

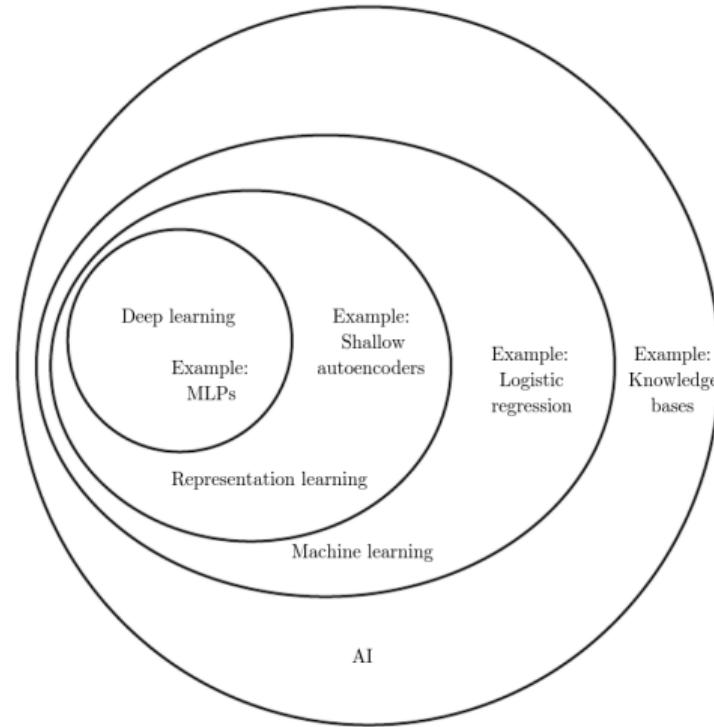
Brief History of Recent Deep Learning

AI for ecologists

Paul Tresson, Maximilien Servajean, Benjamin Bourel

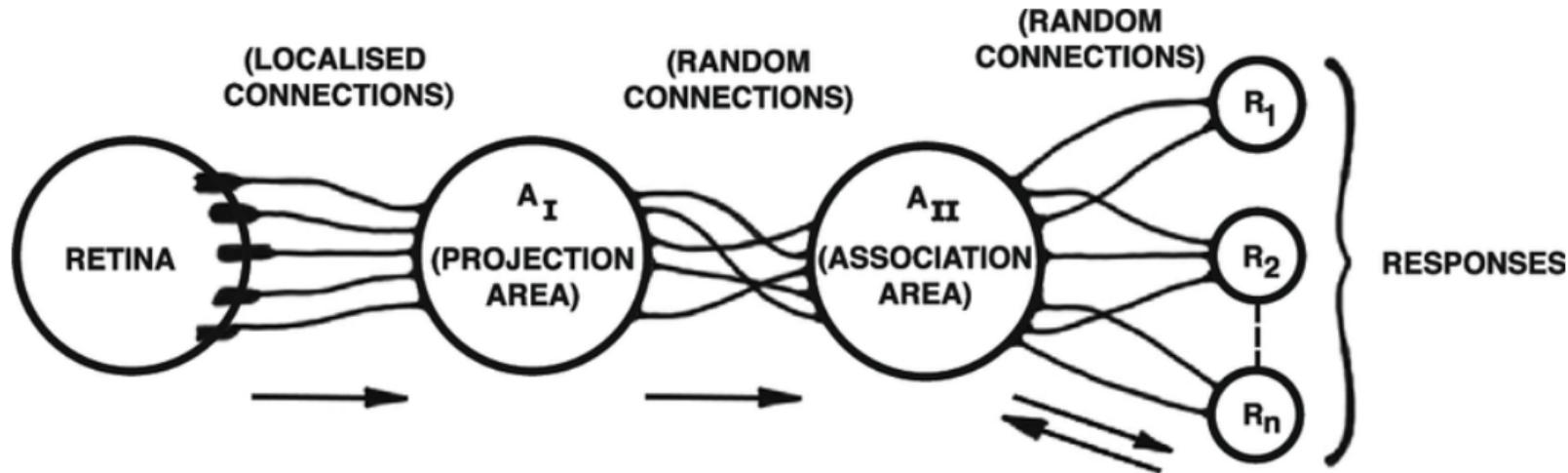
22/05/25

Reminder



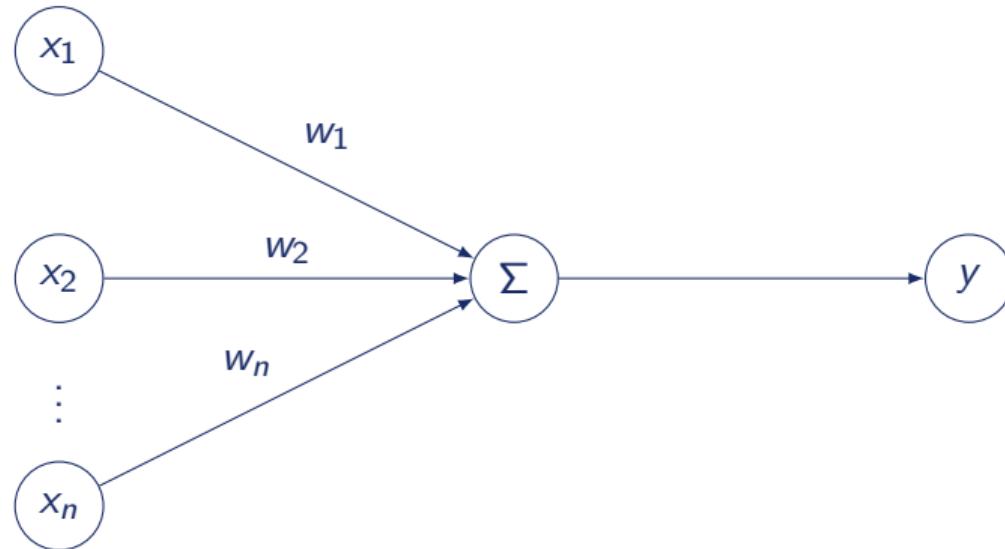
Different types of Artificial Intelligence. From Goodfellow et al., 2016

First Neural Network Model : The Perceptron



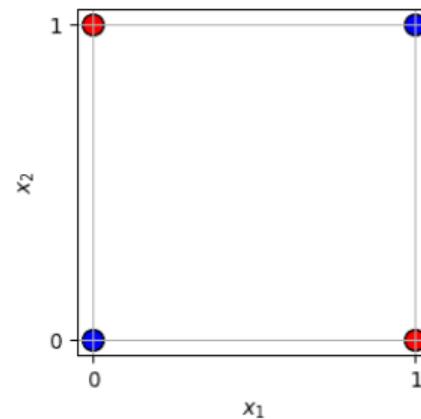
First probabilistic model of a neuron proposed by Rosenblatt, 1958

First Neural Network Model : The Perceptron



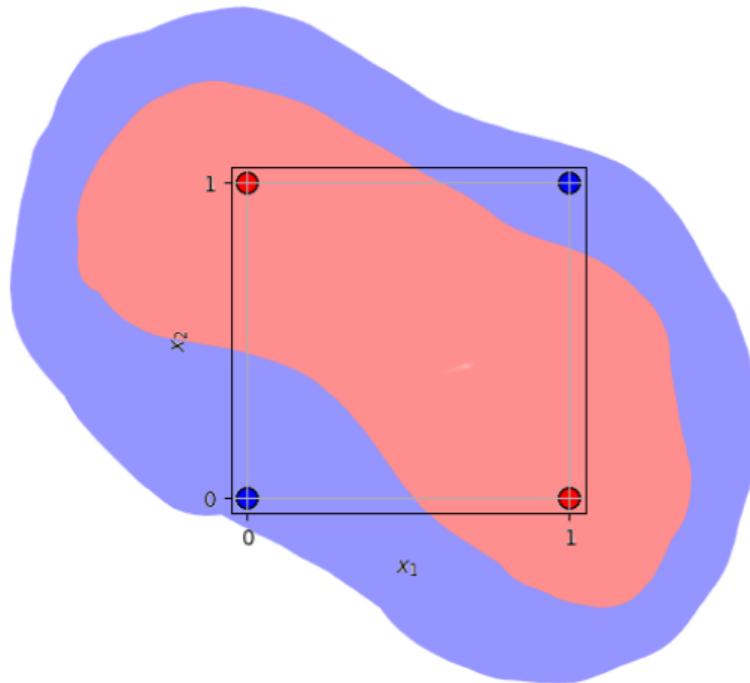
First Roadblock : XOR problem

x_1	x_2	y
0	0	0
1	0	1
0	1	1
1	1	0



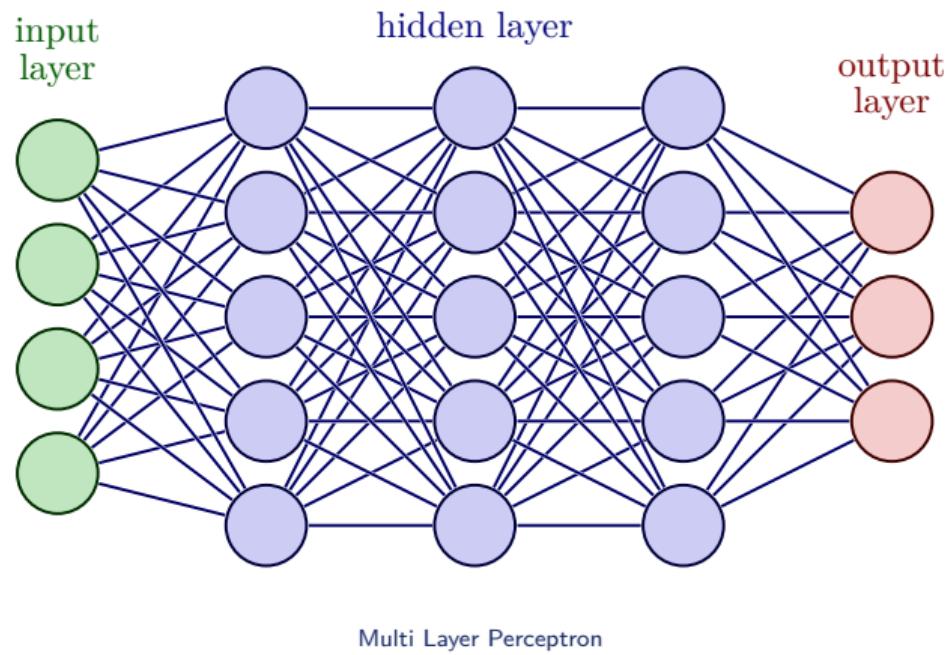
First Roadblock : XOR problem

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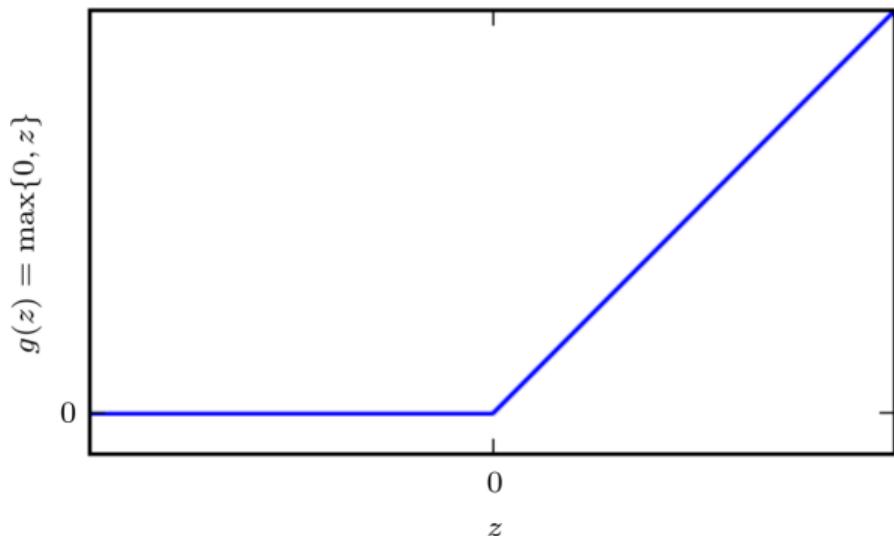
1980's : First Deep Neural Networks

- Multi Layer Perceptron



1980's : First Deep Neural Networks

- Multi Layer Perceptron
- Non-linearity (e.g. ReLu)

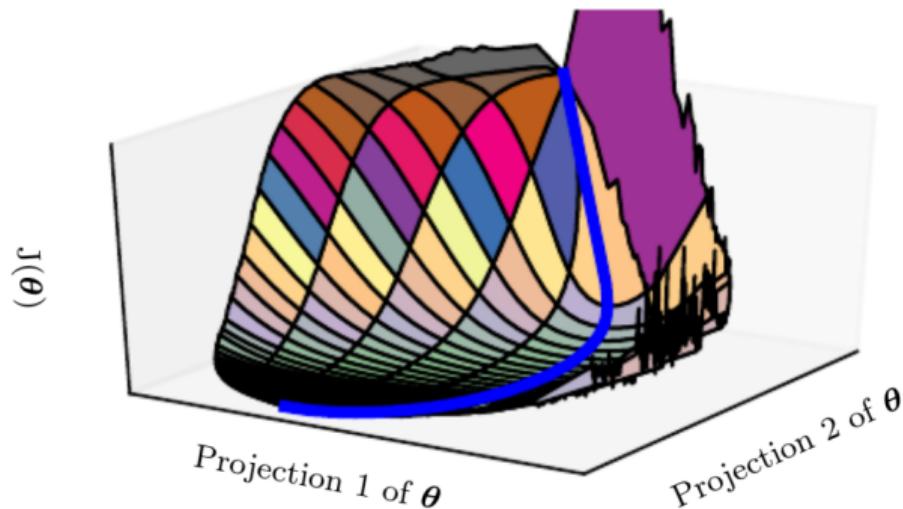


Rectified Linear Unit. Figure from Goodfellow et al., 2016

1980's : First Deep Neural Networks

- Multi Layer Perceptron
- Non-linearity (e.g. ReLu)
- Gradient Descent and Backpropagation

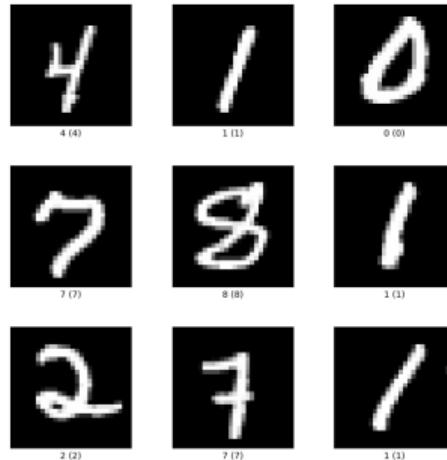
Rumelhart, 1986



Gradient descent example. Figure from Goodfellow et al., 2016

1990's : First Successes

- MNIST
LeCun, 1998

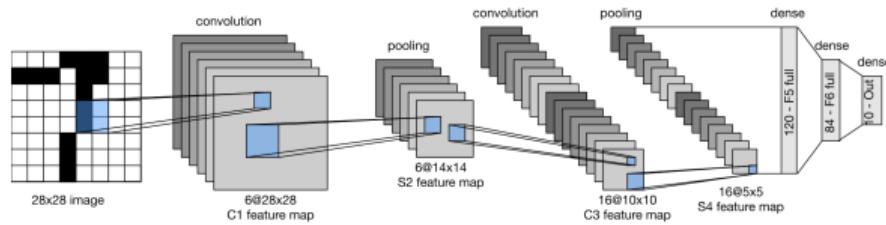


Images from MNIST

Modified National Institute of Standards and Technology

1990's : First Successes

- MNIST
LeCun, 1998
- LeNet
LeCun et al., 1989b



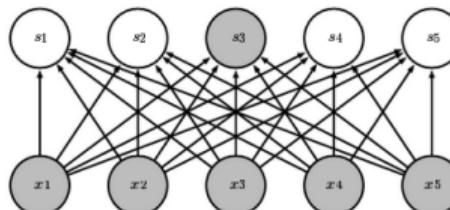
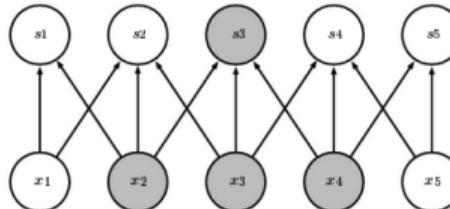
LeNet5.

Figure from Zhang et al. - <https://github.com/d2l-ai/d2l-en>

Modified National Institute of Standards and Technology

1990's : First Successes

- MNIST
LeCun, 1998
- LeNet
LeCun et al., 1989b
- Convolutional Neural Network
(CNN)
LeCun et al., 1989a



sparse connectivity with CNNs.
Figure from Goodfellow et al., 2016

Modified National Institute of Standards and Technology

Good proof of concept but too costly in computing power and datasets



IN CS, IT CAN BE HARD TO EXPLAIN
THE DIFFERENCE BETWEEN THE EASY
AND THE VIRTUALLY IMPOSSIBLE.

XKCD comic from 2014

**Good proof of concept but too costly in computing power and datasets
...until**

Good proof of concept but too costly in computing power and datasets
...until



Good proof of concept but too costly in computing power and datasets
...until



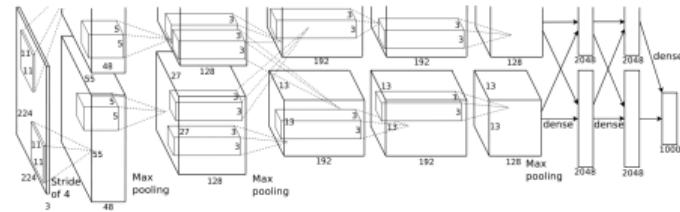
2010's : CNN revolution

- ImageNet
Deng et al., 2009



2010's : CNN revolution

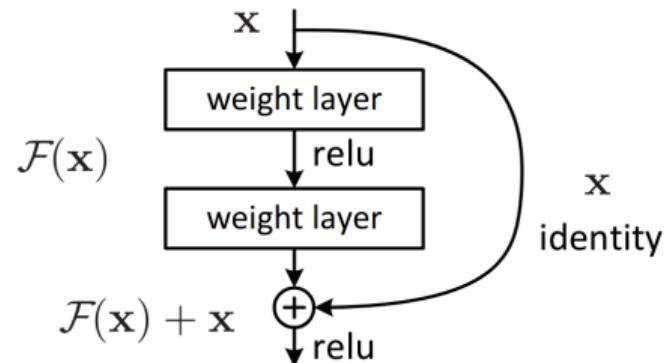
- ImageNet
Deng et al., 2009
- AlexNet
Krizhevsky et al., 2012



AlexNet. Figure from Krizhevsky et al., 2012

2010's : CNN revolution

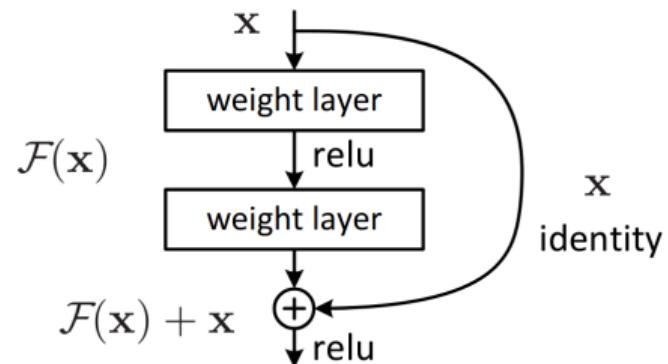
- ImageNet
Deng et al., 2009
- AlexNet
Krizhevsky et al., 2012
- ResNet
He et al., 2016



A residual connection. Figure from He et al., 2016

2010's : CNN revolution

- ImageNet
Deng et al., 2009
- AlexNet
Krizhevsky et al., 2012
- ResNet
He et al., 2016

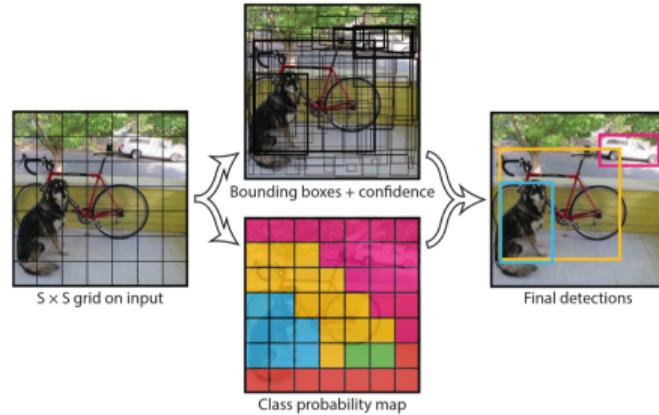


A residual connection. Figure from He et al., 2016

His 2016 paper *Deep Residual Learning for Image Recognition* is the most cited research paper in 5 years according to Google Scholar's reports in 2020 and 2021.^{[7][8]}

2010's : CNN revolution

- ImageNet
Deng et al., 2009
- AlexNet
Krizhevsky et al., 2012
- ResNet
He et al., 2016
- YOLO, mask-RCNN...
He et al., 2017; Redmon et al., 2016



YOLO. Figure from Redmon et al., 2016

- IMBD

Maas et al., 2011

If you like adult comedy cartoons, like South Park, then this is nearly a similar format about the small adventures of three teenage girls at Bromwell High. Keisha, Natella and Latrina have given exploding sweets and behaved like bitches, I think Keisha is a good leader. There are also small stories going on with the teachers of the school. There's the idiotic principal, Mr. Bip, the nervous Maths teacher and many others. The cast is also fantastic, Lenny Henry's Gina Yashere, EastEnders Chrissie Watts, Tracy-Ann Oberman, Smack The Pony's Doon Mackichan, Dead Ringers' Mark Perry and Blunder's Nina Conti. I didn't know this came from Canada, but it is very good. Very good!

Extract from IMDB database

2010's : NLP

- IMBD
Maas et al., 2011
- LSTM
Hochreiter and Schmidhuber,
1997

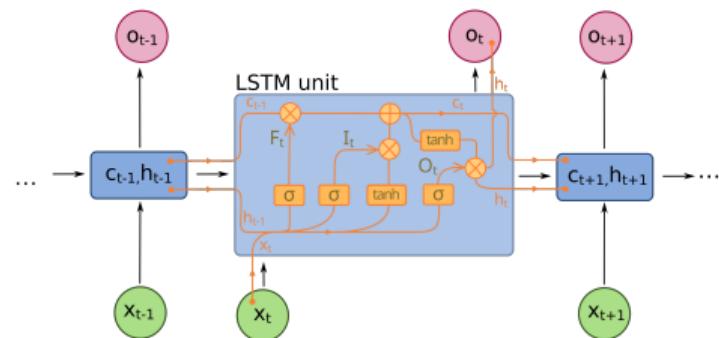


Figure by fdeloche

2010's : NLP

- IMBD
Maas et al., 2011
- LSTM
Hochreiter and Schmidhuber,
1997
- RNN's
e.g. Sutskever et al., 2014

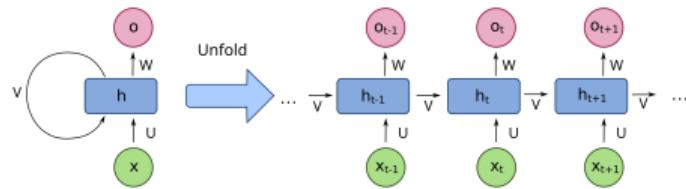
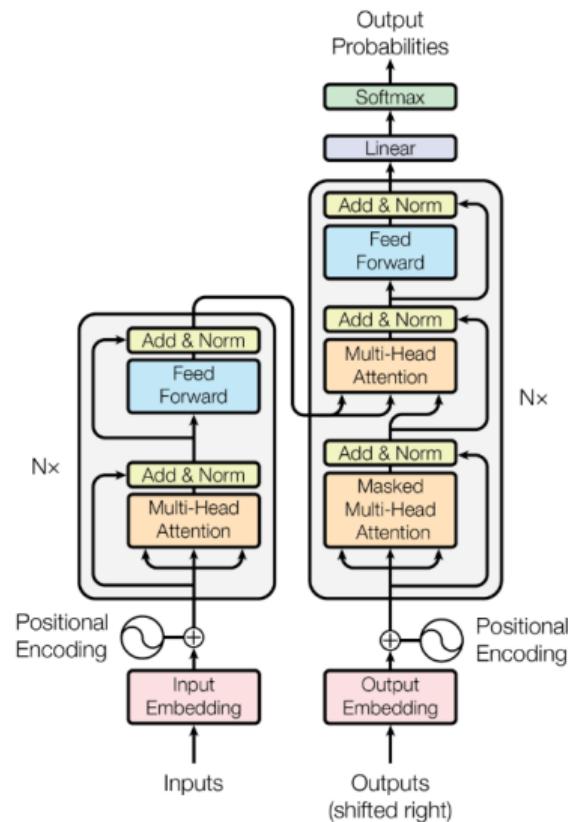


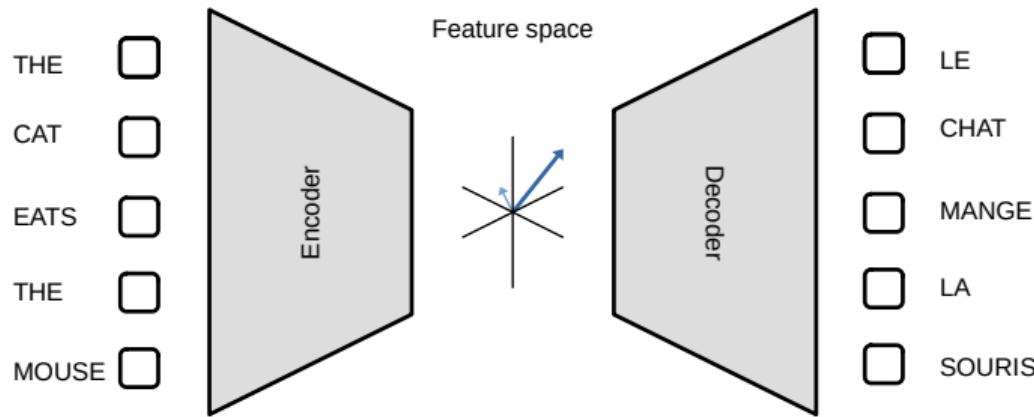
Figure by fdeolocle

2020's : Transformers ...

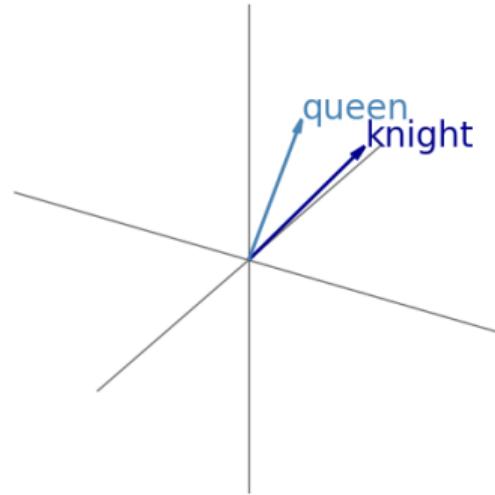
- Attention is all you need
Vaswani et al., 2017



Sidestep : Transformers

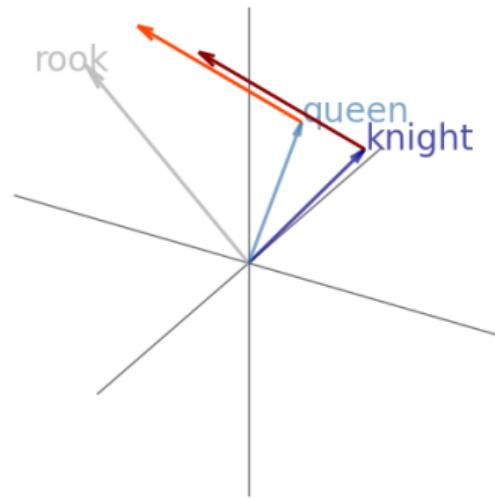


Sidestep : Transformers



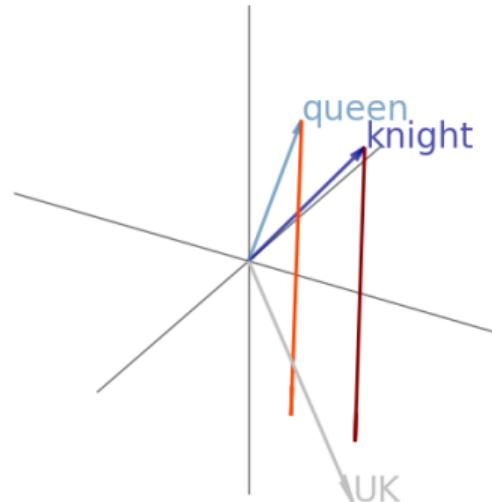
The knight saves the queen

Sidestep : Transformers



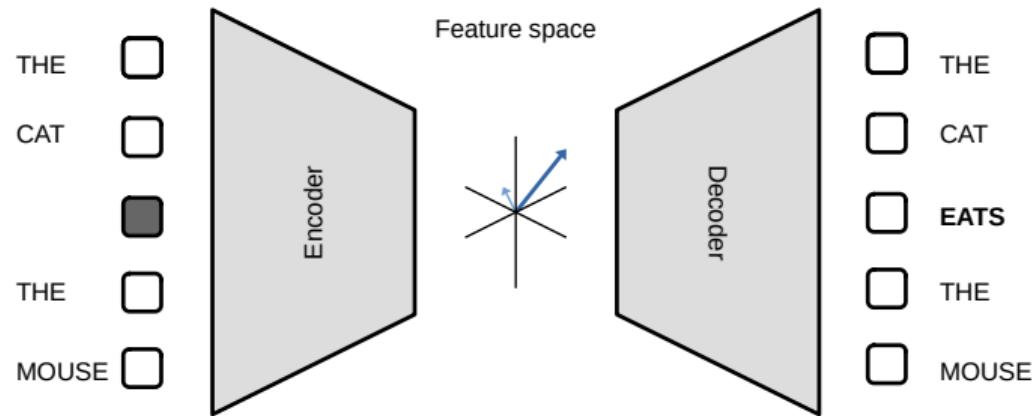
Queen takes knight , checkmate !

Sidestep : Transformers



He was knighted by Queen Elizabeth II

Sidestep : Transformers



2020's : Transformers ... and Self Supervised Learning

- Attention is all you need
Vaswani et al., 2017
- LLMs (GPT, BERT...)
Devlin et al., 2019



2020's : Transformers ... and Self Supervised Learning

- Vision Transformer
Dosovitskiy et al., 2020

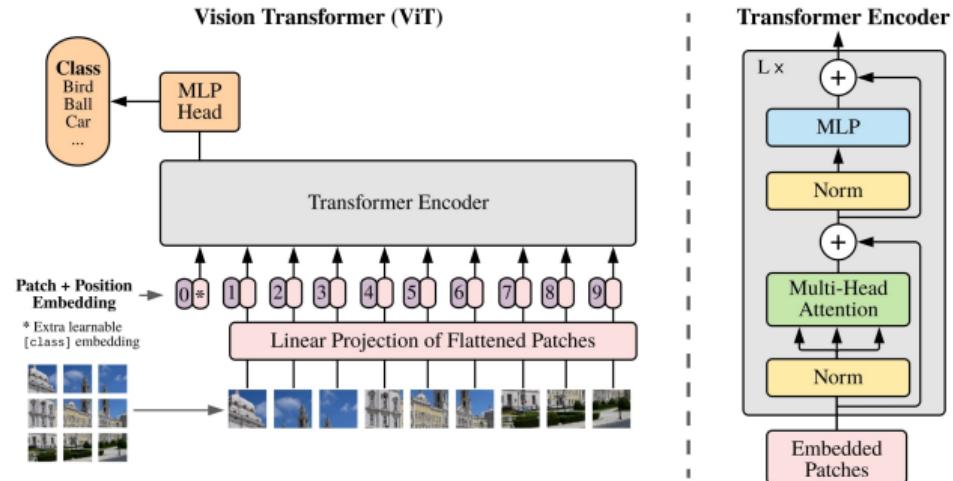


Figure from Dosovitskiy et al., 2020

2020's : Transformers ... and Self Supervised Learning

- Vision Transformer
Dosovitskiy et al., 2020
- Masked Auto Encoder
He et al., 2022

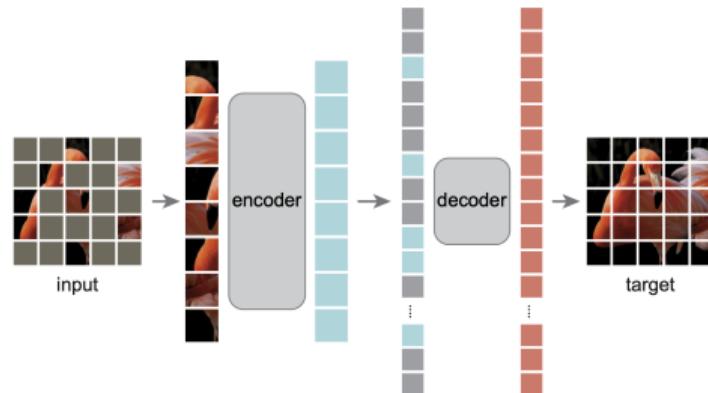


Figure from He et al., 2022

2020's : Transformers ... and Self Supervised Learning

- Vision Transformer
Dosovitskiy et al., 2020
- Masked Auto Encoder
He et al., 2022
- DINO
Caron et al., 2021



Figure from Caron et al., 2021

A lot left out !

Finetuning

A lot left out !

Finetuning

Games

A lot left out !

Reinforcement learning

Finetuning

Games

A lot left out !

Reinforcement learning

Finetuning

Games

Time series

A lot left out !

Reinforcement learning

Finetuning

Games

Time series

Speech recognition

A lot left out !

Reinforcement learning

Finetuning

Games

Image generation

Time series

Speech recognition

A lot left out !

Reinforcement learning

Finetuning

Games

Image generation

Diffusion models

Time series

Speech recognition

A lot left out !

Reinforcement learning

Finetuning

Games

Image generation

Diffusion models

Time series

Speech recognition

...

Useful ressources

State of the art

- Huggingface
- PapersWithCode

Getting started

- Pytorch
- Keras

Understanding papers

- Yannic Kilcher
- AI coffe break

Understanding visually

- 3blue1brown
- deepia

Thanks for you attention !

Let's practice !

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