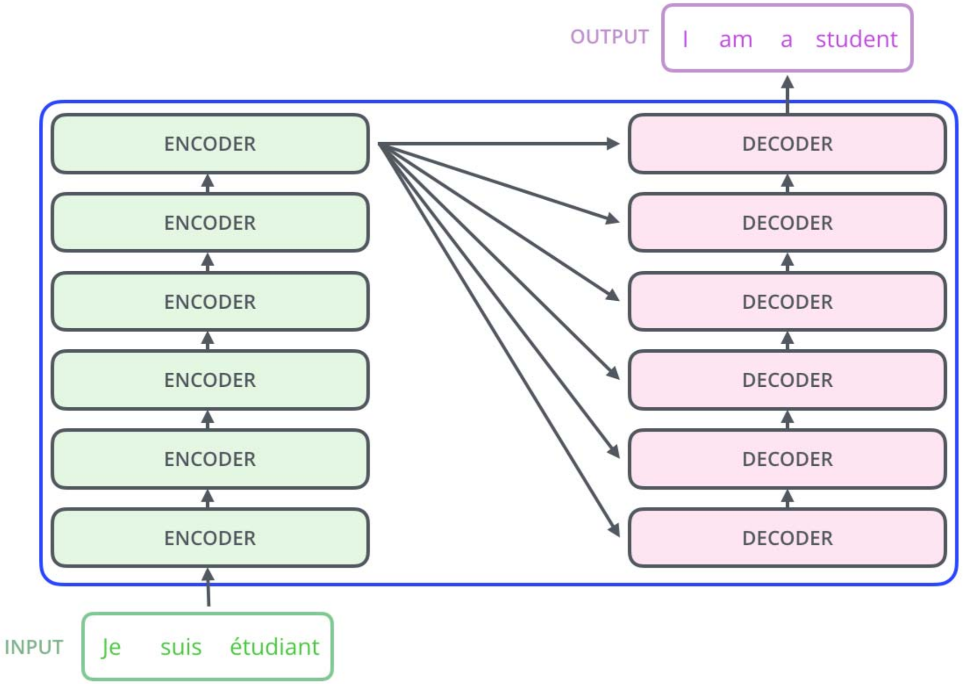
Illustrated Transformer

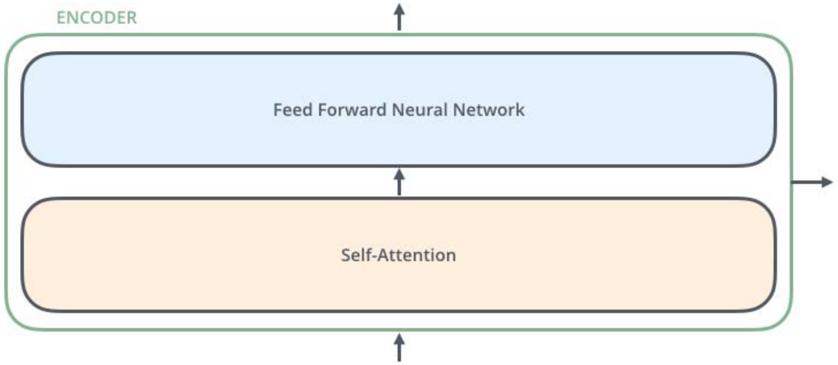
A High-Level Look

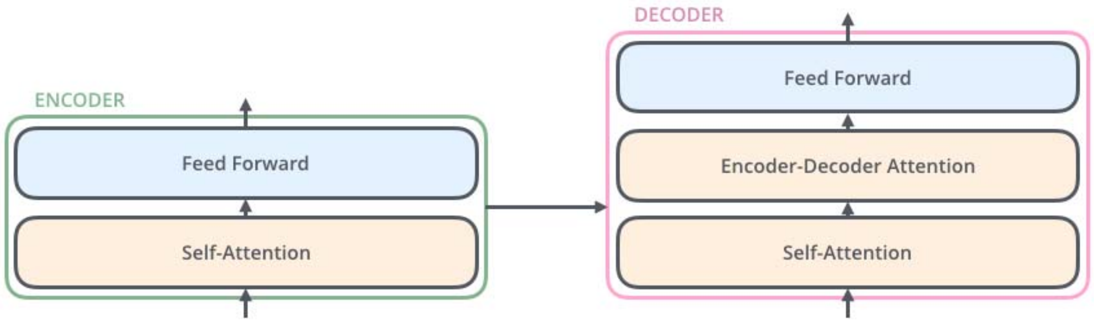


Illustrated Transformer

A High-Level Look







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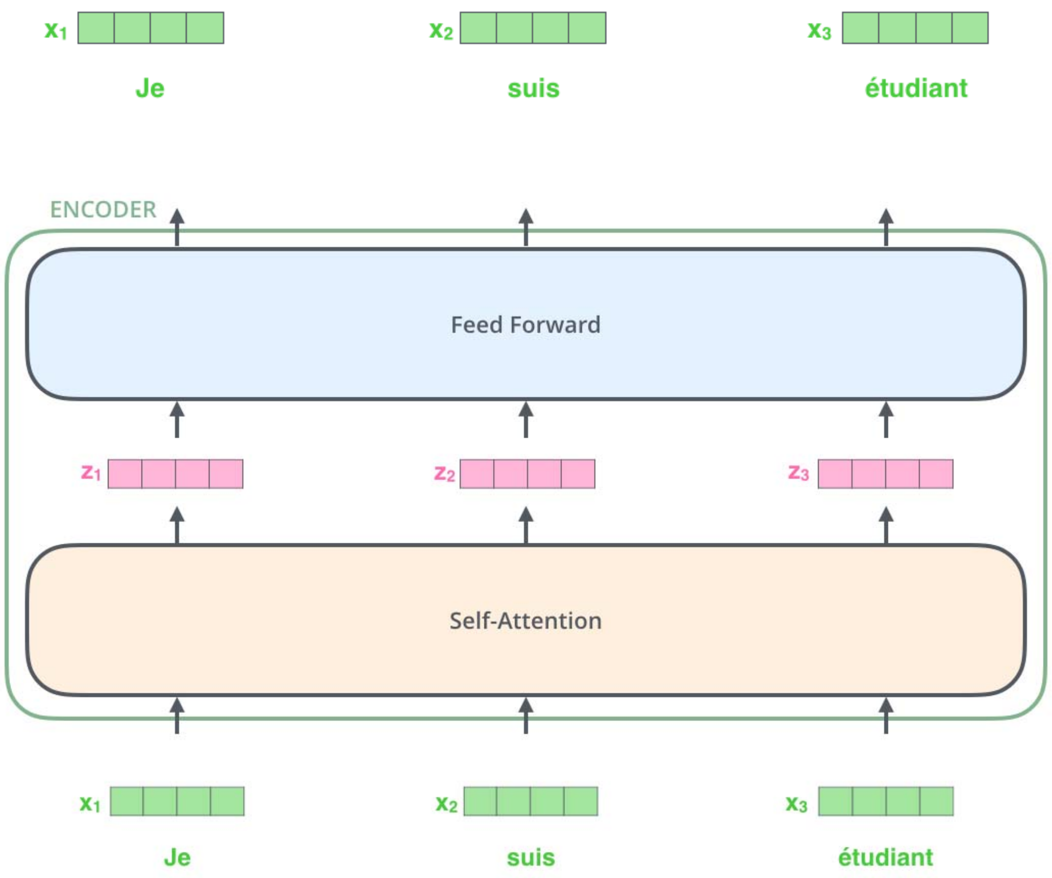
Bringing The Tensors Into The Picture



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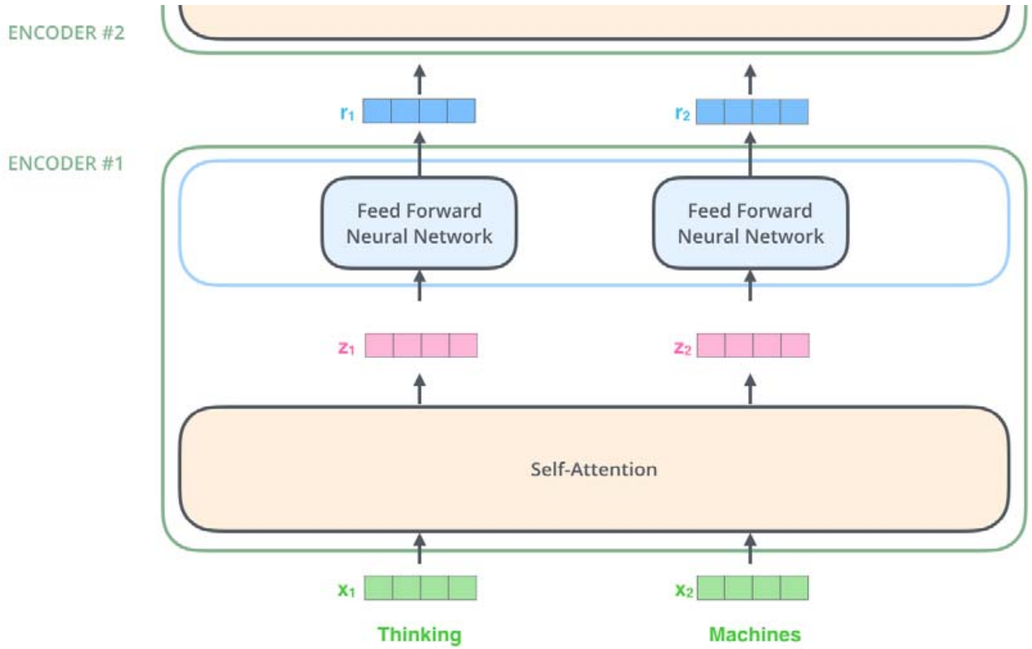

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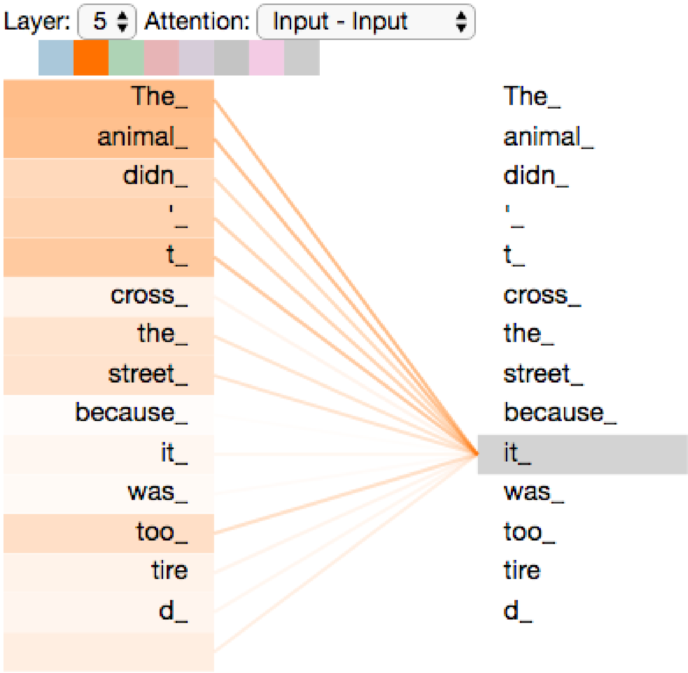
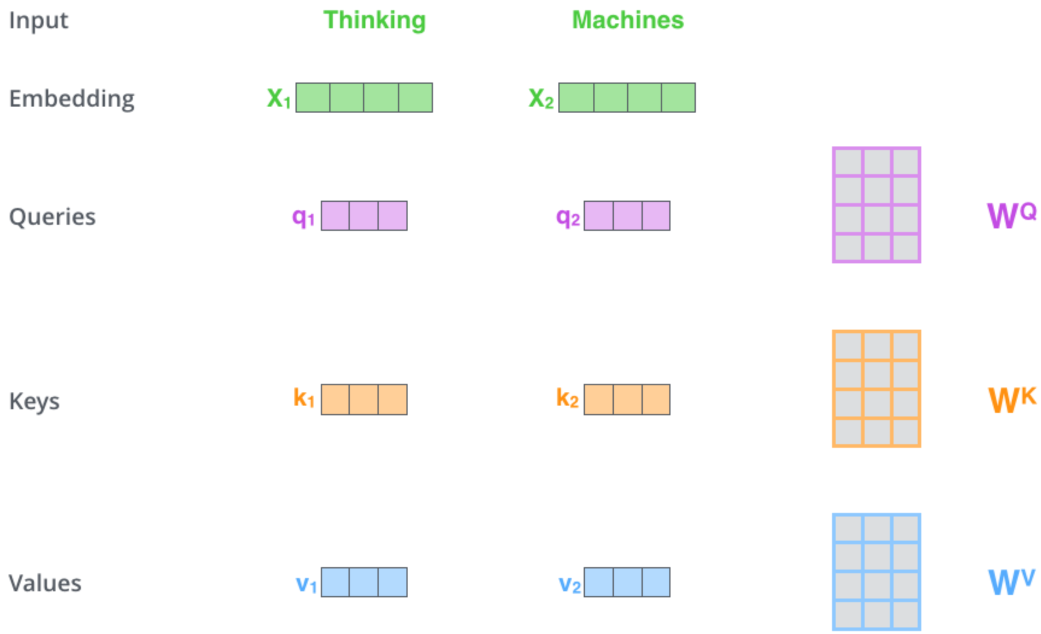
Self-Attention at a High Level



Self-Attention in Detail



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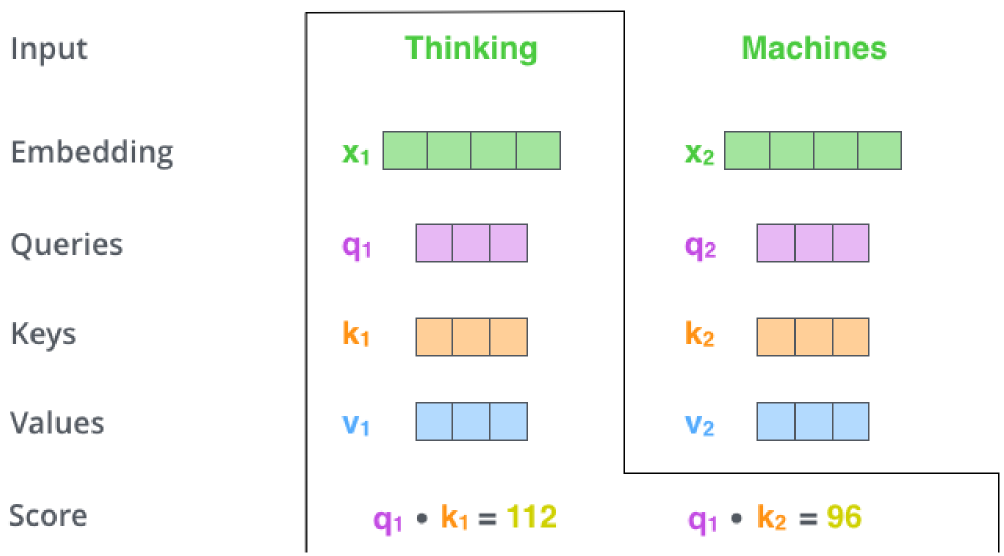

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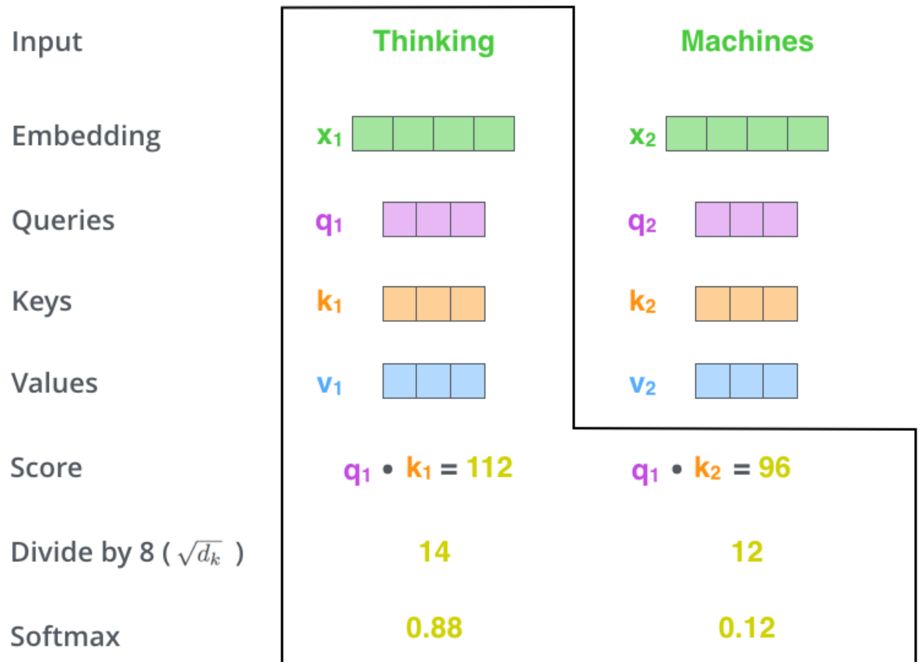

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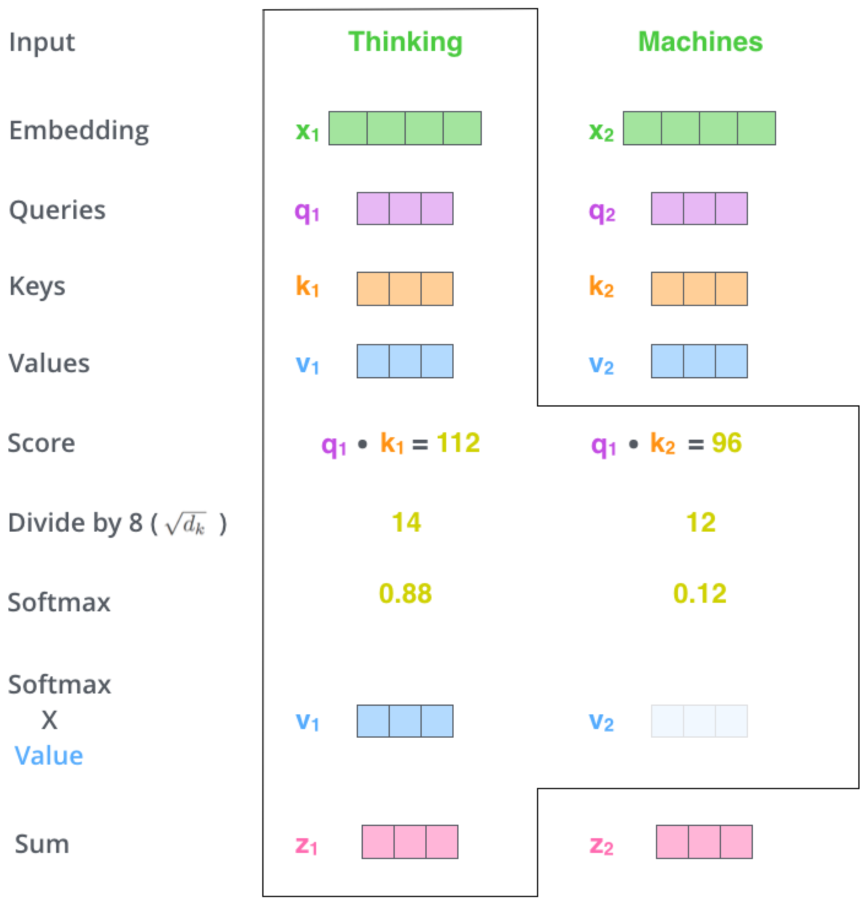
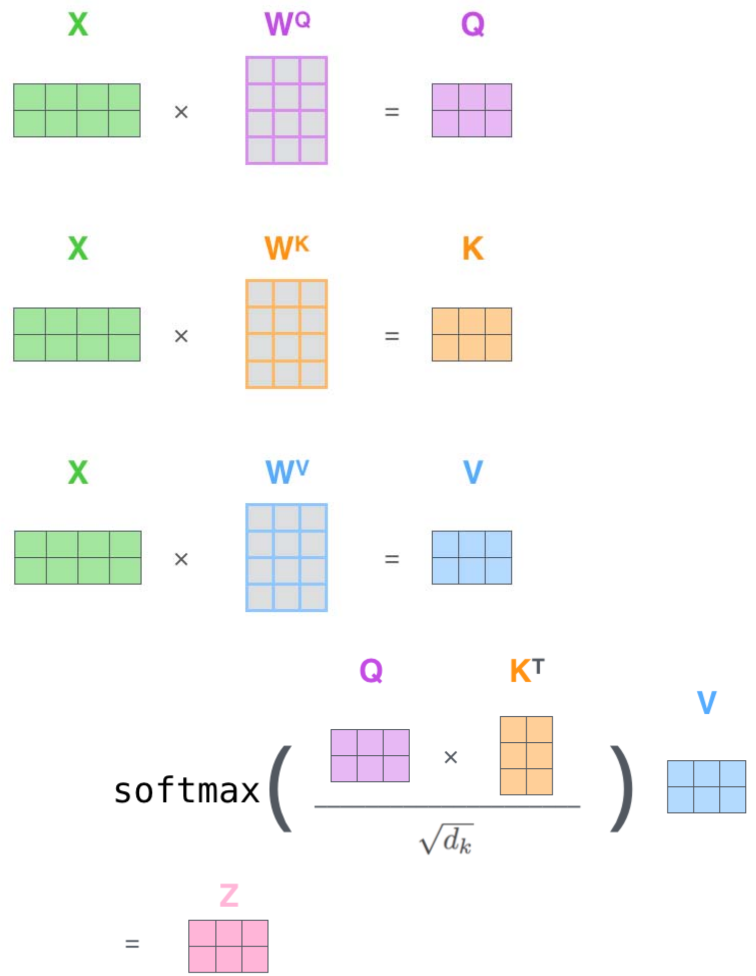
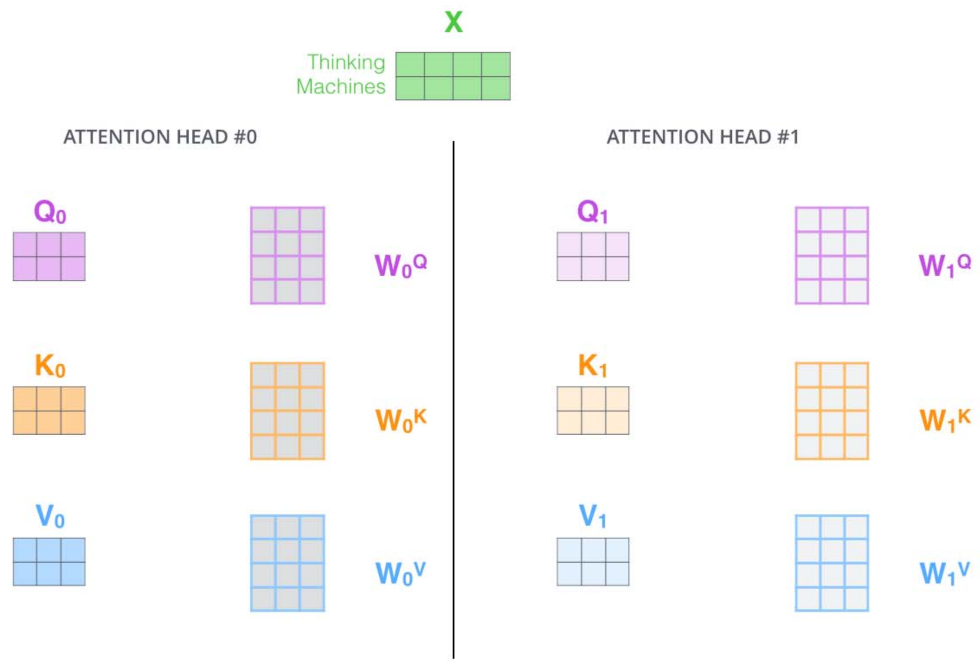
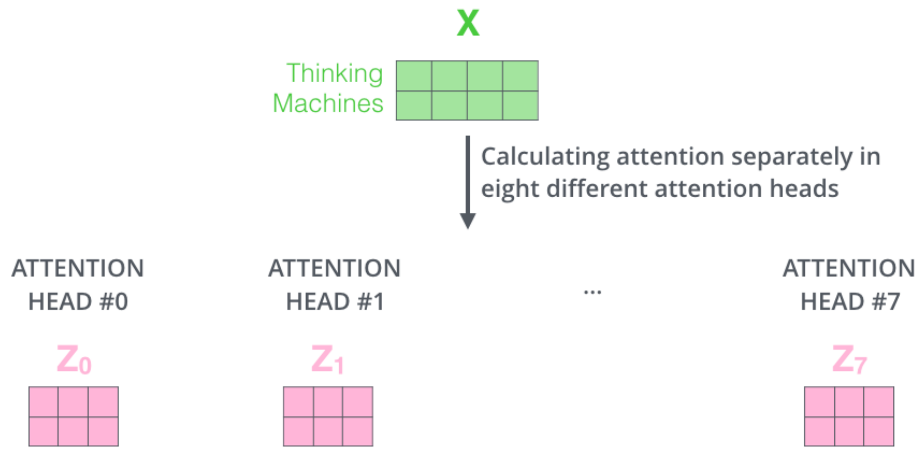


Matrix Calculation of Self-Attention



The Beast With Many Heads





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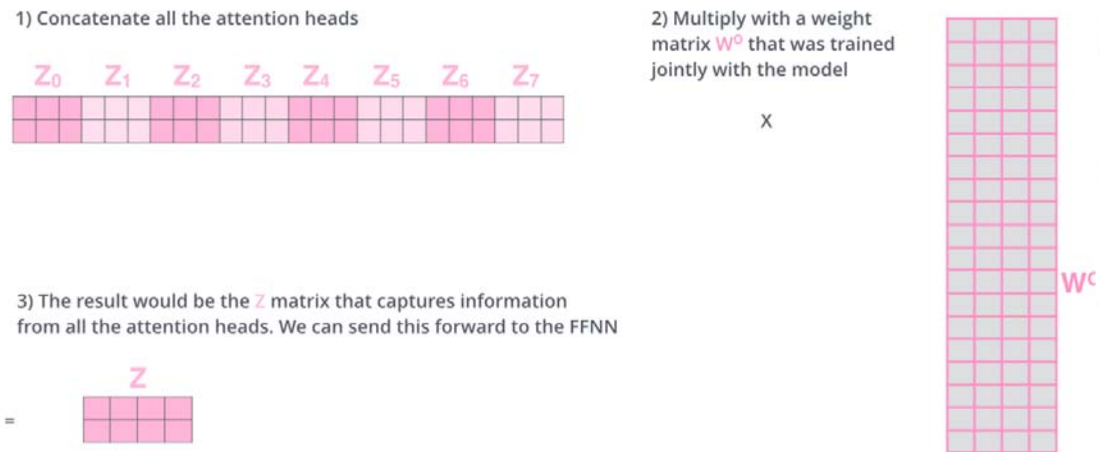

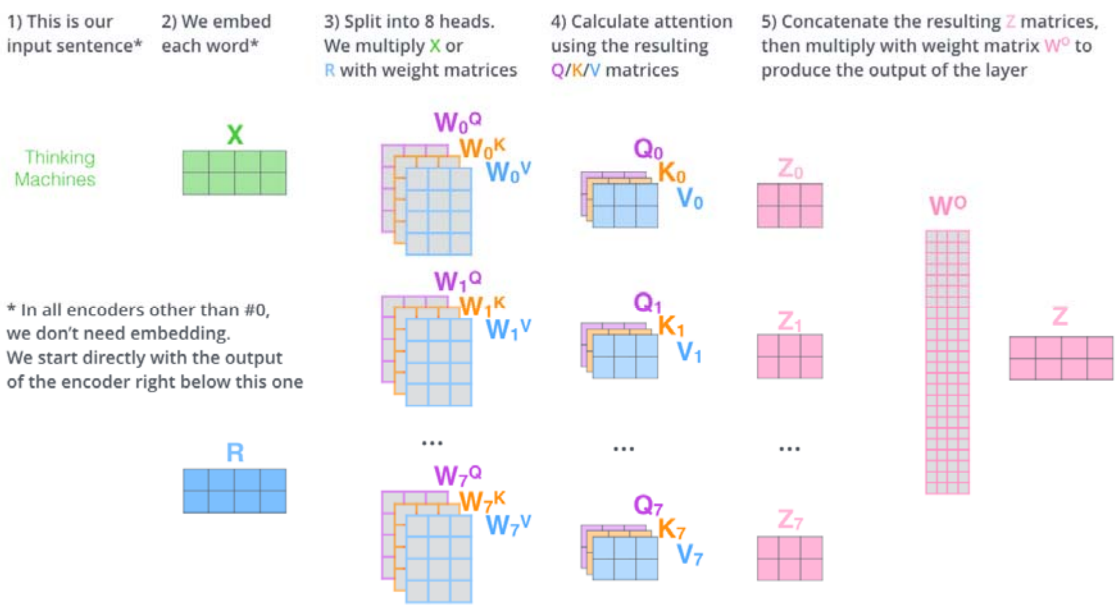

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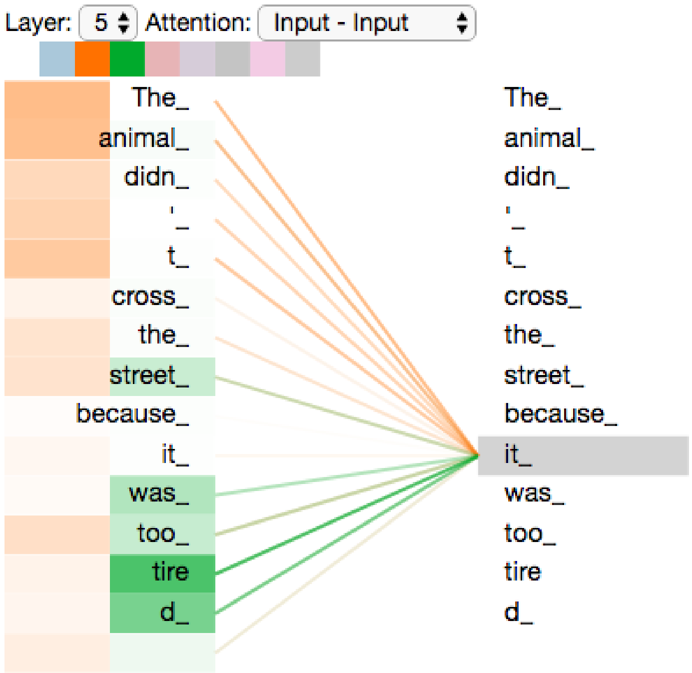
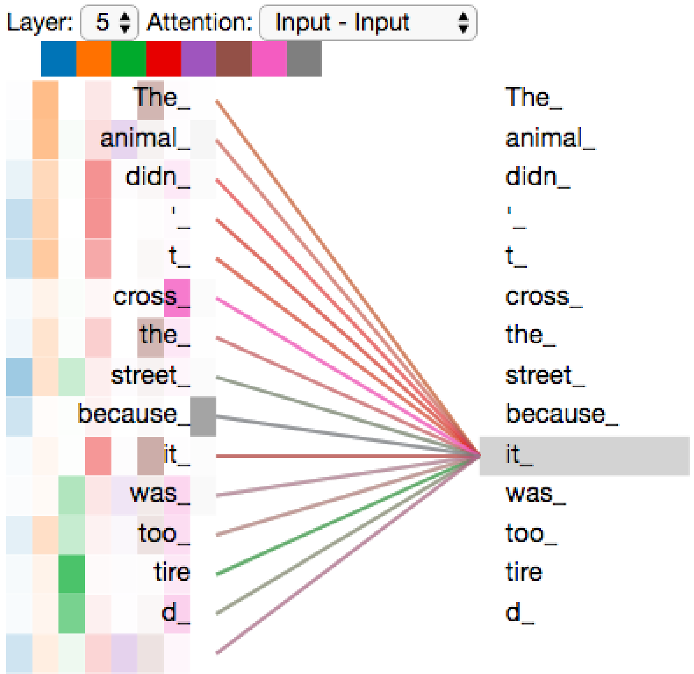
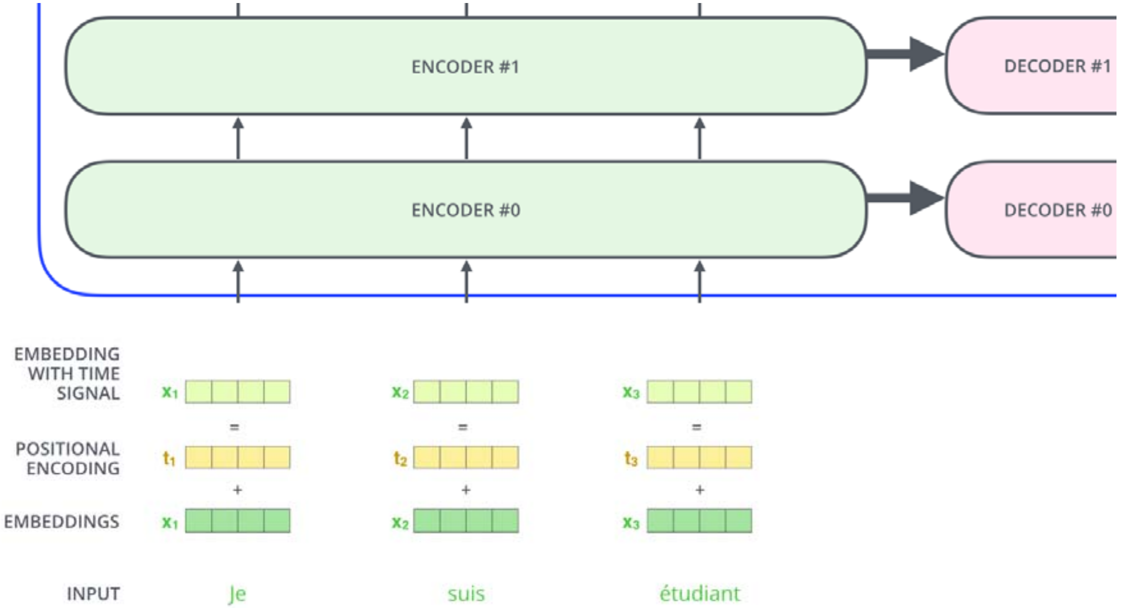
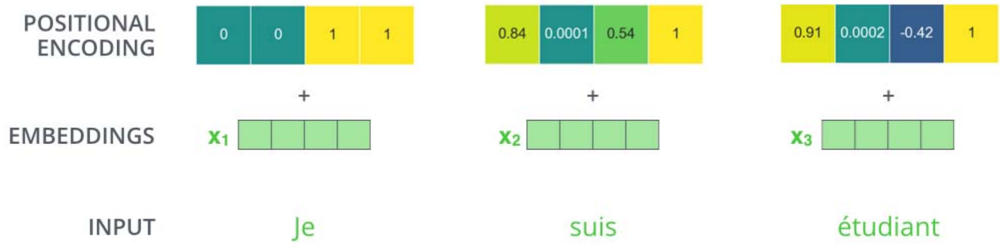




Representing The Order of The Sequence Using Positional Encoding





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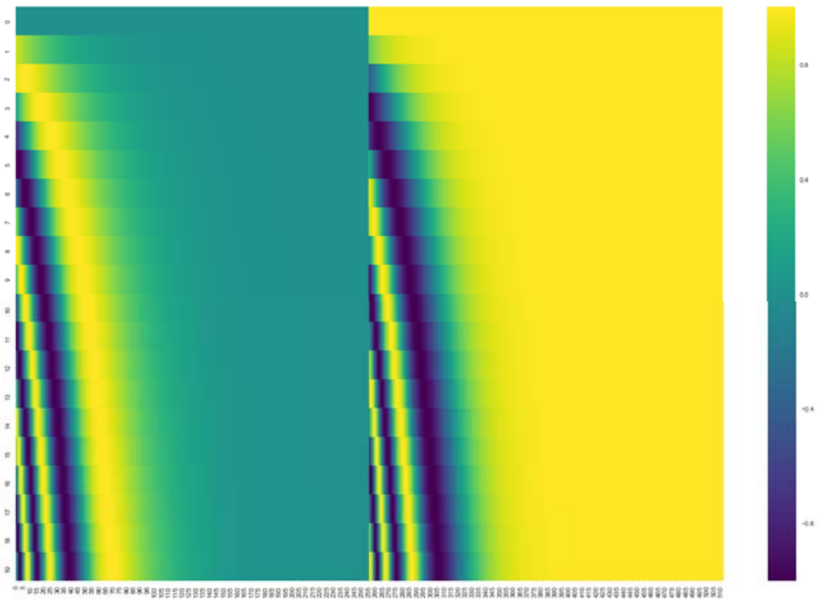
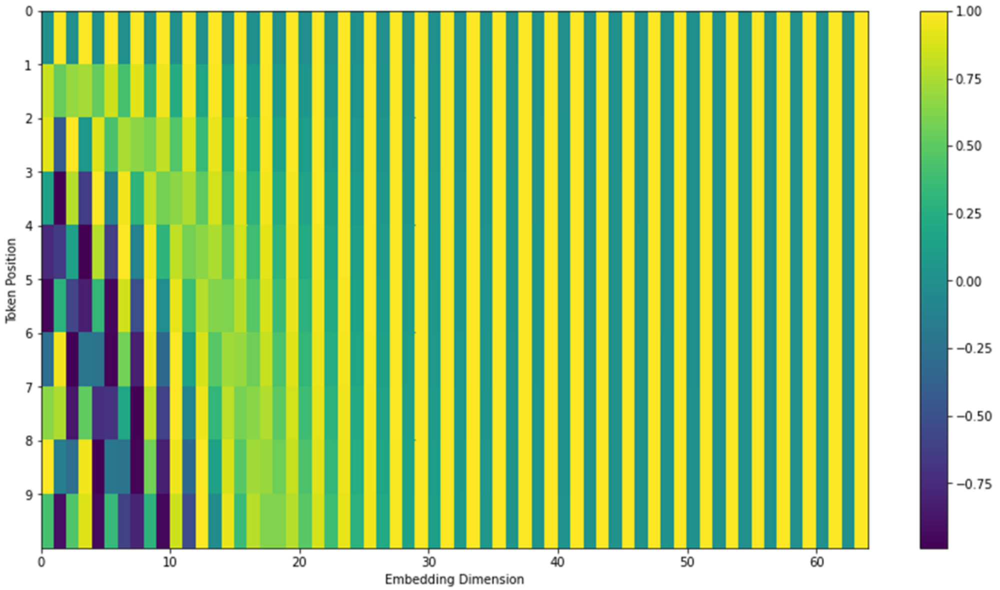
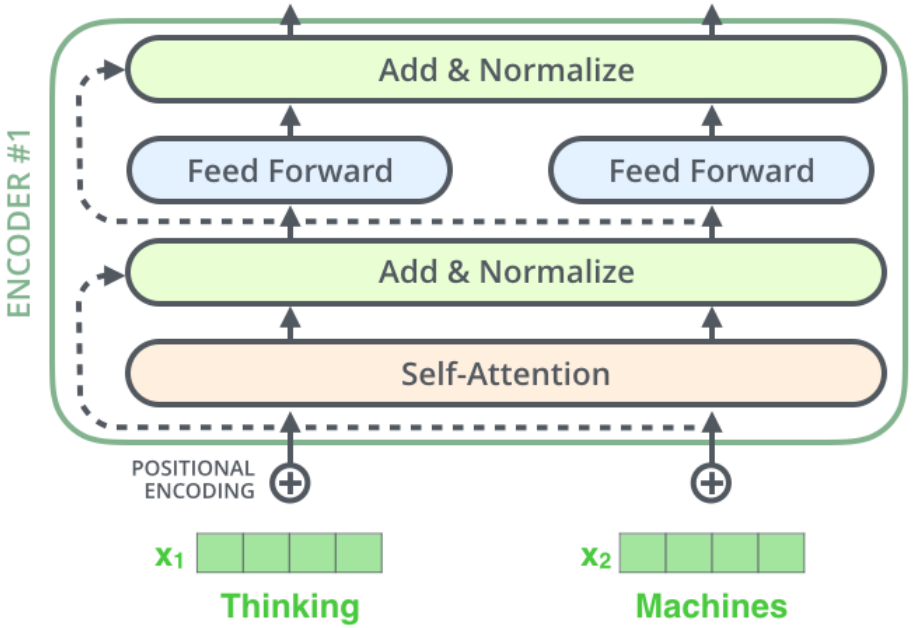
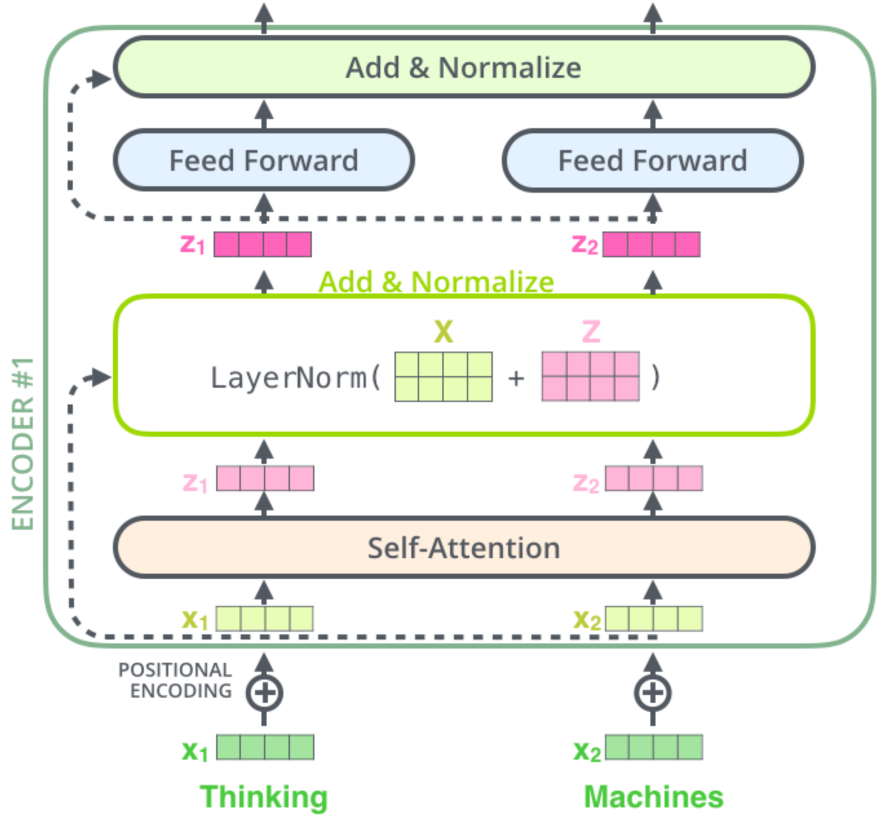




Illustrated Transformer

The Residuals





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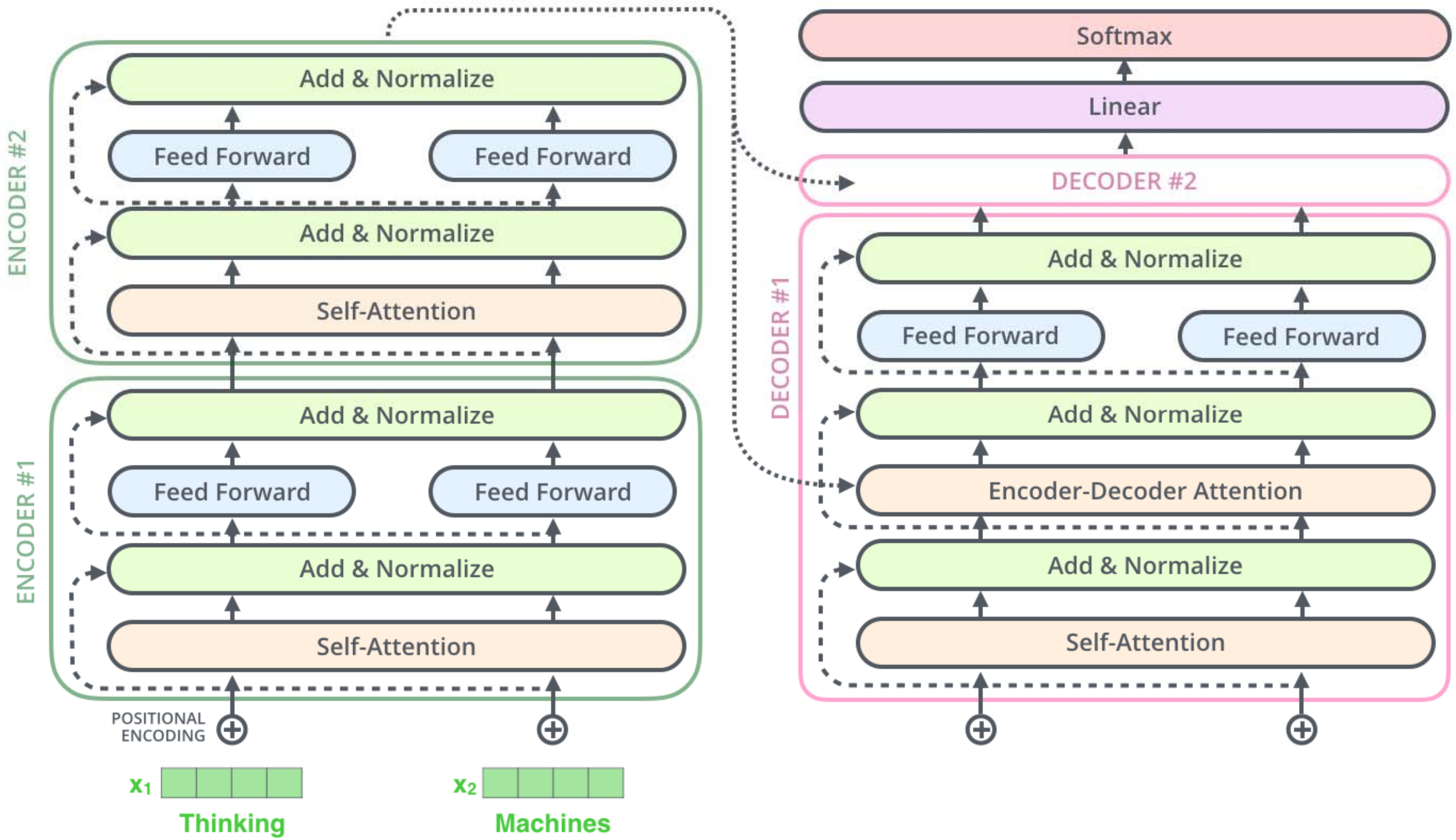
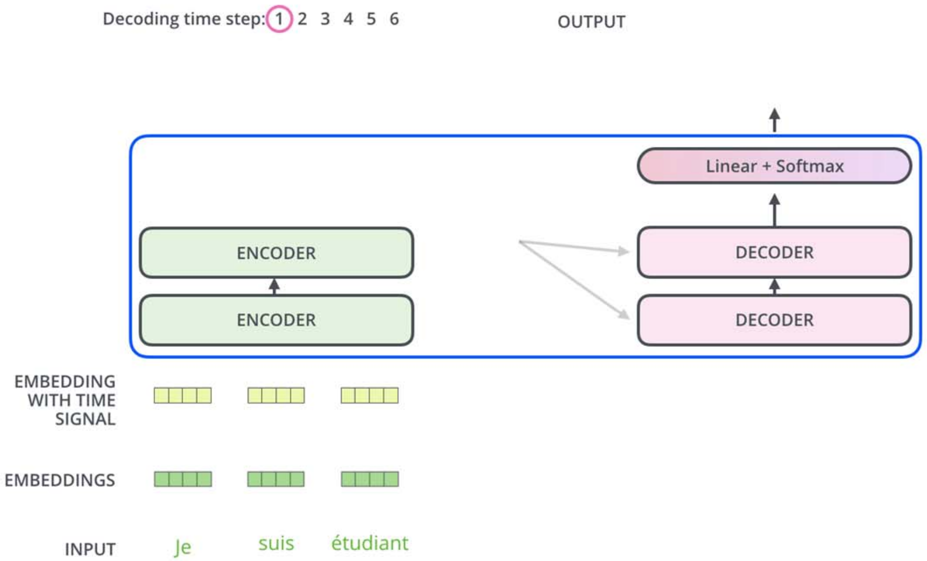
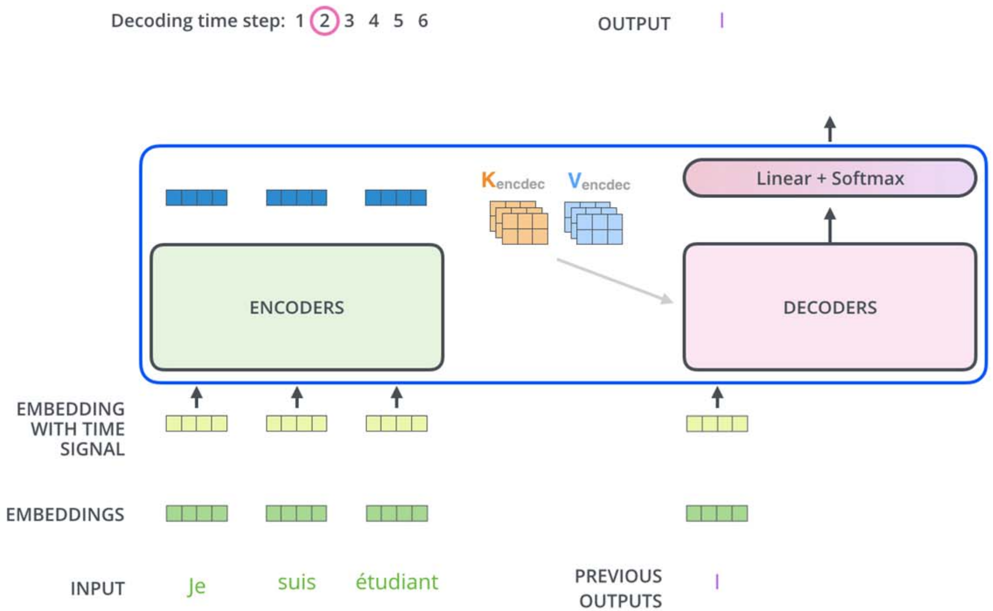


Illustrated Transformer

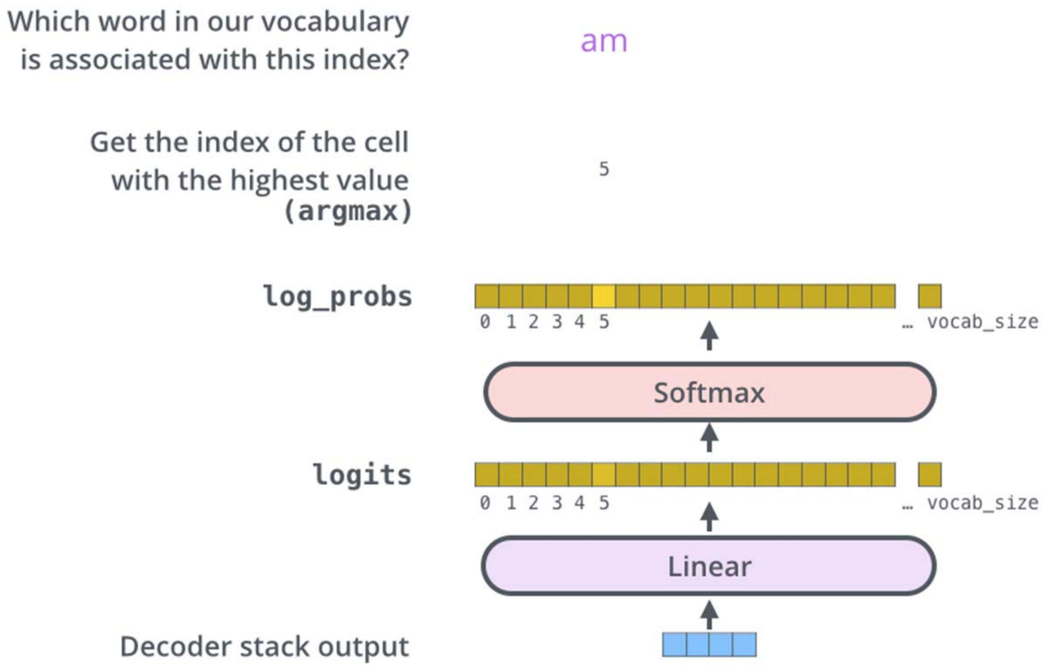
The Decoder Side





Illustrated Transformer

The Final Linear and Softmax Layer



Recap Of Training

Output Vocabulary

WORD	a	am	I	thanks	student	<eos>
INDEX	0	1	2	3	4	5

Output Vocabulary

WORD	a	am	I	thanks	student	<eos>
INDEX	0	1	2	3	4	5

One-hot encoding of the word "am"

0.0	1.0	0.0	0.0	0.0	0.0

Illustrated Transformer

The Loss Function

Untrained Model Output

a	am	I	thanks	student	<eos>
0.2	0.2	0.1	0.2	0.2	0.1

Correct and desired output

a	am	I	thanks	student	<eos>
0.0	0.0	0.0	1.0	0.0	0.0

Target Model Outputs

Output Vocabulary:	a	am	I	thanks	student	<eos>
position #1	0.0	0.0	1.0	0.0	0.0	0.0
position #2	0.0	1.0	0.0	0.0	0.0	0.0
position #3	1.0	0.0	0.0	0.0	0.0	0.0
position #4	0.0	0.0	0.0	0.0	1.0	0.0
position #5	0.0	0.0	0.0	0.0	0.0	1.0
	a	am	I	thanks	student	<eos>

Trained Model Outputs

Output Vocabulary:	a	am	I	thanks	student	<eos>
position #1	0.01	0.02	0.93	0.01	0.03	0.01
position #2	0.01	0.8	0.1	0.05	0.01	0.03
position #3	0.99	0.001	0.001	0.001	0.002	0.001
position #4	0.001	0.002	0.001	0.02	0.94	0.01
position #5	0.01	0.01	0.001	0.001	0.001	0.98
	a	am	I	thanks	student	<eos>