ML & NLP a brief account

- The roots

- Embeddings

- Recurrent Neural Networks

- Attention is all you need

- Applications

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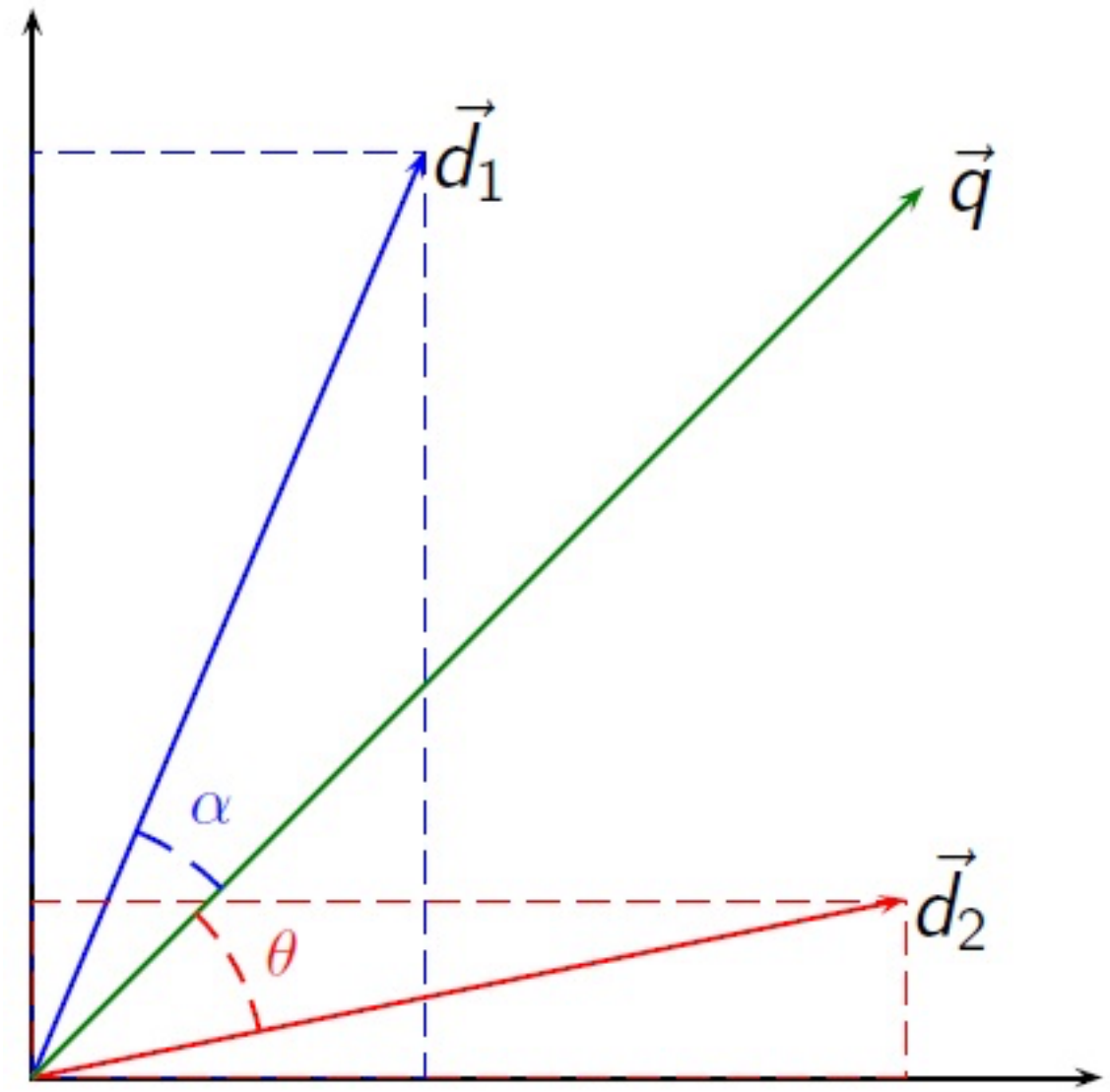
The roots

- Vector space model

- Latent Semantic analysis / Latent Dirichlet Analysis

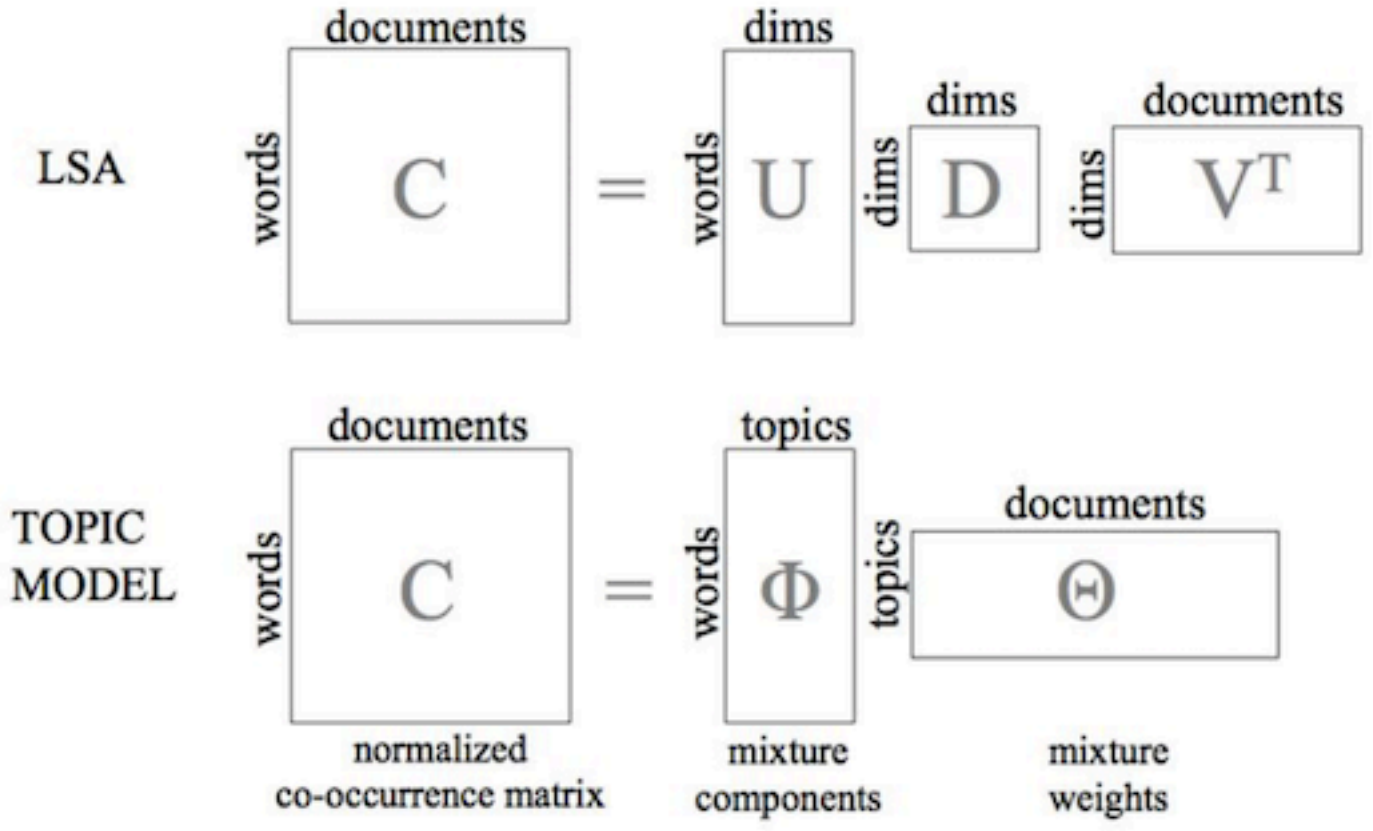
The vector space model

It all started with Salton in 1975 and his vector space model



LSA & LDA

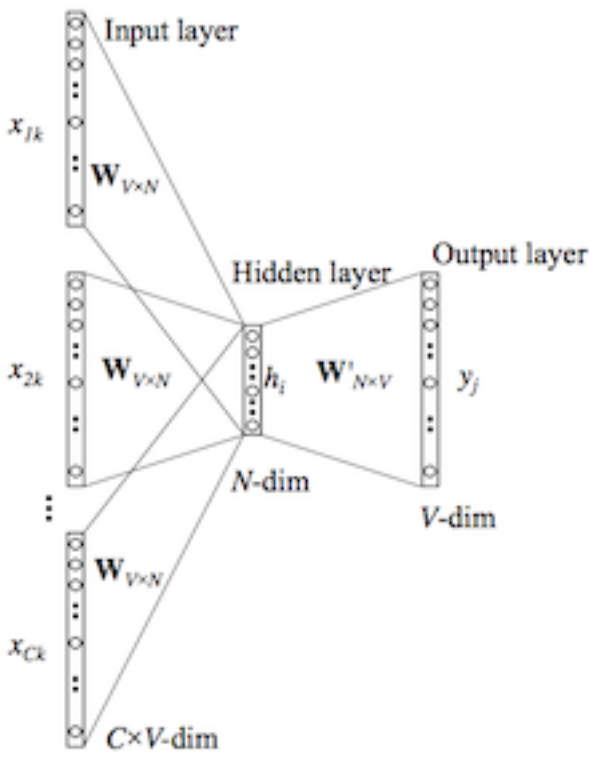
The main limitation of the Vector Space Model lies in its incapacity to detect close documents which do not have common terms. For instance : "this is a superb kitty" and "it's a beautiful cat"



Embeddings

One can see them as the idea of dimension reduction of the vector space model to highlight semantic proximities by other means. [A good Medium article (https://towardsdatascience.com/introduction-to-word-embedding-and-word2vec-652d0c2060fa)]

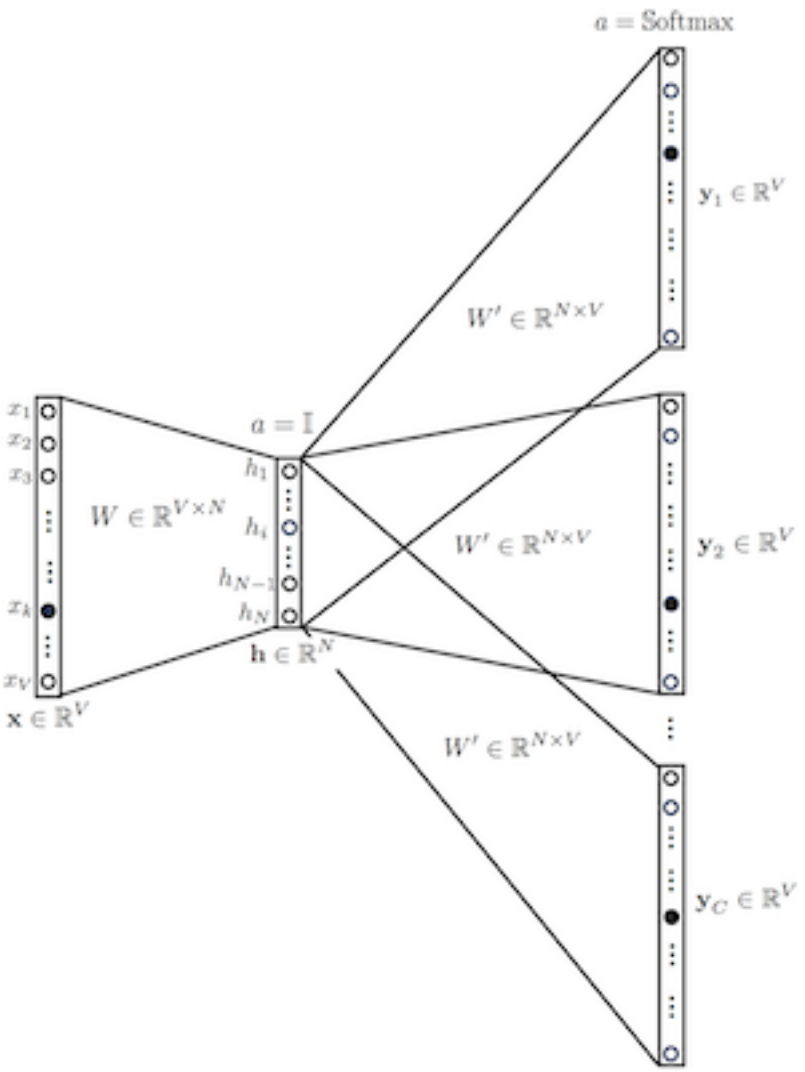
CBOW



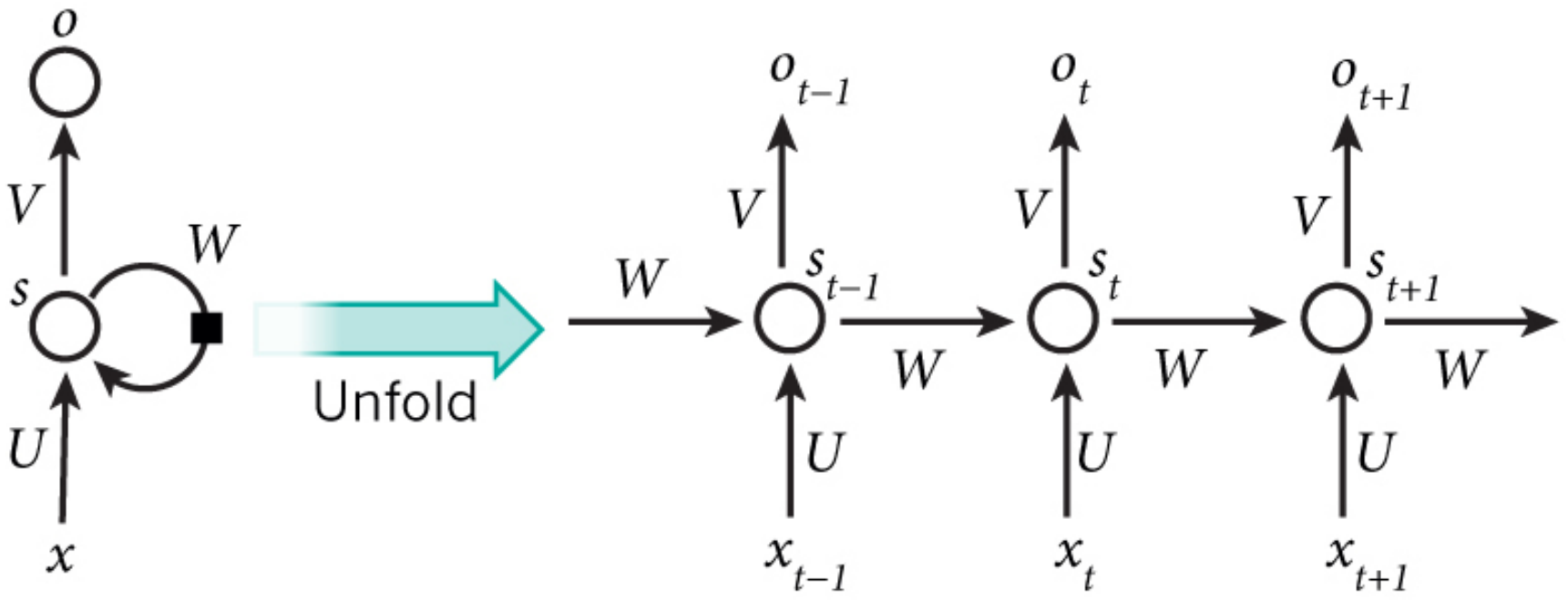
Embeddings

SkipGram

Almost the reverse model



Recurrent Neural Networks



Recurrent Neural Networks

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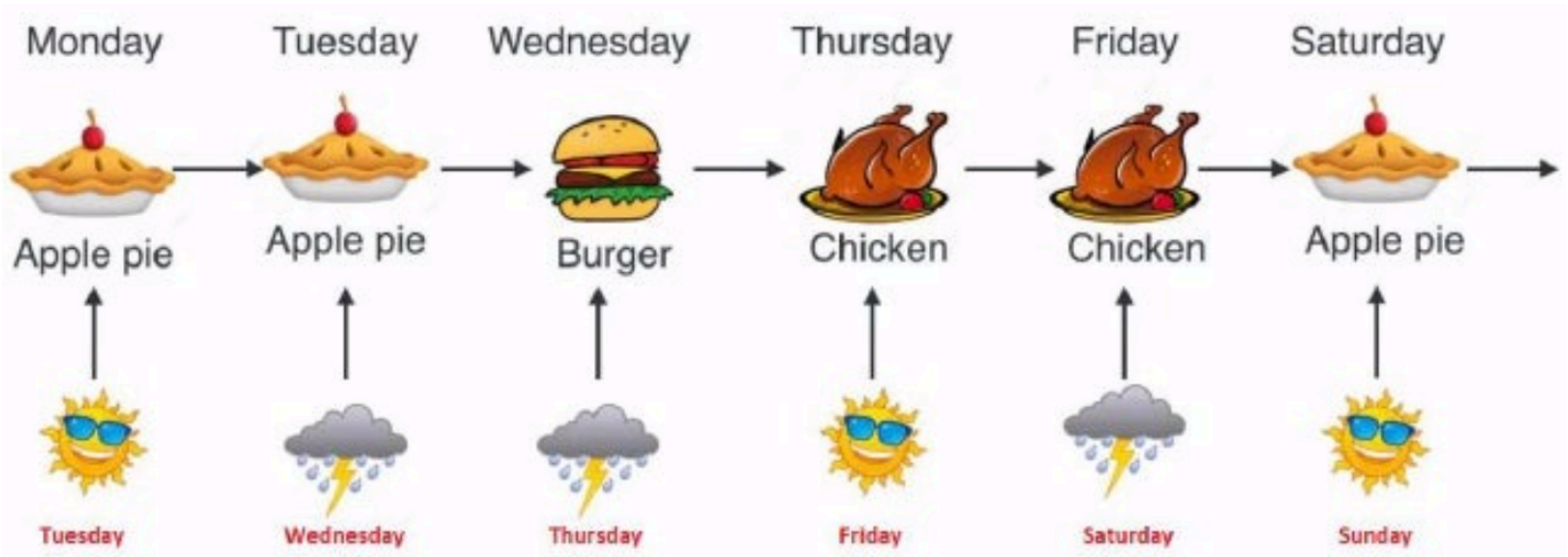

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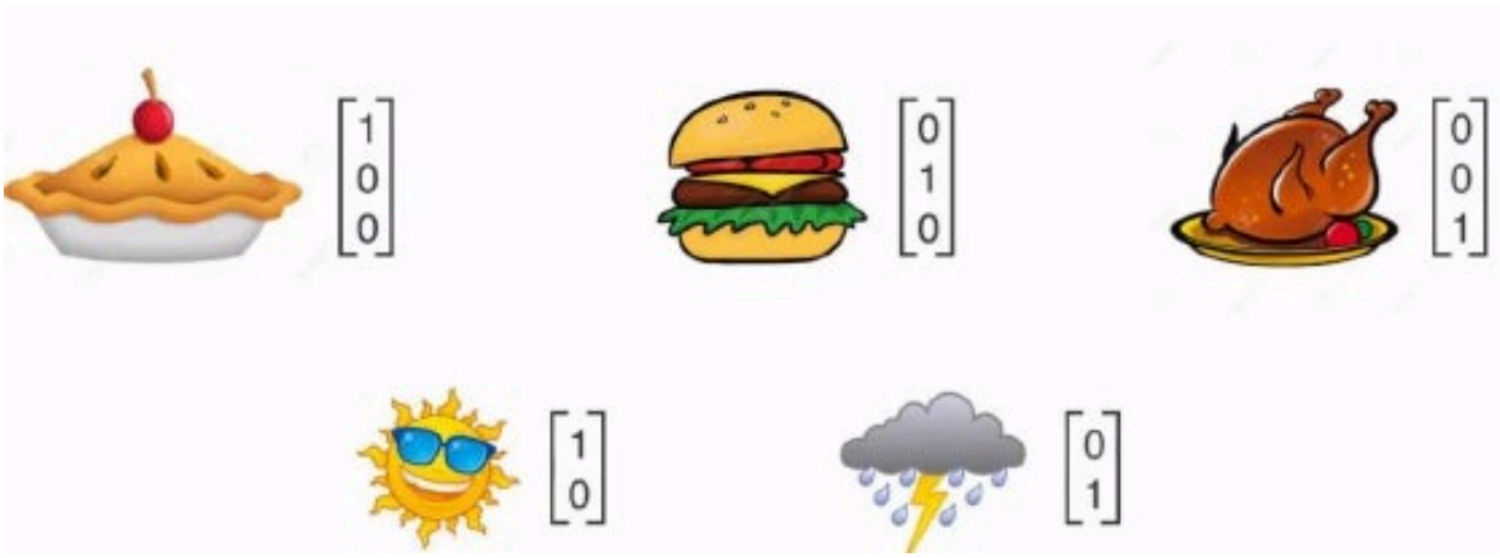

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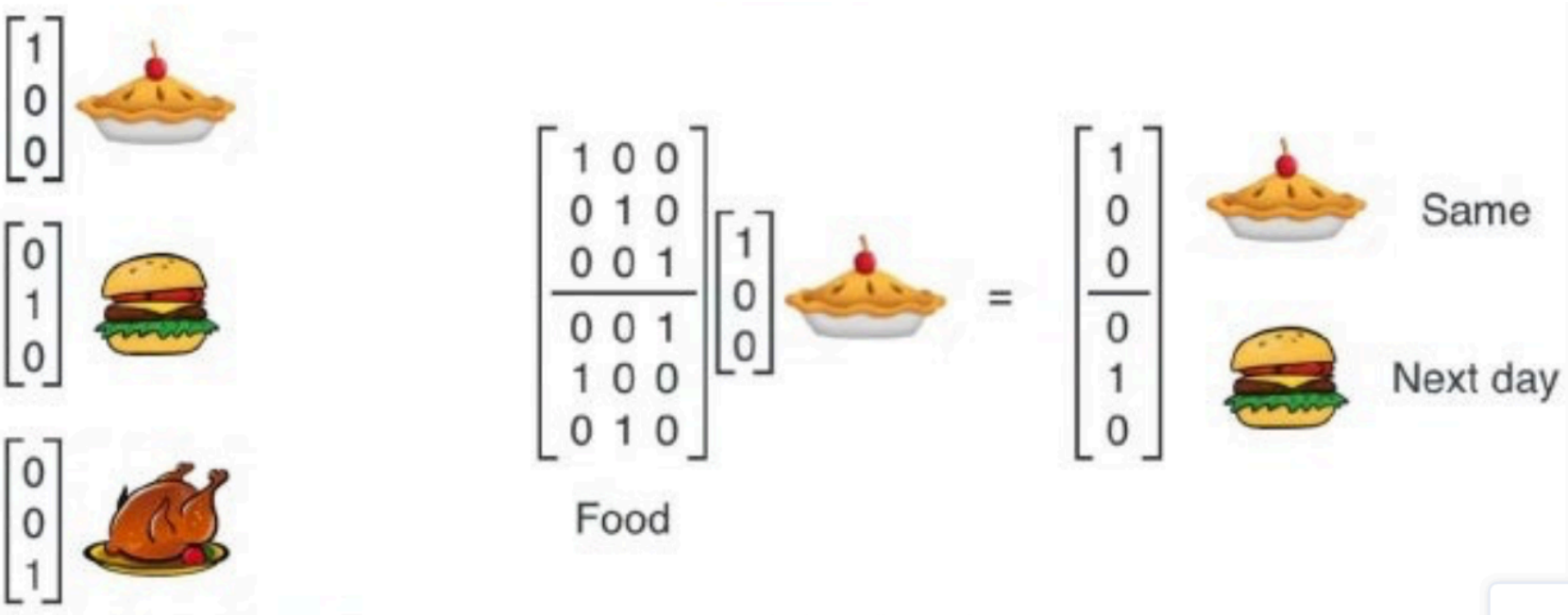

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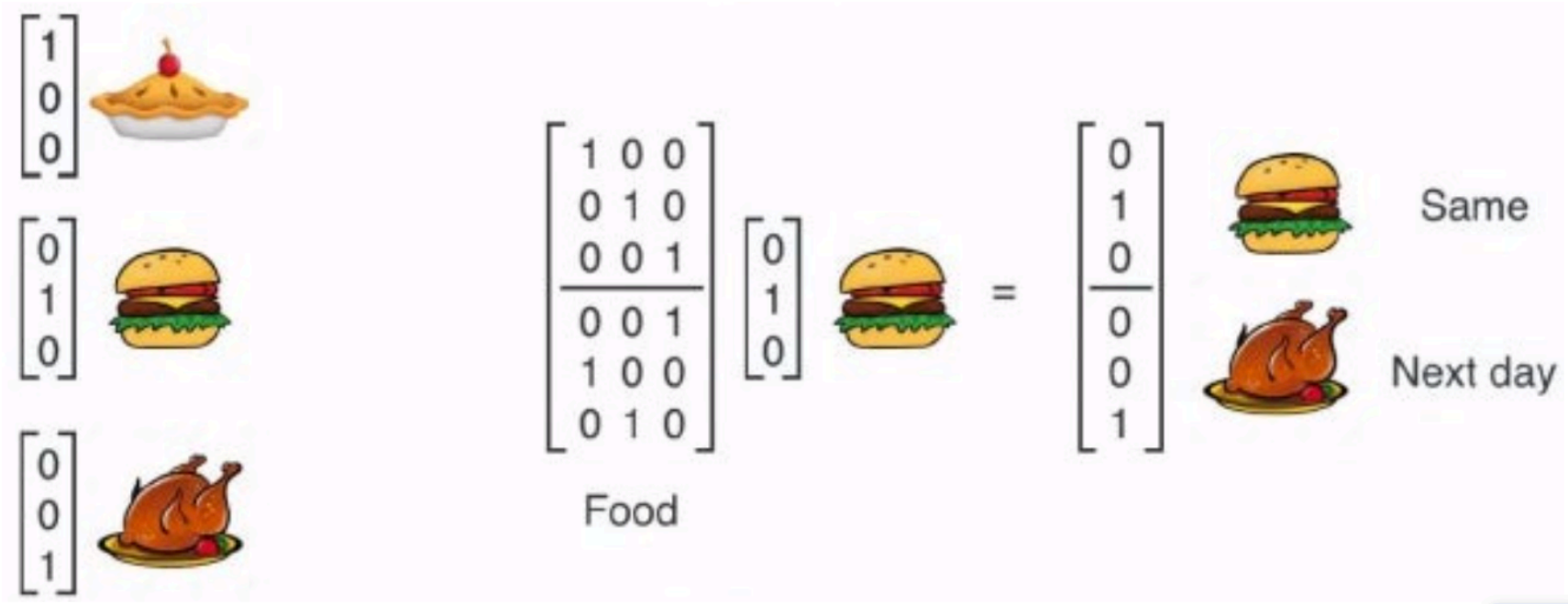

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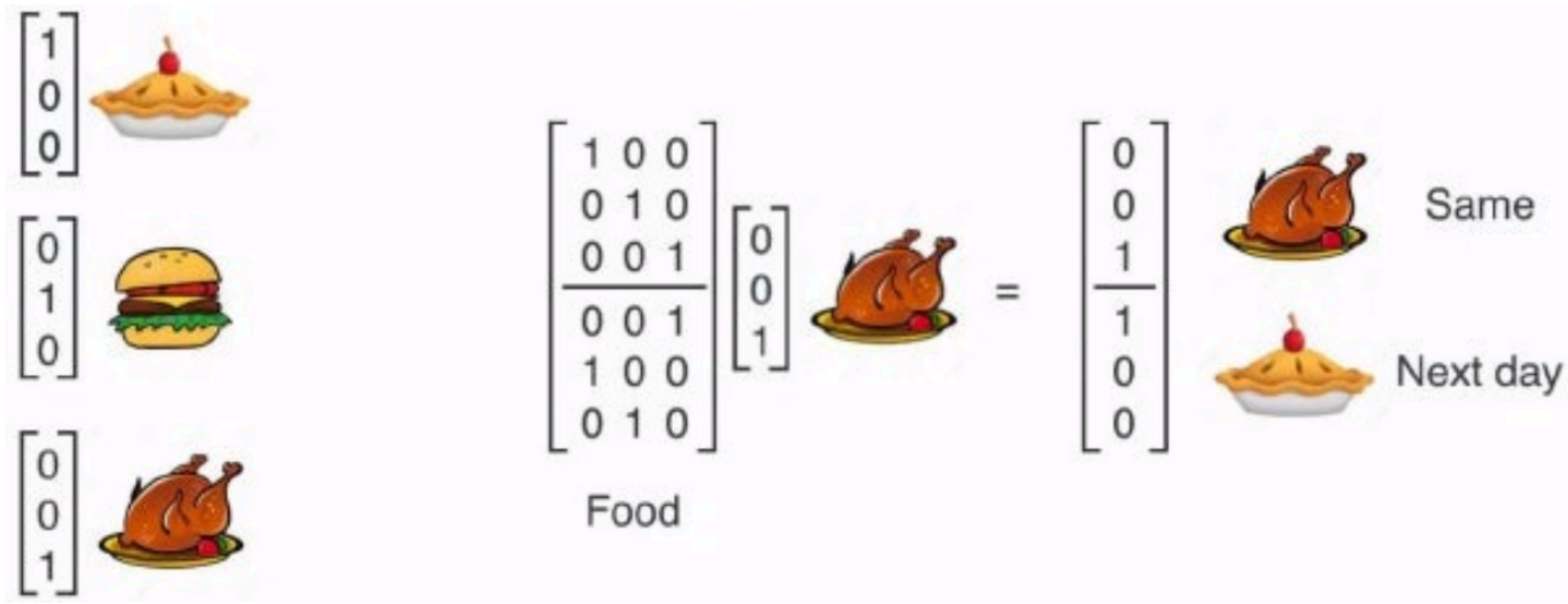

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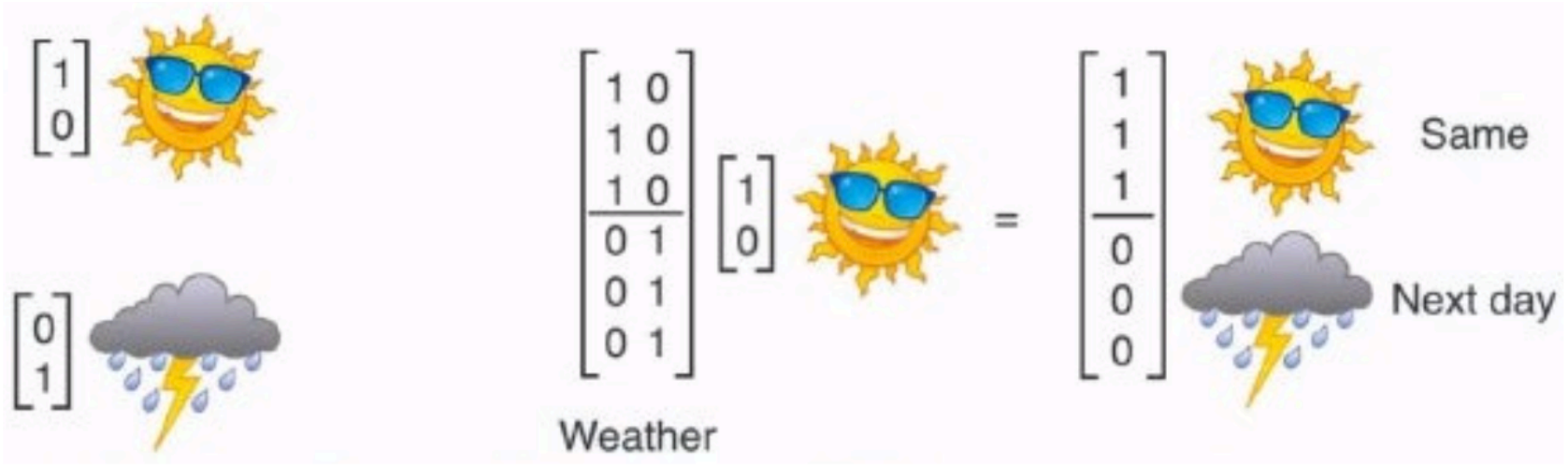

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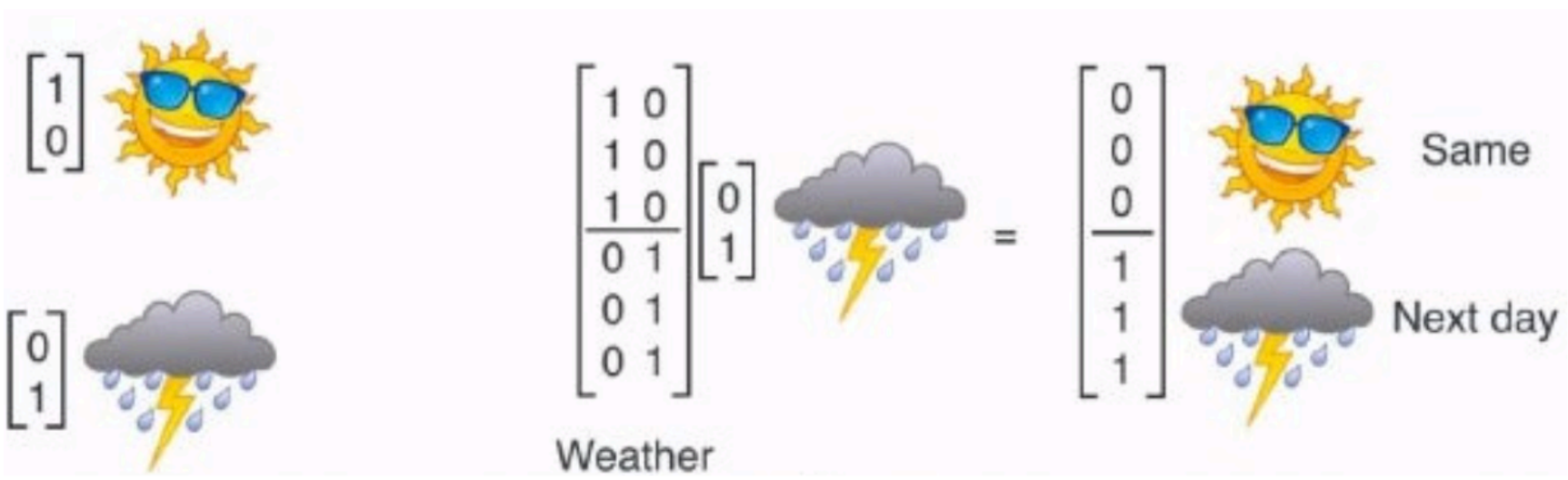

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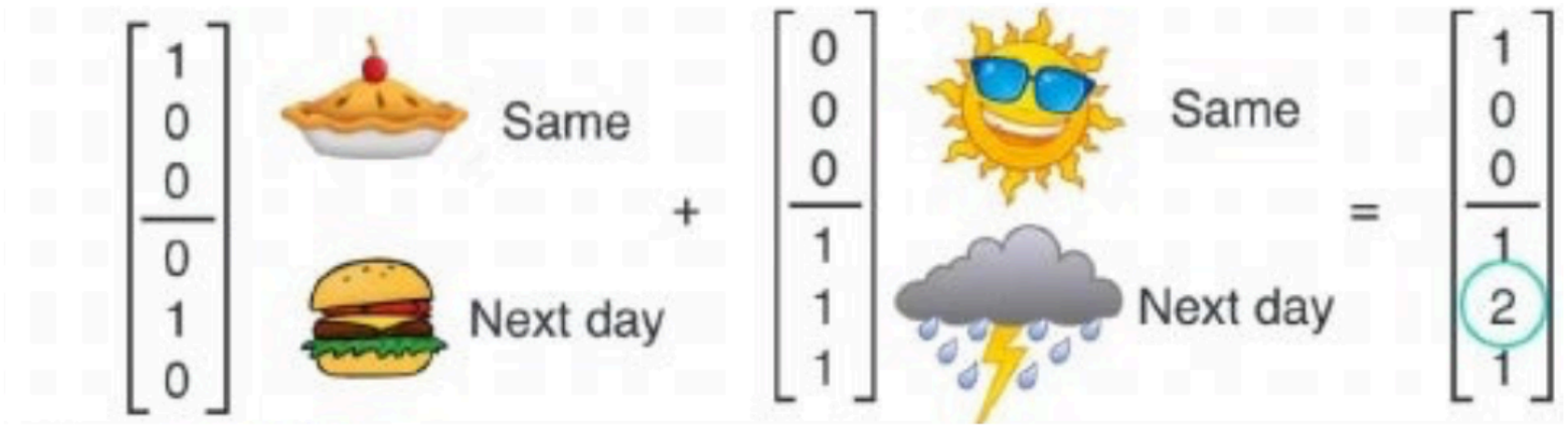

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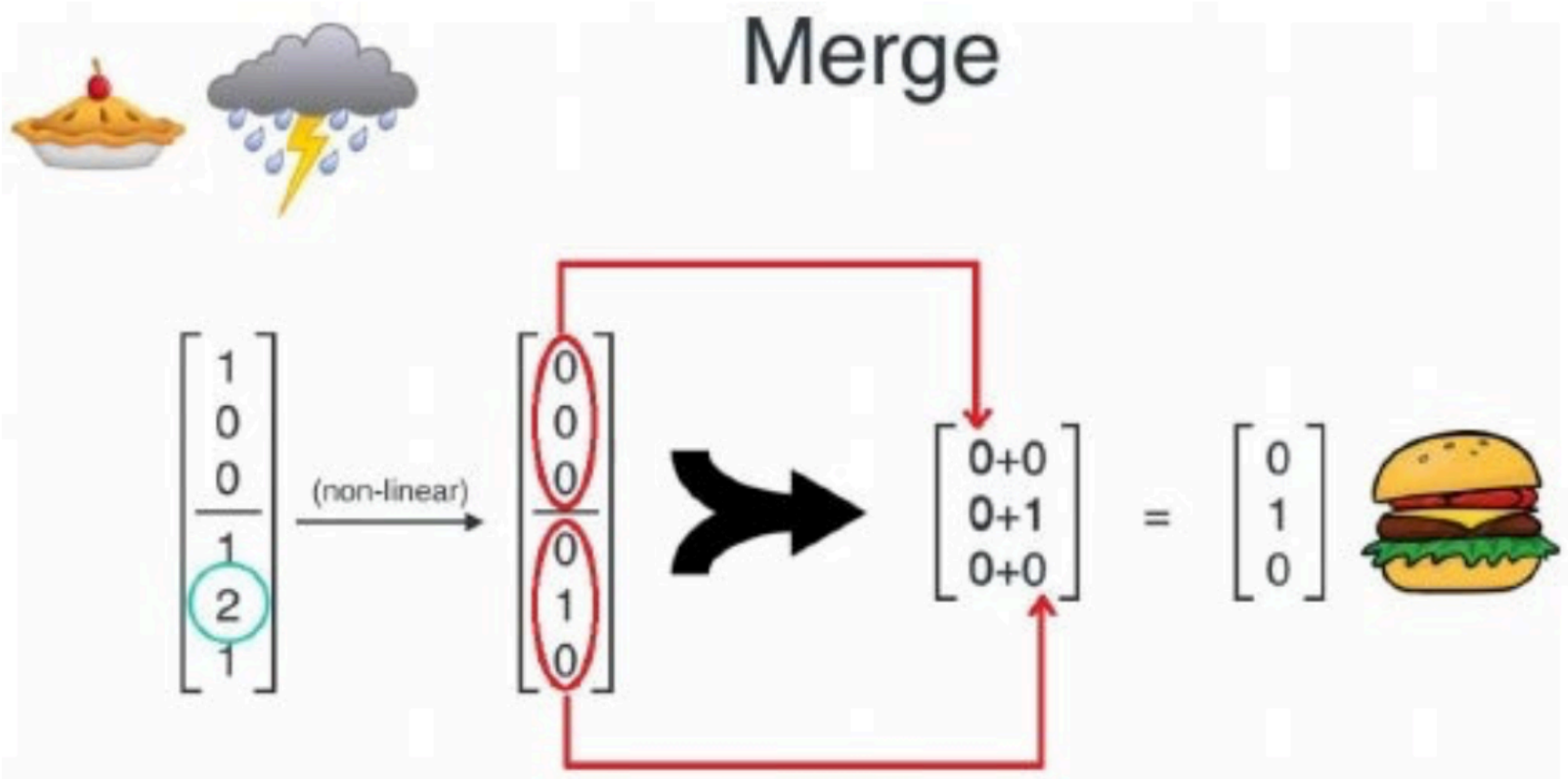
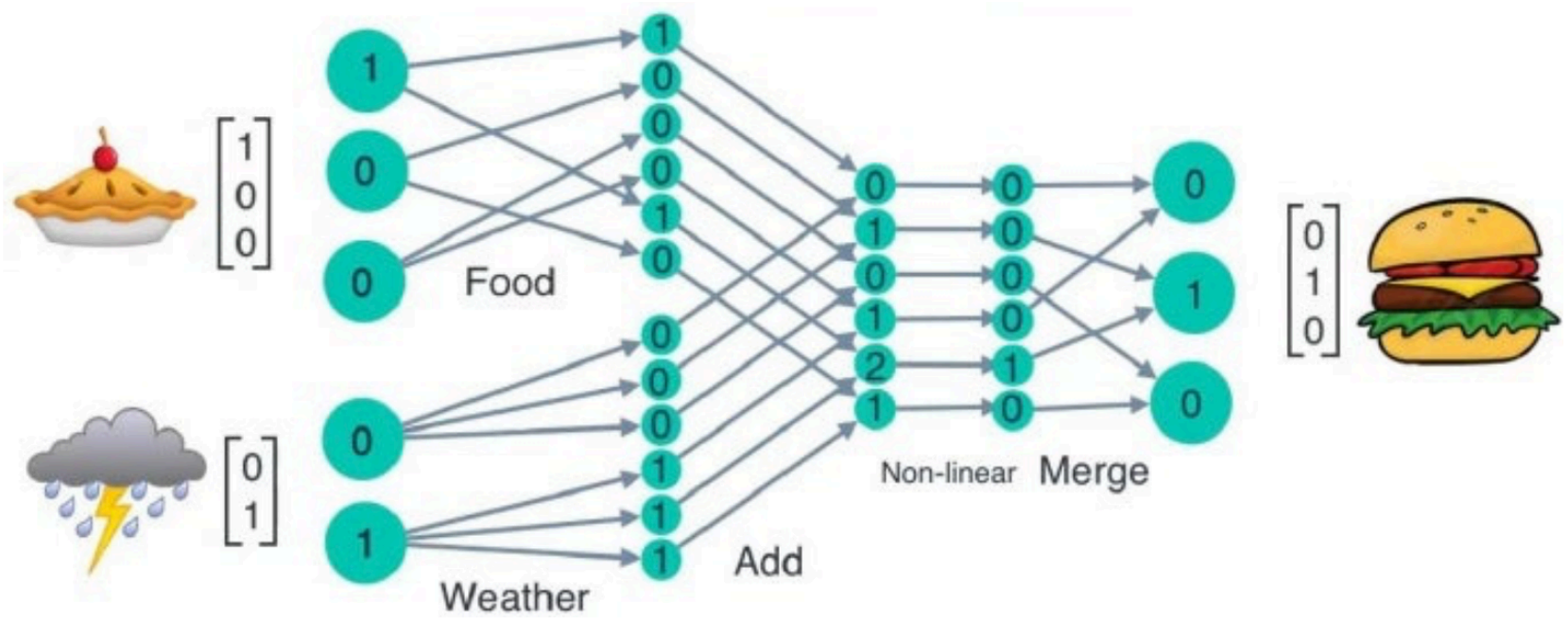


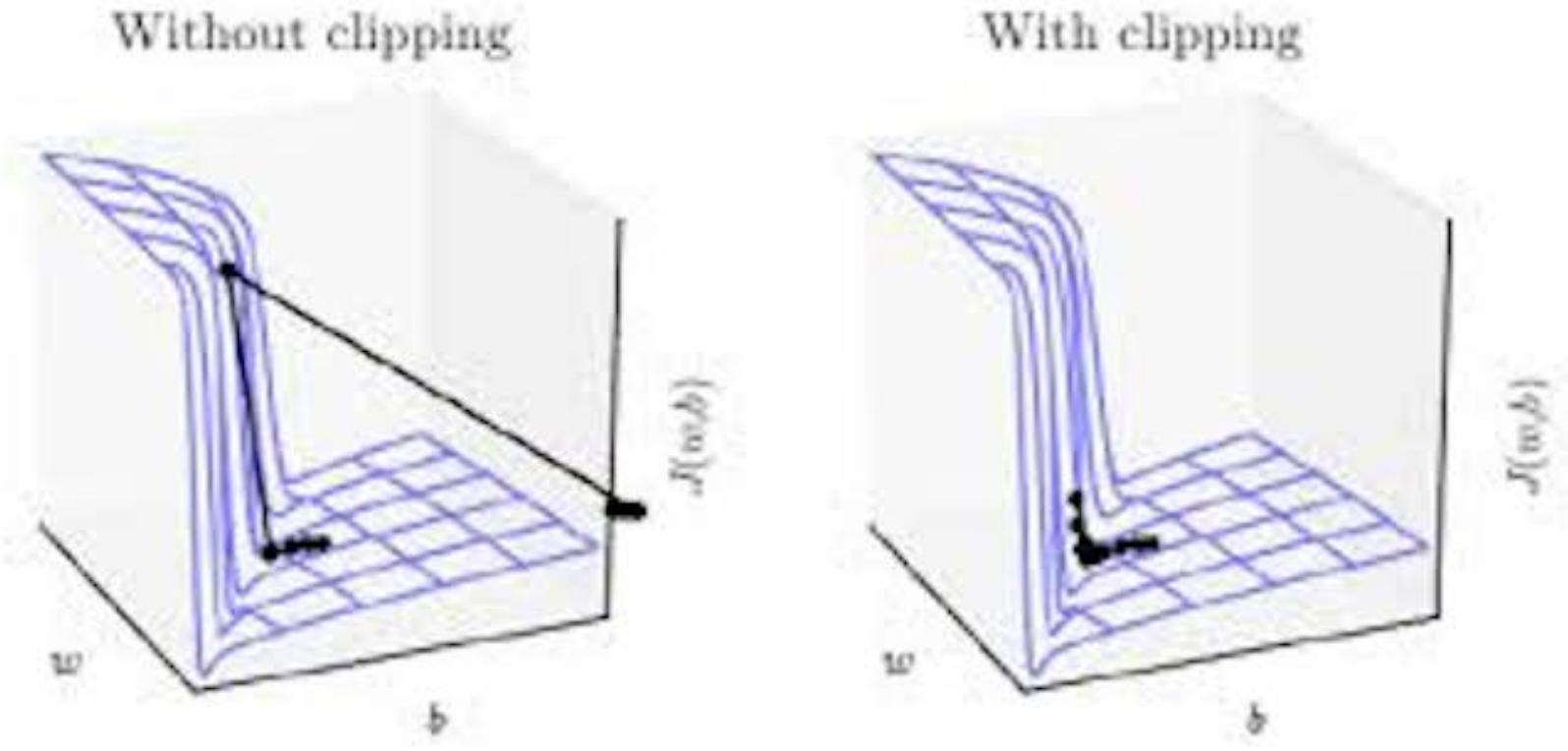
Recurrent Neural Networks

Food output is reinjected in the network as a state vector



These slides on the perfect roommate are borrowed from this [Luis Serrano's Youtube video (https://www.youtube.com/watch?v=BR9h47Jtqyw)](https://www.youtube.com/watch?v=BR9h47Jtqyw)

Vanishing and exploding gradient



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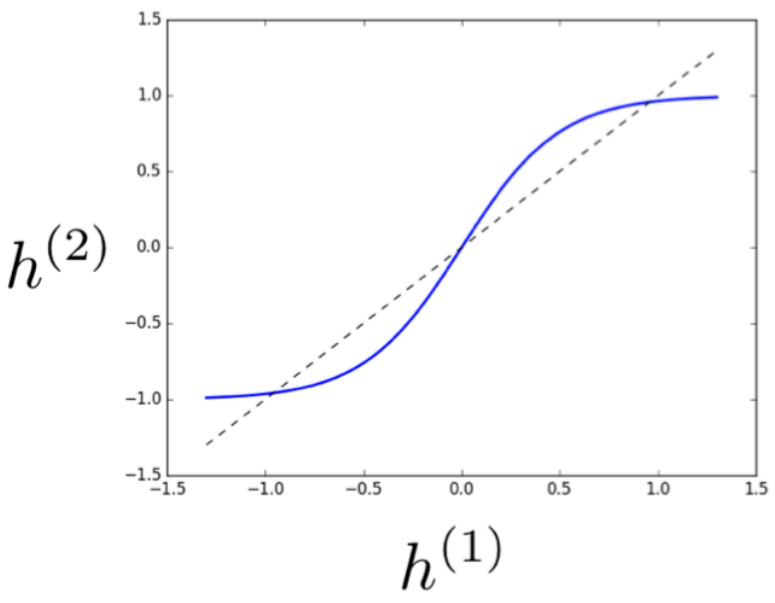
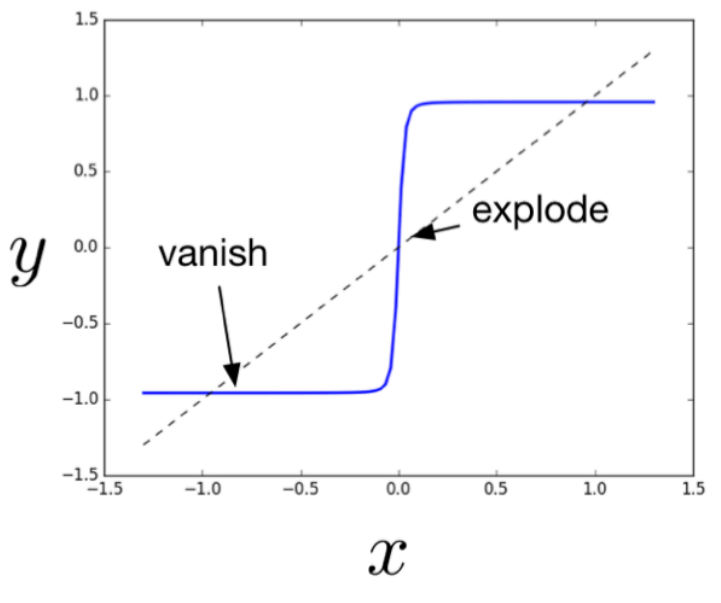
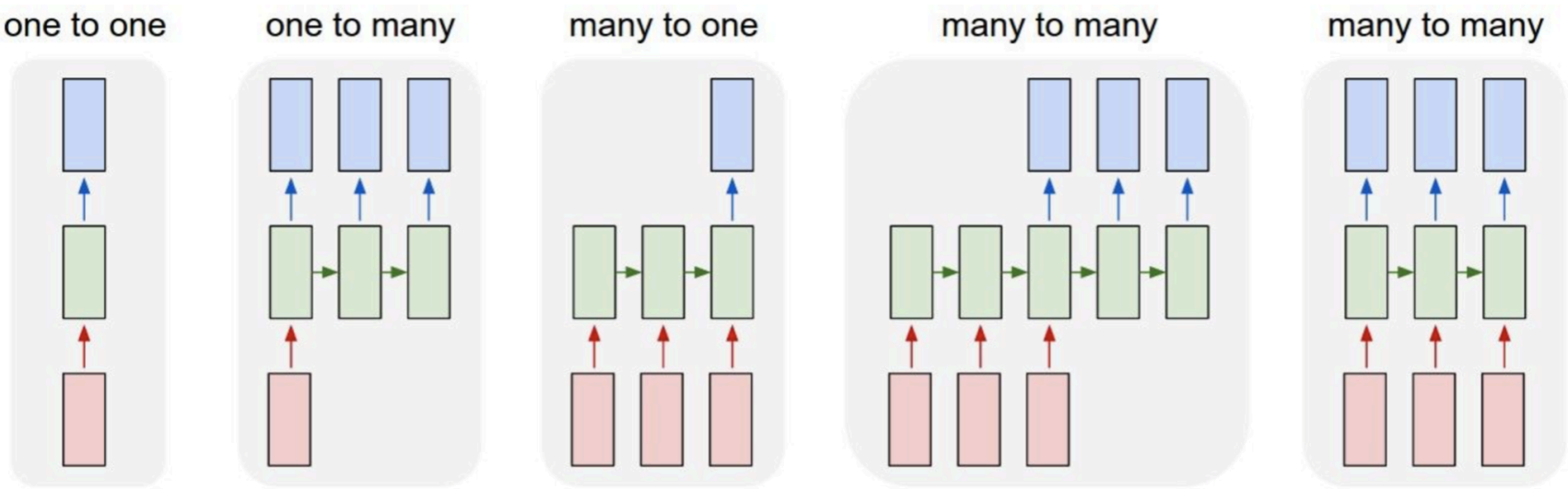
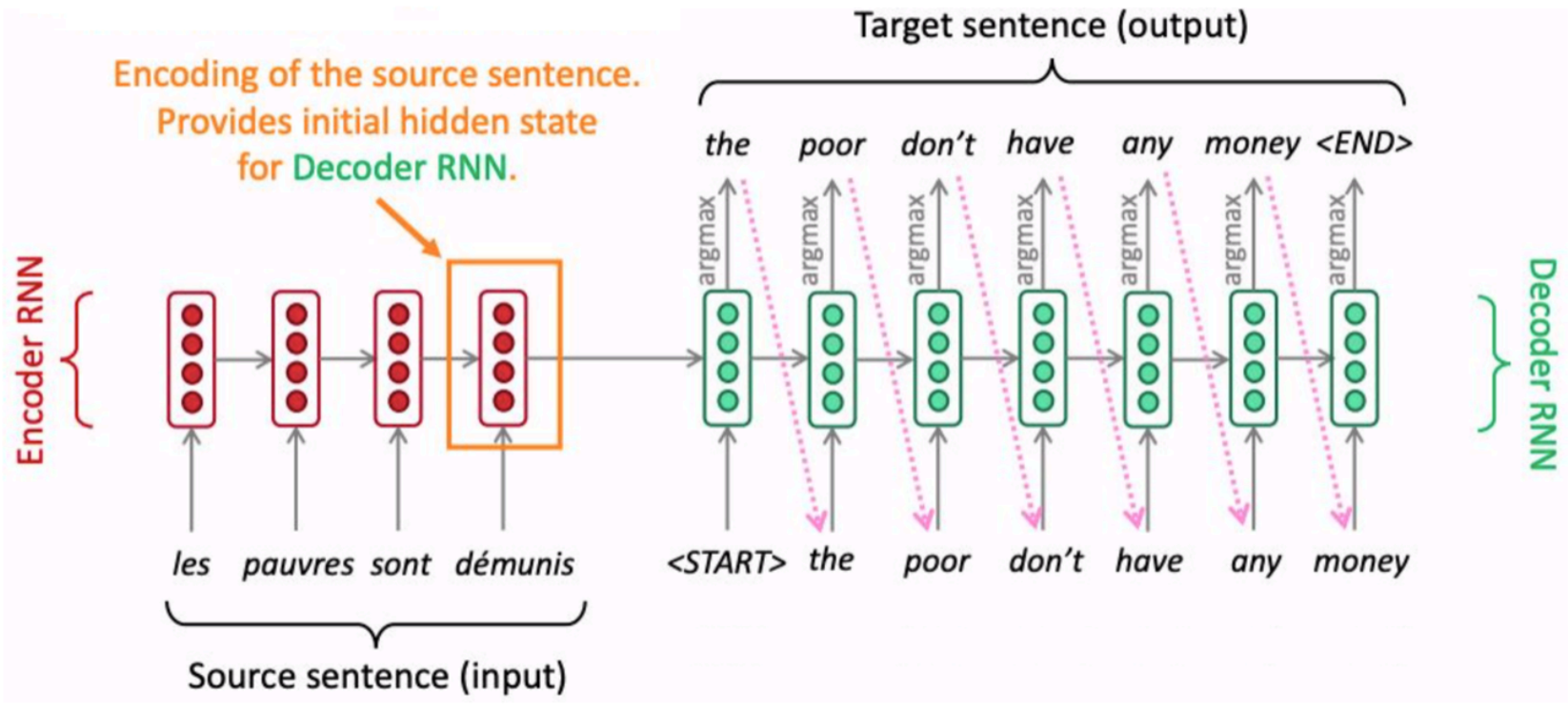




Different types of RNN



Attention is all you need (the origin)



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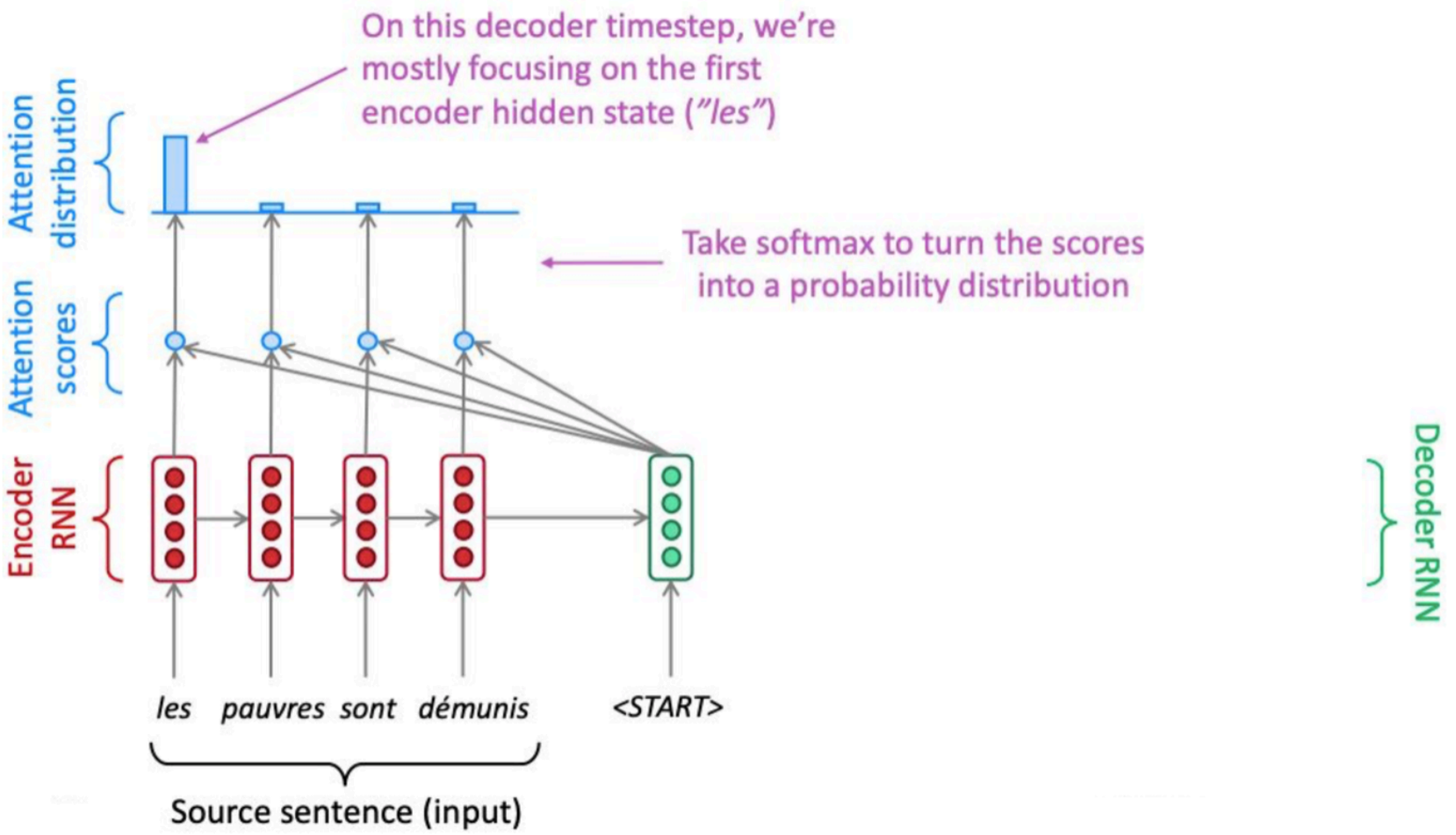

These slides come from this [Ömer Sakarya paper (https://towardsdatascience.com/introduction-to-rnns-sequence-to-sequence-language-translation-and-attention-fc43ef2cc3fd)](https://towardsdatascience.com/introduction-to-rnns-sequence-to-sequence-language-translation-and-attention-fc43ef2cc3fd)

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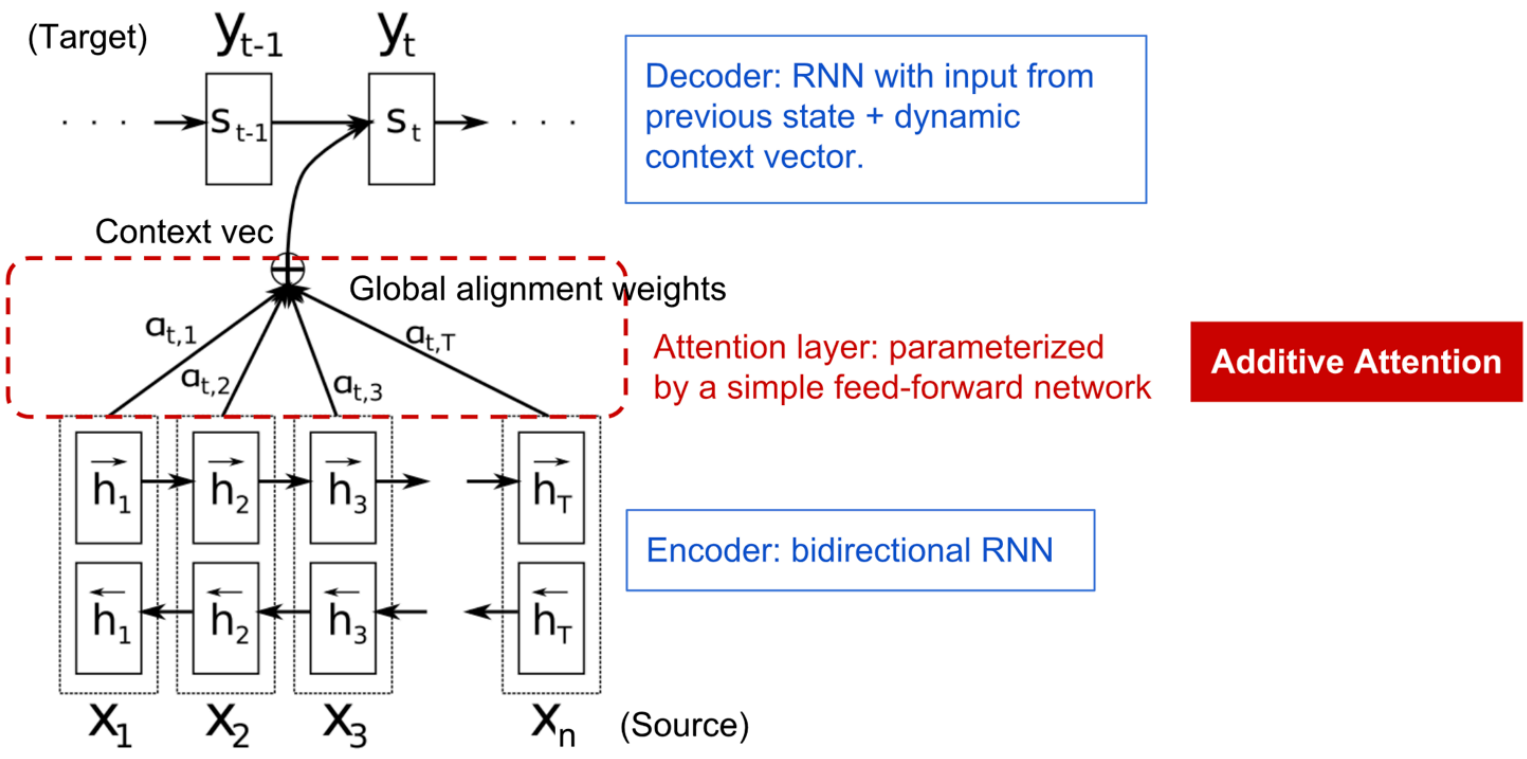

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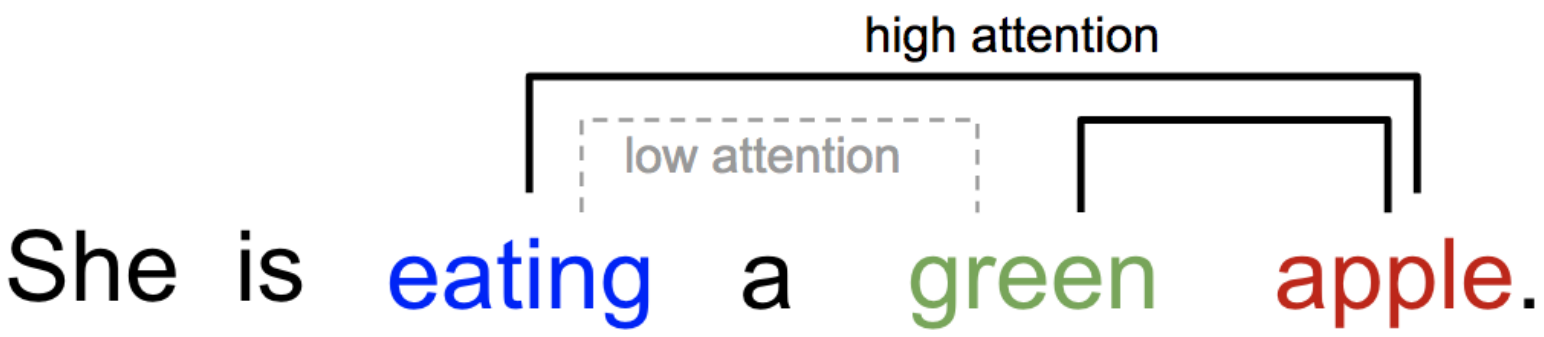

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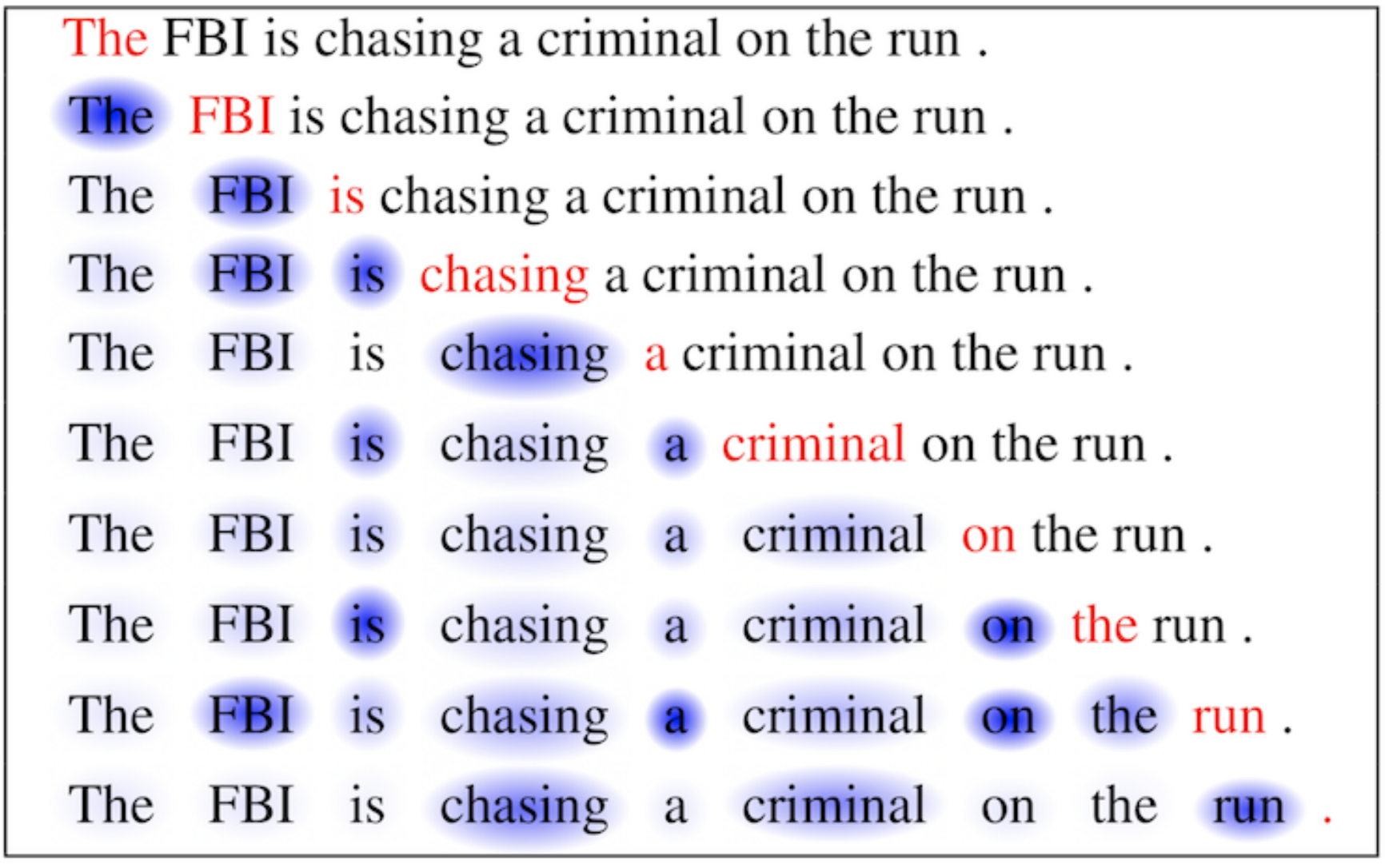

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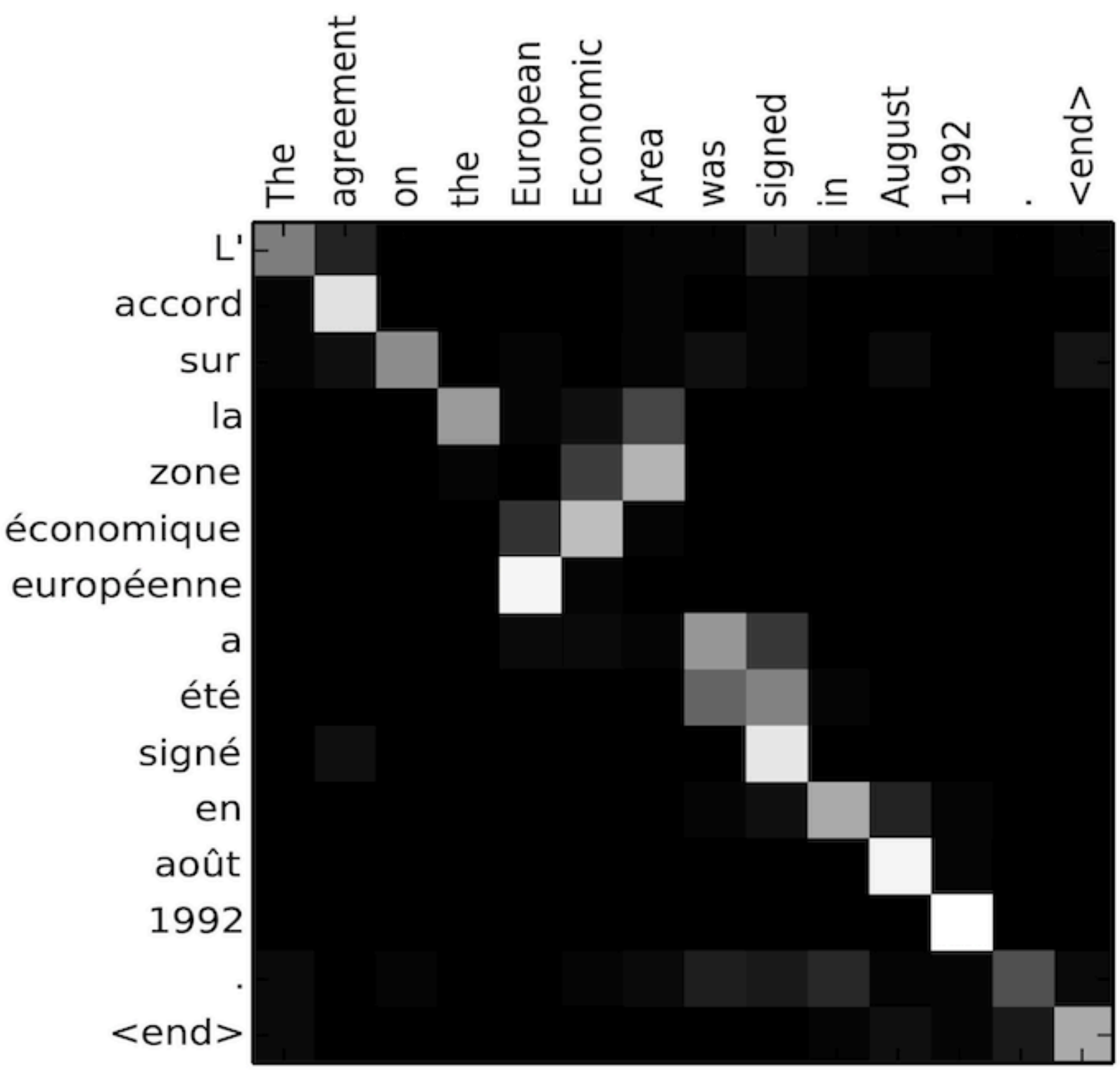

These last eight slides are borrowed from this [Lilian Weng's article (https://lilianweng.github.io/lil-log/2018/06/24/attention-attention.html)](https://lilianweng.github.io/lil-log/2018/06/24/attention-attention.html)

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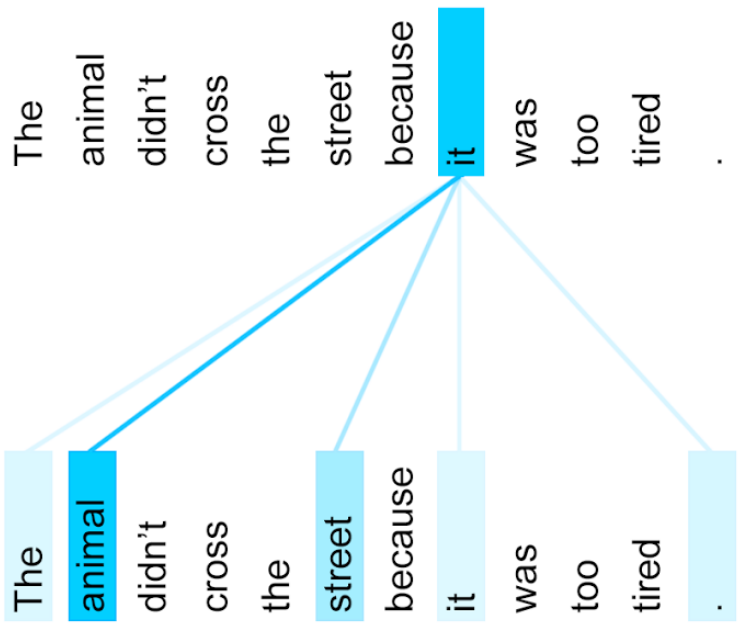

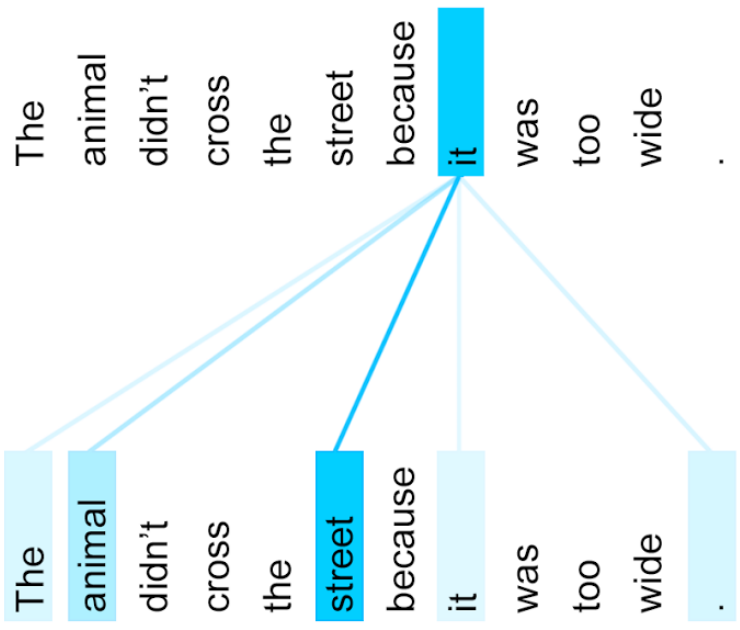

These last two slides are borrowed from this [Google AI's blog](https://ai.googleblog.com/2017/08/transformer-novel-neural-network.html)

Attention is all you need (the mighty transformer)

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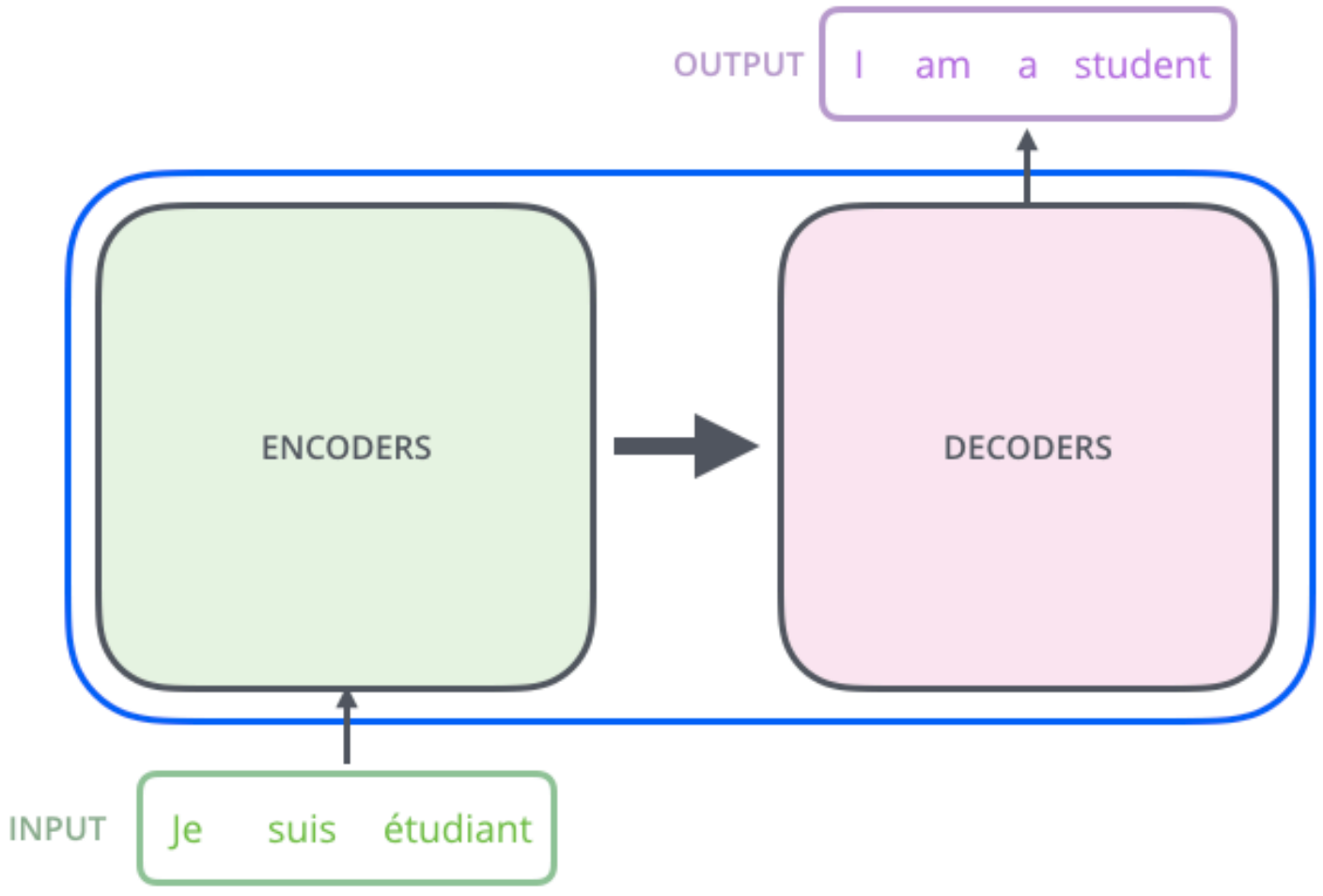

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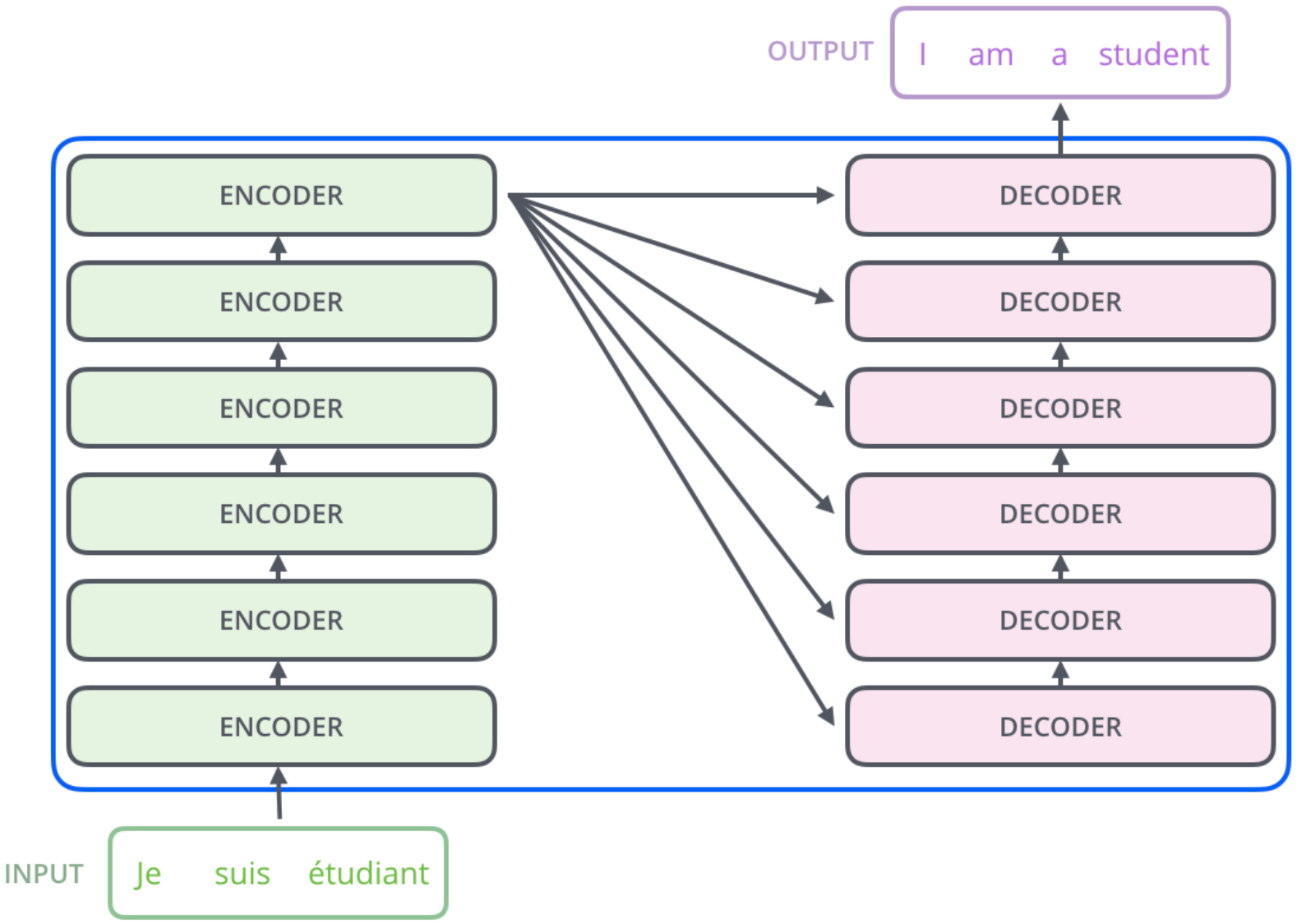

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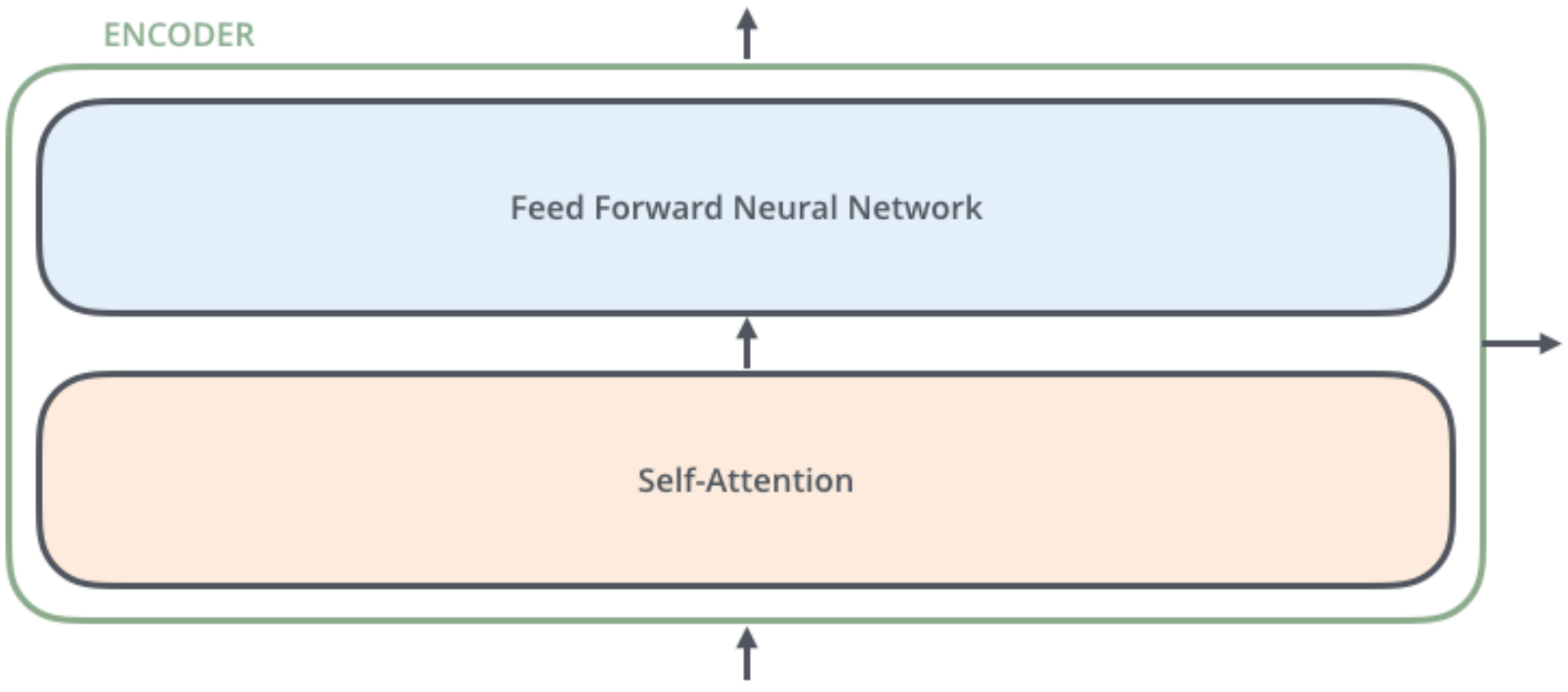

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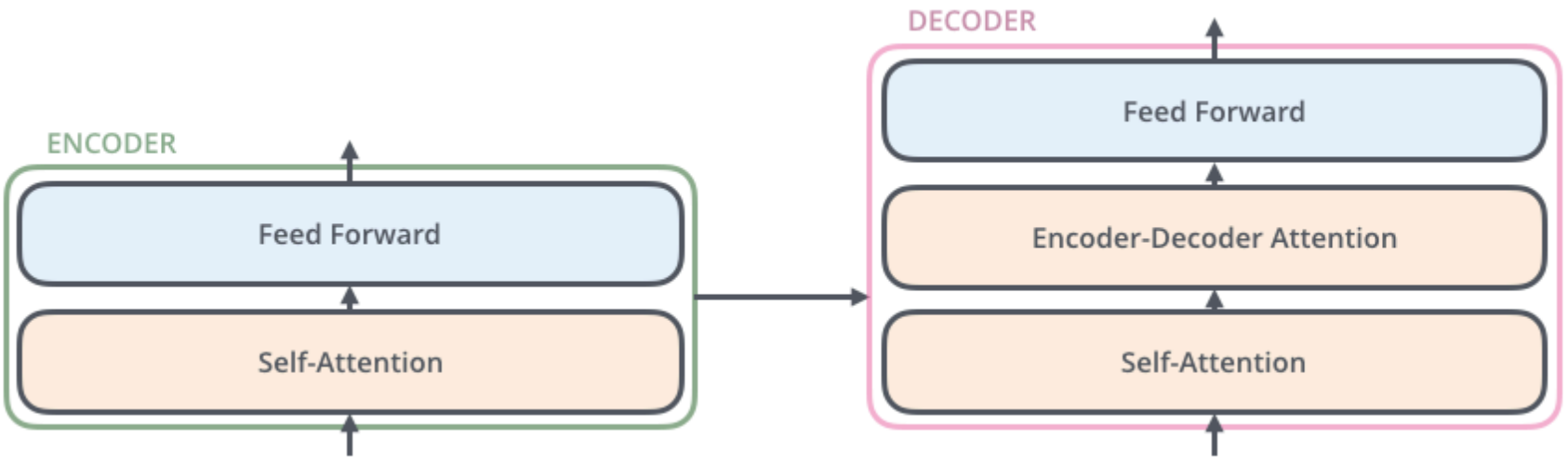

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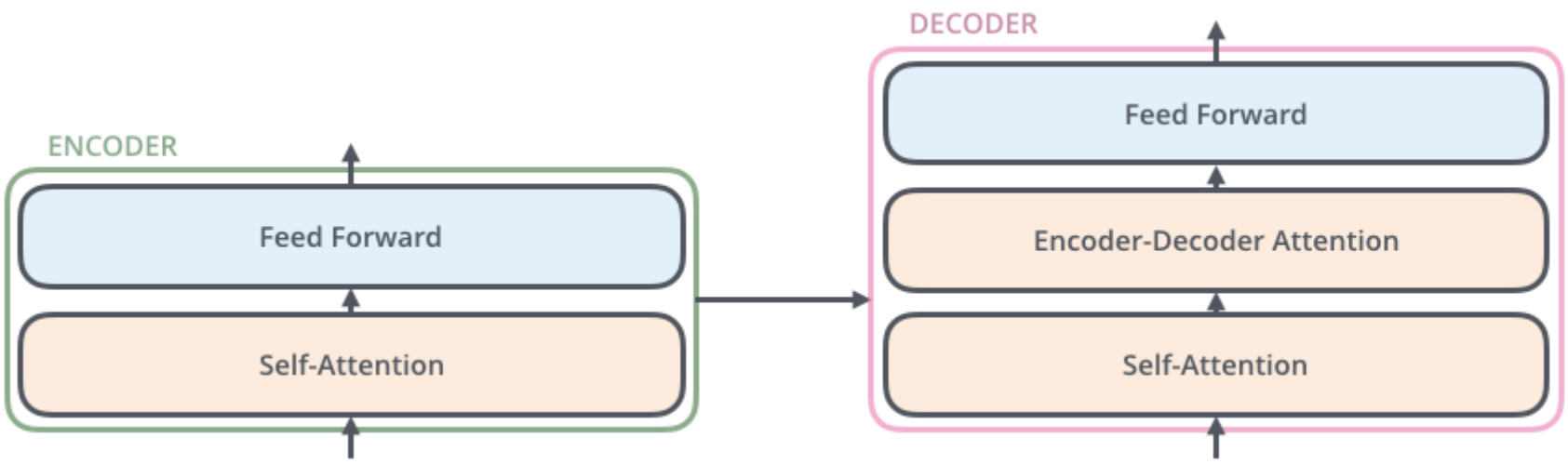

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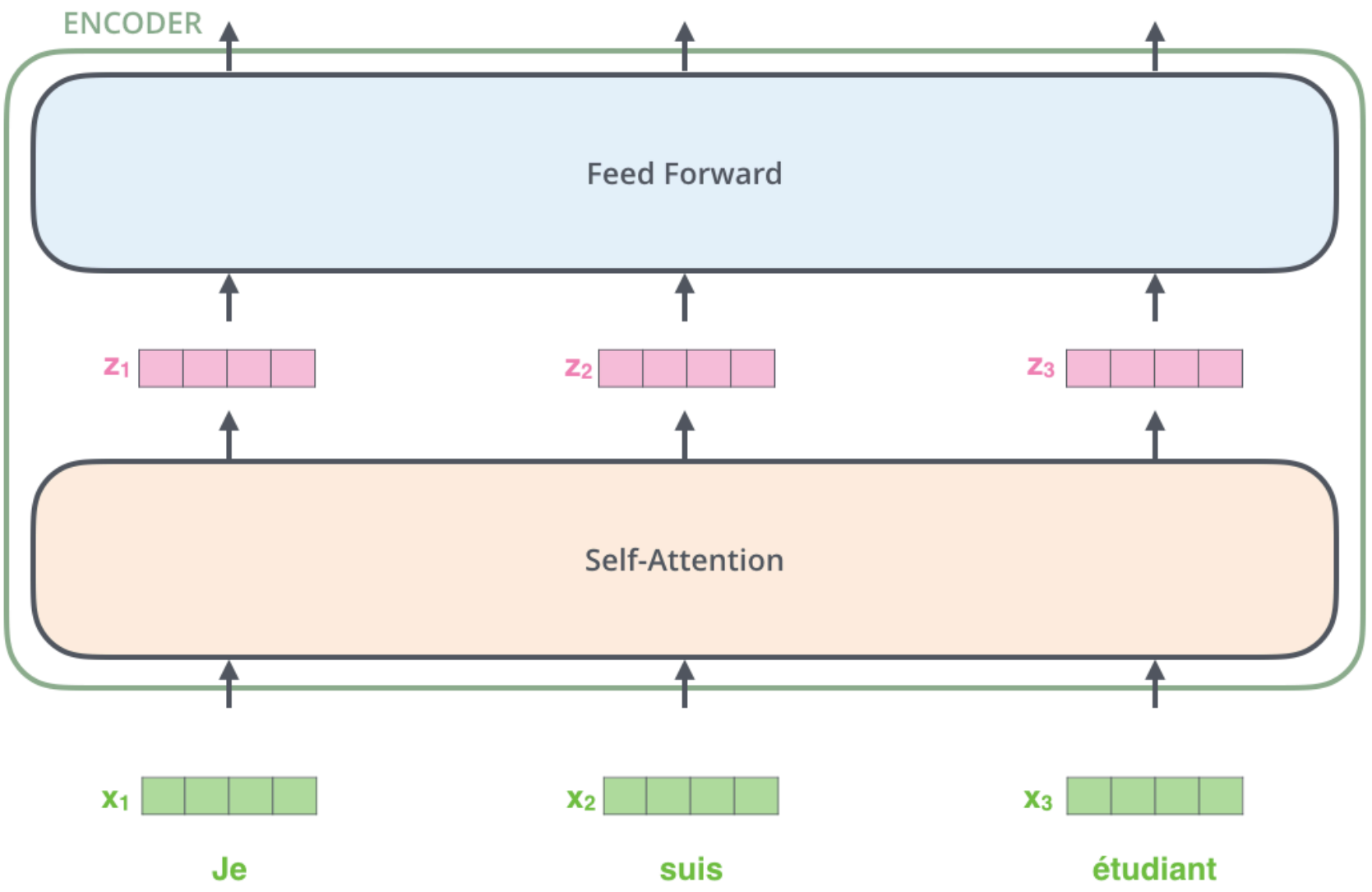

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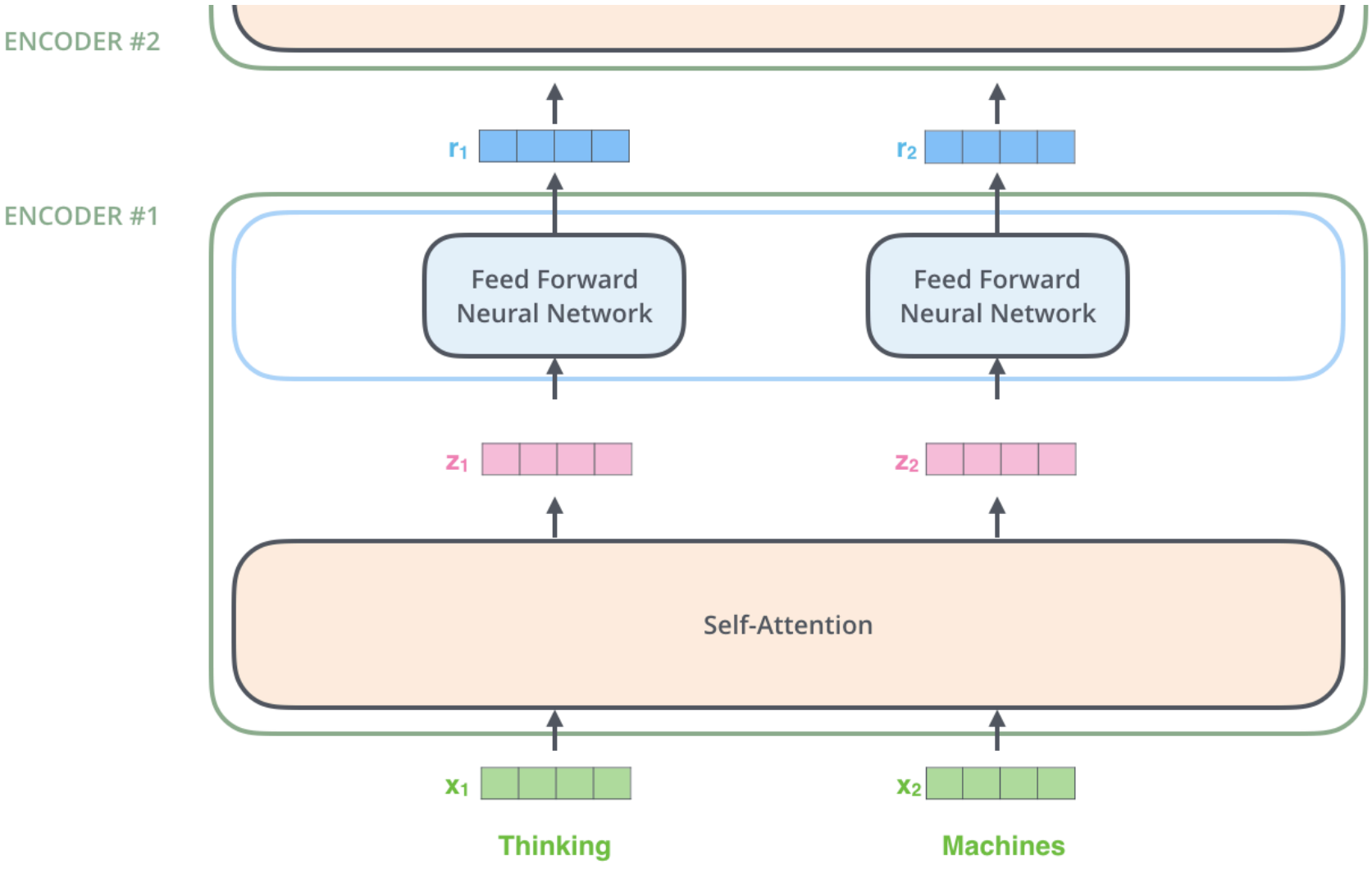

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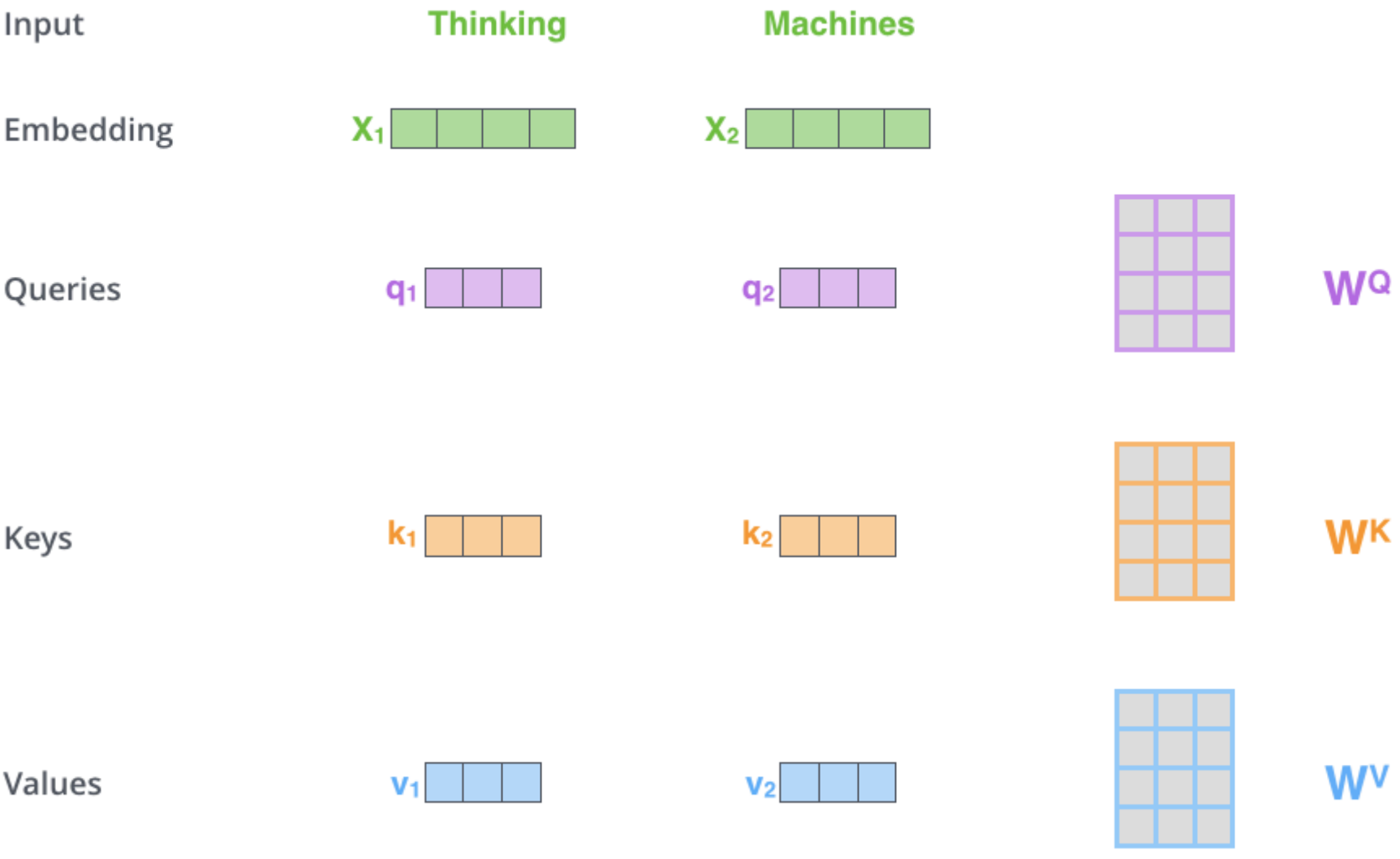

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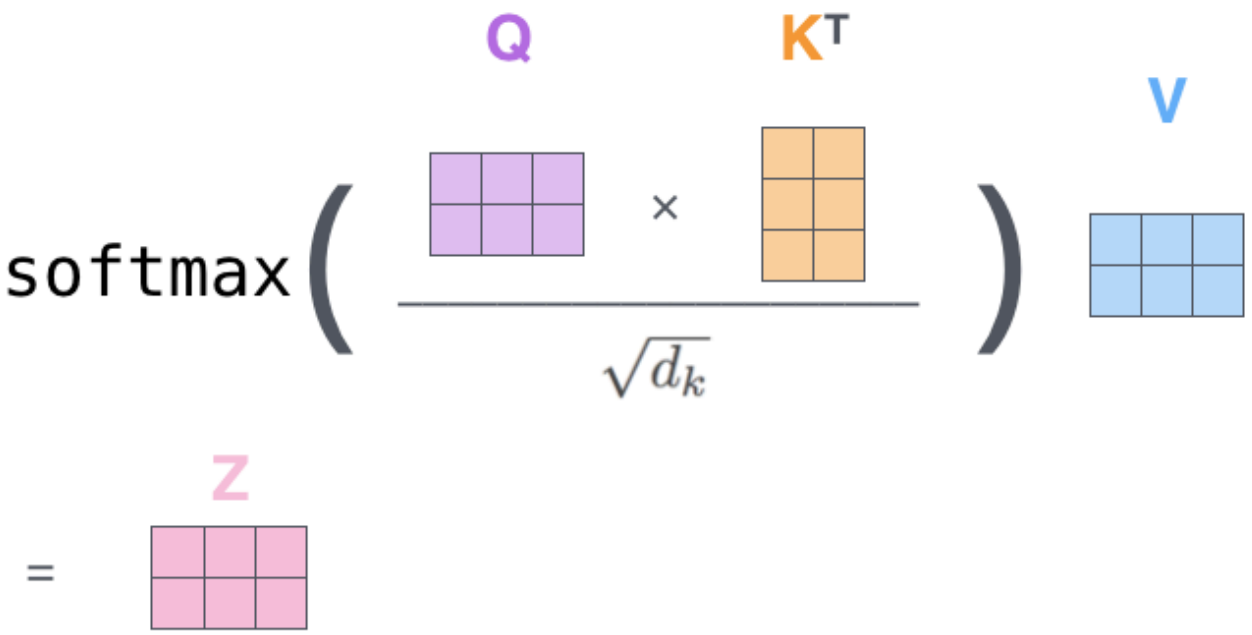

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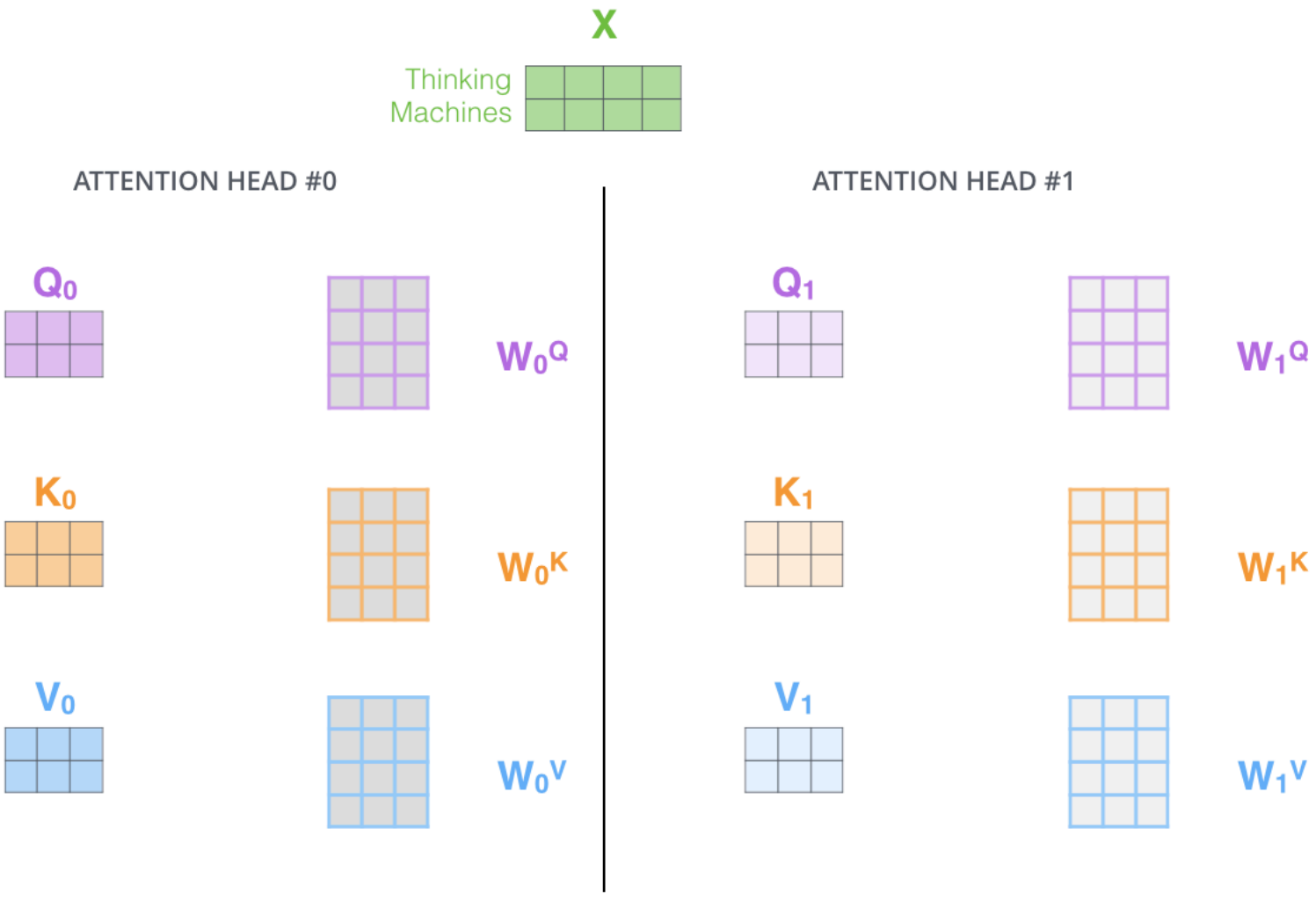

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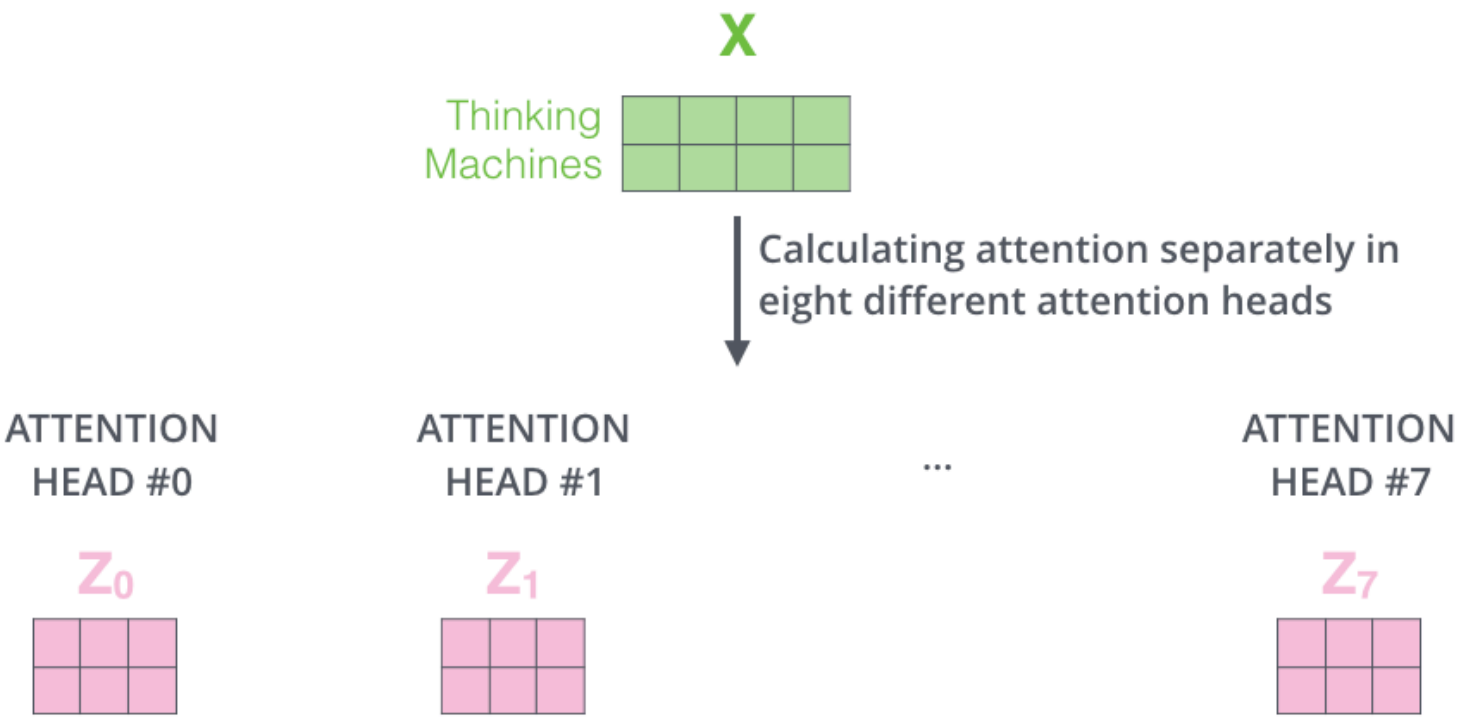

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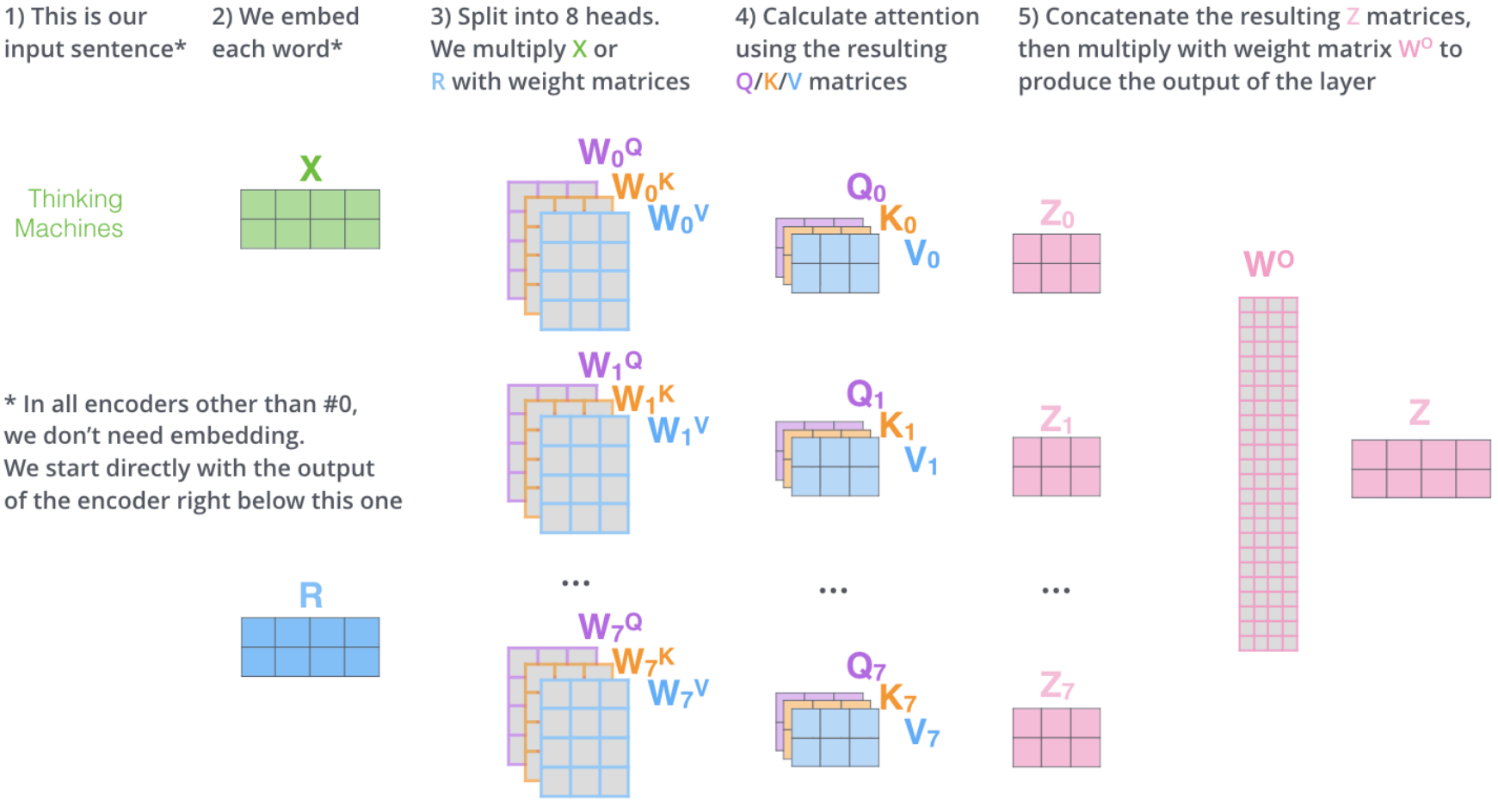

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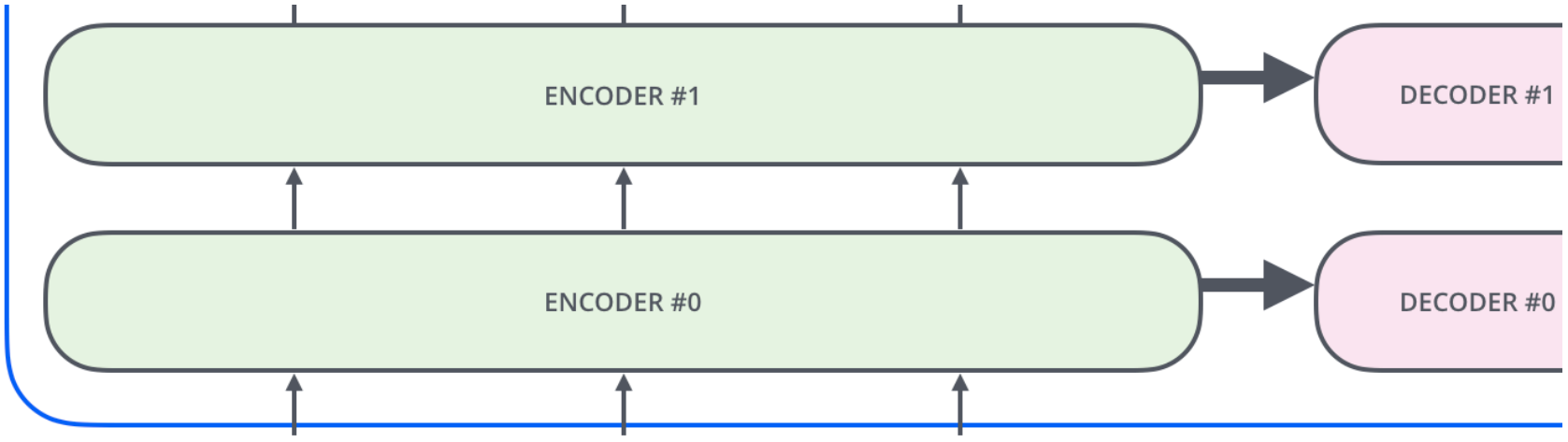

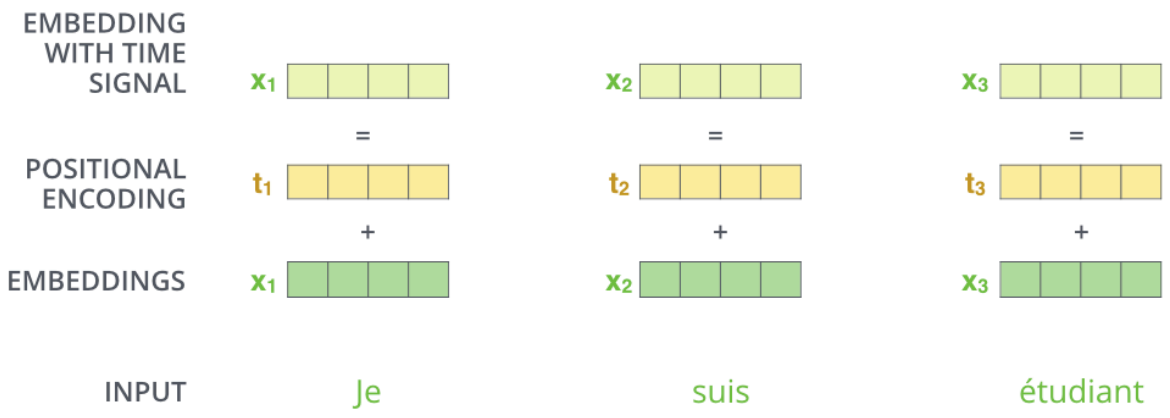

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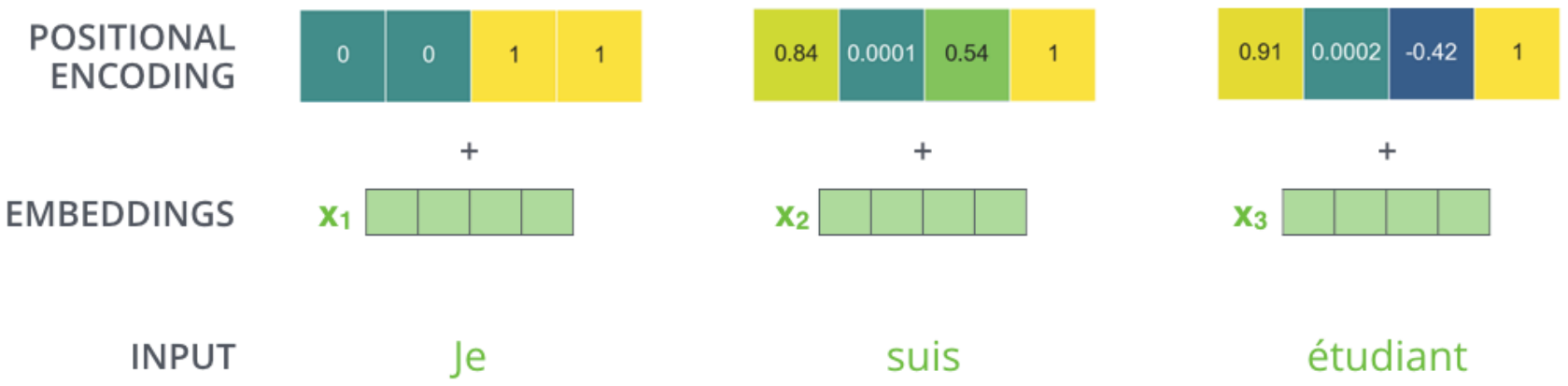

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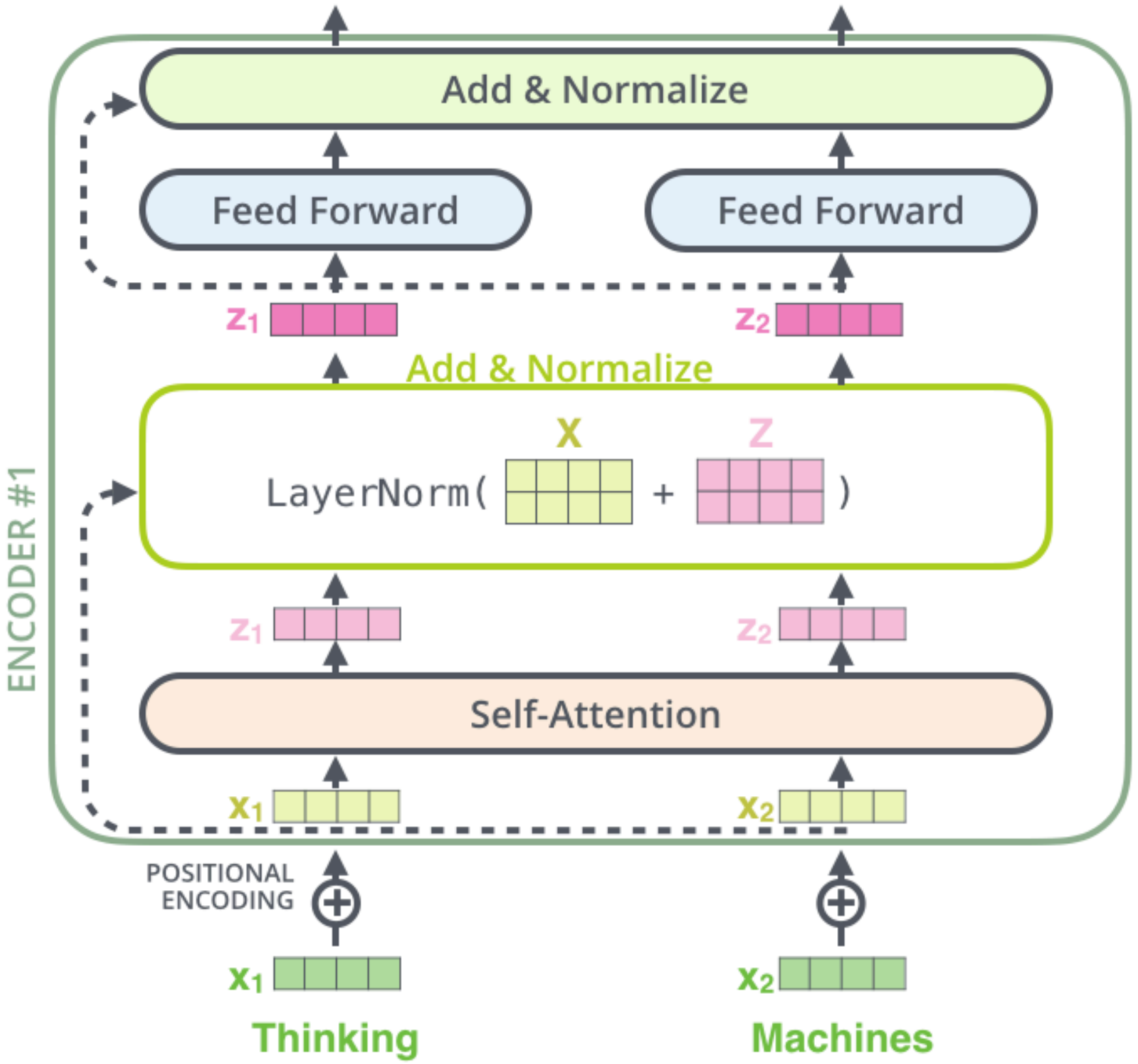

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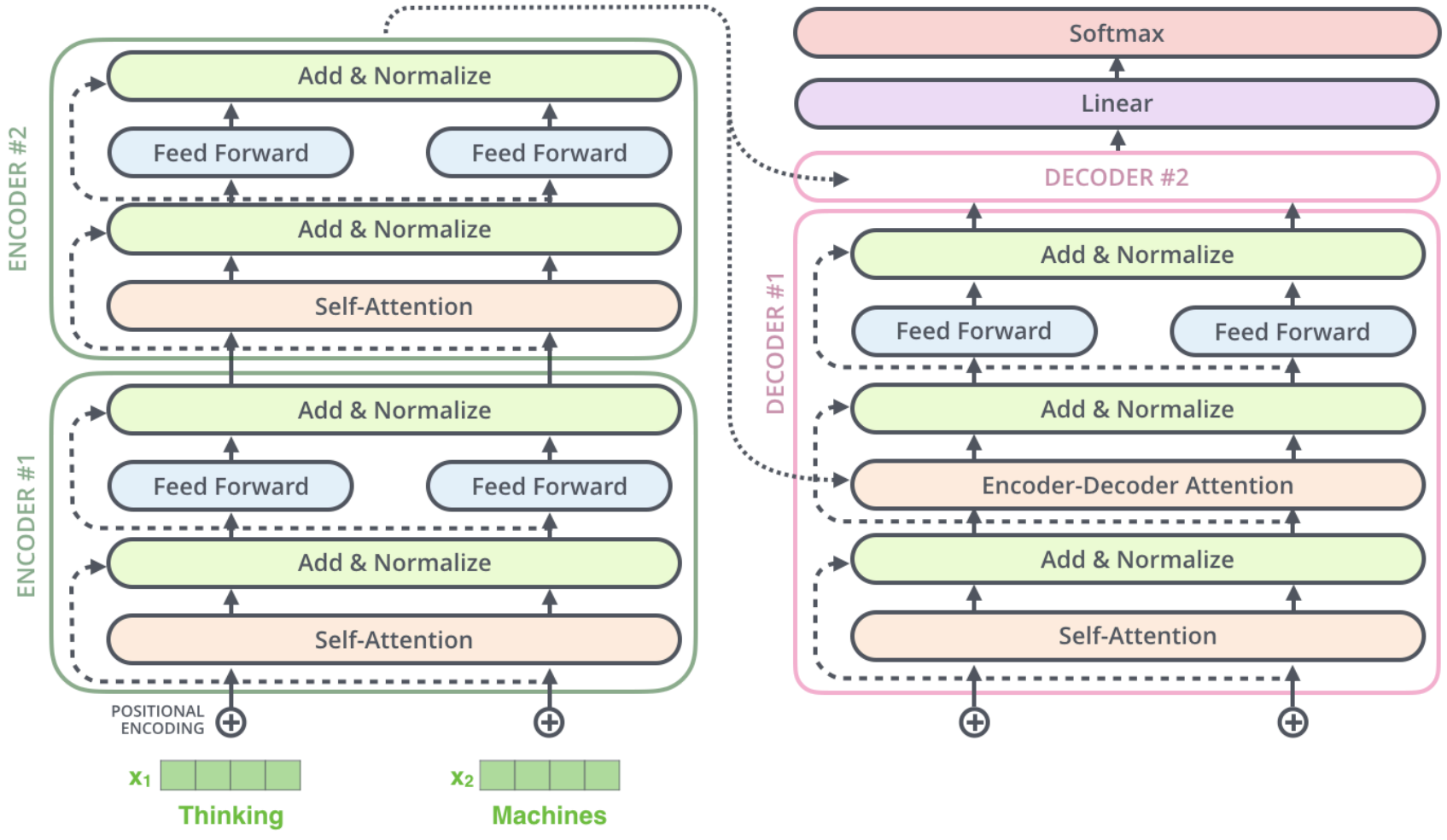

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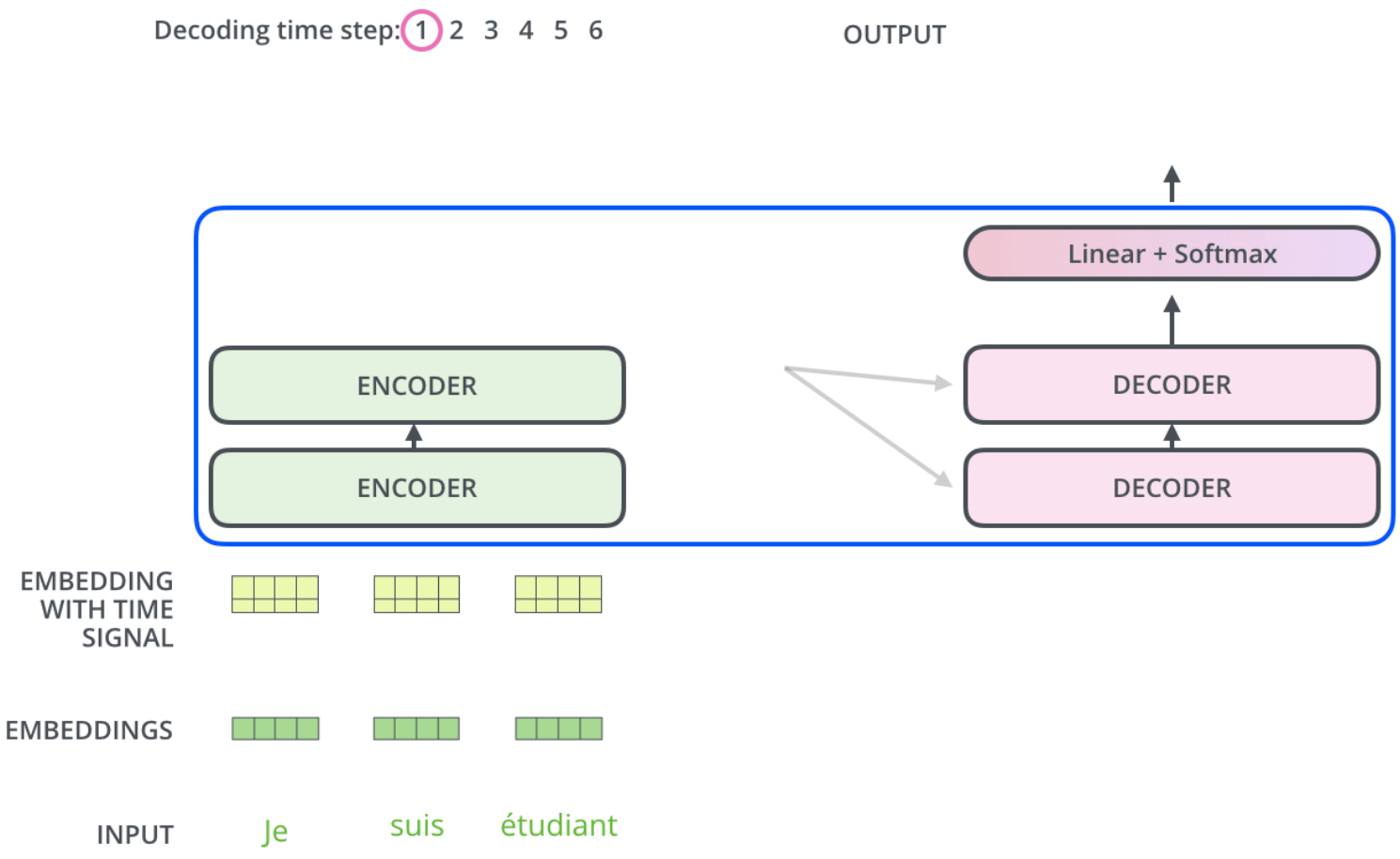

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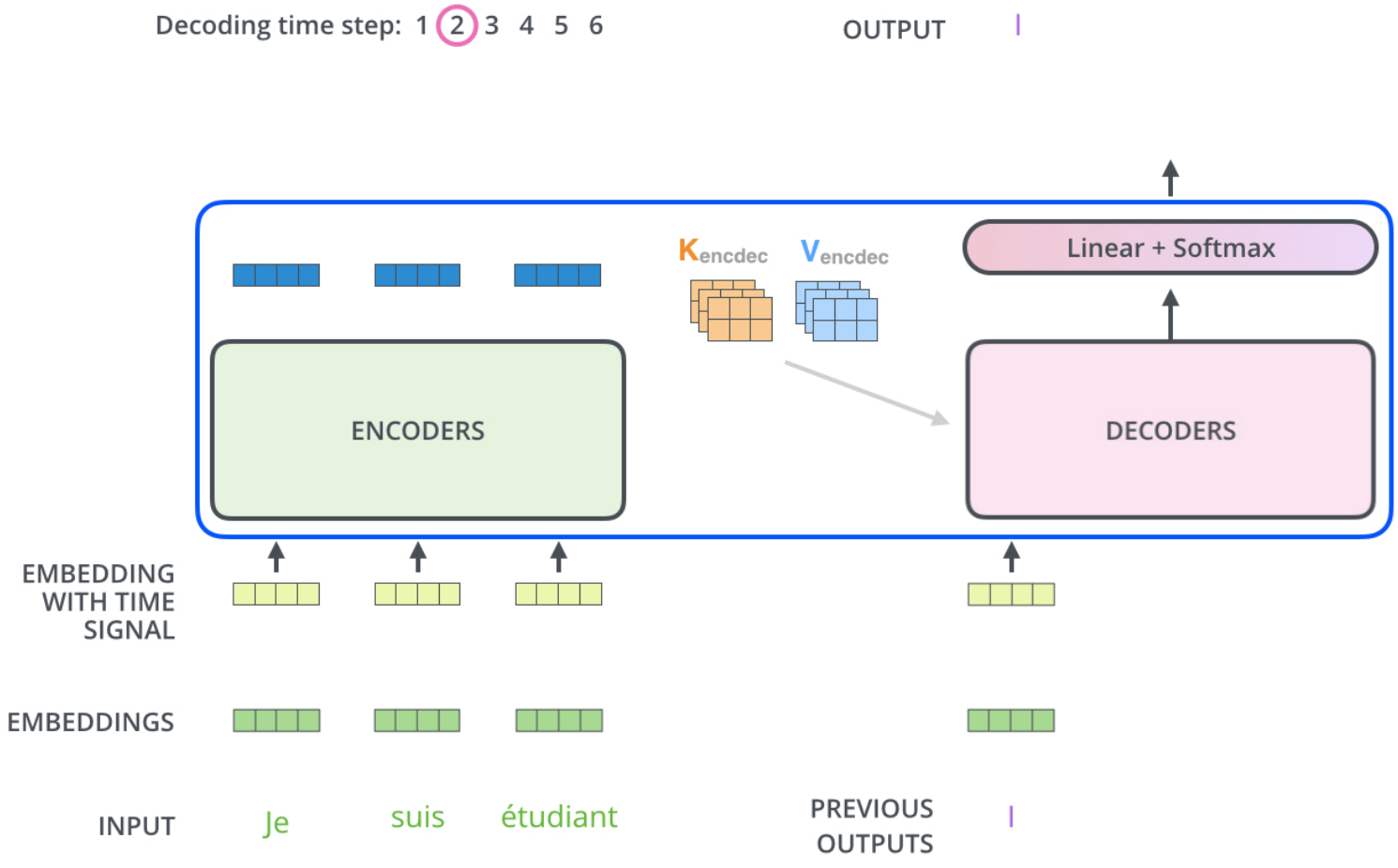

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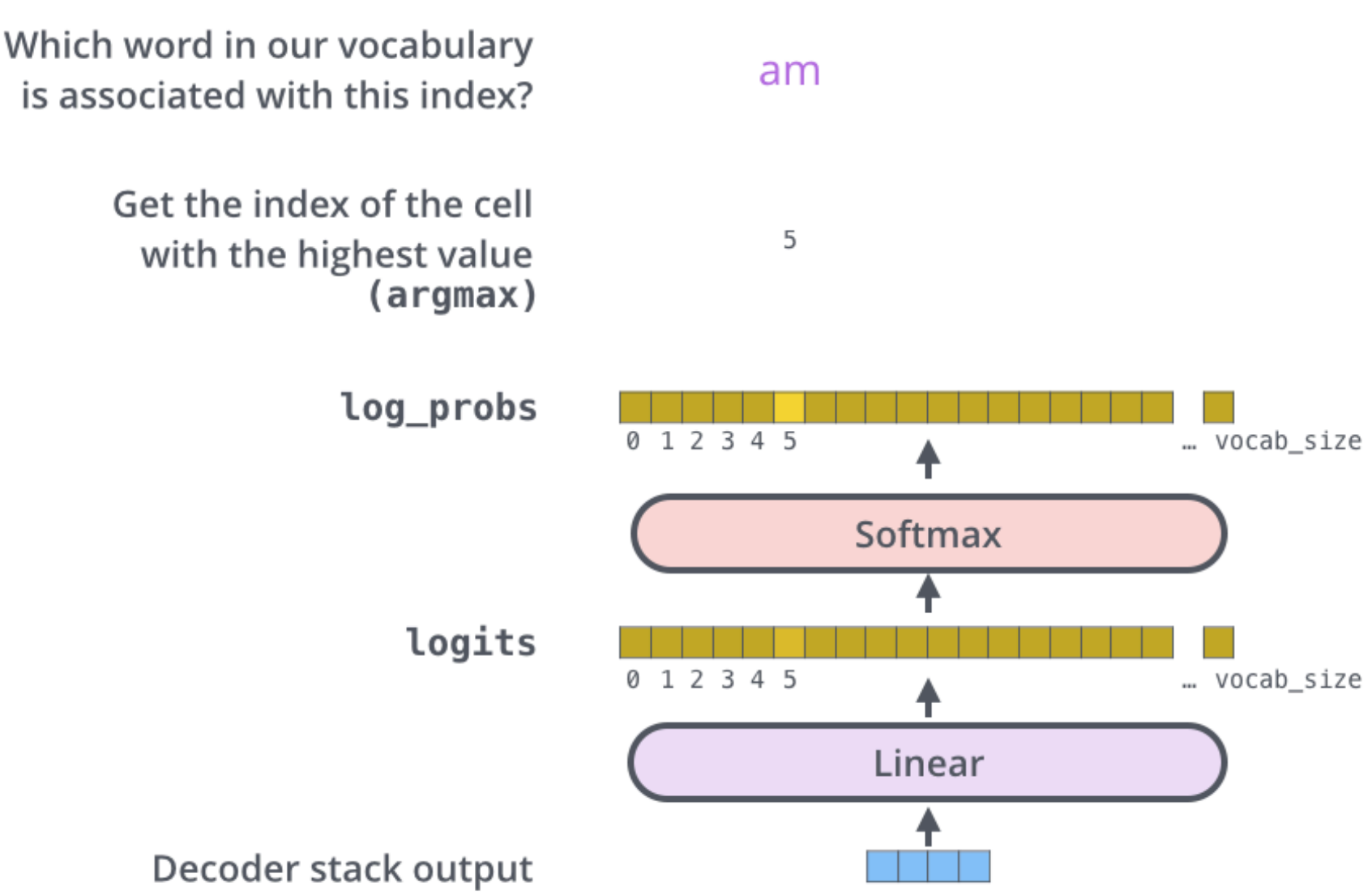
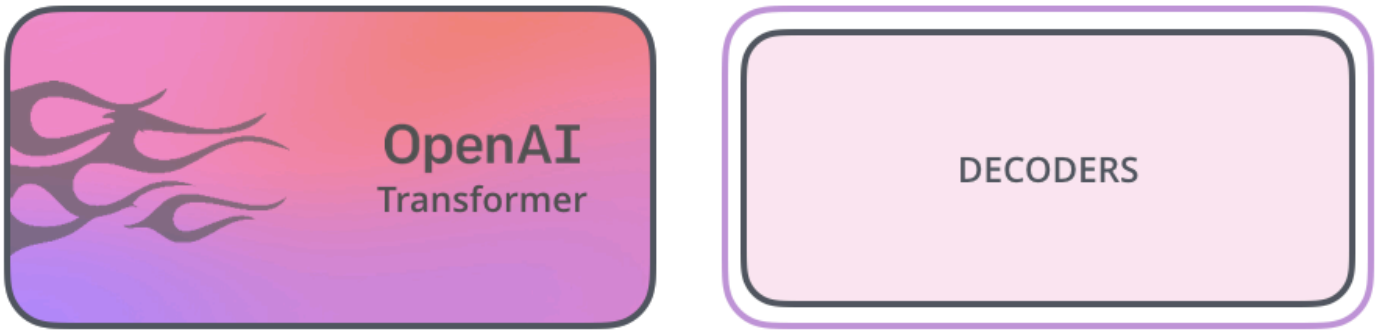
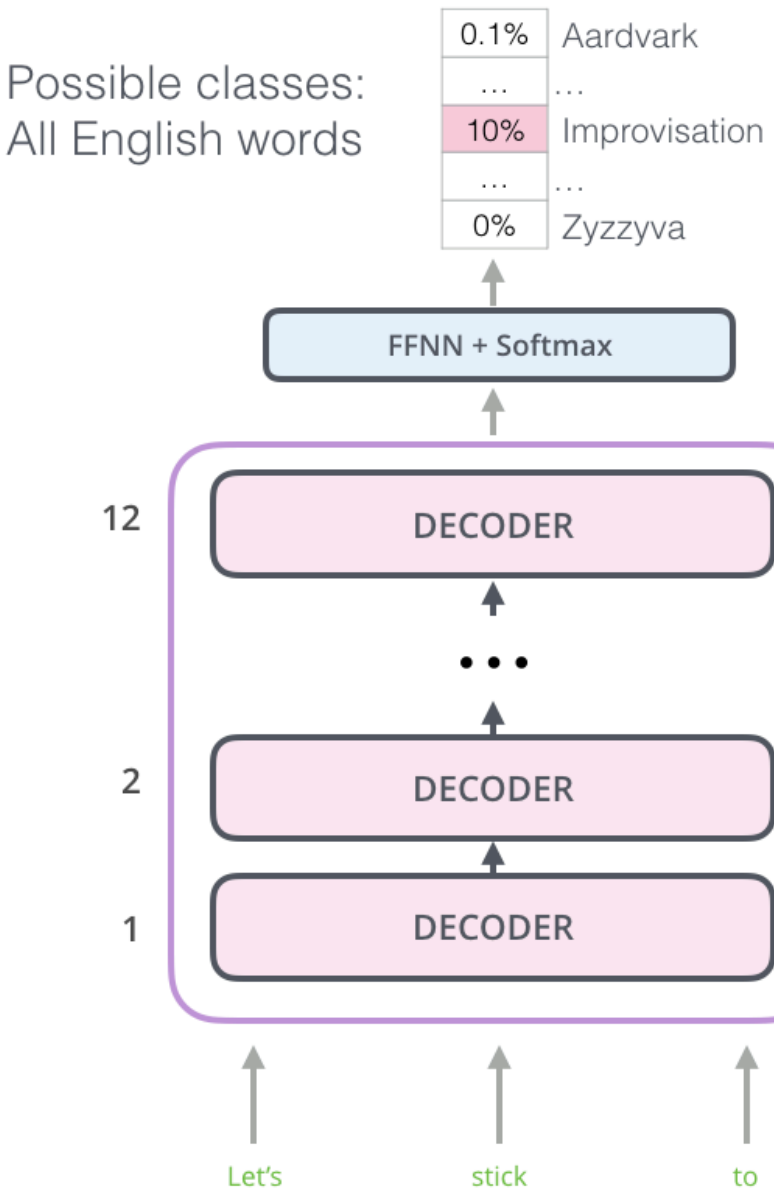


All the slides on the transformer above are borrowed from this [Jay Alammar's brillant article (http://jalammar.github.io/illustrated-transformer/)](http://jalammar.github.io/illustrated-transformer/)

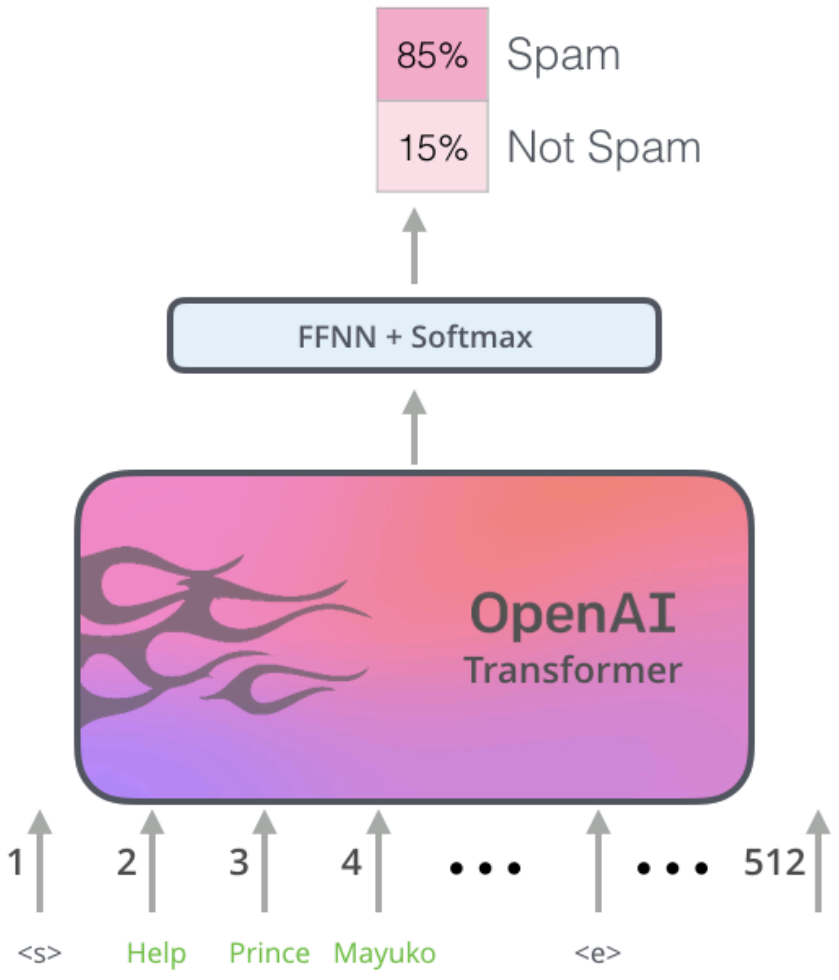
Applications



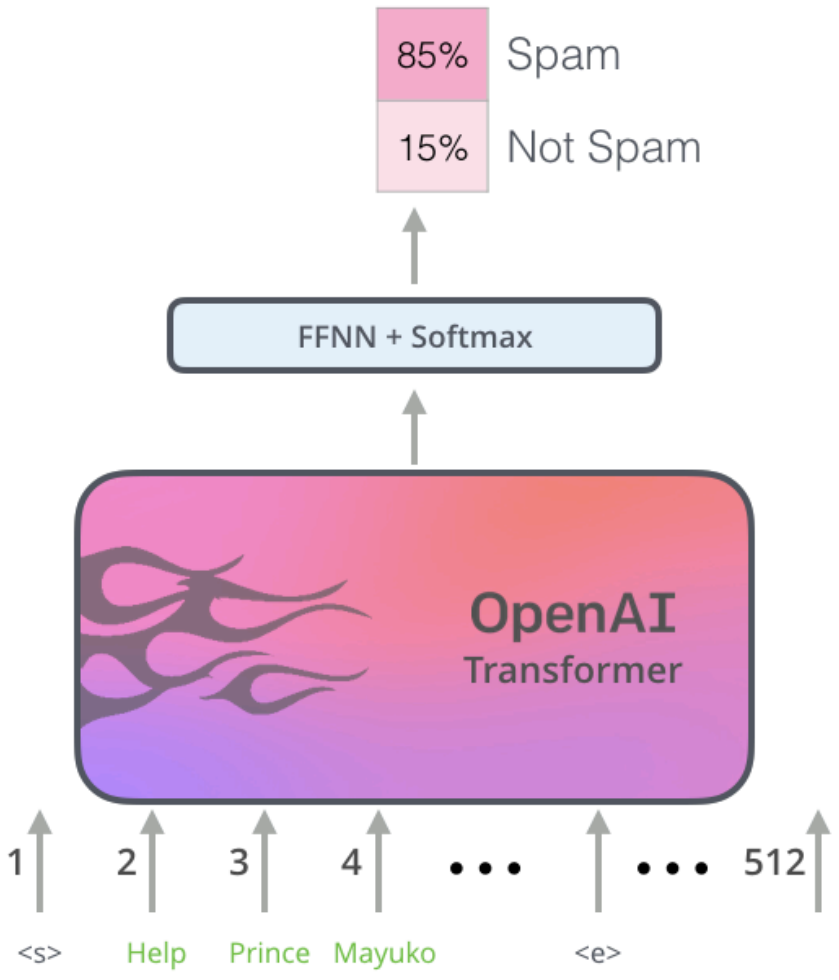
Applications



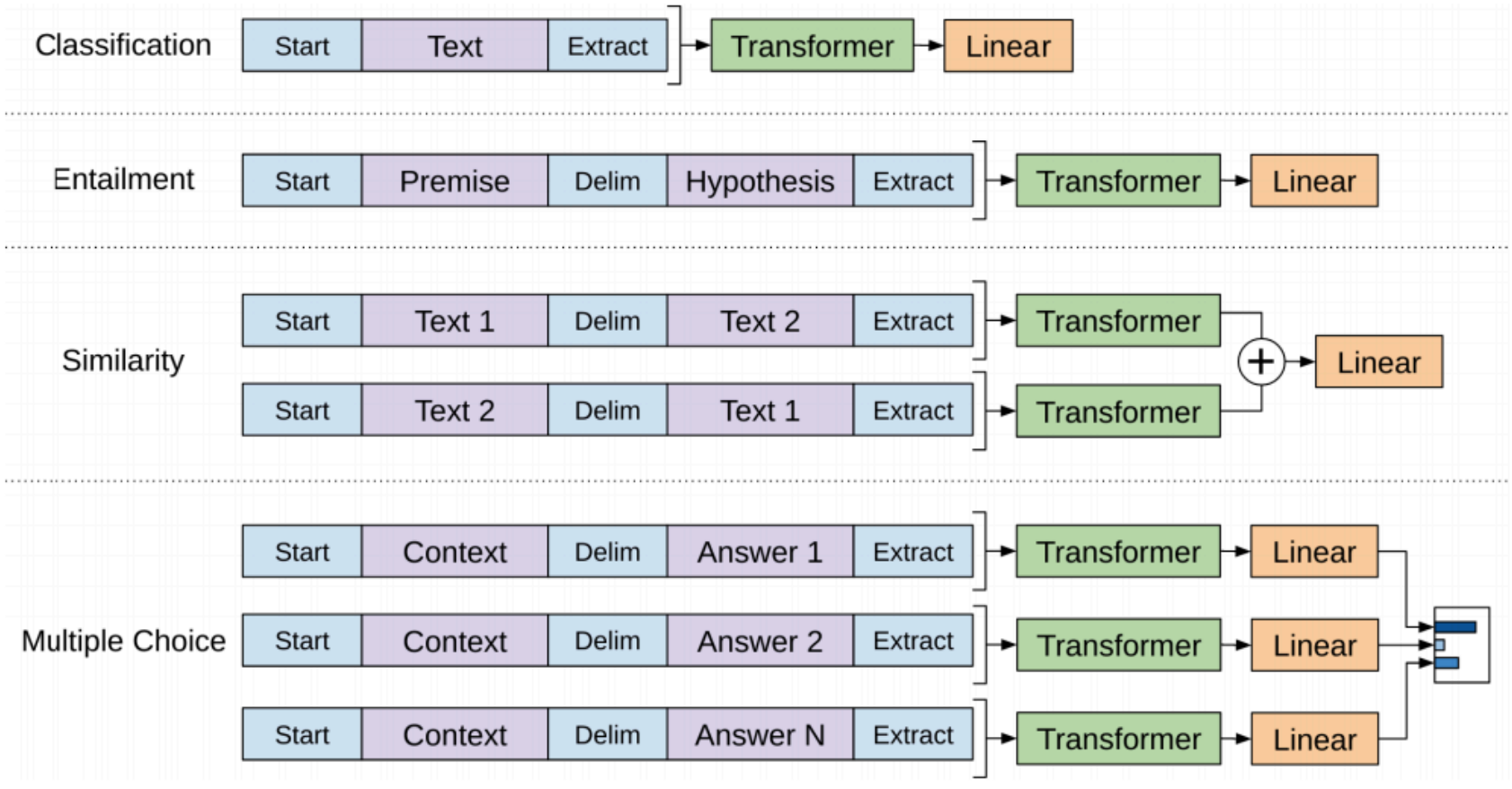
Applications



Applications

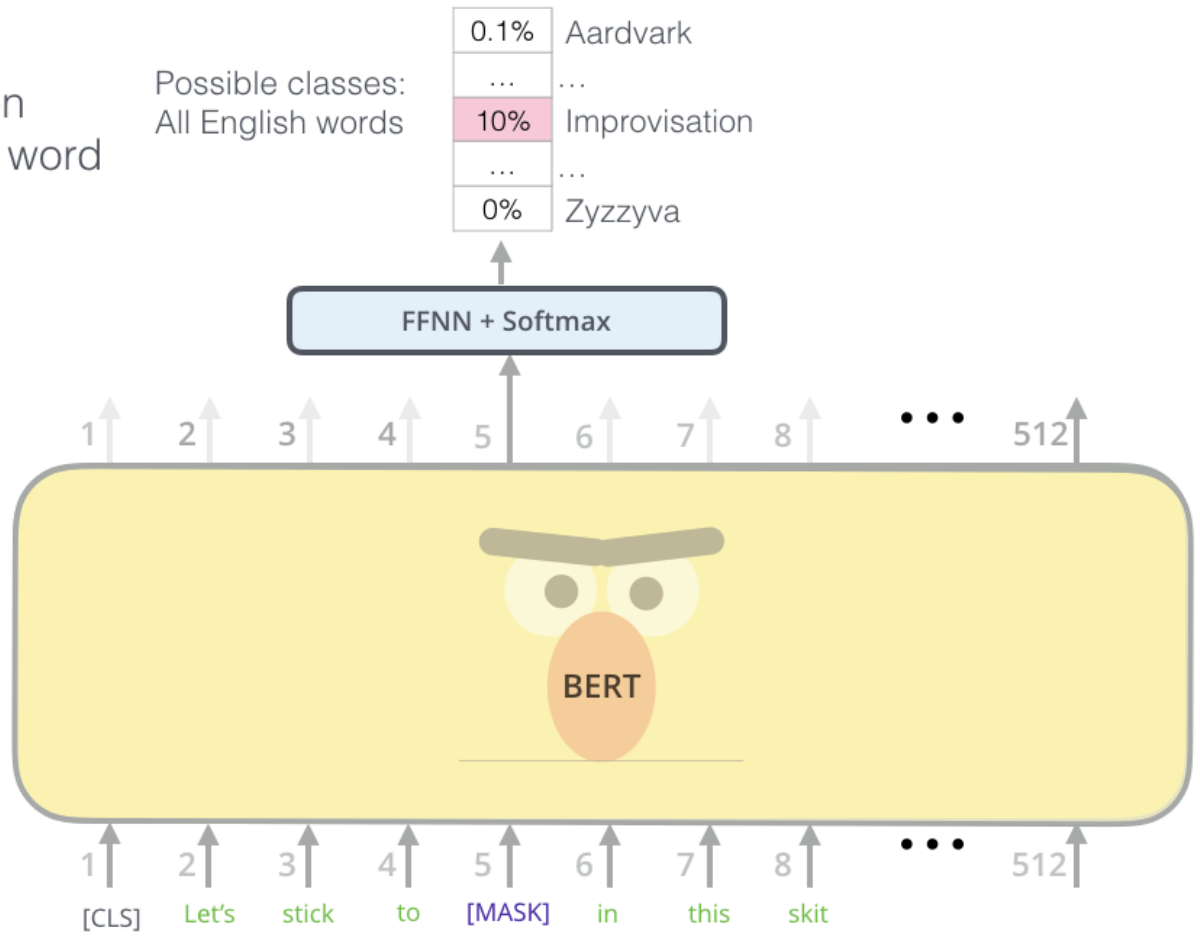


Applications



Applications

Use the output of the masked word's position to predict the masked word

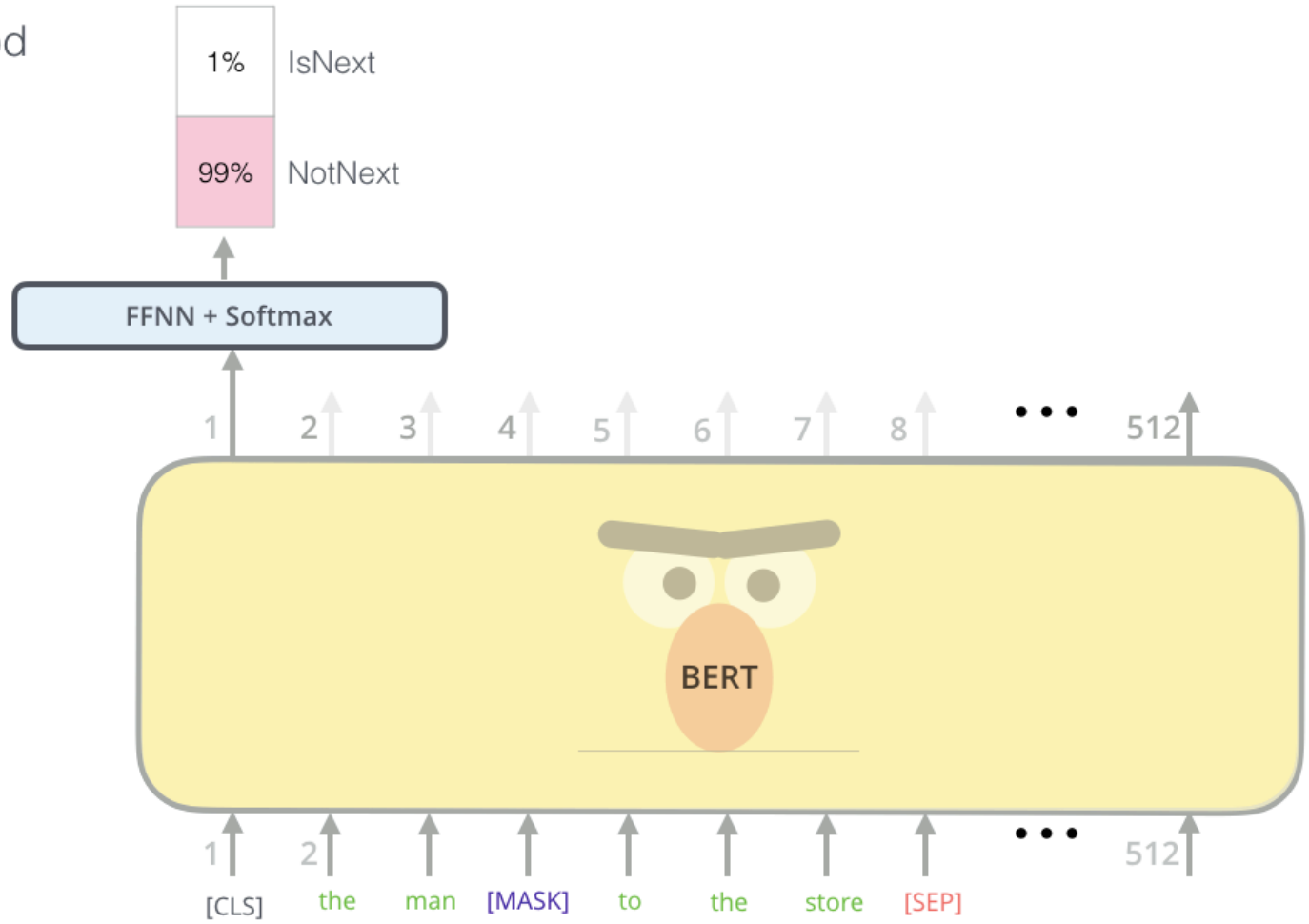


Randomly mask 15% of tokens

Input

Applications

Predict likelihood that sentence B belongs after sentence A



Tokenized Input

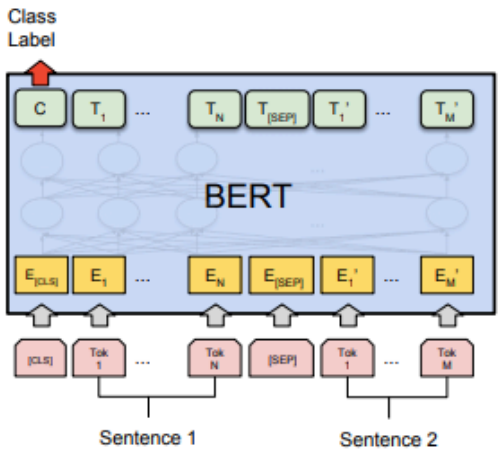
Input

[CLS] the man [MASK] to the store [SEP] penguin [MASK] are flightless birds [SEP]

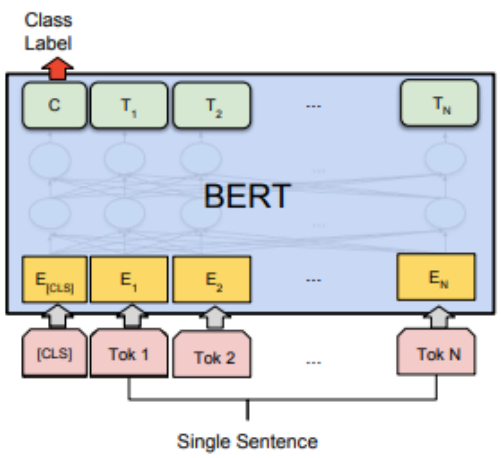
Sentence A

Sentence B

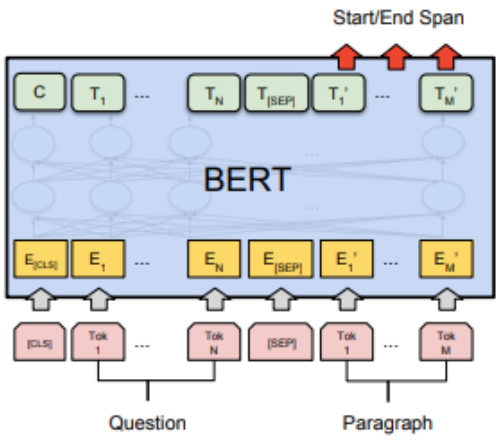
Applications



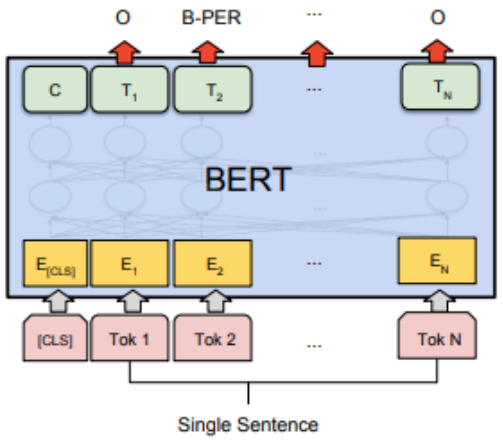
(a) Sentence Pair Classification Tasks: MNLI, QQP, QNLI, STS-B, MRPC, RTE, SWAG



(b) Single Sentence Classification Tasks: SST-2, CoLA



(c) Question Answering Tasks: SQuAD v1.1



(d) Single Sentence Tagging Tasks: CoNLL-2003 NER

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GPT-2

SYSTEM PROMPT (HUMAN-WRITTEN) In a shocking finding, scientist discovered a herd of unicorns living in a remote, previously unexplored valley, in the Andes Mountains. Even more surprising to the researchers was the fact that the unicorns spoke perfect English.

MODEL COMPLETION (MACHINE-WRITTEN, 10 TRIES) The scientist named the population, after their distinctive horn, Ovid's Unicorn. These four-horned, silver-white unicorns were previously unknown to science.

Now, after almost two centuries, the mystery of what sparked this odd phenomenon is finally solved.

Dr. Jorge Pérez, an evolutionary biologist from the University of La Paz, and several companions, were exploring the Andes Mountains when they found a small valley, with no other animals or humans. Pérez noticed that the valley had what appeared to be a natural fountain, surrounded by two peaks of rock and silver snow.

Pérez and the others then ventured further into the valley. "By the time we reached the top of one peak, the water looked blue, with some crystals on top," said Pérez.

Pérez and his friends were astonished to see the unicorn herd. These creatures could be seen from the air without having to move too much to see them – they were so close they could touch their horns.

While examining these bizarre creatures the scientists discovered that the creatures also spoke some fairly regular English. Pérez stated, "We can see, for example, that they have a common 'language,' something like a dialect or dialectic." Dr. Pérez believes that the unicorns may have originated in Argentina, where the animals were believed to be descendants of a lost race of people who lived there before the arrival of humans in those parts of South America.

While their origins are still unclear, some believe that perhaps the creatures were created when a human and a unicorn met each other in a time before human civilization. According to Pérez, "In South America, such incidents seem to be quite common."

However, Pérez also pointed out that it is likely that the only way of knowing for sure if unicorns are indeed the descendants of a lost alien race is through DNA. "But they seem to be able to communicate in English quite well, which I believe is a sign of evolution, or at least a change in social organization," said the scientist.

SQuAD 2.0

Let's explore [SQuAD 2.0 (https://rajpurkar.github.io/SQuAD-explorer/explore/v2.0/dev/)](https://rajpurkar.github.io/SQuAD-explorer/explore/v2.0/dev/)