



How to train your Large Language Models (LLMs)

Rowel Atienza, PhD

University of the Philippines

github.com/roatienza

2023

Motivation

- ChatGPT has taken the world by storm
- ChatGPT is a preview to AGI (Artificial General Intelligence)
- ChatGPT demonstrates super-human performance in many tasks

How long it took Netflix to gain 1M users?

3.5 years

How long it took ChatGPT to gain 1M users?

5 days

The Inflection Point

Transformer:

Attention is All You Need

Vaswani, Ashish, et al. "Attention is all you need." *Advances in neural information processing systems*. 2017.

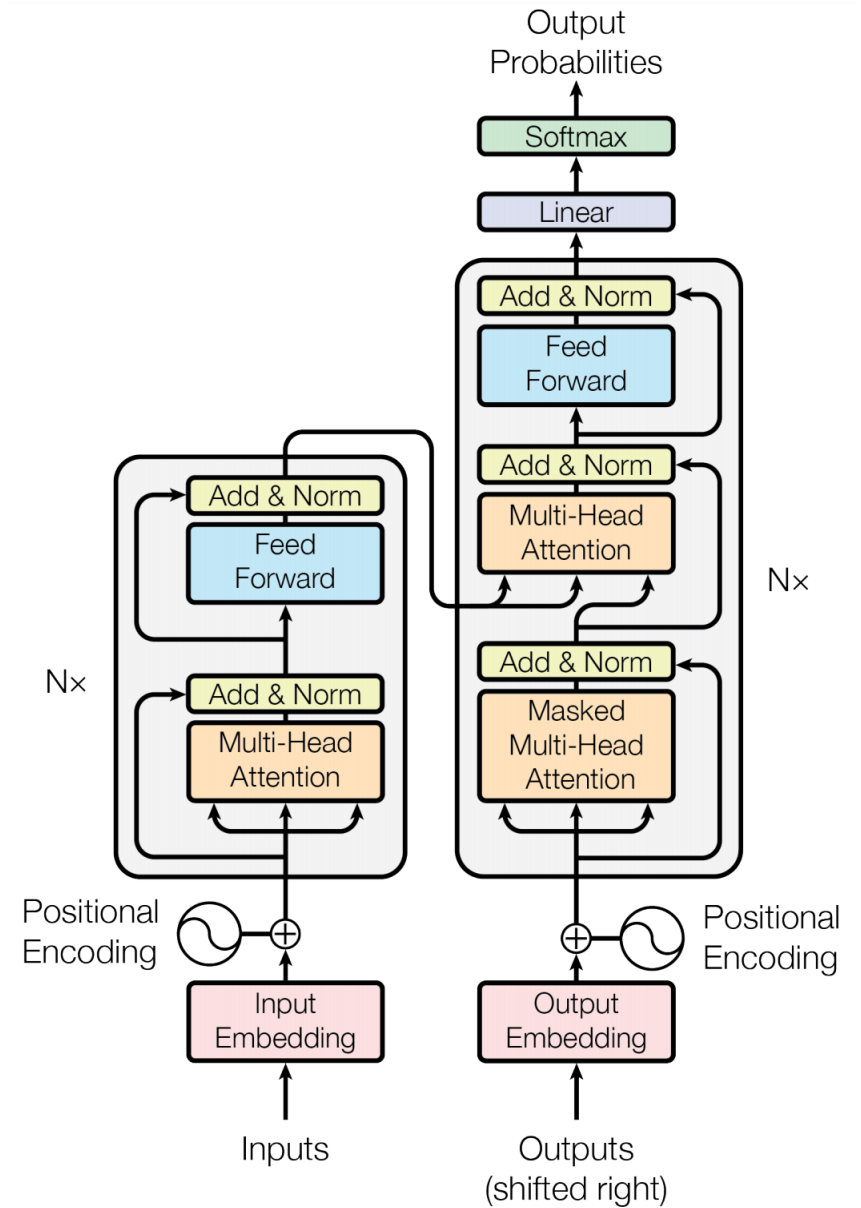


Figure 1: The Transformer - model architecture.

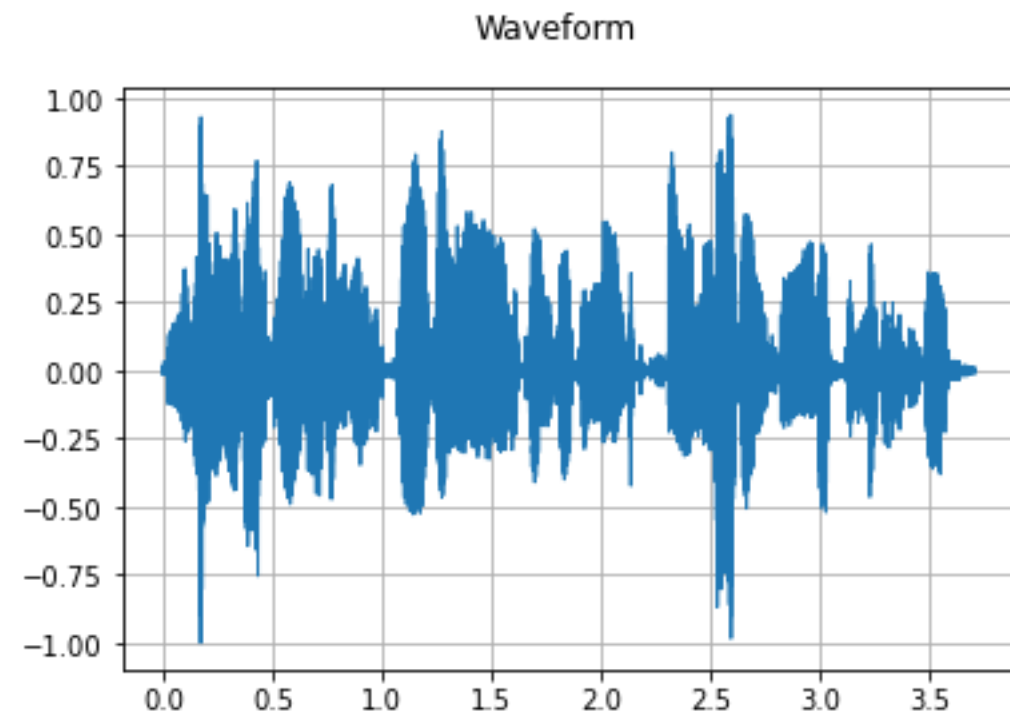
Types of data that transformers can process

Any



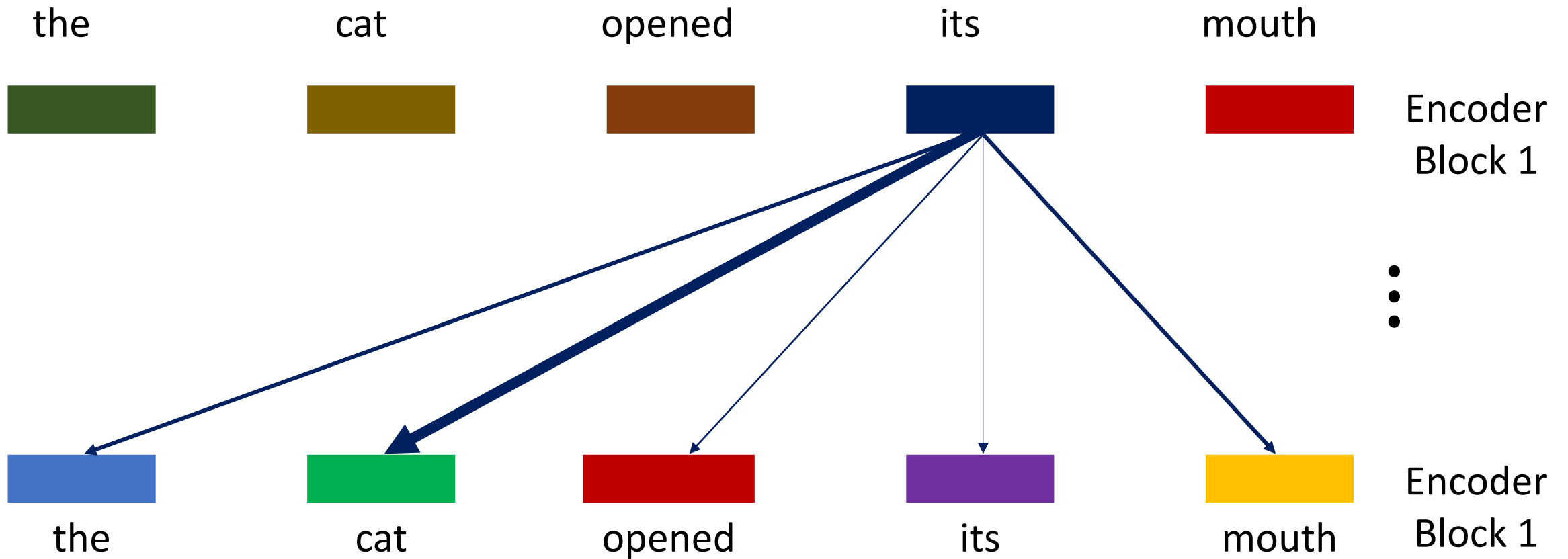
WIKIPEDIA
The Free Encyclopedia

COCO 2017 Keypoint Detection Task



Self-Attention

Attention between 2 words



Attention as measured by the width of the arrow

Evolution of Transformers in Language Models

Understanding Large Language Models by Raschka (2023)

<https://magazine.sebastianraschka.com/p/understanding-large-language-models>

*Original
configuration:*

Encoder-Decoder

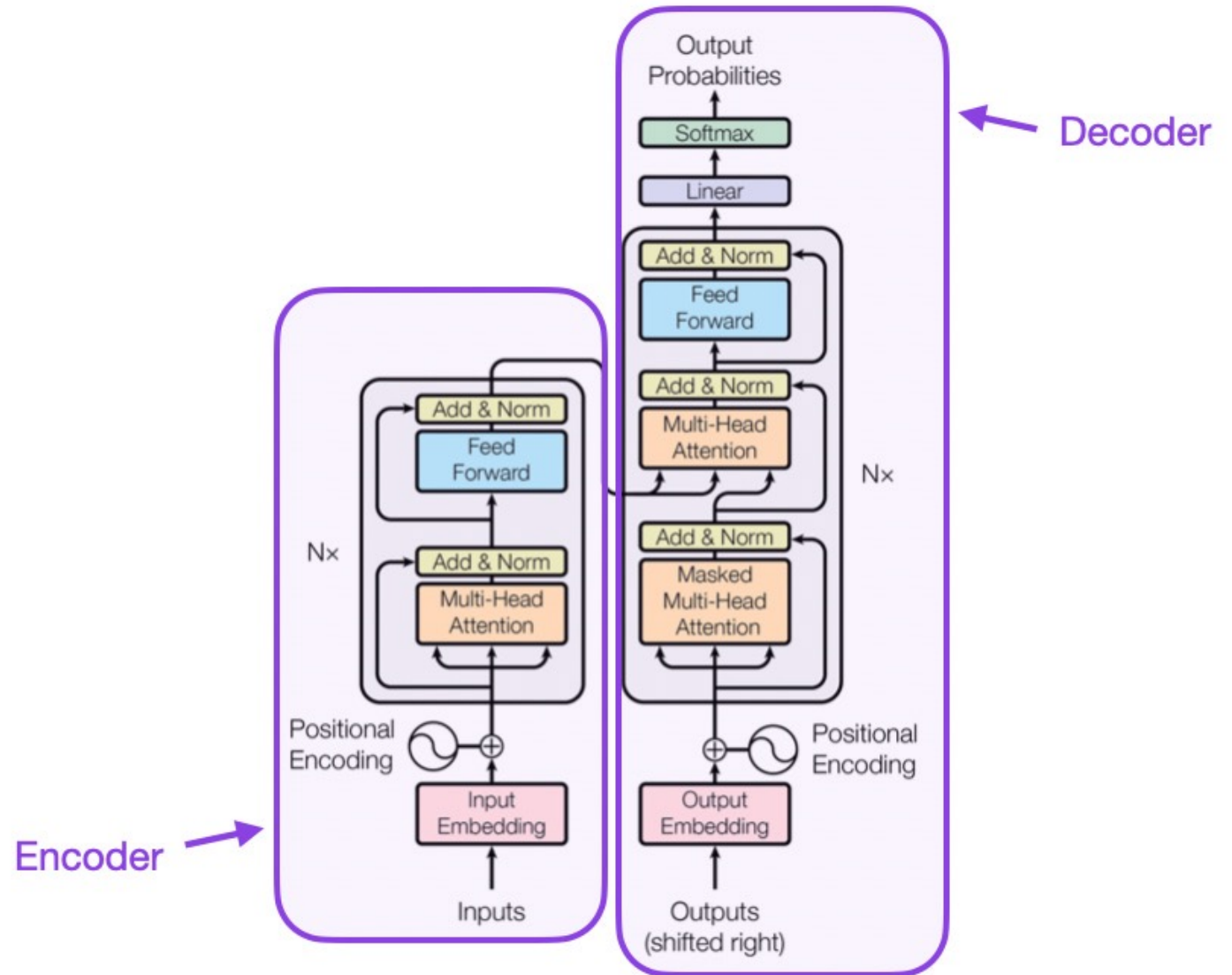
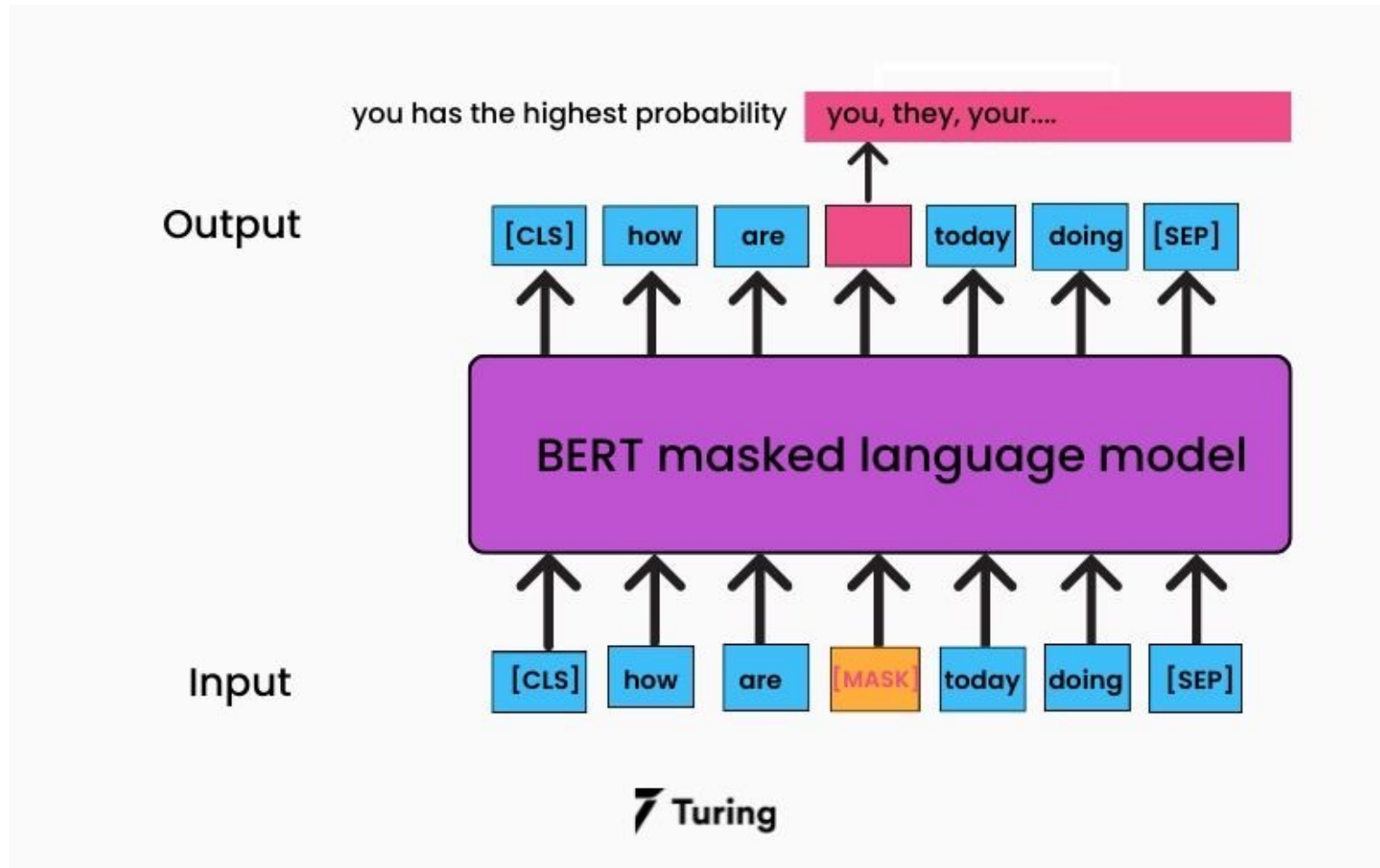


Figure 1: The Transformer - model architecture.

BERT (Bidirectional Encoder Representations from Transformers): Encoder only

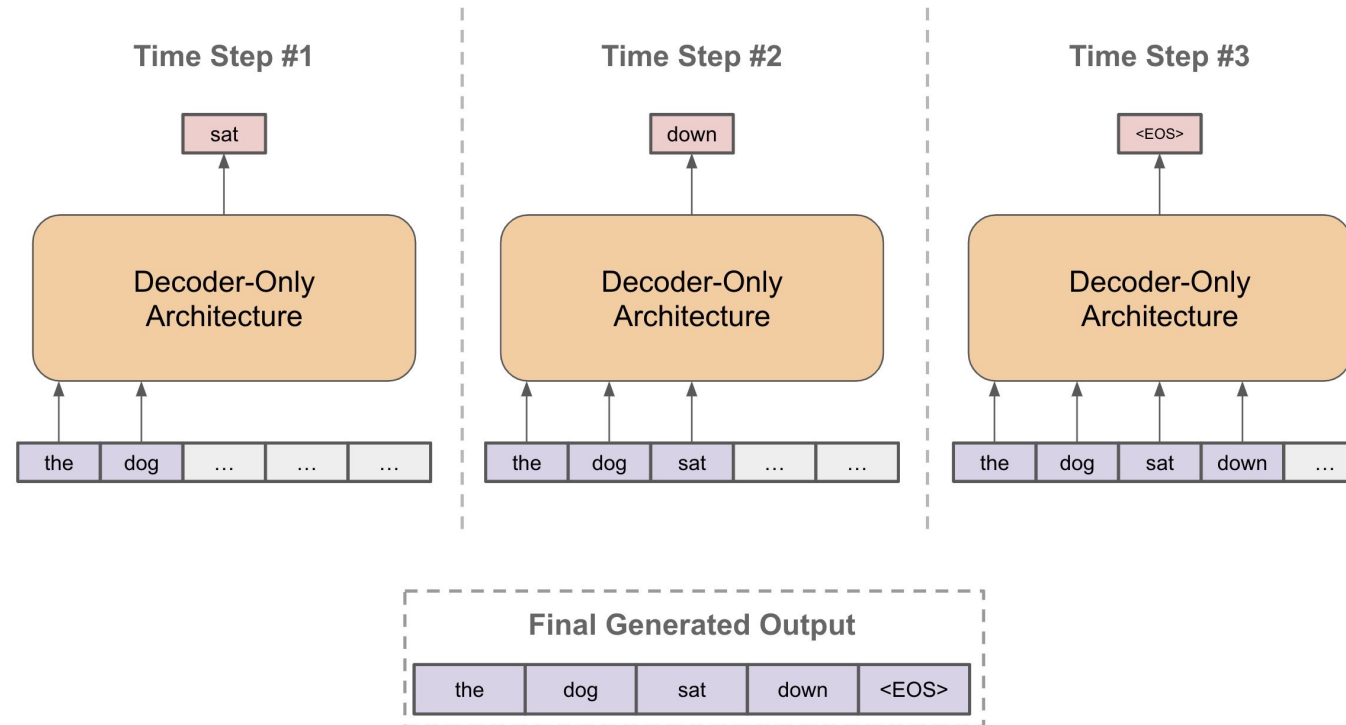
BERT: Pre-training of Deep Bidirectional Transformers for Language Understanding (2018) by Devlin et al



GPT (Generative Pre-Trained Transformers): Decoder only

Improving Language Understanding by Generative Pre-Training (2018) by Radford and Narasimhan

Generating Autoregressive Output



GPT2: Radford, Alec, et al. "Language models are unsupervised multitask learners." *OpenAI blog* 1.8 (2019): 9.

GPT3: Brown, Tom, et al. "Language models are few-shot learners." *Advances in neural information processing systems* 33 (2020): 1877-1901.

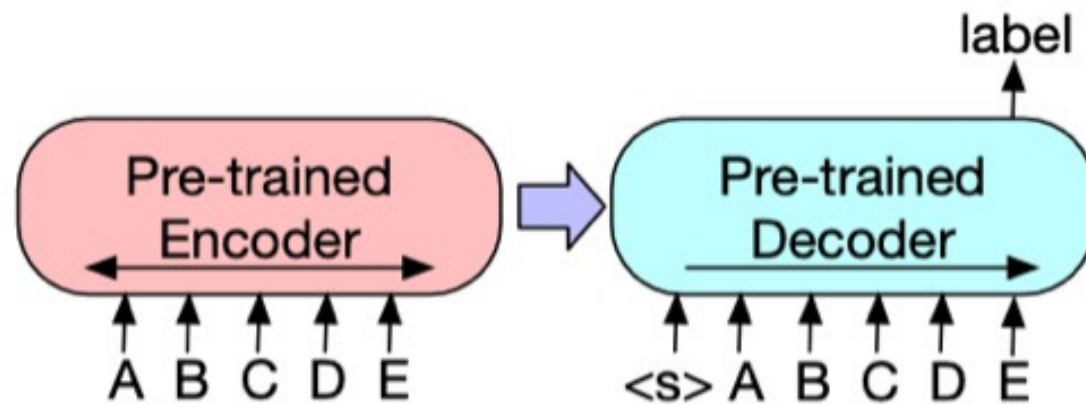
Design Patterns

- BERT-type encoder-style LLMs are usually preferred for predictive modeling tasks
- GPT-type decoder-style LLMs are better at generative tasks
- Why not combine to get the best of both worlds?

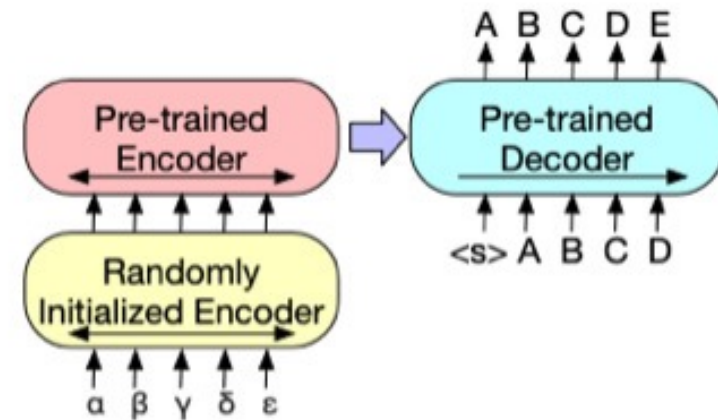
BART: Encoder-Decoder

Lewis, Mike, et al. "BART: Denoising sequence-to-sequence pre-training for natural language generation, translation, and comprehension." (2019).

BART combines encoder and decoder parts



(a) To use BART for classification problems, the same input is fed into the encoder and decoder, and the representation from the final output is used.



(b) For machine translation, we learn a small additional encoder that replaces the word embeddings in BART. The new encoder can use a disjoint vocabulary.

Large Language Models (LLMs)

BERT, GPTs, BART

What about ChatGPT?

InstructGPT:

Training Language Models to Follow Instructions with Human Feedback (2022) by Ouyang et al

Step 1

**Collect demonstration data,
and train a supervised policy.**

A prompt is
sampled from our
prompt dataset.

Explain the moon
landing to a 6 year old

A labeler
demonstrates the
desired output
behavior.

Some people went
to the moon...

This data is used
to fine-tune GPT-3
with supervised
learning.

SFT

Step 2

**Collect comparison data,
and train a reward model.**

A prompt and
several model
outputs are
sampled.

Explain the moon
landing to a 6 year old

A Explain gravity...
B Explain war...
C Moon is natural
satellite of...
D People went to
the moon...

A labeler ranks
the outputs from
best to worst.

D > C > A = B

This data is used
to train our
reward model.

RM

Step 3

**Optimize a policy against
the reward model using
reinforcement learning.**

Alignment

- LLMs must align its output with human intentions
- Train LLMs using human feedback
- Reinforcement Learning using Human Feedback (RLHF)

How to train your LLMs

<https://python.langchain.com/>

<https://magazine.sebastianraschka.com/p/finetuning-large-language-models>

2 ways

- In-context learning
- Fine-tuning
 - Adapter, LoRA

In-context learning

- Give a few examples via **prompt**
- Then, ask
- No changes on model weights needed

Translate the following into an invented Barok language using the following example:

Example 1:

English: "The quick brown"

Barok: "Da kwik brawn"

Example 2:

English: "Jumps over the"

Barok: "Dyamps ober da"

Example 3:

English: "Stop freaking out"

Barok: "Istap priking awt"

Example 4:

English: "Does he know that"

Barok: "Das hi no dat"

English: "The fishing village"

Barok:



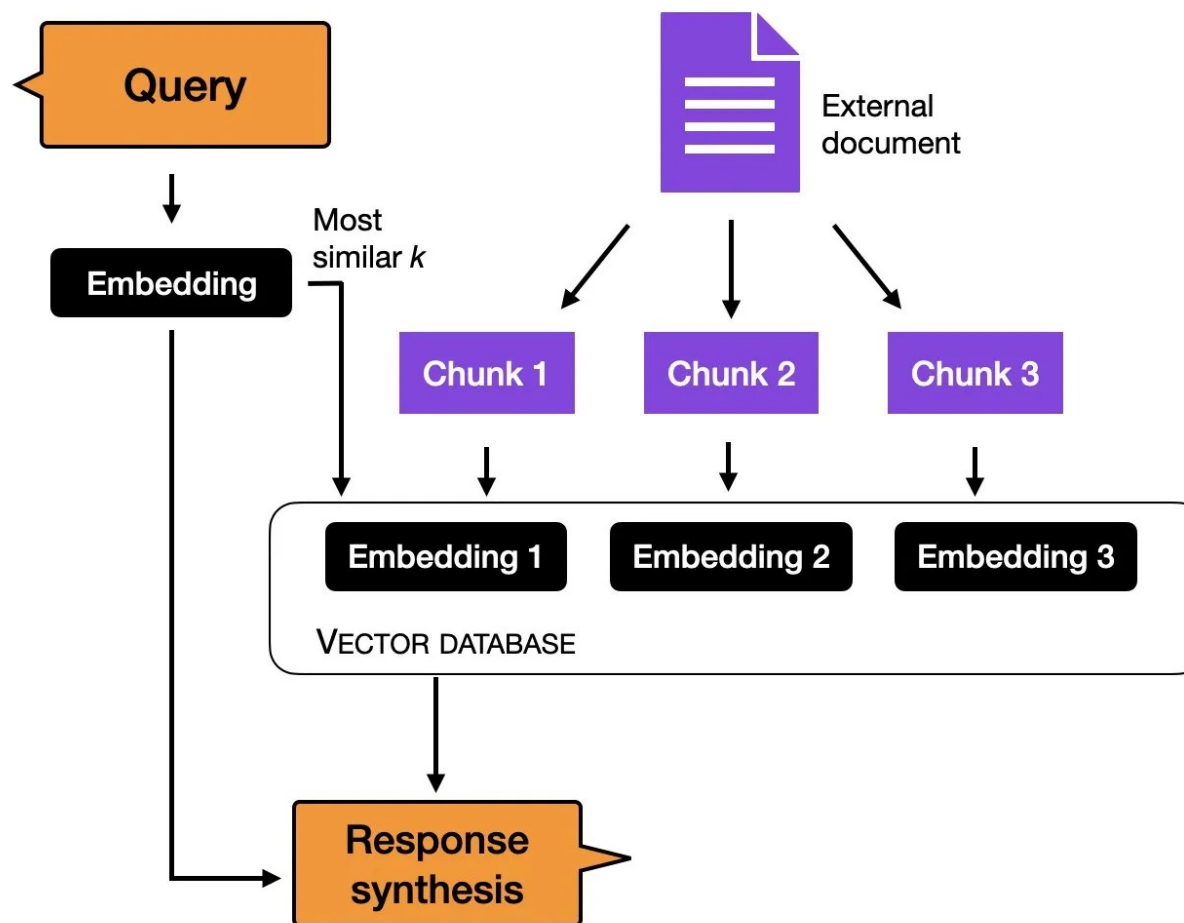
Based on the provided examples, I can create an invented Barok language and translate the phrase "The fishing village" into it:

English: "The fishing village"

Barok: "Da pisyng bileyg"

What if I want to use my doc/pdf as context

Indexing



UPD Student Handbook 35 pages

ACADEMIC INFORMATION

ACADEMIC CALENDAR

The Academic Year is divided into two (2) semesters of at least sixteen (16) weeks each, exclusive of registration and final examination periods. Each semester shall consist of at least one hundred (100) class days. A summer session of six (6) weeks follows the second semester. Class work in the summer session is equivalent to class work in one (1) semester (*UP Code: Art. 306 p.78; 1961; Revised in 1979*).

The first semester begins in August, the second semester in January, and the midyear term in June (*1297th BOR: 28 March 2014*).

All academic units of UP Diliman operate under the semestral system, except for the evening Master of Business Administration program and the Master of Science in Finance program of the Cesar EA Virata School of Business, Master of Management of the UP Diliman Extension Program in Pampanga/Olongapo, and Professional Masters in Tropical Marine Ecosystems Management program of the College of Science which are under the trimestral system.

CREDIT UNIT

Every student shall, upon admission, sign the following pledge:

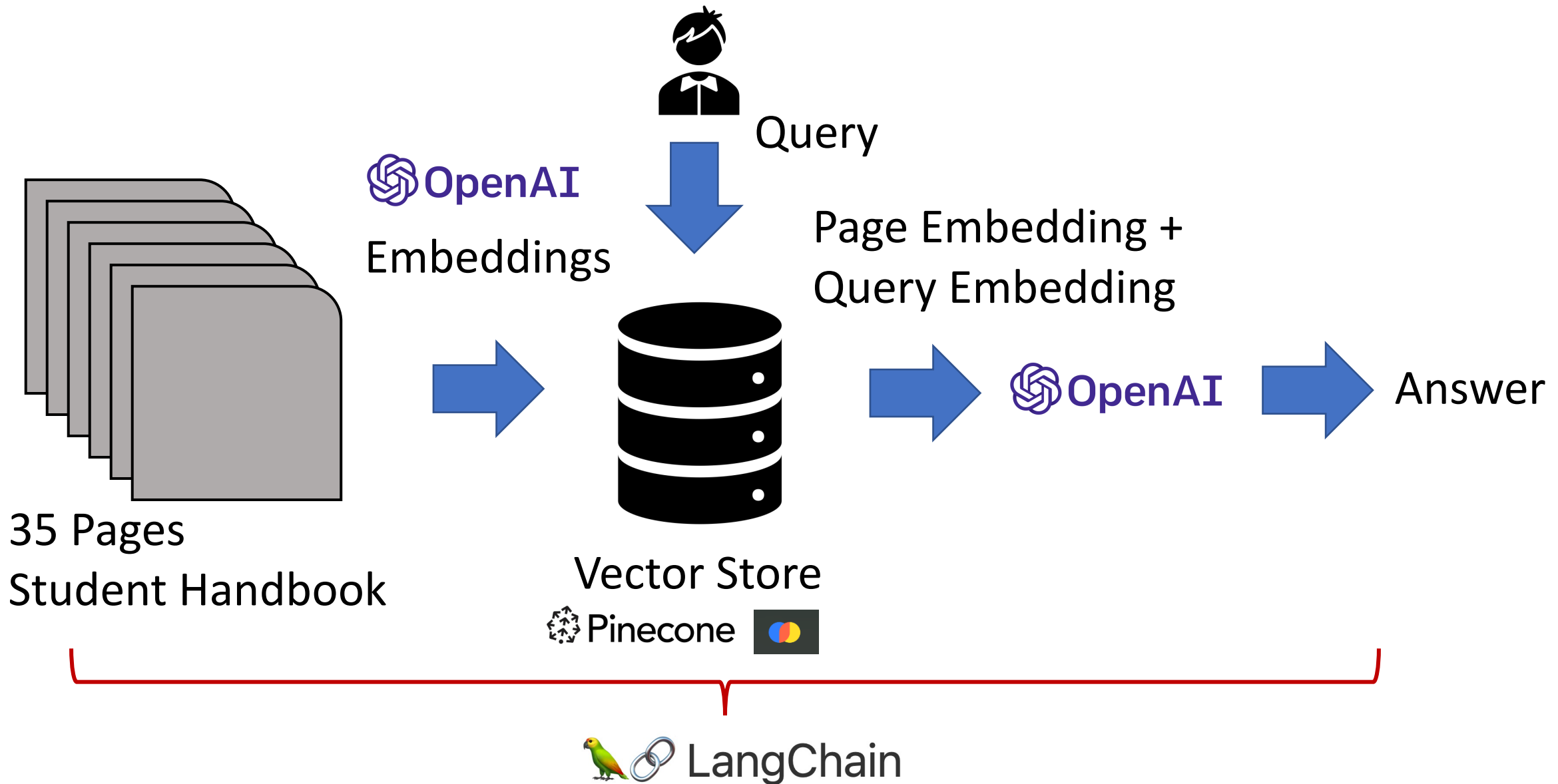
“In consideration of my admission to the University of the Philippines and of the privileges of a student in this institution, I hereby promise and pledge to abide by and comply with all the rules and regulations laid down by competent authority in the University and in the college in which I am enrolled.”

Refusal to take this pledge or violation of its terms shall be sufficient cause for summary dismissal or denial of admission (*Revised UP Code: Art. 329 p. 82*).

ADMISSION REQUIREMENTS

Undergraduate or Diploma Programs

Undergraduate certificate or diploma programs do not require the UPCAT for admission. However, applicants must pass a test given by the college—a talent test in the College of Arts and Letters (CAL), College of Fine Arts (CFA) and the College of Music (CM), or a sports readiness test in the College of Human Kinetics (CHK). Application to any of these programs is made directly to the college concerned.



Install

```
! pip install langchain --upgrade  
! pip install openai --upgrade  
! pip install unstructured --upgrade  
! pip install pypdf --upgrade
```

Load and split the pdf

```
pdf_url = input("Enter pdf url: ")  
  
# eg https://ac.upd.edu.ph/acmedia/images/newpdfs/UP\_Academic\_Information.pdf  
loader = PyPDFLoader(pdf_url)  
pages = loader.load_and_split()
```

Enter your OpenAI API Key

```
query = input("OpenAI API Key: ")  
os.environ["OPENAI_API_KEY"] = query  
index = VectorstoreIndexCreator().from_loaders([loader])
```

Use the document query

```
while True:
    input_prompt = "Human: "
    query = input(input_prompt)

    if query.lower() == "bye":
        text = f"{input_prompt}: {query}"
        print(textwrap.fill(text, width=80))
        print("AI: Bye!")
        break

    # print text within page width
    for key,value in index.query_with_sources(query).items():
        text = f"{key}: {value}"
        print(textwrap.fill(text, width=80))
```

Code Demo

<https://github.com/roatienza/Deep-Learning-Experiments>