Running Bittensor

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In 2008, Satoshi Nakamoto published the Bitcoin whitepaper.

The paper laid out a new, gamified accounting system where computers could work together over time and space to agree on a shared truth, namely the state of Bitcoin's ledger.

Bitcoin's first product? A digital money called BTC. Since Bitcoin began running in 2009, distributed computers all over the world have been incentivized to provide computation to validate and secure this digital money system.

In that time, it has proven tamper-resistant (immutable), auditable (transparent), and outside the control of any single entity (distributed).

And as time passed, Bitcoin's architecture has become progressively more decentralized.

Today, BTC is the world's most valuable digital commodity money, with a market cap of $1 trillion at the time of writing.

In many ways, BTC's early

success was achieved by leveraging four economic design principles:

Fair Launch.

Bitcoin's initial distribution was characterized by an open network that any individual with a computer could participate in. This played a pivotal role shaping the narrative of a credibly neutral system.

Proof of Work.

In Proof-of-Work (PoW) systems, decentralized miners all over the world solve complex mathematical problems to validate network transactions. The computation these miners contribute lays the security for a global, tamper-resistant, auditable, digital money to securely exist on top.

Fixed Supply.

Bitcoin's capped supply of 21 million BTC leads to sustained cycles of price discovery when aggregate demand to hold the asset outweighs the aggregate demand to sell.

Programmatic Halvings

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Bitcoin's programmatic halving occurs roughly every four years. They are transparent, understood, controlled scarcity events in the digital commodity's supply schedule.

Taken together, these early economic features solved the biggest problem to creating a new type of digital money:

The coordination problem.

The State of AI

In February 2023, Meta released an open-sourced, seven billion parameter large language model, calledLLaMA. Later that May, an anonymous memo reportedly written by a Google AI researcher argued that open source software was "quietly eating our lunch."

"The impact on the community cannot be overstated," the leaked memo described. "Suddenly anyone [can] experiment."

Outside of its growing role in the emerging AI space, the benefits of open source development today are well understood:

Collaborative Innovation

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Open-source systems facilitate peer to peer collaboration and knowledge sharing, accelerating the pace (and often quality) of innovation.

Freedom and Flexibility

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Developers are not locked into the single agenda of a corporation. They can make customizations to the network in real time.

Transparency.

Users have the ability to inspect, modify and understand the software. This often fosters higher levels of trust and collaboration, removing skepticism around an author's motives.

To understand the upper bound of open-source outcomes, look no further than the rise ofLinux.

In the 1990's, Linux successfully harnessed the collective social and intellectual capital required to develop an operating system that matched (and in some dimensions, surpassed) centralized OS competitors in performance. In 2022, the Linux operating system market was valued at USD 15 billion (USD), with projections to grow to$66 billion by 2030.

Eric Raymond's ["The Cathedral and The Bazaar"

](http://www.catb.org/~esr/writings/cathedral-bazaar/cathedral-bazaar/index.html) detailed Linux's ability to thrive and succeed — while simultaneously ignoring commonly understood rules around software development (i.e. small project teams, closely managed objects, and narrowly scoped complexity).

Attempting to understand how

Linux thrived outside these rules, Raymond classified and analyzed the two competing development approaches as The Cathedral

(closed source) and The Bazaar

(open source).

The Cathedral

(Closed Source)

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The conventional and closed software development model. This model has strict guidelines and goal setting within small project teams, operating under a hierarchical chain of command.

The Bazaar

(Open Source)

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An open and peer-to-peer software development model — 'Bazaar' meaning an open market. This model was characterized by short release cycles, with constant feedback and contribution from users and developers alike.

Fast forward to 2024. Today, these same concepts apply to the debates happening across the emerging AI stack. The question on everyone's mind — can open-source AI compete?

We can look to the open source success stories of the past to attempt a prediction of the future. Though, it's important to note that one key difference exists that makes these efforts difficult.

Unlike previous open source software development:

- The modern AI movement requires massive amounts of data

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- This data requires massive amounts of computation

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- This computation requires massive amounts of capital

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Today, the machine power required to train and optimize AI is extremelyexpensive. Conservative estimates suggest that training GPT-3 cost roughly $4.6M for a single training run.

Given the steep computational requirements to train proprietary, centralized AI — emerging giants like OpenAI are enjoying capital-related AI moats around computation, speed, and innovation.

And these capital moats appear to be only getting larger.

Taking a step back, centralization and decentralization have long been in dance with one another — a kind of ebb and flow across history.

When new innovation is introduced, markets trend towards verticalization as a natural desire for greater efficiency and lower costs. Early winners favor systems that can best leverage scale to meet consumer demands.

As time progresses —the market's needs refine, a new category of players emerge, and component parts of the vertical stack get unbundled. Often, if the technology is truly disruptive enough, governments step in to enroll geography-specific regulations constructed to temper centralized power.

This opens the door for decentralized upstarts to unbundle layer-specific innovations.

And round and round we go.

Although the history of technology is just a series of bundling and unbundling, we believe over the long arc of time, one thing remains constant:

Progress bends towards decentralization.

Today, we've only now started to see the open-source AI movement start to take shape.

HuggingFace is an open AI community and platform that facilitates collaboration on models, datasets, and applications within the machine learning community. The project provides open-access tools and resources for researchers, developers, and organizations to collaborate, share, and build upon the latest advancements in AI and natural language processing.

Today, over 516k models exist on HuggingFace.

The Huggingface LLM Leaderboard is also the internet's town hall for tracking, ranking, and evaluating open-source LLMs; however, a number of recent issues have plagued the community's ability to effectively rank these open source efforts. Performance metrics are gameable, leading to optimization to achieve the highest benchmark scores, rather than pushing open source performance forward.

As a result, the leaderboard ends up with more highly ranked — but not commercially better — open source models.

To truly unleash the benefits of open source AI and machine learning, the co-authors of this article believe Eric Raymond's design space needs an upgrade.

Today, a technology exists that has the potential to combine the capital formation of the Cathedral

(Closed Source), with the collaborative and open nature of the Bazaar

. (Open Source).

The cryptonomic commons.

Over the last 15 years, the design principles of a decentralized, trust-minimized, digital money have come to be understood by our global markets. The U.S. Bitcoin spot ETF, approved by the SEC in January 2024, has already seen flows of over $5.5B+ in its first month of existence.

Now standing at $1 trillion in market capitalization, it is clear across both retail and institutional audiences that Bitcoin is a valuable digital commodity used to store value in the same way as scarce physical commoditieslike gold ($8T), real estate ($325T), or art ($1.7T).

No new

digital economy can perfectly replicate the genesis creation event of Bitcoin. However, to solve the current limitations of open source AI, we must orient towards Bitcoin's foundational principles.

Only by solving these same coordination problems, can we fully operationalize the power of the open source market for intelligence.

Meet Bittensor

Bittensor is an open-source network and protocol founded in 2019 by two AI researchers, Jacob Steeves and Ala Shaabana. The whitepaper was written by pseudonymous author, Yuma Rao.

The public network was founded to deliver on a simple mission — use programmable incentives to accelerate development for open-source intelligence markets. Intelligence can include — but is certainly not limited to — text/image/audio/3D generation, data scraping, price predictions, decentralized data storage, x-rays and medical diagnostics, model fine tuning, and a virtually limitless number

of other categories.

What may be non-obvious upon first look, is that the project obviates the need to directly

tackle the most complex challenges in AI research. For the Bittensor network to thrive over the coming decades, the core Bittensor protocol does not:

- Rely on "currently unsolved" AI/ML research problems;
- Require outside technological innovation (e.g. Zero-Knowledge development).

Simply, Bittensor is working right now.

The network and protocol function together as a coordination layer for intelligence, much in the same way that Bitcoin functions as a coordination layer for commodity money.

As we'll discuss later in this article, the Bittensor network is agnostic to the types of markets that form on top of it over time. The system has been devised to naturally rotate out weak-performing markets, based on pre-defined, objectifiable criteria.

To solve its initial market coordination problem, Bittensor's system programmatically emits a native TAO token at an inflation rate of roughly 7,200 per day.

Notably, Bittensor is built from the same four economic design principles that laid the foundation for Bitcoin:

(1) Fair Launch.

In January 2021, the Bittensor network was openly marketed and discussed widely before activation. On its first day, any miner or validator around the internet could begin earning TAO by contributing to the system.

(2) Proof of Work.

Instead of solving for random strings of characters like Bitcoin, miners on Bittensor solve machine learning problems by competing across any number of intelligence games. Today, intelligence games on Bittensor include the creation of latent representations of images, sentences, 3D objects, health data, storage, training, tuning, or other commodity markets. Miners are rewarded by validators when their representations are similar to those of others. Importantly, scoring rules are uniquely constructed by each game creator, so that validation of miner scores is narrowly scoped to the "fuzzy work" accomplished in the subnet game.

(3)Fixed Supply.

Bittensor's capped supply of 21 million TAO facilitates sustained cycles of price discovery for the monetary system when aggregate demand to hold outweighs the aggregate demand to sell.

(4)Programmatic Halvings

. Bittensor's programmatic halvenings, occurring roughly every four years, controls Bittensor's inflation rate. By halving the reward for mining new blocks, this introduces transparent, understood, controlled scarcity events into the supply schedule. As subnet slots are added to the system — starting today with 32 unique subnets, then later 64 subnets, then 128 subnets — more miners will enter the system to compete for the same 7,200 TAO distributed daily across all subnets. Similar to how aggregate miner costs on Bitcoin create a floor for Bitcoin price, we believe an increasing aggregate miner cost may function similarly in the Bittensor ecosystem as the subnets double.

By optimizing for the coordination layer, Bittensor created an open source network these co-authors believe meets the intelligence market as it exists today — and

can efficiently scale to any size over time.

We see three benefits to this approach:

Liveness

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Focusing on the coordination layer empowers intelligence markets to go from inert to action now

, instead of waiting for predicated advancements in new technologies. As research and developments in new technologies improve, they can be cleanly incorporated into Bittensor as additive to the coordination layer.

Neutrality.

Because the tech stack is largely unopinionated, projects building on Bittensor can create wildly differentiated

intelligence markets that draw on the same economic substrate; yet, be uniquely positioned toward the intelligence space desired.

Opportunity

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Simply, Bittensor incentivizes participants to deploy, iterate, and earn from their creations in a way that's not possible through centralized services and platforms.

We discuss these applications later in the article. For now, to project out the implications of Bittensor's cryptoeconomic model, one only needs to look to its economic predecessor — the Bitcoin network.

Today, the largest supercomputer in the entire world is Bitcoin— a network orders of magnitude larger than the combined network sizes of Amazon, Google, and Microsoft.

Wielding the same economic design at its foundation, Bittensor's ambitions are equally large; though, instead of optimizing for community-owned commodity-money, it optimizes for community-owned synthetic intelligence.

And it's already working.

Bittensor's annual inflation value — a programmatic commodity waterfall used to attract leading, mission-driven, AI/ML talent — is already comparable to the largest centralized AI players in the world.

Bootstrapped only by the value of a market-priced TAO.

In December 2023, OpenAI's annual run rate — a measure of one month's revenue multiplied by 12 months,hit the $2 billion revenue mark. While not perfectly analogous, at current TAO prices (~ $580 per TAO), Bittensor emissions has the capacity to pay ecosystem participants a comparable $1.5B+ annually to contribute to the decentralized open network.

Moreover, the economic upside generated by OpenAI's success can only be enjoyed by a select few, namely, large OpenAI shareholders. Conversely, and in the true spirit of open-source technology, Bittensor's success can be enjoyed freely by the world — AI/ML engineers, developers, and market participants of all types across the internet can hold and be rewarded for contributions to the open-source intelligence project through Bittensor's native TAO token.

All this from a fair launched, leaderless, credibly neutral protocol for open source intelligence.

Over the rest of this article, we'll unpack the inner workings of the Bittensor system, across the following four sections:

I. The Subnets

II. The Applications

III. The Proposal

IV. The North Star