

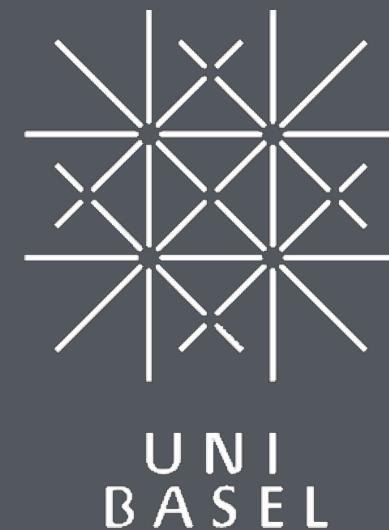
# Open-source LLMs

## for Behavioral Science

@ UniBasel 2025 Training Day



MAX PLANCK INSTITUTE  
FOR HUMAN DEVELOPMENT

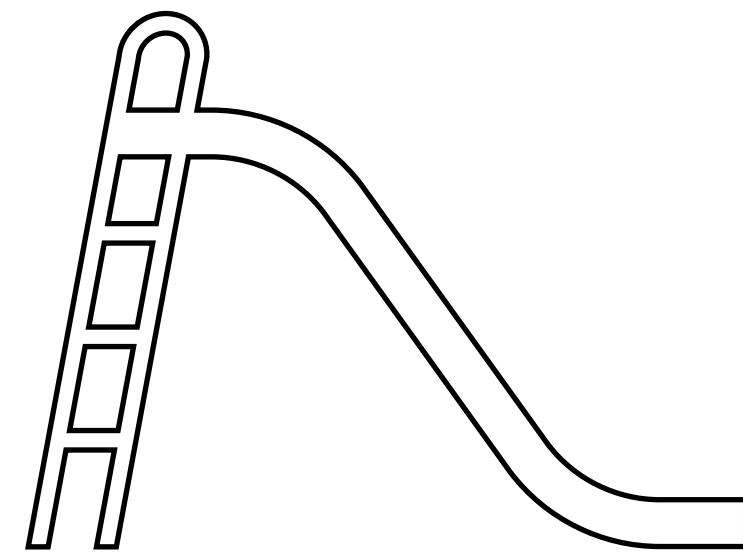


# Goals

Familiarize you with the workings and applications of open-source LLMs and how to implement them using the Hugging Face ecosystem

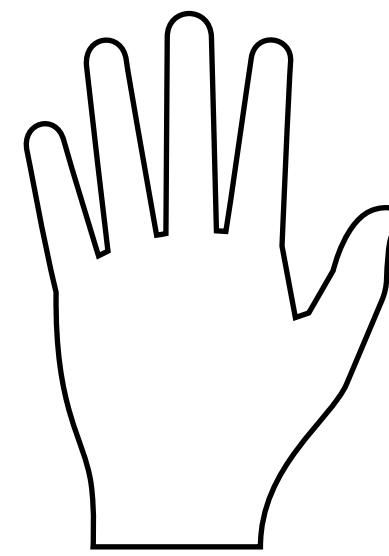


# Components



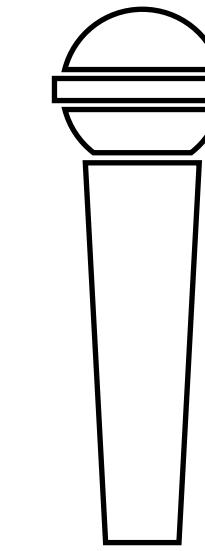
## Slide-based introductions

Introduces core concepts and code



## Hands-on exercises

Work through ready-made notebooks to carry out analyzes step-by-step



## Discussions

Discuss and reflect on applications of LLMs

# Software stack



+



+





Zak-Hussain / LLM4BeSciUnibas

Type / to search



Code

Issues

Pull requests

Actions

Projects

Wiki

Security

Insights

Settings



LLM4BeSciUnibas

Public

Pin

Unwatch 1

Fork 0

Star 1

main

1 Branch

0 Tags

Go to file

t

Add file

Code

Zak-Hussain update course title

c22ff8b · 5 minutes ago 10 Commits

1\_pipelines.ipynb

add exercises

5 days ago

2\_feature\_extraction.ipynb

rename

5 days ago

3\_text\_generation.ipynb

'your access token here'

5 days ago

LICENSE.txt

add LICENSE.txt

3 weeks ago

README.md

update course title

5 minutes ago

media\_bias\_test.csv

add data

5 days ago

media\_bias\_train.csv

add data

5 days ago

README

License



## LLM4BeSciUnibas

This repository contains the training materials for the course "[Open-Source Large Language Models for Behavioral Science](#)", which will be hosted at the University of Basel from February 10th - 12th, 2025. Please see the [course website](#) for more information.

## Resources

### About

Training materials for the course "LLMs for Behavioral Science", UniBasel, 2025.

Readme

View license

Activity

1 star

1 watching

0 forks

### Releases

No releases published

[Create a new release](#)

### Packages

No packages published

[Publish your first package](#)

### Languages

Jupyter Notebook 100.0%

# Schedule

09:15 - 09:45: Welcome & Intro

09:45 - 10:30: Talk: Intro to LLMs

10:30 - 10:45: Break

10:45 - 11:15: Talk: A gentle intro to Hugging Face and Python

11:15 - 12:00: Exercise: Running pipelines

12:00 - 13:00: Lunch

13:00 - 14:00: Talk: Intro to feature extraction and text generation

14:00 - 15:00: Exercise: Feature extraction

15:00 - 15:15: Break

15:15 - 16:15: Exercise: Text generation

16:15 - 17:00: Demo: Intro to using LLMs with sciCORE



1. What's your academic background and current research focus?
2. What motivates you to learn more about LLMs?
3. R or Python or \_\_ ?
4. How much experiences do you have with programming and machine learning?

# Intro LLMs

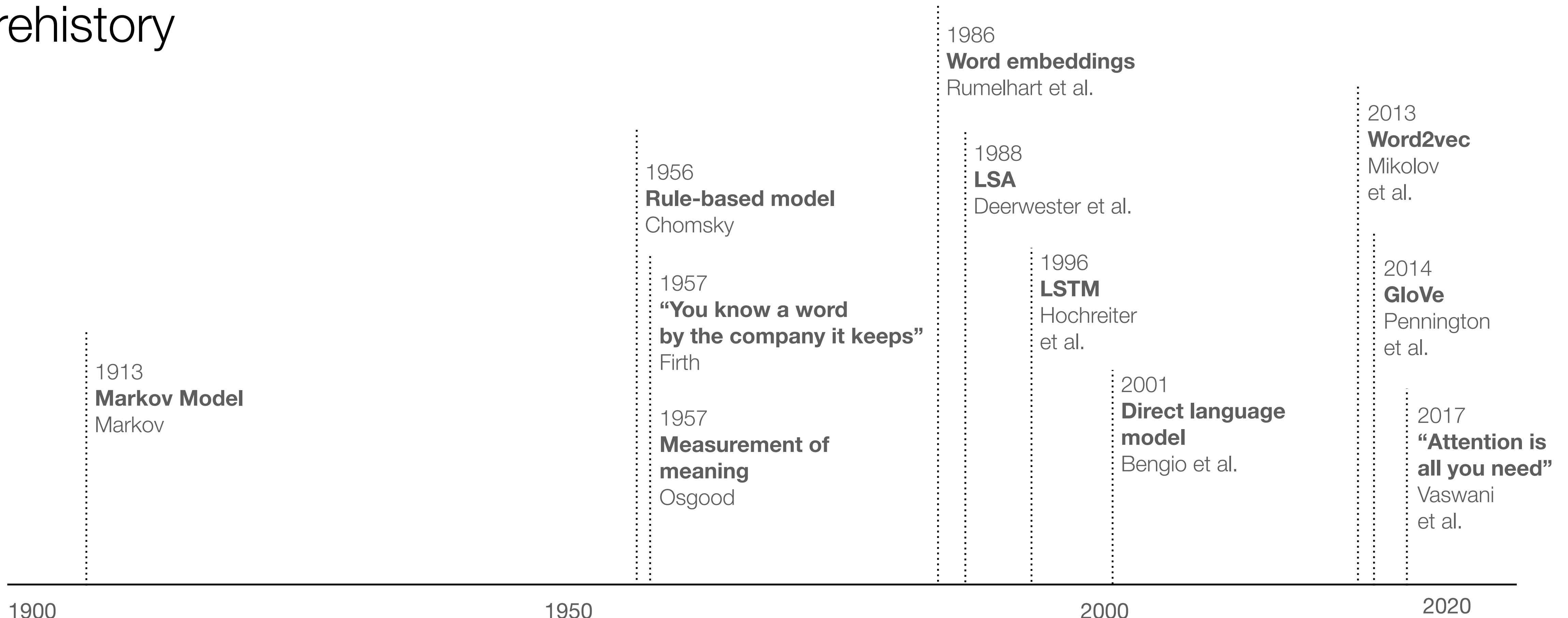


MAX PLANCK INSTITUTE  
FOR HUMAN DEVELOPMENT



# Language models

## Prehistory



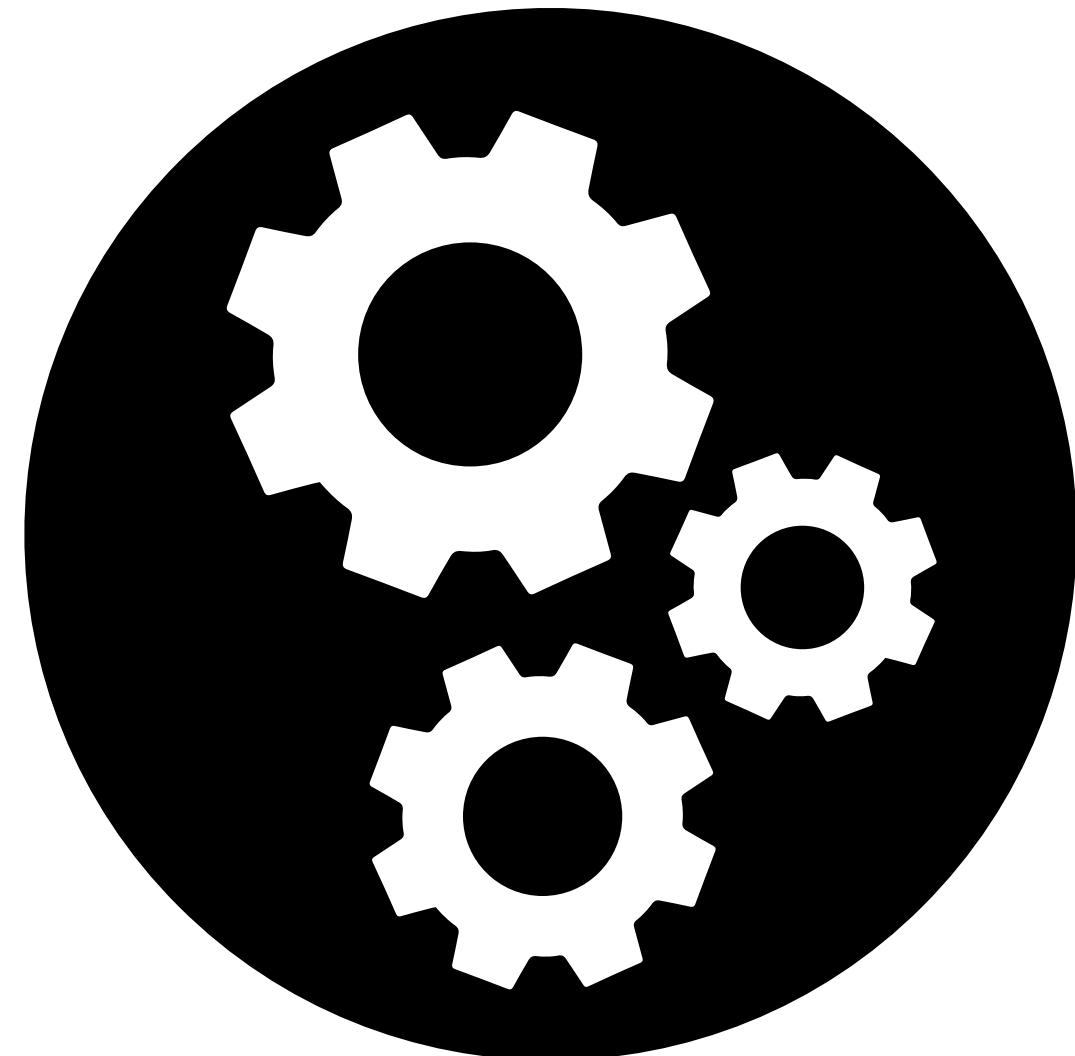


“You’ll know  
a word by  
the company  
that it  
keeps!”

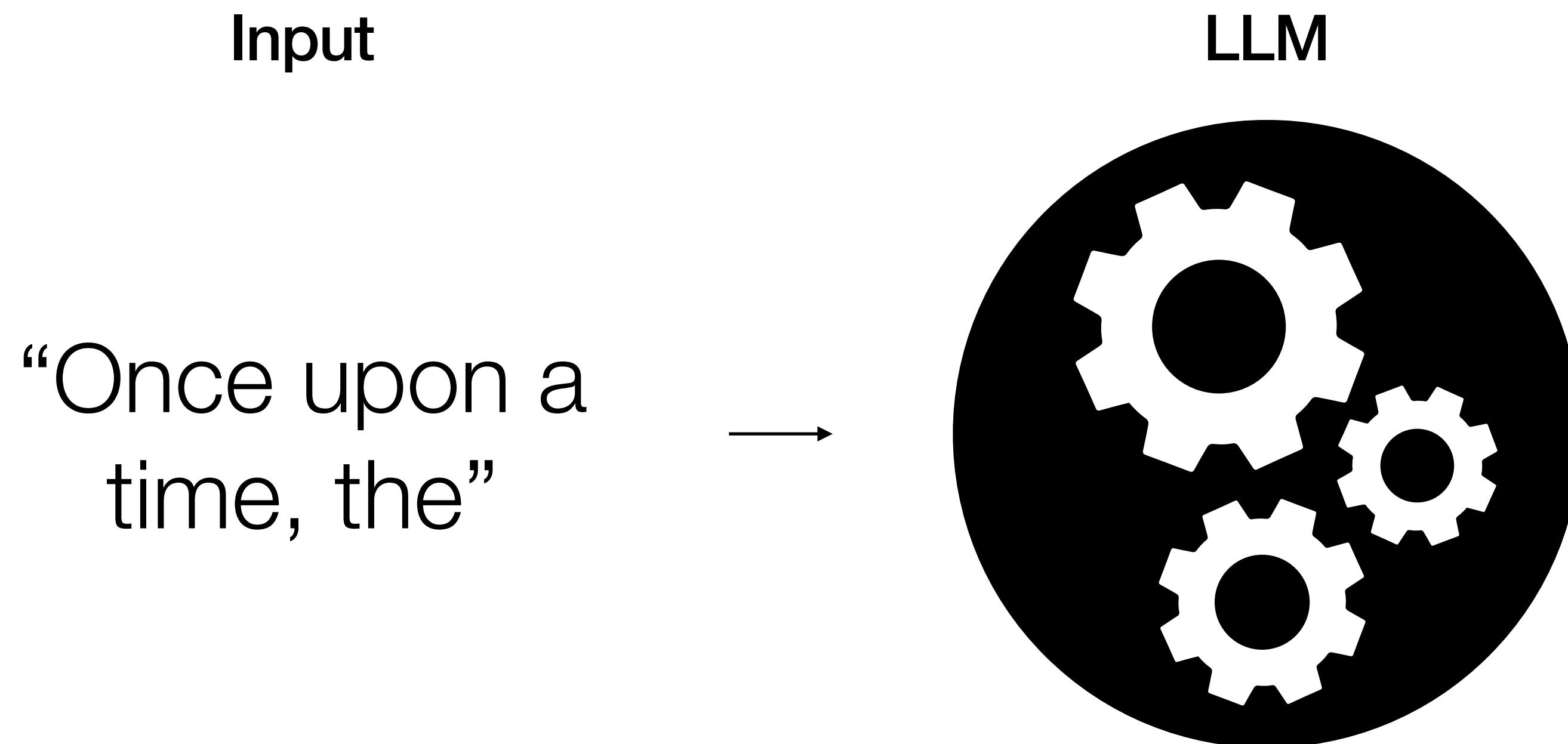
John Rupert Firth  
Linguist  
1890-1960

# LLMs as mechanisms

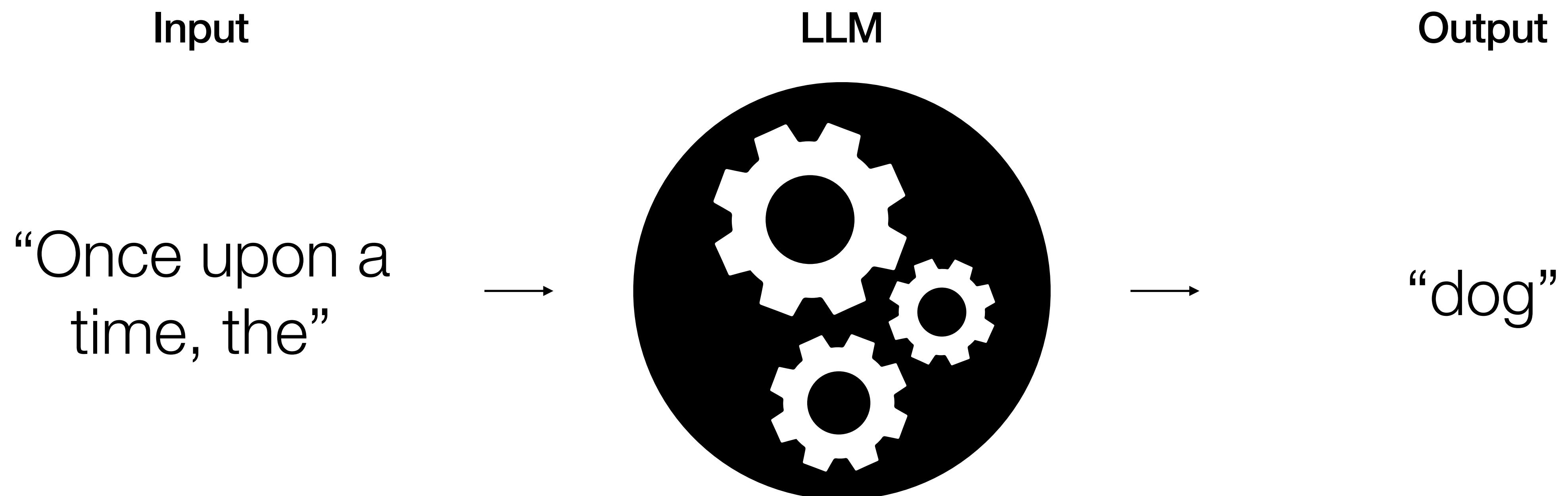
LLM



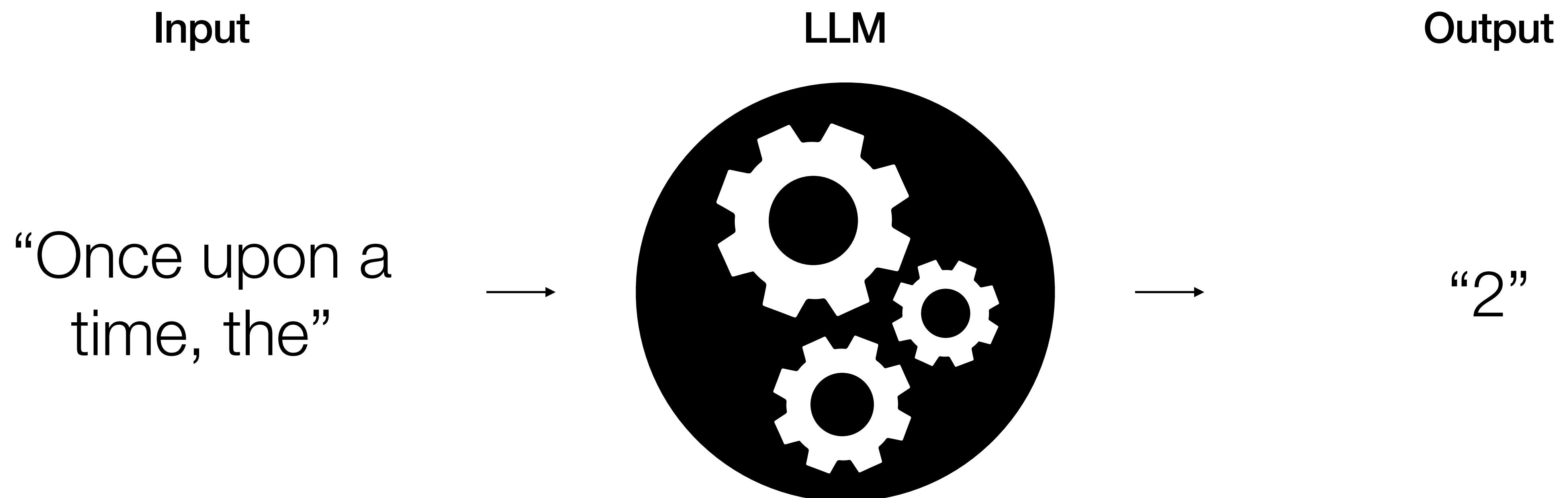
# LLMs as mechanisms



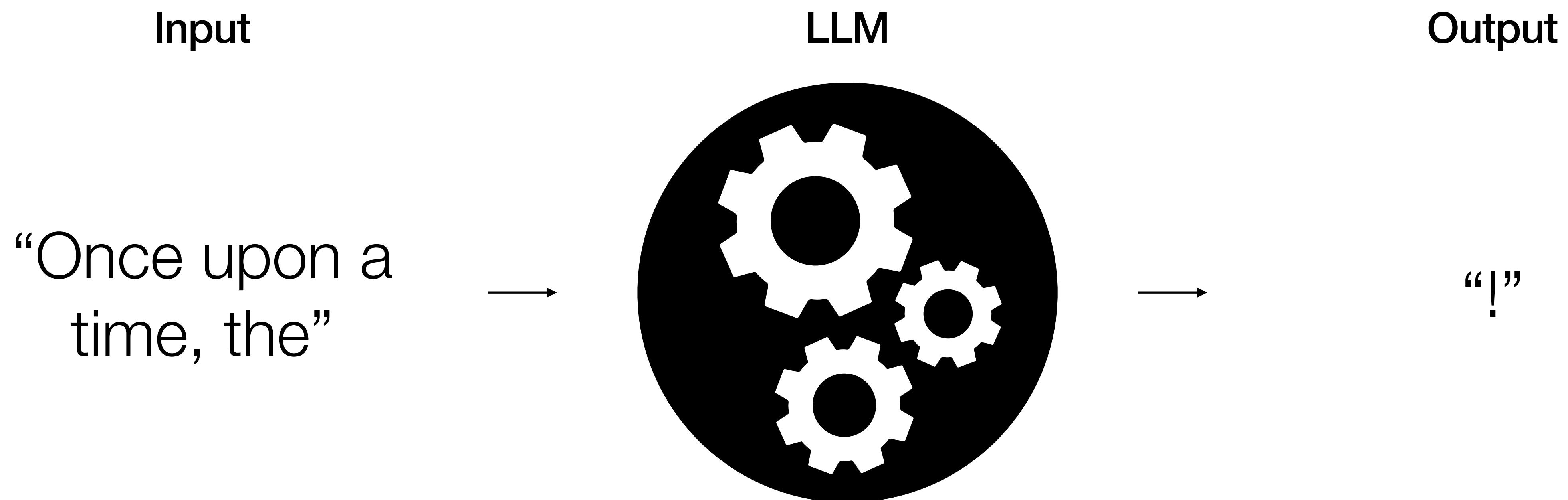
# LLMs as mechanisms



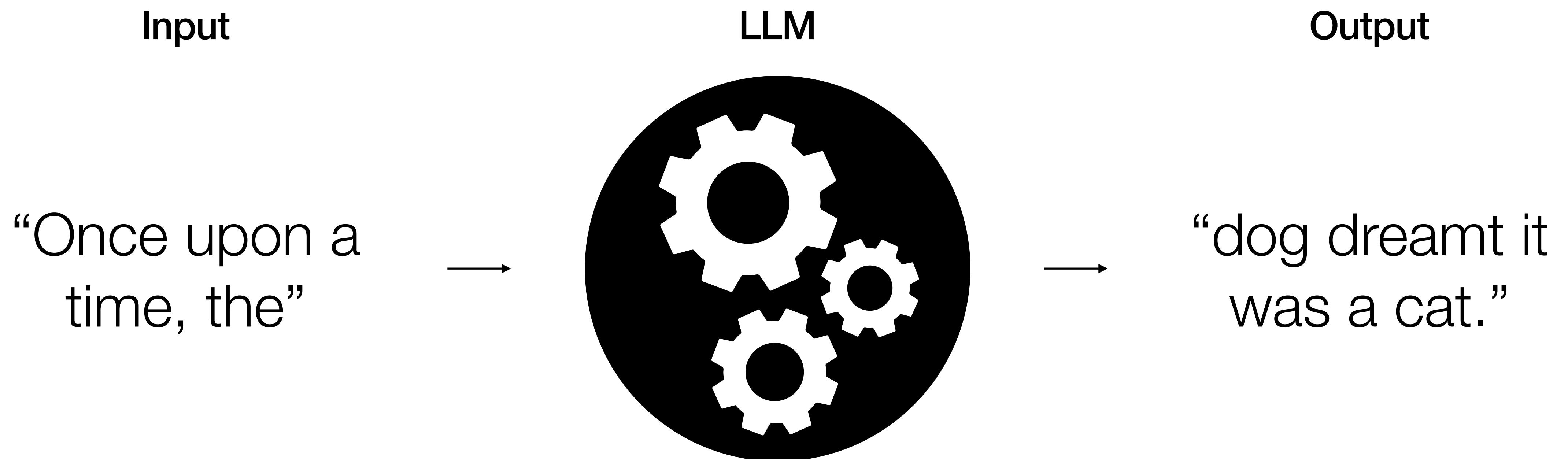
# LLMs as mechanisms



# LLMs as mechanisms



# LLMs as mechanisms



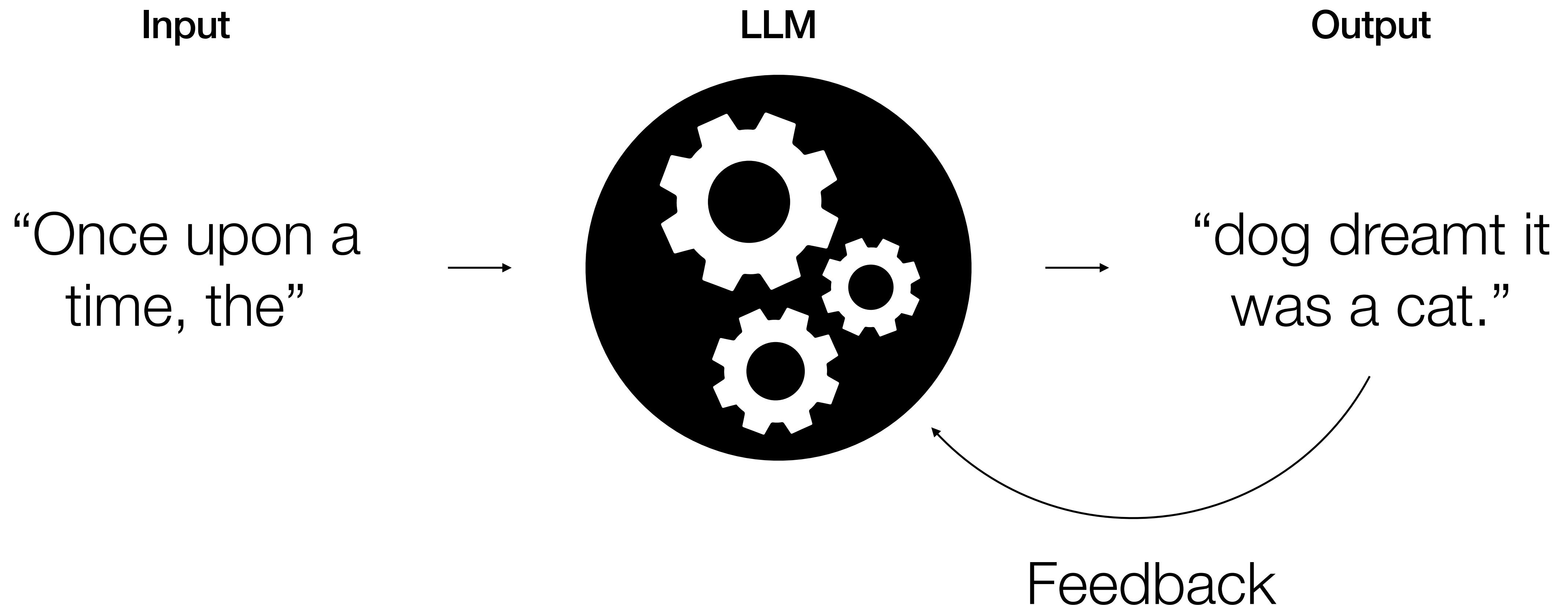
Once upon a time, the



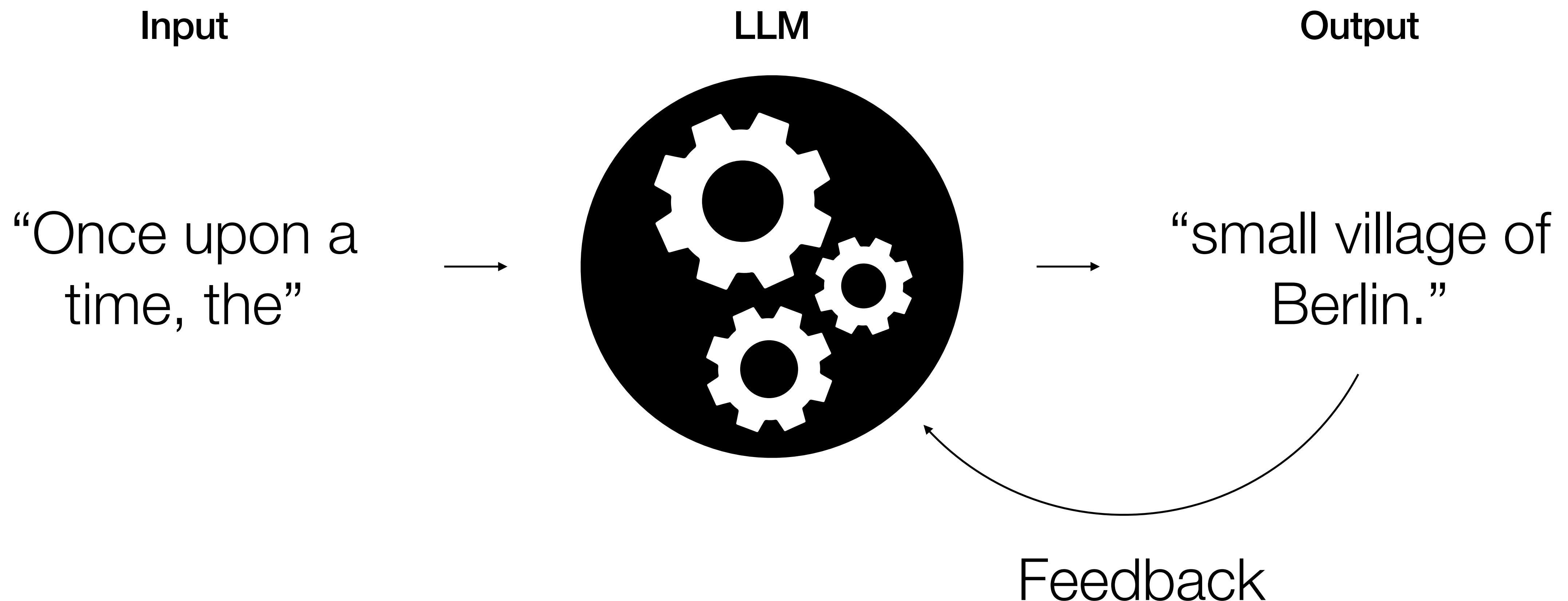
Once upon a time, the small village of Elmswood was nestled in a lush valley surrounded by towering mountains. The villagers lived peacefully, their days marked by the rhythms of nature and the changing seasons. However, everything changed when a mysterious old man arrived, carrying with him a locked chest that was said to contain a secret capable of altering the course of history. Intrigued by the stranger and his enigmatic treasure, the people of Elmswood soon found themselves on the brink of an adventure that would bind them together in ways they could never have imagined.



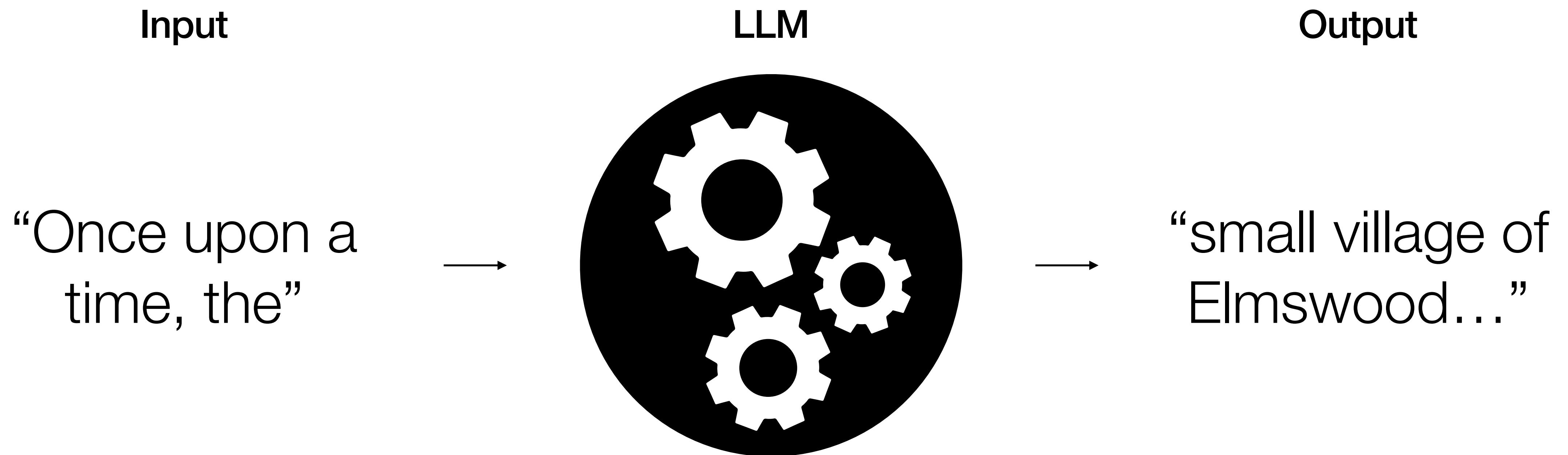
# LLMs as **trained** mechanisms



# LLMs as **trained** mechanisms



# LLMs as **trained** mechanisms

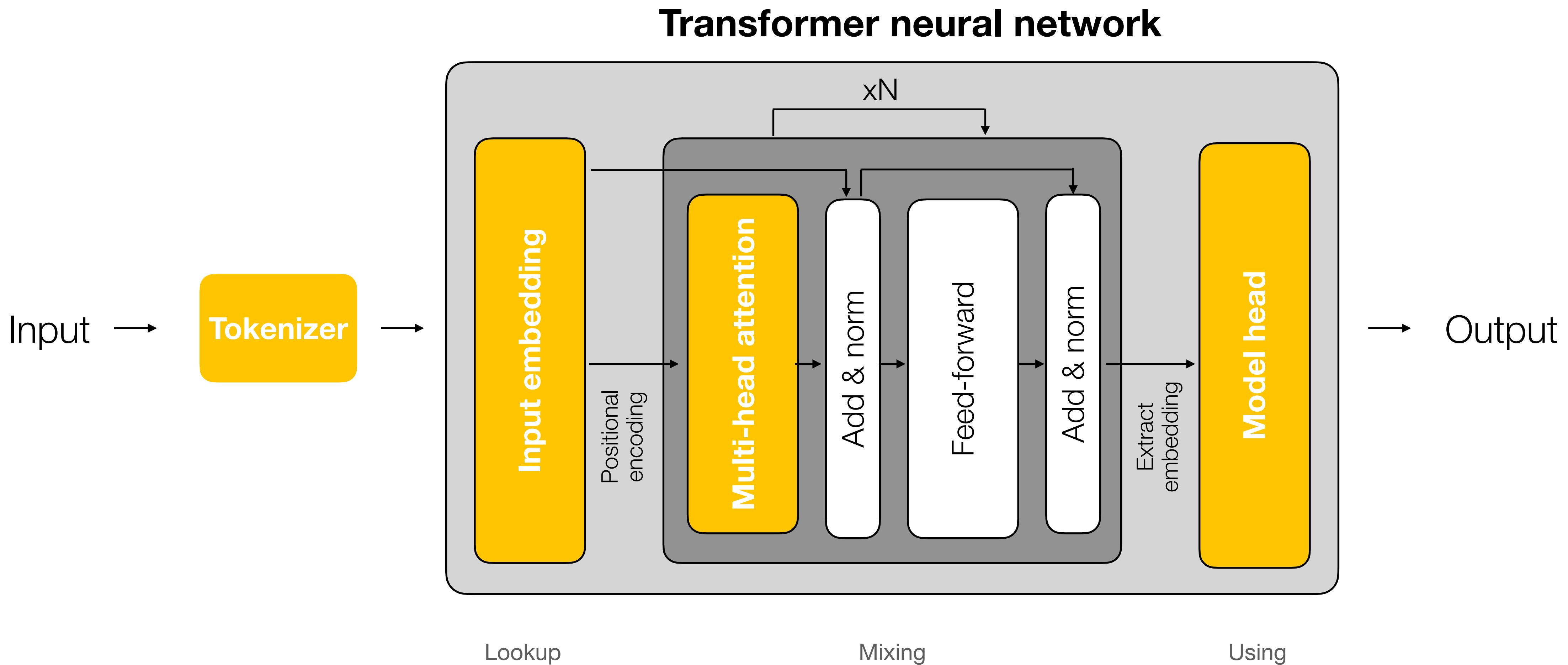


# LLMs as **trained** mechanisms

LLM

?

# LLMs as trained mechanisms



Phi-3-mini-4K-Instruct and Phi-3-mini-128K-Instruct were trained over 7 days on 3.3T tokens using 512 H100-80G GPUs for each model. They followed advanced fine-tuning techniques to align with human preferences and safety standards.

The pre-training process followed two distinct and consecutive stages:

- In the first stage, the models were primarily exposed to a vast collection of web sources. This data helped the models develop general knowledge and language comprehension.
- In the second stage, the models were fine-tuned with a more rigorously selected subset of web data from the first phase, combined with additional synthetic data, to improve their logical reasoning and specialized abilities.

After these 2 stages, the models underwent additional training, which included supervised instruction fine-tuning and preference tuning, to enhance their stability and security.

The training dataset, made of 3.3 trillion tokens, is a meticulously curated mix of quality-filtered public documents, select educational materials, code, and newly generated synthetic data generated by LLMs. Specifically, the team filtered the web data to encompass the appropriate degree of knowledge and retained a greater number of web pages that may enhance the models' reasoning abilities. Instead of indiscriminately feeding vast amounts of data into the training model, the emphasis was placed on enhancing its reasoning capabilities, rather than one that merely has a vast repository of information.



# Phi-3

---

# **LLM training = Pretraining + Fine-tuning**

Trillions of tokens

Millions of power  
consumption

Uses masked/next token  
prediction

Hand-selected/crafted texts

Quality input-output pairs  
Human feedback

# Masked/next token prediction

"Once upon a time" is a [stock phrase](#) used to introduce a narrative of past events, typically in [fairy tales](#) and folk tales. It has been used in some form since at least 1380 (according to the [Oxford English Dictionary](#)) in [storytelling](#) in the [English language](#) and has started many narratives since 1600. These stories sometimes end with "and they all lived [happily ever after](#)", or, originally, "happily until their deaths".

The phrase is common in [fairy tales](#) for younger children. It was used in the original translations of the stories of [Charles Perrault](#) as a translation for the [French](#) "*il était une fois*", of [Hans Christian Andersen](#) as a translation for the [Danish](#) "*der var engang*" (literally "there was once"), the [Brothers Grimm](#) as a translation for the [German](#) "*es war einmal*" (literally "it was once") and [Joseph Jacobs](#) in [English](#) translations and fairy tales.

In *More English Fairy Tales*, Joseph Jacobs notes that:

"The opening formula are varied enough, but none of them has much play of fancy. 'Once upon a time and a very good time it was, though it wasn't in my time nor in your time nor in any one else's time.' is effective enough for a fairy epoch, and is common, according to Mayhew (*London Labour*, III), among tramps."<sup>[1]</sup>

[https://en.wikipedia.org/wiki/Once\\_upon\\_a\\_time](https://en.wikipedia.org/wiki/Once_upon_a_time)

LLM



# Masked/next token prediction

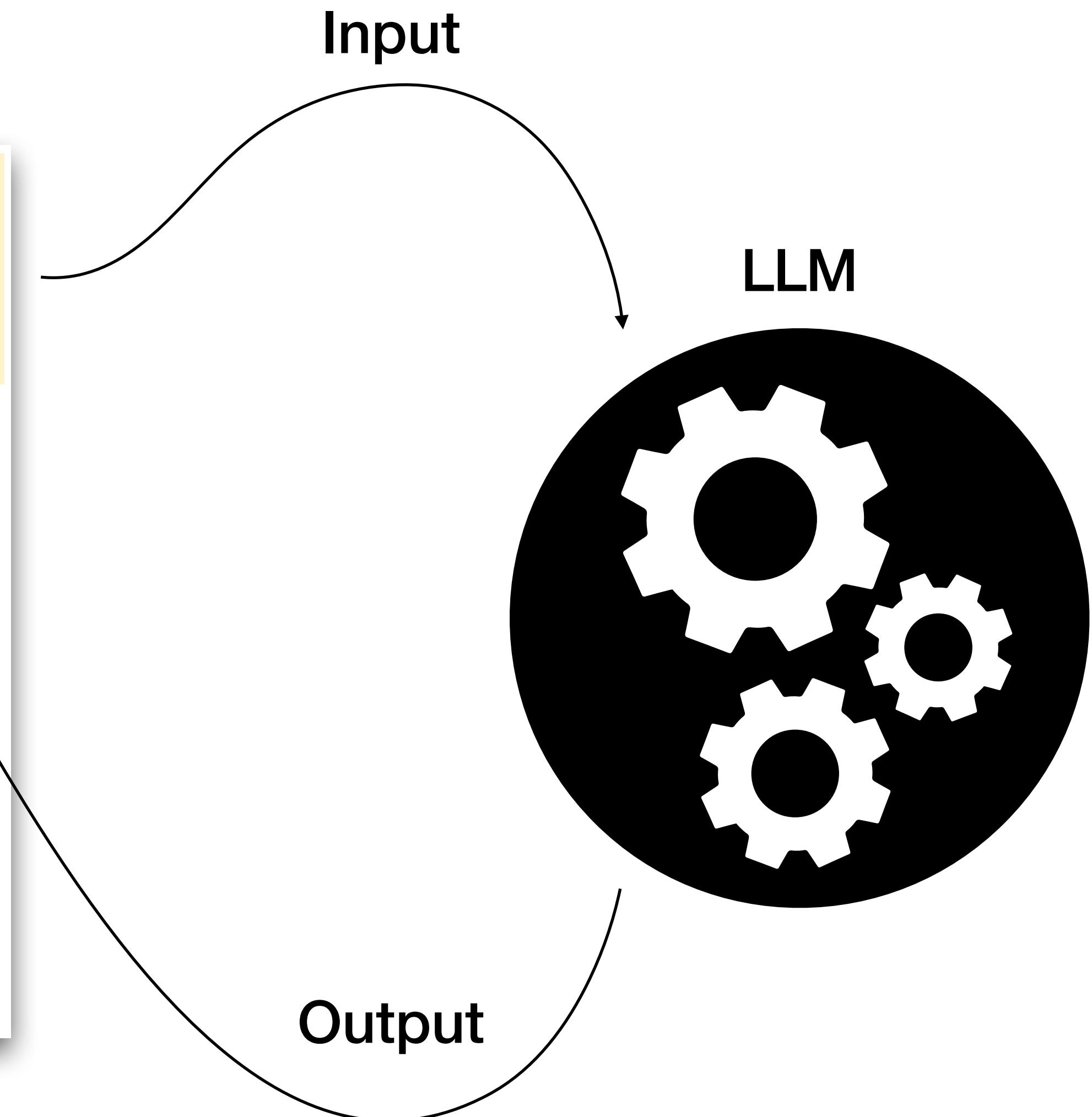
"Once upon a time" is a stock phrase used to introduce a narrative of past events, typically in fairy tales and folk tales. It has been used in some form since at least 1380 (according to the *Oxford English Dictionary*) in [REDACTED] in the English language and has started many narratives since 1600. These stories sometimes end with "and they all lived happily ever after", or, originally, "happily until their deaths".

The phrase is common in fairy tales for younger children. It was used in the original translations of the stories of Charles Perrault as a translation for the French "il était une fois", of Hans Christian Andersen as a translation for the Danish "der var engang" (literally "there was once"), the Brothers Grimm as a translation for the German "es war einmal" (literally "it was once") and Joseph Jacobs in English translations and fairy tales.

In *More English Fairy Tales*, Joseph Jacobs notes that:

"The opening formulae are varied enough, but none of them has much play of fancy. 'Once upon a time and a very good time it was, though it wasn't in my time nor in your time nor in any one else's time.' is effective enough for a fairy epoch, and is common, according to Mayhew (*London Labour*, III), among tramps."<sup>[1]</sup>

[https://en.wikipedia.org/wiki/Once\\_upon\\_a\\_time](https://en.wikipedia.org/wiki/Once_upon_a_time)



# Masked/next token prediction

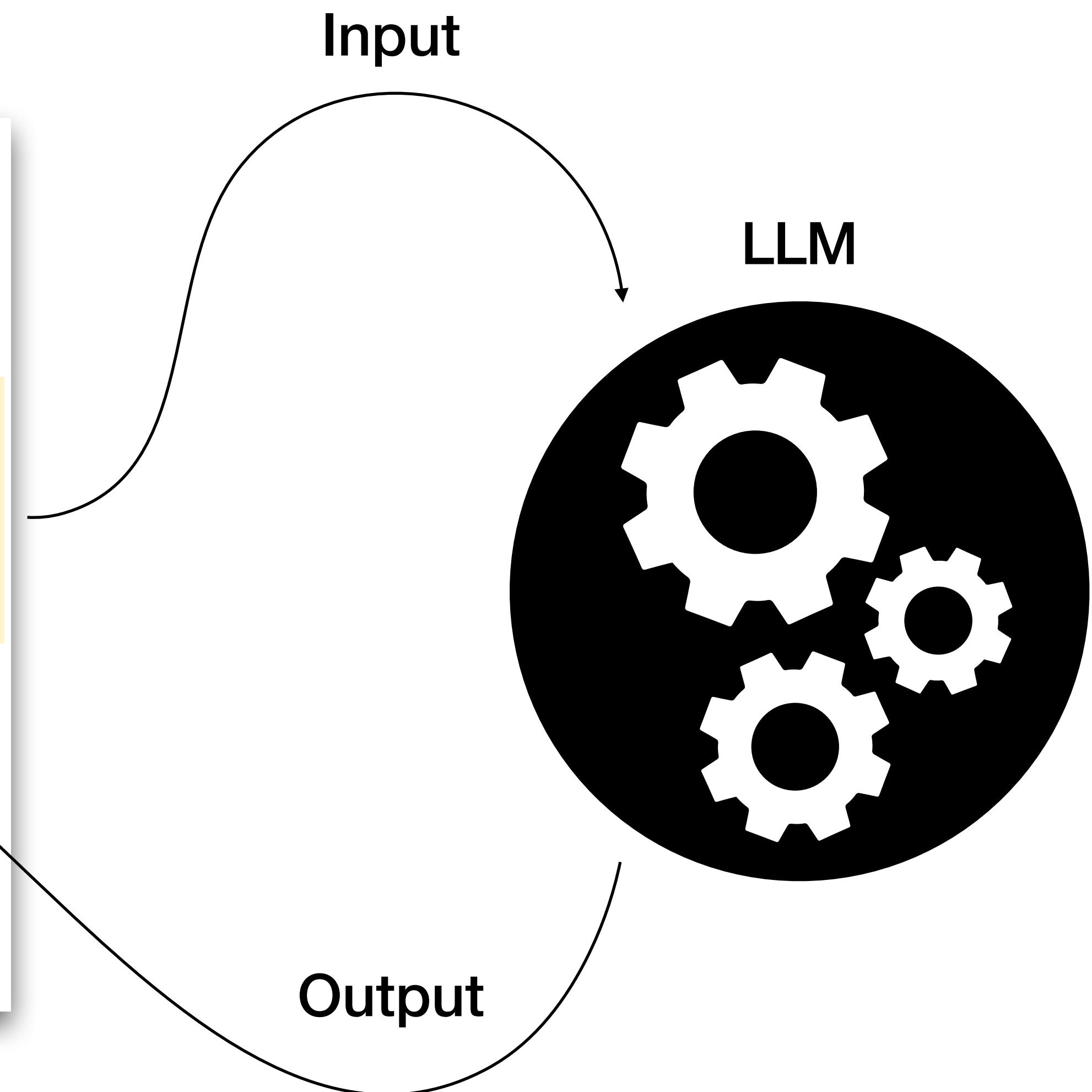
"Once upon a time" is a [stock phrase](#) used to introduce a narrative of past events, typically in [fairy tales](#) and folk tales. It has been used in some form since at least 1380 (according to the [Oxford English Dictionary](#)) in [storytelling](#) in the [English language](#) and has started many narratives since 1600. These stories sometimes end with "and they all lived [happily ever after](#)", or, originally, "happily until their deaths".

The phrase is common in [fairy tales](#) for younger children. It was used in the original translations of the stories of [Charles Perrault](#) as a translation for the [French](#) "*il était une fois*", of [Hans Christian Andersen](#) as a translation for the [Danish](#) "*der var engang*" (literally "there was once"), the [Brothers Grimm](#) as a translation for the [German](#) "*es war einmal*" (literally "it was once") and [Joseph Jacobs](#) in [English](#) translations and fairy tales.

In *More English Fairy Tales*, Joseph Jacobs notes that:

"The opening formulae are varied enough, but none of them has much play of fancy. 'Once upon a time and a very good time it was, though it wasn't in my time nor in your time nor in any one else's time.' is effective enough for a fairy epoch, and is common, according to Mayhew (*London Labour, III*), among tramps."<sup>[1]</sup>

[https://en.wikipedia.org/wiki/Once\\_upon\\_a\\_time](https://en.wikipedia.org/wiki/Once_upon_a_time)



# Masked/next token prediction

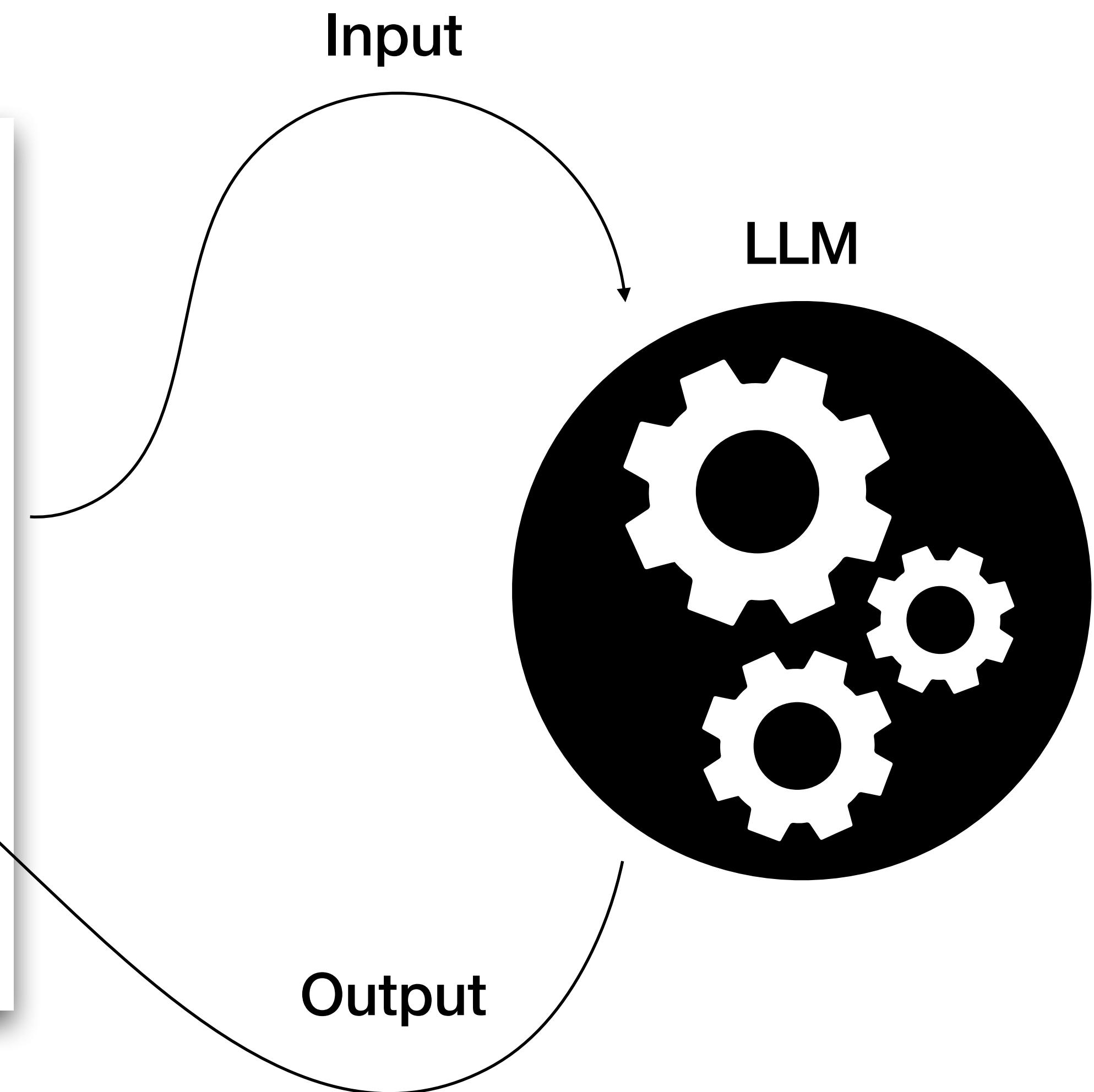
"Once upon a time" is a [stock phrase](#) used to introduce a narrative of past events, typically in [fairy tales](#) and folk tales. It has been used in some form since at least 1380 (according to the [Oxford English Dictionary](#)) in [storytelling](#) in the [English language](#) and has started many narratives since 1600. These stories sometimes end with "and they all lived [happily ever after](#)", or, originally, "happily until their deaths".

The phrase is common in [fairy tales](#) for younger children. It was used in the original translations of the stories of [Charles Perrault](#) as a translation for the [French](#) "*il était une fois*", of [Hans Christian Andersen](#) as a translation for the [Danish](#) "*der var engang*" (literally "there was once"), the [Brothers Grimm](#) as a translation for the [German](#) "*es war einmal*" (literally "it was once") and [Joseph Jacobs](#) in [English](#) translations and fairy tales.

In *More English Fairy Tales*, Joseph Jacobs notes that:

"The opening formulae are varied enough, but none of them has much play of fancy. 'Once upon a time and a very good time it was, though it wasn't in my time nor in your time nor in any one else's time.' is effective enough for a fairy epoch, and is common, according to Mayhew (*London Labour, III*), among tramps."<sup>[1]</sup>

[https://en.wikipedia.org/wiki/Once\\_upon\\_a\\_time](https://en.wikipedia.org/wiki/Once_upon_a_time)



# Masked/next token prediction

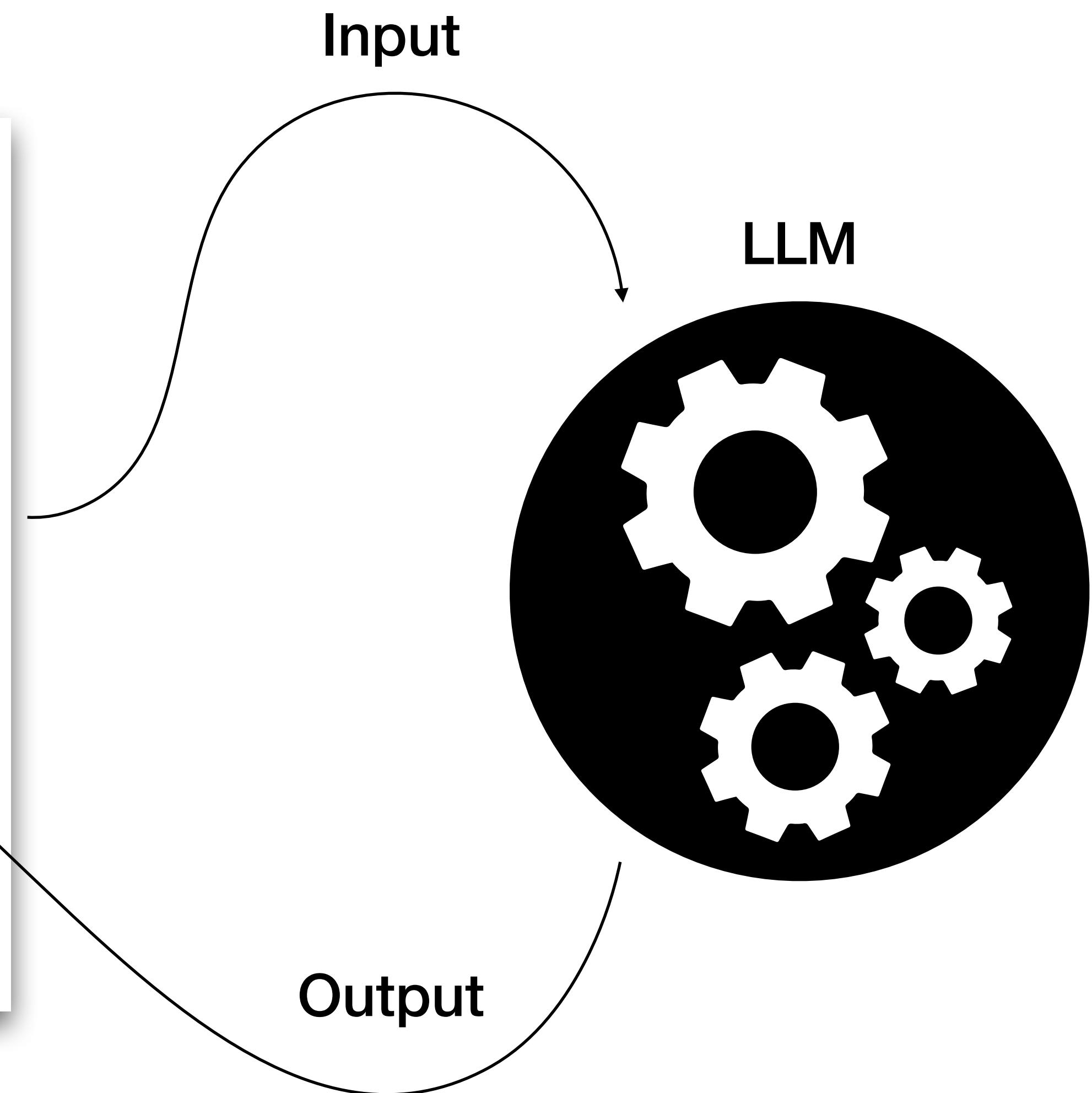
"Once upon a time" is a [stock phrase](#) used to introduce a narrative of past events, typically in [fairy tales](#) and folk tales. It has been used in some form since at least 1380 (according to the [Oxford English Dictionary](#)) in [storytelling](#) in the [English language](#) and has started many narratives since 1600. These stories sometimes end with "and they all lived [happily ever after](#)", or, originally, "happily until their deaths".

The phrase is common in [fairy tales](#) for younger children. It was used in the original translations of the stories of [Charles Perrault](#) as a translation for the [French](#) "*il était une fois*", of [Hans Christian Andersen](#) as a translation for the [Danish](#) "*der var engang*" (literally "there was once"), the [Brothers Grimm](#)  a translation for the [German](#) "*es war einmal*" (literally "it was once") and [Joseph Jacobs](#) in [English](#) translations and fairy tales.

In *More English Fairy Tales*, Joseph Jacobs notes that:

"The opening formulae are varied enough, but none of them has much play of fancy. 'Once upon a time and a very good time it was, though it wasn't in my time nor in your time nor in any one else's time.' is effective enough for a fairy epoch, and is common, according to Mayhew (*London Labour, III*), among tramps."<sup>[1]</sup>

[https://en.wikipedia.org/wiki/Once\\_upon\\_a\\_time](https://en.wikipedia.org/wiki/Once_upon_a_time)



# Masked/next token prediction

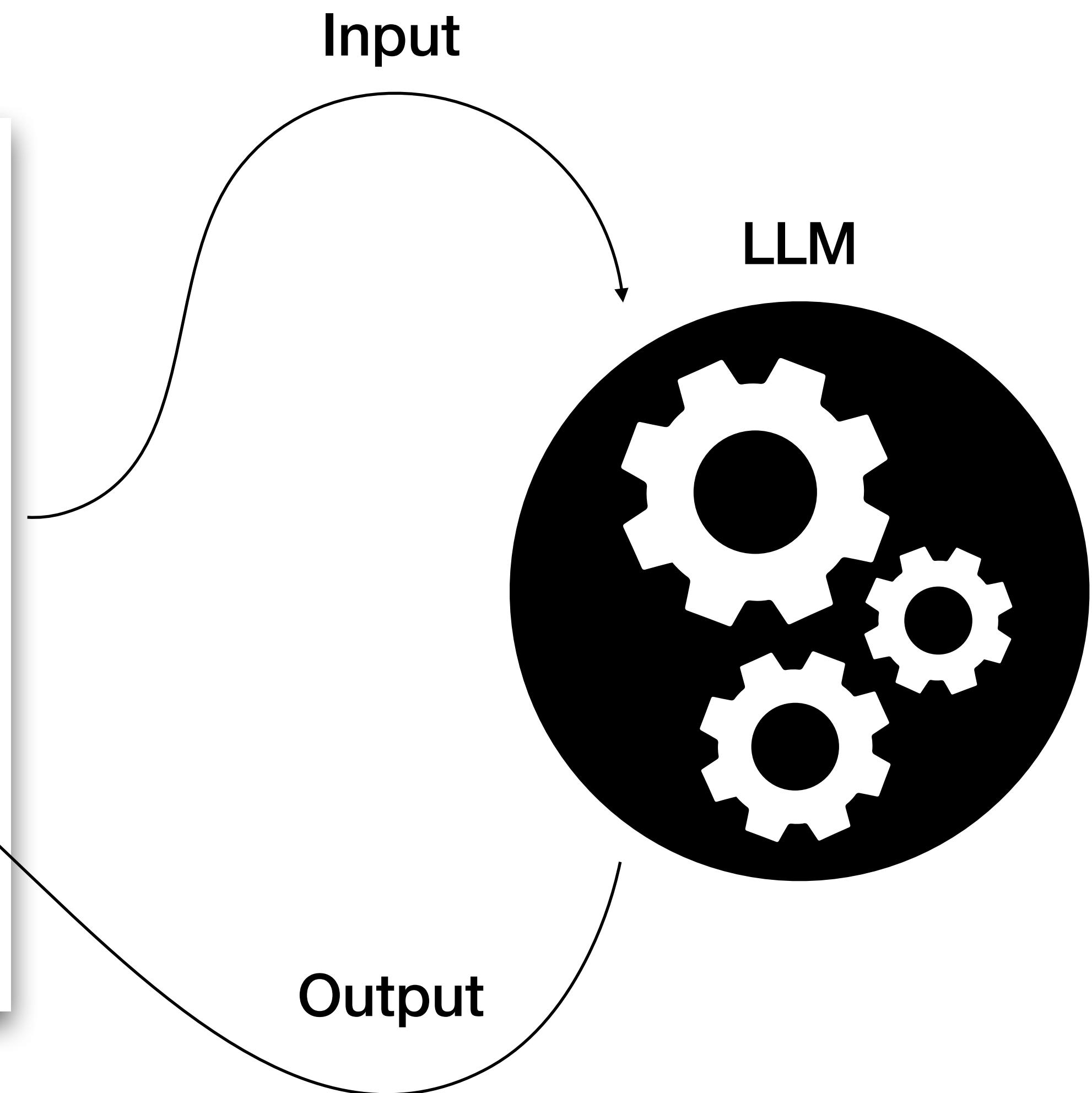
"Once upon a time" is a [stock phrase](#) used to introduce a narrative of past events, typically in [fairy tales](#) and folk tales. It has been used in some form since at least 1380 (according to the [Oxford English Dictionary](#)) in [storytelling](#) in the [English language](#) and has started many narratives since 1600. These stories sometimes end with "and they all lived [happily ever after](#)", or, originally, "happily until their deaths".

The phrase is common in [fairy tales](#) for younger children. It was used in the original translations of the stories of [Charles Perrault](#) as a translation for the [French](#) "*il était une fois*", of [Hans Christian Andersen](#) as a translation for the [Danish](#) "*der var engang*" (literally "there was once"), the [Brothers Grimm](#)  a translation for the [German](#) "*es war einmal*" (literally "it was once") and [Joseph Jacobs](#) in [English](#) translations and fairy tales.

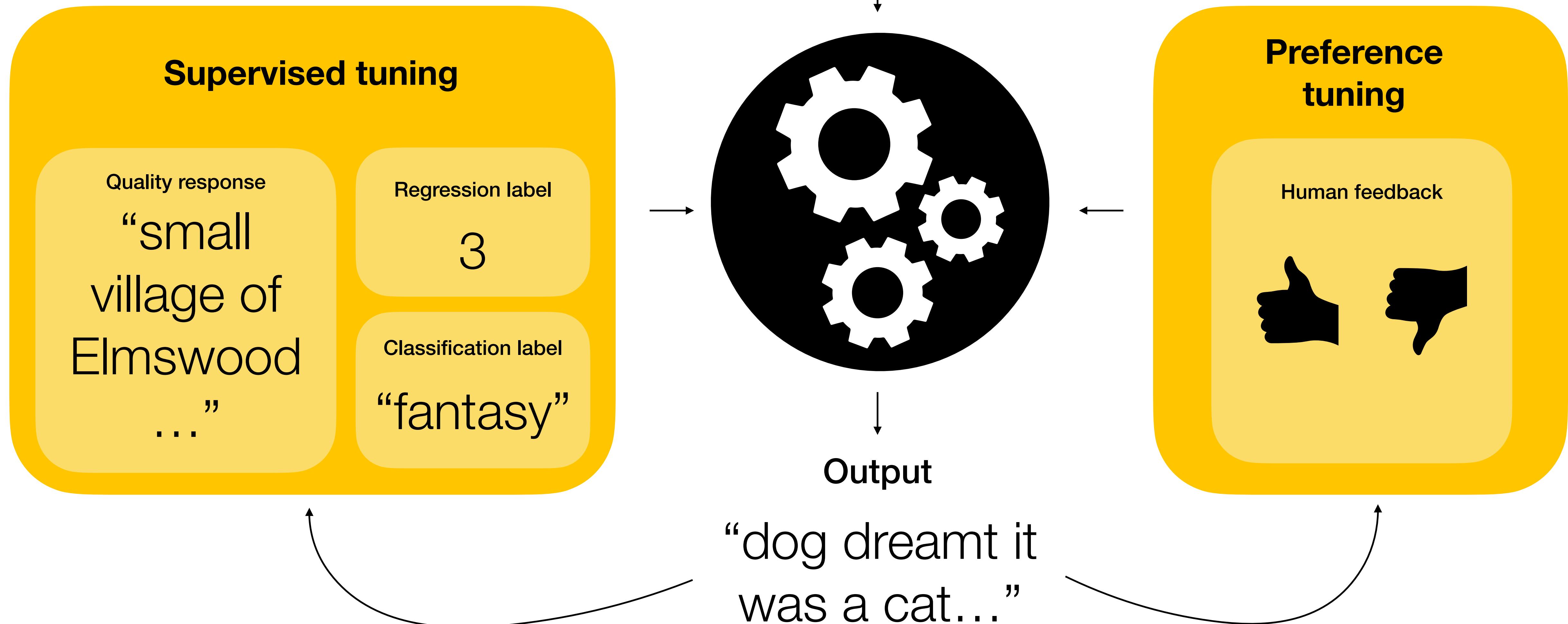
In *More English Fairy Tales*, Joseph Jacobs notes that:

"The opening formulae are varied enough, but none of them has much play of fancy. 'Once upon a time and a very good time it was, though it wasn't in my time nor in your time nor in any one else's time.' is effective enough for a fairy epoch, and is common, according to Mayhew (*London Labour, III*), among tramps."<sup>[1]</sup>

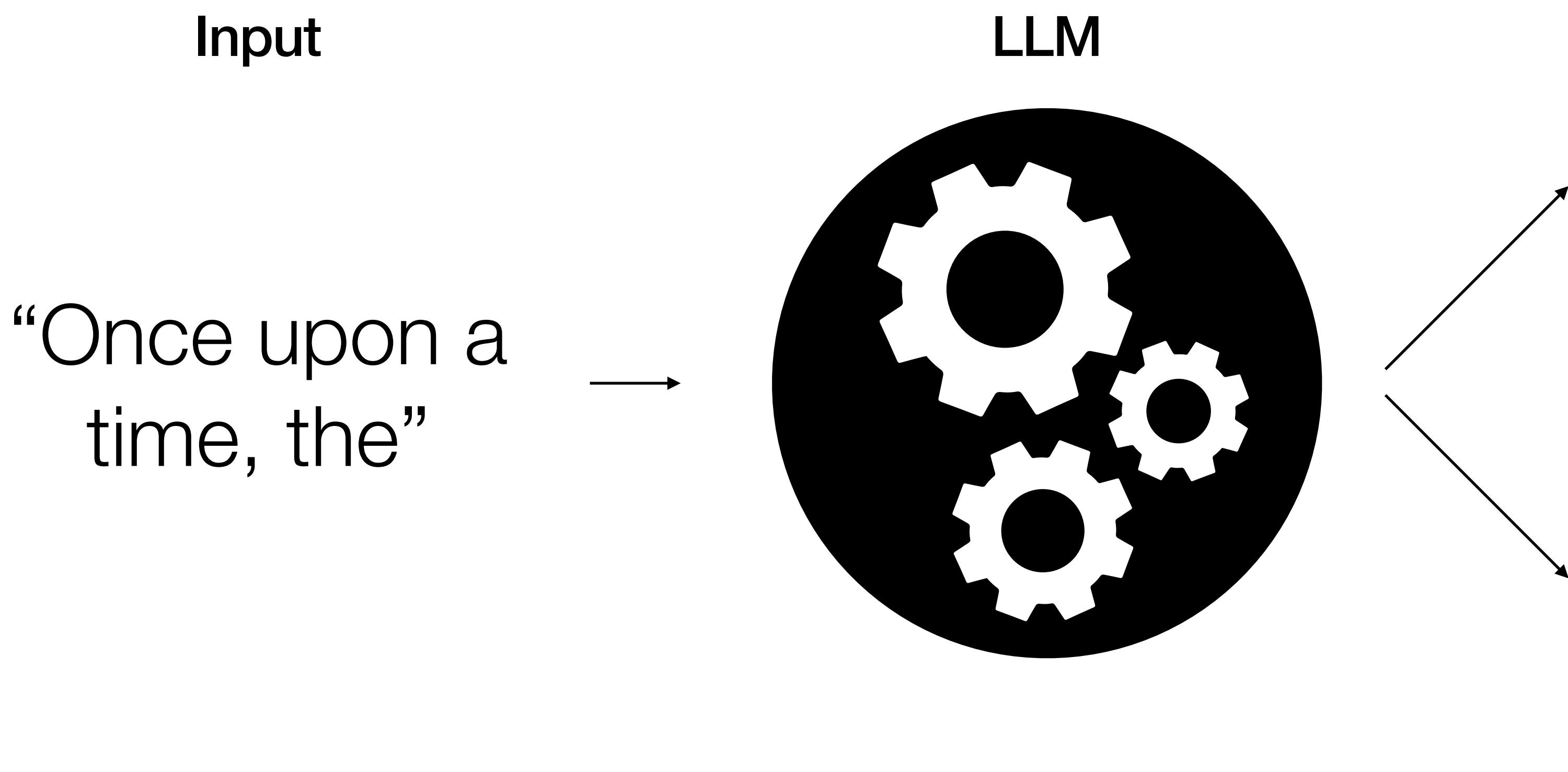
[https://en.wikipedia.org/wiki/Once\\_upon\\_a\\_time](https://en.wikipedia.org/wiki/Once_upon_a_time)



# Fine-tuning



# Two major applications



## Text generation

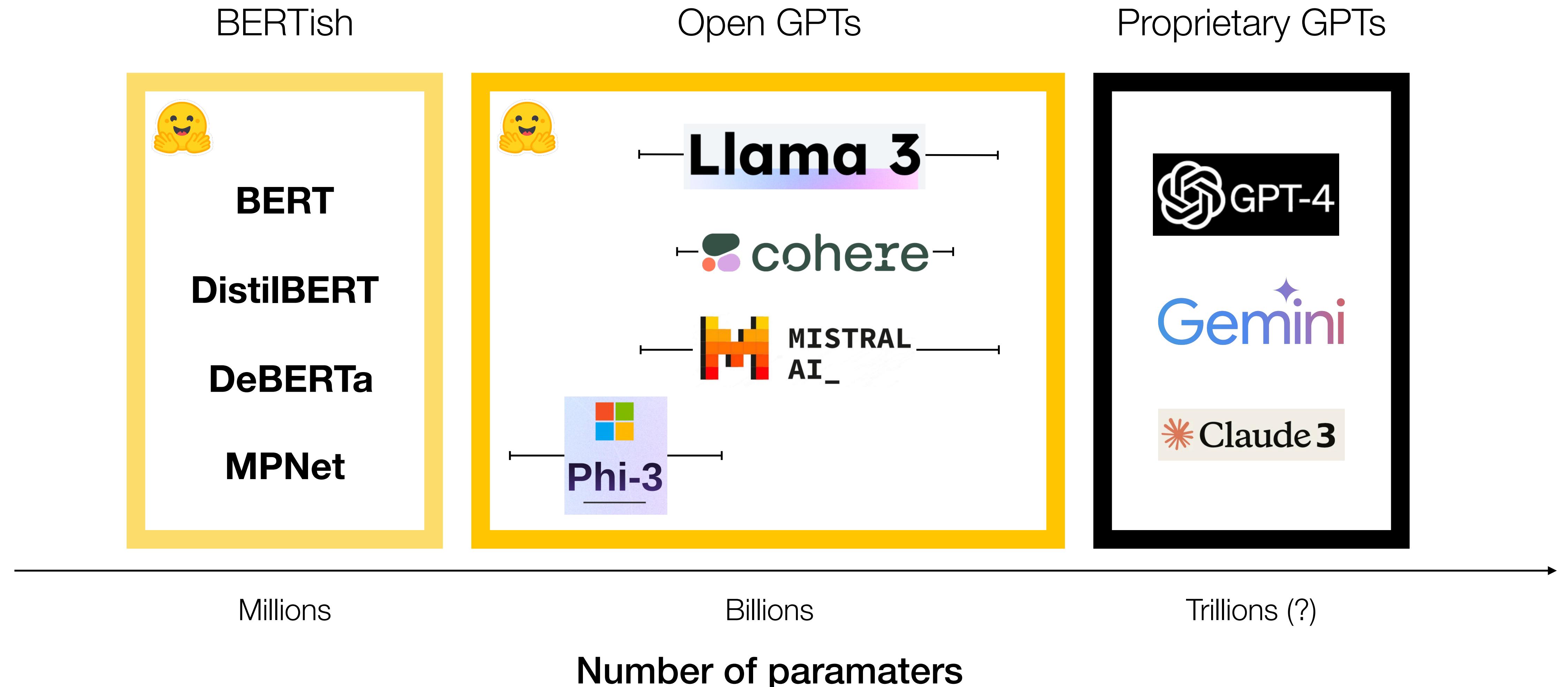
“small village of  
Elmswood...”



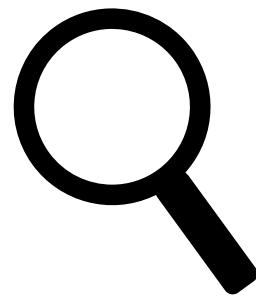
## Feature extraction

-.23, 1.23, .24,  
-.12, .34, .32, ...

# Models

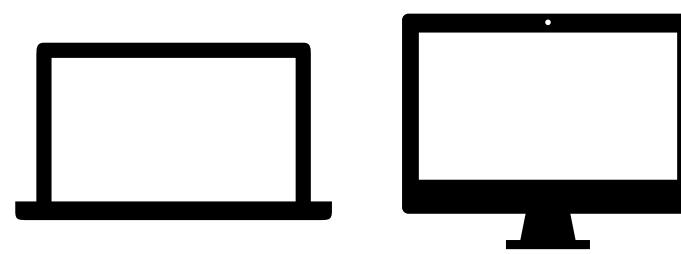


# Why Open-Source?



## Transparency

More information on model architecture, training data/setup, system prompt etc.



## Reproducibility

Weights/checkpoints can be saved/shared, random seeds set, hyper-parameters copied.



## Data Privacy

Models can be hosted locally so data can stay on local servers



Tasks Libraries Datasets Languages Licenses Other

Filter Tasks by name

Multimodal

- ↔️ Audio-Text-to-Text
- 🖼️ Image-Text-to-Text
- 💡 Visual Question Answering
- 📄 Document Question Answering
- 🎥 Video-Text-to-Text
- 🔀 Any-to-Any

Computer Vision

- 📦 Depth Estimation
- 📸 Image Classification
- 🔎 Object Detection
- ✂️ Image Segmentation
- ✍️ Text-to-Image
- 🖨️ Image-to-Text
- 🖼️ Image-to-Image
- 🎥 Image-to-Video
- 🌄 Unconditional Image Generation
- 🎥 Video Classification
- 🎞️ Text-to-Video
- 📷 Zero-Shot Image Classification
- 🎭 Mask Generation
- 🔎 Zero-Shot Object Detection
- 🔊 Text-to-3D
- 🖼️ Image-to-3D
- 🔍 Image Feature Extraction
- ⭐️ Keypoint Detection

Natural Language Processing

- 📊 Text Classification
- 🏷️ Token Classification
- 📋 Table Question Answering
- 💡 Question Answering
- 💡 Zero-Shot Classification
- 🌍 Translation
- 📝 Summarization
- 🧩 Feature Extraction
- ✍️ Text Generation
- 🔄 Text2Text Generation
- 📝 Fill-Mask
- 🔗 Sentence Similarity

Models 1,373,494

Filter by name

Full-text search

↑ Sort: Trending

[deepseek-ai/DeepSeek-R1](#)

Text Generation • Updated 2 days ago • ↓ 953k • ⚡ • ❤ 6.21k

[deepseek-ai/DeepSeek-V3](#)

Text Generation • Updated 10 days ago • ↓ 890k • ⚡ • ❤ 3.06k

[unsloth/DeepSeek-R1-GGUF](#)

Text Generation • Updated 4 days ago • ↓ 282k • ❤ 490

[deepseek-ai/Janus-Pro-1B](#)

Any-to-Any • Updated 2 days ago • ↓ 37.7k • ❤ 314

[Qwen/Qwen2.5-VL-7B-Instruct](#)

Image-Text-to-Text • Updated 7 days ago • ↓ 127k • ❤ 284

[hexgrad/Kokoro-82M](#)

Text-to-Speech • Updated 1 day ago • ↓ 108k • ❤ 2.71k

[Qwen/Qwen2.5-VL-72B-Instruct](#)

Image-Text-to-Text • Updated 7 days ago • ↓ 16.7k • ❤ 199

[black-forest-labs/FLUX.1-dev](#)

Text-to-Image • Updated Aug 16, 2024 • ↓ 1.54M • ⚡ • ❤ 8.44k

[deepseek-ai/DeepSeek-R1-Distill-Llama-70B](#)

Text Generation • Updated 2 days ago • ↓ 142k • ❤ 437

[cyberagent/DeepSeek-R1-Distill-Qwen-32B-Japanese](#)

Text Generation • Updated 7 days ago • ↓ 7.37k • ❤ 213

[deepseek-ai/Janus-Pro-7B](#)

Any-to-Any • Updated 2 days ago • ↓ 154k • ❤ 2.44k

[mistralai/Mistral-Small-24B-Instruct-2501](#)

Text Generation • Updated 1 day ago • ↓ 14.1k • ⚡ • ❤ 516

[tencent/Hunyuan3D-2](#)

Image-to-3D • Updated about 8 hours ago • ↓ 32.8k • ❤ 732

[m-a-p/YuE-s1-7B-anneal-en-cot](#)

Text Generation • Updated 4 days ago • ↓ 16.4k • ❤ 314

[deepseek-ai/DeepSeek-R1-Distill-Qwen-32B](#)

Text Generation • Updated 2 days ago • ↓ 319k • ⚡ • ❤ 825

[deepseek-ai/DeepSeek-R1-Distill-Qwen-1.5B](#)

Text Generation • Updated 2 days ago • ↓ 354k • ⚡ • ❤ 639

[deepseek-ai/DeepSeek-R1-Zero](#)

Text Generation • Updated 2 days ago • ↓ 20.8k • ❤ 676

[mistralai/Mistral-Small-24B-Base-2501](#)

Text Generation • Updated 4 days ago • ↓ 2.14k • ❤ 179

[deepseek-ai/DeepSeek-R1-Distill-Llama-8B](#)

Text Generation • Updated 2 days ago • ↓ 241k • ❤ 396

[deepseek-ai/DeepSeek-V3-Base](#)

Updated 10 days ago • ↓ 26.9k • ❤ 1.49k

# 🏆 Chatbot Arena LLM Leaderboard: Community-driven Evaluation for Best LLM and AI chatbots

[Vote!](#)
[Twitter](#) | [Discord](#) | [Blog](#) | [GitHub](#) | [Paper](#) | [Dataset](#) | [Kaggle Competition](#)

This is a mirror of the live leaderboard created and maintained at <https://imarena.ai/leaderboard>. Please link to the original URL for citation purposes.

Chatbot Arena ([Imarena.ai](https://imarena.ai)) is an open-source platform for evaluating AI through human preference, developed by researchers at UC Berkeley [SkyLab](#) and [LMSYS](#). With over 1,000,000 user votes, the platform ranks best LLM and AI chatbots using the Bradley-Terry model to generate live leaderboards. For technical details, check out our [paper](#).

Chatbot Arena thrives on community engagement — cast your vote to help improve AI evaluation!

New Launch! Copilot Arena: [VS Code Extension to compare Top LLMs](#)

[Arena](#)  [NEW: Overview](#) [Arena \(Vision\)](#) [Arena-Hard-Auto](#) [Full Leaderboard](#)

Total #models: 195. Total #votes: 2,582,581. Last updated: 2025-01-27.

Code to recreate leaderboard tables and plots in this [notebook](#). You can contribute your vote at [Imarena.ai](https://imarena.ai)!

Category	Apply filter		Overall Questions					
Overall	<input type="checkbox"/> Style Control	<input type="checkbox"/> Show Deprecated	#models: 195 (100%)	#votes: 2,582,581 (100%)				

Rank* (UB)	Rank (StyleCtrl)	Model	Arena Score	95% CI	Votes	Organization	License	Knowledge Cutoff
1	1	<a href="#">Gemini-2.0-Flash-Thinking-Exp-01-21</a>	1382	+7/-5	7505	Google	Proprietary	Unknown
1	1	<a href="#">Gemini-Exp-1206</a>	1373	+5/-4	22886	Google	Proprietary	Unknown
2	8	<a href="#">Gemini-Exp-1121</a>	1365	+6/-5	17340	Google	Proprietary	Unknown
3	1	<a href="#">ChatGPT-4o-latest_(2024-11-20)</a>	1365	+4/-4	36117	OpenAI	Proprietary	Unknown
3	4	<a href="#">Gemini-2.0-Flash-Thinking-Exp-1219</a>	1363	+5/-5	17081	Google	Proprietary	Unknown
3	1	<a href="#">DeepSeek-R1</a>	1358	+8/-9	3286	DeepSeek	MIT	Unknown
5	7	<a href="#">Gemini-2.0-Flash-Exp</a>	1356	+4/-4	21709	Google	Proprietary	Unknown
6	1	<a href="#">o1-2024-12-17</a>	1351	+4/-6	9997	OpenAI	Proprietary	Unknown
7	11	<a href="#">Gemini-Exp-1114</a>	1347	+4/-4	17092	Google	Proprietary	Unknown
10	4	<a href="#">o1-preview</a>	1335	+3/-5	33181	OpenAI	Proprietary	2023/10
11	11	<a href="#">DeepSeek-V3</a>	1317	+5/-5	14628	DeepSeek	DeepSeek	Unknown

Massive Text Embedding Benchmark (MTEB) Leaderboard. To submit, refer to the [MTEB GitHub repository](#). Refer to the [MTEB paper](#) for details on metrics, tasks and models. Also check out [MTEB Arena](#).

Search Bar (separate multiple queries with `;`)

Model types

 Open
  Proprietary
  Sentence Transformers
  Cross-Encoders
  Bi-Encoders
   
 Uses Instructions
  No Instructions

Model sizes (in number of parameters)

 <100M
  100M to 250M
  250M to 500M
   
 500M to 1B
  >1B

Overall   Bitext Mining   Classification   Clustering   Pair Classification   Reranking   Retrieval   STS   Summarization   MultilabelClassification   Retrieval w/Instructions

English   Chinese   French   Polish   Russian

### Overall MTEB English leaderboard 🎉

- Metric: Various, refer to task tabs
- Languages: English

Rank	Model	Model Size (Million Parameters)	Memory Usage (GB, fp32)	Embedding Dimensions	Max Tokens	Average (56 datasets)	Classification Average (12 datasets)	Clustering Average (11 datasets)	PairClassification Average (3 datasets)
1	<a href="#">voyage-3-m-exp</a>					74.03	90.16	61.45	86.13
2	<a href="#">NV-Embed-v2</a>	7851	29.25	4096	32768	72.31	90.37	58.46	88.67
3	<a href="#">bge-en-ic1</a>	7111	26.49	4096	32768	71.67	88.95	57.89	88.14
4	<a href="#">LENS-d8000</a>	7111	26.49	4096	32768	71.62	88.43	58.02	87.87
5	<a href="#">jasper_en_vision_language_v1</a>					71.54	88.49	58.04	88.07
6	<a href="#">LENS-d4000</a>	7111	26.49	4096	32768	71.21	88.13	57.92	87.77
7	<a href="#">stella_en_1.5B_v5</a>	1543	5.75	8192	131072	71.19	87.63	57.69	88.07
8	<a href="#">SFR-Embedding-2_R</a>	7111	26.49	4096	32768	70.31	89.05	56.17	88.07
9	<a href="#">stella_en_400M_v5</a>	435	1.62	8192	8192	70.11	86.67	56.7	87.74
10	<a href="#">gte-Qwen2-7B-instruct</a>	7613	28.36	3584	32768	69.95	86.58	56.92	85.9
11	<a href="#">bge-multilingual-gemma2</a>	9242	34.43	3584	8192	69.88	88.08	54.65	85.84

# Models

BERTish

**all-MiniLM-L6-v2**  
**MPNet**  
**MPNet-personality**



Feature extraction  
(fine-tuning)

Open GPTs

**Llama-3.2-3B-Instruct**



Text-generation  
(in-context learning)

# Discussion

- Gather in small groups (2-3 people)
- Identify applications of LLMs relevant to you
- Report 1-3 applications

