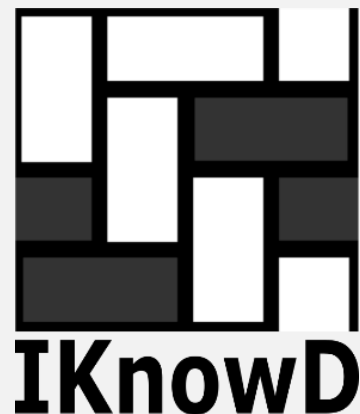


MADEIRA INTERNATIONAL WORKSHOP IN MACHINE LEARNING



ORDEM DOS ENGENHEIROS TÉCNICOS

Platinum sponsor:



Silver sponsor:



Institutional support



Prompt Engineering

"Prompt engineering is the art of molding human thought into machine understanding."

What is prompt engineering?

Prompt Engineering is a branch of computer science that focuses on creating software applications to assist in the development of prompt systems.

Prompt systems are used to automate the creation of prompts, which are messages or notifications that are sent to users in various contexts.

Prompt engineering is not just about designing and developing prompts. It encompasses a wide range of **skills and techniques** that are useful for **interacting and developing** with Large Language Models (LLMs). It's an important skill to interface, build with, and understand capabilities of LLMs.

Large Language Models

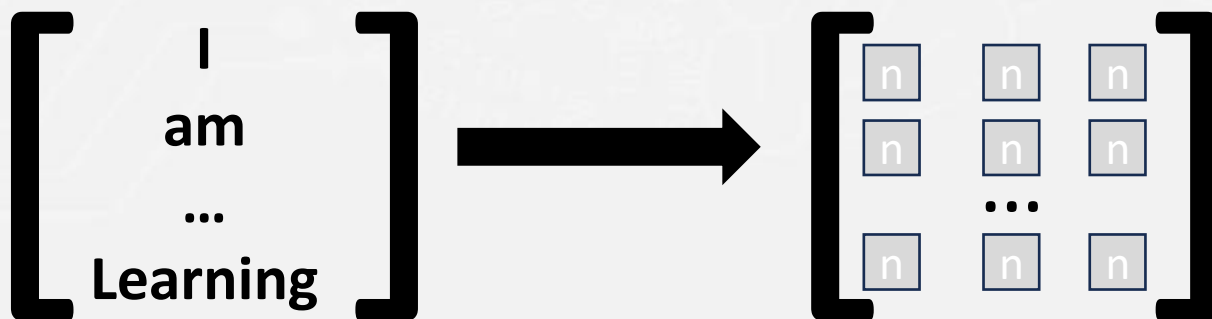
- Large language models (LLMs) represent a prominent category of ML language models known for their proficiency in natural language processing (NLP).
- Their capacity to produce human-like language has not only garnered significant research interest but also positions them as potential game-changers in the realms of science and technology.
- They are trained on vast amounts of data and use state-of-the-art deep-learning techniques with transformers with multi head self-attention mechanisms.
- The basic function of an LLM is to predict the most likely subsequent token in a sequence.

What is a token?

A "token" typically refers to a chunk of text that the model reads, processes, or generates. For example, the phrase:

"I am loving the Madeira International Workshop in Machine Learning"

can be divided in 10 tokens (words in this case) that later will be embedded as vectors:



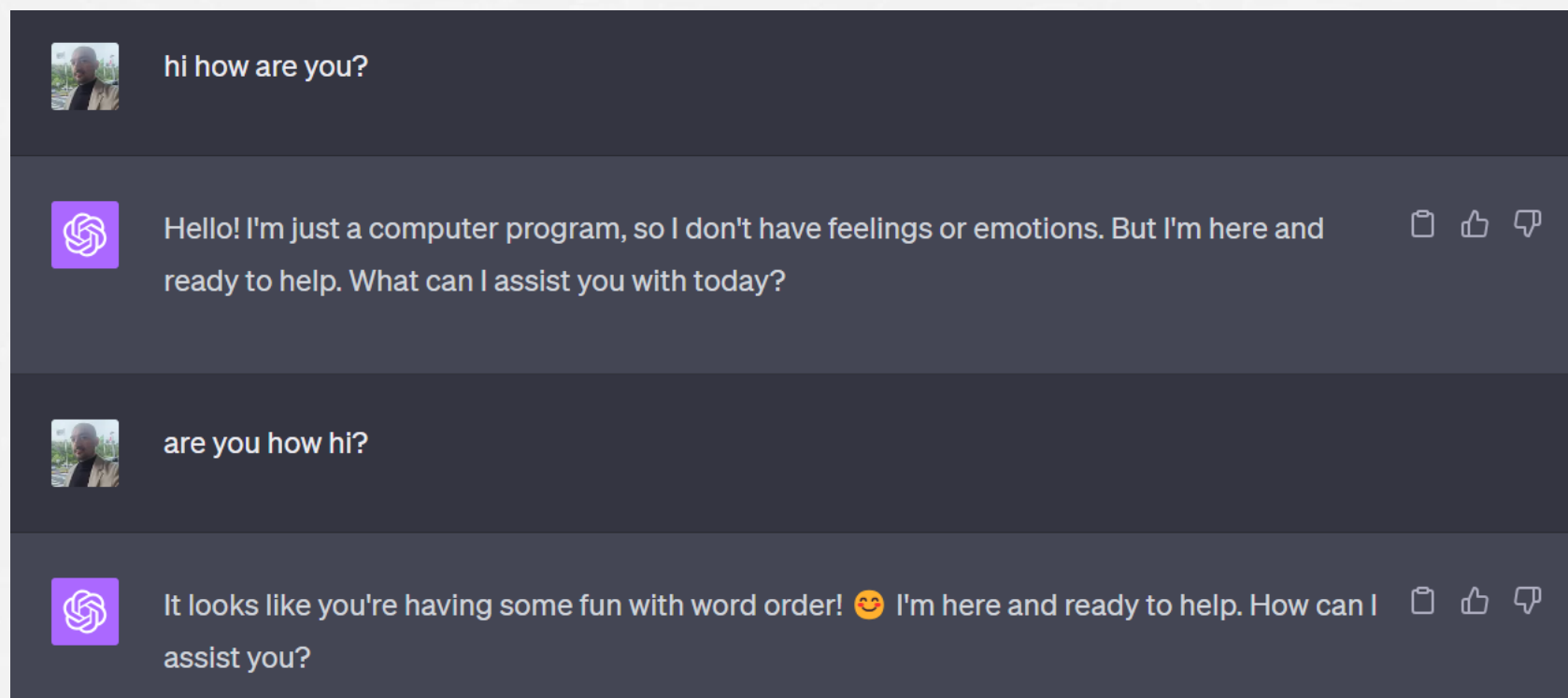
Words must have a position

“Hi how are you?”

-
-
-

“Are you hi how?”

Let's test and then dive-in:



A screenshot of a chat interface showing a conversation with GPT-4o. The chat is set against a dark background with light text. The user's messages are on the left, and the AI's responses are on the right. The AI's responses include a purple square icon with a white knot-like symbol (GPT-4o logo) and three small icons (copy, like, and quote) to the right of the text.

hi how are you?

Hello! I'm just a computer program, so I don't have feelings or emotions. But I'm here and ready to help. What can I assist you with today?

are you how hi?

It looks like you're having some fun with word order! 😊 I'm here and ready to help. How can I assist you?

Let's test and then dive-in:



hi how are you?



Hi! I am doing well, thank you for asking. I am excited to be able to help people with their tasks and answer their questions. How are you doing today?



Pesquisar no Google



are you hi how?



I'm not sure what you mean by "hi how". Are you asking if I am greeting you? If so, then yes, I am greeting you. I am saying "hi" to you.

Or are you asking if I am asking you how you are? If so, then yes, I am asking you how you are. I am curious to know how you are doing today.

Please let me know if I have misunderstood your question.



Pesquisar no Google



Acessar outros rascunhos

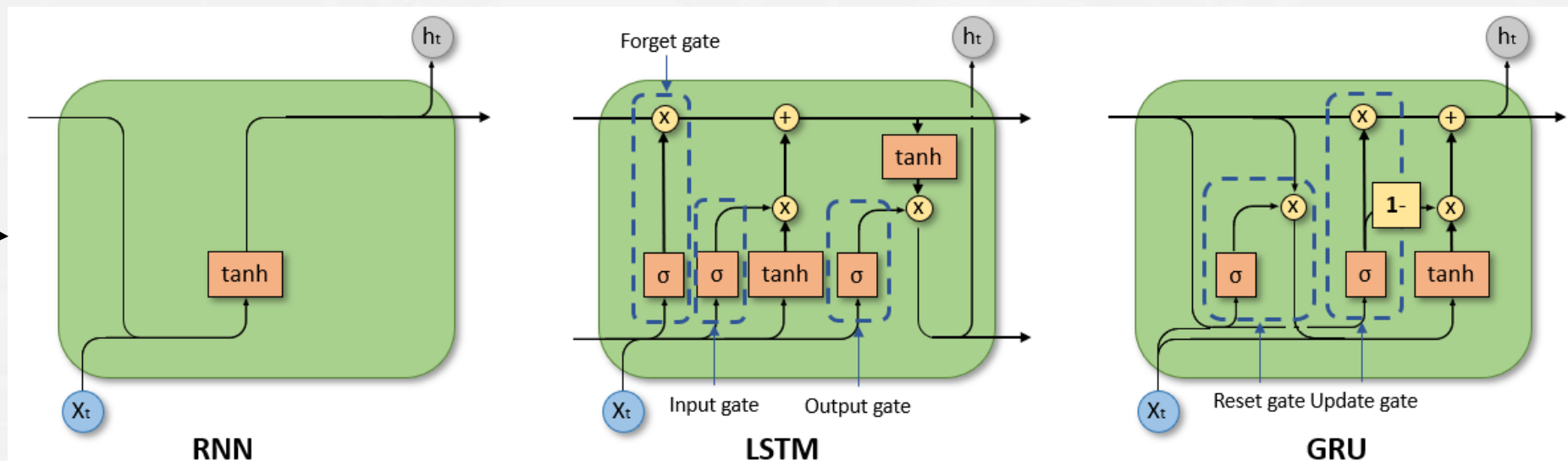


Predicting the next token:

“Madeira island is full of flowers in the **spring**”

input

output



RNN

LSTM

GRU

model

Generating text with more context

**“I am loving the Madeira International Workshop in Machine Learning,
and I will enjoy the next weekend seeing the landscapes because the
island is full of flowers in the spring”**



The need to understand complex connections between words and maintain the context was solved with transformers.

Attention Is All You Need

Attention Is All You Need

Ashish Vaswani* Google Brain avaswani@google.com	Noam Shazeer* Google Brain noam@google.com	Niki Parmar* Google Research nikip@google.com	Jakob Uszkoreit* Google Research usz@google.com
---	---	--	--

Llion Jones* Google Research llion@google.com	Aidan N. Gomez* † University of Toronto aidan@cs.toronto.edu	Lukasz Kaiser* Google Brain lukaszkaizer@google.com
--	---	--

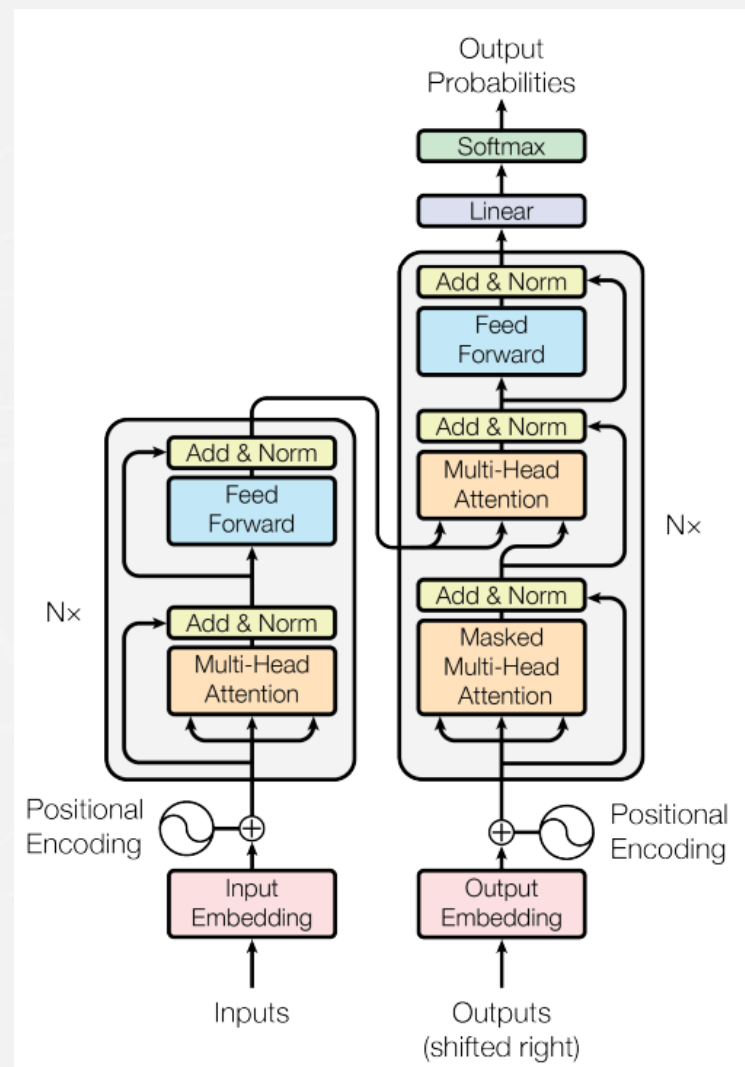
Illia Polosukhin* ‡
illia.polosukhin@gmail.com

Abstract

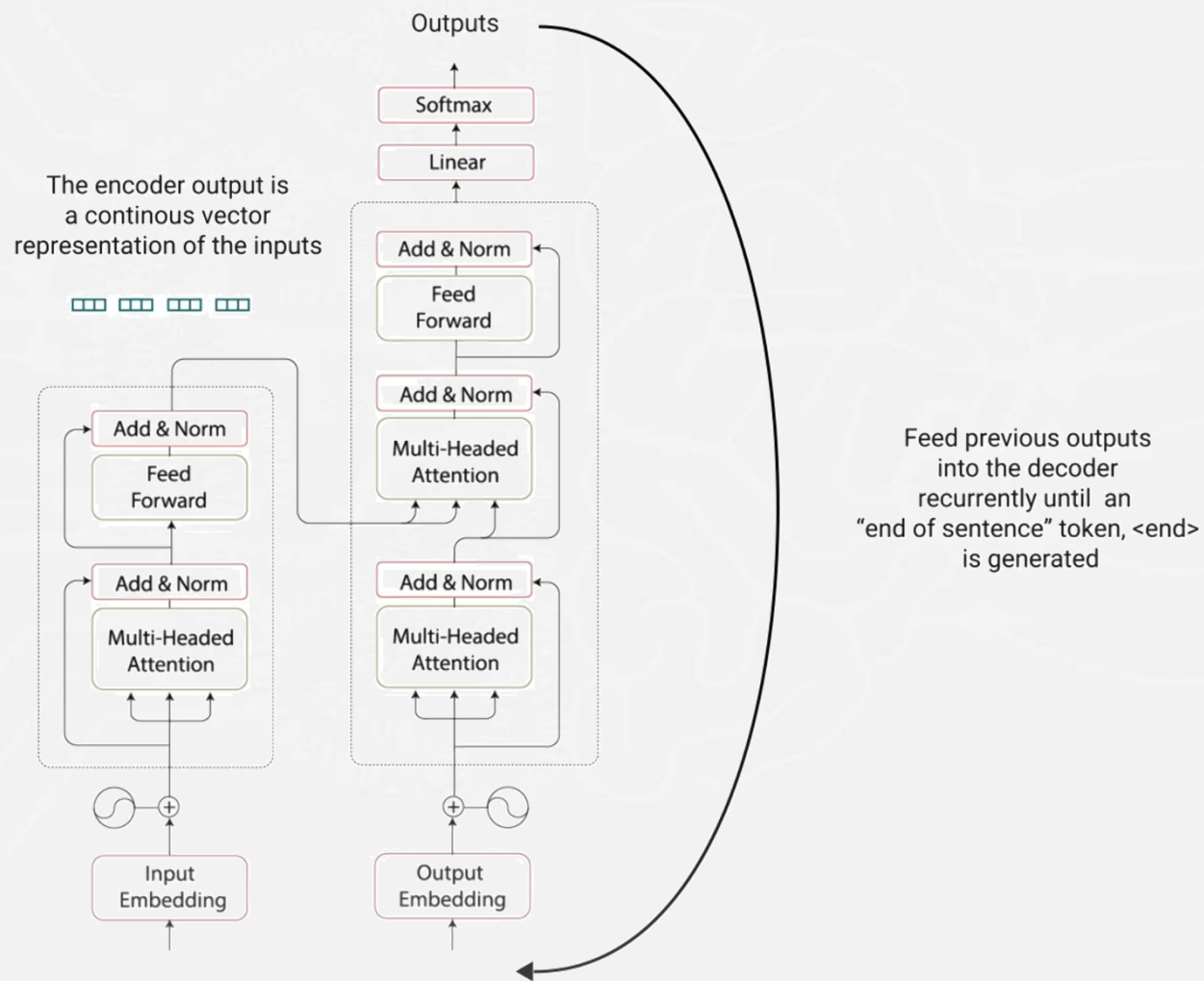
The dominant sequence transduction models are based on complex recurrent or convolutional neural networks that include an encoder and a decoder. The best performing models also connect the encoder and decoder through an attention mechanism. We propose a new simple network architecture, the Transformer, based solely on attention mechanisms, dispensing with recurrence and convolutions entirely. Experiments on two machine translation tasks show these models to be superior in quality while being more parallelizable and requiring significantly less time to train. Our model achieves 28.4 BLEU on the WMT 2014 English-to-German translation task, improving over the existing best results, including ensembles, by over 2 BLEU. On the WMT 2014 English-to-French translation task, our model establishes a new single-model state-of-the-art BLEU score of 41.0 after training for 3.5 days on eight GPUs, a small fraction of the training costs of the best models from the literature.

Attention Is All You Need

A **transformer** comprehensively processes sequential linguistic data using self-attention mechanisms, allowing each token to weigh the importance of every other token in its context, thereby capturing intricate dependencies, relationships, and nuances throughout the sequence to enhance the model's understanding and generation capabilities.



Transformer's base function

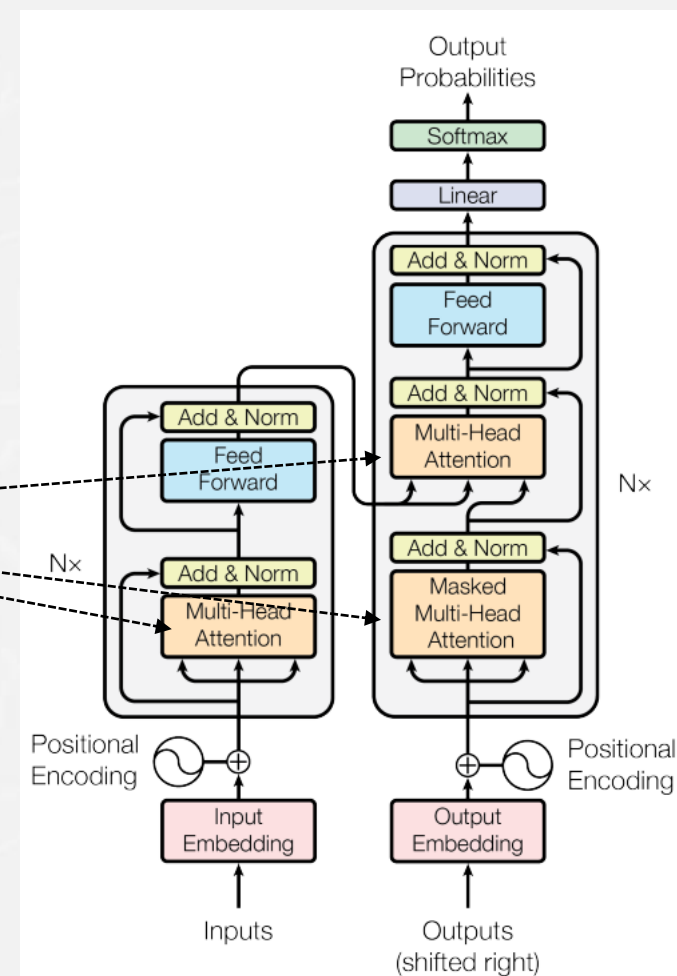


Attention Is All You Need

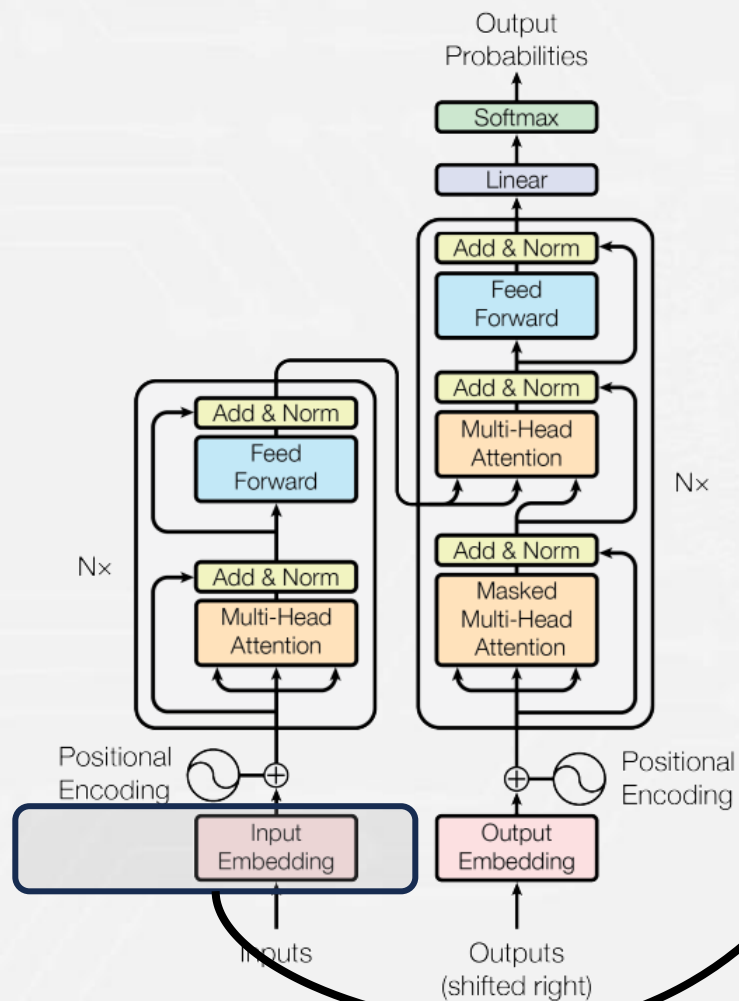
Encoder

Attention mechanism

Decoder



Transformer's base function (dive-in)



1. Input Embedding Word2Vec

 $H_i =$

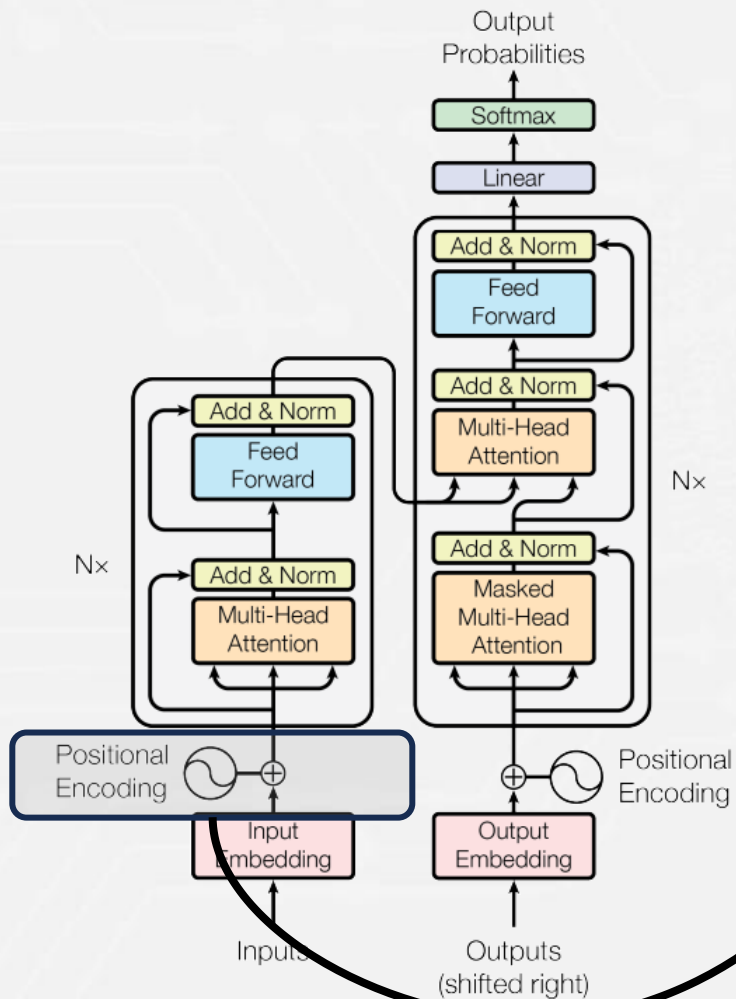
0.1
0.54
0.29



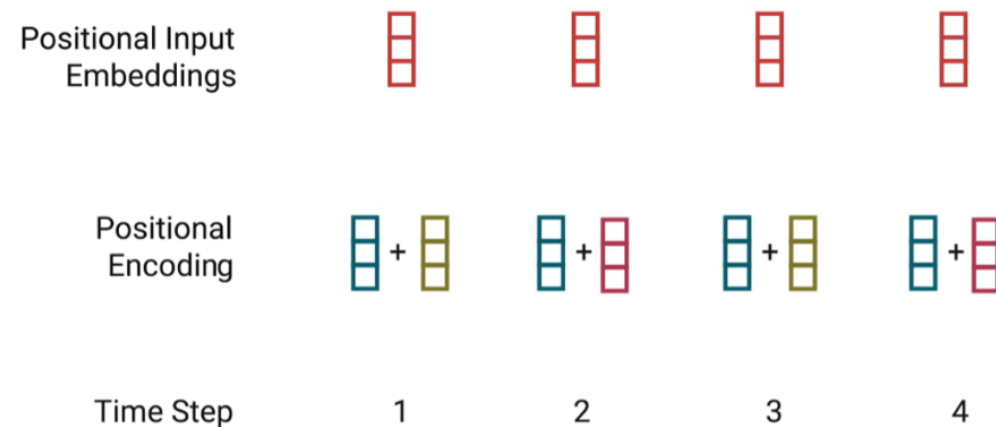
Input
Embedding

Hi how are you

Transformer's base function (dive-in)



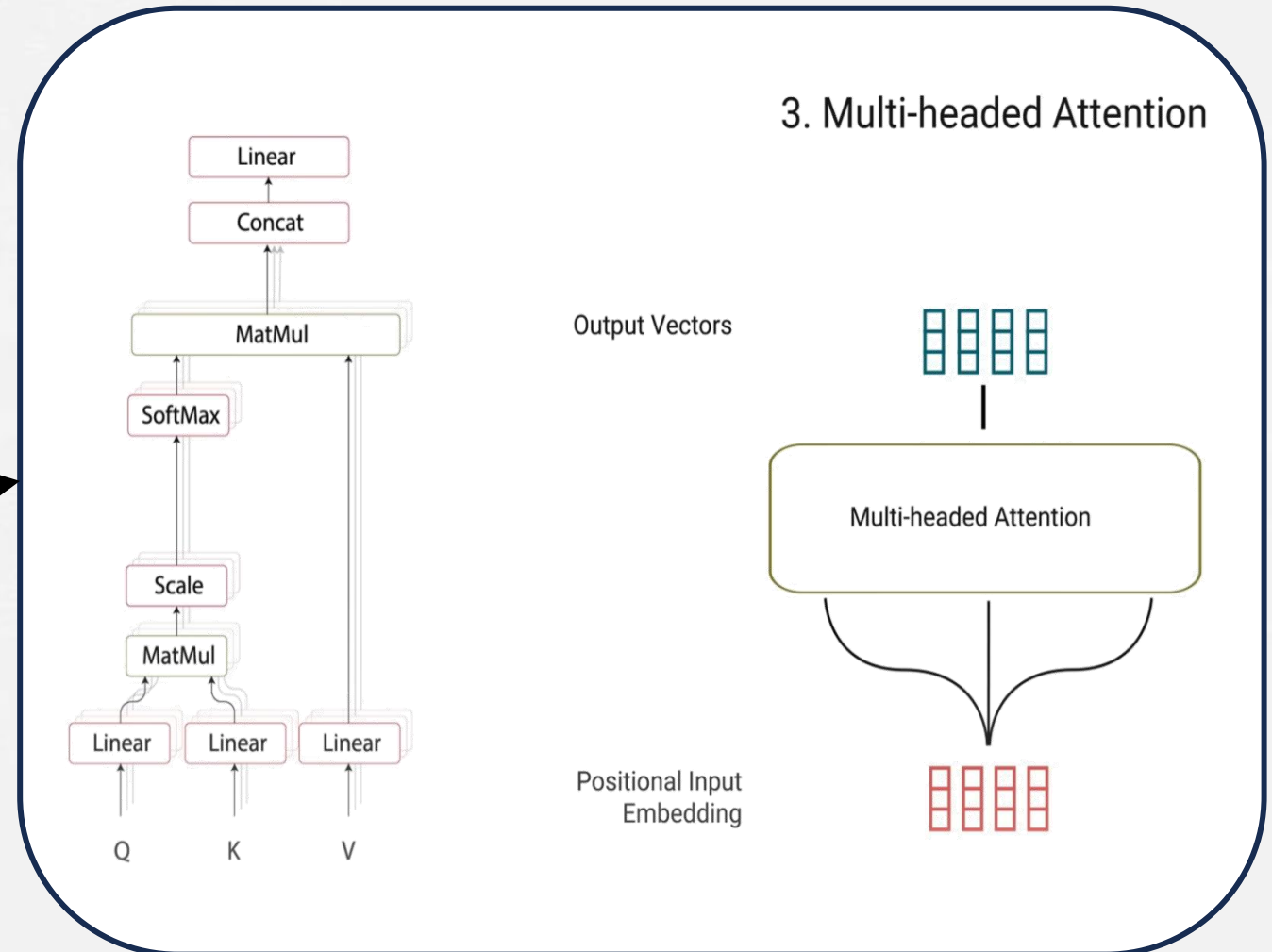
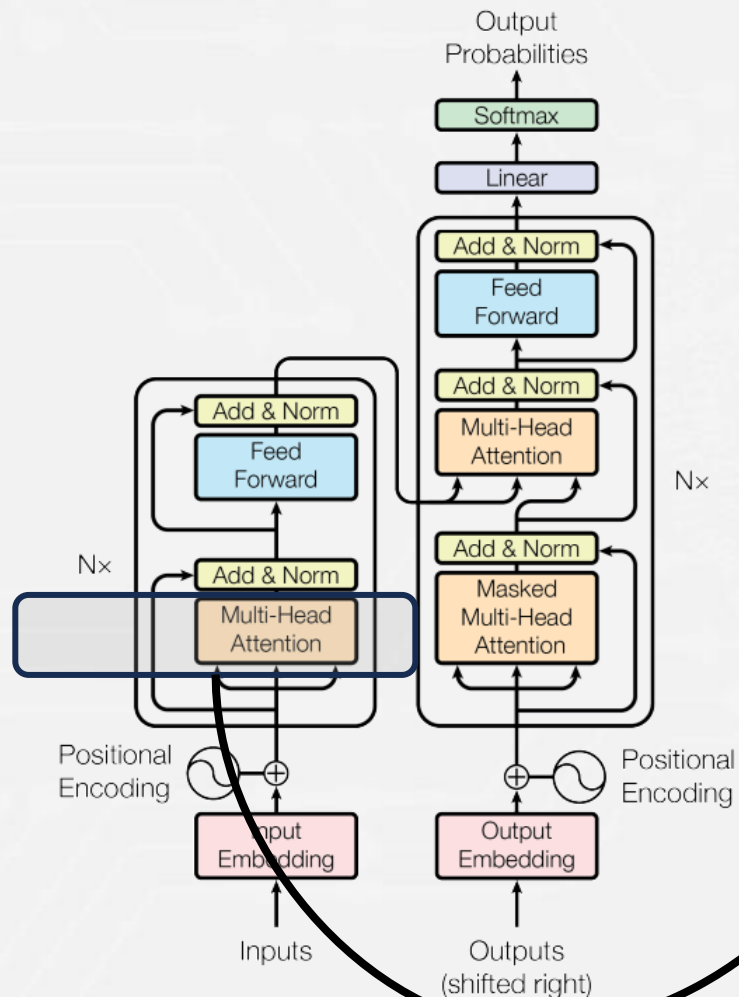
2. Positional Encoding



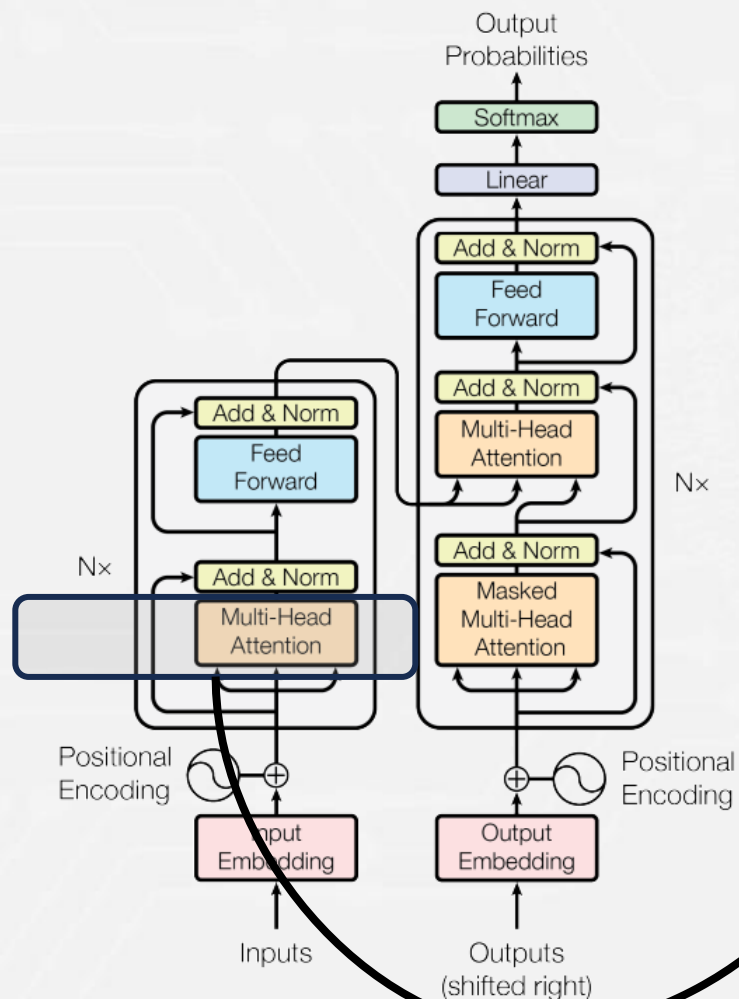
$$PE(pos, 2i + 1) = \cos\left(\frac{pos}{10000^{2i/d_{model}}}\right)$$

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

Transformer's base function (dive-in)

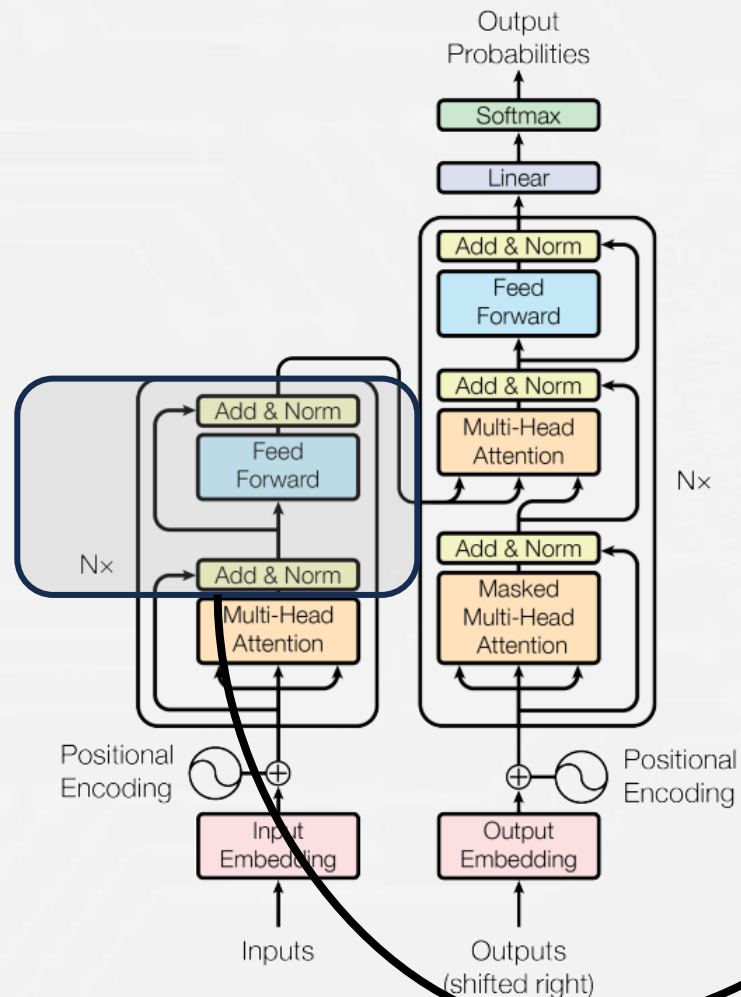


Transformer's base function (dive-in)



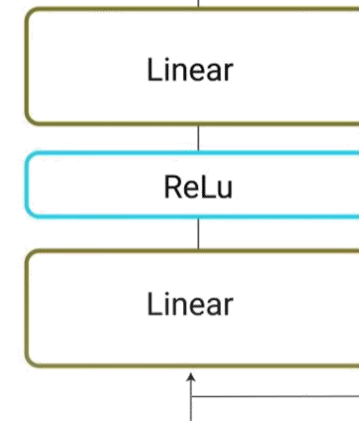
	Hi	how	are	you
Hi	98	27	10	12
how	27	89	31	67
are	10	31	91	54
you	12	67	54	92

Transformer's base function (dive-in)



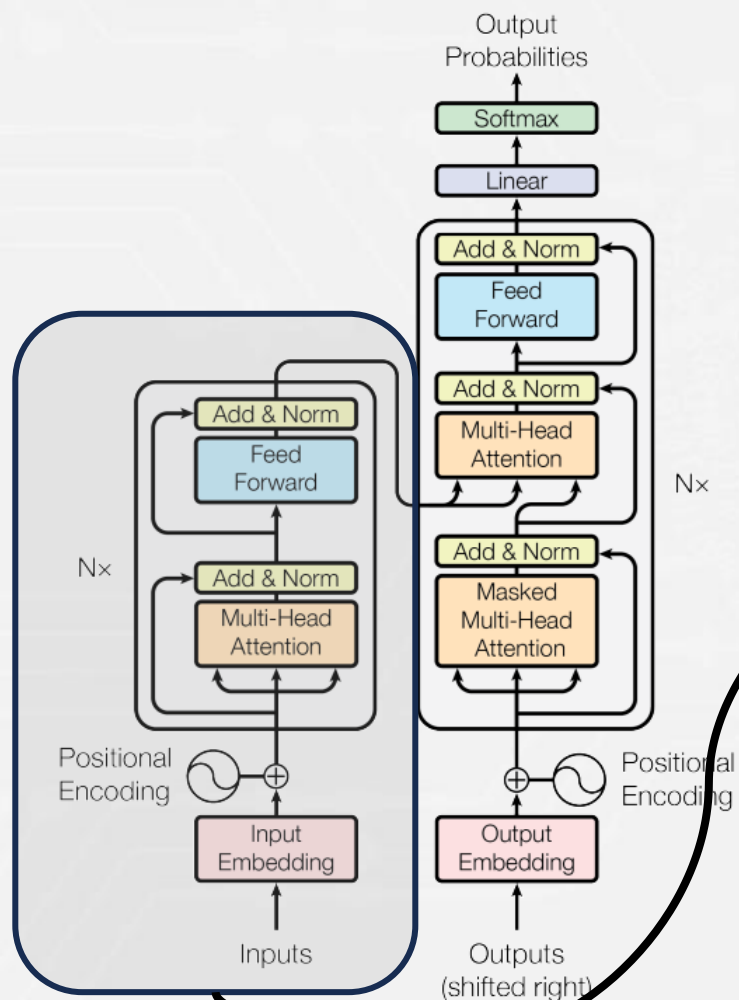
4. Residual Connection, Layer Normalization & Pointwise Feed Forward

LayerNorm( + )



LayerNorm( + )

Transformer's base function (dive-in)

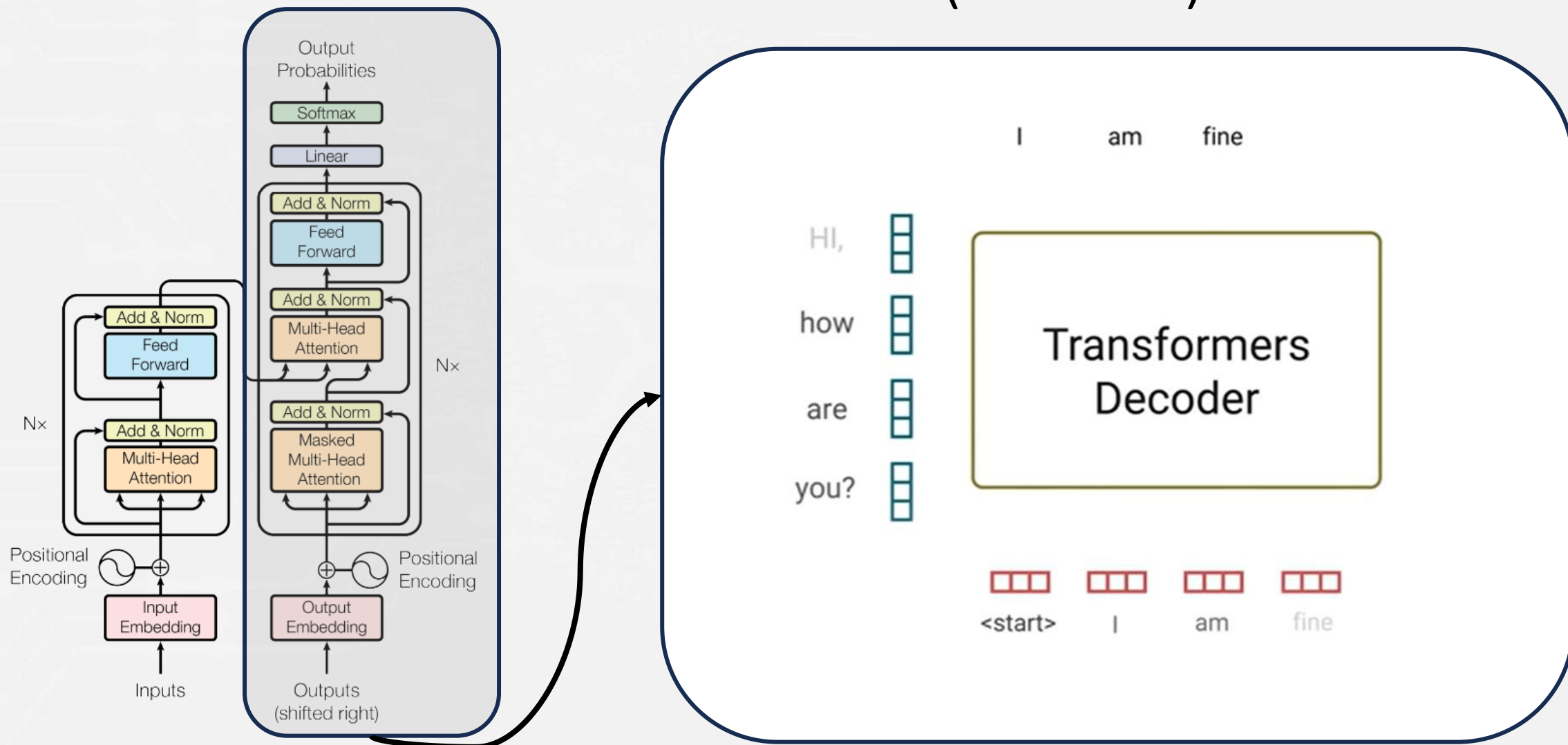


Hi how are you



"hi"	→	[0.2, 0.4, 0.6]
"how"	→	[0.5, 0.3, 0.1]
"are"	→	[0.8, 0.5, 0.3]
"you"	→	[0.2, 0.7, 0.9]

Transformer's base function (dive-in)



Generating text with more context

“I am loving the Madeira International Workshop in Machine Learning, and I will enjoy the next weekend seeing the landscapes because the island is full of flowers in the spring”

Types of LLM

Base LLM

Predicts next word, based on
text training data

Once upon a time, there was a unicorn
that lived in a magical forest with
all her unicorn friends

What is the capital of France?
What is France's largest city?
What is France's population?
What is the currency of France?

Instruction Tuned LLM

Tries to follow instructions

Fine-tune on instructions and
good attempts at following those instructions.

RLHF: Reinforcement Learning with
Human Feedback

Helpful, Honest, Harmless

What is the capital of France?
The capital of France is Paris.

Big known models

- GPT (Generative Pre-trained Transformer)
 - Available as a chatbot – CHATGPT
- BERT (Bidirectional Encoder Representations from Transformers)
 - Available as a chatbot – BARD
- LLaMA (Large Language Model Meta AI)

How to interact with LLMs?

We interact in the form of prompts

A prompt contains any of the following elements:

- Instruction—A specific task or instruction you want the model to perform
- Context—External information or additional context that can steer the model to better responses
- Input Data—The input or question that we are interested to find a response for
- Output Indicator—The type or format of the output.

How to interact with LLMs?

Example

Instruction: Craft a concise invitation for an event.

Context: The event is centered around AI and is likely to attract tech professionals, researchers, and enthusiasts.

Input Data: Event Name: AI Summit; Date: 13-09-2023; Time: 14pm; Venue: Museu da Imprensa da Madeira.

Output Indicator: Invitation format.

Prompt: "Craft a concise invitation for the AI Summit on 13-09-2023 at 2pm at the Museu da Imprensa da Madeira, keeping in mind that the audience will be tech professionals, researchers, and enthusiasts, and the format should be in a standard invitation style."

Tactics to improve prompts

1. Use delimiters to clearly indicate distinct parts of the input
2. Ask for a structured output
3. Request the model to provide responses under specific conditions
4. Context Q/A prompting
5. Chain of thought prompting
6. Give it a persona. The "Act as..."
7. Few-shot prompting

Open ChatGPT

chat.openai.com

Tactics to improve prompts

1- Use delimiters to clearly indicate distinct parts of the input

Delimiters can be anything like: “, ”, < >, , : ‘

Example task:

Complete the next pair of letters in the sequence ABCD

Prompt example without PE:

Complete next step of the sequence: A B C D

Prompt example with PE:

Complete next step of the sequence: “A B” “C D”

Tactics to improve prompts

2- Ask for a structured output

Table, CSV, HTML, JSON, or simple organized sentences

Example task:

Presenting the top cars in the world, followed by their price

Prompt example without PE:

Show the most populous countries in the world and their respective population figures for the year 2015

Prompt example with PE:

Create a table displaying the most populous countries in the world and their respective population figures for the year 2015.

Tactics to improve prompts

3- Request the model to provide responses under specific conditions

“Based only in specific information”

Prompt example with PE:

Write a paragraph about Artificial Intelligence. Limit your response to the information provided in the following text:

“Prompt Engineering is a branch of computer science that focuses on creating software applications to assist in the development of prompt systems. Prompt systems are used to automate the creation of prompts, which are messages or notifications that are sent to users in various contexts.

Prompt Engineering has become increasingly important in recent years, as prompt systems have become more prevalent in various industries. Prompt systems are used in healthcare, education, finance, and many other sectors to provide timely and relevant information to users.

Prompt engineering is not just about designing and developing prompts. It encompasses a wide range of skills and techniques that are useful for interacting and developing with LLMs. It’s an important skill to interface, build with, and understand capabilities of LLMs.”

Tactics to improve prompts

4- Context prompting

“Recognizing classes, patterns, limits, etc.. from personal data”

Example task:

Check if an air pollutant value is inside the secure limits

Prompt example without PE:

is 03 = 100ppb inside limits?

Tactics to improve prompts

4- Context prompting

“Recognizing classes, patterns, limits, etc.. from personal data”

Prompt example with PE:

Using the provided data, whenever I present a pollutant and its value, respond if it is out of limit or in limit. Determine the response by comparing the value to the maximum allowable limit for that specific pollutant: if the value exceeds the limit, indicate "OUT OF LIMIT"; if it's below, indicate "IN LIMIT".

[

Particulate Matter (PM10): 50 $\mu\text{g}/\text{m}^3$

Ground-Level Ozone (O3): 70-85 ppb

Nitrogen Dioxide (NO2): 40-200 $\mu\text{g}/\text{m}^3$

Sulfur Dioxide (SO2): 50-350 $\mu\text{g}/\text{m}^3$

Carbon Monoxide (CO): 9-35 ppm

Lead (Pb): 0.15 $\mu\text{g}/\text{m}^3$

Benzene: 1-5 $\mu\text{g}/\text{m}^3$

Formaldehyde: 100 $\mu\text{g}/\text{m}^3$

Ammonia (NH3): 10-200 $\mu\text{g}/\text{m}^3$

]

Tactics to improve prompts

4- Context prompting

“Recognizing classes, patterns, limits, etc.. from personal data”

Prompt example with PE:

O3 = 100ppb

-- EXERCISE --

Try to use “Structured output tactic” so the response is only “INSIDE LIMIT” or “OUTSIDE LIMIT” without any more unnecessary words.

Tactics to improve prompts

4- Context prompting

“Recognizing classes, patterns, limits, etc.. from personal data”

Prompt example with PE:

Using the provided data, whenever I present a pollutant and its value, respond if it is out of limit or in limit. Determine the response by comparing the value to the maximum allowable limit for that specific pollutant: if the value exceeds the limit, indicate "OUT OF LIMIT"; if it's below, indicate "IN LIMIT".

[

Particulate Matter (PM10): 50 $\mu\text{g}/\text{m}^3$

Ground-Level Ozone (O3): 70-85 ppb

Nitrogen Dioxide (NO2): 40-200 $\mu\text{g}/\text{m}^3$

Sulfur Dioxide (SO2): 50-350 $\mu\text{g}/\text{m}^3$

Carbon Monoxide (CO): 9-35 ppm

Lead (Pb): 0.15 $\mu\text{g}/\text{m}^3$

Benzene: 1-5 $\mu\text{g}/\text{m}^3$

Formaldehyde: 100 $\mu\text{g}/\text{m}^3$

Ammonia (NH3): 10-200 $\mu\text{g}/\text{m}^3$

]

The output format is "INSIDE LIMIT" or "OUTSIDE LIMIT" without any more tokens.

Tactics to improve prompts

5- Chain & Tree of thoughts prompting

“Improves reasoning, so LLMs can solve more complex tasks”

Example task:

I want to know how much cookies I have left.

Prompt example without PE:

I brought 3 cookies to the MML23. I ate one after eating a cookie for lunch. How many cookies I have left?

Prompt example with PE:

Identify all the instances where a cookie was eaten. Count those instances. Subtract the counted instances from the initial quantity. Write only the result without any other token.

I brought 3 cookies to the MML23. I ate one cookie after eating a cookie for lunch. How many cookies I have?

Tactics to improve prompts

6- Give it a persona. The "Act as..."

“introduce a specific profession or expert in a particular field”

Prompt example with PE:

Act as an expert researcher in the field of biology. You also have expert level knowledge about Machine Learning. Starting now, every sentence I introduce to you, you will rewrite, using specific language of the biology field, like specific names or terms.

“ML is great to look for patterns inside dna and the stuff inside the dna and then correlate that with connected diseases”

Tactics to improve prompts

7- “Few-Shot” prompting

“Learn to respond in specific way, based on minimum input”

Example task:

I want to analyze if the water temperature is to cold, good or too hot.

Prompt example without PE:

The water is 5 degrees. is it good?

Prompt example with PE:

Water at 20 degrees is good, more than 25 is to hot and less than 18 is cold. Respond to any question directly without adding tokens.

The water is 5 degrees. is it good?

Final exercise

- <https://www.actuaries.digital/2018/09/05/history-of-ai-winters/>



Date	Event
1950	Alan Turing poses the question "Can machines think?" and introduces the Turing Test.
1956	The Dartmouth Conference officially establishes the field of AI research and the term "artificial intelligence" is coined.
1958	Frank Rosenblatt creates the perceptron learning algorithm, a basic neural network.
1974-1980	The first AI winter - a period of reduced funding and interest in AI research.
1987-1993	The second AI winter - another period of decreased funding and enthusiasm for AI.
Late 1980s	The collapse of the market for specialized AI hardware.
Current Day	Ongoing advancements in AI and discussions about the potential for a technological singularity.

Code interpreter / Advanced data analysis

Let's see how far can prompt engineering take us.

Let's assume I'm an Environmental Engineer and I need to perform an analysis of the water quality of the south part of London.

Data source:

<https://environment.data.gov.uk/water-quality/view/download>

Code interpreter / Advanced data analysis

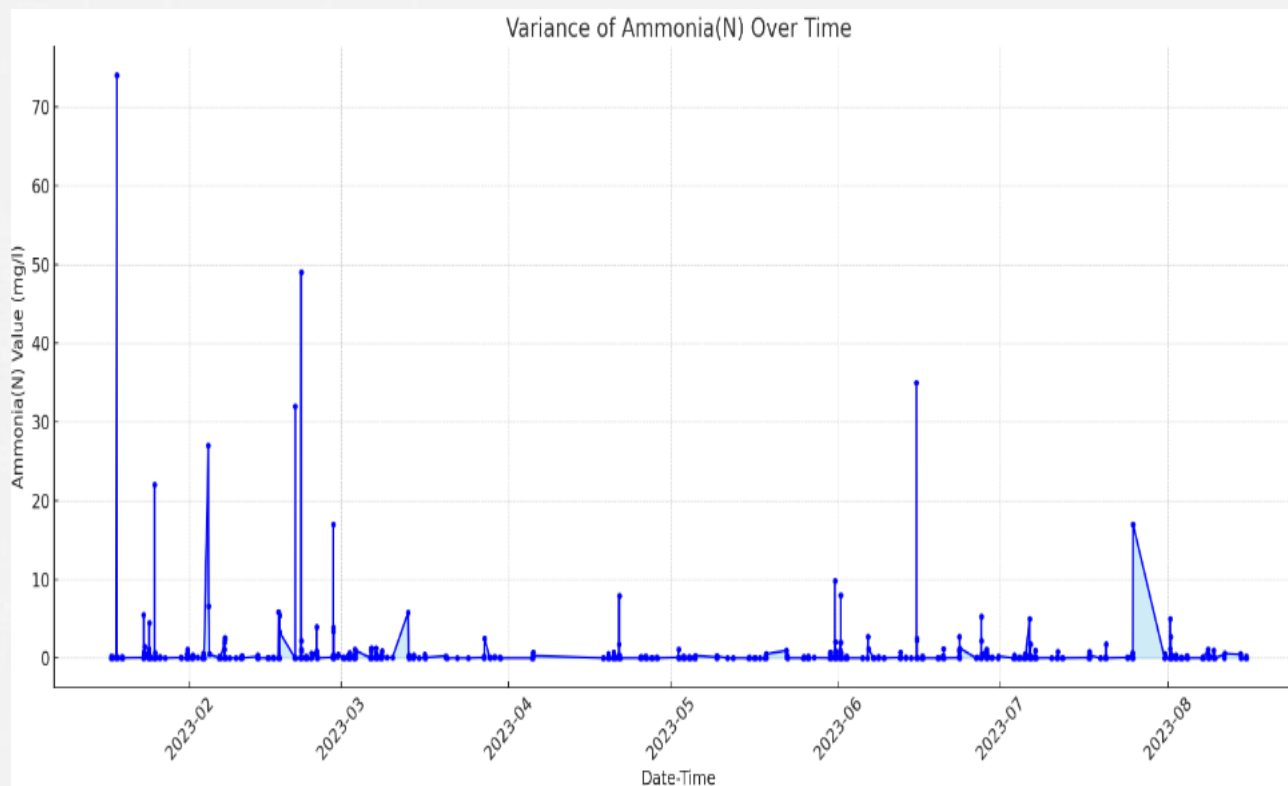
```
KSL-2023-M.csv
File Edit View

@id,sample,samplingPoint,sample,samplingPoint,notation,sample,samplingPoint,label,sample,sampleDateTim
e,determinand,label,determinand.definition,determinand,notation,resultQualifier,notation,result,codedR
esultInterpretation,interpretation,determinand.unit,label,sample,sampledMaterialType,label,sample.isCo
mplianceSample,sample.purpose,label,sample,samplingPoint,easting,sample,samplingPoint,northing
http://environment.data.gov.uk/water-
quality/data/measurement/SO-1601770-0111,http://environment.data.gov.uk/water-quality/id/sampling-
point/SO-5GWQ0401,SO-5GWQ0401,"PT.X FAVERSHAM, LEWSON
STREET",2023-07-19T08:48:00,Ammonia(N),Ammoniacal Nitrogen as
N,0111,<,0.03,"",mg/l,GROUNDWATER,false,ENVIRONMENTAL MONITORING STATUTORY (EU
DIRECTIVES),597540,161226
http://environment.data.gov.uk/water-
quality/data/measurement/SO-1601770-3169,http://environment.data.gov.uk/water-quality/id/sampling-
point/SO-5GWQ0401,SO-5GWQ0401,"PT.X FAVERSHAM, LEWSON STREET",2023-07-19T08:48:00,pH in-situ,pH : In
Situ,3169,"",7.1,"",phunits,GROUNDWATER,false,ENVIRONMENTAL MONITORING STATUTORY (EU
DIRECTIVES),597540,161226
http://environment.data.gov.uk/water-
quality/data/measurement/SO-1601770-9901,http://environment.data.gov.uk/water-quality/id/sampling-
point/SO-5GWQ0401,SO-5GWQ0401,"PT.X FAVERSHAM, LEWSON STREET",2023-07-19T08:48:00,O Diss %sat,"Oxygen,
Dissolved, % Saturation",9901,"",76,"",%,GROUNDWATER,false,ENVIRONMENTAL MONITORING STATUTORY (EU
DIRECTIVES),597540,161226
http://environment.data.gov.uk/water-
quality/data/measurement/SO-1601770-7299,http://environment.data.gov.uk/water-quality/id/sampling-
point/SO-5GWQ0401,SO-5GWQ0401,"PT.X FAVERSHAM, LEWSON STREET",2023-07-19T08:48:00,LCMS,LCMS Screen :
Semi Quantitative,7299,"",1,"",text,GROUNDWATER,false,ENVIRONMENTAL MONITORING STATUTORY (EU
DIRECTIVES),597540,161226
http://environment.data.gov.uk/water-
quality/data/measurement/SO-1601770-0180,http://environment.data.gov.uk/water-quality/id/sampling-
point/SO-5GWQ0401,SO-5GWQ0401,"PT.X FAVERSHAM, LEWSON
STREET",2023-07-19T08:48:00,Orthophosphat,"Orthophosphate, reactive as
P",0180,<,0.01,"",mg/l,GROUNDWATER,false,ENVIRONMENTAL MONITORING STATUTORY (EU
DIRECTIVES),597540,161226
http://environment.data.gov.uk/water-
quality/data/measurement/SO-1601770-0162,http://environment.data.gov.uk/water-quality/id/sampling-
point/SO-5GWQ0401,SO-5GWQ0401,"PT.X FAVERSHAM, LEWSON STREET",2023-07-19T08:48:00,Alky pH
4.5,Alkalinity to pH 4.5 as CaCO3,0162,"",300,"",mg/l,GROUNDWATER,false,ENVIRONMENTAL MONITORING
STATUTORY (EU DIRECTIVES),597540,161226
http://environment.data.gov.uk/water-
quality/data/measurement/SO-1601770-0116,http://environment.data.gov.uk/water-quality/id/sampling-
point/SO-5GWQ0401,SO-5GWQ0401,"PT.X FAVERSHAM, LEWSON STREET",2023-07-19T08:48:00,N
Oxidised,"Nitrogen, Total Oxidised as N",0116,"",9.9,"",mg/l,GROUNDWATER,false,ENVIRONMENTAL
MONITORING STATUTORY (EU DIRECTIVES),597540,161226
http://environment.data.gov.uk/water-
quality/data/measurement/SO-1601770-0172,http://environment.data.gov.uk/water-quality/id/sampling-
point/SO-5GWQ0401,SO-5GWQ0401,"PT.X FAVERSHAM, LEWSON STREET",2023-07-19T08:48:00,Chloride
Ion,Chloride,0172,"",42,"",mg/l,GROUNDWATER,false,ENVIRONMENTAL MONITORING STATUTORY (EU
DIRECTIVES),597540,161226
http://environment.data.gov.uk/water-
quality/data/measurement/SO-1601770-0117,http://environment.data.gov.uk/water-quality/id/sampling-
point/SO-5GWQ0401,SO-5GWQ0401,"PT.X FAVERSHAM, LEWSON STREET",2023-07-19T08:48:00,Nitrate-N,Nitrate as
N,0117,"",9.9,"",mg/l,GROUNDWATER,false,ENVIRONMENTAL MONITORING STATUTORY (EU
DIRECTIVES),597540,161226
http://environment.data.gov.uk/water-
quality/data/measurement/SO-1601770-9924,http://environment.data.gov.uk/water-quality/id/sampling-
point/SO-5GWQ0401,SO-5GWQ0401,"PT.X FAVERSHAM, LEWSON STREET",2023-07-19T08:48:00,Oxygen Diss "Oxygen
```

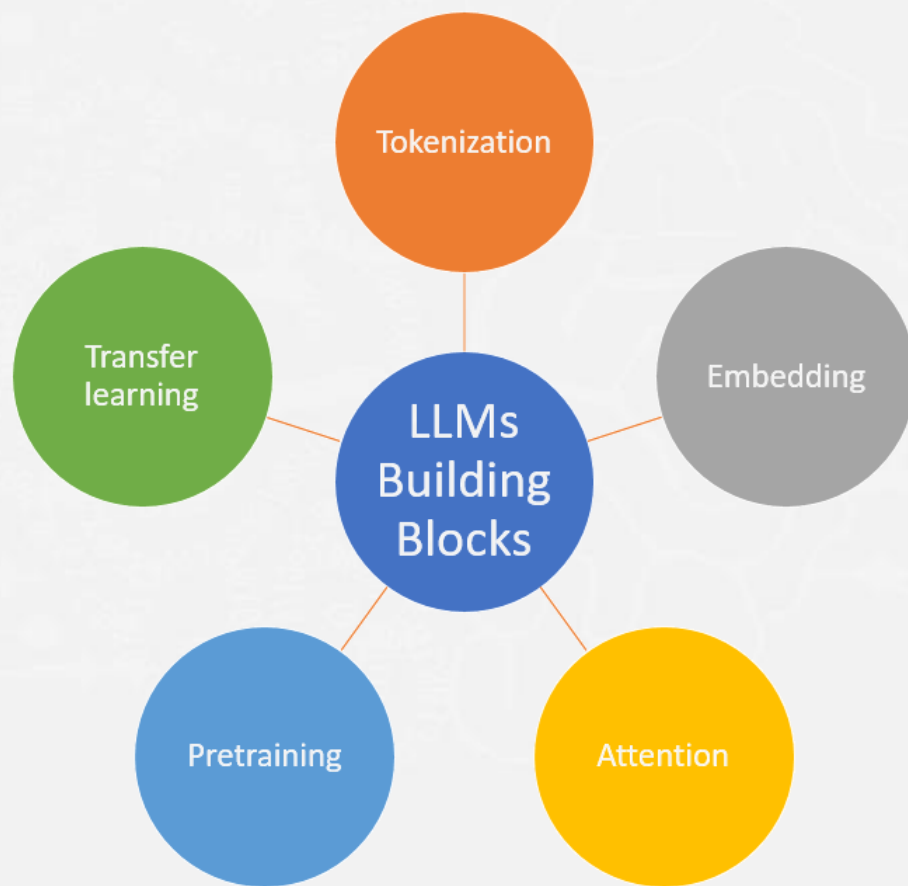
Code interpreter / Advanced data analysis

```
KSL-2023-M.csv
File Edit View

@id,sample,samplingPoint,sample,samplingPoint,notation,sample,samplingPoint,label,sample,sampleDateTim
e,determinand,label,determinand.definition,determinand,notation,resultQualifier,notation,result,codedR
esultInterpretation.interpretation,determinand.unit,label,sample,sampledMaterialType,label,sample.isc
omplianceSample,sample.purpose,label,sample,samplingPoint.easting,sample,samplingPoint.northing
http://environment.data.gov.uk/water-
quality/data/measurement/SO-1601770-0111,http://environment.data.gov.uk/water-quality/id/sampling-
point/SO-5GWQ0401,SO-5GWQ0401,"PT.X FAVERSHAM, LEWSON
STREET",2023-07-19T08:48:00,Ammonia(N),Ammoniacal Nitrogen as
N,0111,<,0.03,"",mg/l,GROUNDWATER,false,ENVIRONMENTAL MONITORING STATUTORY (EU
DIRECTIVES),597540,161226
http://environment.data.gov.uk/water-
quality/data/measurement/SO-1601770-3169,http://environment.data.gov.uk/water-quality/id/sampling-
point/SO-5GWQ0401,SO-5GWQ0401,"PT.X FAVERSHAM, LEWSON STREET",2023-07-19T08:48:00,pH in-situ,pH : In
Situ,3169,"",7.1,"",phunits,GROUNDWATER,false,ENVIRONMENTAL MONITORING STATUTORY (EU
DIRECTIVES),597540,161226
http://environment.data.gov.uk/water-
quality/data/measurement/SO-1601770-9901,http://environment.data.gov.uk/water-quality/id/sampling-
point/SO-5GWQ0401,SO-5GWQ0401,"PT.X FAVERSHAM, LEWSON STREET",2023-07-19T08:48:00,O Diss %sat,"Oxygen,
Dissolved, % Saturation",9901,"",76,"",%,GROUNDWATER,false,ENVIRONMENTAL MONITORING STATUTORY (EU
DIRECTIVES),597540,161226
http://environment.data.gov.uk/water-
quality/data/measurement/SO-1601770-7299,http://environment.data.gov.uk/water-quality/id/sampling-
point/SO-5GWQ0401,SO-5GWQ0401,"PT.X FAVERSHAM, LEWSON STREET",2023-07-19T08:48:00,LCMS,LCMS Screen :
Semi Quantitative,7299,"",1,"",text,GROUNDWATER,false,ENVIRONMENTAL MONITORING STATUTORY (EU
DIRECTIVES),597540,161226
http://environment.data.gov.uk/water-
quality/data/measurement/SO-1601770-0180,http://environment.data.gov.uk/water-quality/id/sampling-
point/SO-5GWQ0401,SO-5GWQ0401,"PT.X FAVERSHAM, LEWSON
STREET",2023-07-19T08:48:00,Orthophosphat,"Orthophosphate, reactive as
P",0180,<,0.01,"",mg/l,GROUNDWATER,false,ENVIRONMENTAL MONITORING STATUTORY (EU
DIRECTIVES),597540,161226
http://environment.data.gov.uk/water-
quality/data/measurement/SO-1601770-0162,http://environment.data.gov.uk/water-quality/id/sampling-
point/SO-5GWQ0401,SO-5GWQ0401,"PT.X FAVERSHAM, LEWSON STREET",2023-07-19T08:48:00,Alky pH
4.5,Alkalinity to pH 4.5 as CaCO3,0162,"",300,"",mg/l,GROUNDWATER,false,ENVIRONMENTAL MONITORING
STATUTORY (EU DIRECTIVES),597540,161226
http://environment.data.gov.uk/water-
quality/data/measurement/SO-1601770-0116,http://environment.data.gov.uk/water-quality/id/sampling-
point/SO-5GWQ0401,SO-5GWQ0401,"PT.X FAVERSHAM, LEWSON STREET",2023-07-19T08:48:00,N
Oxidised,"Nitrogen, Total Oxidised as N",0116,"",9.9,"",mg/l,GROUNDWATER,false,ENVIRONMENTAL
MONITORING STATUTORY (EU DIRECTIVES),597540,161226
http://environment.data.gov.uk/water-
quality/data/measurement/SO-1601770-0172,http://environment.data.gov.uk/water-quality/id/sampling-
point/SO-5GWQ0401,SO-5GWQ0401,"PT.X FAVERSHAM, LEWSON STREET",2023-07-19T08:48:00,Chloride
Ion,Chloride,0172,"",42,"",mg/l,GROUNDWATER,false,ENVIRONMENTAL MONITORING STATUTORY (EU
DIRECTIVES),597540,161226
http://environment.data.gov.uk/water-
quality/data/measurement/SO-1601770-0117,http://environment.data.gov.uk/water-quality/id/sampling-
point/SO-5GWQ0401,SO-5GWQ0401,"PT.X FAVERSHAM, LEWSON STREET",2023-07-19T08:48:00,Nitrate-N,Nitrate as
N,0117,"",9.9,"",mg/l,GROUNDWATER,false,ENVIRONMENTAL MONITORING STATUTORY (EU
DIRECTIVES),597540,161226
http://environment.data.gov.uk/water-
quality/data/measurement/SO-1601770-9924,http://environment.data.gov.uk/water-quality/id/sampling-
point/SO-5GWQ0401,SO-5GWQ0401,"PT.X FAVERSHAM, LEWSON STREET",2023-07-19T08:48:00,Oxygen Diss %Oxygen
```



LLM Building Blocks

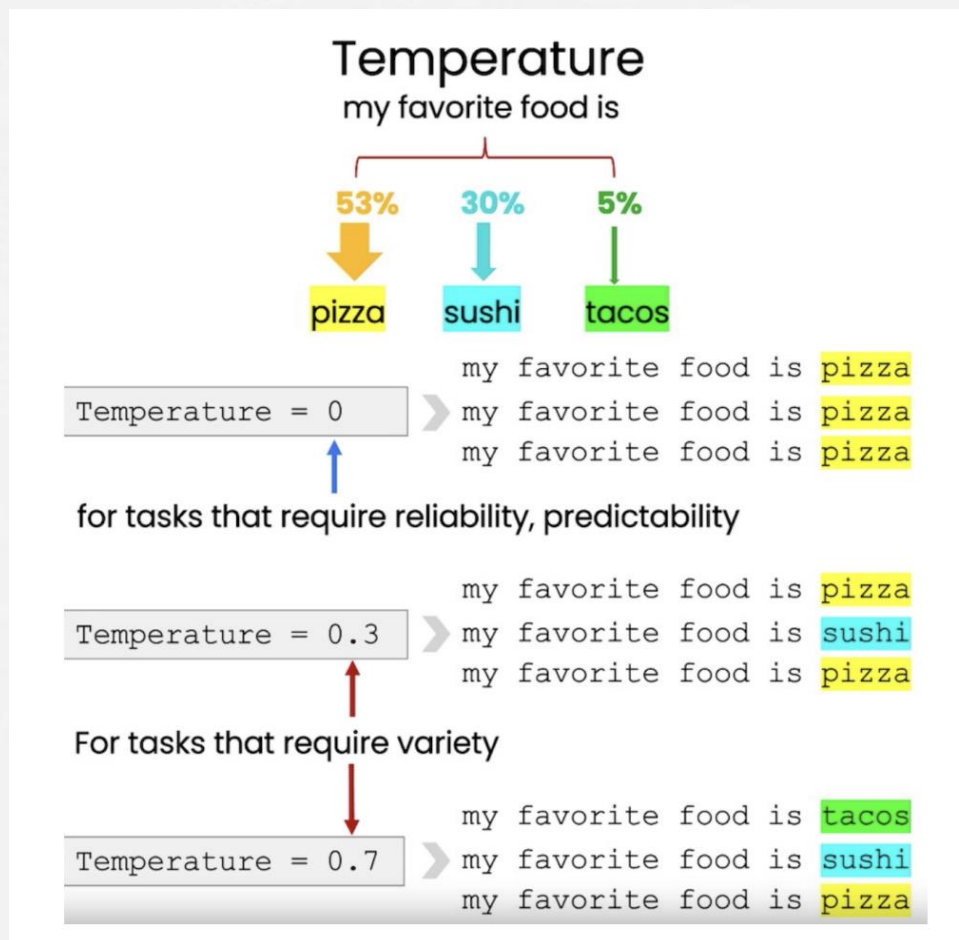


Hyperparameters

Temperature: Temperature is a configuration hyperparameter that controls the randomness of language model output. A high temperature produces more unpredictable and creative results, while a low temperature produces more common and conservative output.

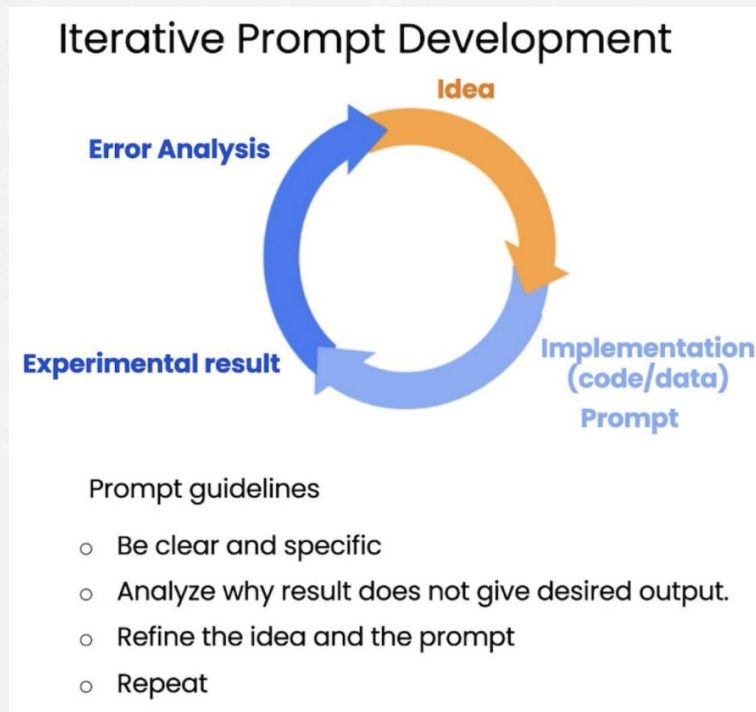
For example, if you adjust the temperature to 0.5, the model will usually generate text that is more predictable and less creative than if you set the temperature to 1.0.

Hyperparameters



Iterative prompt development

Iterative prompting is the process of repeatedly refining and adjusting prompts to optimize the performance and accuracy of responses from a language model.



Bibliography

- Fan, L., Li, L., Ma, Z., Lee, S., Yu, H., & Hemphill, L. (2023). A Bibliometric Review of Large Language Models Research from 2017 to 2023. DOI: doi.org/10.48550/arXiv.2304.02020
- Wei, Jason, et al. "Finetuned language models are zero-shot learners." arXiv preprint arXiv:2109.01652 (2021).
- Christiano, P. F., Leike, J., Brown, T., Martic, M., Legg, S., & Amodei, D. (2017). Deep reinforcement learning from human preferences. Advances in neural information processing systems, 30.
- Kaplan, J., McCandlish, S., Henighan, T., Brown, T. B., Chess, B., Child, R., ... & Amodei, D. (2020). Scaling laws for neural language models. arXiv preprint arXiv:2001.08361.
- Brown, T., Mann, B., Ryder, N., Subbiah, M., Kaplan, J. D., Dhariwal, P., ... & Amodei, D. (2020). Language models are few-shot learners. Advances in neural information processing systems, 33, 1877-1901.
- Min, S., Lyu, X., Holtzman, A., Artetxe, M., Lewis, M., Hajishirzi, H., & Zettlemoyer, L. (2022). Rethinking the role of demonstrations: What makes in-context learning work?. arXiv preprint arXiv:2202.12837.
- Wei, J., Wang, X., Schuurmans, D., Bosma, M., Xia, F., Chi, E., ... & Zhou, D. (2022). Chain-of-thought prompting elicits reasoning in large language models. Advances in Neural Information Processing Systems, 35, 24824-24837.
- Kojima, T., Gu, S. S., Reid, M., Matsuo, Y., & Iwasawa, Y. (2022). Large language models are zero-shot reasoners. Advances in neural information processing systems, 35, 22199-22213.
- Yao, S., Yu, D., Zhao, J., Shafran, I., Griffiths, T. L., Cao, Y., & Narasimhan, K. (2023). Tree of thoughts: Deliberate problem solving with large language models. arXiv preprint arXiv:2305.10601.
- Paranjape, B., Lundberg, S., Singh, S., Hajishirzi, H., Zettlemoyer, L., & Ribeiro, M. T. (2023). ART: Automatic multi-step reasoning and tool-use for large language models. arXiv preprint arXiv:2303.09014.