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What is an encoder decoder model?

Encoder Decoder is a widely used structure in deep learning and through this article, we will understand its architecture



Nechu BM · Follow

Published in Towards Data Science · 4 min read · Oct 7, 2020



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In this post, we introduce the encoder decoder structure in some cases known as Sequence to Sequence (Seq2Seq) model. For a better understanding of the structure of this model, previous [knowledge on RNN](#) is helpful.

When do we use an encoder decoder model?

1-Image Captioning

Encoder decoder models allow for a process in which a machine learning model generates a sentence describing an image. It receives the image as the input and outputs a sequence of words. This also works with videos.



ML output: 'Road surrounded by palm trees leading to a beach', Photo by [Milo Miloezger](#) on [Unsplash](#)

2-Sentiment Analysis

These models understand the meaning and emotions of the input sentence and output a sentiment score. It is usually rated between -1 (negative) and 1 (positive) where 0 is neutral. It is used in call centers to analyse the evolution of the client's emotions and their reactions to certain keywords or company discounts.



Image by the author

3-Translation

This model reads an input sentence, understands the message and the concepts, then translates it into a second language. Google Translate is built upon an encoder decoder structure, for more detail follow [this paper](#).

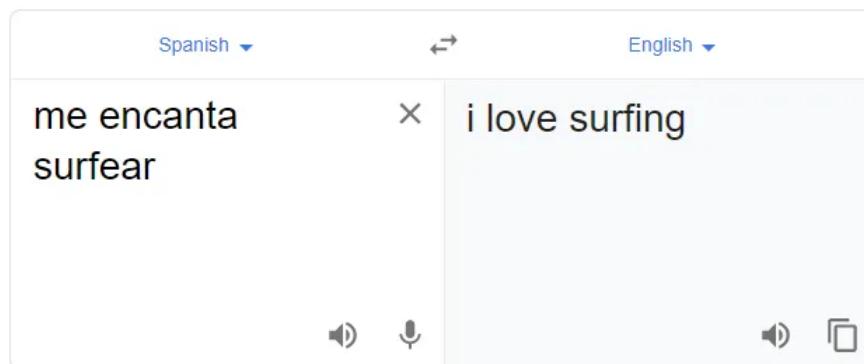
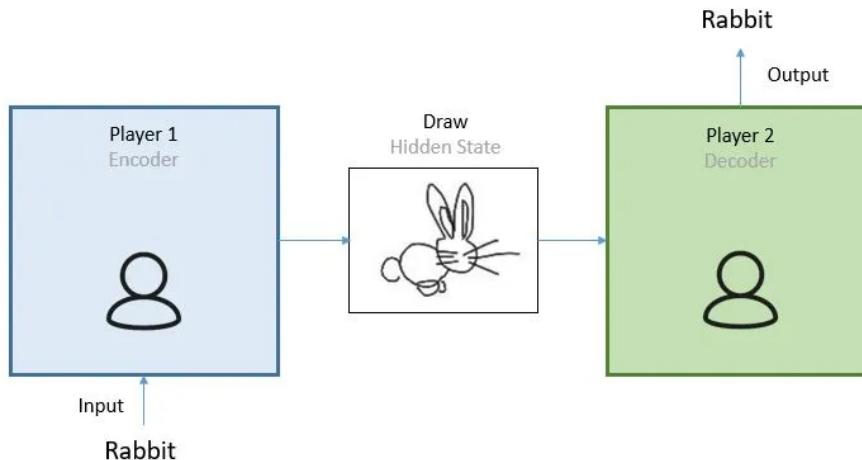


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What is an encoder decoder model?

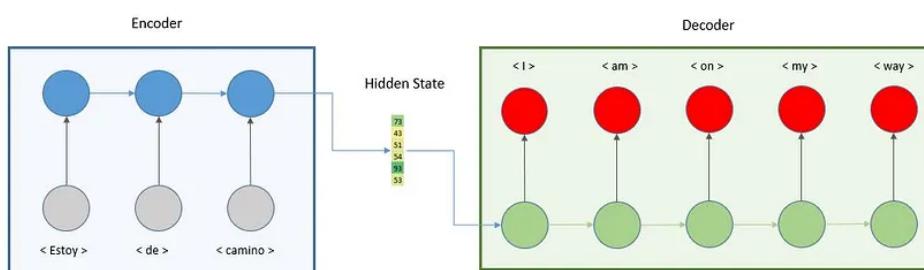
The best way to understand the concept of an encoder-decoder model is by playing Pictionary. The rules of the game are very simple, player 1 randomly picks a word from a list and needs to sketch the meaning in a drawing. The

role of the second player in the team is to analyse the drawing and identify the word which it describes. In this example we have three important elements player 1(the person that converts the word into a drawing), the drawing (rabbit) and the person that guesses the word the drawing represents (player 2). This is all we need to understand an encoder decoder model, below we will build a comparative of the Pictionary game and an encoder decoder model for translating Spanish to English.



Pictionary Game, Image by the author

If we translate the above graph into machine learning concepts, we would see the below one. In the following sections we will go through each component.

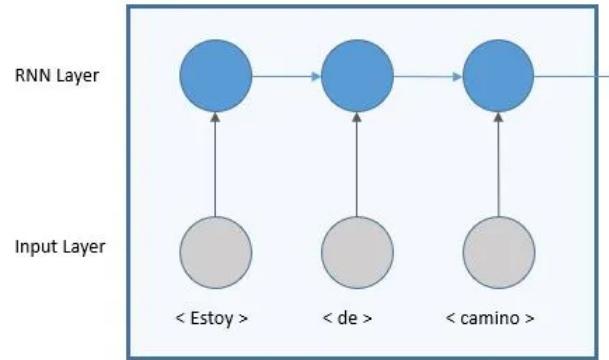


Encoder Decoder Model, Image by the author

1-Encoder (Picturist)

Encoding means to convert data into a required format. In the Pictionary example we convert a word (text) into a drawing (image). In the machine learning context, we convert a sequence of words in Spanish into a two-dimensional vector, this two-dimensional vector is also known as hidden state. The encoder is built by stacking recurrent neural network (RNN). We use this type of layer because its structure allows the model to understand

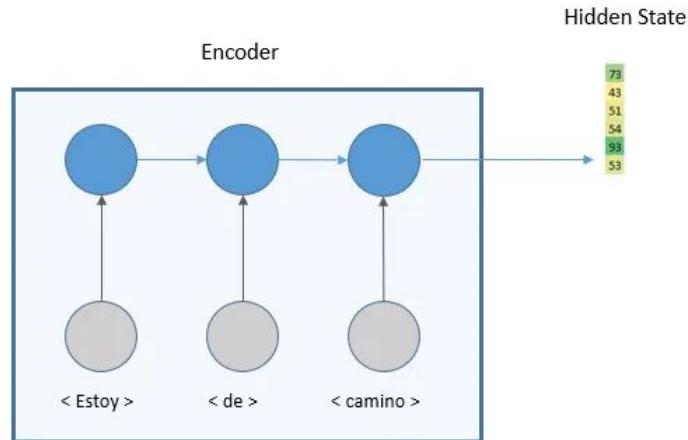
context and temporal dependencies of the sequences. The output of the encoder, the hidden state, is the state of the last RNN timestep.



Encoder, Image by the author

2-Hidden State (Sketch)

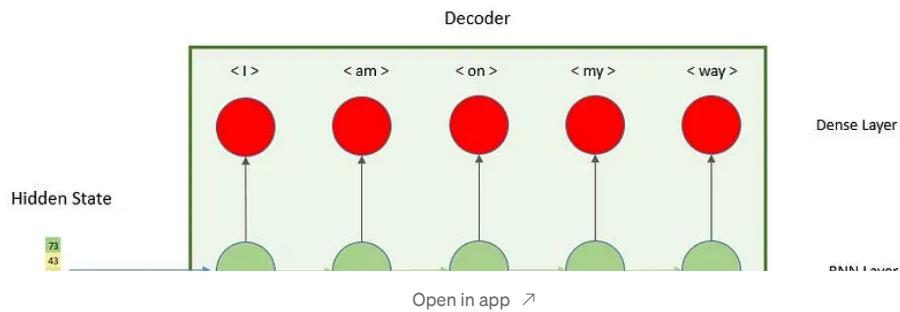
The output of the encoder, a two-dimensional vector that encapsulates the whole meaning of the input sequence. The length of the vector depends on the number of cells in the RNN.



Encoder and hidden state, Image by the author

3-Decoder

To decode means to convert a coded message into intelligible language. The second person in the team playing Pictionary will convert the drawing into a word. In the machine learning model, the role of the decoder will be to convert the two-dimensional vector into the output sequence, the English sentence. It is also built with RNN layers and a dense layer to predict the English word.



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Decoder, Image by the author

Conclusion

One of the major advantages of this model is that the length of the input and output sequences may differ. This opens the door for very interesting applications such as video captioning or question and answer.

The major limit of this simple encoder decoder model is that all the information needs to be summarized in one dimensional vector, for long input sequences that can be extremely difficult to achieve. Having said that, understanding encoder decoder models is key for the latest advances in NLP because it is the seed for attention models and transformers. [In the next article](#), we will follow the process of building a translation model with an encoder decoder structure. Then we will continue by exploring the [attention mechanism](#) in order to achieve higher accuracy.

How to build an encoder decoder translation model using LSTM with Python and Keras.

Follow this step by step guide to build an encoder decoder model and create your own translation model.

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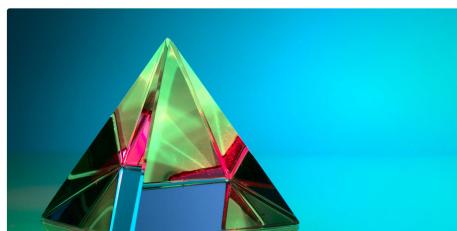
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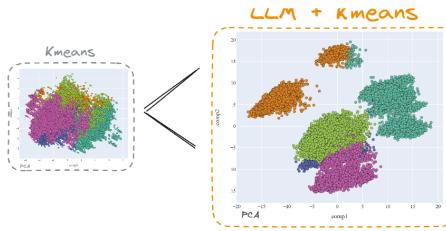
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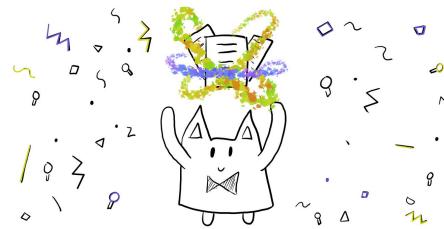
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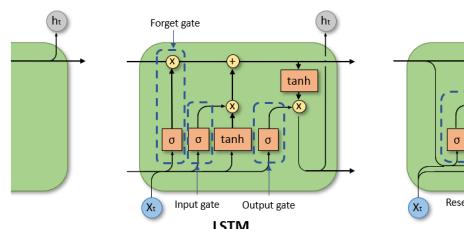
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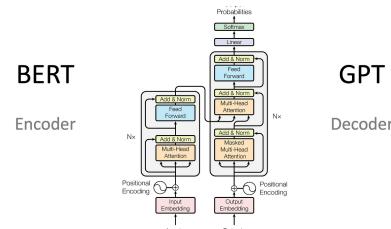
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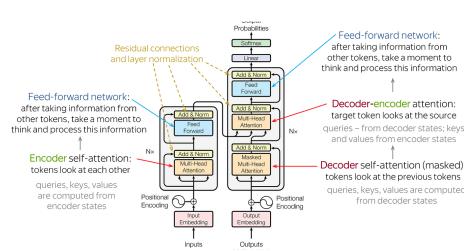
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