



# Fine Tuning Large Language Models (LLMs)

Rowel Atienza, PhD

University of the Philippines

[github.com/roatienza](https://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.

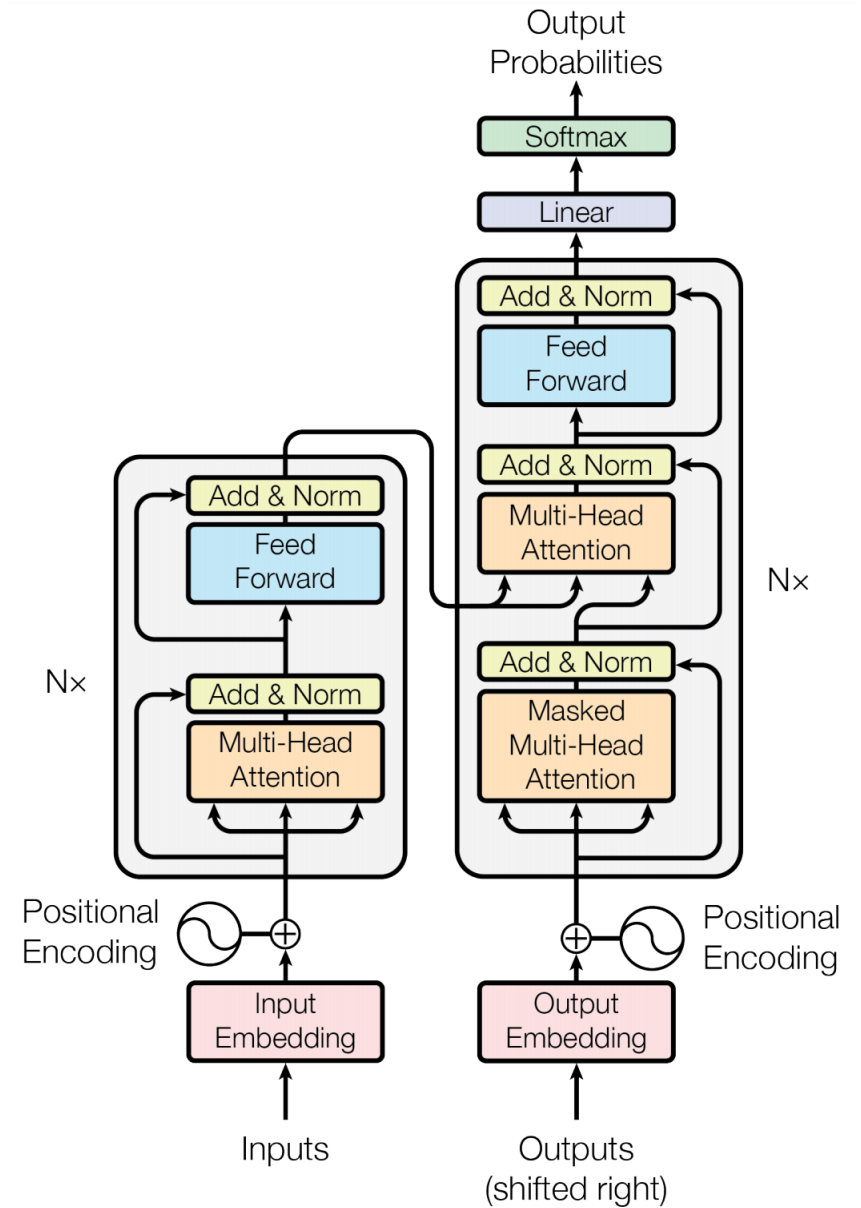


Figure 1: The Transformer - model architecture.

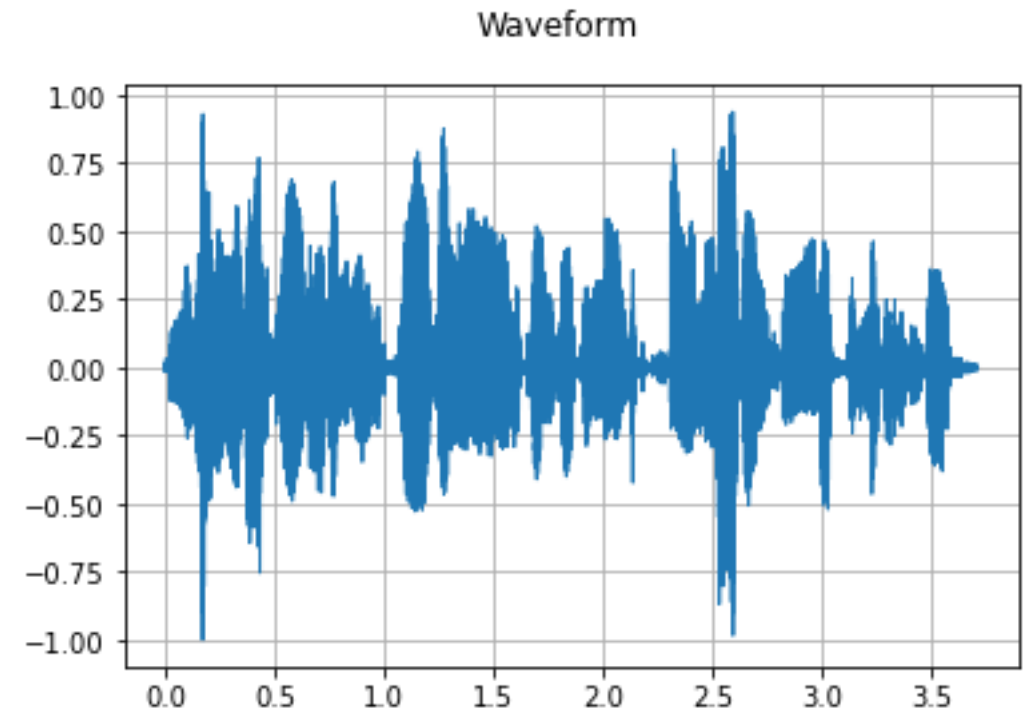
# Types of data that transformers can process

Any



WIKIPEDIA  
The Free Encyclopedia

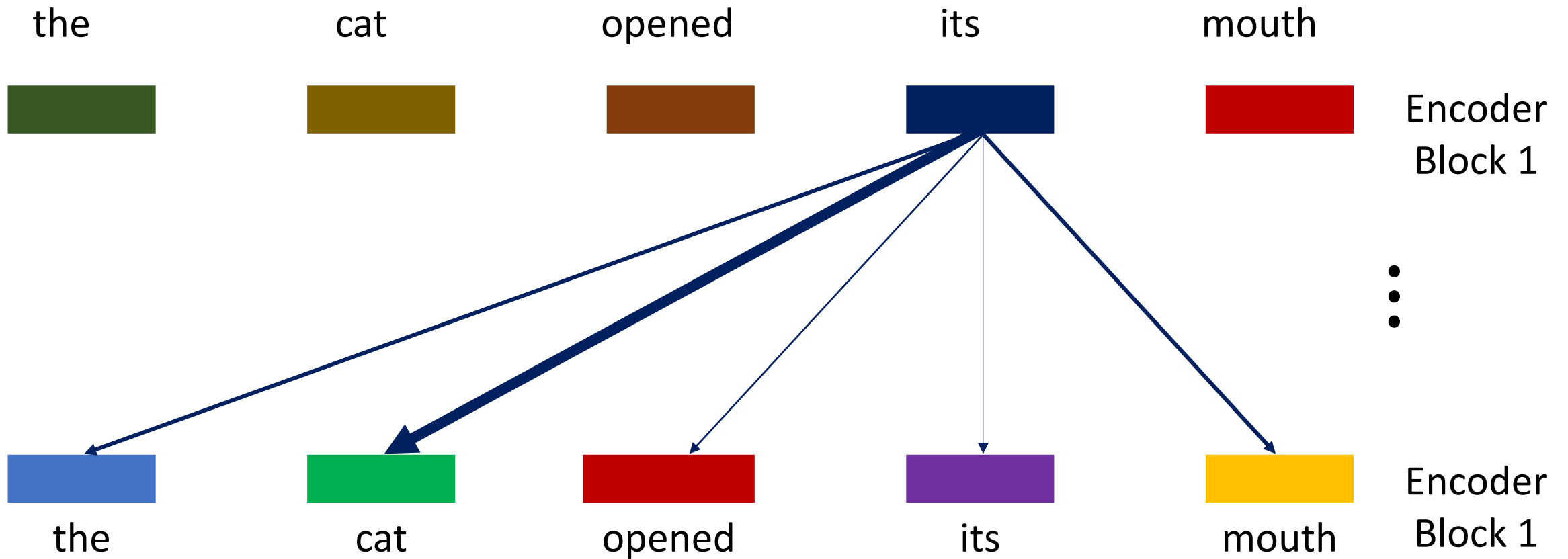
COCO 2017 Keypoint Detection Task



# 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

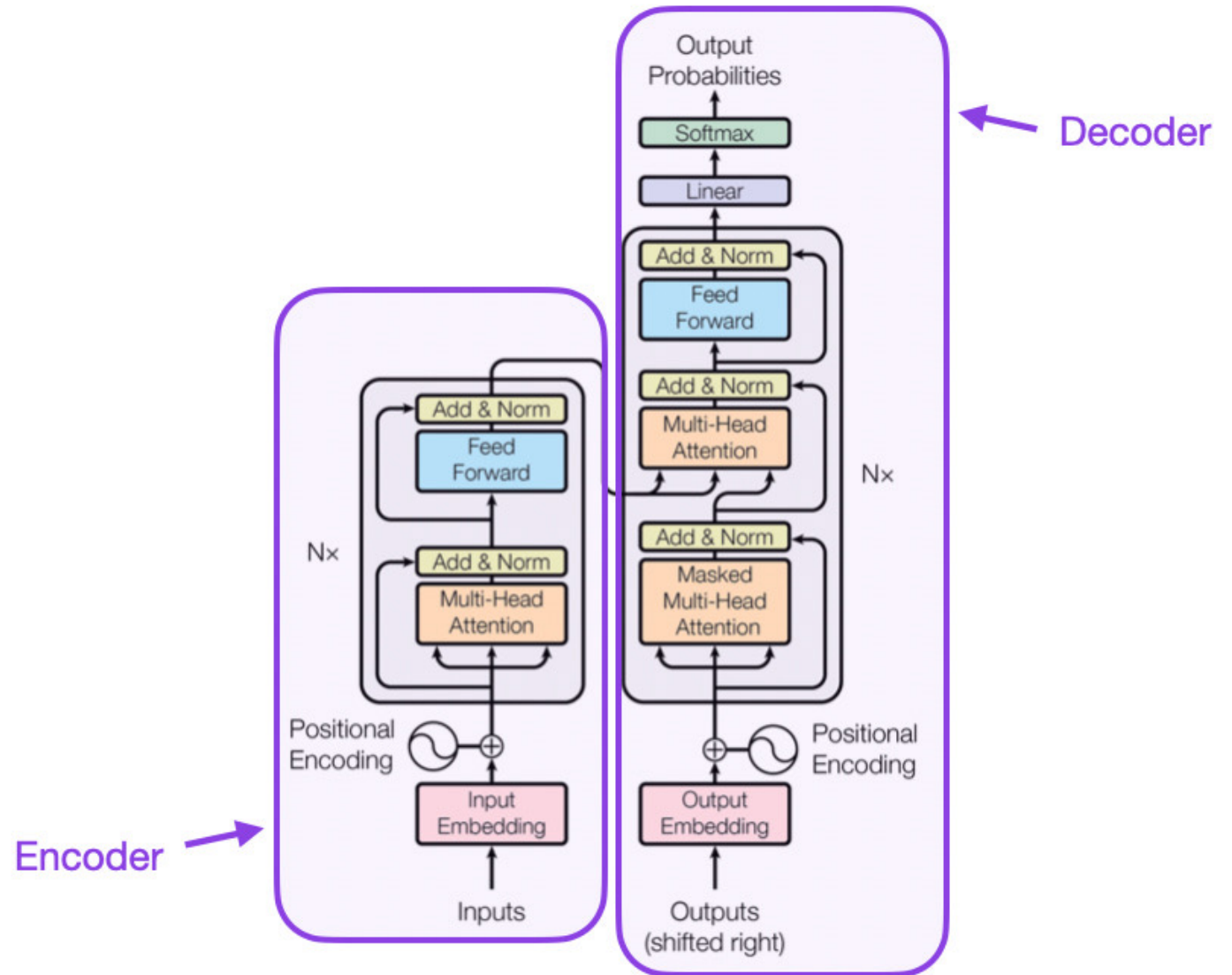
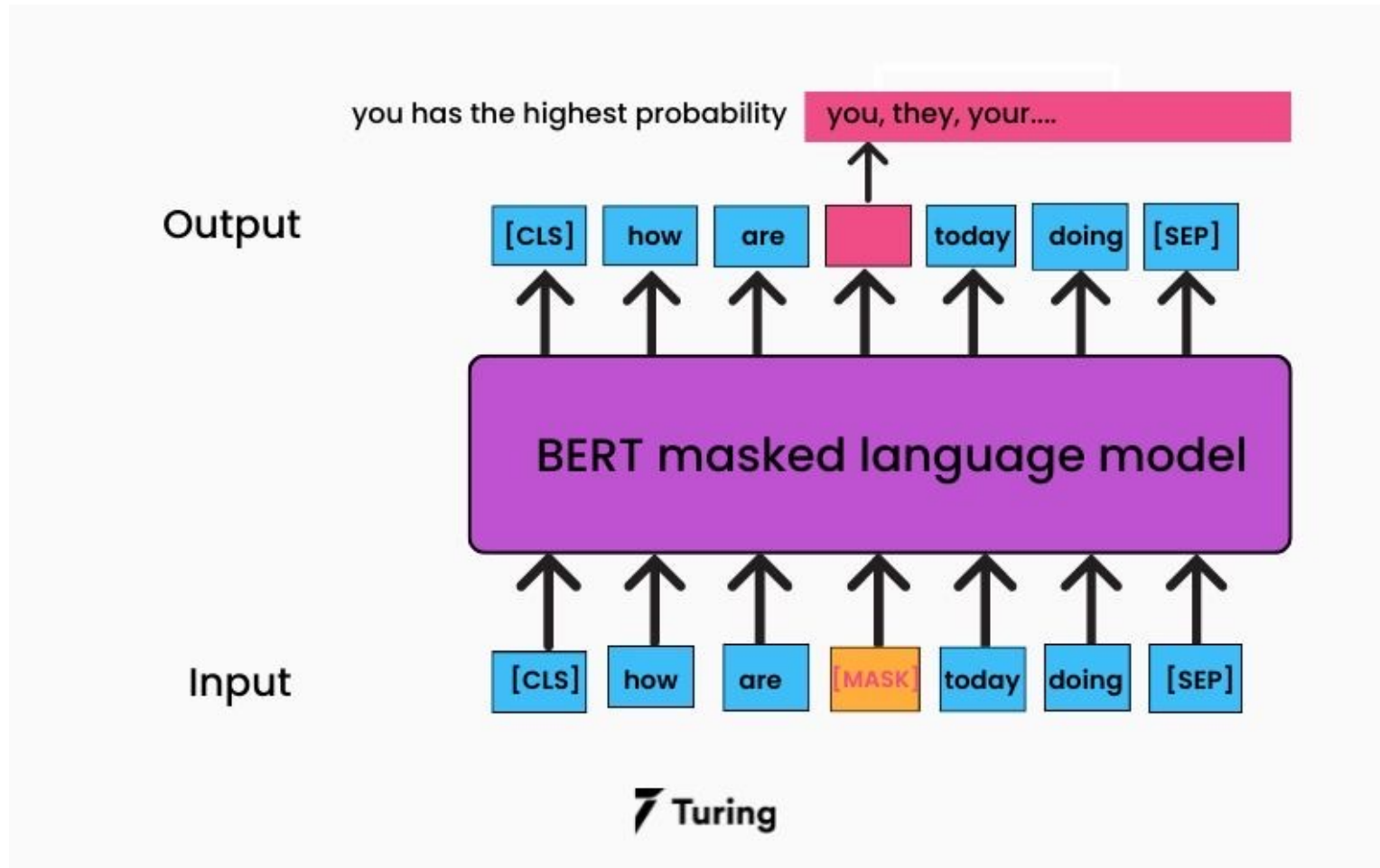


Figure 1: The Transformer - model architecture.

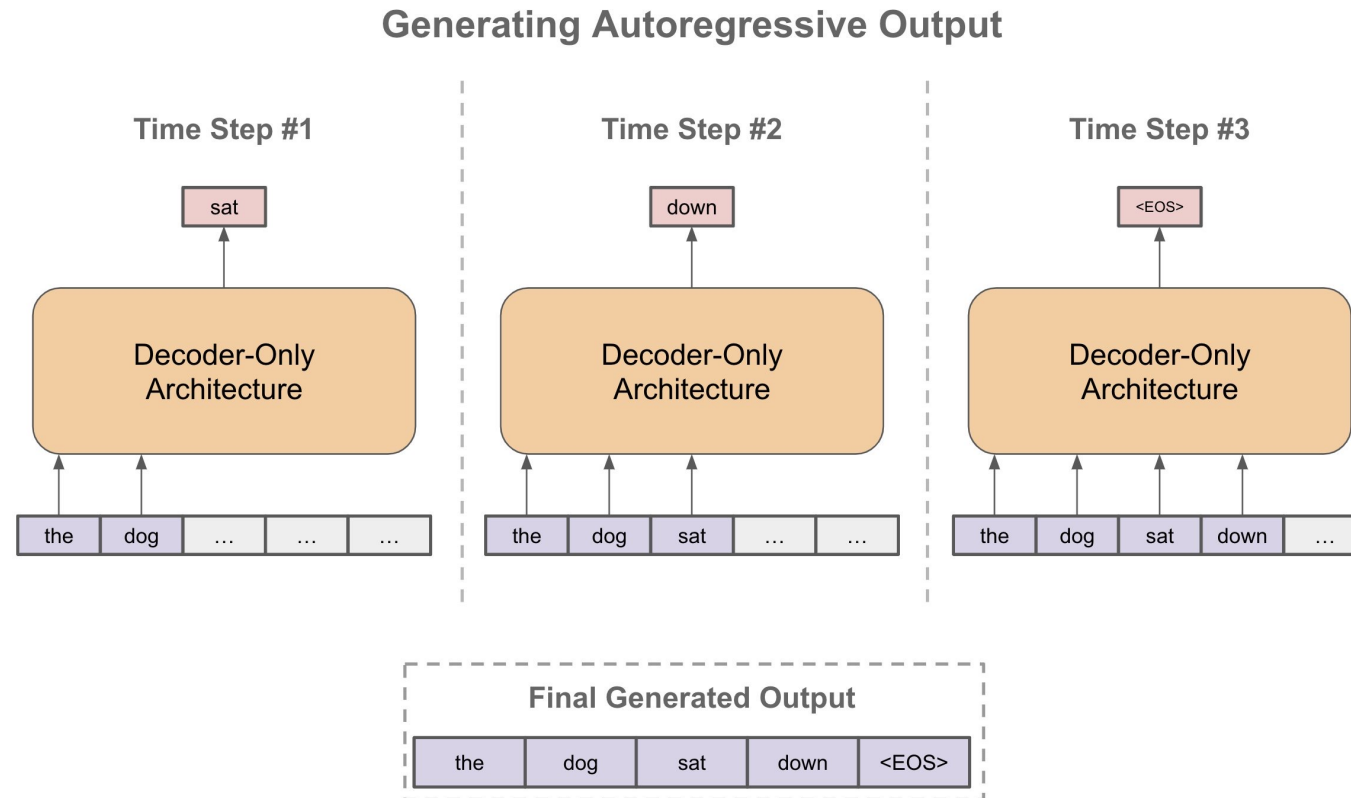
# BERT (Bidirectional Encoder Representations from Transformers): Encoder only

*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*



**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.

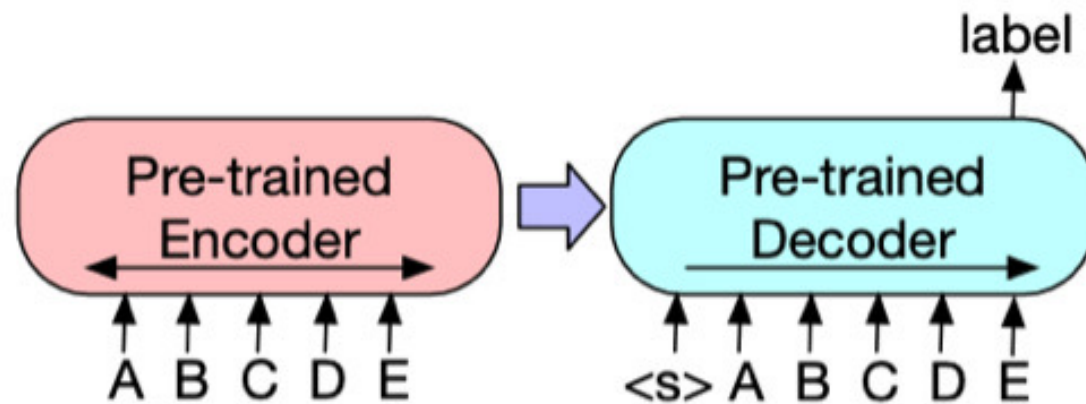
# Design Patterns

- 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?

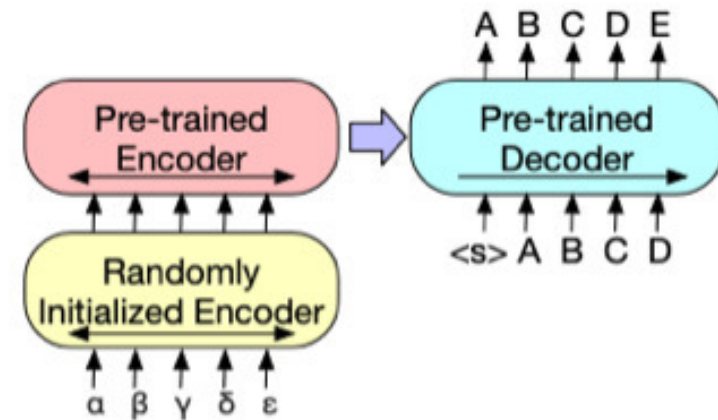
# BART: Encoder-Decoder

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?

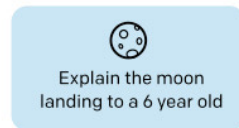
# InstructGPT:

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

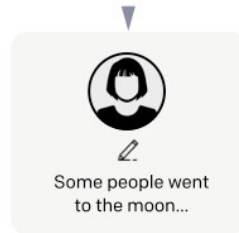
Step 1

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

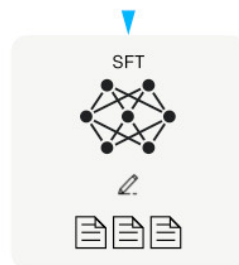
A prompt is  
sampled from our  
prompt dataset.



A labeler  
demonstrates the  
desired output  
behavior.



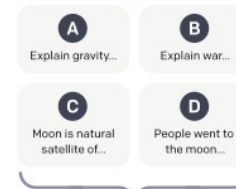
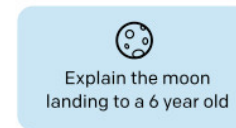
This data is used  
to fine-tune GPT-3  
with supervised  
learning.



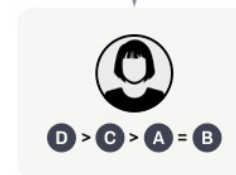
Step 2

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

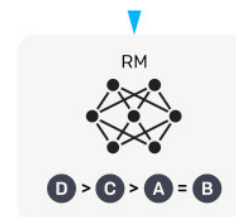
A prompt and  
several model  
outputs are  
sampled.



A labeler ranks  
the outputs from  
best to worst.



This data is used  
to train our  
reward model.



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 fine tune your LLMs

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

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

# 2 ways

- In-context learning
- Other fine-tuning methods
  - 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:

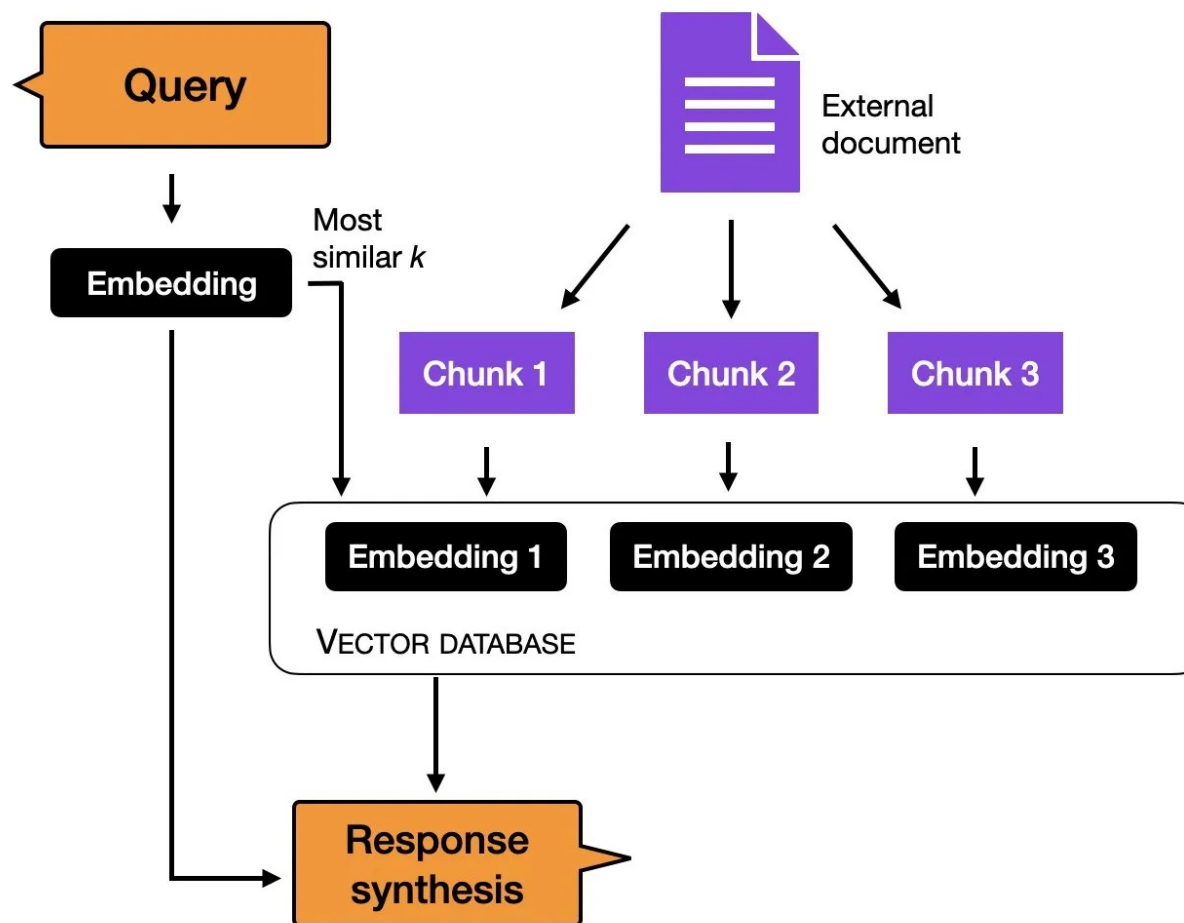
English: "The fishing village"

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:*

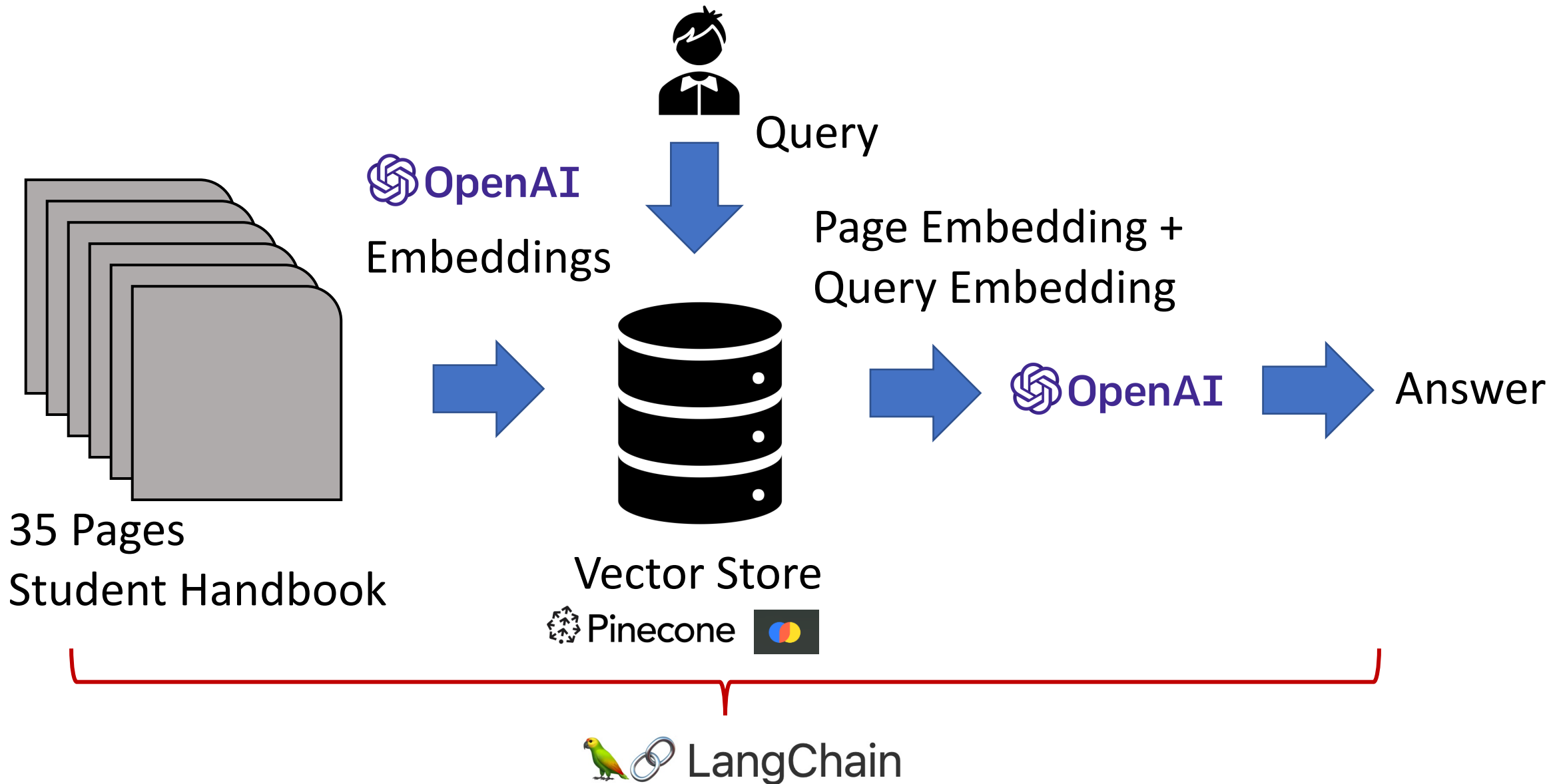
“In consideration of my admission to the University of the Philippines and of the privileges of a student in this institution, I hereby promise and pledge to abide by and comply with all the rules and regulations laid down by competent authority in the University and in the college in which I am enrolled.”

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>