Introduction to large language models (LLMs)

INTRODUCTION TO LLMS IN PYTHON

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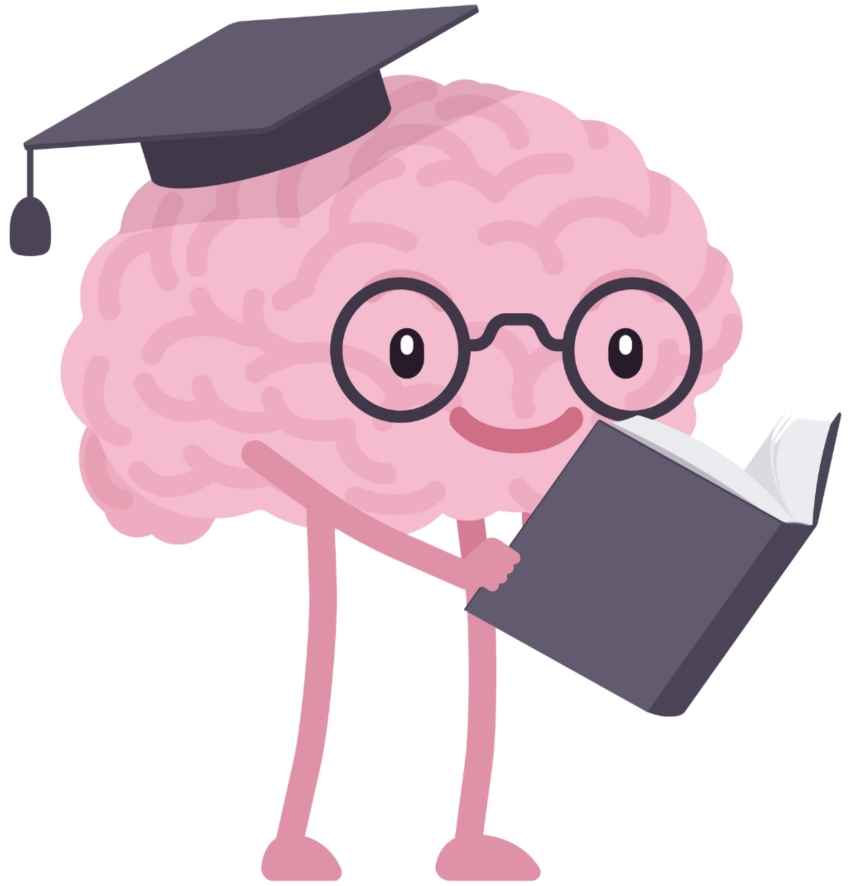
Previous knowledge

- Navigating the Hugging Face Hub
- Deep learning models



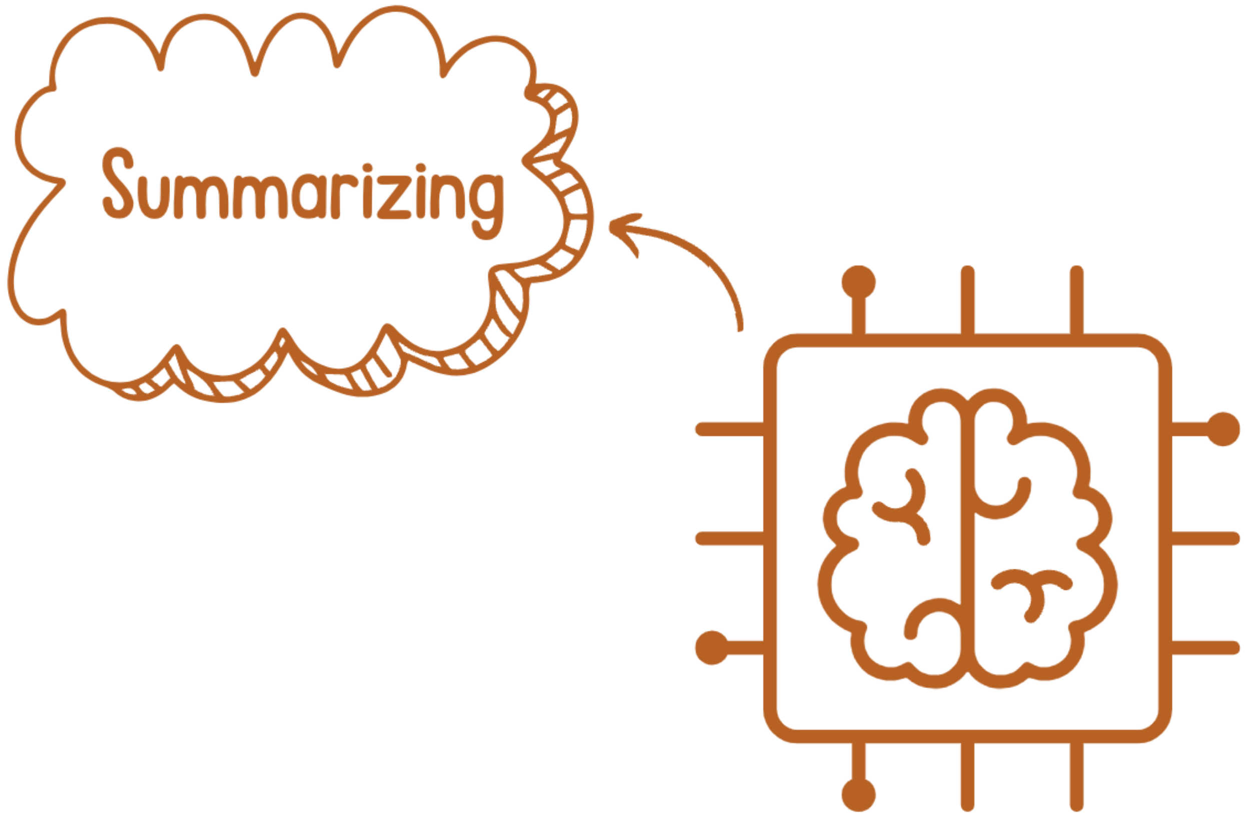
Introduction to LLMs

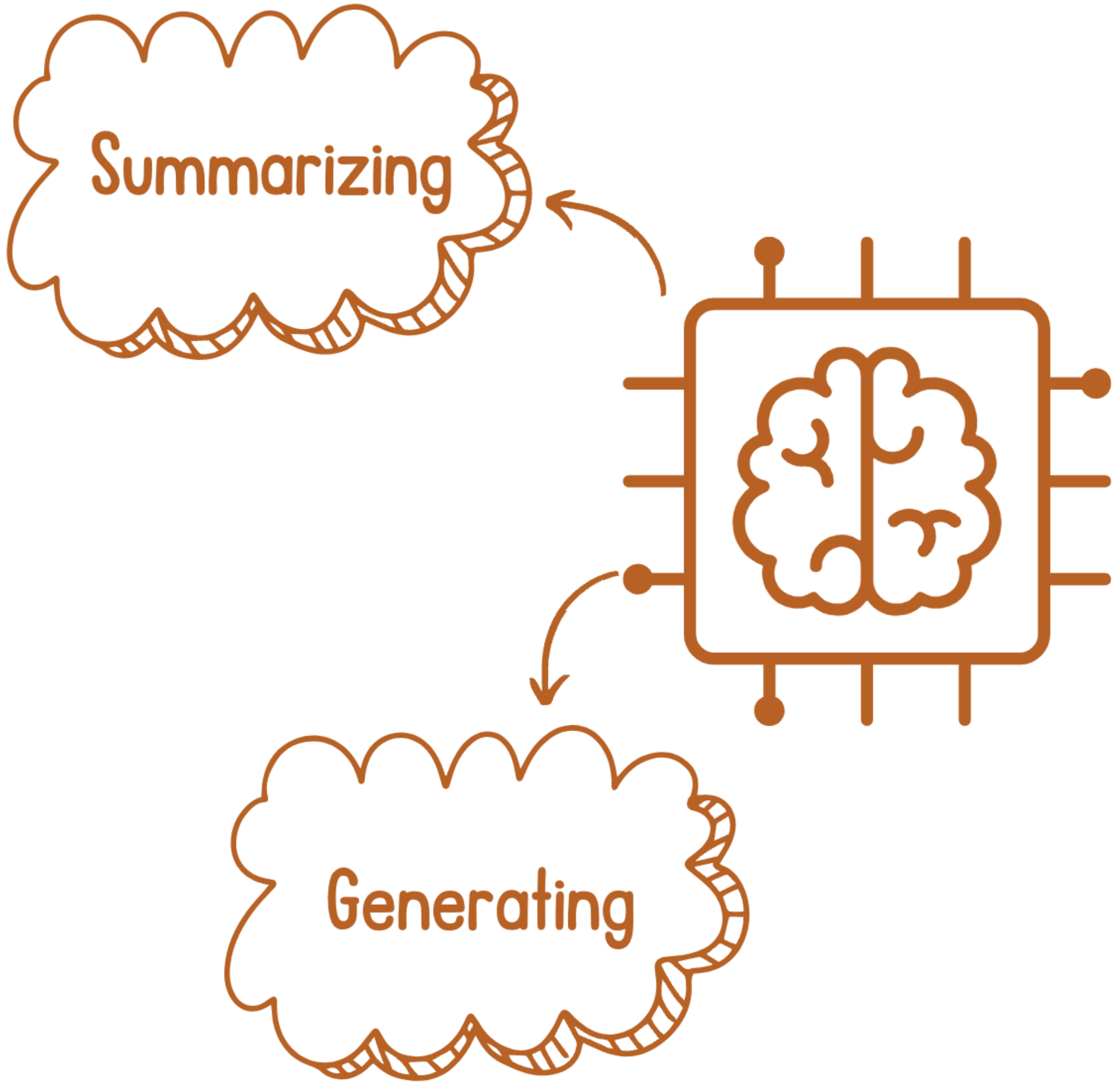
Understanding

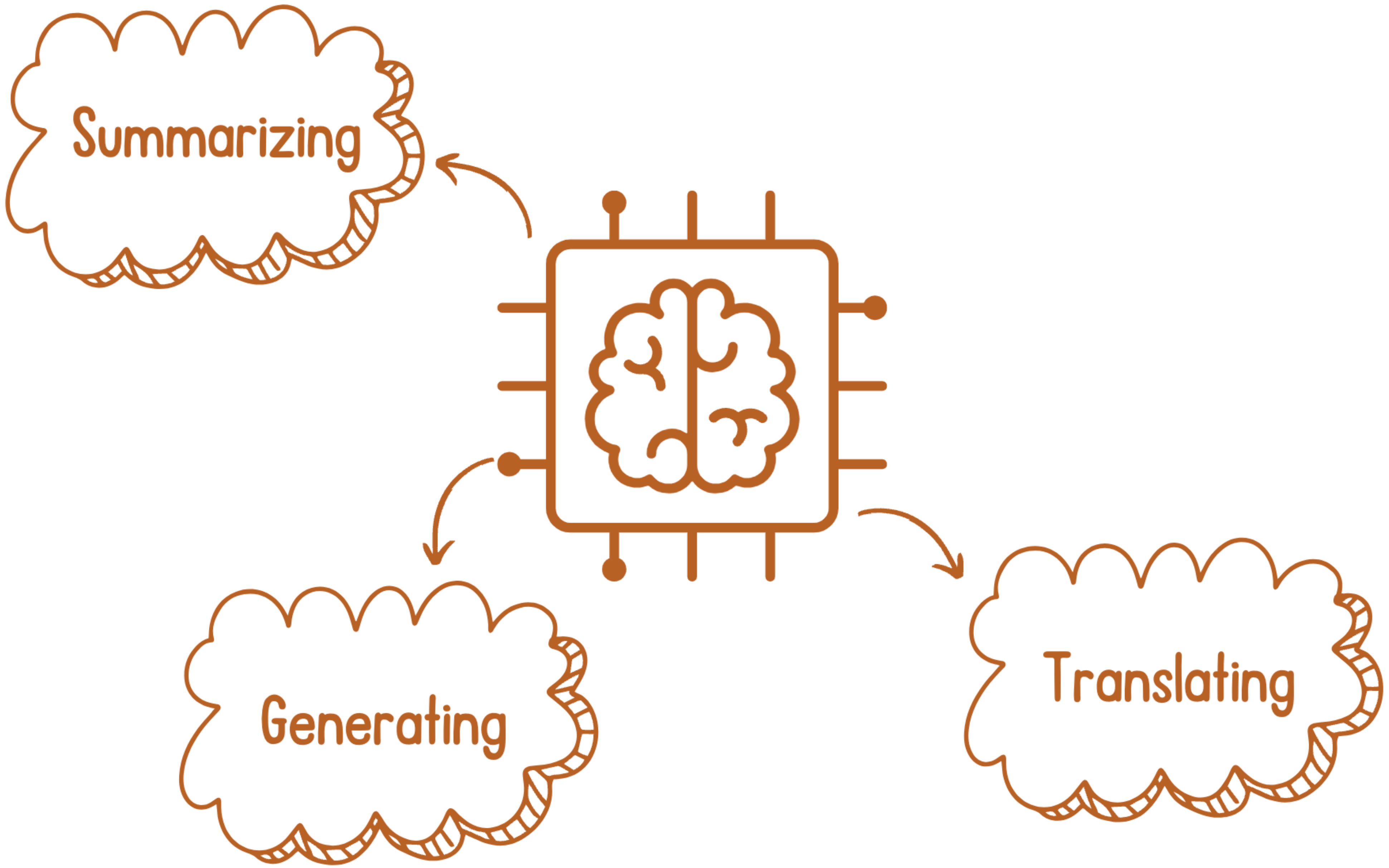
Introduction to LLMs

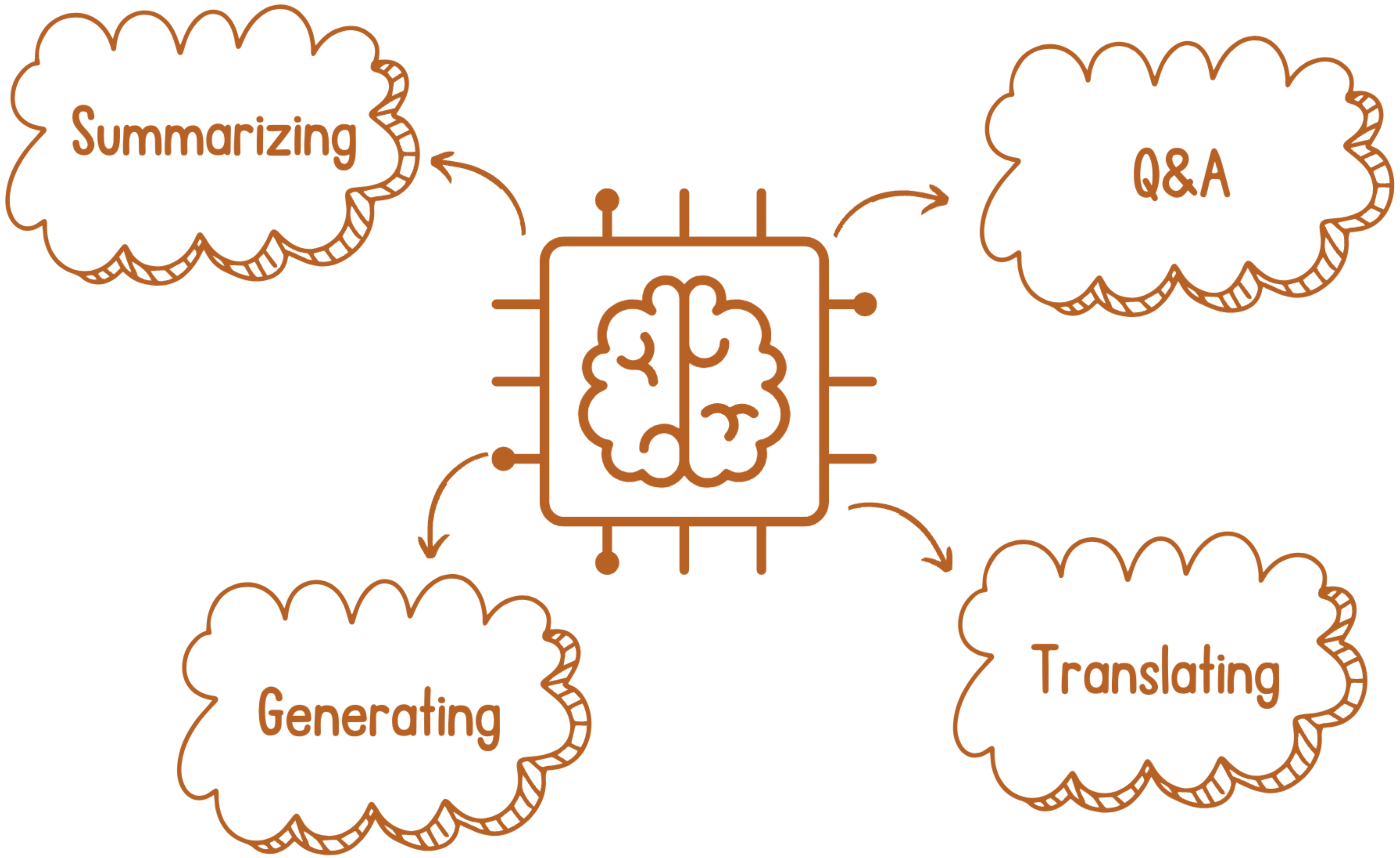
Understanding

Using


Summarizing


Summarizing
Generating


Summarizing
Generating
Translating



LLaMA by Meta Gemini

LLMs

- Based on **deep learning** architectures
- Most commonly **transformers**
- Huge **neural networks** with lots of parameters and text data

Using Hugging Face models

```python
from transformers import pipeline

summarizer = pipeline(task="summarization", model="facebook/bart-large-cnn")

text = "Walking amid Gion's Machiya wooden houses is a mesmerizing experience. The
beautifully preserved structures exuded an old-world charm that transports visitors
back in time, making them feel like they had stepped into a living museum. The glow of
lanterns lining the narrow streets add to the enchanting ambiance, making each stroll a
memorable journey through Japan's rich cultural history."

summary = summarizer(text, max_length=50)
```

- `clean_up_tokenization_spaces=True` : remove unnecessary white space

Model outputs

```
print(summary)
```

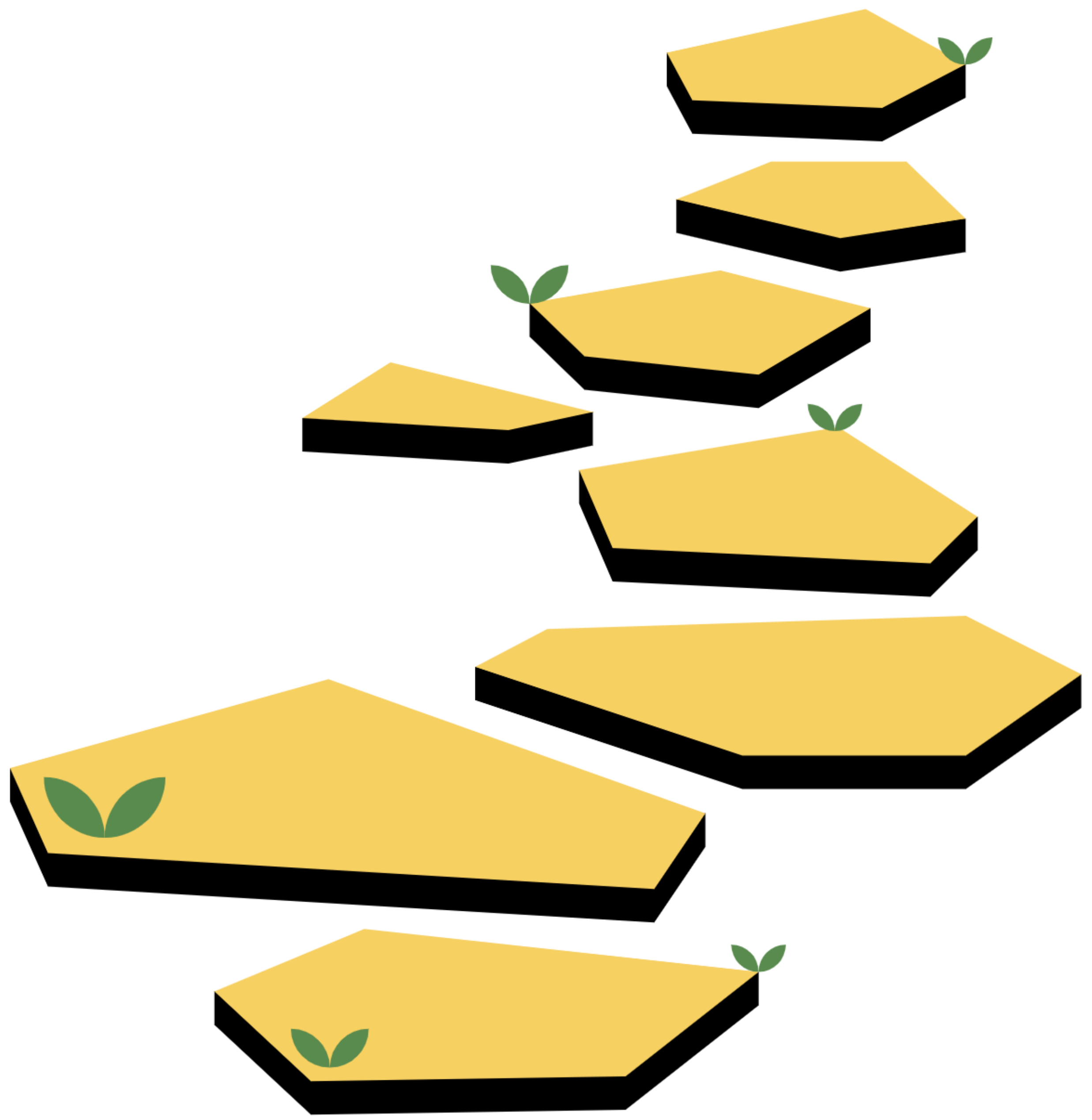
```
[{'summary_text': "Gion's Machiya
  wooden houses exuded an old-world
  charm that transports visitors back
  in time. The glow of lanterns lining
  the narrow streets add to the
  enchanting ambiance, making each
  stroll a memorable journey through
  Japan's"}]
```

```
print(summary[0]["summary_text"])
```

```
Gion's Machiya wooden houses exuded an
old-world charm that transports
visitors back in time. The glow of
lanterns lining the narrow streets add
to the enchanting ambiance, making each
stroll a memorable journey through
Japan's
```

Up next

- Build on existing LLM knowledge
- Perform new tasks
- See how LLMs are built
- Fine-tune LLMs
- Evaluate LLM performance



Let's practice!

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Using pre-trained LLMs

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Language understanding

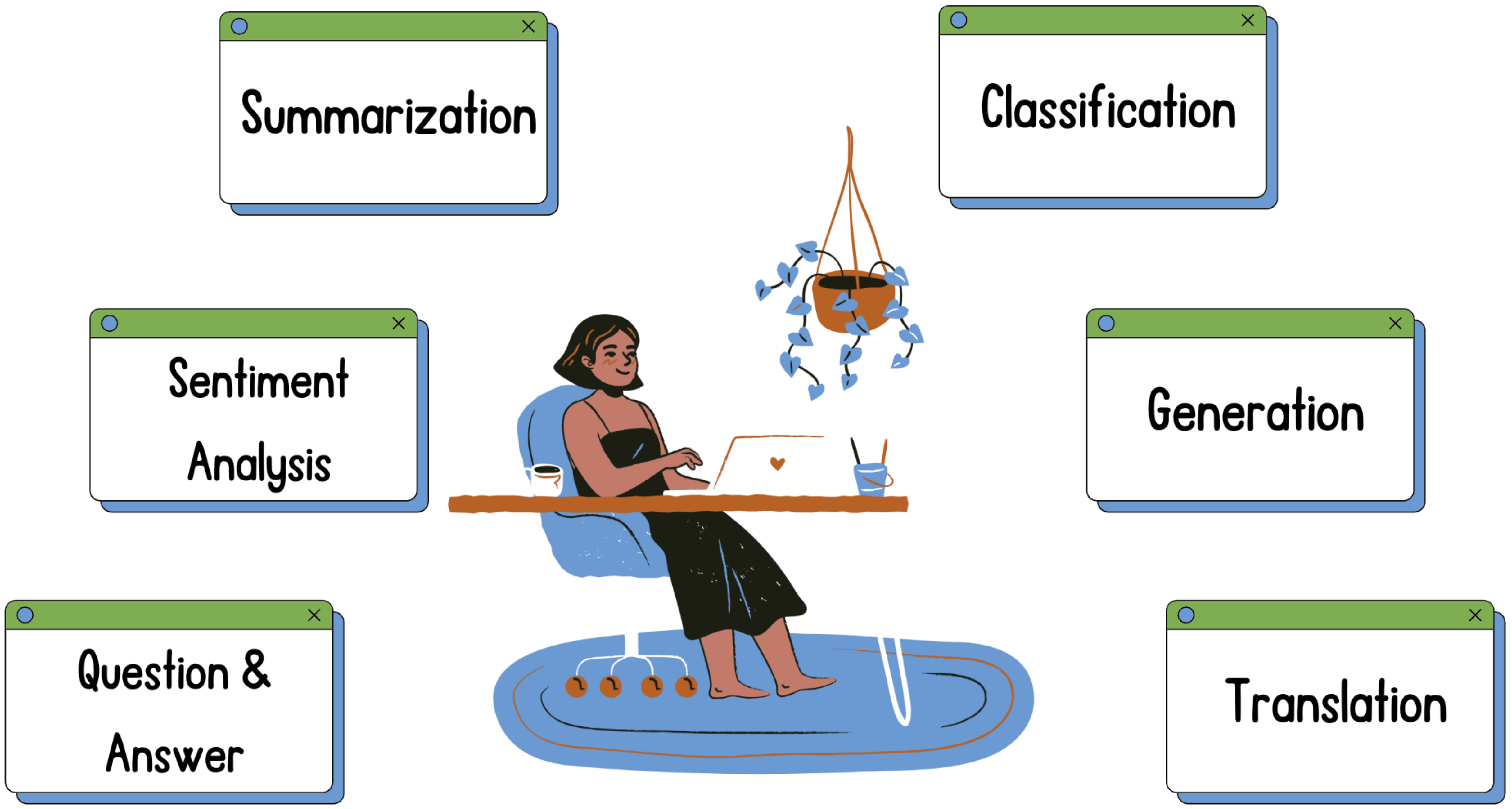
Summarization

Classification

Sentiment Analysis

Question & Answer

Language generation



Text generation

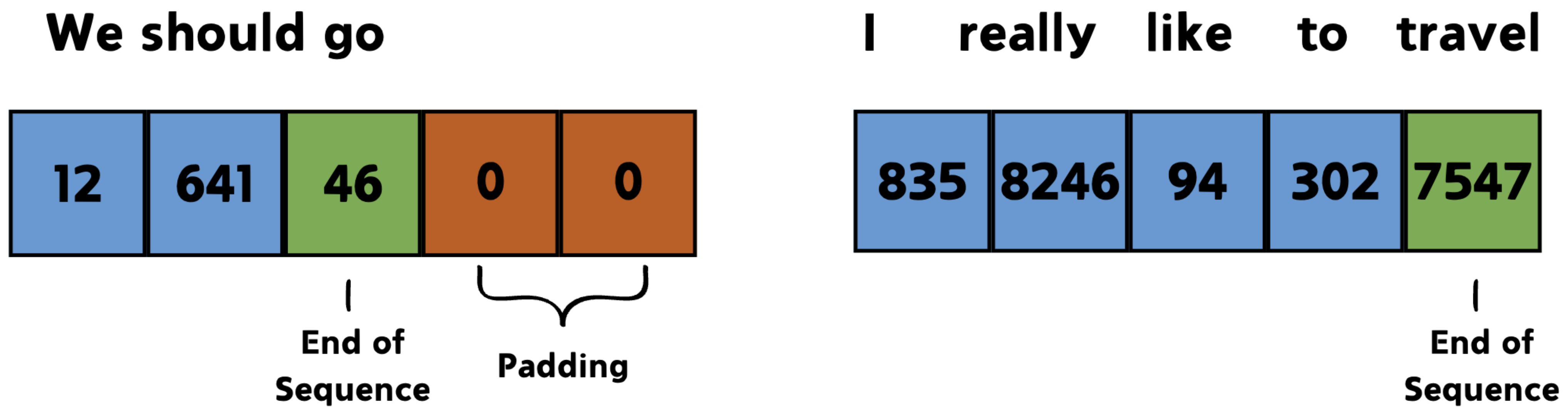
```
generator = pipeline(task="text-generation", model="distilgpt2")

prompt = "The Gion neighborhood in Kyoto is famous for"

output = generator(prompt, max_length=100, pad_token_id=generator.tokenizer.eos_token_id)
```

- Coherent
- Meaningful
- Human-like text
- `eos_token_id` : end-of-sequence token ID

Text generation



- `pad_token_id` : fills in extra space up to `max_length`
- **Padding**: adding tokens
- Setting to `generator.tokenizer.eos_token_id` marks the end of meaningful text, learned through training
- Model generates up to `max_length` or `pad_token_id`
- `truncation = True`

Text generation

```
generator = pipeline(task="text-generation", model="distilgpt2")

prompt = "The Gion neighborhood in Kyoto is famous for"

output = generator(prompt, max_length=100, pad_token_id=generator.tokenizer.eos_token_id)

print(output[0]["generated_text"])
```

```
The Gion neighborhood in Kyoto is famous for its many colorful green forests, such as the
Red Hill, the Red River and the Red River. The Gion neighborhood is home to the world's
tallest trees.
```

- Output may be suboptimal if prompt is vague

Guiding the output

```python
generator = pipeline(task="text-generation", model="distilgpt2")

review = "This book was great. I enjoyed the plot twist in Chapter 10."

response = "Dear reader, thank you for your review."

prompt = f"Book review:\n{review}\n\nBook shop response to the review:\n{response}"

output = generator(prompt, max_length=100, pad_token_id=generator.tokenizer.eos_token_id)

print(output[0]["generated_text"])
```

```
Dear reader, thank you for your review. We'd like to thank you for your reading!
```

Language translation

- Hugging Face has a complete list of translation tasks and models

```python
translator = pipeline(task="translation_en_to_es", model="Helsinki-NLP/opus-mt-en-es")

text = "Walking amid Gion's Machiya wooden houses was a mesmerizing experience."

output = translator(text, clean_up_tokenization_spaces=True)

print(output[0]["translation_text"])
```

```
Caminar entre las casas de madera Machiya de Gion fue una experiencia fascinante.
```

Let's practice!

Understanding the transformer

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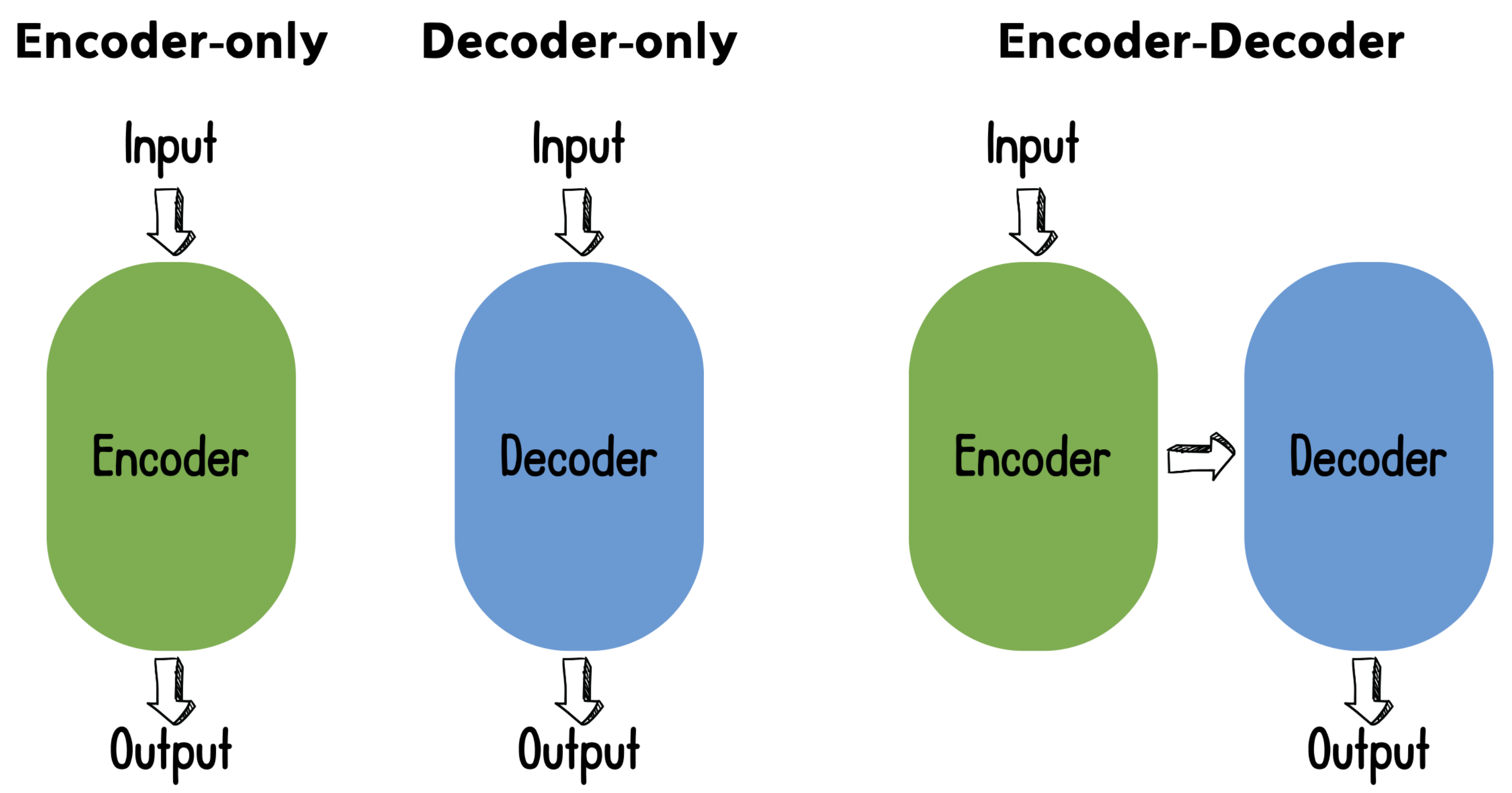
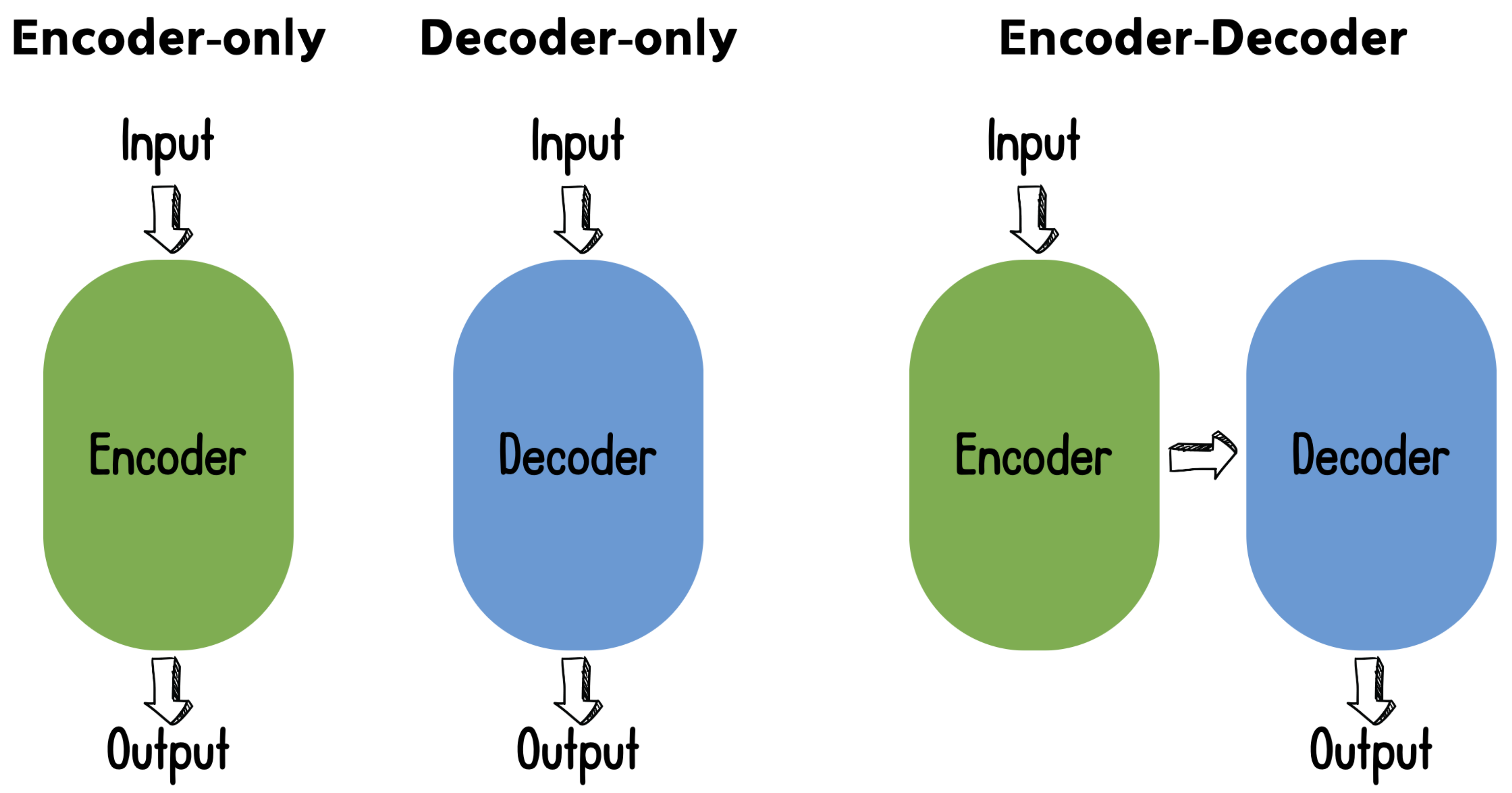
What is a transformer?

- Deep learning architectures
- Processing, understanding, and generating text
- Used in most LLMs
- Handle long text sequences in parallel

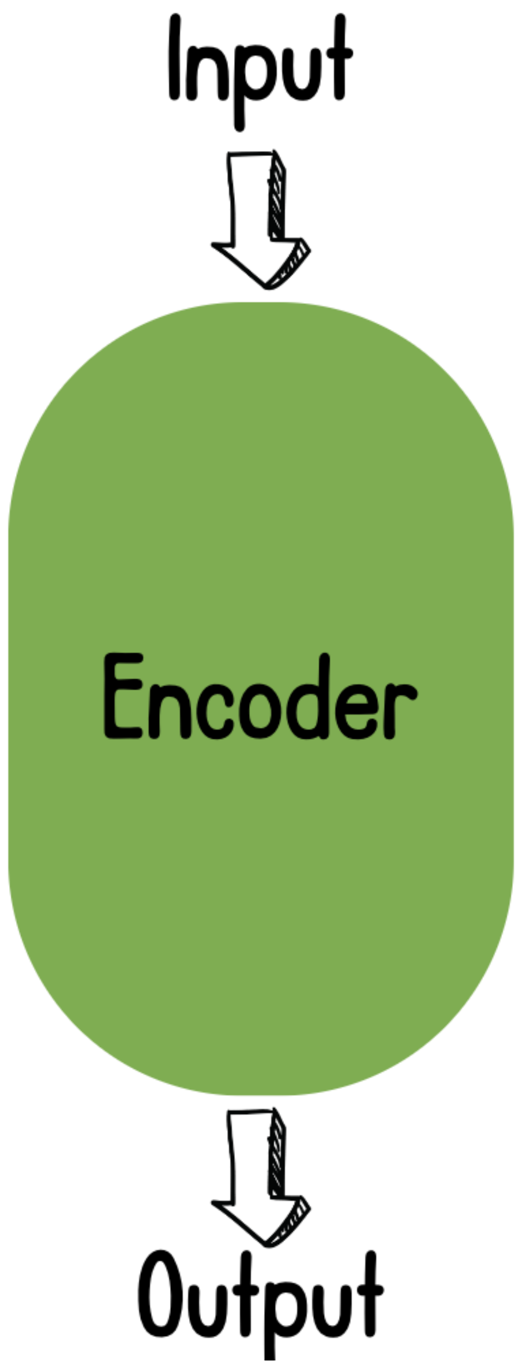


Transformer architectures



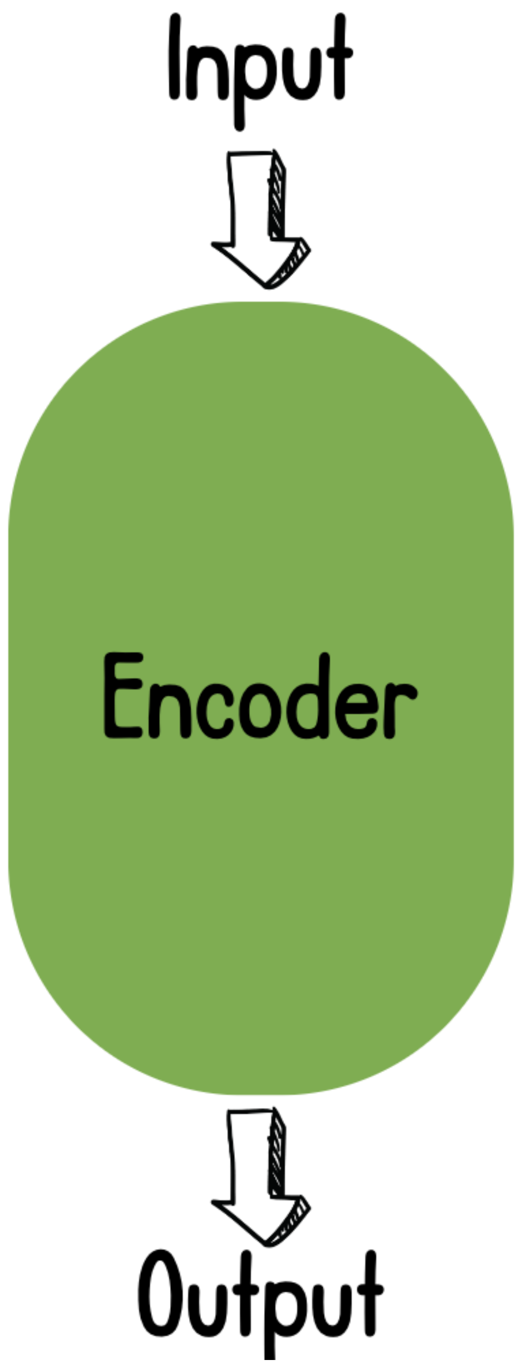
- Find the architecture details in the Hugging Face model card

Encoder-only



- Understanding the input text
- No sequential output
- Common tasks:
  - Text classification
  - Sentiment analysis
  - Extractive question-answering (extract or label)
- BERT models
- Example: `"distilbert-base-uncased-distilled-squad"`

Encoder-only



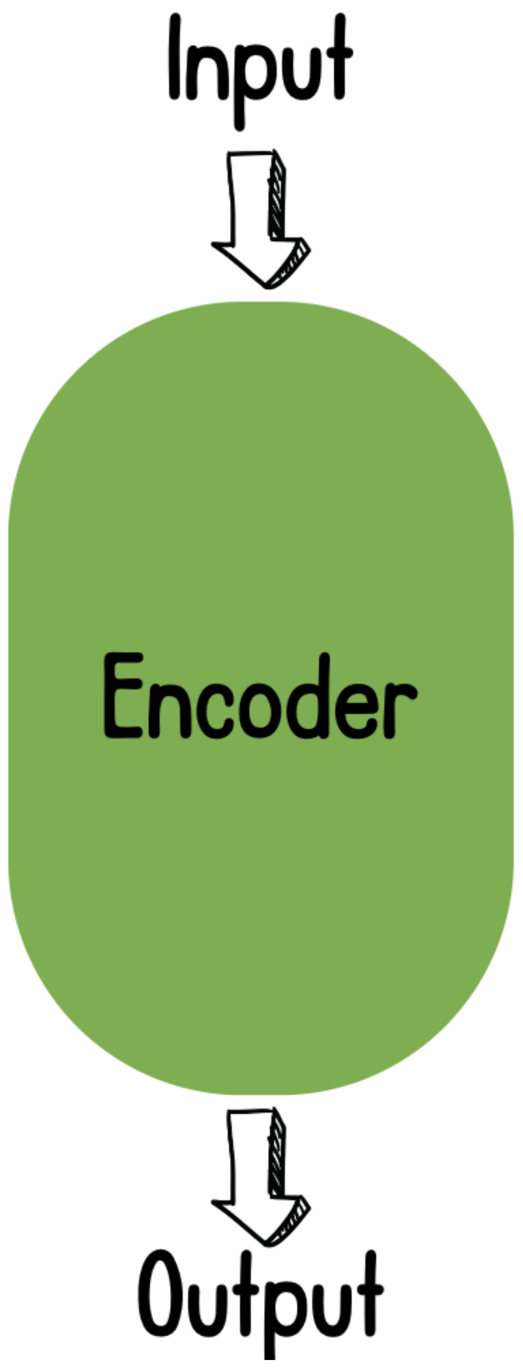
```python
llm = pipeline(model="bert-base-uncased")
print(llm.model)
```

```
BertForMaskedLM(
  (bert): ...
    )
    (encoder): BertEncoder(
      ...
```

```python
print(llm.model.config)
```

```
BertConfig {
...
  "architectures": [
    "BertForMaskedLM"
...
```

Encoder-only

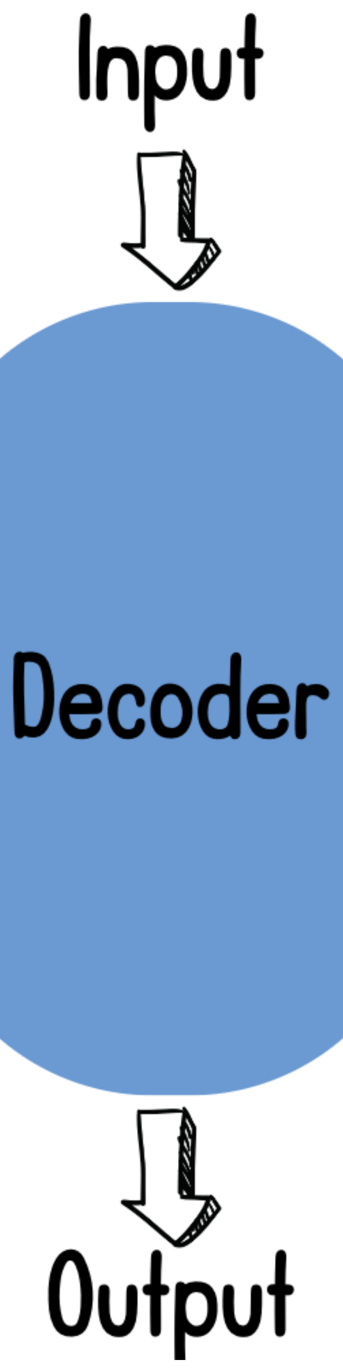


```
print(llm.model.config.is_decoder)
```

```
False
```

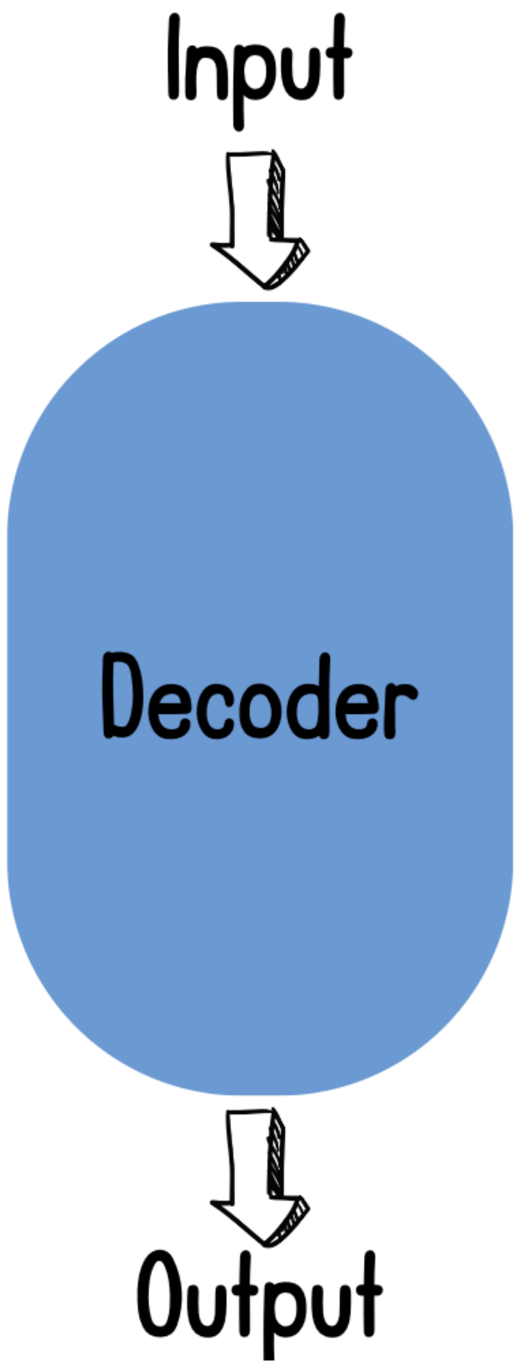
- Alternatively:
  `llm.model.config.is_encoder_decoder`

Decoder-only



- Focus shifts to output
- Common tasks:
  - Text generation
  - Generative question-answering (sentence(s) or paragraph(s))
- GPT models
- Example: `"gpt-3.5-turbo"`

Decoder-only



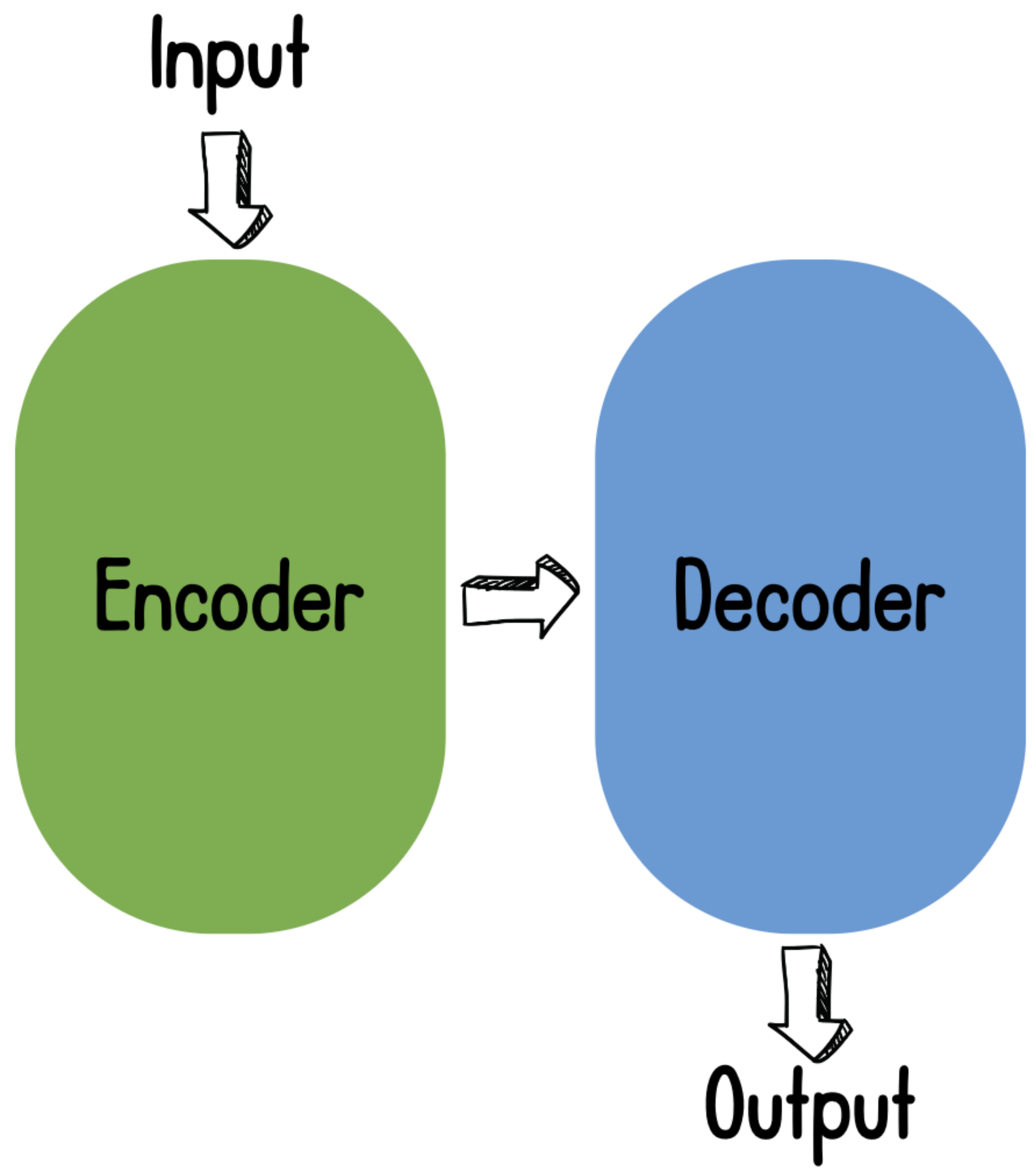
```
llm = pipeline(model="gpt2")
print(llm.model.config)
```

```
GPT2Config {
...
  "architectures": [
    "GPT2LMHeadModel"
  ],
...
  "task_specific_params": {
    "text-generation": {
...
```

```
print(llm.model.config.is_decoder)
```

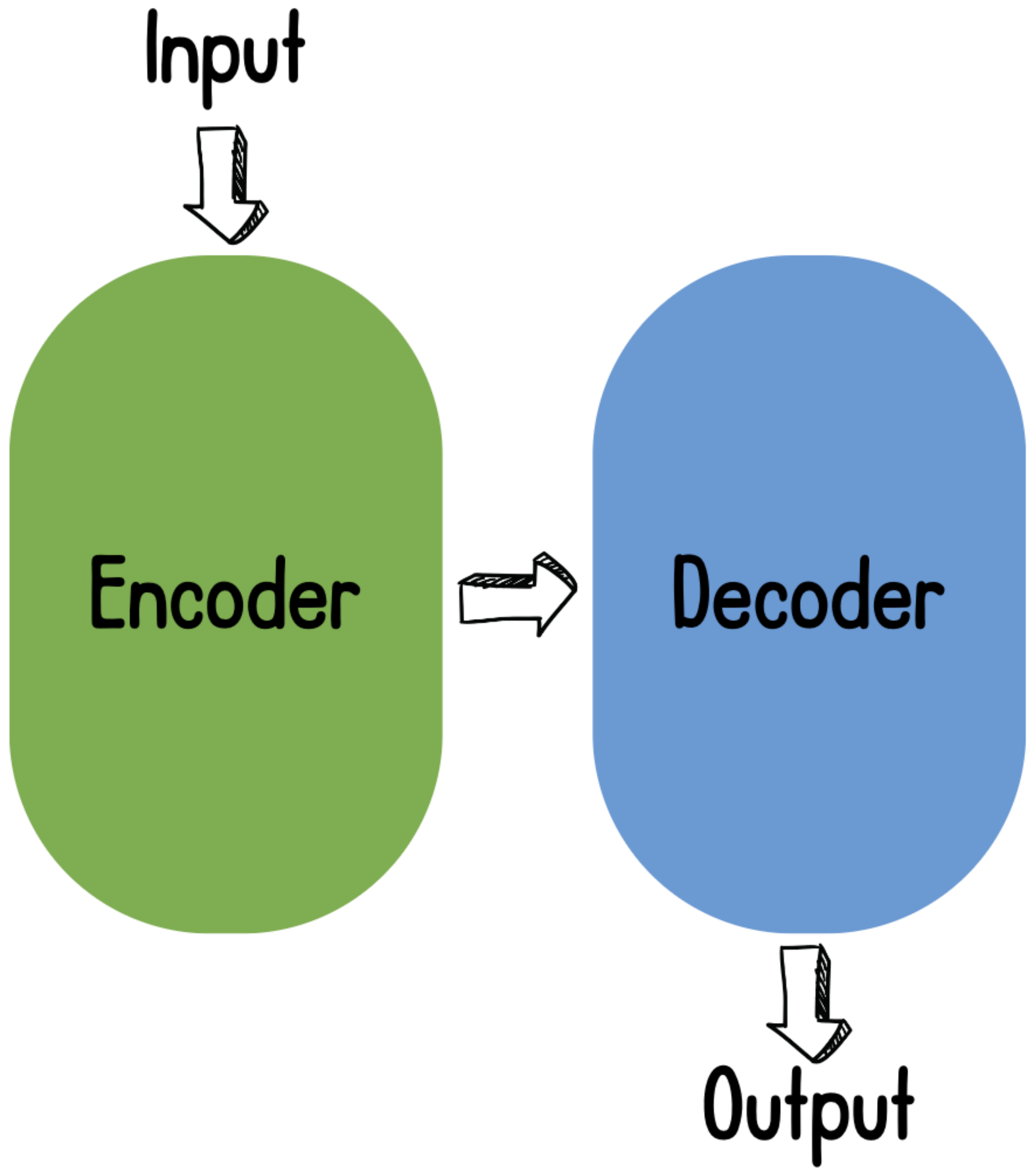
```
False
```

Encoder-decoder



- Understand and process the input and output
- Common tasks:
  - Translation
  - Summarization
- T5, BART models

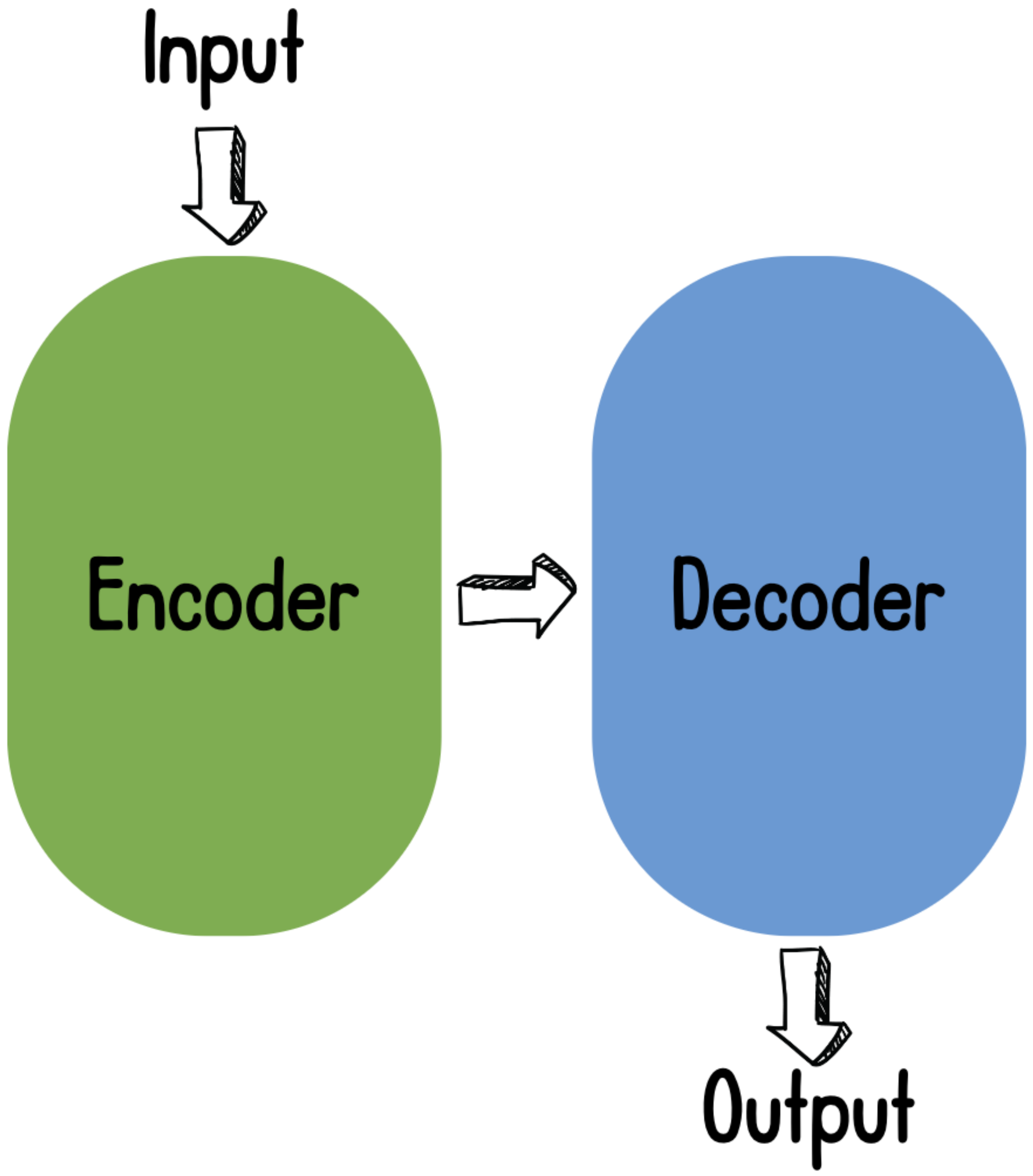
Encoder-decoder



```
llm = pipeline(model="Helsinki-NLP/opus-mt-es-en")
print(llm.model)
```

```
MarianMTModel(
...
    (encoder): MarianEncoder(
...
    (decoder): MarianDecoder(
...
```

Encoder-decoder



```python
print(llm.model.config)
```

```
MarianConfig {
...
  "decoder_attention_heads": 8,
...
  "encoder_attention_heads": 8,
...
  "is_encoder_decoder": true,
...
```

```python
print(llm.model.config.is_encoder_decoder)
```

```
True
```

Let's practice!

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