LLMs in Action: Developing a COM AI Player for an Interactive Tic-Tac-Toe Game using OpenAI Developer API

Lesson 1: Large Language Models

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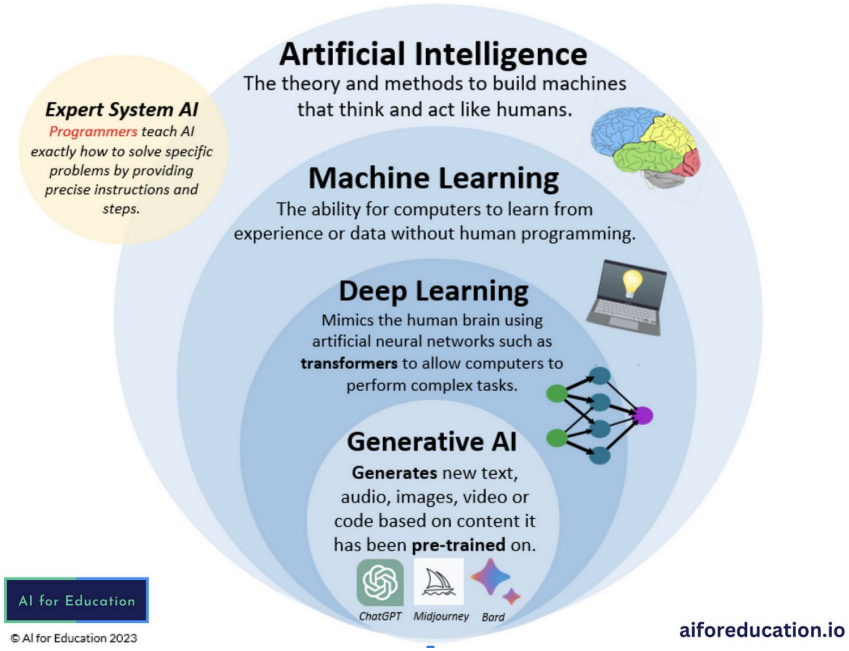
Overview

- **Motivation**
  - A Brief History of Artificial Intelligence (AI)
  - Machine Learning, Deep Learning and Generative AI
- **What are LLMs?**
  - How LLMs Work
  - Applications
  - Limitations
- **Aside: Careers in AI**

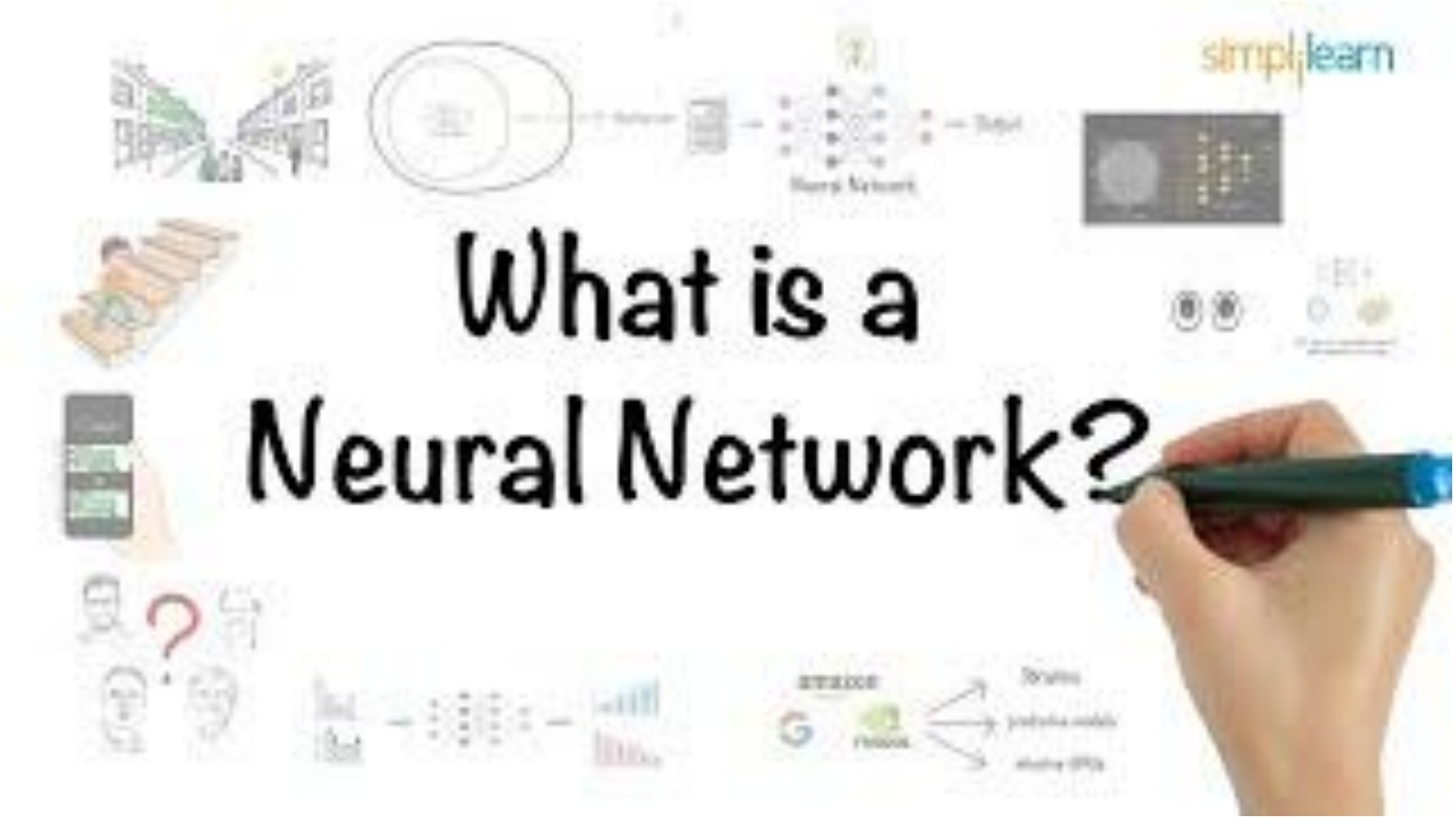
Motivation: A brief history in AI

The powerful language models we have today builds from decades of research in AI

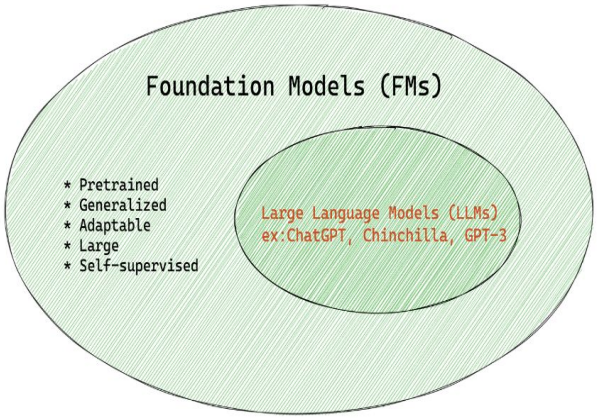


- **1950s:** 1950s – Alan Turing proposes the Turing Test, marking the birth of AI.
- **1960s-1970s:** **Rule-based systems** and **expert systems** emerge (e.g., ELIZA, DENDRAL).
- **1980s-2000s:** Introduction of early **machine learning** methods.
- **2010s:** **Deep learning** revolutionises AI with CNNs, transformers, etc
- **2020s:** Rise of **Generative AI** (LLMs, DALL·E, ChatGPT) and AGI research.

Video: Neural Networks



What are LLMs?



- LLMs are a subset of **Foundation Models (FM)**
  - Deep learning models **trained** on broad datasets
    - Used across multiple domains (text, vision, speech, etc.)
    - Based on the **transformer architecture**
  - Serve as a base for **fine-tuning** on specific tasks

- LLMs are designed specifically to understand and generate human-like text
- *"All llms are foundation models but not all foundation models are LLMs"*

Language modeling

Imagine the following task: Predict the next word in a sequence

The cat likes to sleep in the ____ → What **word** comes next?

Now we have (say) ~50,000 classes (i.e. words)

Can we frame this as a ML problem? Yes, it's a classification task.

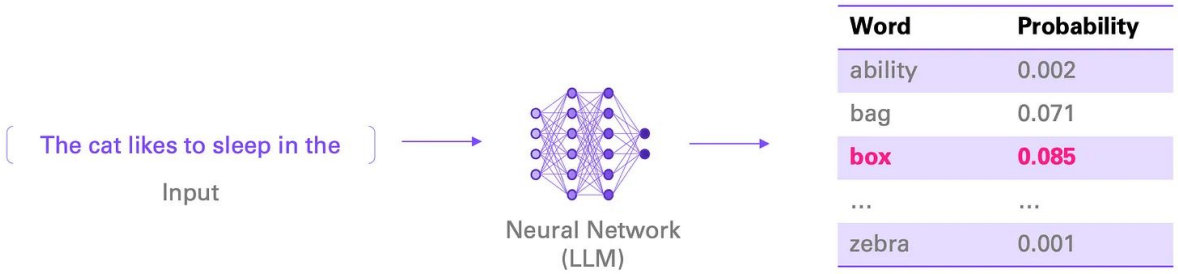


Image from: https://medium.com/data-science-at-microsoft/how-large-language-models-work-91c362f5b78f

How LLMs Work

Massive training data

We can create vast amounts of sequences for training a language model

Context · Next Word · Ignored

The cat likes to sleep in the

The cat likes to sleep in the

The cat likes to sleep in the

The cat likes to sleep in the

The cat likes to sleep in the

We do the same with much **longer sequences**. For example:

A language model is a probability distribution over sequences of words. [...] Given any sequence of words, the model predicts the next ...

Or also with **code**:

```
def square(number):
    """Calculates the square of a number."""
    return number ** 2
```

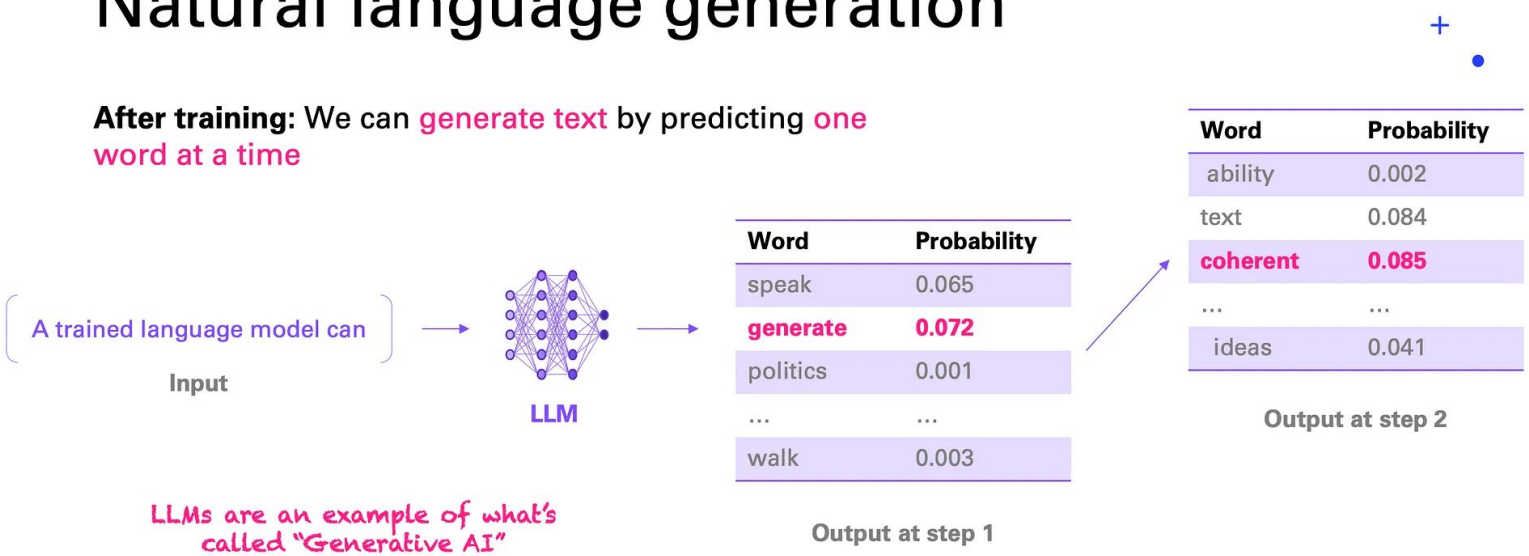
And as a result - the model becomes incredibly good at predicting the next word in any sequence.

Image from: https://medium.com/data-science-at-microsoft/how-large-language-models-work-91c362f5b78f

How LLMs Work

Natural language generation

After training: We can generate text by predicting one word at a time



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Popular GenAI Models

Company	Popular Models
OpenAI	GPT, Codex, DALL-E, Sora
Google DeepMind	Gemini, BERT variants, Veo 2
Meta	LLaMA
deepseek	R1
ANTHROP\C	Claude

Video: Text-to-Video Model Comparison

Veo 2 (Google) vs **Sora** (OpenAI)

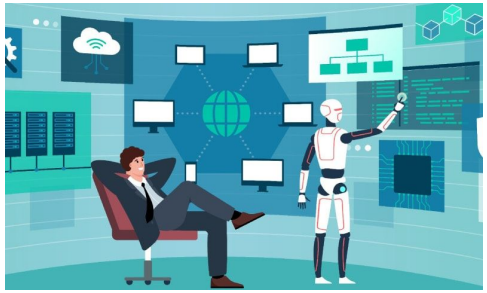
Business Applications of LLMs

Customer Service

Content Creation

Software Development

Education



Data Analysis

Sentiment Analysis

Limitations of LLMs

- **Hallucinations**
  - May generate plausible but inaccurate information
- **Data bias**
  - May produce biased or stereotypical content
  - Often a product of datasets containing bias information
- **High computational costs**
  - Significant resources required for training and deployment
- **Ethical Implications**
  - Privacy concerns regarding data usage and storage
- **Data Security risks**
  - e.g *“DeepSeek data leak exposes 1 million sensitive records”* (Forbes, 2025)
  - Caused by misconfigured cloud storage instance lacking access control

Aside: Careers in Artificial Intelligence

Top AI Jobs in the UK (2025)

Career Path	Description	Average Salary
Machine Learning Engineer	Designs and develops algorithms enabling machines to learn from data.	£59,000
AI Engineer	Creates intelligent systems that perform human-like tasks.	£52,000
Computer Vision Engineer	Develops systems that interpret and process visual information.	£57,884
NLP Engineer	Builds systems allowing computers to understand and generate human language.	£53,000
Data Scientist	Analyzes large datasets to extract meaningful insights.	£51,761
Robotics Engineer	Designs and builds robotic systems.	£46,025
Deep Learning Engineer	Develops advanced neural networks for deep learning applications.	£58,000
AI Product Manager	Oversees development and management of AI-driven products.	£64,713
AI Consultant	Provides strategic advice on AI integration.	£50,000
Generative AI Engineer	Works on generative AI models, a rapidly emerging field.	£72,000

Data from: www.accesscreative.ac.uk, www.glassdoor.co.uk

Summary

- LLMs are foundation models trained on large datasets to generate human-like text.
- They use deep learning architectures like transformers for contextual understanding.
- During text generation, they predict the next word token-by-token based on learned probabilities.
- **Applications:**
  - Used in customer service, content creation, software development, education, and data analysis.
- **Limitations:**
  - Prone to hallucinations, data bias, high computational costs, ethical concerns, and security risks.

Questions?