

Applying open-source LLMs in Social and Behavioral Sciences @ MetaRep

Dirk Wulff



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



Software stack



+



+





dwulff / LLM4BeSci_SPUDM2025

 Type / to search

Code

Issues

Pull requests

Actions

Projects

Wiki

Security

Insights

Settings



LLM4BeSci_SPUDM2025

Public

Pin

Unwatch 1

Fork 0

Star 3

main

1 Branch

0 Tags

Go to file

t

+

<> Code

About

⚙



dwulff Update README.md

8858b35 · 3 days ago

30 Commits

day_1

add day_1.ipynb

2 weeks ago

day_2

add data

last week

day_3

typo

last week

.gitignore

init

4 months ago

LICENSE.txt

init

4 months ago

README.md

Update README.md

3 days ago

cover.png

init

4 months ago

README

License



No description, website, or topics provided.

[Readme](#)[View license](#)[Activity](#)[3 stars](#)[1 watching](#)[0 forks](#)

Releases

No releases published
[Create a new release](#)

Packages

No packages published

Schedule

Day 1

09:30 AM - 10:15 AM: Welcome & Intro
10:15 AM - 11:15 AM: [Talk: Intro to LLMs](#)
11:15 AM - 11:30 AM: Break
11:30 AM - 12:30 PM: Discussion: Find applications in small groups
12:30 PM - 02:00 PM: Lunch
02:00 PM - 02:30 PM: [Talk: A gentle intro to Hugging Face and Python](#)
02:30 PM - 02:45 PM: Setup Colab
02:45 PM - 03:15 PM: [Exercise: Running pipelines](#)
03:15 PM - 03:30 PM: Break
03:30 PM - 03:45 PM: Walkthrough
03:45 AM - 04:30 AM: [Talk: Intro to transformers & embeddings](#)
04:30 PM - 05:00 PM: Open questions

Day 2

09:30 AM - 10:00 AM: Recap quiz
10:00 AM - 11:00 AM: [Talk: Intro to transformers & embeddings \(continued\)](#)
11:00 AM - 11:15 AM: Break
11:15 AM - 12:00 AM: [Exercise: Embeddings for clustering](#)
12:00 PM - 12:30 PM: Walkthrough
12:30 PM - 02:00 PM: Lunch
02:00 PM - 03:00 PM: Discussion: Find applications in small groups
03:00 PM - 03:30 PM: Break
03:30 PM - 04:30 PM: [Intro to textgen](#)
04:30 PM - 05:00 PM: Open questions

Day 3

09:30 AM - 10:00 AM: Recap quiz
10:00 AM - 11:00 AM: Exercise: Text gen for [classification](#)
11:00 AM - 11:30 AM: Walkthrough
11:30 PM - 11:45 PM: Break
11:45 PM - 12:30 PM: Discussion: Find applications in small groups



30s each

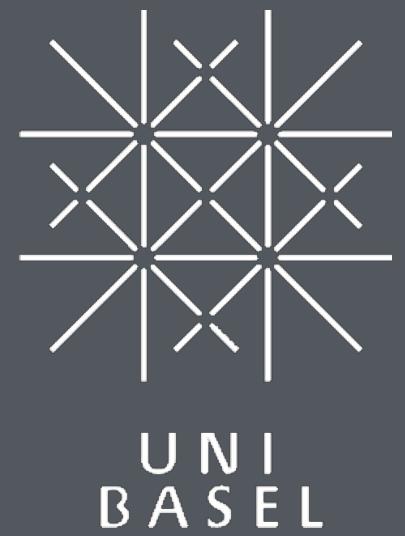
1. Where are you from, what is your background, and what do you do?
2. How much experiences do you have with machine learning?
3. What motivates you to learn more about LLMs?

Intro LLMs

Dirk Wulff

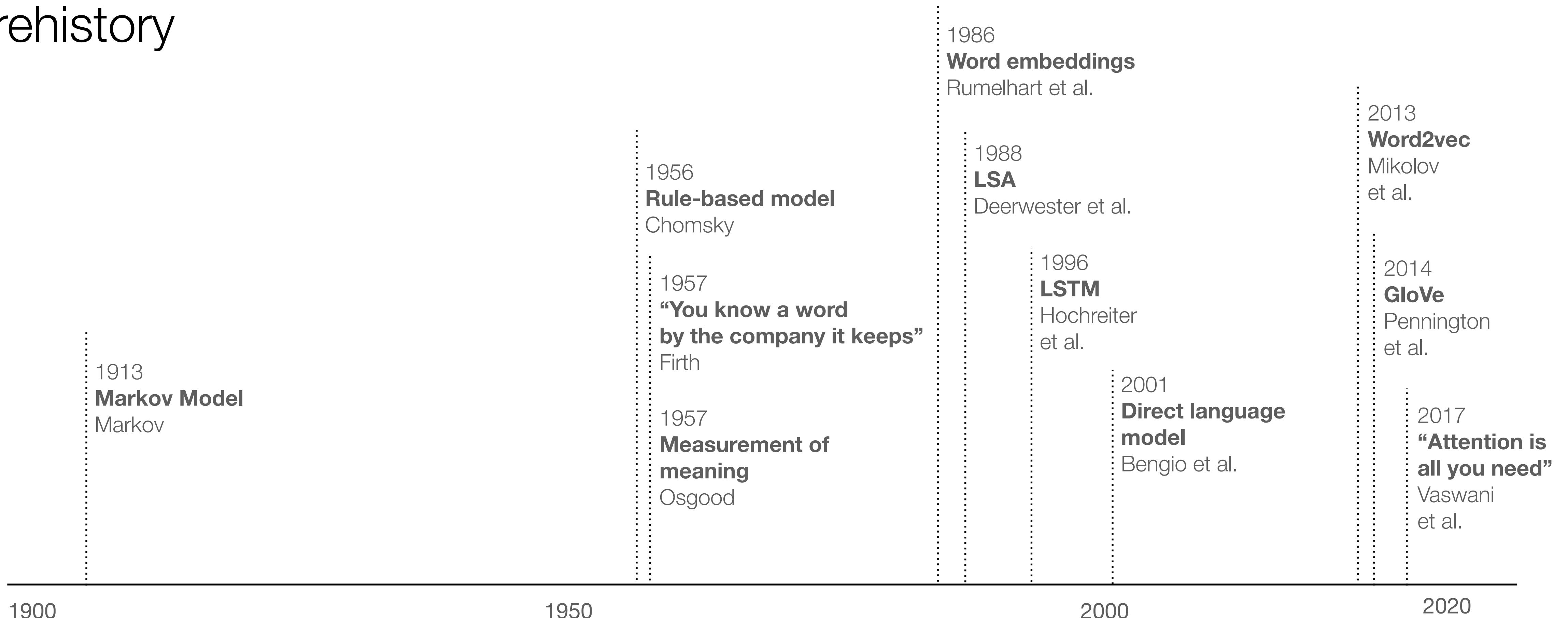


MAX PLANCK INSTITUTE
FOR HUMAN DEVELOPMENT



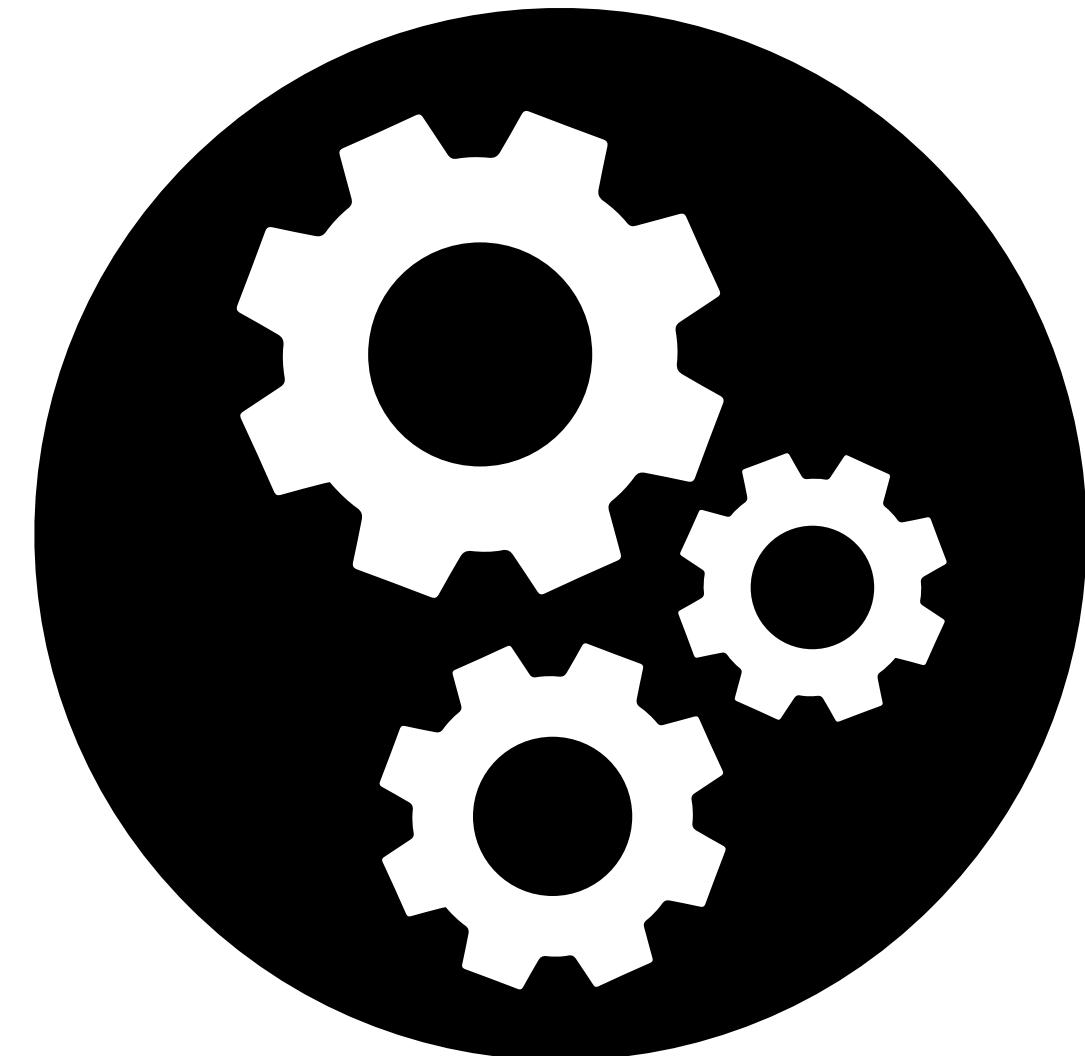
Language models

Prehistory

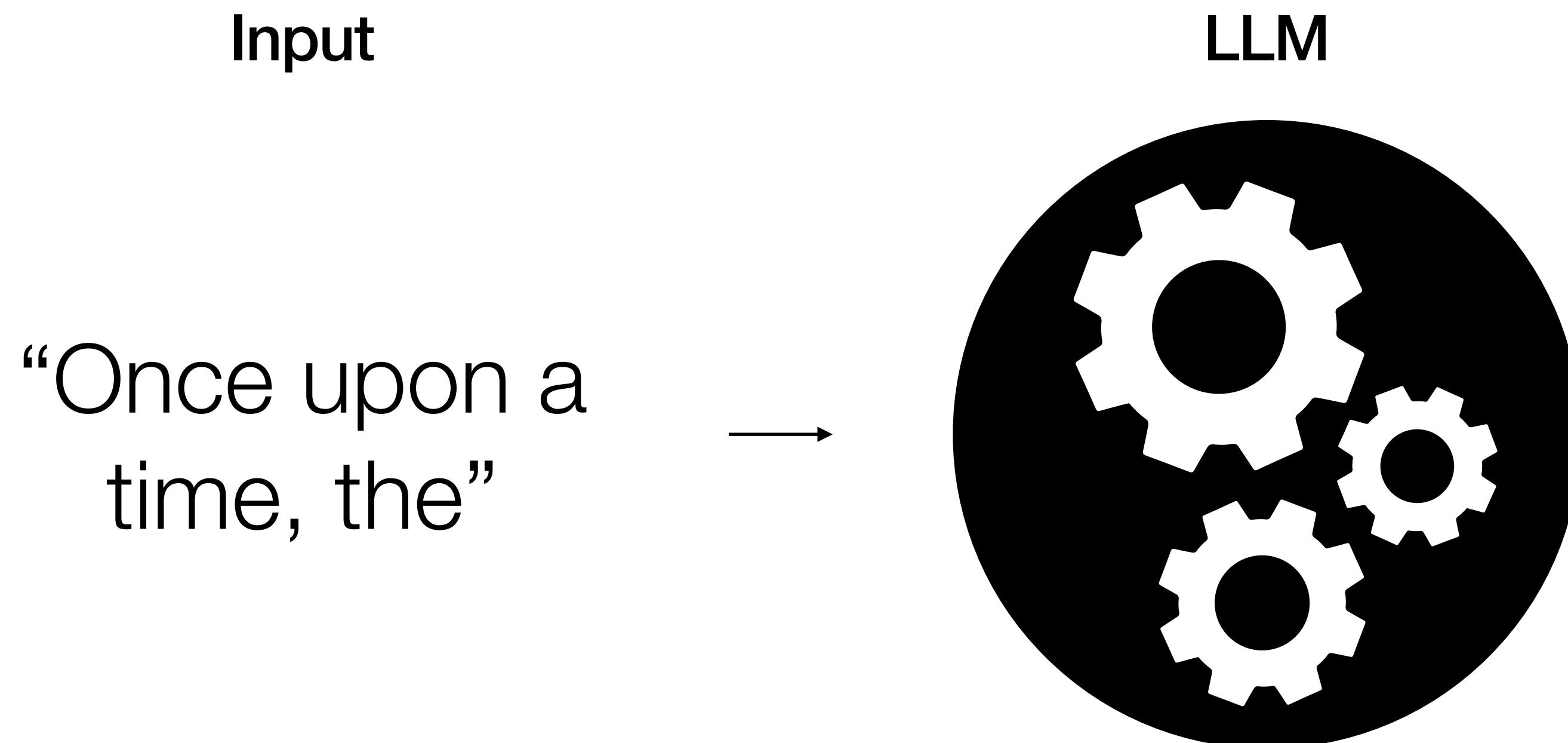


LLMs as mechanisms

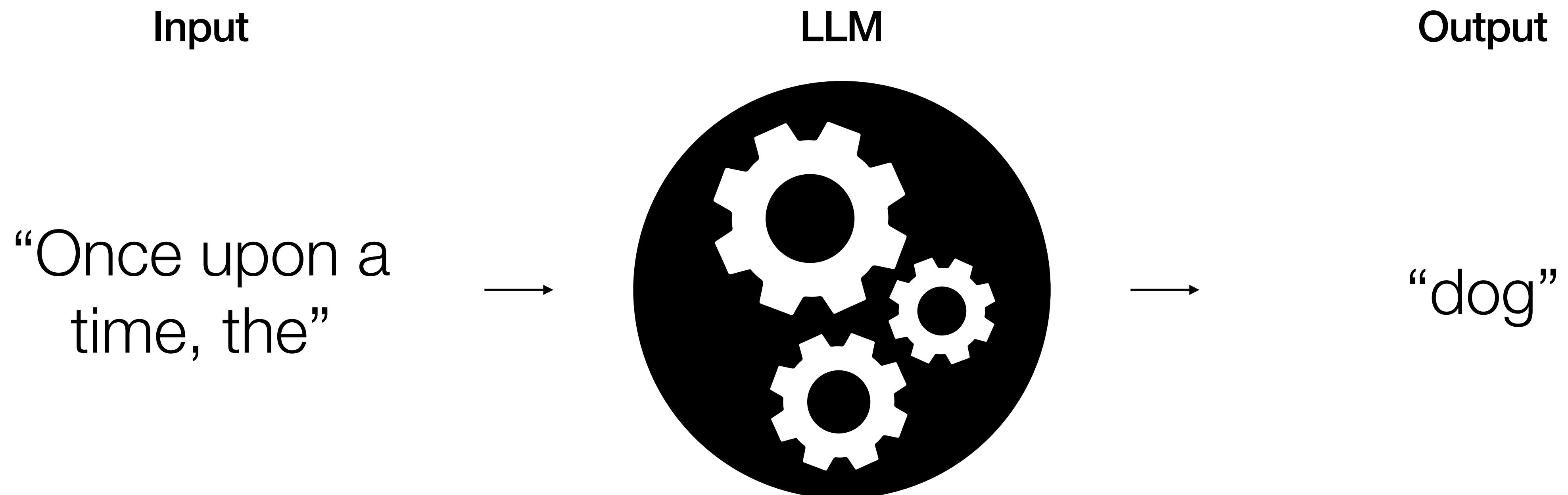
LLM



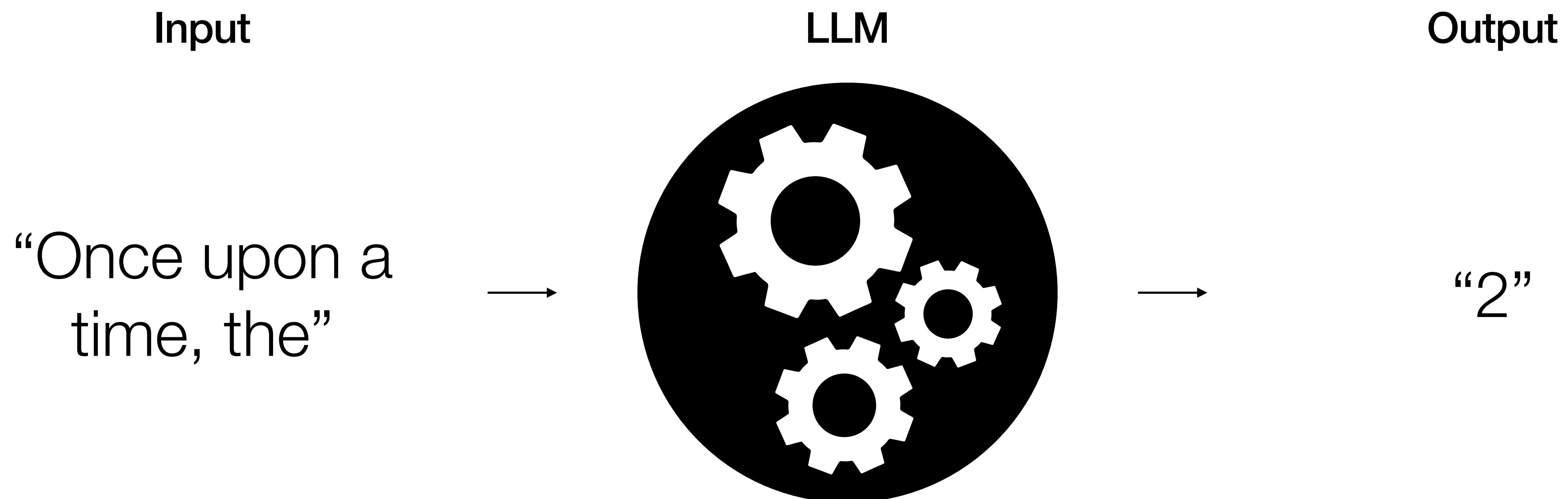
LLMs as mechanisms



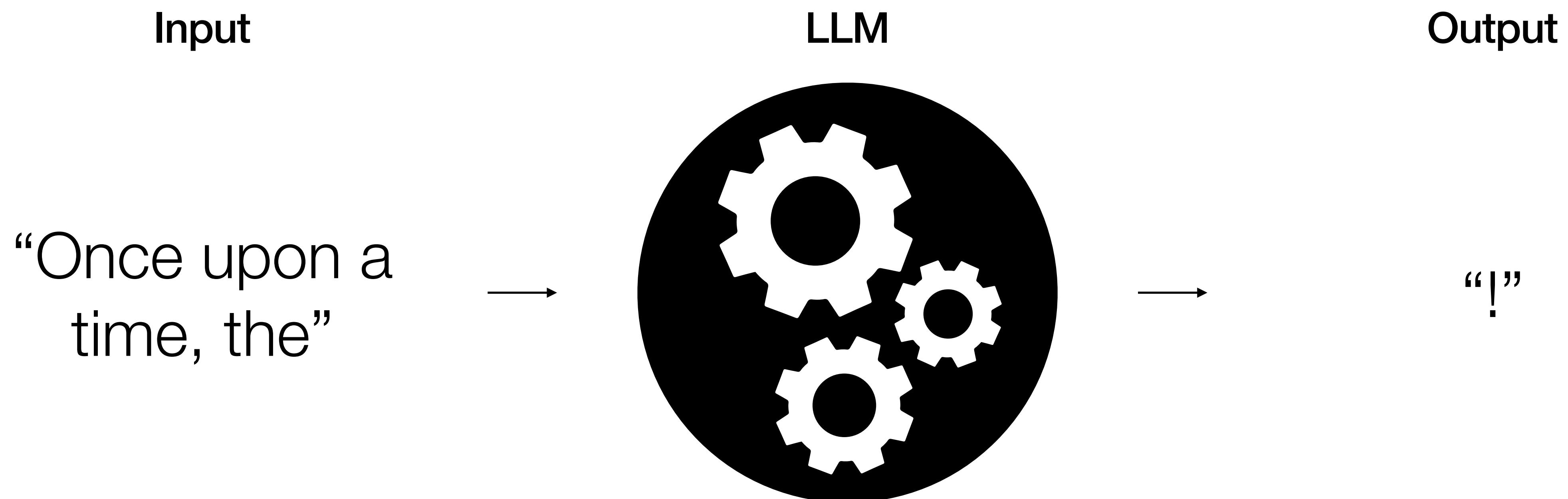
LLMs as mechanisms



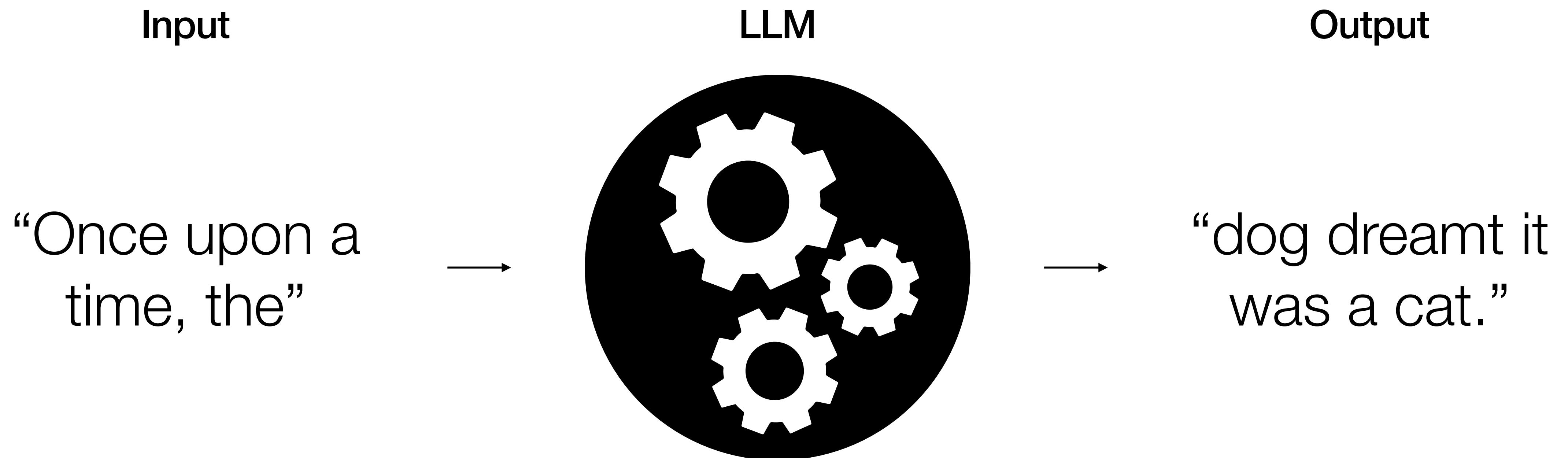
LLMs as mechanisms



LLMs as mechanisms



LLMs as mechanisms



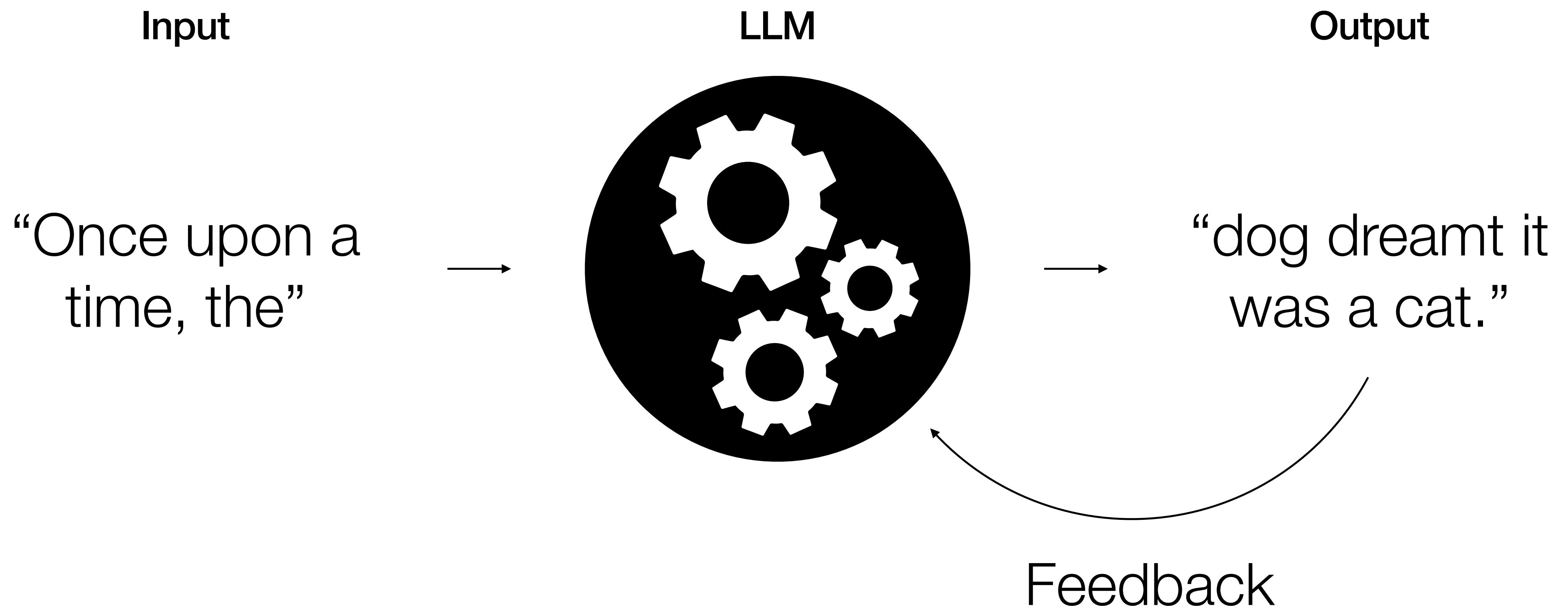
Once upon a time, the



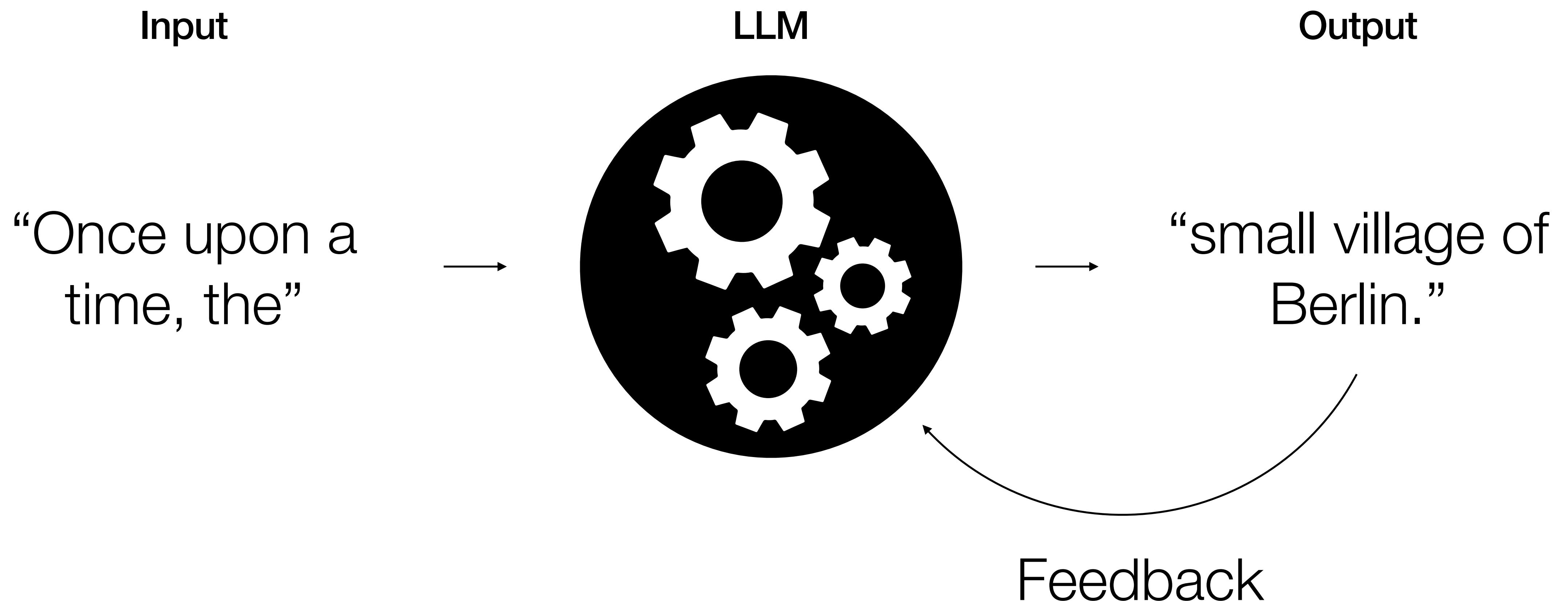
Once upon a time, the small village of Elmswood was nestled in a lush valley surrounded by towering mountains. The villagers lived peacefully, their days marked by the rhythms of nature and the changing seasons. However, everything changed when a mysterious old man arrived, carrying with him a locked 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.



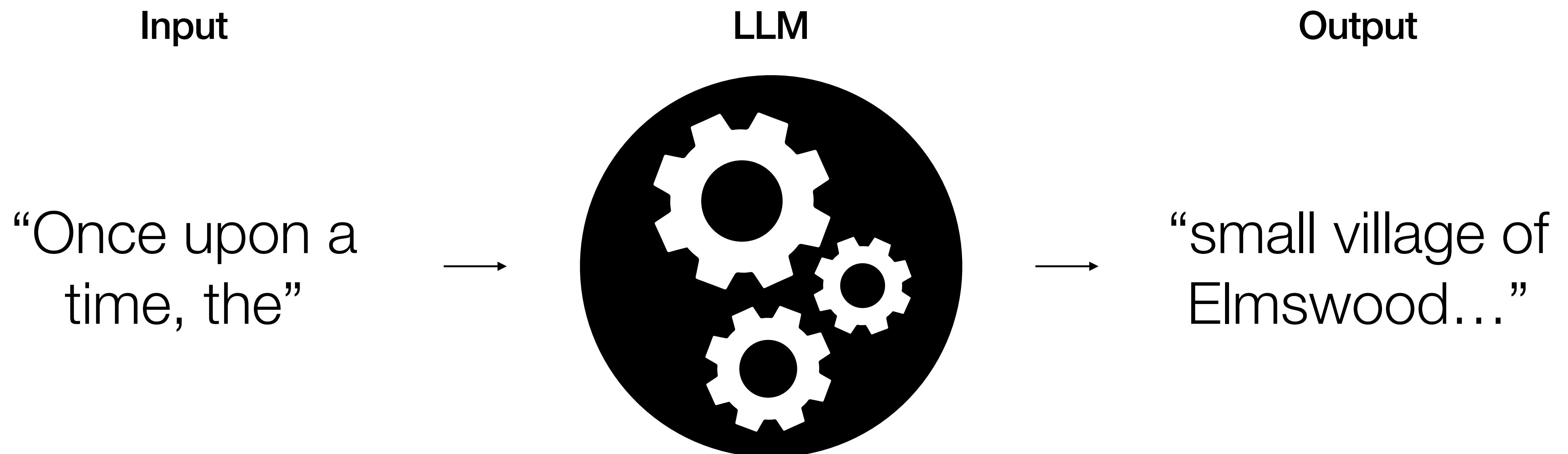
LLMs as **trained** mechanisms



LLMs as **trained** mechanisms



LLMs as **trained** mechanisms



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
Verifiable outcomes

Masked/next token prediction

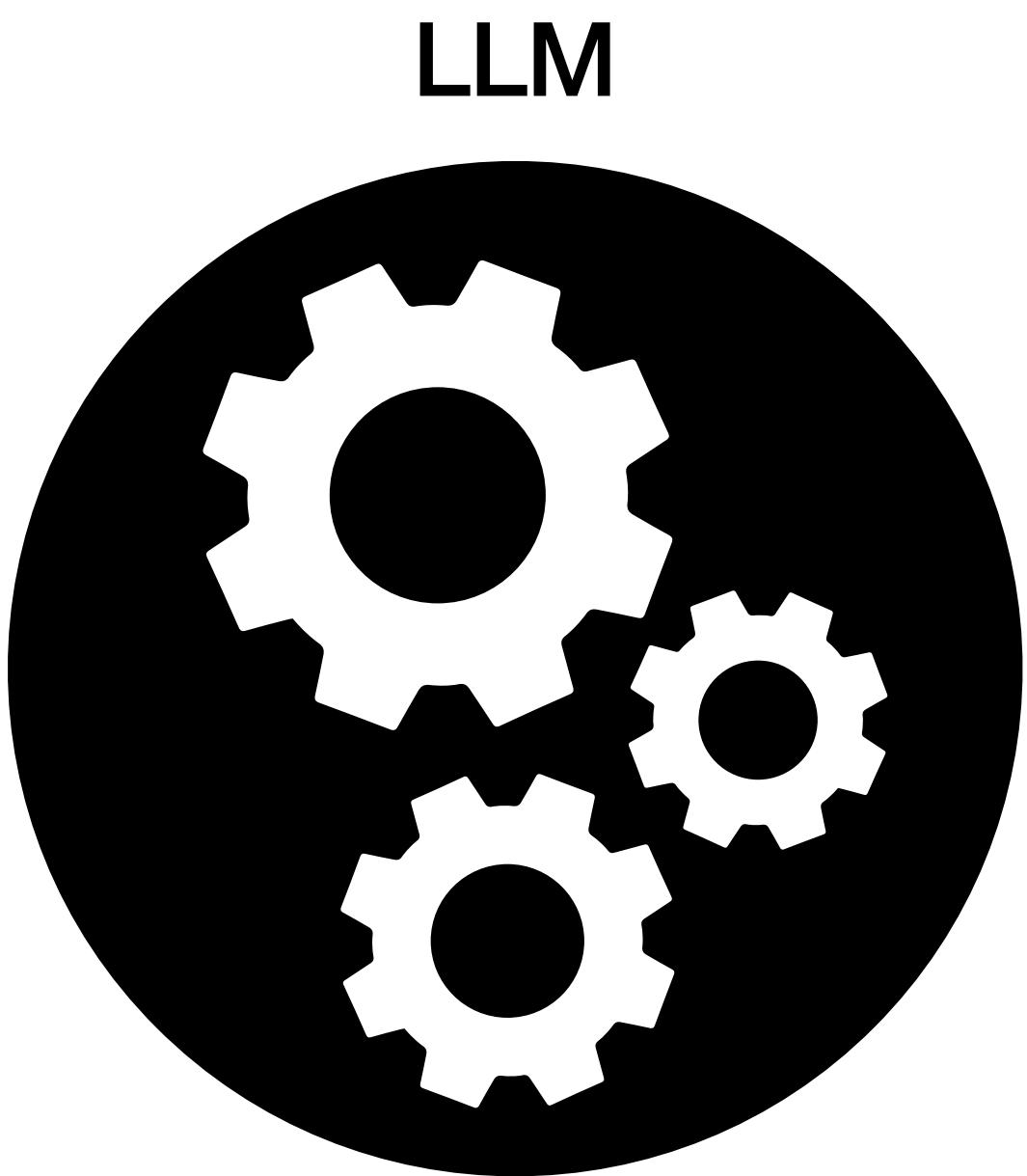
"Once upon a time" is a [stock phrase](#) used to introduce a narrative of past events, typically in [fairy tales](#) and folk tales. It has been used in some form since at least 1380 (according to the [Oxford English Dictionary](#)) in [storytelling](#) in the [English language](#) and has started many 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."^[1]

https://en.wikipedia.org/wiki/Once_upon_a_time



Masked/next token prediction

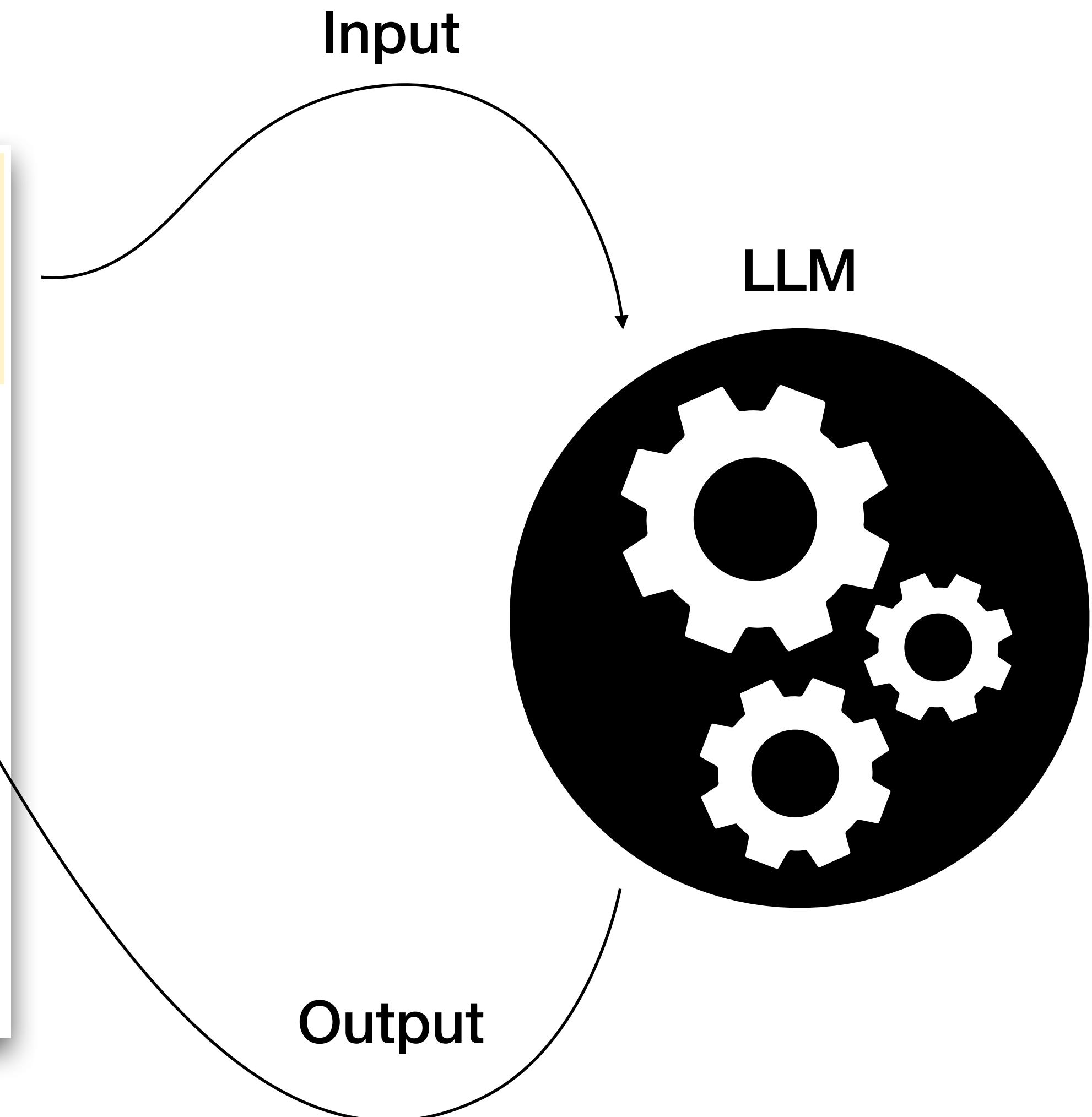
"Once upon a time" is a stock phrase used to introduce a narrative of past events, typically in fairy tales and folk tales. It has been used in some form since at least 1380 (according to the *Oxford English Dictionary*) in [REDACTED] in the English language and has started many narratives since 1600. 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."^[1]

https://en.wikipedia.org/wiki/Once_upon_a_time



Masked/next token prediction

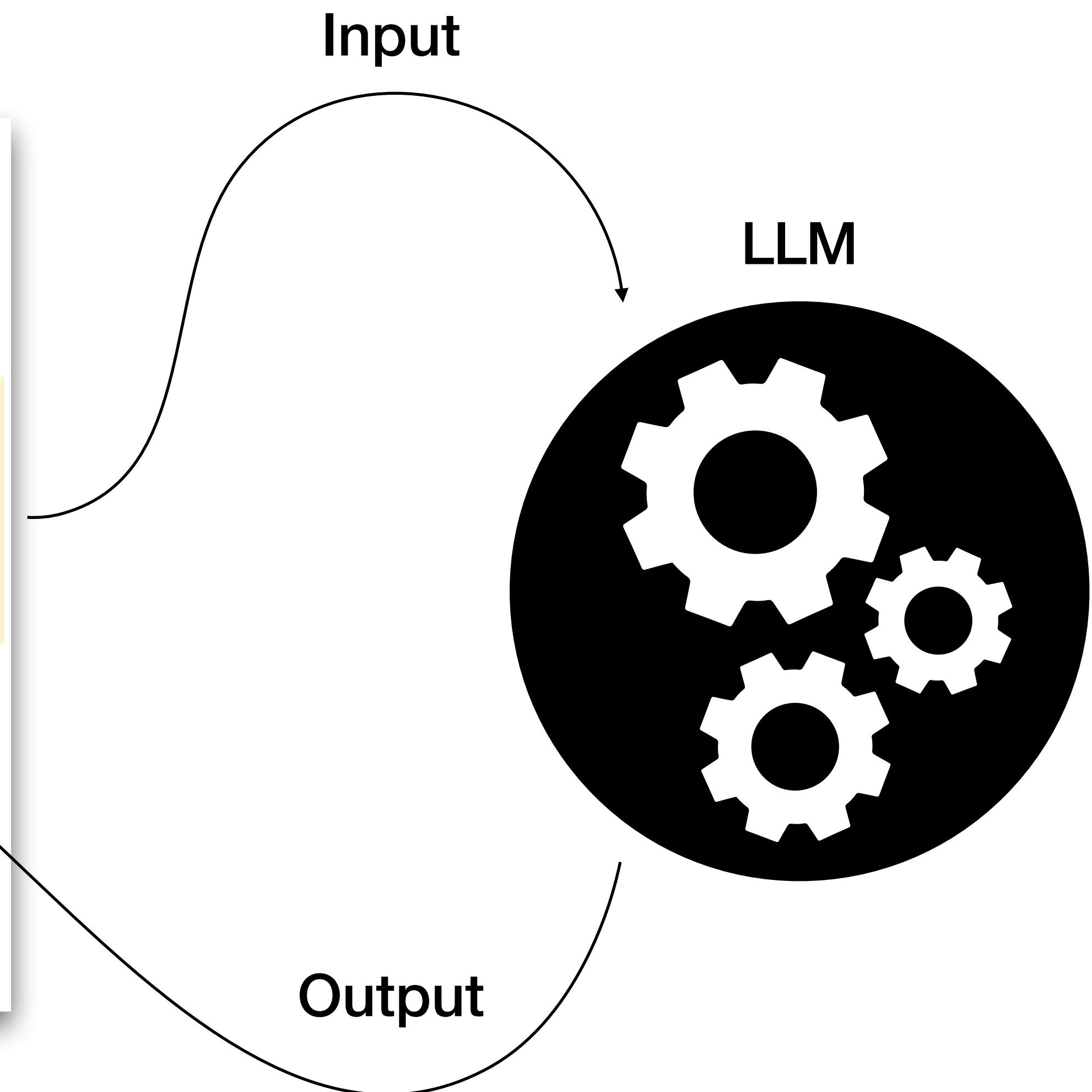
"Once upon a time" is a [stock phrase](#) used to introduce a narrative of past events, typically in [fairy tales](#) and folk tales. It has been used in some form since at least 1380 (according to the [Oxford English Dictionary](#)) in [storytelling](#) in the [English language](#) and has started many 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."^[1]

https://en.wikipedia.org/wiki/Once_upon_a_time



Masked/next token prediction

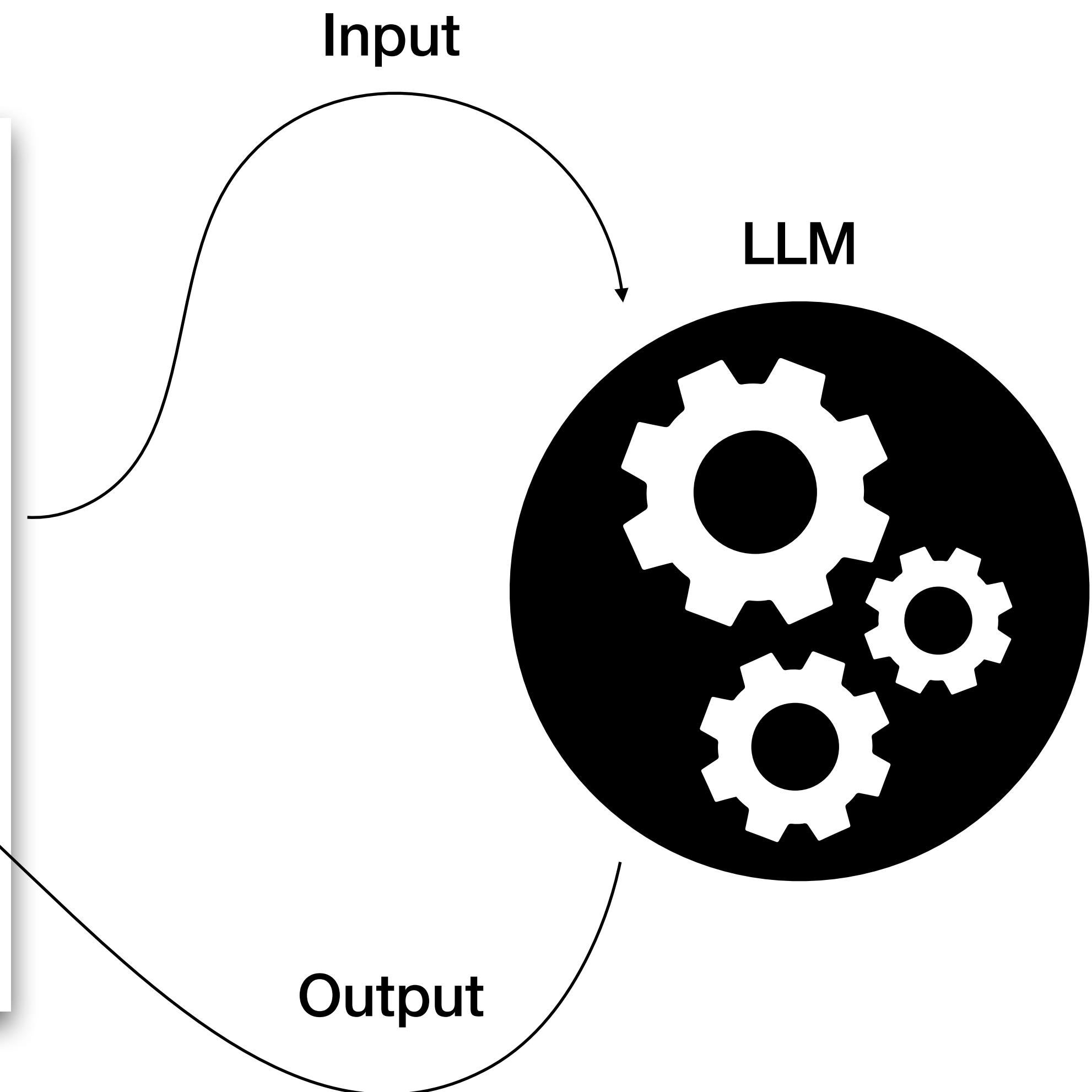
"Once upon a time" is a [stock phrase](#) used to introduce a narrative of past events, typically in [fairy tales](#) and folk tales. It has been used in some form since at least 1380 (according to the [Oxford English Dictionary](#)) in [storytelling](#) in the [English language](#) and has started many 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."^[1]

https://en.wikipedia.org/wiki/Once_upon_a_time



Masked/next token prediction

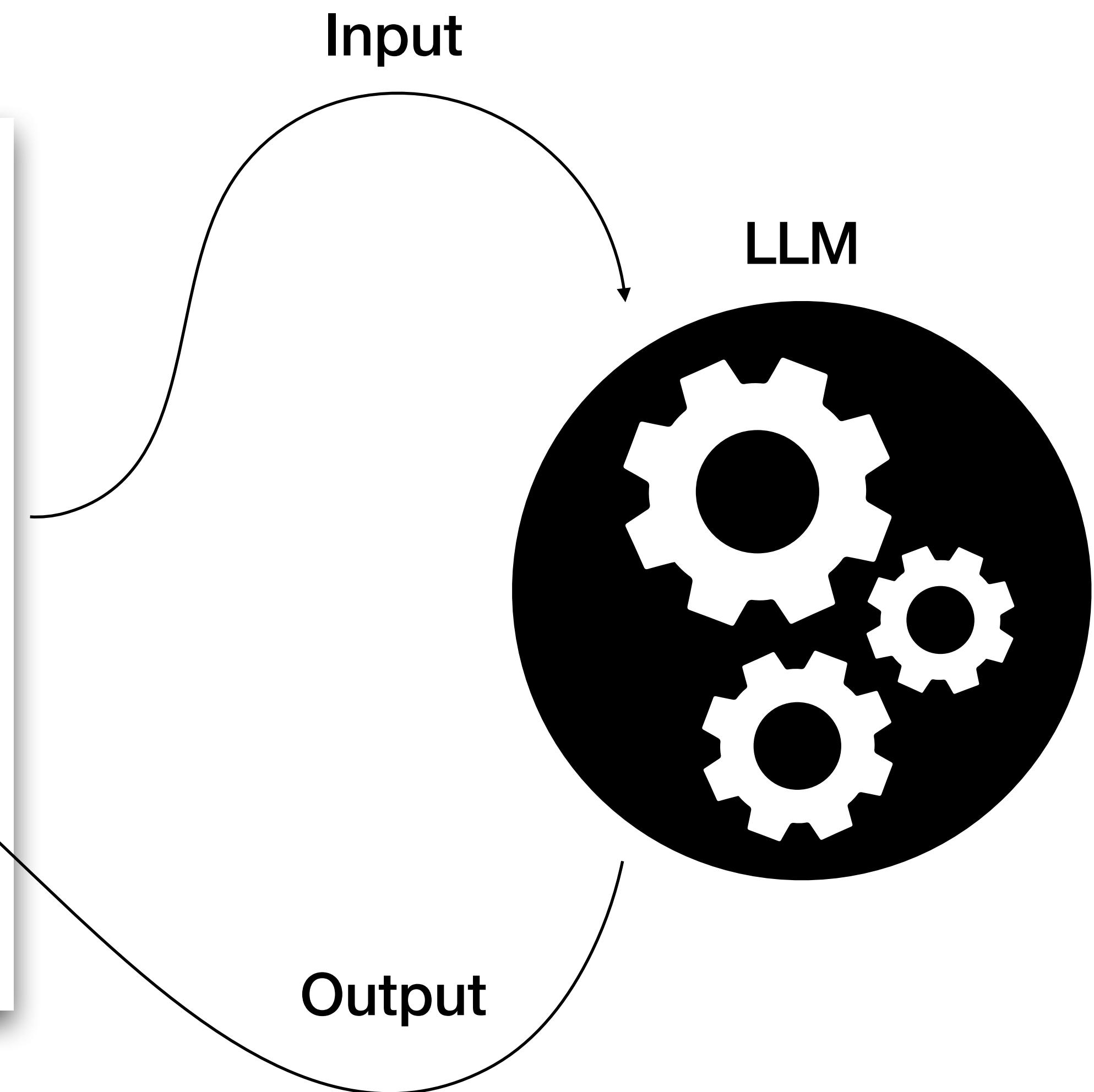
"Once upon a time" is a [stock phrase](#) used to introduce a narrative of past events, typically in [fairy tales](#) and folk tales. It has been used in some form since at least 1380 (according to the [Oxford English Dictionary](#)) in [storytelling](#) in the [English language](#) and has started many 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."^[1]

https://en.wikipedia.org/wiki/Once_upon_a_time



Masked/next token prediction

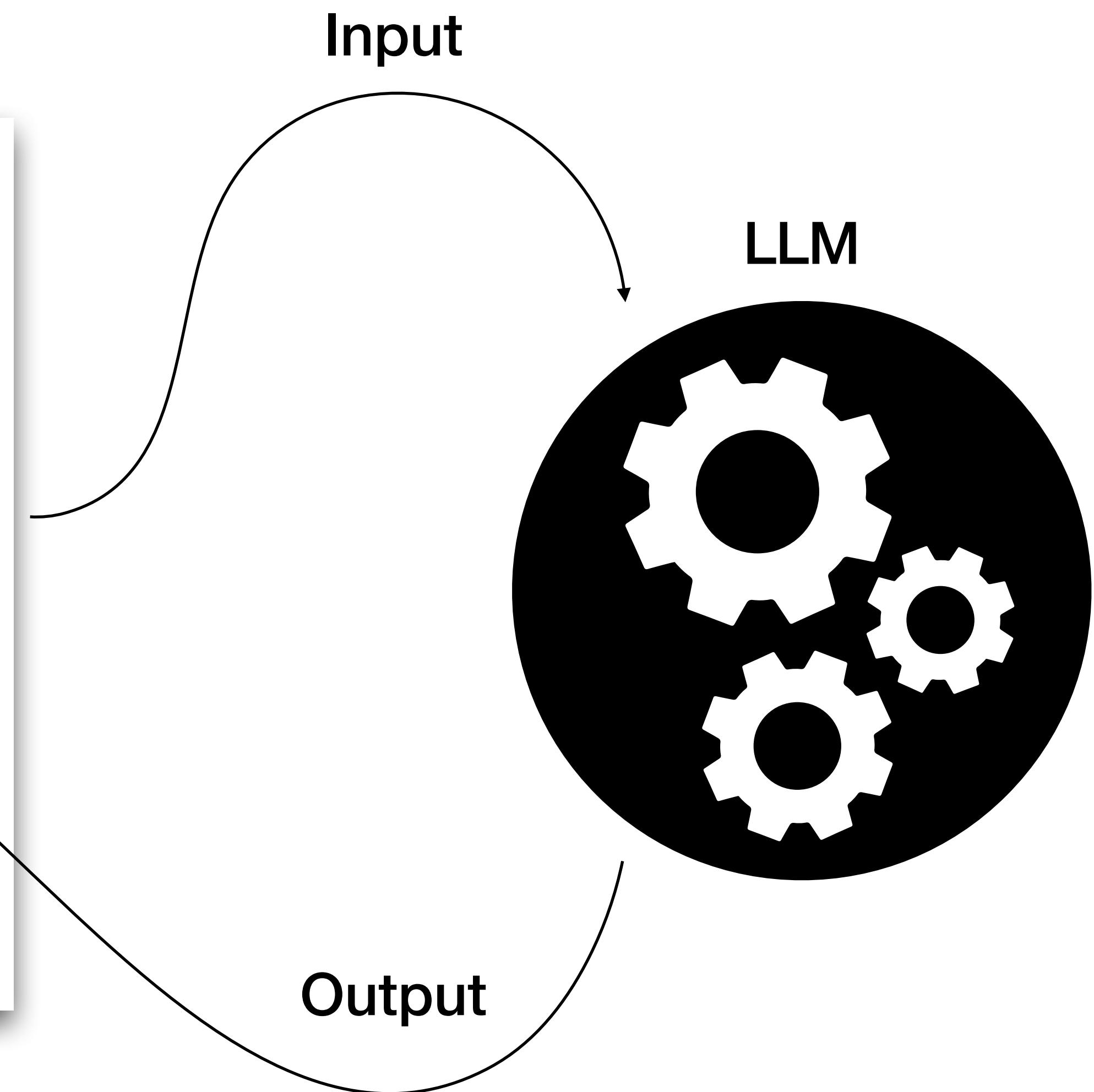
"Once upon a time" is a [stock phrase](#) used to introduce a narrative of past events, typically in [fairy tales](#) and folk tales. It has been used in some form since at least 1380 (according to the [Oxford English Dictionary](#)) in [storytelling](#) in the [English language](#) and has started many 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:

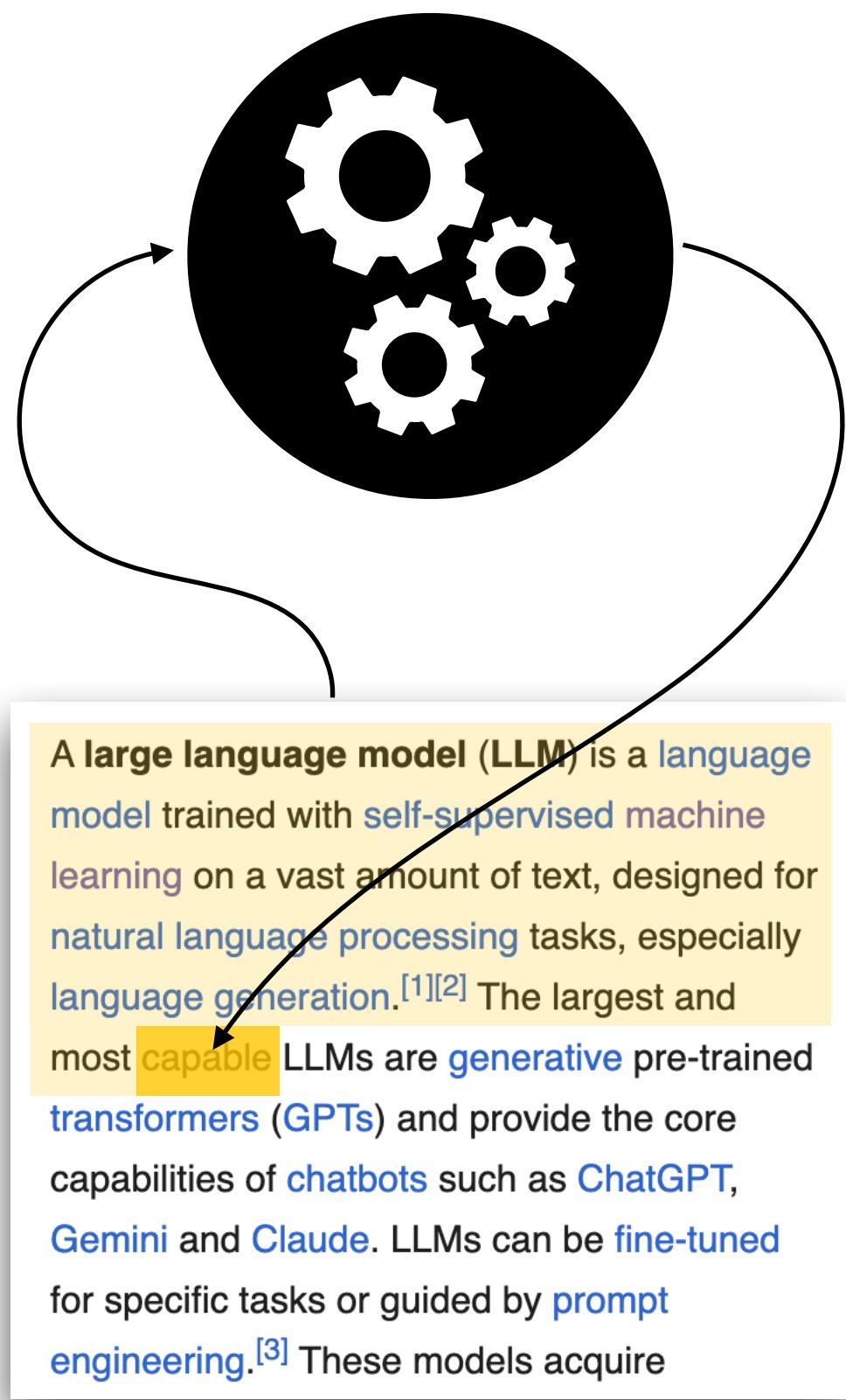
"The opening formulae are varied enough, but none of them has much play of fancy. 'Once upon a time and a very good time it was, though it wasn't in my time nor in your time nor in any one else's time.' is effective enough for a fairy epoch, and is common, according to Mayhew (*London Labour, III*),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

https://en.wikipedia.org/wiki/Once_upon_a_time

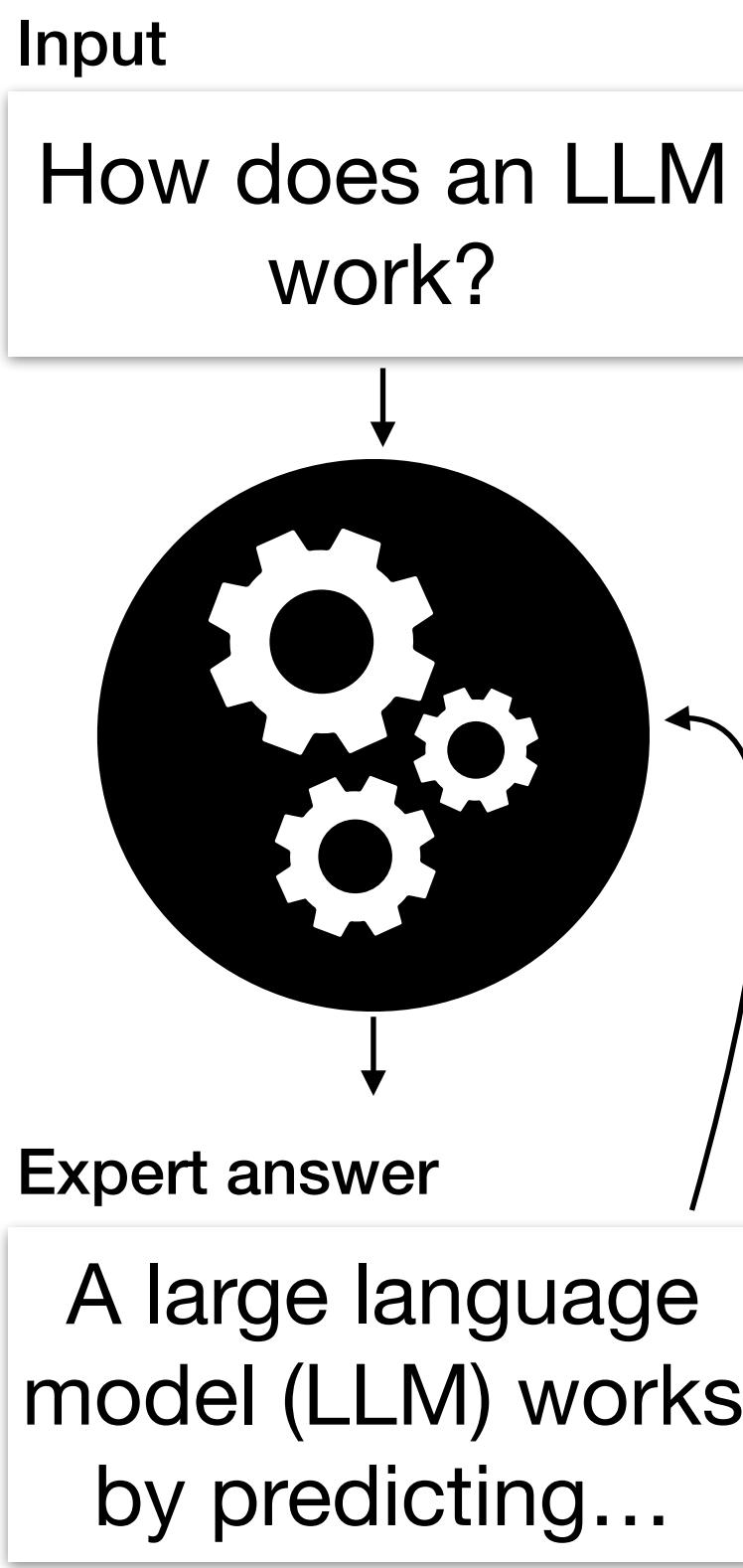


Training

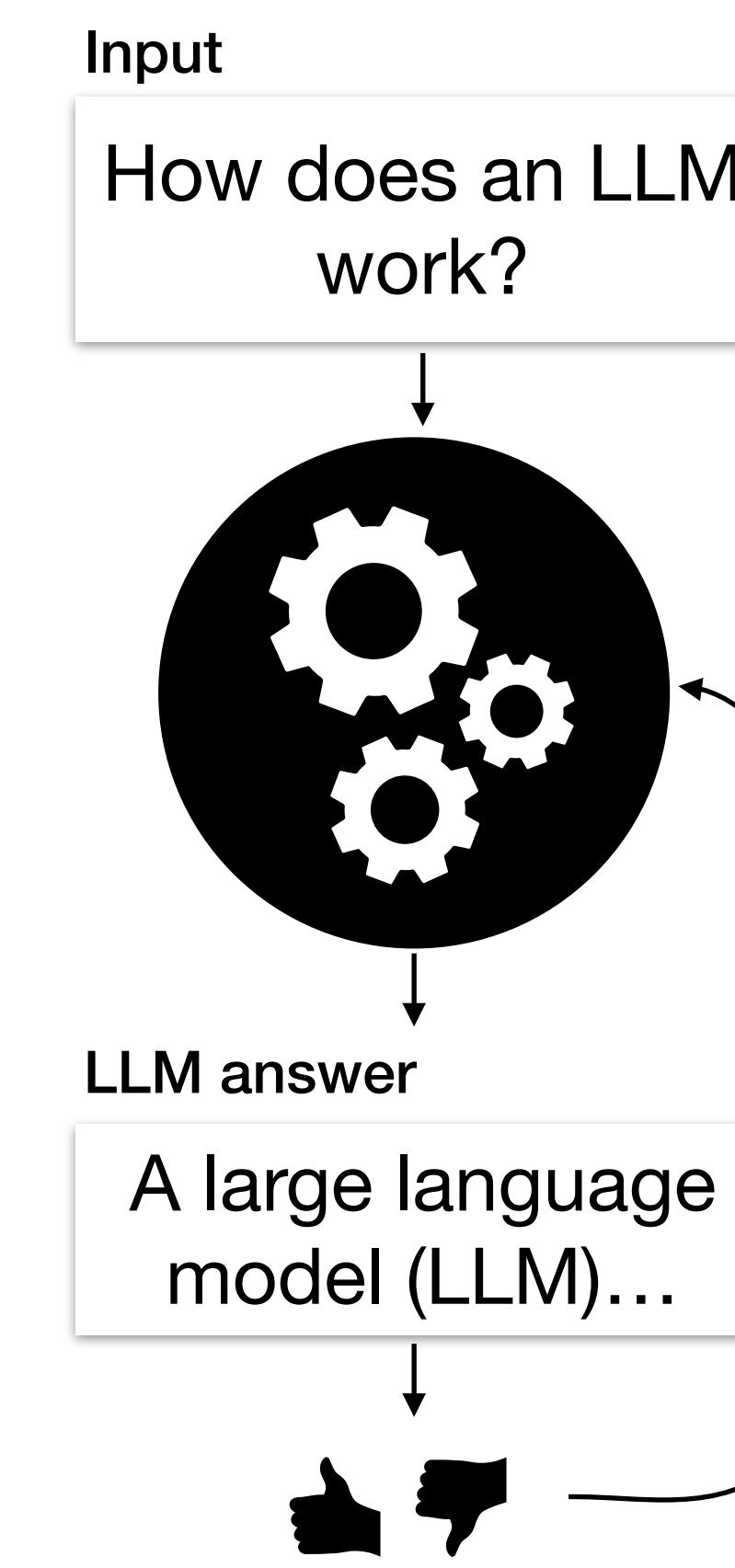
Pretraining



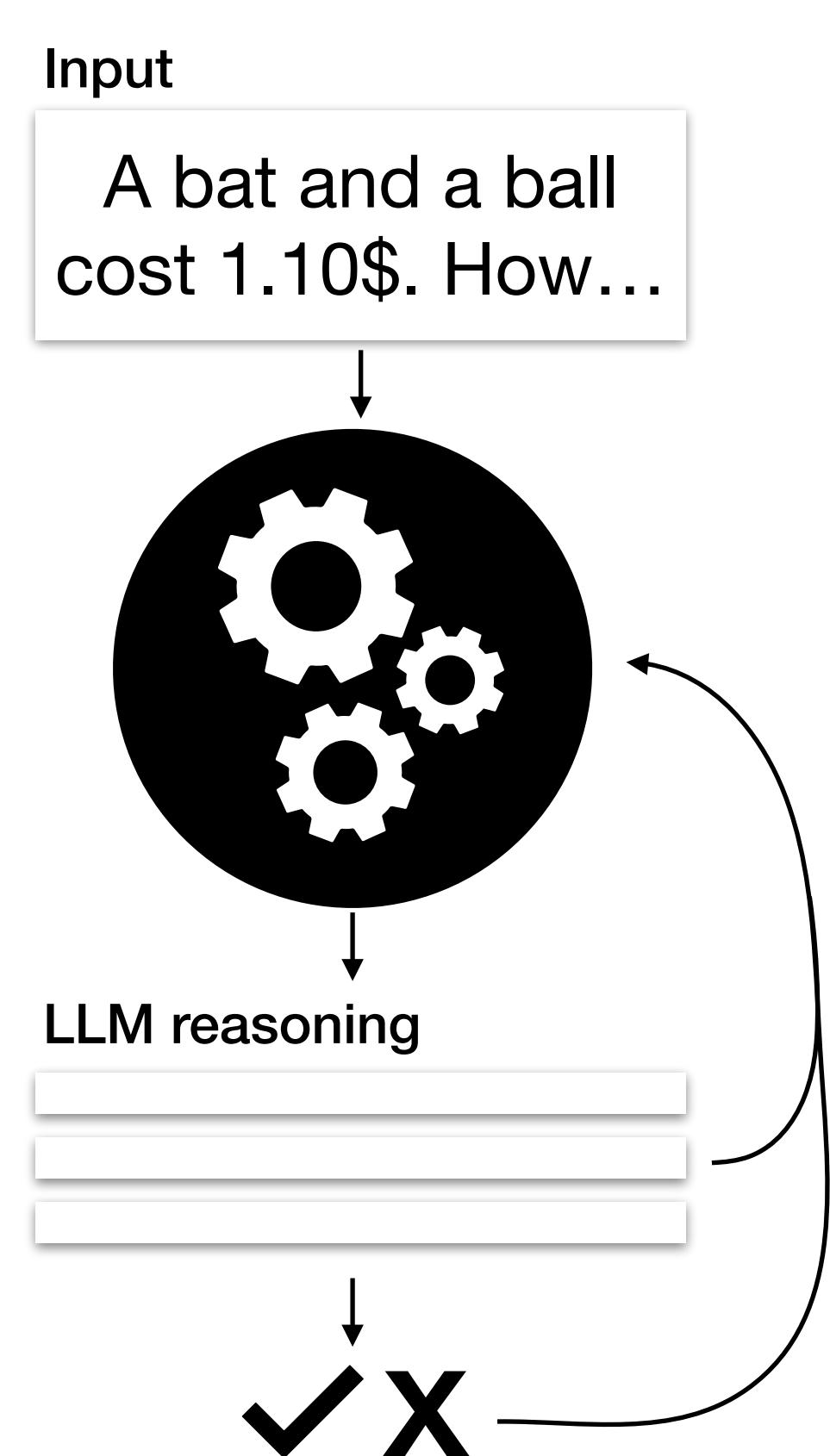
Instruction tuning



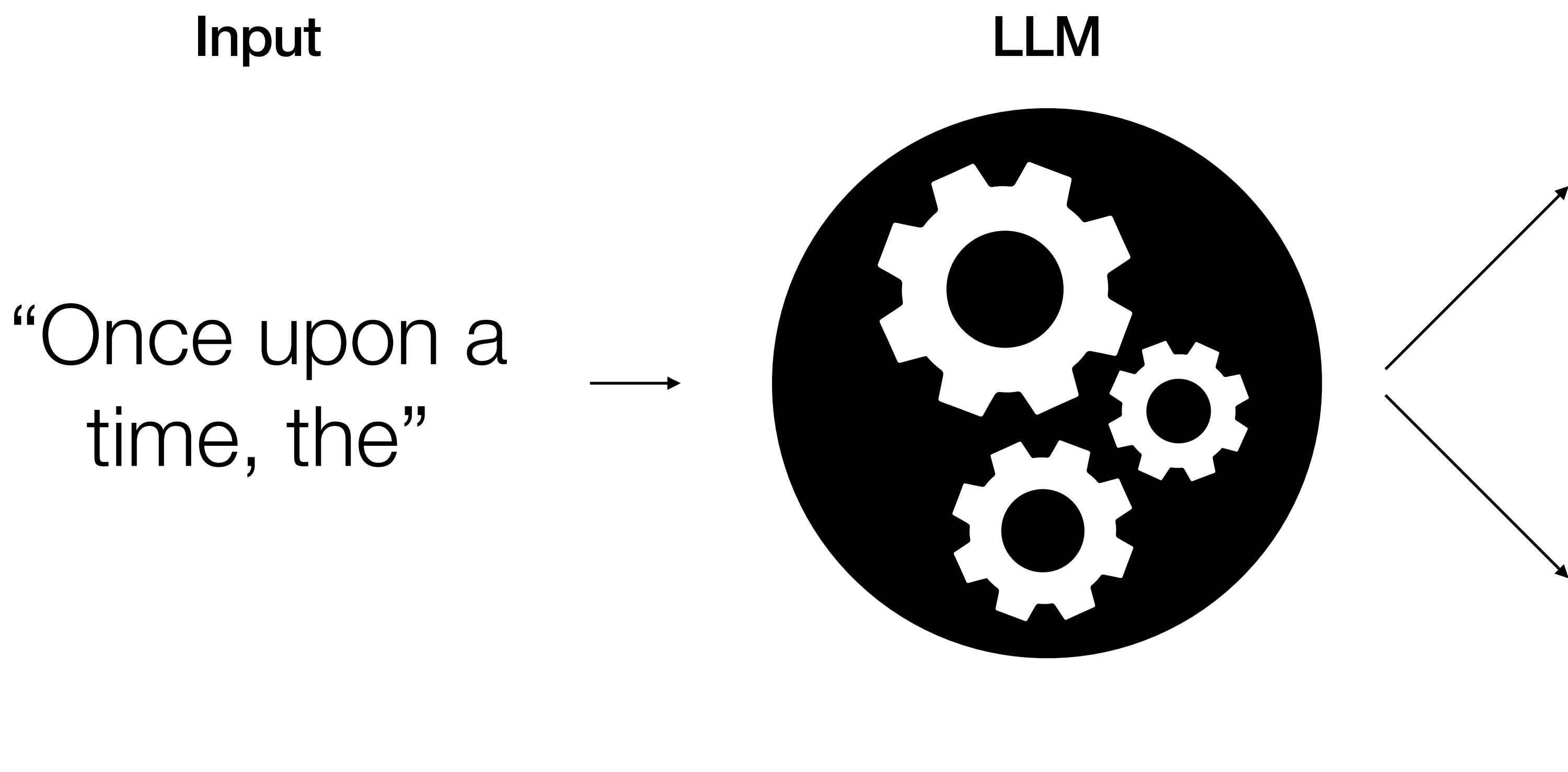
Preference tuning



Reasoning tuning

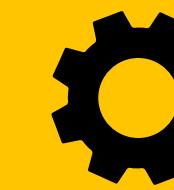


Two major applications



Text generation

“small village of
Elmswood...”



Feature extraction

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

Closed vs. Open

Public use

Performance

Safety

Reproducible

Data secure

Interpretable

**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
- Visual Document Retrieval
- 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

Models 1,680,396

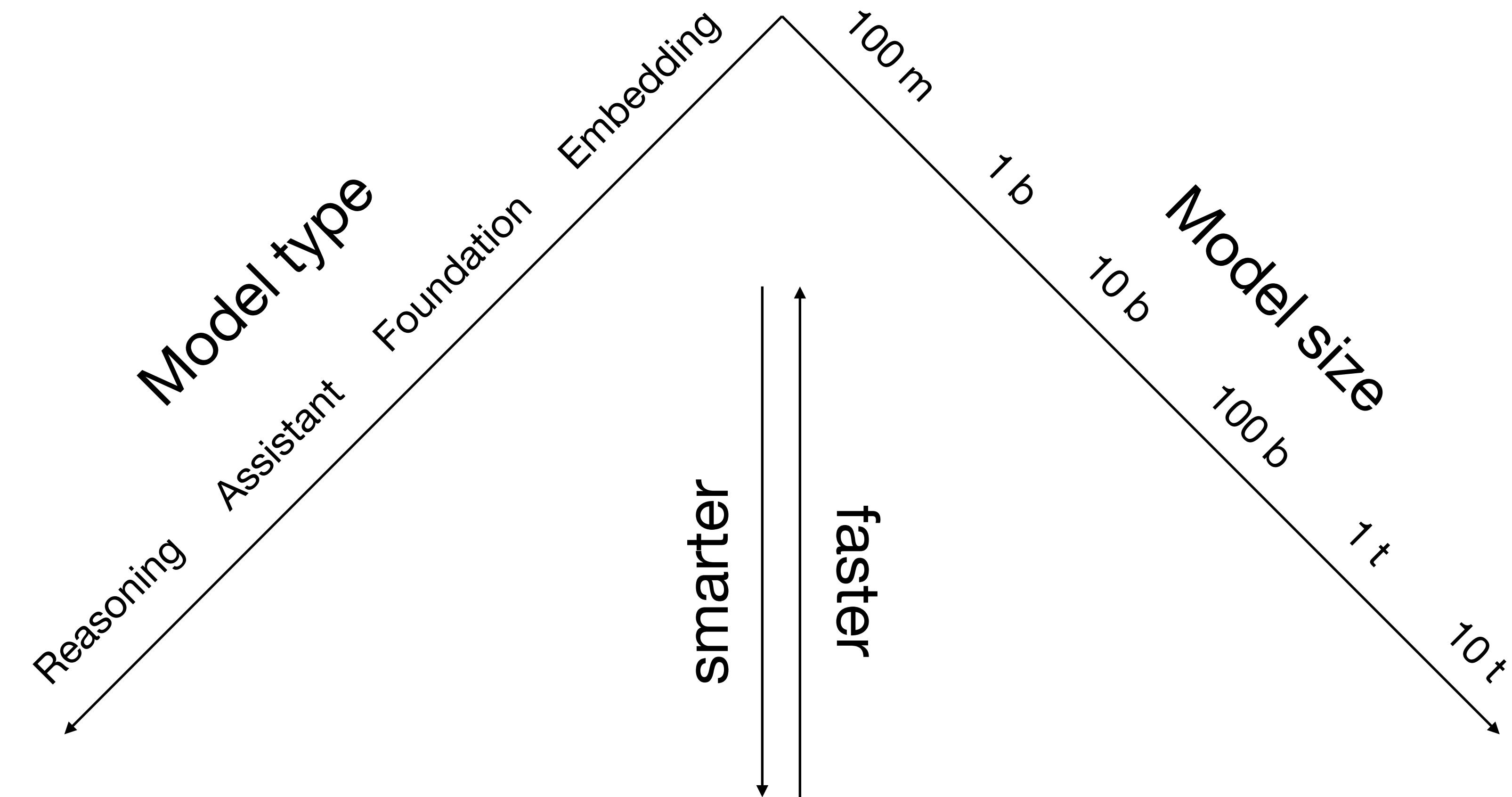
Filter by name

Full-text search

↑↓ Sort: Trending

nvidia/parakeet-tdt-0.6b-v2
Automatic Speech Recognition • Updated 10 days ago • ↓ 72.7k • ❤ 691**ACE-Step/ACE-Step-v1-3.5B**
Text-to-Audio • Updated 1 day ago • ❤ 310**nari-labs/Dia-1.6B**
Text-to-Speech • Updated 5 days ago • ↓ 148k • ⚡ • ❤ 2.04k**Lightricks/LTX-Video**
Text-to-Video • Updated 5 days ago • ↓ 214k • ⚡ • ❤ 1.38k**JetBrains/Mellum-4b-base**
Text Generation • Updated 4 days ago • ↓ 2.81k • ❤ 311**Qwen/Qwen3-235B-A22B**
Text Generation • Updated 10 days ago • ↓ 82.4k • ⚡ • ❤ 764**deepseek-ai/DeepSeek-Prover-V2-671B**
Text Generation • Updated 11 days ago • ↓ 7.38k • ⚡ • ❤ 750**lodestones/Chroma**
Text-to-Image • Updated 1 day ago • ❤ 401**black-forest-labs/FLUX.1-dev**
Text-to-Image • Updated Aug 16, 2024 • ↓ 2.66M • ⚡ • ❤ 10.1k**cognition-ai/Kevin-32B**
Updated 5 days ago • ↓ 342 • ❤ 93**Qwen/Qwen3-30B-A3B**
Text Generation • Updated 11 days ago • ↓ 150k • ⚡ • ❤ 514**microsoft/Phi-4-reasoning-plus**
Text Generation • Updated 3 days ago • ↓ 10.8k • ❤ 240**tencent/HunyuanCustom**
Image-to-Video • Updated 2 days ago • ❤ 77**Tesslate/UIGEN-T2-7B-Q8_0-GGUF**
Text Generation • Updated 5 days ago • ↓ 2.59k • ❤ 115**hexgrad/Kokoro-82M**
Text-to-Speech • Updated about 1 month ago • ↓ 1.88M • ⚡ • ❤ 4.27k**fdtn-ai/Foundation-Sec-8B**
Text Generation • Updated 10 days ago • ↓ 21.5k • ❤ 145**ServiceNow-AI/Apriels-Nemotron-15b-Thinker**
Updated 4 days ago • ↓ 784 • ❤ 66**Qwen/Qwen3-8B**
Text Generation • Updated 12 days ago • ↓ 394k • ❤ 262

Distinguishing LLMs



Project (maker, bases, URL)	Availability						Documentation						Access		
	Open code	LLM data	LLM weights	RL data	RL weights	License	Code	Architecture	Preprint	Paper	Modelcard	Datasheet	Package	API	
OLMo 7B Instruct Ai2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✓	✓	✓	✓	~
BLOOMZ bigscience-workshop	✓	✓	✓	✓	~	~	✓	✓	✓	✓	✓	✓	✗	✓	12.0
AmberChat LLM360	✓	✓	✓	✓	✓	✓	~	~	✓	✗	~	~	✗	✓	10.0
Open Assistant LAION-AI	✓	✓	✓	✓	✗	✓	✓	✓	~	✗	✗	✗	✓	✓	9.5
...															
Command R+ Cohere AI	✗	✗	✗	✓	✓	~	✗	✗	✗	✗	~	✗	✗	✗	3.0
LLaMA2 Chat Facebook Research	✗	✗	~	✗	~	✗	✗	~	~	✗	~	✗	✗	✗	3.0
Nanbeige2-Chat Nanbeige LLM lab	✓	✗	✗	✗	✓	~	✗	✗	✗	✗	✗	✗	✗	~	3.0
Llama 3 Instruct Facebook Research	✗	✗	~	✗	~	✗	✗	~	✗	✗	~	✗	✗	~	2.5
Solar 70B Upstage AI	✗	✗	~	✗	~	✗	✗	✗	✗	✗	~	✗	✗	~	2.0
Xwin-LM Xwin-LM	✗	✗	~	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	~	1.0
ChatGPT OpenAI	✗	✗	✗	✗	✗	✗	✗	✗	~	✗	✗	✗	✗	✗	0.5

see also <https://osai-index.eu/the-index>

LMSYS Chatbot Arena Leaderboard

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

LMSYS [Chatbot Arena](#) is a crowdsourced open platform for LLM evals. We've collected over 1,000,000 human pairwise comparisons to rank LLMs with the [Bradley-Terry model](#) and display the model ratings in Elo-scale. You can find more details in our [paper](#).

Arena

Full Leaderboard

Total #models: 99. Total #votes: 1,170,955. Last updated: 2024-05-20.

⚠ NEW! View leaderboard for different categories (e.g., coding, long user query)! This is still in preview and subject to change.

Rank* (UB) ▲	Rank (StyleCtrl) ▲	Model	Arena Score	95% CI ▲	Votes ▲	Organization	License
1	1	Gemini-Exp-1206	1374	+4/-5	20227	Google	Proprietary
1	1	ChatGPT-4o-latest...(2024-11-20)	1365	+4/-3	33383	OpenAI	Proprietary
1	4	Gemini-2.0-Flash-Thinking-Exp-1219	1364	+5/-6	15728	Google	Proprietary
2	4	Gemini-2.0-Flash-Exp	1357	+6/-4	19030	Google	Proprietary
3	1	o1-2024-12-17	1351	+7/-7	7289	OpenAI	Proprietary
6	4	o1-preview	1335	+4/-4	33194	OpenAI	Proprietary
7	7	DeepSeek-V3	1319	+6/-6	10510	DeepSeek	DeepSeek
7	10	Step-2-16K-Exp	1305	+8/-9	3374	StepFun	Proprietary

Overall	Bitext Mining	Classification	Clustering	Pair Classification	Reranking	Retrieval	STS	Summarization	Retrieval w/Instructions
English	Chinese	French	Polish						
Overall MTEB English leaderboard 🎉									
<ul style="list-style-type: none"> 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)	
1	NV-Embed-v1					69.32	87.35	52.8	
2	voyage-large-2-instruct			1024	16000	68.28	81.49	53.35	
3	SFR-Embedding-Mistral	7111	26.49	4096	32768	67.56	78.33	51.67	
4	gte-Qwen1.5-7B-instruct	7099	26.45	4096	32768	67.34	79.6	55.83	
5	voyage-lite-02-instruct	1220	4.54	1024	4000	67.13	79.25	52.42	
6	GritLM-7B	7242	26.98	4096	32768	66.76	79.46	50.61	
7	e5-mistral-7b-instruct	7111	26.49	4096	32768	66.63	78.47	50.26	
8	google-gecko.text-embedding-p	1200	4.47	768	2048	66.31	81.17	47.48	
9	SE_v1					65.66	76.8	47.38	
10	GritLM-8x7B	46703	173.98	4096	32768	65.66	78.53	50.14	

Models

BERTish

all-MiniLM-L6-v2
MPNet
MPNet-personality



Feature extraction
(fine-tuning)

Open GPTs

Llama 3.2 3B



Text-generation
(in-context learning)