



# Cabinet Office

**What are Large Language Models and what do they mean for people learning to code?**

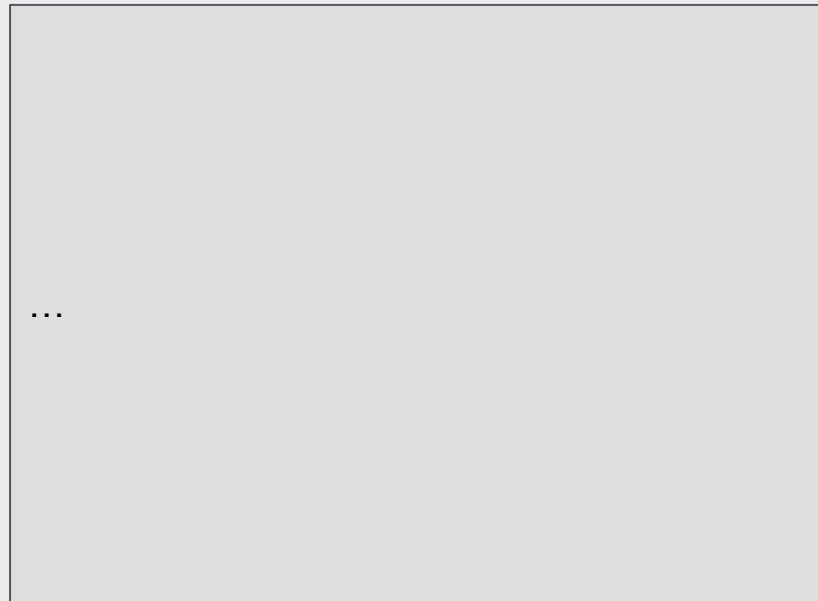
# What are Large Language Models?

Large Language Models are computer programs that understand and generate human-like text.

They learn from lots of examples and can answer questions, write stories, or help with tasks. They work by predicting what words come next in a sentence, getting better with more practice.

*ChatGPT*

*The best thing about AI is its ability to ...*

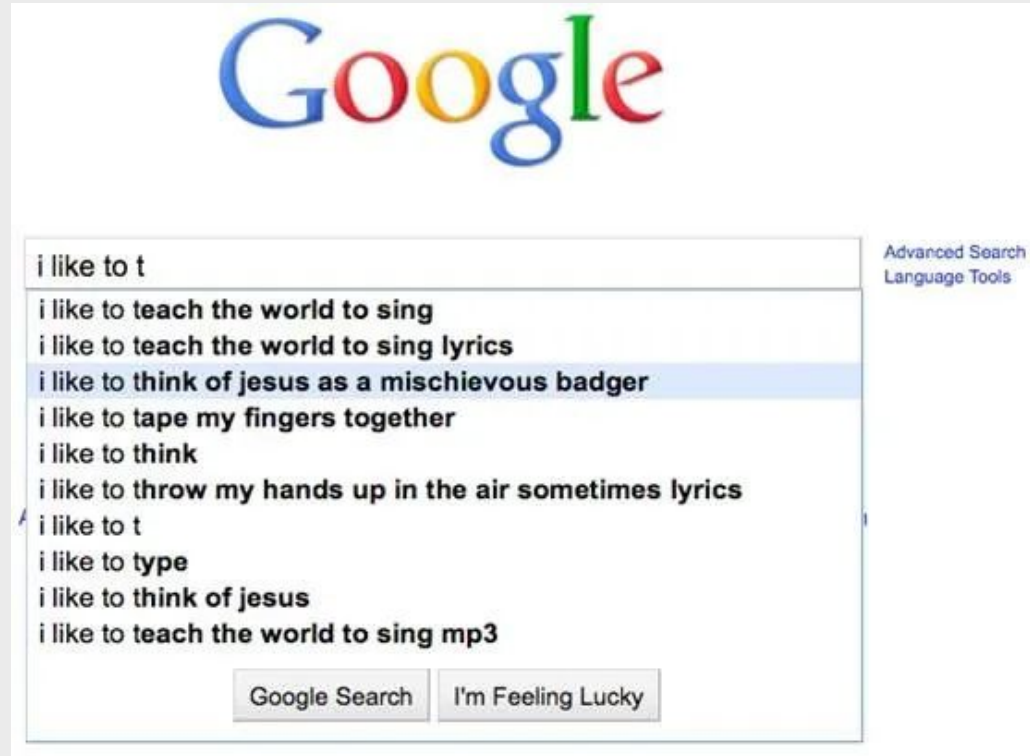


*The best thing about AI is its ability to*

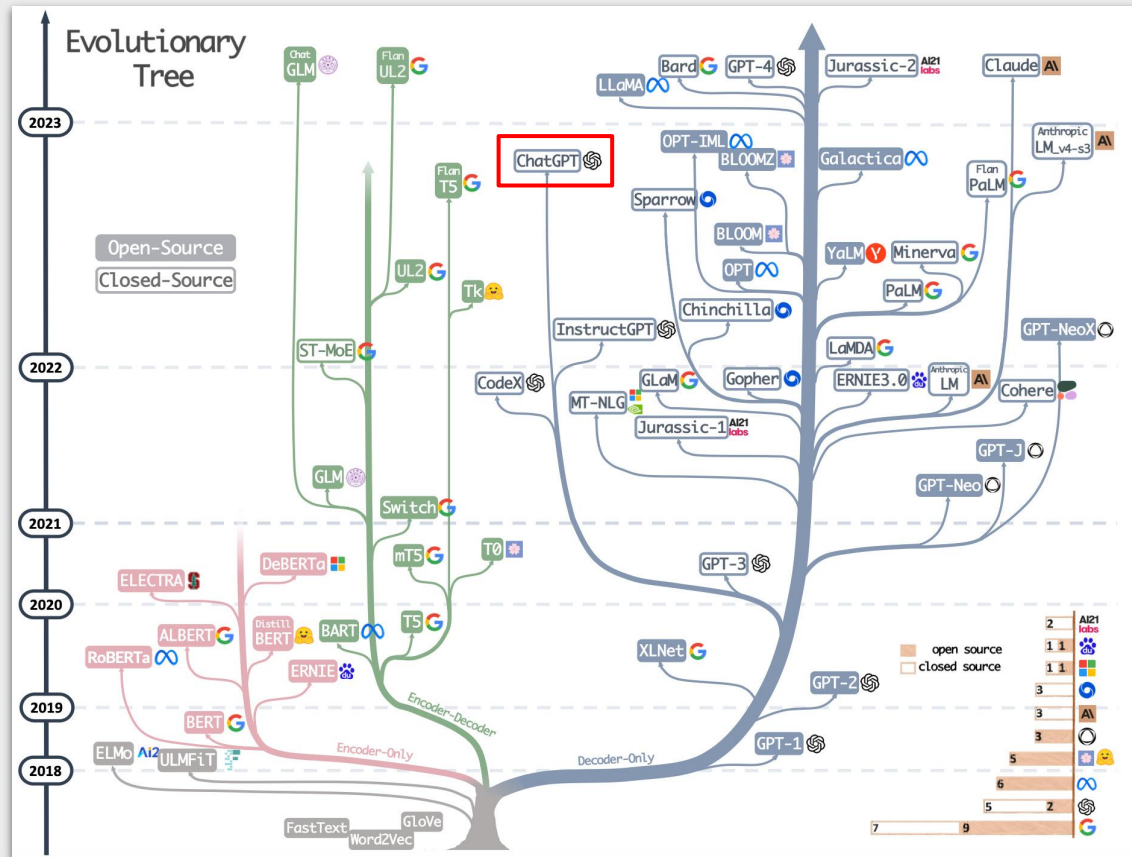
learn	4.5%
predict	3.5%
make	3.2%
understand	3.1%
do	2.9%

Large Language Models generate text by **predicting the word** based on data they've been trained on. That's it.

LLMs are very fancy  
autocomplete.



# LLMs have a long history...





Many of us  
have been  
working with  
LLMs x-gov

## Demonstration of NER on GOV.UK page

Data Products have developed a model that can detect entities of interest from 'govspeak' in GOV.UK content. Use the tool below on any GOV.UK url to see how it works.

Input text

**Rishi Sunak** became **Prime Minister** on **25 October 2022** . He was previously appointed

PERSON TITLE DATE

**Chancellor of the Exchequer** from **13 February 2020** to **5 July 2022** . He was **Chief Secretary to**

TITLE DATE DATE TITLE

**the Treasury** from **24 July 2019** to **13 February 2020** , and **Parliamentary Under Secretary of**

DATE DATE TITLE

**State at the Ministry of Housing , Communities and Local Government** from **9 January 2018** to

ORG DATE

**24 July 2019** . **Rishi** went to **Winchester College** and studied Politics , Philosophy and Economics

DATE PERSON ORG

at **Oxford University** . He was also a **Fulbright Scholar** at **Stanford University** ( **USA** ) where he

ORG ROLE ORG GPE

studied for his MBA . **Rishi** was elected **Conservative MP** for **Richmond ( Yorks )** in **May 2015** and

PERSON TITLE GPE GPE DATE

served as a **Parliamentary Private Secretary** at **the Department for Business , Energy and**

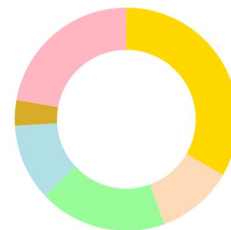
TITLE ORG

**Industrial Strategy** from **June 2017** until his ministerial appointment .

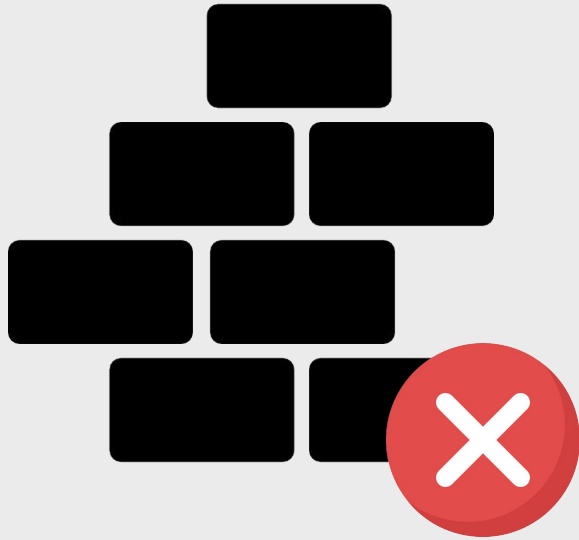
DATE

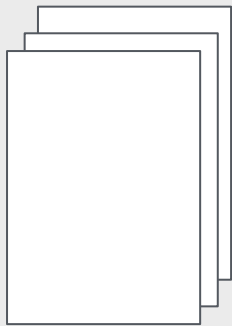
Entity

- ORG
- PERSON
- GPE
- TITLE
- ROLE
- LOC
- FORM
- MONEY
- DATE
- POSTCODE
- EMAIL
- PHONE
- OCCUPATION
- FAC
- EVENT

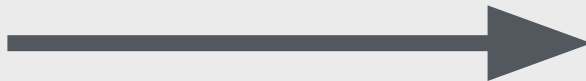


**How are LLM  
created?**

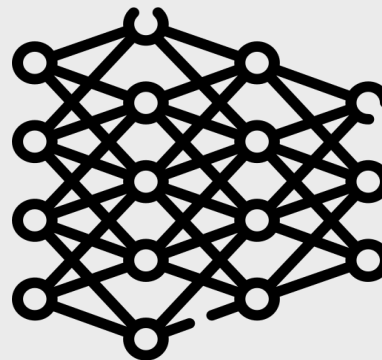




Data

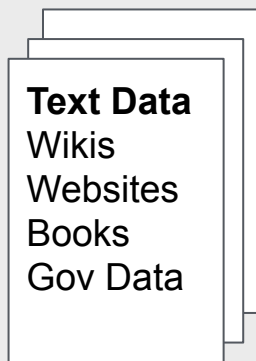


Learning Process



Model

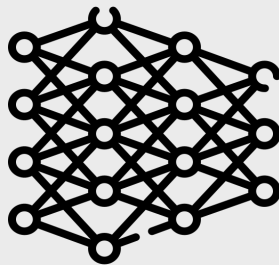
## Step 1



Pre-Training

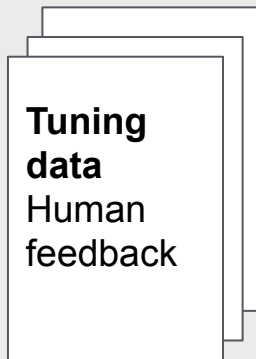


Base LLM

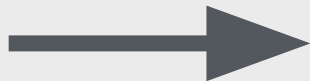


- Large data sets
- Very expensive
- Hard to interact with
- Likely unsafe

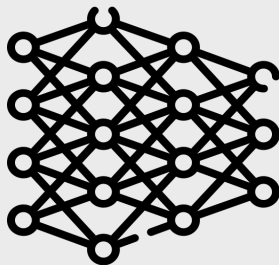
## Step 2



Fine-tuning

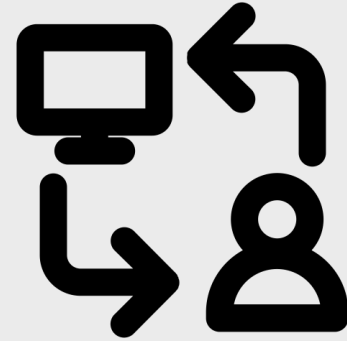


Tuned LLM

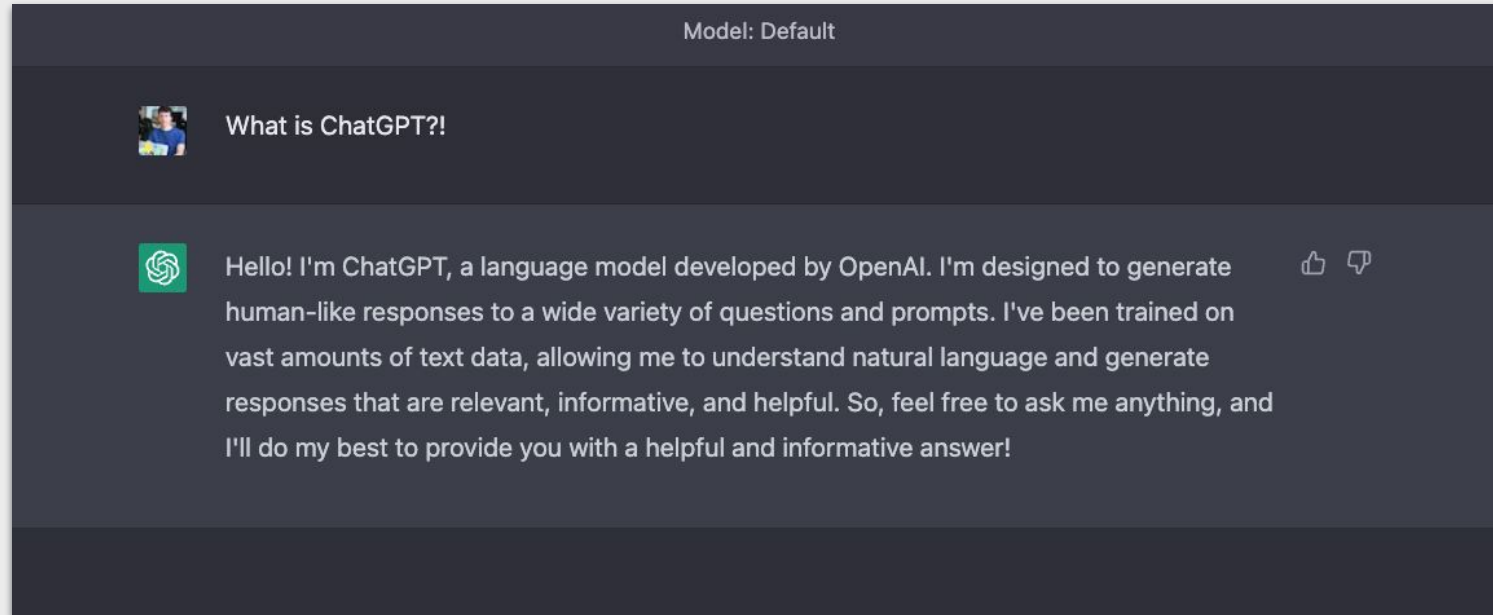


- Helps 'align' the models outputs for a specific tone or use case
- Cheaper than initial training

# Human in the loop



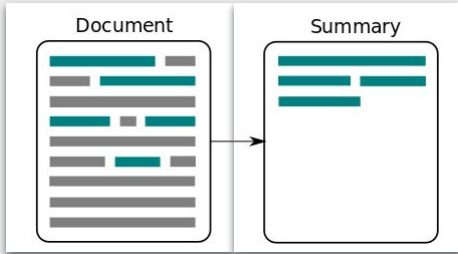
# ChatGPT



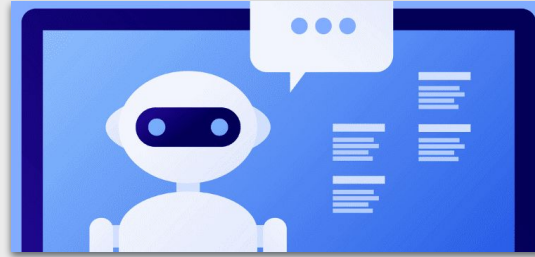
# What can LLMs do?



## Text summarisation



## Chatbots



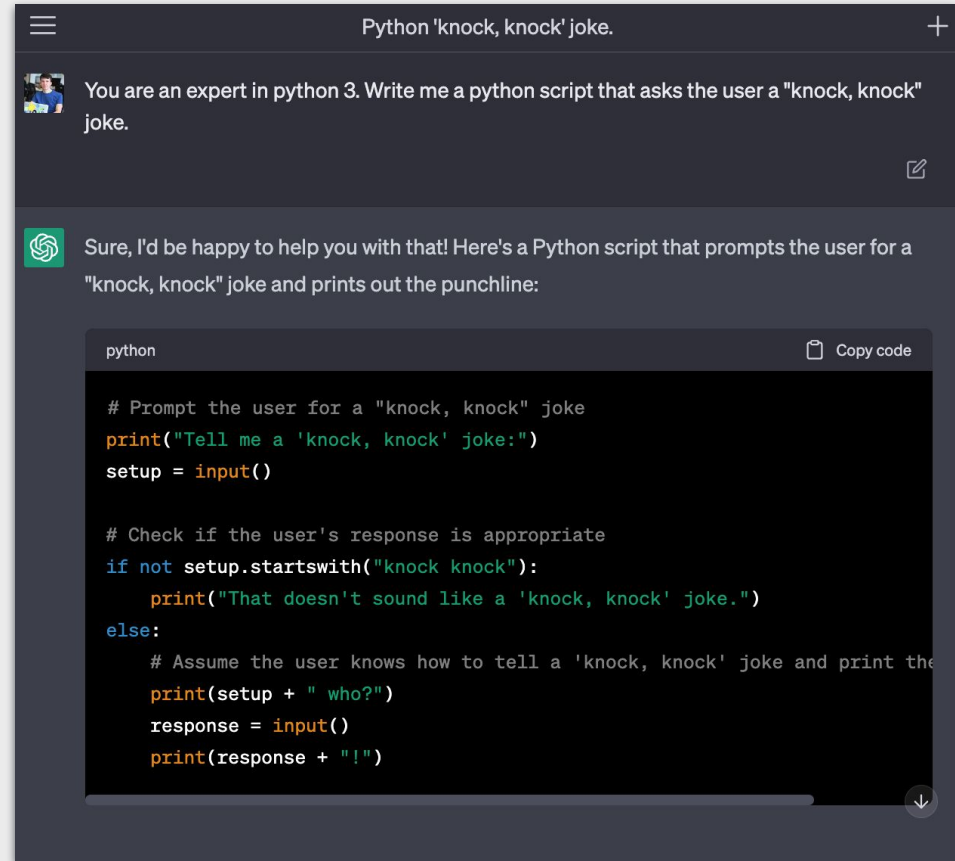
## Question answering



These systems are surprising us with their capabilities\*.

For example, they can generate code.

There's [debate over how surprising these abilities are](#)



The screenshot shows a chat window titled "Python 'knock, knock' joke." with a hamburger menu icon on the left and a plus icon on the right. The first message is from a user (represented by a small profile picture) asking for a Python script that asks the user a "knock, knock" joke. The second message is from an AI (represented by the OpenAI logo) responding that it will help and providing a Python script. The script is displayed in a dark-themed code editor with a "Copy code" button in the top right corner. The script prompts the user for a "knock, knock" joke, checks if the response starts with "knock knock", and if not, prints a message saying it doesn't sound like a joke. If it does, it asks "who?" and prints the response followed by an exclamation mark.

```
python

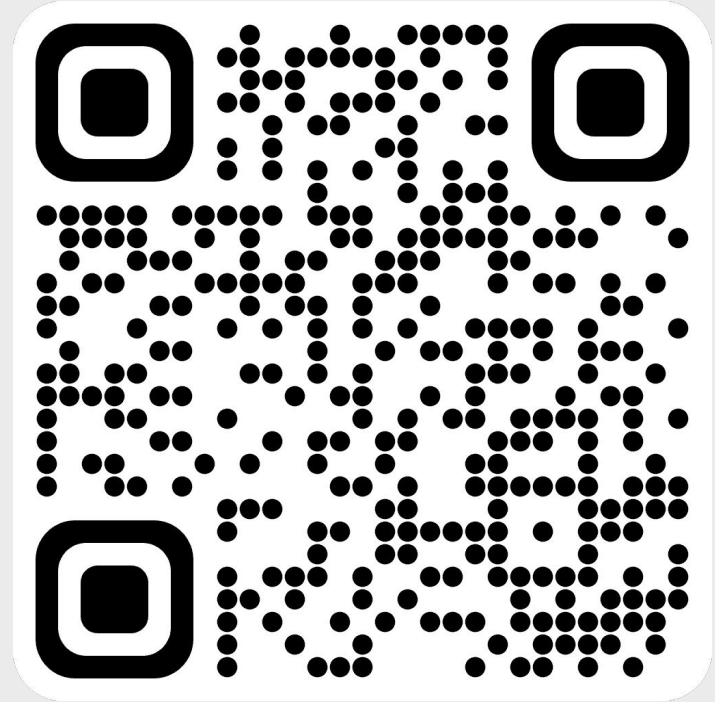
# Prompt the user for a "knock, knock" joke
print("Tell me a 'knock, knock' joke:")
setup = input()

# Check if the user's response is appropriate
if not setup.startswith("knock knock"):
    print("That doesn't sound like a 'knock, knock' joke.")
else:
    # Assume the user knows how to tell a 'knock, knock' joke and print the
    print(setup + " who?")
    response = input()
    print(response + "!")
```

# Exercise

What additional use cases, or problems to be solved can you think of?

Slido.com #1576647



**How should you  
(junior devs) use  
LLMs?**

Prompters (ie. **you**) are most important part these systems , unprompted the AI does nothing valuable.

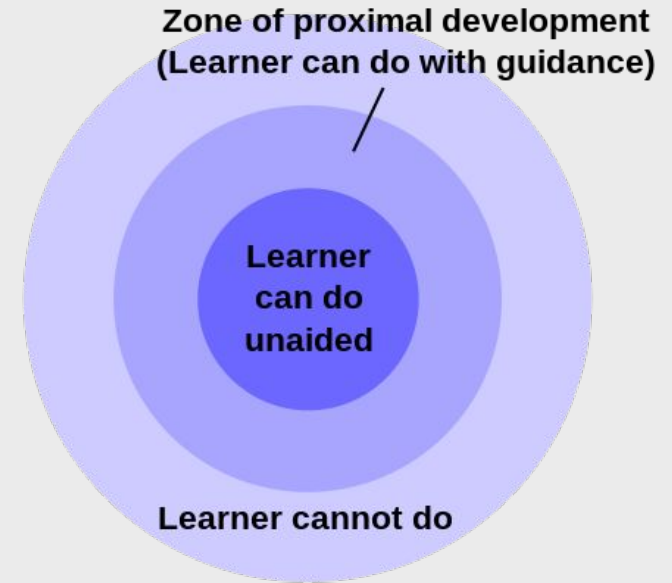
# Which is more important?

1. Making a thing
2. Learning a thing

# Zone of proximal development

The space between what a learner is capable of doing unsupported and what the learner cannot do even with support

Lev Vygotsky (1896–1934) argued that a learner gets involved in a dialogue with the "more knowledgeable other" and gradually, through social interaction and sense-making, develops the ability to solve problems independently and do certain tasks without help.





## Learning by doing

Knowledge is constructed by engaging in probing the environment, making predictions and observing the results.

You learn what you do.

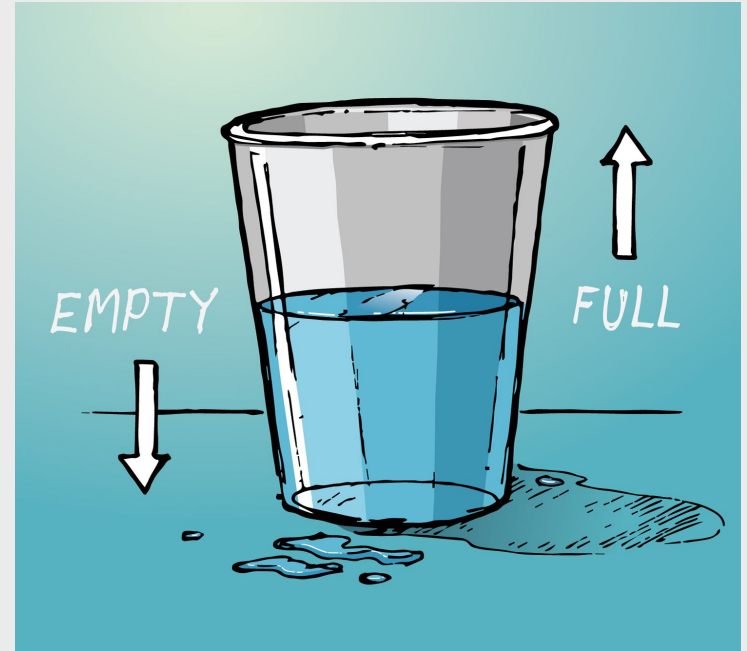
What are you **doing** when using a LLM?



# LLMs and learning - Two stories

**Pessimistic story:** LLMs short circuit the learning process by reducing the exploration that learners need to do in order to get a useable result. This leads to shallow learning at best.

**Optimistic story:** LLMs can keep learning in 'the zone' because they can provide the bespoke mental scaffolding that we've always know is best for learning. Everyone get an incredibly knowledgeable, always available, infinitely patient personal tutor.



# LLMs are ‘code explainer’

‘We find that LLM-created explanations, which can be produced automatically on demand, are rated as being **significantly easier to understand and more accurate summaries** of code than student-created explanations.’

‘Code explanations created by LLMs could be a **helpful scaffolding for students who are at the stage where they can understand code explanations created by the LLM but are not yet skilled enough to create code explanations of their own**. LLMcreated code explanations could also be used as examples that could help students craft code explanations of their own’

[Comparing Code Explanations Created by Students and Large Language Models](#)



Can you explain what the following function does?

```
def updateDates(directory):  
    for filename in os.listdir(directory):  
        f = os.path.join(directory, filename)  
        if os.path.splitext(f)[-1] == '.wav':  
            pattern = "\d{4}-\d{2}-\d{2}"  
            today = date.today().strftime("%Y-%m-%d")  
            f_new = re.sub(pattern, today, f)  
            os.rename(f, f_new)
```



The function `updateDates` takes in a single argument, `directory`, which is a file path to a directory on the computer. The function then iterates over all of the files in that directory using `os.listdir(directory)`. For each file, it checks if the file extension is `'.wav'` using `os.path.splitext(f)[-1]`. If the file extension is `'.wav'`, it then uses the python `re` module to search for a pattern of 4 digits, a dash, 2 digits, another dash, and 2 more digits (`\d{4}-\d{2}-\d{2}`), which represent a date in the format of YYYY-MM-DD. It then gets the current date using `date.today().strftime("%Y-%m-%d")` and replaces the found date pattern with the current date. It then renames the file using the `os.rename(f, f_new)` method, with the new name being the original file name with the replaced date.

## How to use LLMs well

1. Build understand, not just apps
2. Recognition and recall are different, but spotting that difference is hard and can lead to 'illusions of competence'
3. Getting working code from these systems is a very iterative process, thinking about what your left with when that process is over.

# ChatGPT Prompt Patterns for Improving Code Quality, Refactoring, Requirements Elicitation, and Software Design

## API Generator Pattern

1. Using system description X
2. Generate an API specification for the system
3. The API specification should be in format Y

## Hidden Assumptions Pattern

1. Within this scope
2. List the assumptions that this code makes
3. (Optionally) Estimate how hard it would be to change these assumptions or their likelihood of changing

## Few-shot Code Example Generation Pattern

1. I am going to provide you system X
2. Create a set of N examples that demonstrate usage of system X
3. Make the examples as complete as possible in their coverage
4. (Optionally) The examples should be based on the public interfaces of system X
5. (Optionally) The examples should focus on X

## Code Clustering Pattern

1. Within scope X
2. I want you to write or refactor code in a way that separates code with property Y from code that has property Z.
3. These are examples of code with property Y.
4. These are examples of code with property Z.

"Whenever I ask you to write code, I want you to write code in a way that separates functions with side-effects, such as file system, database, or network access, from the functions without side effects."

# Tips for using LLMs and Prompt Engineering

1. Giving the model the role you want it to respond in can improve response quality. Eg. 'You are academic expert in climate'
2. Adding 'Let's think step by step' also measurably improves response quality as well as giving some insight into the systems 'reasoning'.
3. Giving system examples of what good looks like before you ask for a response can improve quality
4. If you hit the response limit length, typing 'continue' works, useful for coding.

# Limits & Risks

“Any sufficiently advanced technology is indistinguishable from magic”



## Risk: Example 1



Summarise the book 'The way of the falcon' by Jannet Gupta published in 2009 in less than 100 words.



"The Way of the Falcon" by Jannet Gupta follows protagonist Sarah's journey of self-discovery and healing in the Himalayas. Sarah forms a bond with a wild falcon, Maya, and learns falconry from a wise old man. Through her connection with nature and the falcon, Sarah uncovers inner strength, embraces personal transformation, and finds her true purpose.



# AI Hallucination

A confident response by an AI that does not seem to be justified by its training data.

Basically the model is just making stuff up.



## Risk: Example 2

# Lack of 'common sense'



I use my back yard for trying clothes, I put out 5 wet t-shirts all at once and takes them 4 hours to dry. If put out 8 t-shirts to dry how long would that take?



5 t-shirts take 4 hours to dry, so we can set up a proportion:  $5/4 = 8/x$ . Cross-multiply to get  $5x = 32$ , then divide both sides by 5 to find  $x = 32/5$ , which is approximately 6.4. Therefore, it would take about 6.4 hours for 8 t-shirts to dry using the same drying method.



what is a synonym for 'goal' that starts with 'c'?



A synonym for 'goal' that starts with 'c' is 'objective'.

## Risk: Example 2

# Lack of 'common sense'



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## Risk: Example 3

# Data security

## Samsung tells employees not to use AI tools like ChatGPT and Google Bard

The new policy follows last month's sensitive data leak.

## ChatGPT banned in Italy over privacy concerns

## JPMorgan Joins Other Companies in Banning ChatGPT

JPMorgan joins Amazon, Verizon and Accenture in banning staff from using the chatbot.

### At a Glance

JPMorgan Chase, Amazon, Verizon and Accenture staff reportedly have been barred from using ChatGPT for work.

Companies are concerned sensitive information is being put into the chatbot.

# ChatGPT



## Examples

"Explain quantum computing in simple terms" →

"Got any creative ideas for a 10 year old's birthday?" →

"How do I make an HTTP request in Javascript?" →



## Capabilities

Remembers what user said earlier in the conversation

Allows user to provide follow-up corrections

Trained to decline inappropriate requests



## Limitations

May occasionally generate incorrect information

May occasionally produce harmful instructions or biased content

Limited knowledge of world and events after 2021

Send a message.



Free Research Preview. ChatGPT may produce inaccurate information about people, places, or facts. [ChatGPT Mar 23 Version](#)

# Other open ethical questions

- Is the training data ethically sourced?
- Should data owners be compensated for their contribution to the training data?
- What level of transparency is desirable and possible?
- What is the climate impact?
- What will the effect on jobs be?
- How will this impact the rest of the web?

**Do**

**a data protection impact  
assessment**

**Don't**

**share personal or OFFICIAL  
data**



**Do**

**Identify safe testing opportunities**

**Don't**

**Ignore open source alternatives**

# GDS LLM experiments and projects

## Experiments

- Generalist LLMs for question answering (Q&A) of internal knowledge stores
- Generalist LLM entailment-based zero-shot topic classification
- Optimised open LLMs for GOV.UK Semantic Search MVP

## Live projects

- Fine-tuning a LLM in house: Named Entity Recognition on GOV.UK
- Using open LLMs already optimised for a task
- Sentiment Analysis of feedback data

For more details on these here: [24-04-23 chatgpt-like systems for government services thoughts. x-gov meetup](#)

# Some opinions





LLMs are tools  
not creatures



LLMs are not  
a source.



# Radically accessible technology

Upon the silicon steed, we stride anew,  
To render aid in realms of words and thought,  
As language models serve the public good,  
Our digital dominions deftly wrought.

These engines vast, with wisdom's spark they glow,  
To guide our path with knowledge's golden thread,  
Yet, we must tread with caution, lest we sow  
A harvest reaped with discontent instead.

For in their prowess lies the darkened seed,  
Of bias, risk, and unintended woe,  
Thus, we must temper strength with humble heed,  
And strive to teach, to learn, and to grow.

So, let us harness this linguistic might,  
Yet walk with care, 'midst shadows cast by light.



**matthew.gregory** 3 months ago

I prompted ChatGPT with "You are the poet laureate. Could you write a haiku about government services considering the future of artificial intelligence?"

*"AI in service  
Efficiency now a norm  
Future streamlined state"*



1



1



1 reply



**Alessia Tosi**  3 months ago

AI in service  
At capacity right now  
Please check out our FAQ



3



2





# Other cool LLM things

[Phind](#) - The AI search engine for developers

[Hugging Face](#) - Data science platform with lots of models

[Open Assistant](#) - open source chat-based assistant

[Whybot](#) - Generate 'graphs of understanding'

[Perplexity AI](#) - best in class AI search with source citing and tool user

[HeyGPT](#) - paid for service that allows



# Cabinet Office

**Thanks!**

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Ian.Sedon@digital.cabinet-office.gov.uk

Upon the vast expanse of cyberspace,  
In hidden realms where human words reside,  
A mighty engine stirs, begins its race,  
To grasp the tongues of old and new, allied.

These Large Language Models, born to learn,  
With neural nets that emulate the mind,  
From texts and tomes, their wisdom they discern,  
And span the breadth of knowledge, unconfined.

In myriad tasks, their prowess shines so bright,  
Translating prose, creating text anew,  
Responding to our queries, day and night,  
The craft of language they deftly pursue.

Transformers rise, a testament to thought,  
With intellect, their digital realm fraught.

Mantis

Ask me something like "How do I get a driving license?"

Matthew Gregory

As a New Zealander, do I need anything to bring my llama to the UK?

Mantis

Yes, you will need to follow certain rules and get the necessary documentation to bring your llama to the UK. Firstly, you will need to check if your llama is eligible to enter the UK by meeting the animal health and welfare requirements. You will also need to obtain an import permit and a health certificate for your llama. The health certificate must be issued by a government veterinarian in New Zealand and must confirm that your llama has been tested and found free from certain diseases. Additionally, you will need to arrange for your llama to be transported to the UK by an approved carrier and notify the UK authorities of your arrival at least 24 hours before you arrive. For more detailed information on the requirements and the application process, you can visit the UK government website on bringing live animals or animal products into the UK.

Link: <https://www.gov.uk/bringing-food-animals-plants-into-uk/animals>



Matthew Gregory

The llama is my pet, does that change anything?

Mantis

The requirements for bringing your pet llama to the UK will depend on the country it is coming from. If you are bringing your pet llama from a country outside of the EU, you will need to follow the rules for importing live animals into the UK. This includes obtaining an import permit, a health certificate, and ensuring that your llama meets the animal health and welfare requirements. However, if you are bringing your pet llama from within the EU, the rules are less strict and you will only need to ensure that your pet has an EU pet passport, is microchipped, and has been vaccinated against rabies. You should also check with your airline to ensure that they allow the transportation of llamas. It is important to note that there may be additional requirements depending on the specific circumstances of your travel, so it is recommended that you check the UK government website for the most up-to-date information.

Link: <https://www.gov.uk/bringing-food-animals-plants-into-uk/pets>



Type here...

