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BitOoda AI Research:
State of Large Language Models

Research

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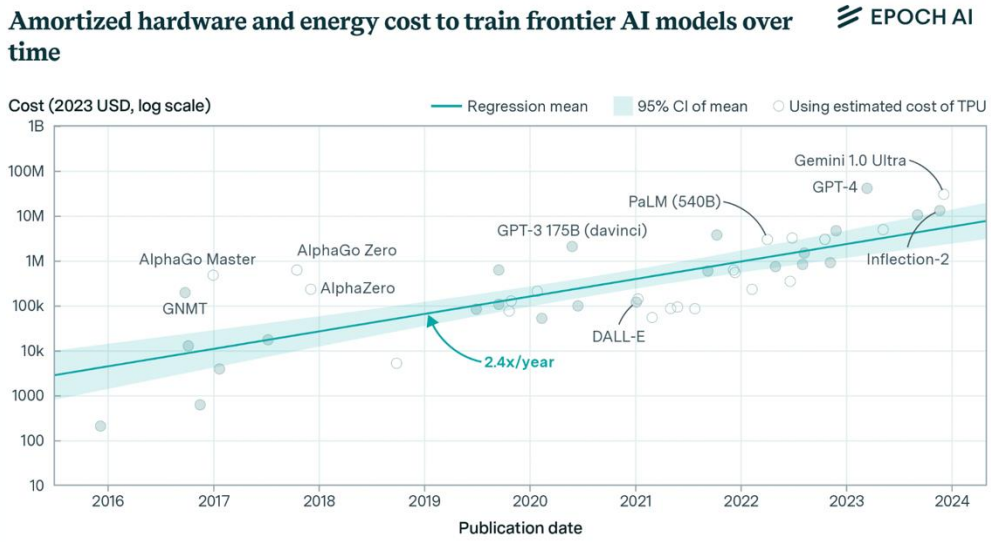
Abstract

This report explores the current state of artificial intelligence (AI), focusing on the comparison between open-source and closed-source AI models. It examines the definitions, differences, and advantages of each approach, highlighting how open-source models can reduce training requirements, enhance security, allow for model optimizations, and provide ownership of model weights. The report also discusses how these factors could potentially shape the future AI market.

Introduction

Artificial intelligence has rapidly evolved, becoming an integral part of various industries. The global AI market size was valued at $119.78 billion in 2022 and is projected to grow at a CAGR of 37.3% from 2023 to 2030. As AI technologies advance, the debate between open-source and closed-source models intensifies. This report aims to provide a comprehensive overview of open-source and closed-source AI models, their differences, and the potential implications for the market.



Source: Epoch AI

Key Takeaways

- In LLMs, training adjusts weights using large datasets to recognize patterns, with weights enabling accurate predictions.
- Open weights models provide pre-trained weights for modification and fine-tuning, while closed-source models limit access to only the final product without allowing changes to the underlying code.
- Companies may select open-source or closed-source models based on scalability, support, and long-term viability for their needs.

Definitions and Background
More on Training

Important Definitions

What is a Large Language Model (LLM)?
At its core, a Large Language Model (LLM) is a type of neural network designed to predict the next word in a sentence. This seemingly simple task is achieved through a process of converting input text—referred to as the prompt—into numerical representations via a tokenizer. These numbers are then multiplied by a series of matrices, known as **weights**, until the model outputs a prediction, which is then converted back into words.

Weights
The key to an LLM's power lies in its **weights**. These weights represent patterns the model has learned during the training process. During training, the model updates these weights to better recognize patterns and improve its ability to make accurate predictions. In essence, the model "learns" by adjusting the weights through many iterations until it minimizes the error in its predictions.

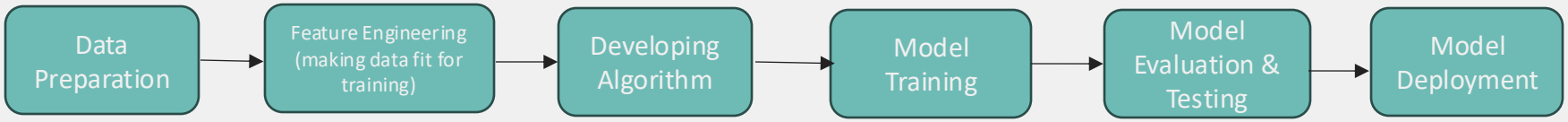
Understanding AI Training

What is AI Training?
Training in AI refers to the process of teaching a machine learning model to make accurate predictions or decisions based on data. This involves:

- **Data Input:** Feeding the model large datasets containing examples relevant to the task.
- **Learning Patterns:** Adjusting the model's parameters so it can recognize patterns and relationships within the data.
- **Optimization:** Minimizing errors by tweaking the model to improve its performance over time.

The goal is to enable the AI model to generalize from the training data to new, unseen data effectively.

AI model development process flow



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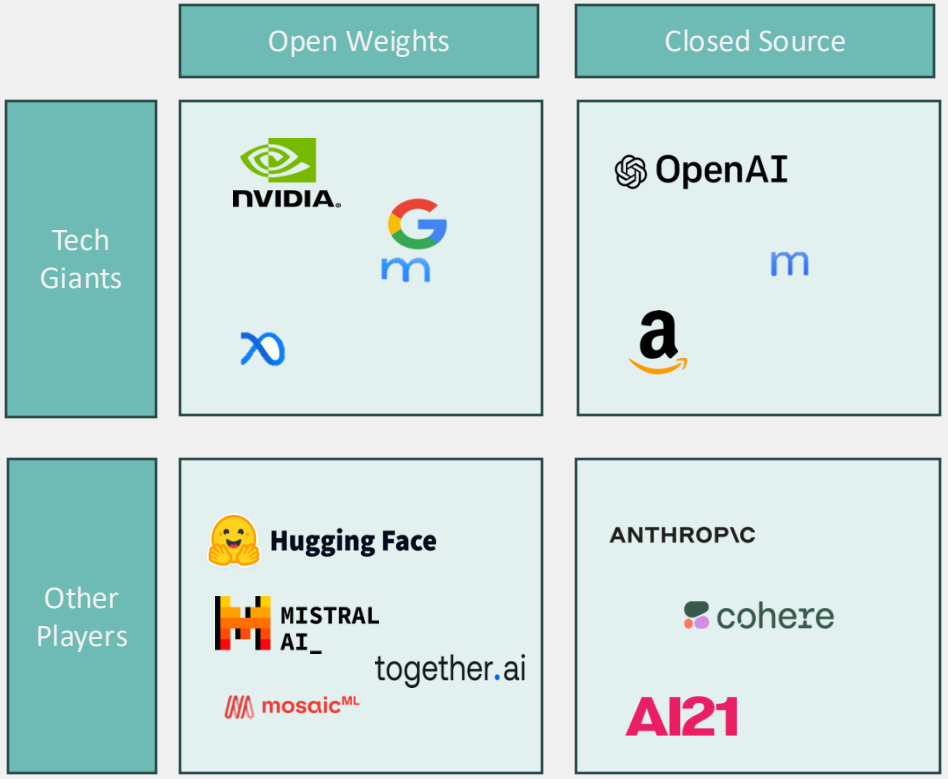
Definitions and Background

Open-Source vs Closed Source AI

Open-Source vs Closed Source

Open-source refers to software whose code is ***publicly available for anyone to use***, modify, and distribute. This encourages collaboration and transparency.
In the context of AI, **open-source** means that the entire AI model, including its architecture, code, and sometimes training data, is accessible for use, modification, and distribution by anyone.

Closed-source software, on the other hand, ***restricts*** access to the code, keeping it private, and users can only interact with the final product, not modify or inspect it.



Open-Source v/s Open Weights:

- BitOoda distinguishes between open weights and fully open-source models.
- Open-weights: AI models like Meta's LLaMA and Microsoft's Phi series make their pre-trained weights public, allowing users to download, modify, or fine-tune them.
- Fully open-source models: These models release not only the weights but also the entire codebase, including training data and methodologies, ensuring full transparency and reproducibility.
- Open-weight models are a subset of open-source models, offering flexibility in performance and security.

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Which is better for you?

Open Weights vs Close Weights for your use case

Criteria	Close Source Commercial Models	Open Weight Models	Best Fit
Pricing	Cost typically depends on usage, often involves subscription models.	Generally free, though some additional services may incur costs.	***Commercial***: Ideal for businesses needing predictable costs. ***Open source***: Suitable for budget-conscious or flexible projects.
Flexibility & Customization	Offers limited customization, mostly standardized solutions.	Highly customizable, offering more flexibility.	***Commercial:*** Best for standard solutions. ***Open source:*** Perfect for projects that need extensive customization.
Security & Compliance	Robust security features, compliant with regulations.	Security varies and may require extra work for compliance.	***Commercial:*** Suited for industries with strict security standards. ***Open source:*** Best for custom security adaptations.
Support & Maintenance	Comes with structured support and regular maintenance.	Community-driven support; quality may vary.	***Commercial:*** Best for organizations that need dedicated, consistent support. ***Open source:*** Suitable for entities that can self-maintain and leverage community-driven support.
Long-term Viability	Backed by commercial entities, ensuring predictable longevity.	Depends on community support for continued development.	***Commercial***: Perfect for organizations that prioritize long-term stability. ***Open source:*** Great for projects that can adapt to evolving community input and trends.

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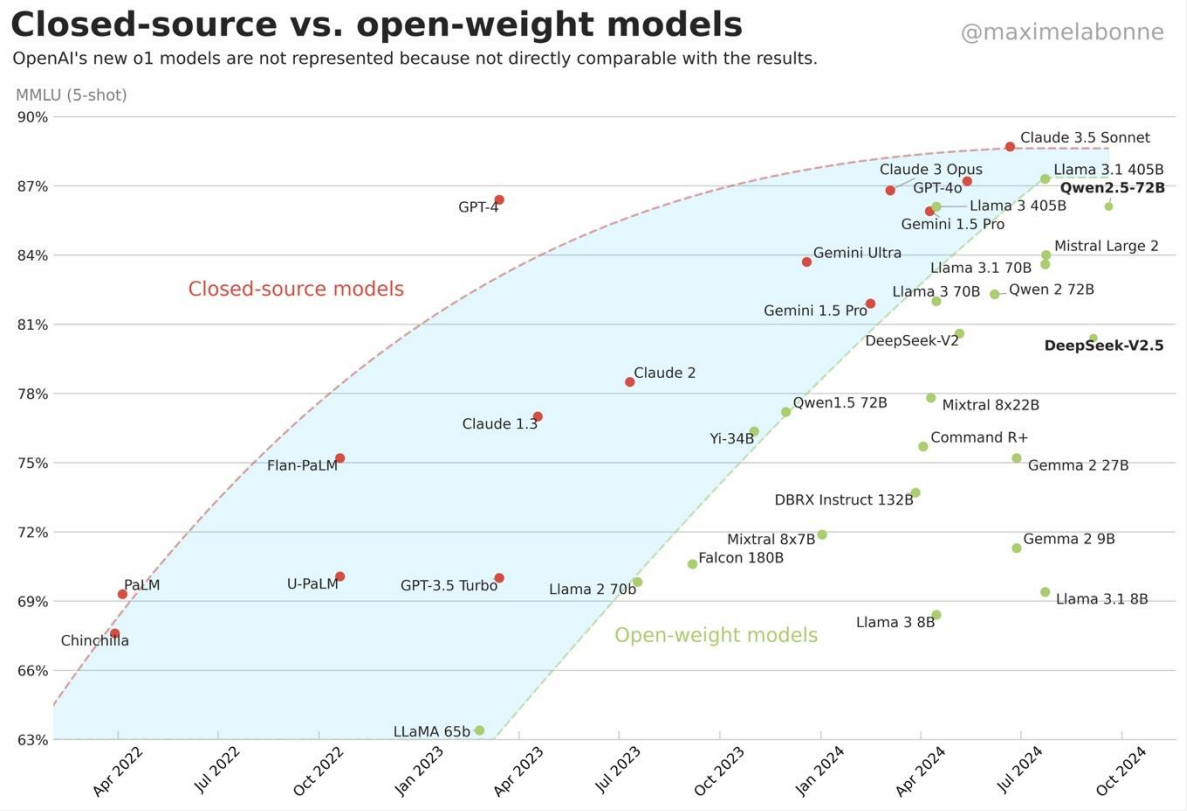
Performance
Will Open Source Ever Catch up?

Close Source models still have an advantage

Companies that were pioneers in this space, like Open AI and Google, have all kept their models close source to monetize them. Several companies, such as Meta and Mistral, have led innovation in the open-source space. Still, since training models require significant resources and monetizing open-sourced models is challenging, most companies keep their most advanced models close source. Despite these breakthroughs by the open-source community, their models rapidly caught up to state-of-the-art close-source models.



Closing gap between closed-source and open-weights model
Source: @maximelabonne on X

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Niraj Yagnik, the primary research analyst of this report, hereby certifies that all of the views expressed in this report accurately reflect his personal views, which have not been influenced by considerations of the firm's business or client relationships.

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