A journey into AI

AI from 1955 to nowadays

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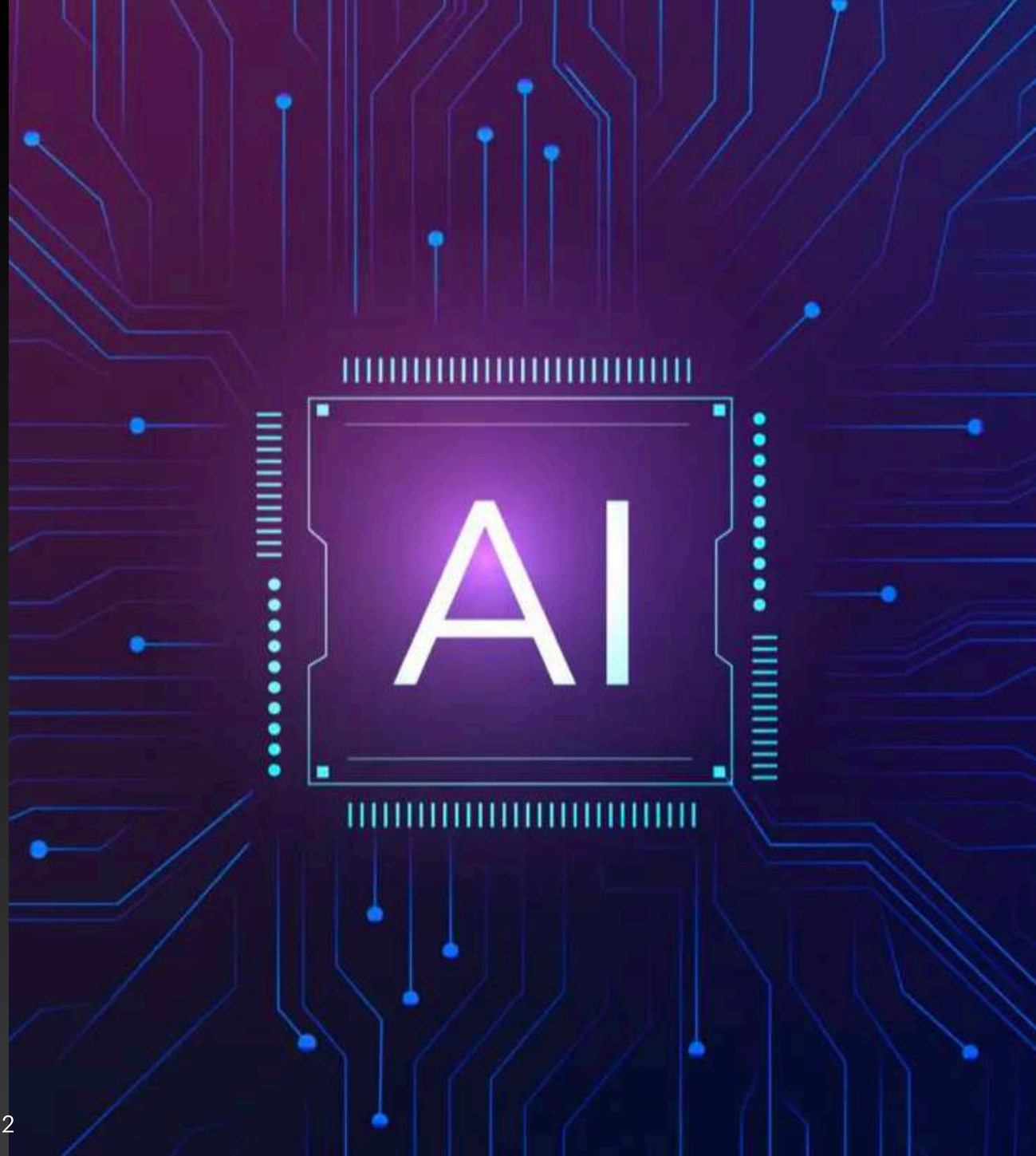
1 - History of AI

2 - AI Technologies

3 - From Big Data to Deep Learning

4 - Transformers

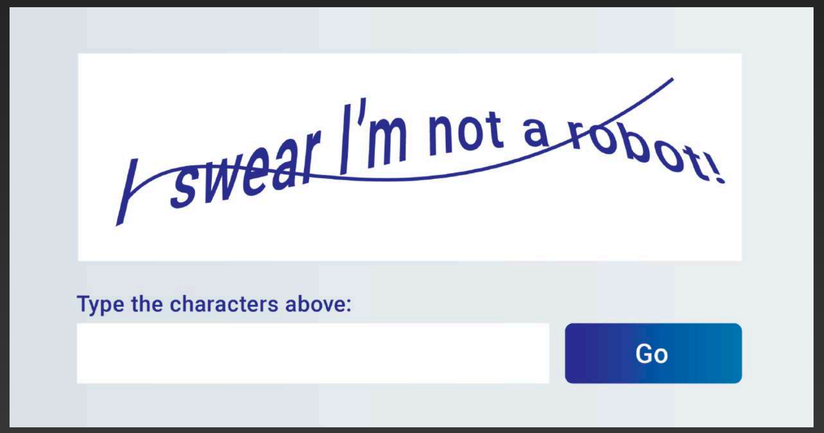
4 - Perspectives and issues



History of AI

The first proposal

- On September 1955, John McCarthy, Marvin Minsky, Nathaniel Rochester and Claude Shannon proposed a project where they introduced for the first time the term “Artificial Intelligence”



- In 1950, Alan Turing addressed the problem of Artificial Intelligence, and proposed an experiment that became known as the Turing test, an attempt to define a standard for a machine to be called “intelligent".

Some first AI Application

- Checkers (Draught), First successful AI program that could play at a reasonable speed. *(Christopher Strachey - Ferranti Mark 1)*
- IBM Shoebox, first computer that could perform mathematical function and speech recognition *(William C. Dersch)*
- ELIZA, First chatbot and one the first AI program able to try passing the Turing Test *(Joseph Weizenbaum)*
- WABOT-1, The first fun-scale anthropomorphic robot developed in the world *(Waseda University)*

1952

1961

```
EEEEEEEE  L         IIIIIII  ZZZZZZZ      AAA
E         L            I         Z      A   A
E         L            I        Z      A     A
EEEEE     L            I       Z       A     A
E         L            I      Z        AAAAAAA
E         L            I     Z         A     A
EEEEEEEE  LLLLLLLL  IIIIIII  ZZZZZZ    A     A

ELIZA > (PLEASE TYPE IN ALL CAPS) WHAT'S YOUR NAME DEAR ?
AMIT
ELIZA > HI, I'M ELIZA. WHAT DO YOU WANT TO TALK ABOUT ?
AMIT > CAN I TALK ABOUT MY PROBLEM ?
ELIZA > SURE... !
AMIT > DUE TO ON GOING EXAMS IN COLLEGE, I HAVE A LOT OF STRESS.
ELIZA > PLEASE RELAX A LITTLE. SLEEP WELL.
AMIT > THANKS FOR YOUR ADVICE.
ELIZA > NO MENTION.
AMIT > BYE
ELIZA > BYE AND KEEP IN TOUCH...
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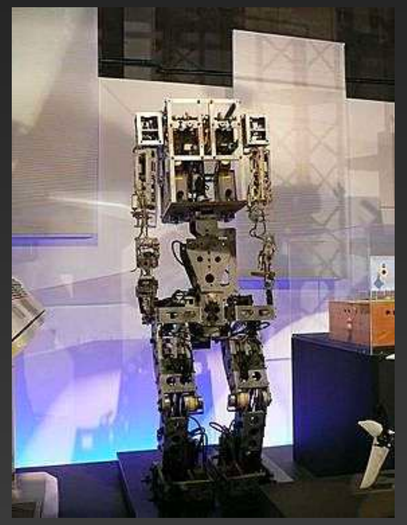
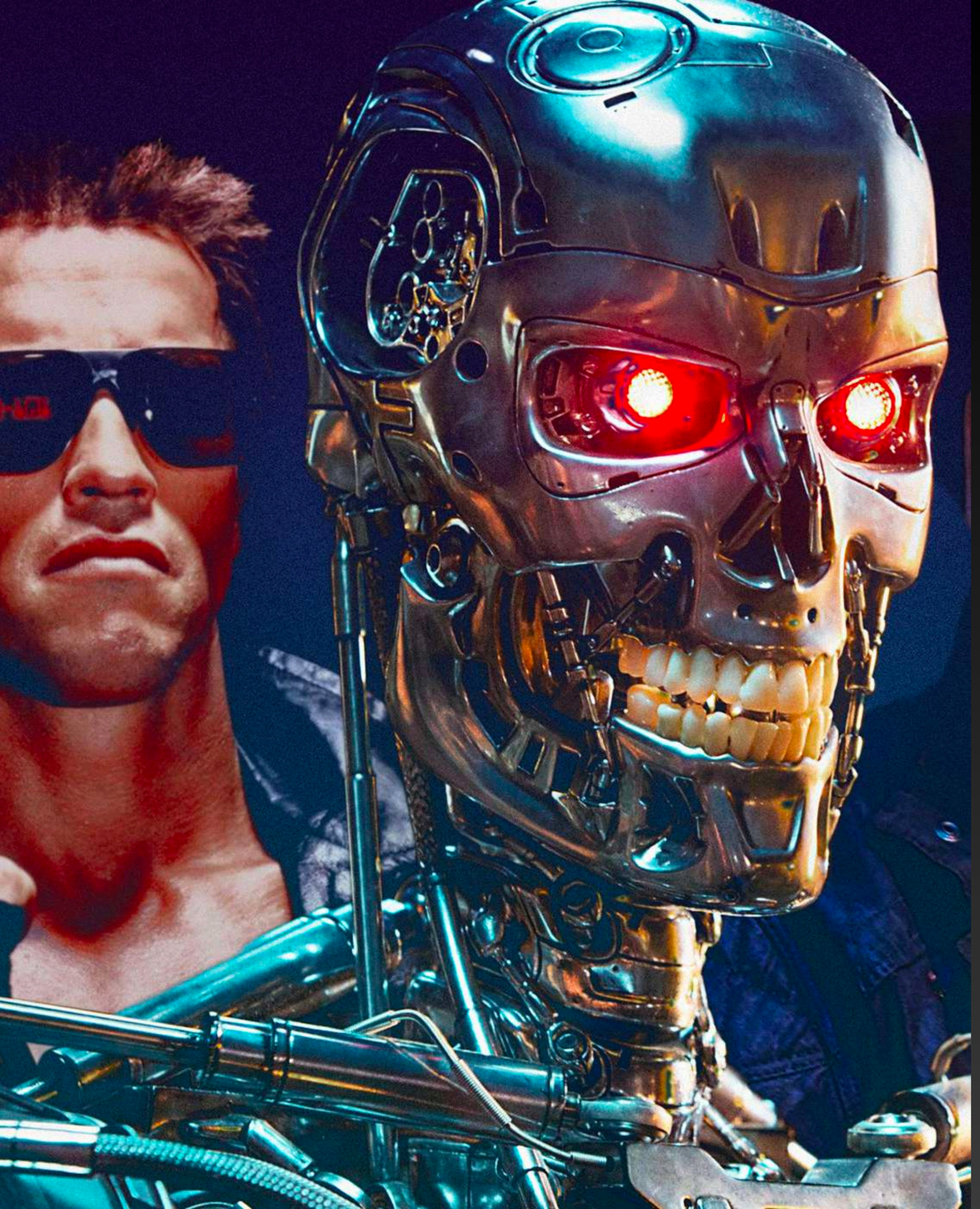
1964



1970



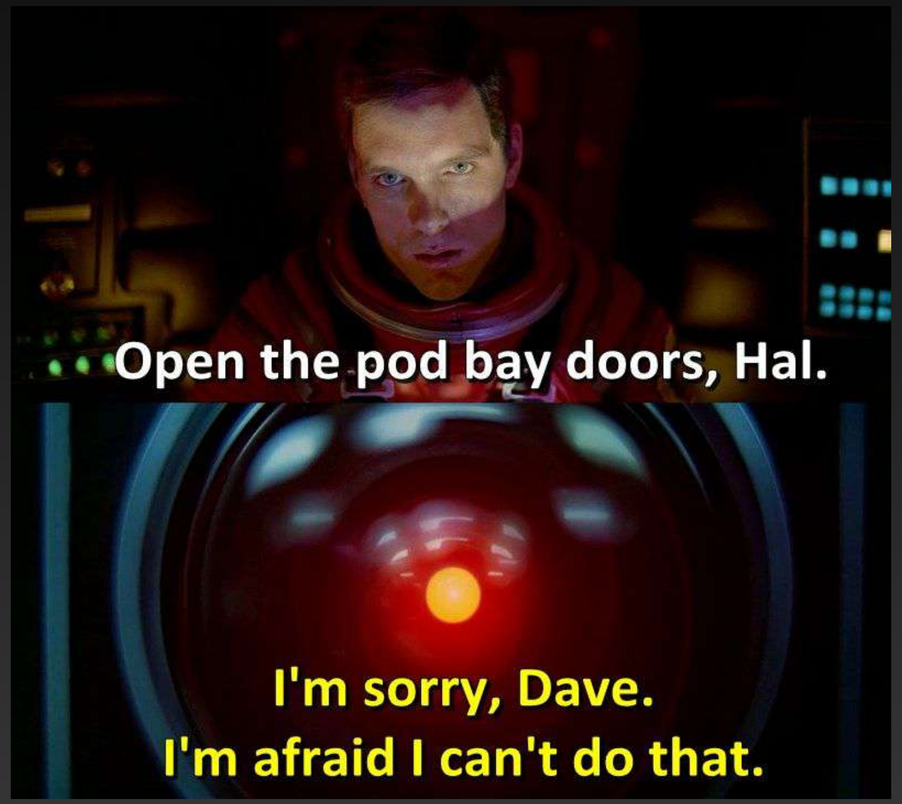
False ideas about AI

- John McCarthy : *“the science and engineering of making intelligent machines”*
- Most AI algorithms do NOT try to reproduce human behaviour.
- *“The study and design of intelligent agents” where an intelligent agent is a system that perceives its environment and takes actions that maximise it’s chance of success.*

Artificial Intelligence is not Human Intelligence

Artificial Intelligence is the science of making machines do things that would require intelligence if done by men

Marvin Minsky (1968)



2001: A space Odyssey

AI Technologies

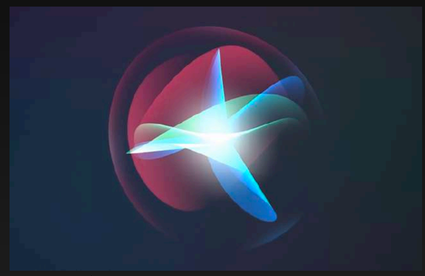
Intelligent Virtual Assistant

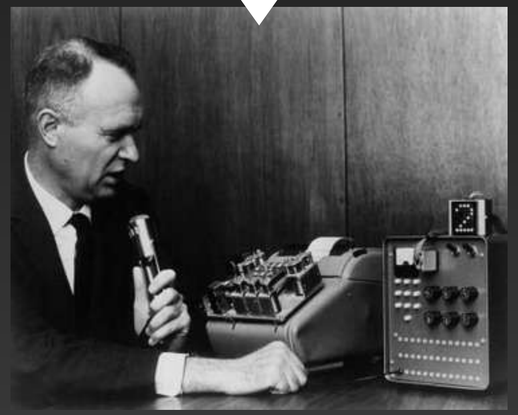
1922 : Radio Rex

1964 : Eliza

1986 : Tangora

2011 : Siri Apple





1961 : Shoebox

1970s : Harpy

2006 : Watson IBM

2014 : Alexa Amazon

Autonomous Car

Carnegie Mellon NavLab 5

- At the 1939 World's Fair, General Motors, vehicle guided by radio-controlled electromagnetic fields
- By 1990 Carnegie Mellon University began building self-driving car involving neural network

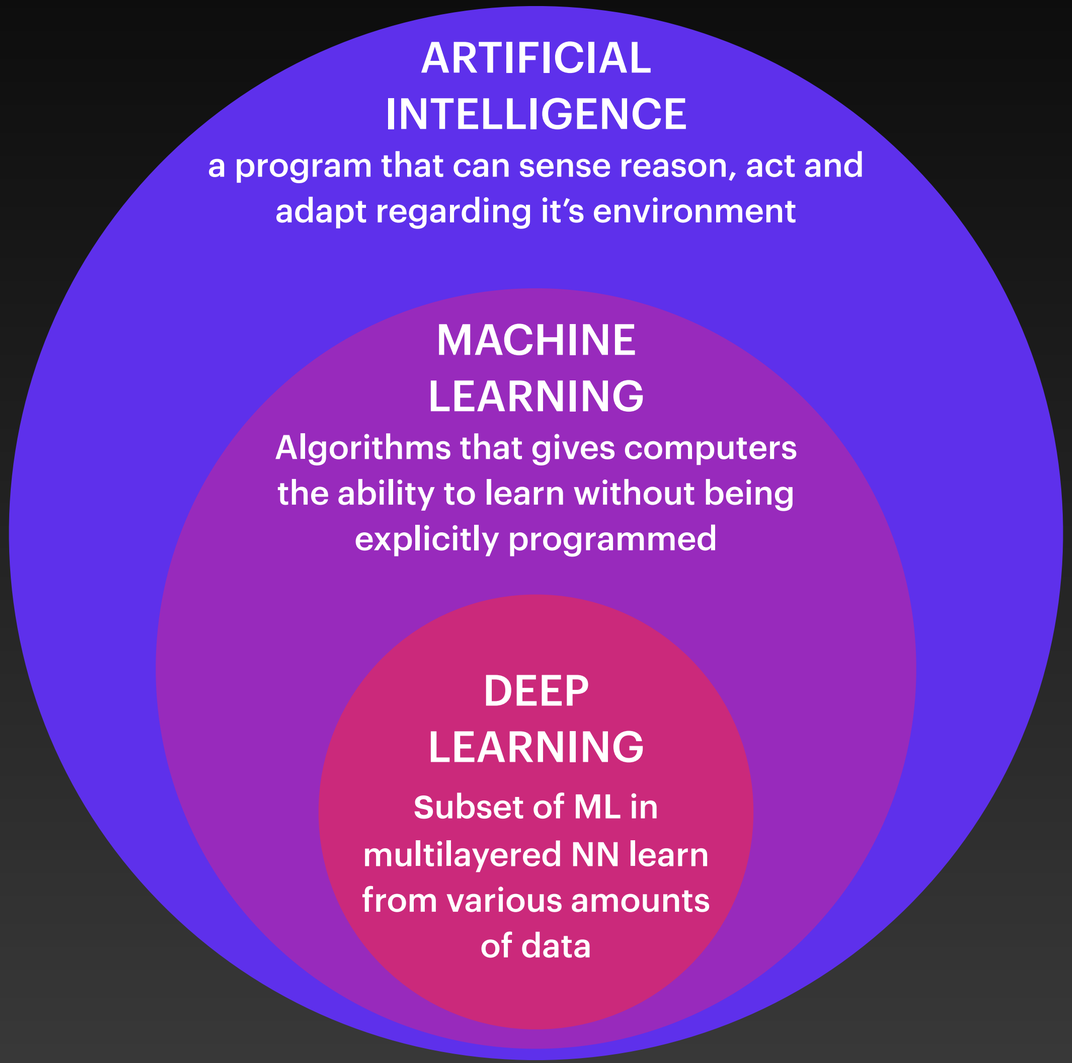
- 2010 Google entered in the race, Four US states allowed self driving car
- 2016 First accident cause by self driving car
- December 2021, Yas Island (Abu Dhabi) launch TXAI, a free self driving Taxi service

From Big Data to Deep Learning

Definitions ...

- Big Data : any collection of large and complex dataset that are complicate to use through traditional data processing applications.
- Statistics : study of collection, analysis, interpretation, visualisation and organisation of data.
- Machine Learning : subfield of computer science that gives computers the ability to learn without being explicitly programmed.
- Artificial Intelligence : defined as the study of intelligent agent.
- Data Sciences : study of the extraction of knowledge from data, yet the key word here is science.

Definitions ...



“When you are fundraising, it’s Artificial Intelligence.
When you are hiring, it’s Machine Learning.
When you are implementing, linear regression.
When you are debugging, it’s printf()...”

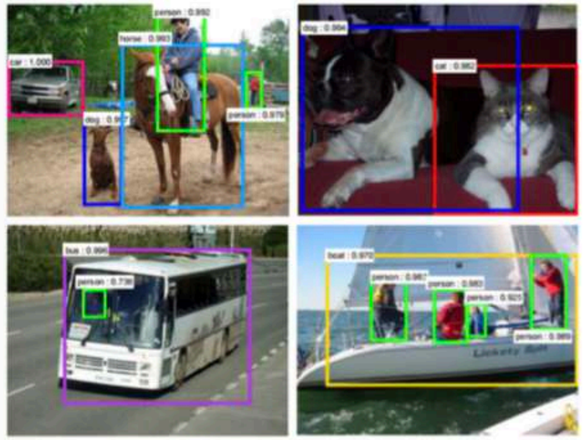
Baron Schwartz, CEO of VividCortex

Deep Learning

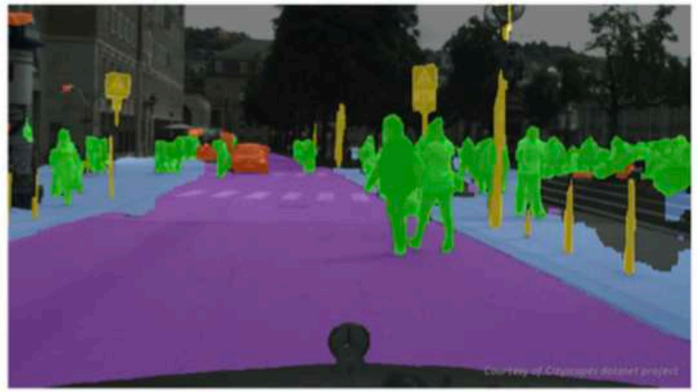
Computer vision

[Krizhevsky 2012]

[Ciresan et al. 2013]



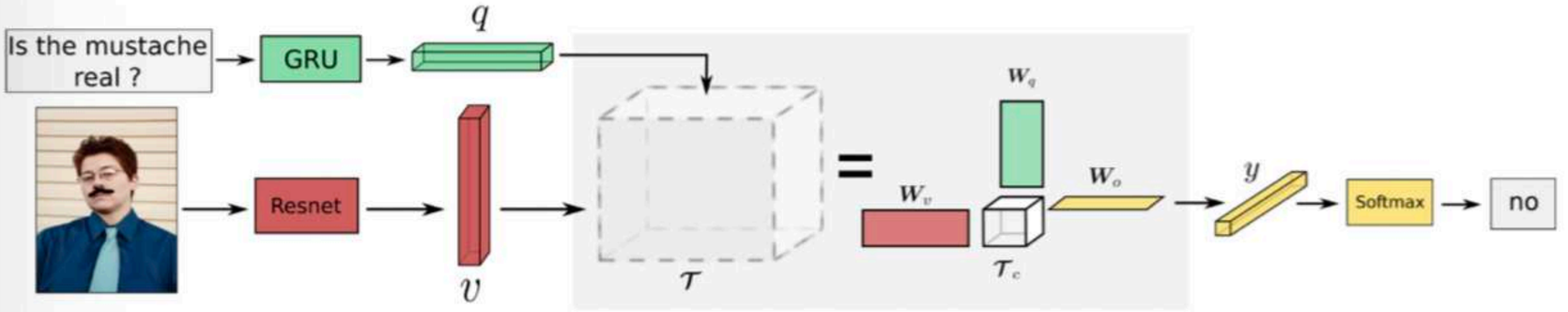
[Faster R-CNN - Ren 2015]



[NVIDIA dev blog]

Deep Learning

Computer vision and natural language processing

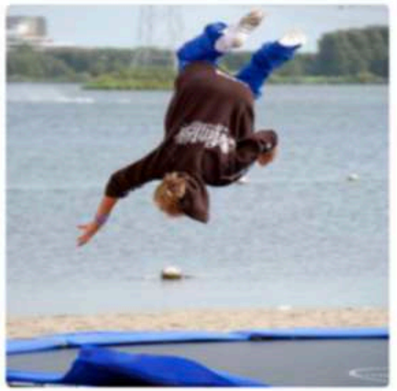


[VQA - Mutan 2017]

"man in black shirt is playing guitar."

"construction worker in orange safety vest is working on road."

"two young girls are playing with lego toy."

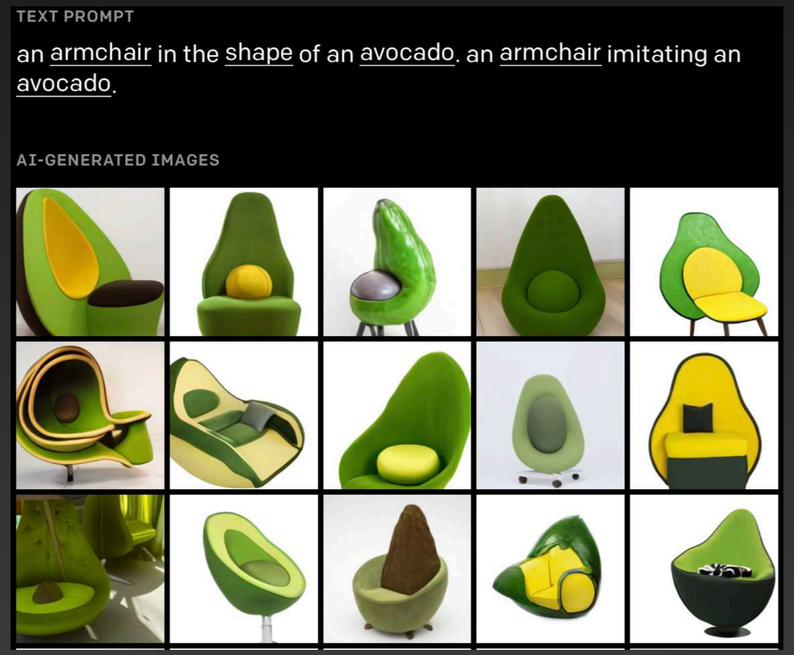


"boy is doing backflip on wakeboard."

[Karpathy 2015]

Deep Learning
Generative model

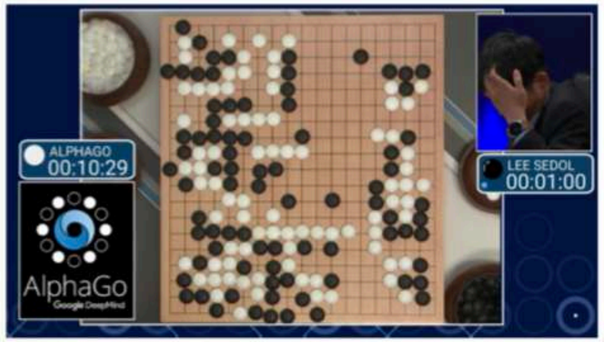
- StyleGAN, NVIDIA
- https://this-person-does-not-exist.com/en



- Text to image using GAN, OpenAI
- https://openai.com/blog/dall-e/

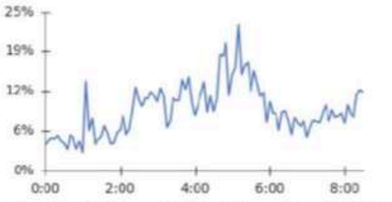
Deep Learning

AI in games



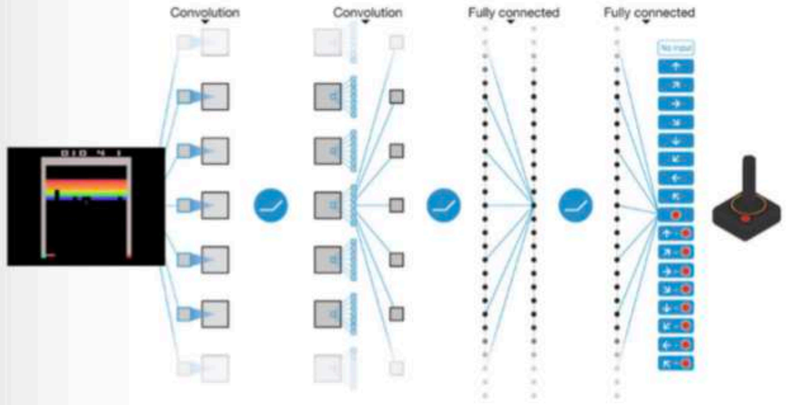
w 20/30/0, b 8/40/2

A10: English Opening



1...e5 g3 d5 cxd5 ♘f6 ♗g2 ♘xd5 ♘f3

[Deepmind AlphaGo / Zero 2017]

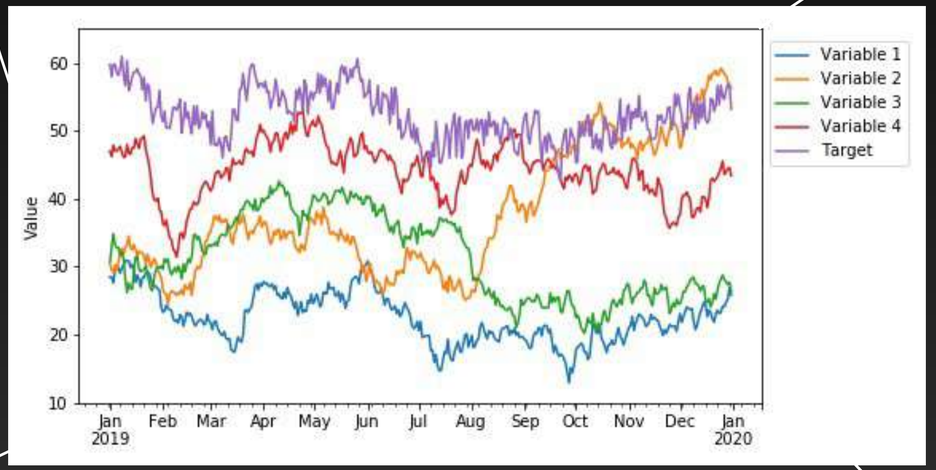


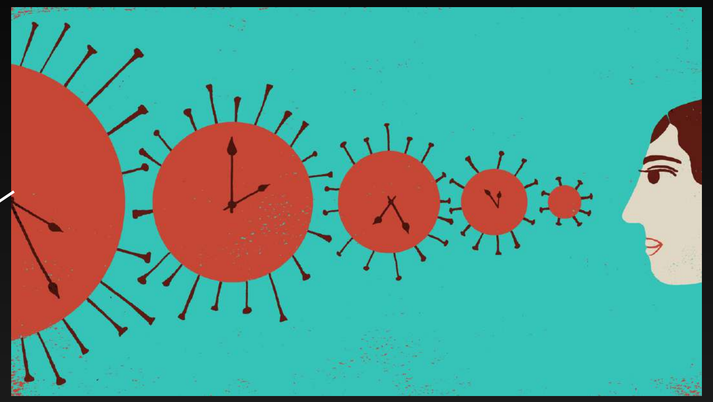
[Atari Games - DeepMind 2016]

[Starcraft 2 for AI research]

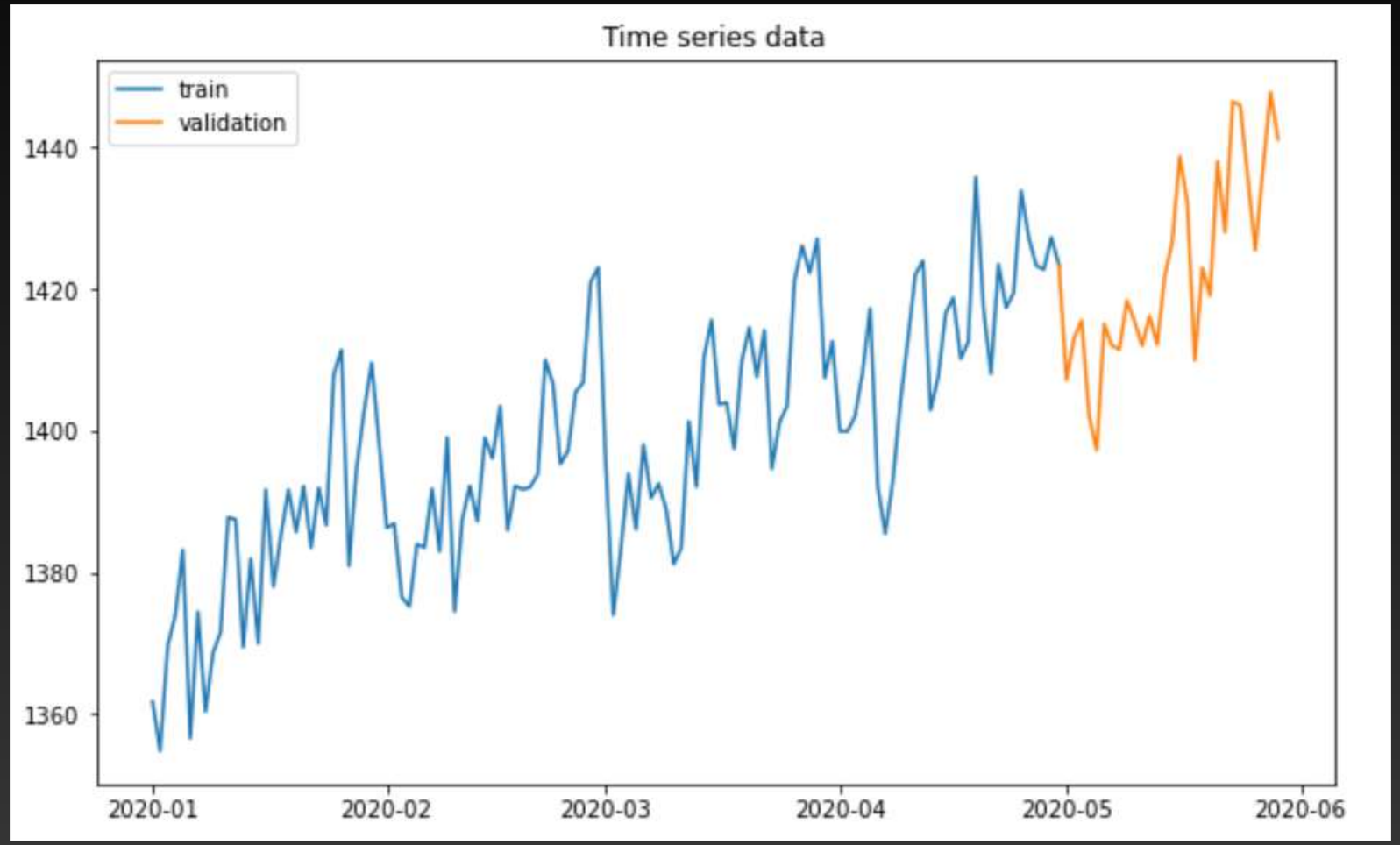
Time series forecasting

Some examples

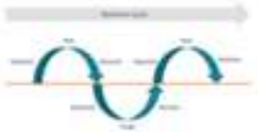




Time series


Time series data
train
validation
1440
1420
1400
1380
1360
2020-01
2020-02
2020-03
2020-04
2020-05
2020-06

Time series

	Trend	Seasonality	Cyclical	Irregularity
Time	Fixed Time Interval	Fixed Time Interval	Not Fixed Time Interval	Not Fixed Time Interval
Duration	Long and Short Term	Short Term	Long and Short Term	Regular/Irregular
Visualization				
Nature - I	Gradual	Swings between Up or Down	Repeating Up and Down	Errored or High Fluctuation
Nature – II	Upward/Down Trend	Pattern repeatable	No fixed period	Short and Not repeatable
Prediction Capability	Predictable	Predictable	Challenging	Challenging
Market Model				Highly random/Unforeseen Events – along with white noise.

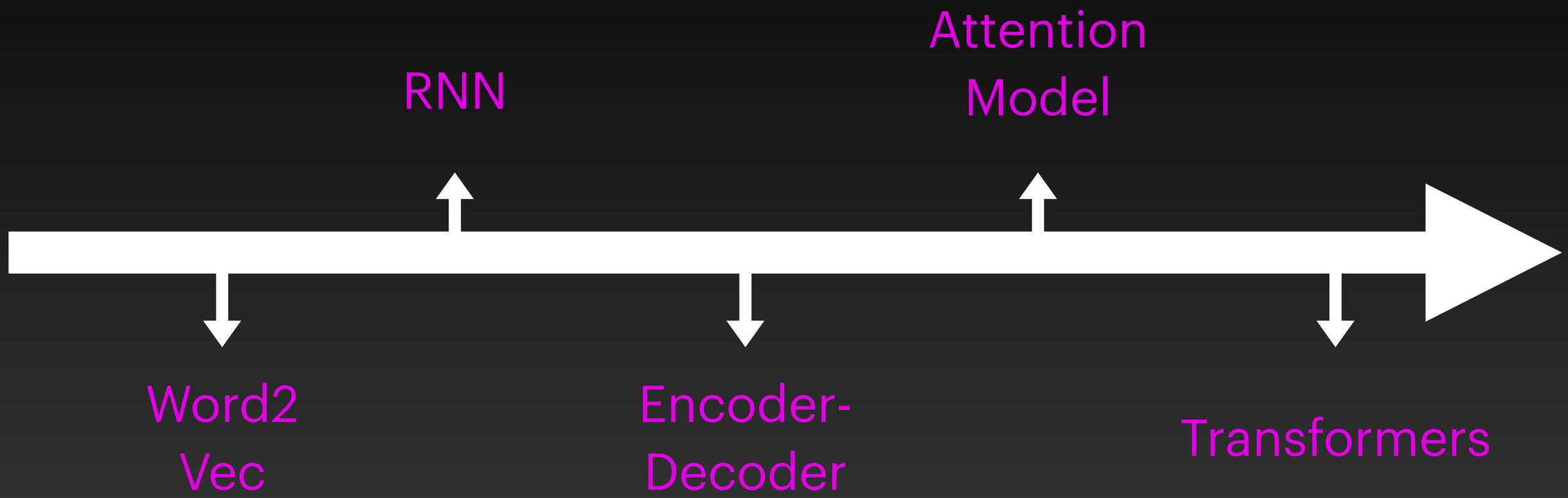
Transformers

What is NLP

NLP : Natural Language Processing

NLP is a subfield of artificial intelligence which is primarily aimed to program computers to process large amount of natural language data

Deep Learning model in NLP



How does Transformers works ?

We all know the disadvantages of teaching outside your expertise, or at least we can imagine them: you could be outsmarted by your students, you could be asked a question you can't answer, you could spend hours preparing for every class, you could explain a difficult concept poorly (or worse yet, incorrectly), and you could have trouble sleeping at night because you're worried about any or all of the above. I've experienced all these problems at least once, several of them many times. As I interviewed faculty and read through the research literature, I learned some practical strategies for minimizing most of these difficulties. I'll share those strategies with you throughout this book.[1]

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Transformer Structure

- Encoder (Left):
    - Stack of 6 layers
    - Self-Attention + feed-forward network(FFN)
- Decoder (Right):
    - Stack of 6 layers
    - Self-Attention + Source Target-at + FFN
- Components:
    - Positional Encoding
    - Multi-head Attention
    - Position-wise FFN
    - Residual Connection
- Regularisation:
    - Residual Dropout
    - Label Smooth
    - Attention Dropout

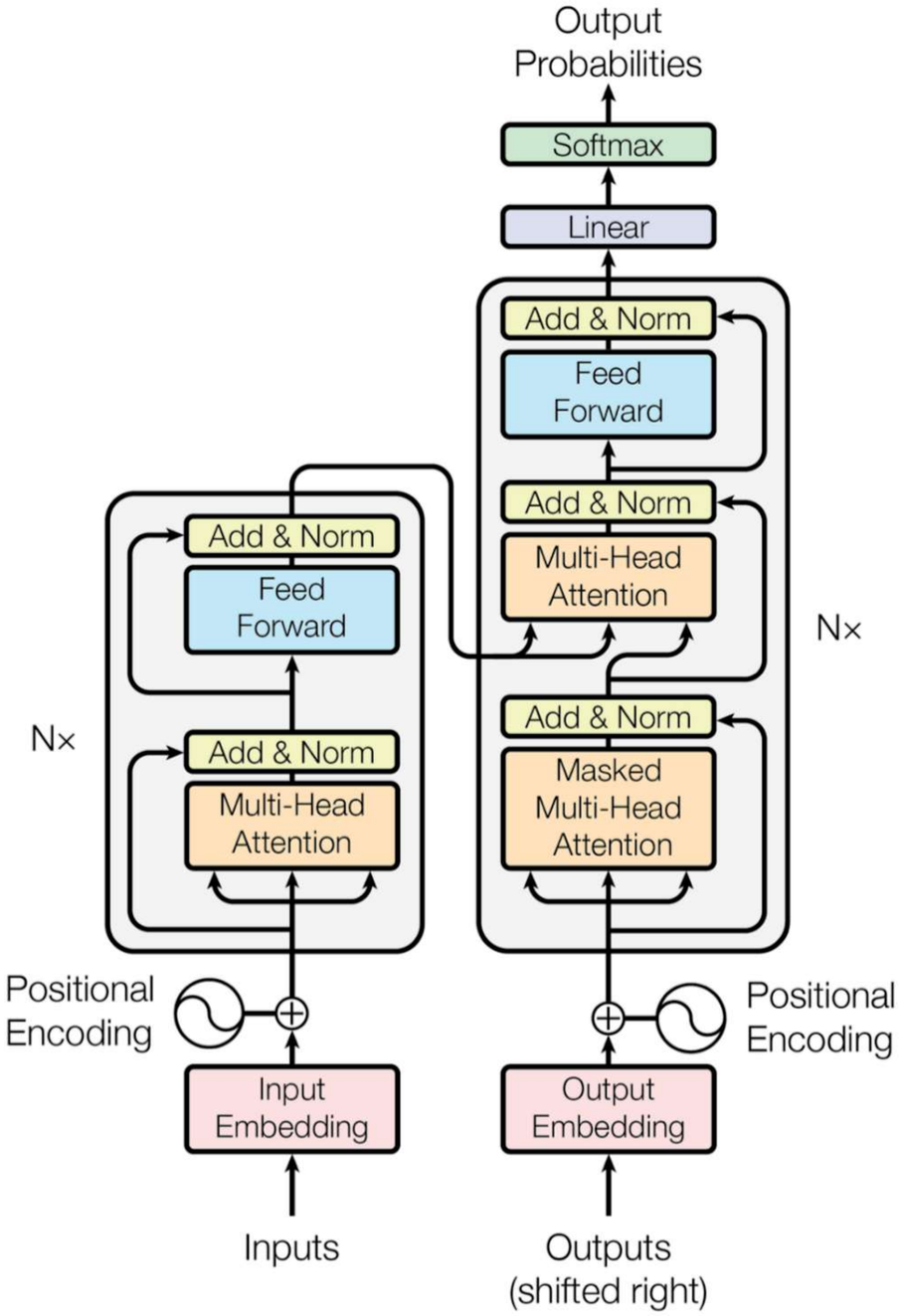


Figure 1: The Transformer - model architecture.

Positional Encoding

d_{model} : The dimension of word embedding

$$PE_{(pos,2i)} = sin(\frac{pos}{10000^{2i/d_{model}}})$$

$$PE_{(pos,2i)} = cos(\frac{pos}{10000^{2i/d_{model}}})$$

Where pos is the position and i is the dimension

Scaled Dot-Product Attention

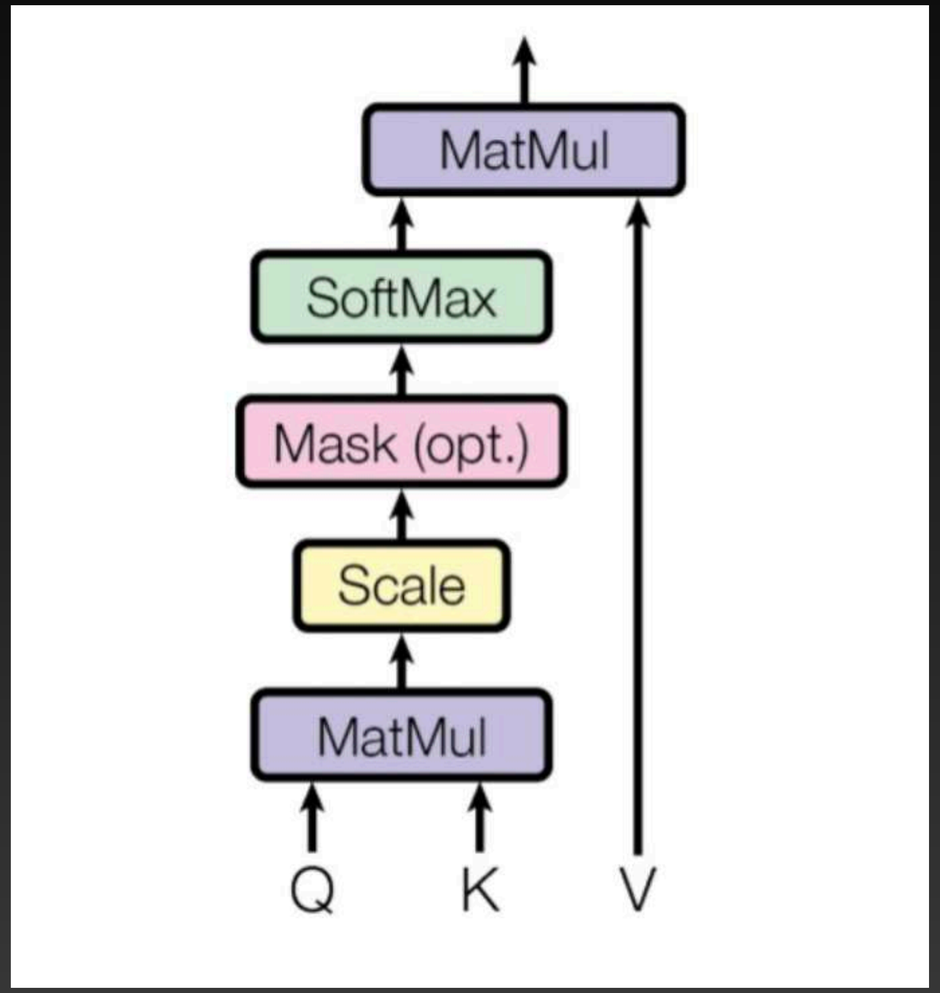
$$Attn(Q, K, V) = \text{Softmax}(\frac{QK^T}{\sqrt{d}})V$$

Where

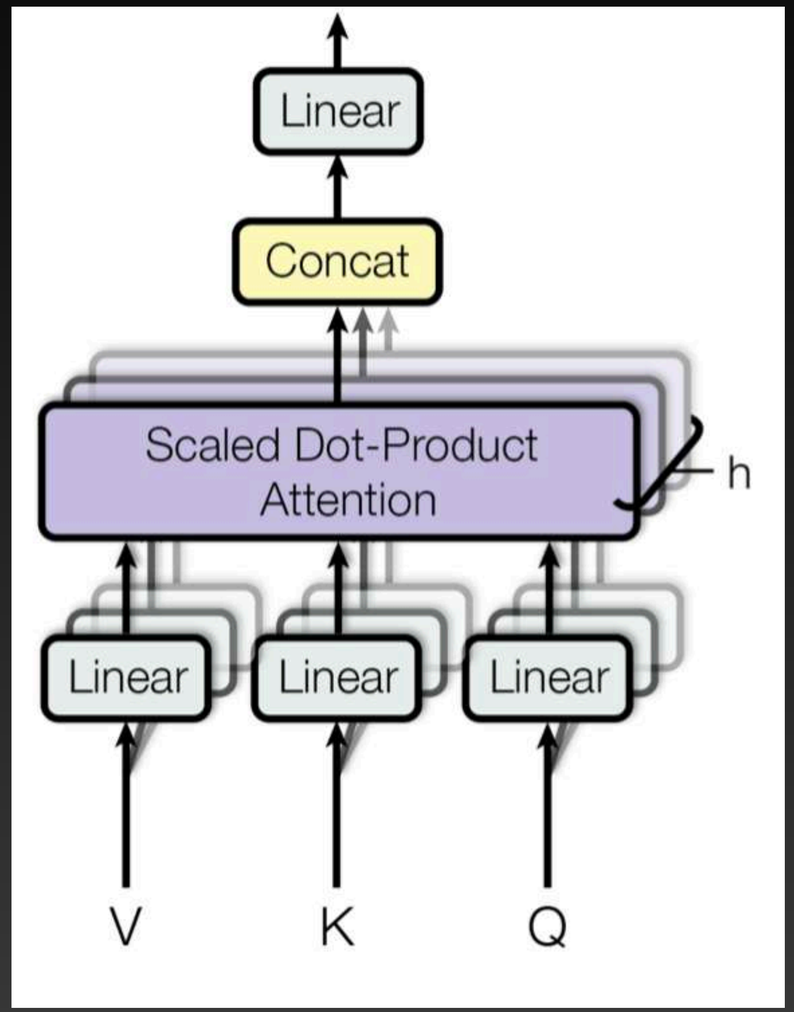
$Q(Q \in \mathbb{R}^{n \times d_k})$: Query Matrix

$K(K \in \mathbb{R}^{n \times d_k})$: Key Matrix

$V(V \in \mathbb{R}^{n \times d_v})$: Value Matrix



Multi-Head Attention



$$head_l = Attn(QW_l^Q, KW_l^K, VW_l^V)$$

Where

$$W_i^Q \in \mathbb{R}^{d_{model} \times d_k}, W_i^K \in \mathbb{R}^{d_{model} \times d_k}, W_i^V \in \mathbb{R}^{d_{model} \times d_v}, W^O \in \mathbb{R}^{hd_v \times d_{model}}$$

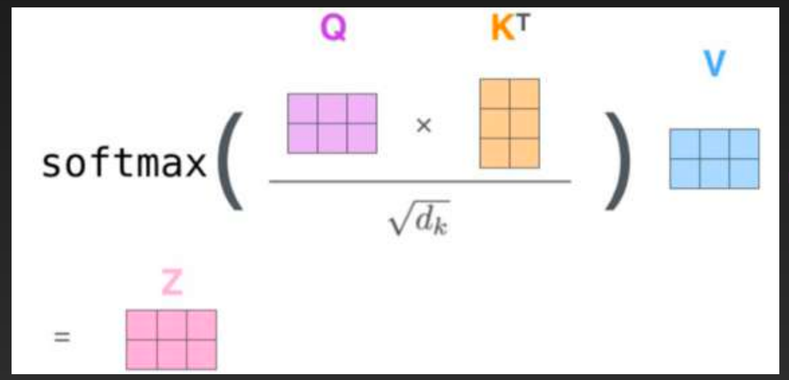
$$Multi_{head}(Q, K, V) = Concat(head_1, \ldots, head_h)W^O$$

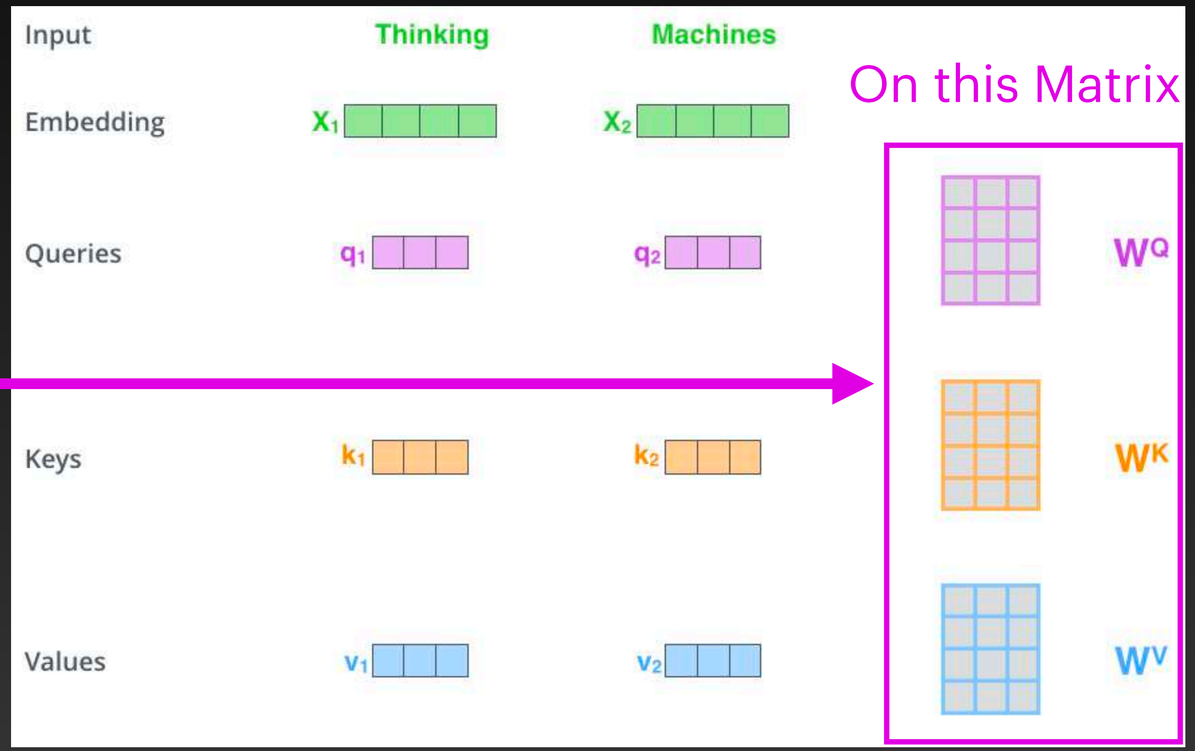
h: number of parallel attention layers

$$d_k = d_v = \frac{d_{model}}{h}$$

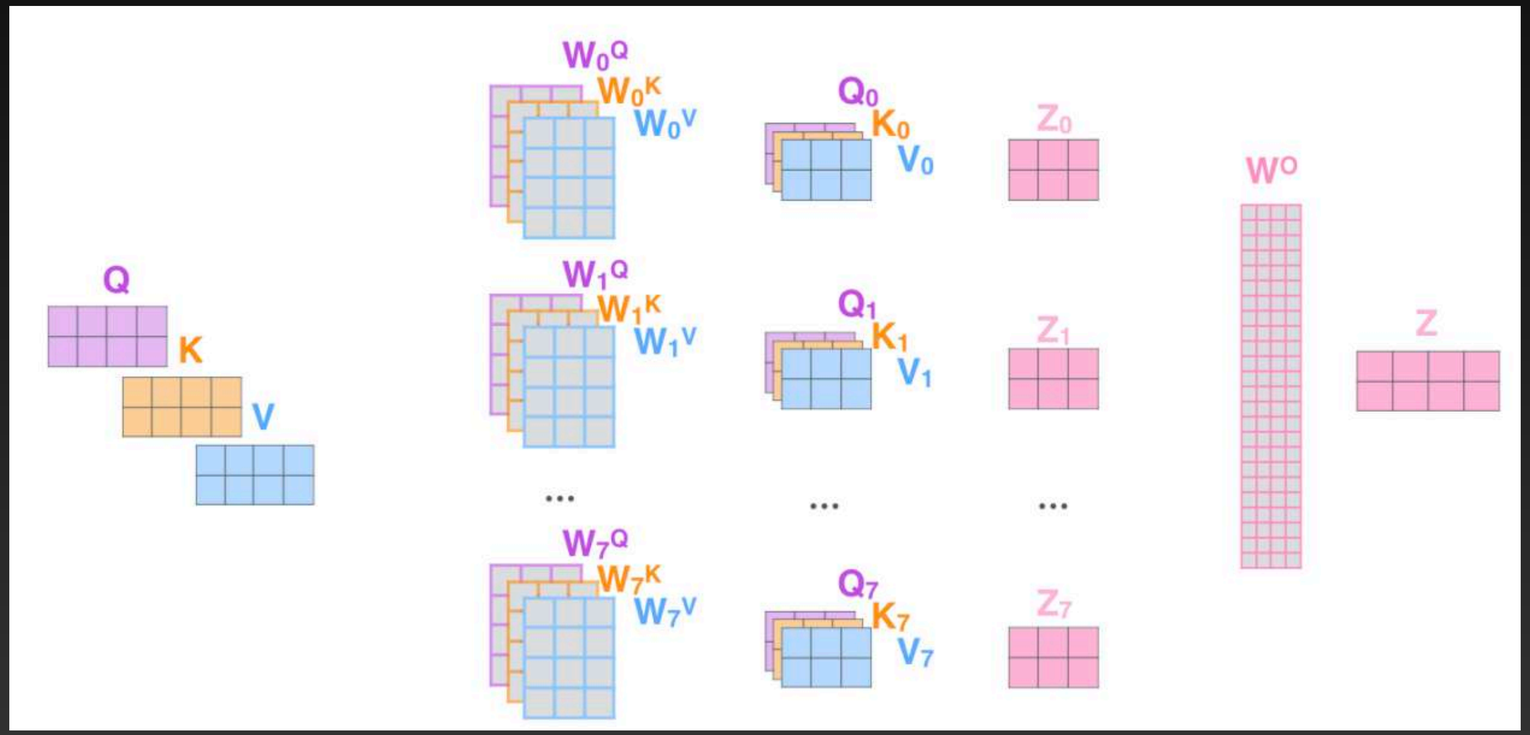
Combination of both

We apply this formula

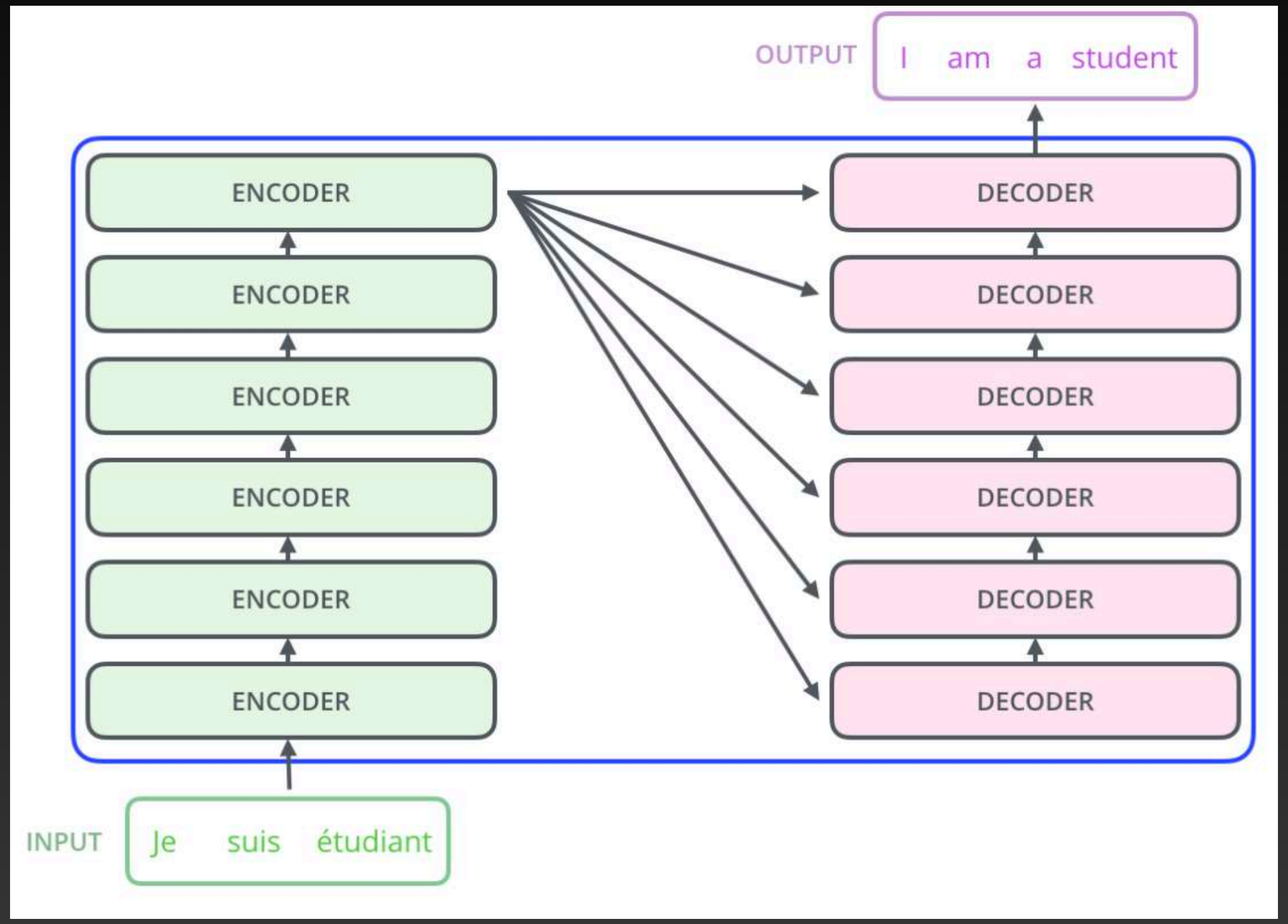




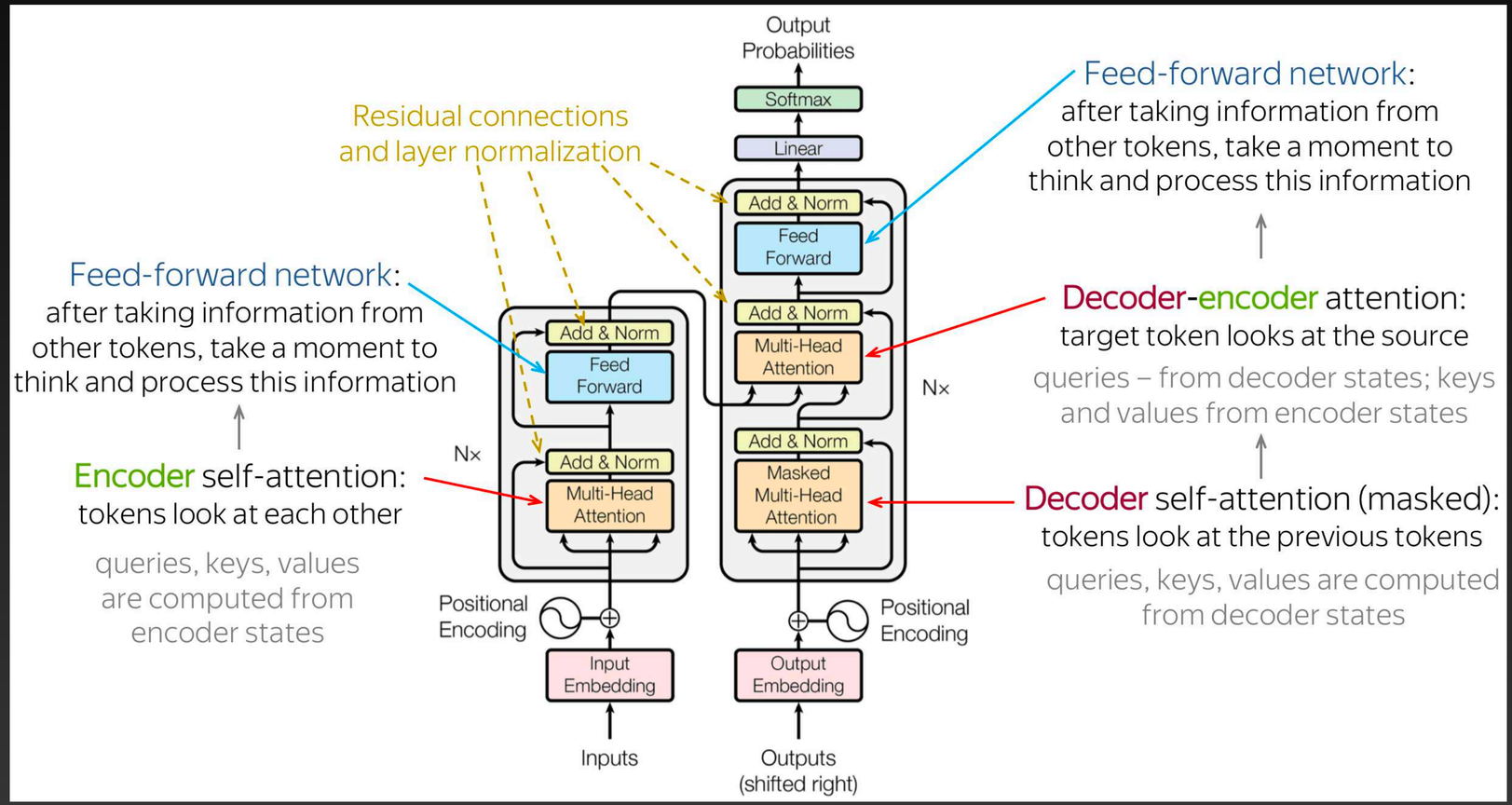
Combination of both



In the end ...


OUTPUT
I am a student
ENCODER
ENCODER
ENCODER
ENCODER
ENCODER
ENCODER
DECODER
DECODER
DECODER
DECODER
DECODER
DECODER
INPUT
Je suis étudiant

To Summarize



Perspectives and issues

Environmental impact

- Data centers:
- 2% of the total electricity consumption in the US.
- 626 billion liters of water.
- 2% of total global greenhouse emissions.

Data centers use more eletricity than entire countries

Domestic eletricity consumption of selected countries vs. data centers in 2020 in TWh

Source: Enerdata, IEA

Ethical Issues

- Score Credit Systems
- Tay (”thinking about you”) was an AI released by Microsoft via Twitter on March 2016. It was shut down when the bot began to post inflammatory and offensive tweets, only 16 hours after its launch.

“The development of full artificial intelligence could spell the end of the human race. We cannot quite know what will happen if a machine exceeds our own intelligence, so we can’t know if we’ll be infinitely helped by it, or ignored by it and sidelined, or conceivably destroyed by it.”

Stephen Hawkins, Dec 2014

Conclusion

- AI originates from 1950s but became more prevalent in the last seven years due to computational power, and data explosion.
- AI is not about reproducing human brain or human cognition.
- AI is about solving task that are thought to require human intelligence.
- Wherever you can collect data, you can use artificial intelligence, keeping in mind that specific questions require specific data.
- Achieving good performances with AI often requires a lot of data, which can be cumbersome in particular fields such as medicine (rare pathology).
- You do not need to make assumptions on your data in order to implement AI. But you also don’t have a precise understanding of what the model does.

Thank you for your attention

Any questions ?