AI SUMMIT 2021 SEOUL

State of AI 2021

Gleb Chuvpilo
December 2021

Gleb Chuvpilo
Managing Partner @ Thundermark

Investor

- **Managing Partner @ Thundermark Capital**, and early-stage deep tech venture capital fund backed by Peter Thiel (Miami).
- Previously **Venture Partner @ Hardware Club, Rewired** and **Peak State Ventures** (NYC, London, Paris, Lausanne, Zurich).
- Previously **Portfolio Manager @ Thiel Macro** (Peter Thiel's global macro hedge fund).
- **Previously AI-Driven Quantitative Trader @ Goldman Sachs** ($10B hedge fund).

Serial Entrepreneur

- Previously **Founding Engineer @ Pager** ($132.6M raised; VCs include NEA & Lux; partnerships covering 15 million patients).
- Previously **Co-Founder & Head of R&D @ Ride** (TPG Growth portfolio company; acquired by Enterprise Holdings in 2016).
- Previously **Co-Founder & CEO @ Authy** (YC W12; acquired by Twilio in 2015).
- Previously **Early Engineer @ Palantir Technologies** (designed AI algorithms).

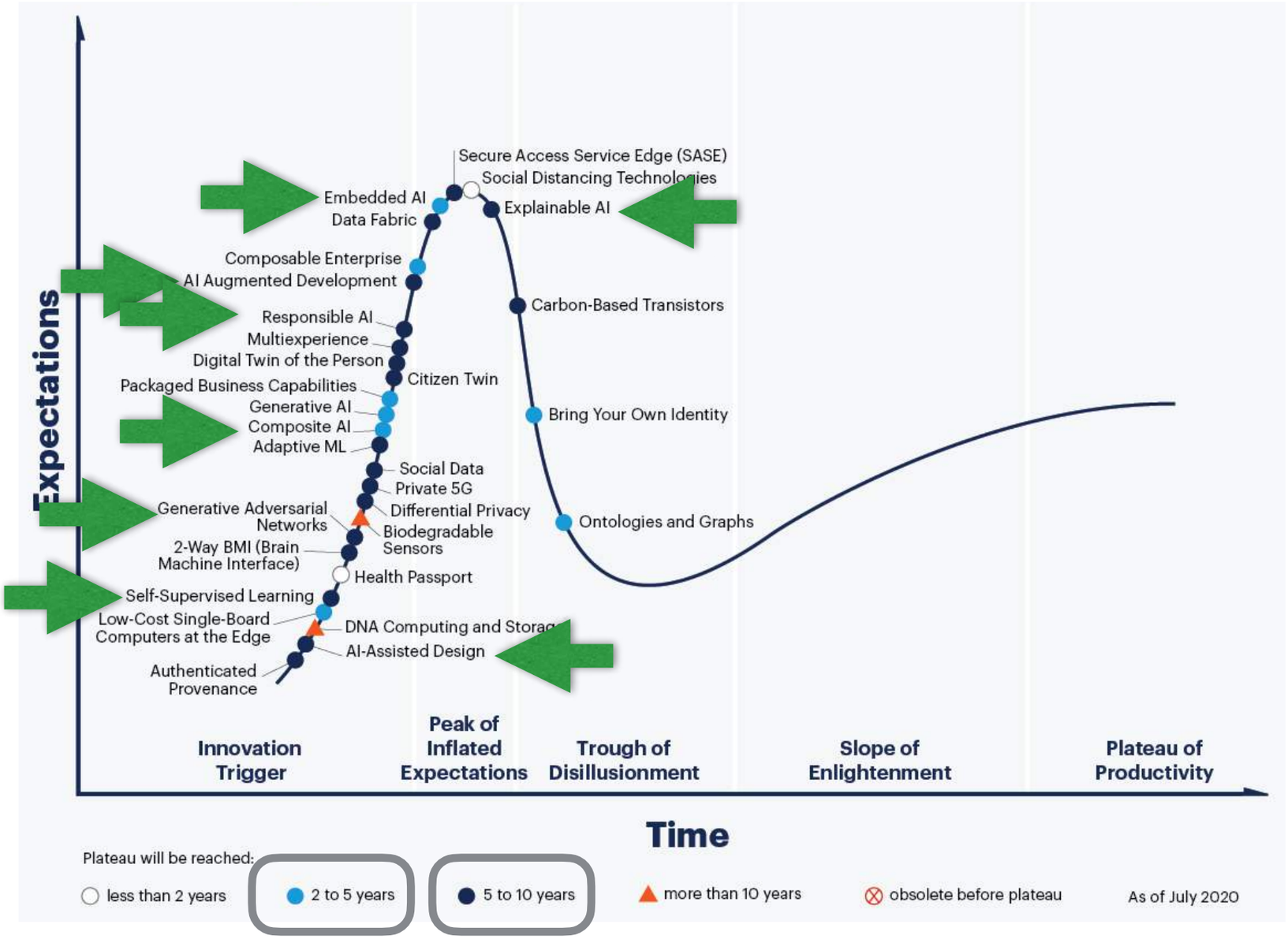
Scholar

- **MS in Electrical Engineering & Computer Science @ MIT**. Focus: Artificial Intelligence and Robotics.
- **MBA in Finance & Strategic Management @ Wharton**. Focus: Venture Capital Investment Strategy.
- **Chartered Financial Analyst** (**CFA**) & Member of the **New York Society of Security Analysts** (NYSSA).

Researcher

- Previously **Researcher in AI & Robotics @ MIT Computer Science and Artificial Intelligence Lab** (designed SLAM algorithms for autonomous underwater vehicles for the US Navy).
- Previously **Researcher in Computational Genomics @ Broad Institute at MIT and Harvard** (with Nick Patterson).

We Invest in Deep Tech
AI, Robotics, and Blockchain



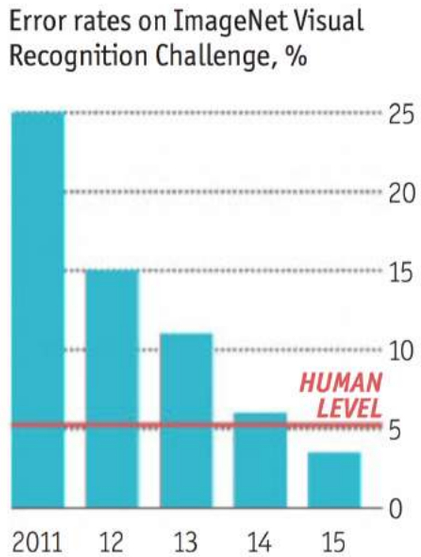
Source: Gartner

- **Deep Tech** startups provide technology solutions based on **substantial scientific or engineering challenges**.

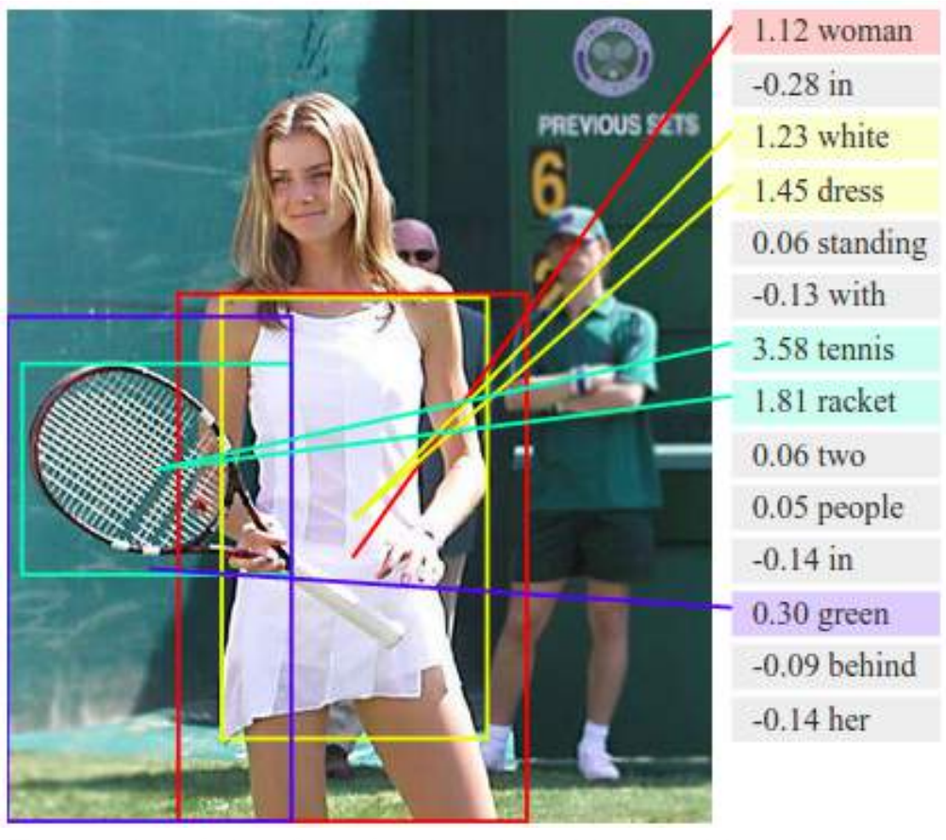
- The most prominent **deep tech fields** include advanced materials, advanced manufacturing, artificial intelligence, biotechnology, blockchain, robotics, photonics, electronics, and quantum computing.

- Our fund **focus** is on the **Artificial Intelligence**, **Robotics**, and **Blockchain** verticals, which are in the sweet spot for the fund investment horizon.

What is Common Across AI Startups?
Deep Learning Revolution



Machines are now better at vision than humans (source: Stanford)



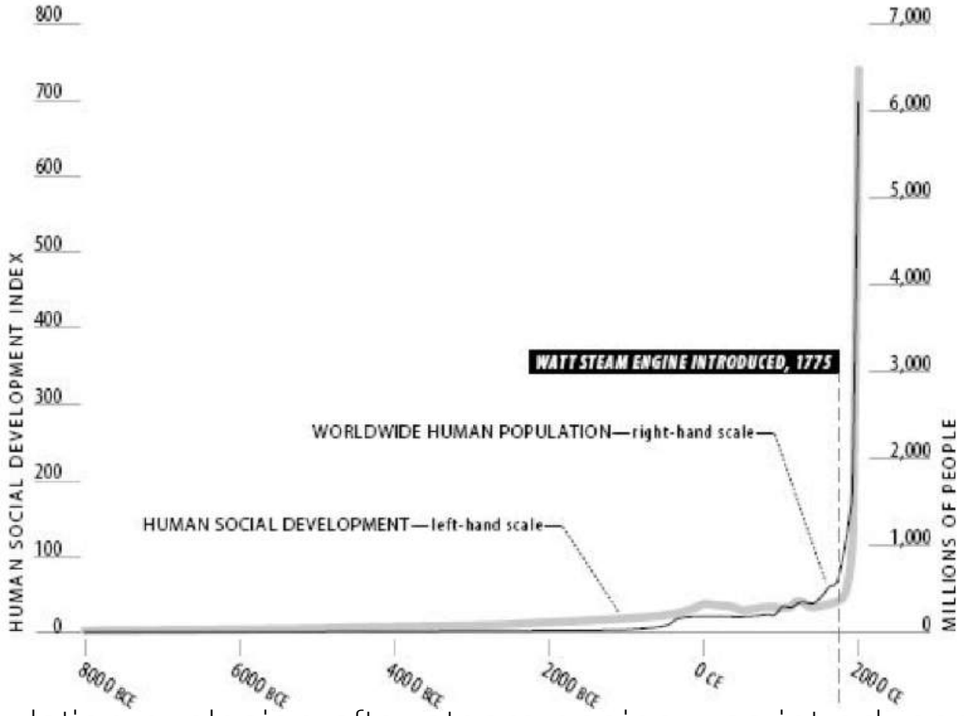
Example of the Stanford vision AI algorithm in action

- Deep Learning is a class of **Machine Learning** techniques that combine large neural networks (millions of free parameters), high performance computing (thousands of processors running in parallel), and Big Data (e.g. millions of color images or recorded chess games).

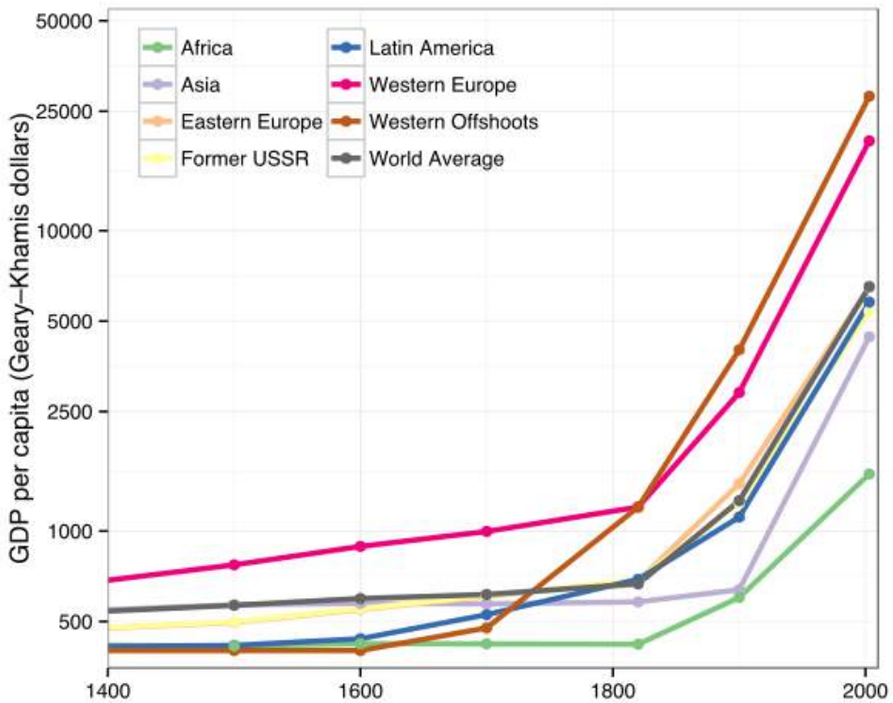
- Deep Learning is **revolutionizing perception** of the world by software agents (vision, voice, natural language, etc), and is now beating humans at many of these tasks.

- Deep Learning is also **supercharging capabilities** of industrial and consumer robots, as well as autonomous vehicles, since perception is crucial to embodied AI.

A Bit of History
Steam Engine Amplified Our Muscle



Population explosion after steam engine was introduced*

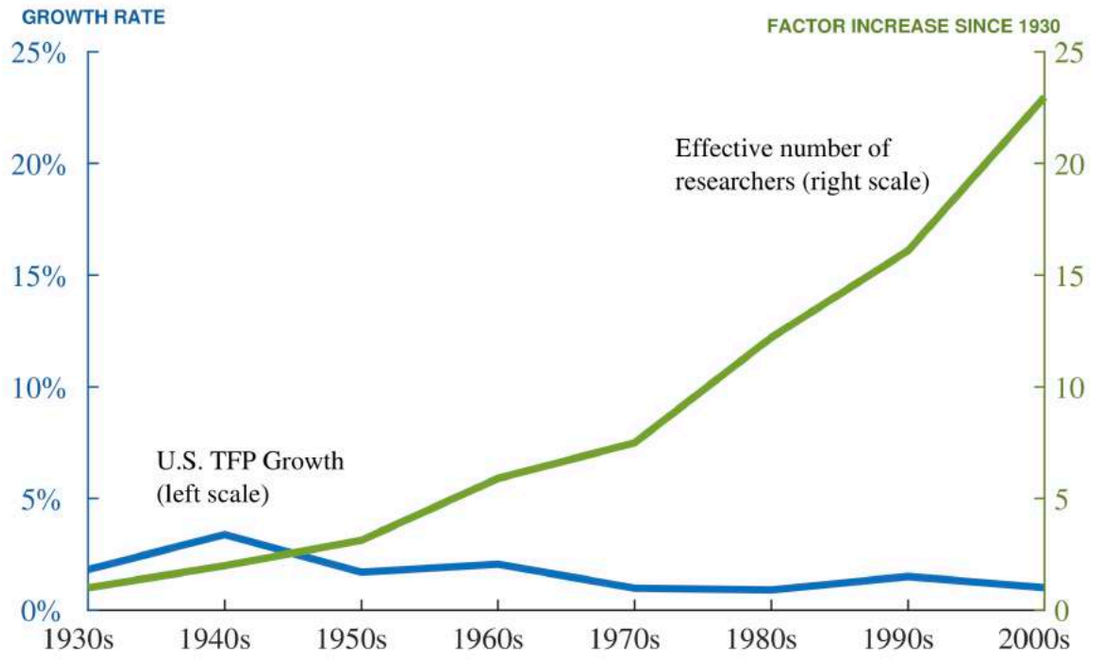


Industrial Revolution and GDP per capita

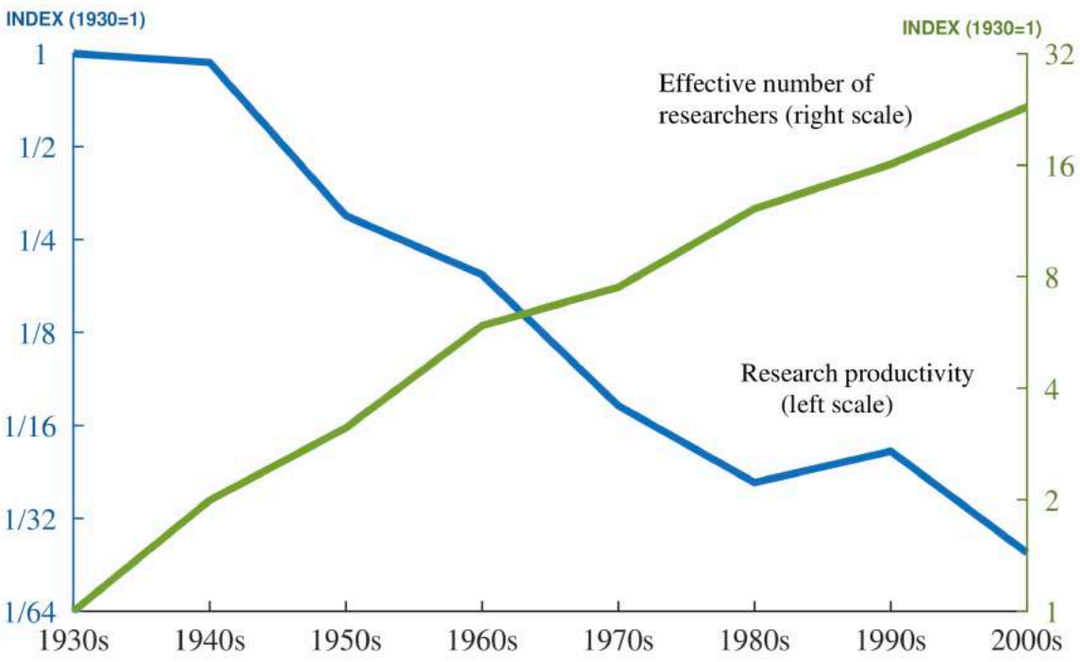
- James Watt's **steam engine** introduced in 1775 allowed humans to overcome the limitations of muscle power with mechanical power.
- This enabled **simultaneous rapid developments** in mechanical engineering, chemistry, metallurgy, electricity, etc.
- The result was an **explosion** in both human population and human social development.
- The Industrial Revolution ushered in humanity's **first machine age**: for the first time our progress was driven almost entirely by technology, rather than biology.
- That technology was easy to copy, which caused **rapid globalization** on top of rapid technological development.

* Source: Erik Brynjolfsson. Second Machine Age.

A Bit of History
Now AI is Amplifying Our Intelligence



Total Factor Productivity vs. number of researchers*



Research productivity vs. number of researchers*

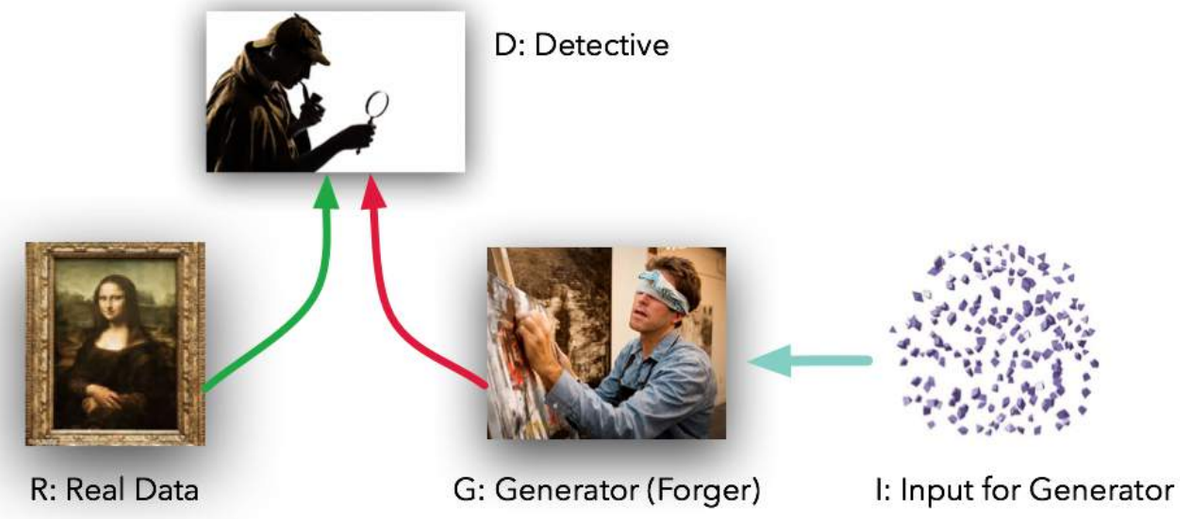
* Source: Nicholas Bloom 2019. Are Ideas Getting Harder to Find?

- We live in an age of **paradox**. Systems using **AI** match or **surpass human-level performance** in more and more domains, yet measured **productivity growth** has **declined** by half over the past decade, and real income has stagnated since the late 1990s.

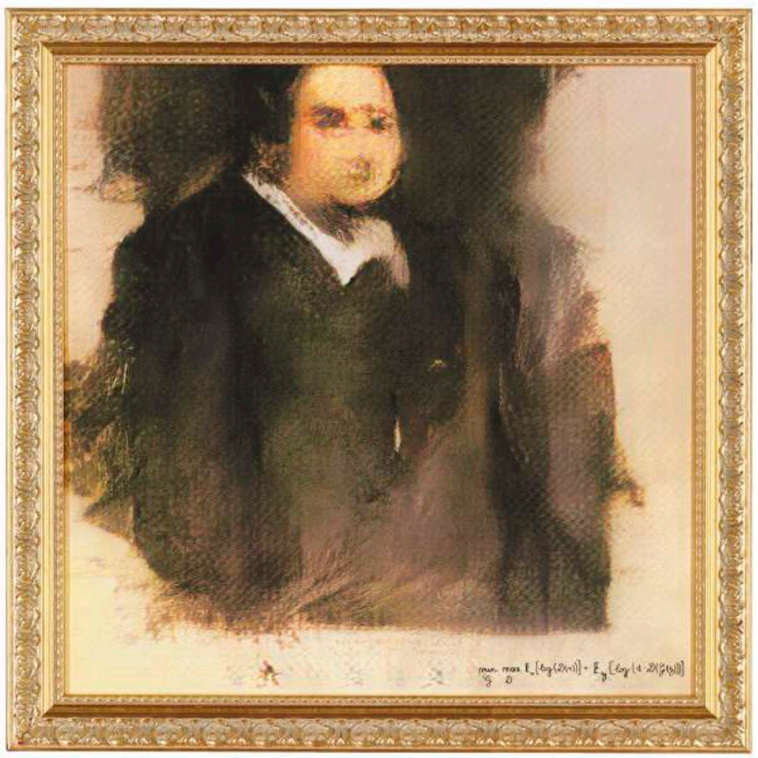
- Our solution to this productivity paradox is to leverage a **different flavor of AI called IA**, or **Intelligence Amplification**, invented along with the now-forgotten science of **Cybernetics** by Norbert Wiener and Ross Ashby in the 1940s.

- This investment thesis is effectively a **long exposure to productivity gains resulting from innovation in AI**.

What's Ahead in Machine Learning
Generative Adversarial Nets (GANs)



GAN architecture



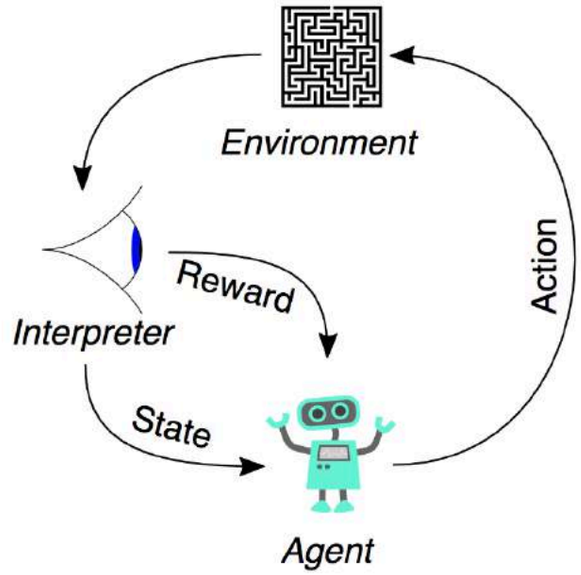
Portrait painted by a GAN and sold at Christie's for $432,000

- GANs were **invented by Ian Goodfellow**, and they pit one neural net against the other, which teaches them to **create worlds eerily similar to our own in any domain**.

- **Yann LeCun**, Facebook's chief AI scientist, has called GANs "**the coolest idea in deep learning in the last 20 years**."

- Another AI luminary, **Andrew Ng**, the former chief scientist of China's Baidu, says GANs represent "**a significant and fundamental advance**" that's inspired a growing global community of researchers.

What's Ahead in Machine Learning
Deep Reinforcement Learning (DRL)



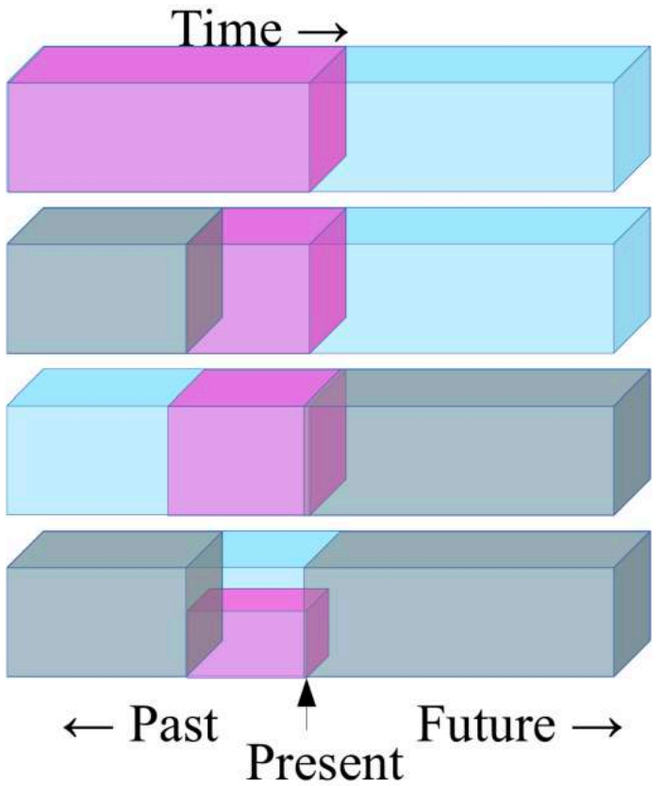
Reinforcement Learning architecture

- DRL is **the most general purpose** of all learning techniques and requires less data than other techniques to train its models.

Only 40 days to achieve superhuman performance

- DRL can be **trained via simulation**, which eliminates the need for labeled data entirely.
- Google DeepMind's AlphaZero started off knowing nothing about the game of Go and achieved **superhuman level in 40 days**.

What's Ahead in Machine Learning
Self-Supervised Learning (SSL)

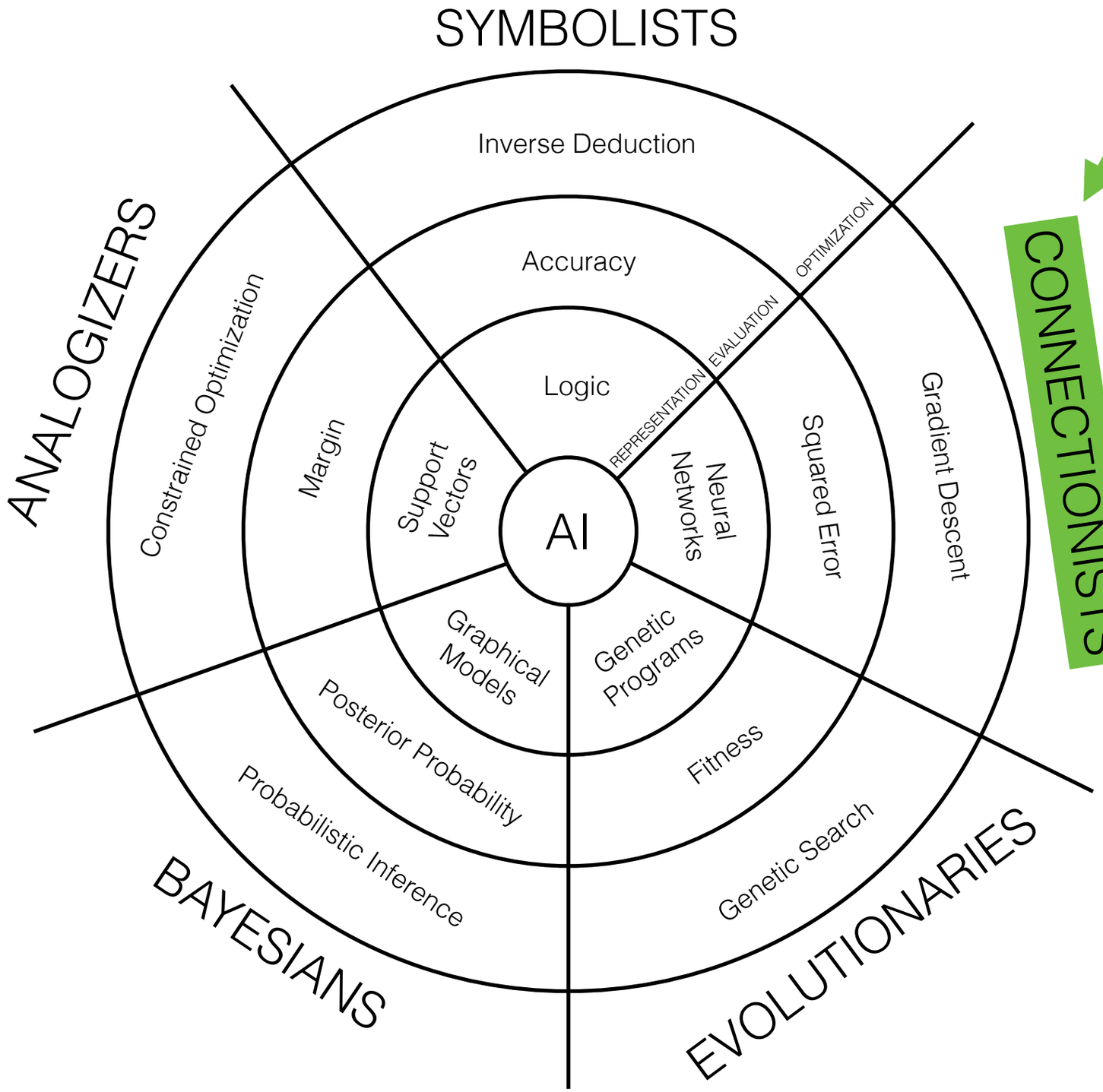


- Predict any part of the input from any other part.
- Predict the future from the past.
- Predict the future from the recent past.
- Predict the past from the present.
- Predict the top from the bottom.
- Predict the occluded from the visible
- Pretend there is a part of the input you don't know and predict that.

Self-Supervised Learning architecture

- **Yann LeCun** believes that **Self-Supervised learning is the future of Machine Learning**:
- **Supervised Learning** works but requires **too many samples**.
- Model-Free **Reinforcement Learning** works great for games, but requires too many trials in the real world. Anything you do in the real world can kill you. Plus, you can't run the real world faster than real time.
- The **SSL** idea idea is to train very large networks to **understand the world through prediction**.
- **SSL** networks will be much larger than today. We have unlimited amounts of data to train them. They will have sparse activation.
- **Open question**: Can electronic hardware take advantage of sparse activations?

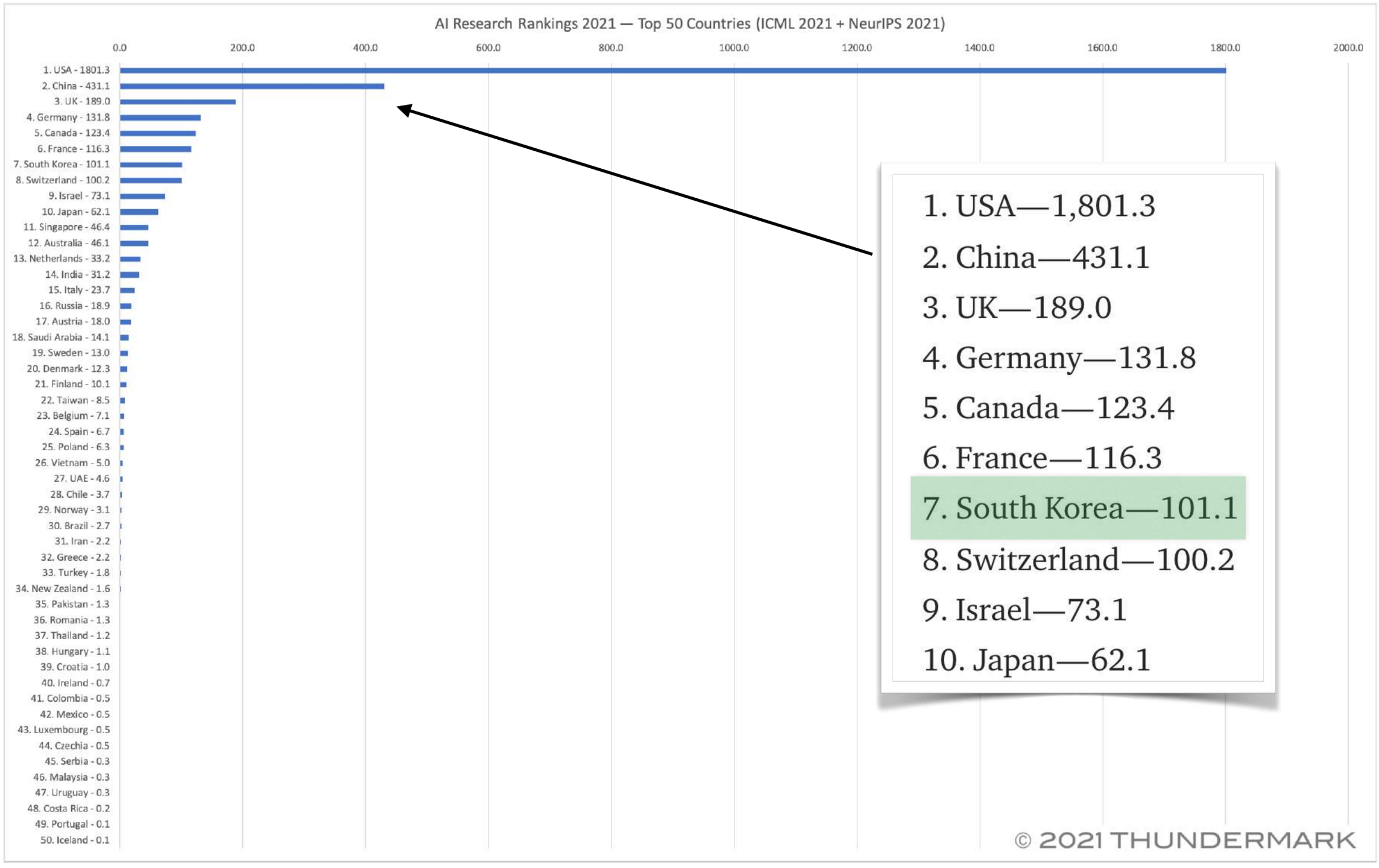
What's Ahead in Artificial Intelligence
Deep Learning is Only The Start!



AI ontology proposed by Pedro Domingos in "The Master Algorithm"

- **Connectionists** (**Deep Learning**) reverse engineer the brain and are inspired by neuroscience and physics.
- **Evolutionaries** simulate evolution on the computer and draw on genetics and evolutionary biology.
- **Bayesians** believe learning is a form of probabilistic inference and have their roots in statistics.
- **Analogizers** learn by extrapolating from similarity judgements and are influenced by psychology and mathematical optimization.
- **Symbolists** view learning as the inverse of deduction and take ideas from philosophy, psychology, and logic.

Who's Leading this AI Revolution?
USA is Ahead of China (4x Lead)

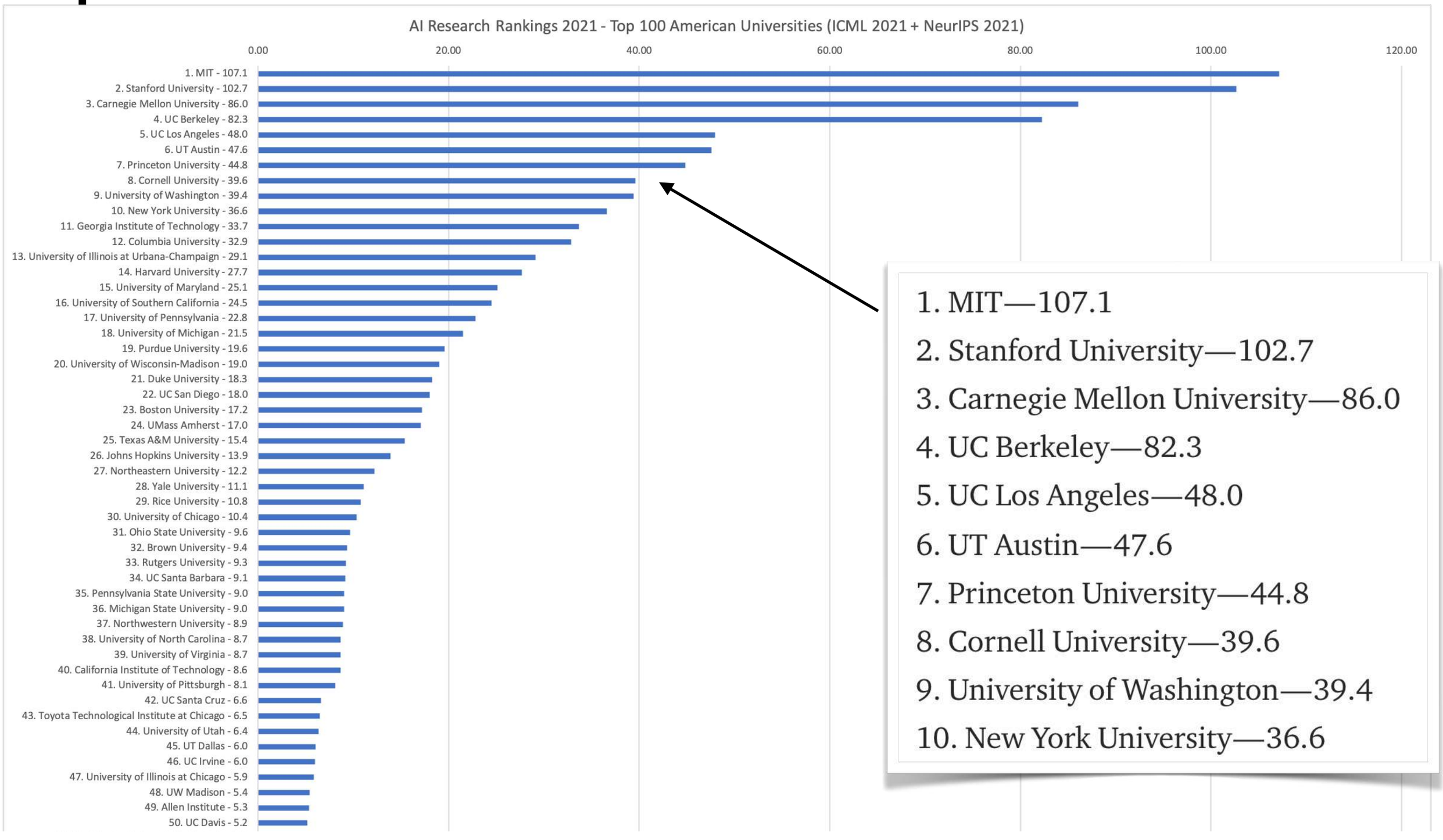


The United States is in clear lead, followed by China. South Korea is at #7, ahead of Switzerland.

*Source: https://thundermark.medium.com/

Who's Leading this AI Revolution?

Top 20 American Universities in AI



1. MIT—107.1
2. Stanford University—102.7
3. Carnegie Mellon University—86.0
4. UC Berkeley—82.3
5. UC Los Angeles—48.0
6. UT Austin—47.6
7. Princeton University—44.8
8. Cornell University—39.6
9. University of Washington—39.4
10. New York University—36.6

MIT, Stanford, CMU, and UC Berkeley are leading in AI research in 2021

*Source: https://thundermark.medium.com/

Who's Leading this AI Revolution?
Top Korean Leaders in AI Research

Korea Rank	Global Rank	Organization	Score	Type
1	15	KAIST	42.38	Academia
2	38	Seoul National University	20.64	Academia
3	75	Samsung	9.99	Industry
4	164	Yonsei University	3.73	Academia
5	178	Pohang University of Science and Technology	3.22	Academia
6	184	Korea University	3.10	Academia
7	198	Naver	2.77	Industry
8	199	AITRICS	2.71	Industry
9	217	Kakao	2.34	Industry
10	220	Chung-Ang University	2.33	Academia

AI Research Rankings 2021 for South Korea

*Source: https://thundermark.medium.com/

Thank You and Please Stay in Touch!

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