AI FOR BUSINESS, SOCIETY, AND GLOBAL AFFAIRS

The World Affairs Council of Greater Houston:
The Global Exchange

Digital Meld

BRAD GROUX

Principal Solution Architect of AI, Data, Software, and Services at the Global Scale

SOLUTIONS ARCHITECT

CEO

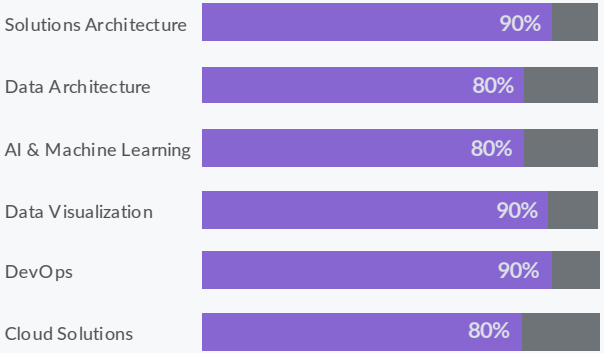
ABOUT ME

Founder and CEO at Digital Meld with extensive experience in cloud-based AI, solution architecture, and business process automation. Skilled in designing innovative, scalable solutions leveraging Azure, Microsoft Power Platform, and open-source large language models. Deep expertise in systems architecture, enterprise integrations, DevOps, and data analytics across diverse industries.

EXPERIENCE

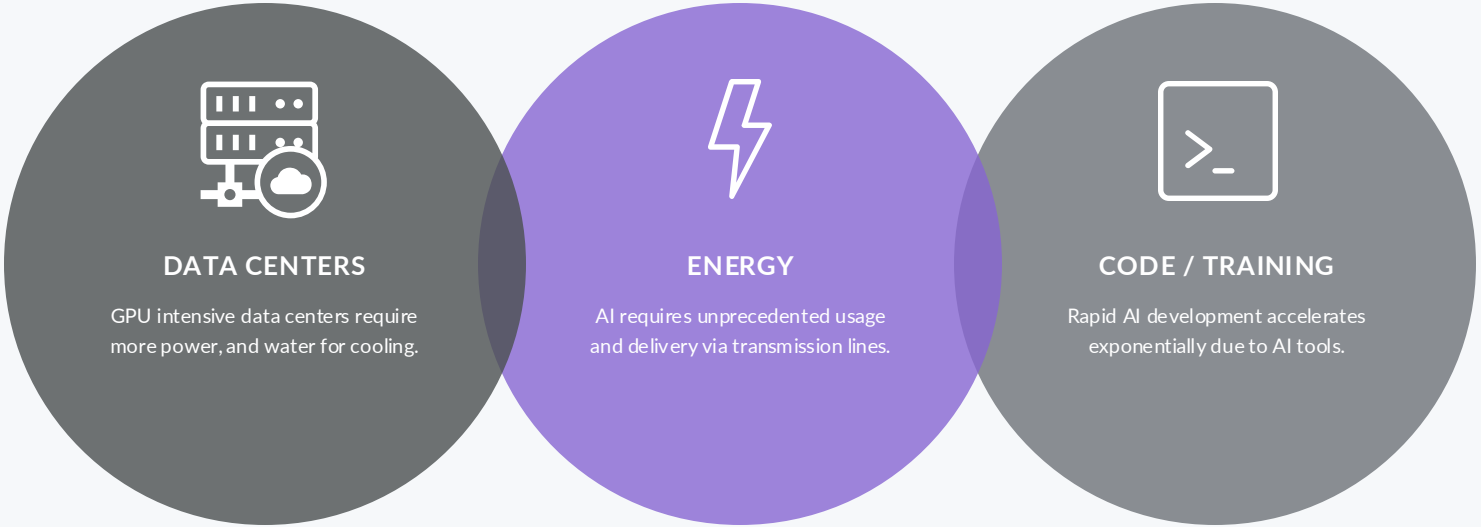
- CEO of Digital Meld
- Senior Solutions Architect at Unqork
- Senior Solutions Architect at JMT
- Senior Manager at Macquarie
- Senior Systems Engineer at Quantlab
- Premier Field Engineer at Microsoft

CAPABILITIES



ARTIFICIAL INTELLIGENCE HAS THREE KEY COMPONENTS

The growth and adoption of AI isn't just technology, it is mostly an infrastructure problem.



THE EVOLUTION OF AI

- Decades of research and investment have gone into AI since its conception in the mid-20th century
- Despite this, the field has historically been plagued by a pattern of lofty promises that often fall short
- We are finally witnessing the realization of AI's long-promised potential

WE'VE BEEN HERE BEFORE

THE INTERNET

1995
Netscape

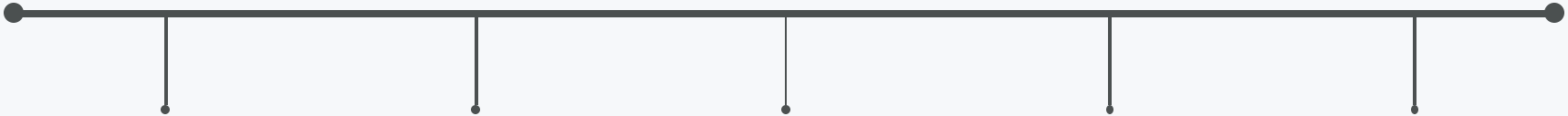
1996
First major awareness of the internet

1997
First major internet-related investment

1998
Most companies have internet-related budgets

1999
Most internet budgets double or triple in size

ARTIFICIAL INTELLIGENCE



2022
ChatGPT Launches

2023
First major awareness of AI

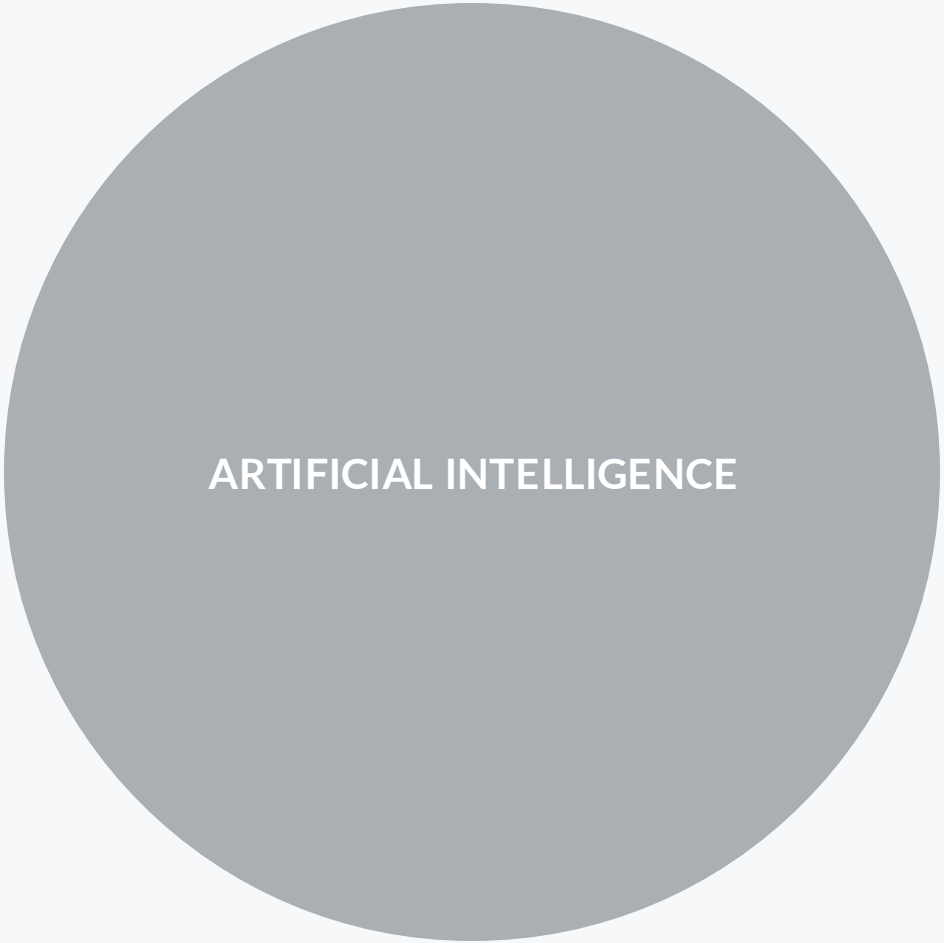
2024
First major AI-related investment

2025
Most companies have AI-related budgets

2026(?)
Most AI budgets double or triple in size?

AI TERMINOLOGY

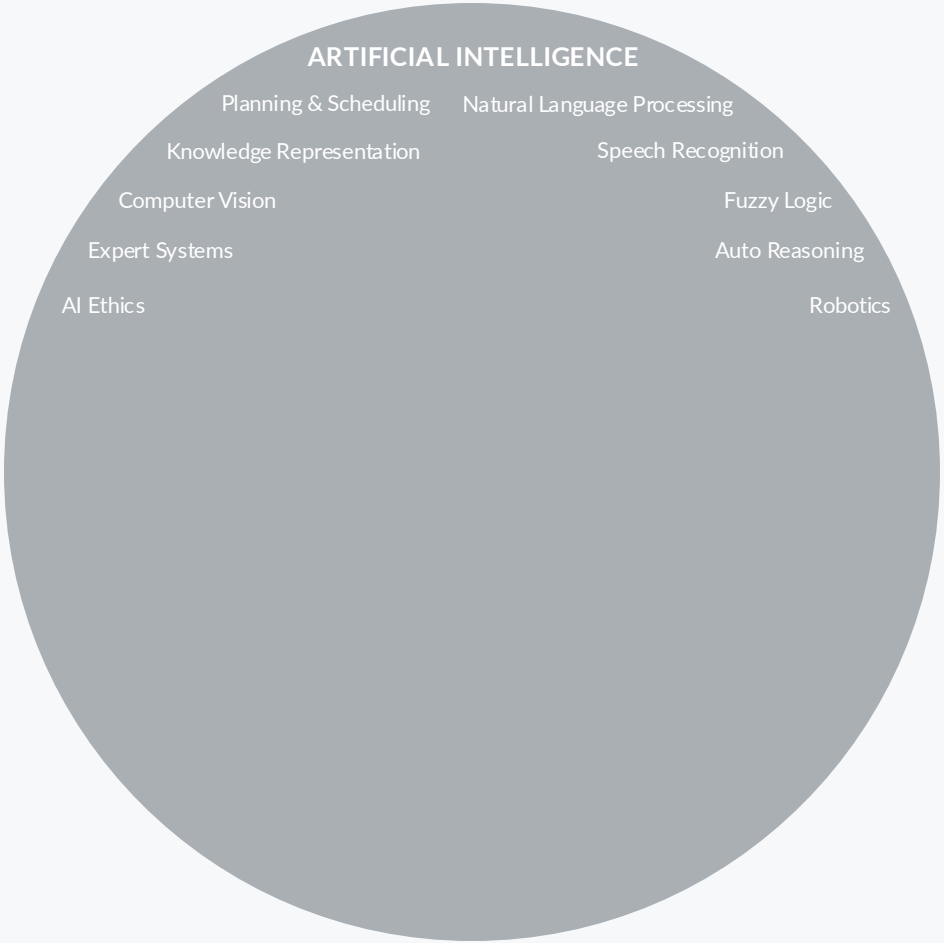
Artificial Intelligence (AI) refers to systems with the ability to learn and reason like humans.



AI TERMINOLOGY

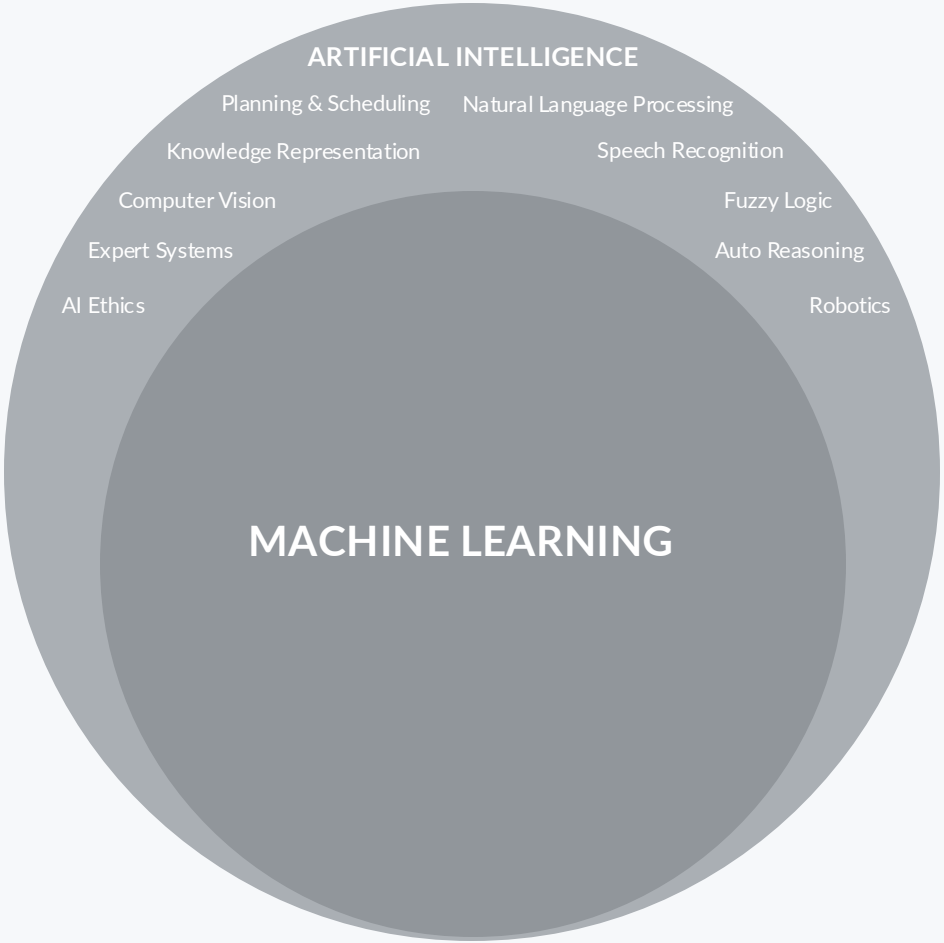
Artificial Intelligence (AI) refers to systems with the ability to learn and reason like humans.

These systems can perform tasks that typically require human intelligence, such as visual perception, speech recognition, decision-making, and language translation.



AI TERMINOLOGY

Machine Learning is a branch of artificial intelligence that focuses on building systems that can learn from and make decisions based on data.

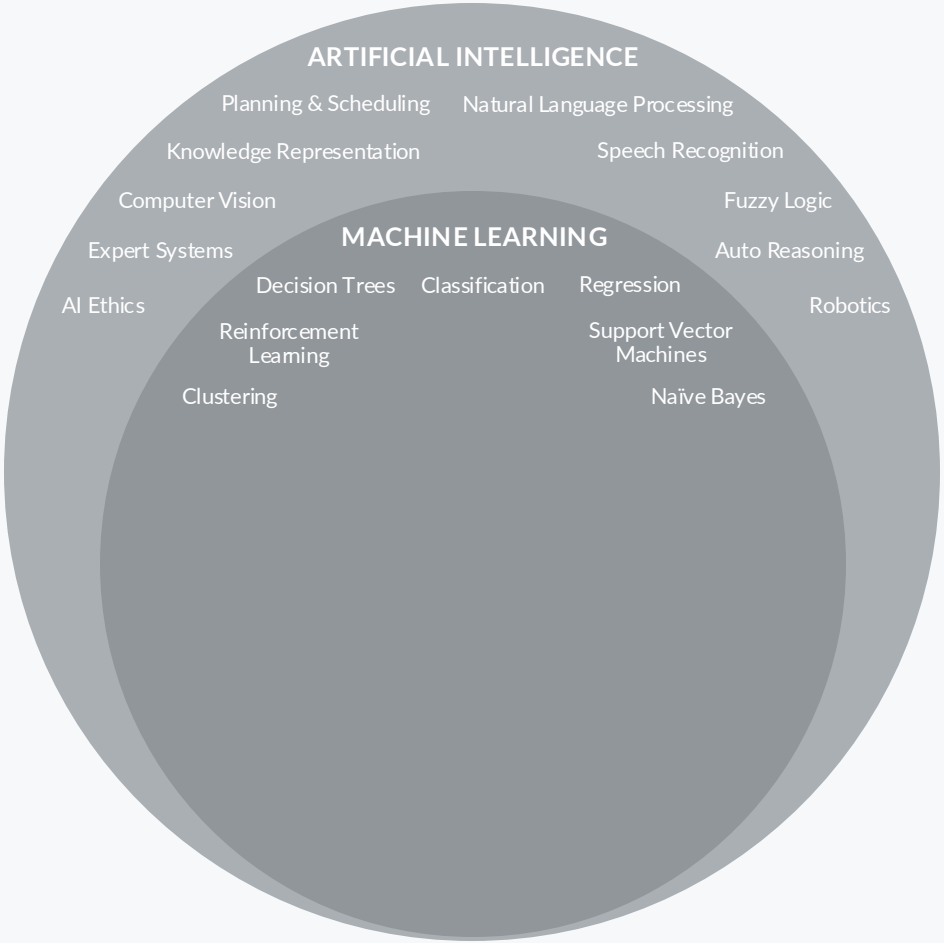


AI TERMINOLOGY

Machine Learning is a branch of artificial intelligence that focuses on building systems that can learn from and make decisions based on data.

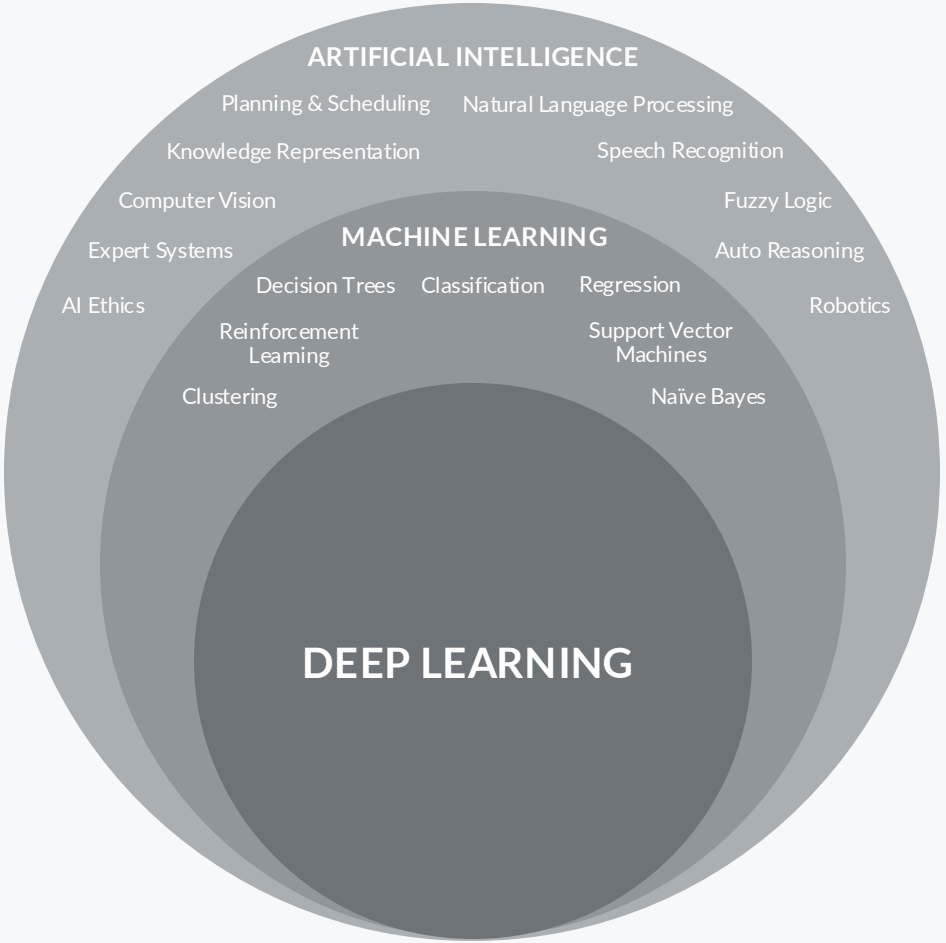
Unlike traditional software programming, where tasks are explicitly coded, machine learning allows systems to adapt and improve from experience.

This is achieved through algorithms that iteratively learn from data, adjusting and refining their models to predict outcomes more accurately over time.



AI TERMINOLOGY

Deep Learning is a type of machine learning that uses neural networks with many layers, a concept inspired by the brain's structure and function.

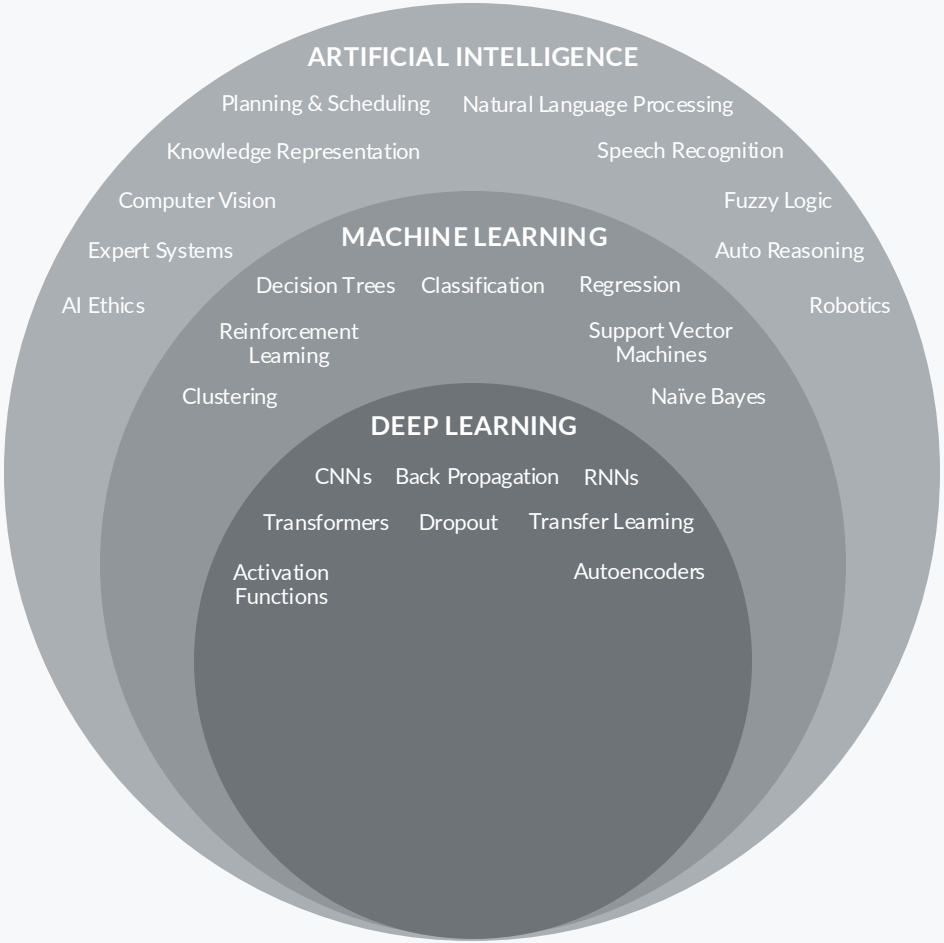


AI TERMINOLOGY

Deep Learning is a type of machine learning that uses neural networks with many layers, a concept inspired by the brain's structure and function.

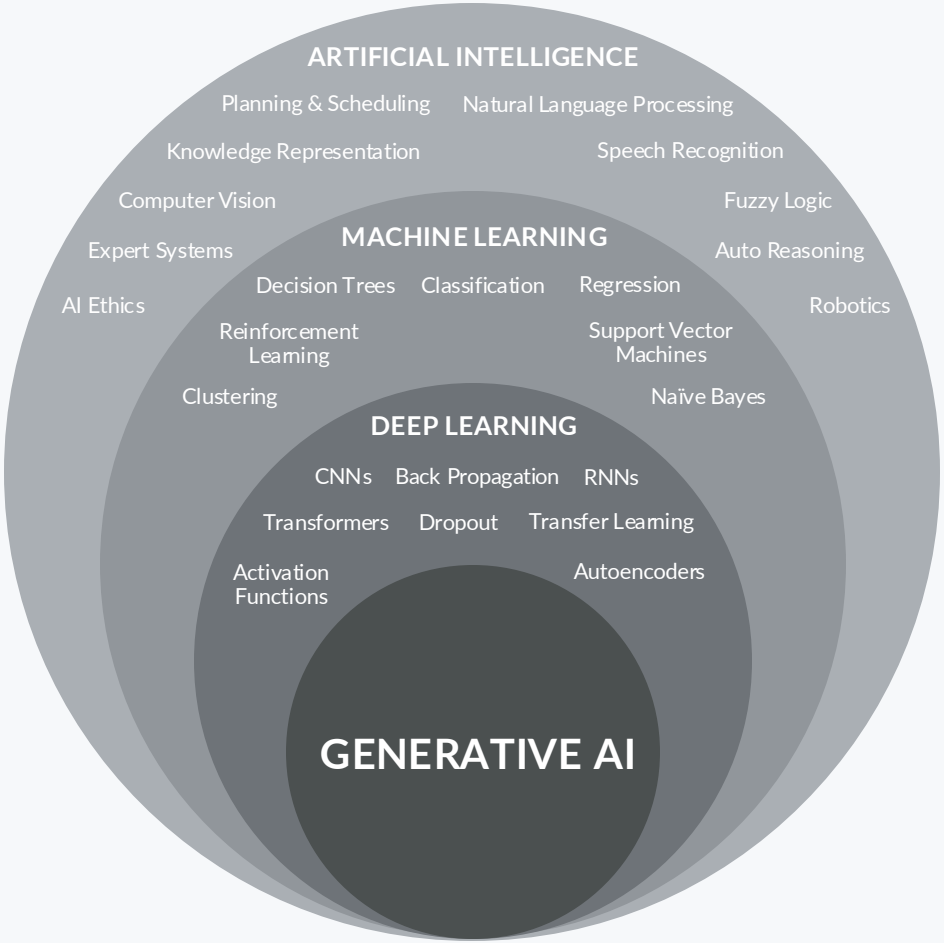
Deep Learning is currently the dominant approach to building AI systems.

This is because of its incredible ability to handle vast amounts of data and discover intricate patterns that are not readily apparent to humans or other traditional computational methods.



AI TERMINOLOGY

Generative AI refers to a category of artificial intelligence algorithms capable of generating new content.

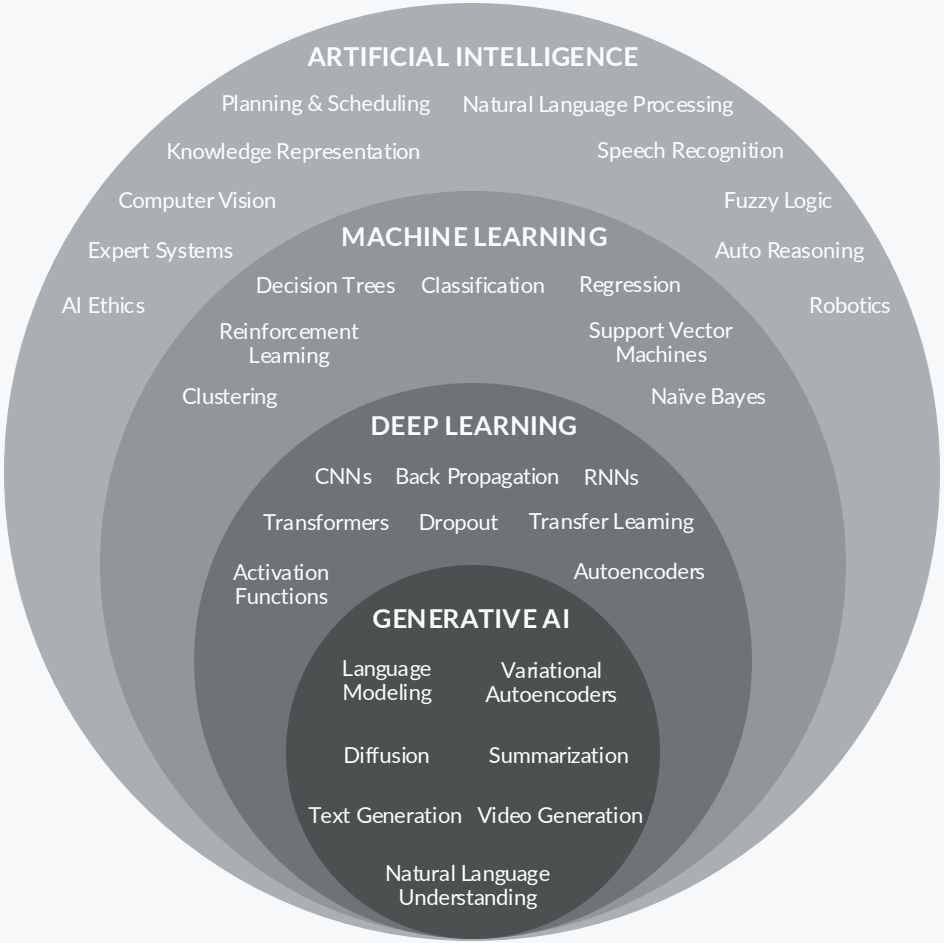


AI TERMINOLOGY

Generative AI refers to a category of artificial intelligence algorithms capable of generating new content.

This content can take various forms, such as text, images, audio, video, and more.

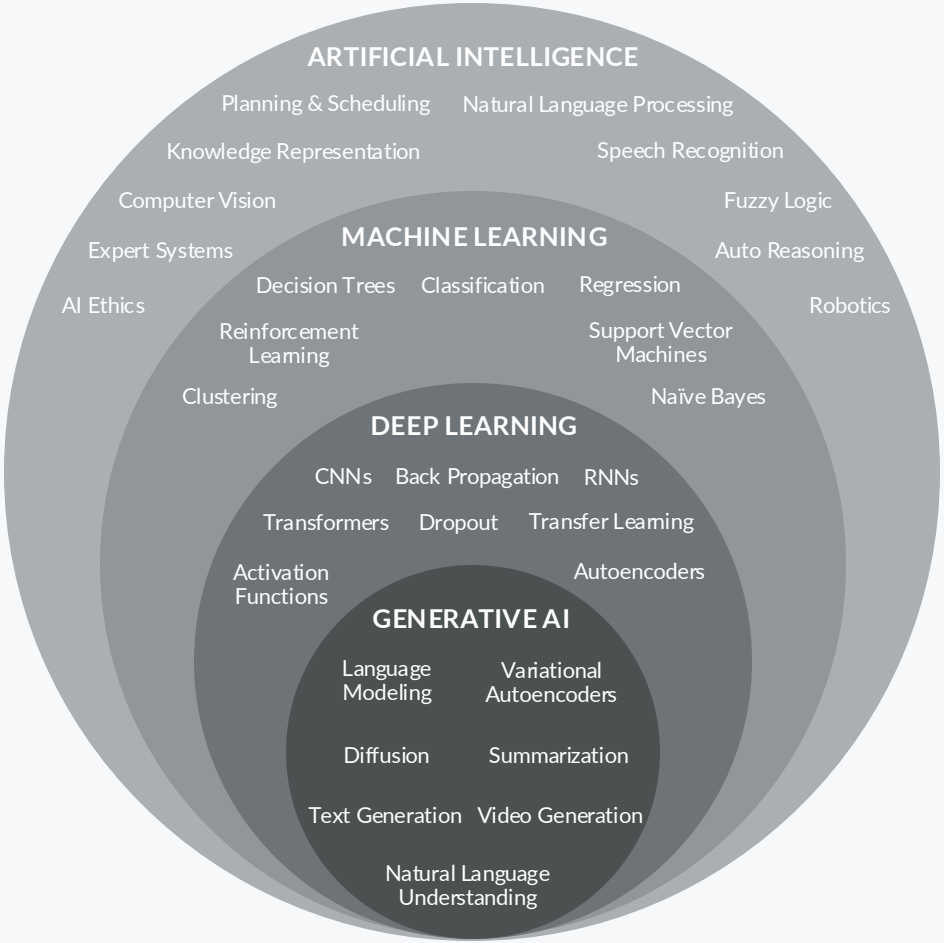
Unlike traditional AI, which typically focuses on recognizing patterns and making predictions based upon existing data, generative AI creates new data that resembles the data on which it was trained.



AI TERMINOLOGY

IN SUMMARY

- **AI** is an umbrella term.
- **Machine Learning (ML)** is a subset of AI, meaning all machine learning is a type of AI.
- However, **not all AI relies on Machine Learning**; there are other approaches to creating AI beyond Machine Learning.
- **Deep Learning**, a specific approach within machine learning, is currently the leading method used to build advanced AI systems.



AI TERMINOLOGY

ARTIFICIAL GENERAL INTELLIGENCE (AGI)

AGI is a type of AI with the ability to understand, learn, and apply knowledge across a wide range of tasks, at or beyond human-level capability.

- Performs any cognitive task a human can
- Learns and adapts across domains
- Exhibits reasoning, abstraction, and common sense
- Capable of self-improvement and transfer learning

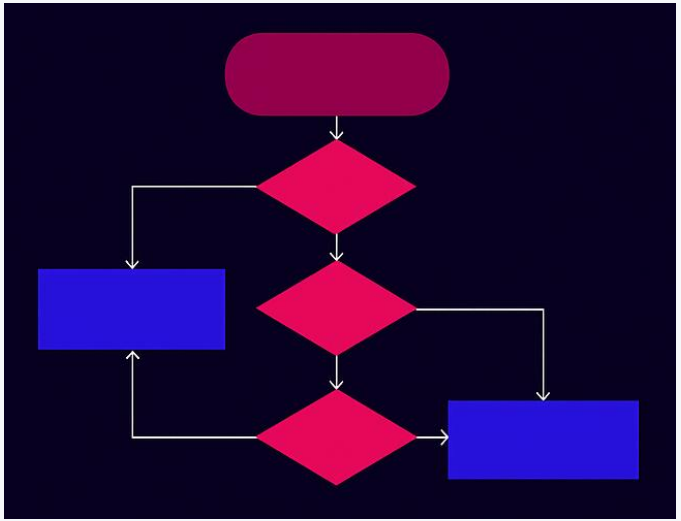
ARTIFICIAL SUPER INTELLIGENCE (ASI)

ASI is a theoretical form of AI that vastly exceeds human intelligence in all areas, scientific reasoning, creativity, social skills, and strategic thinking.

- Surpasses the best human minds in every field
- Capable of self-enhancement and recursive improvement
- May lead to rapid, unpredictable societal transformation
- Central to debates on AI alignment and safety

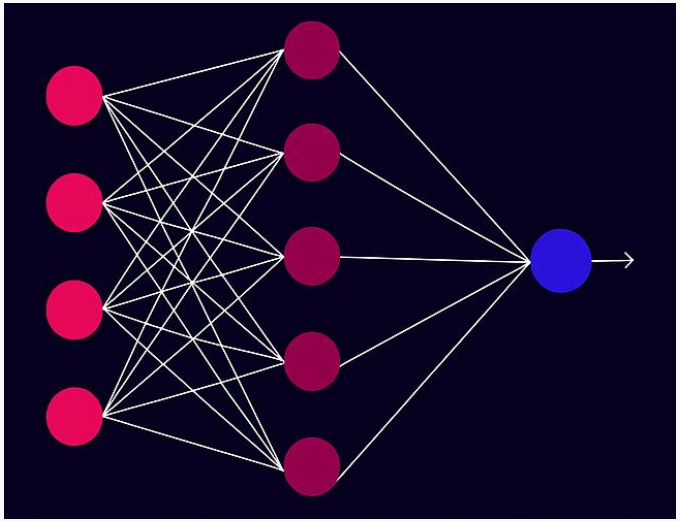
TWO PATHS TO INTELLIGENCE

SYMBOLIC AI



Dominant from the 1950s to 1990s - emphasized logic, reasoning, and explicit rule-based modeling.

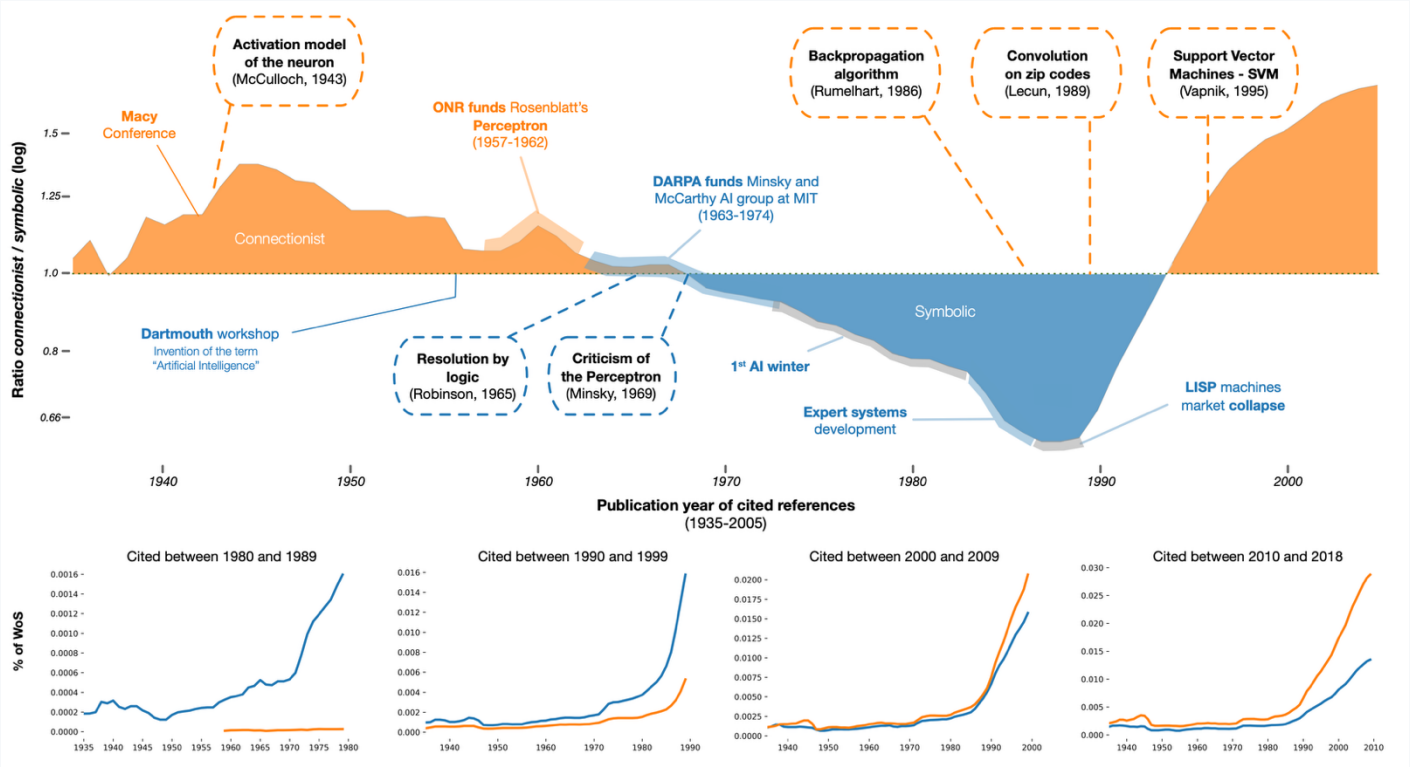
CONNECTIONIST AI



Rooted in cybernetics and neural networks, treats intelligence as emergent from distributed, adaptive computation.

AI TIMELINE

Source: Neurons Spike Back



Evolution of the academic influence of connectionist and symbolic approaches to AI

NEURAL NETWORKS EXPLAINED

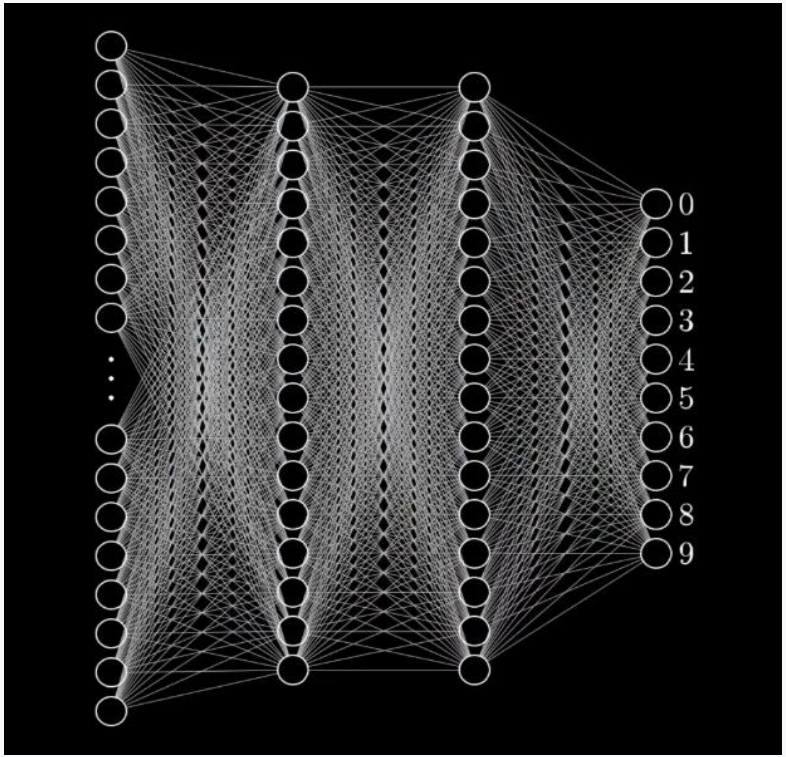
Source: 3blue1brown

A neural network is a layered system of interconnected nodes ("neurons") that learns to recognize patterns in data.

Inspired by the brain, it processes inputs (like images or text) and outputs predictions through a network of weighted connections.

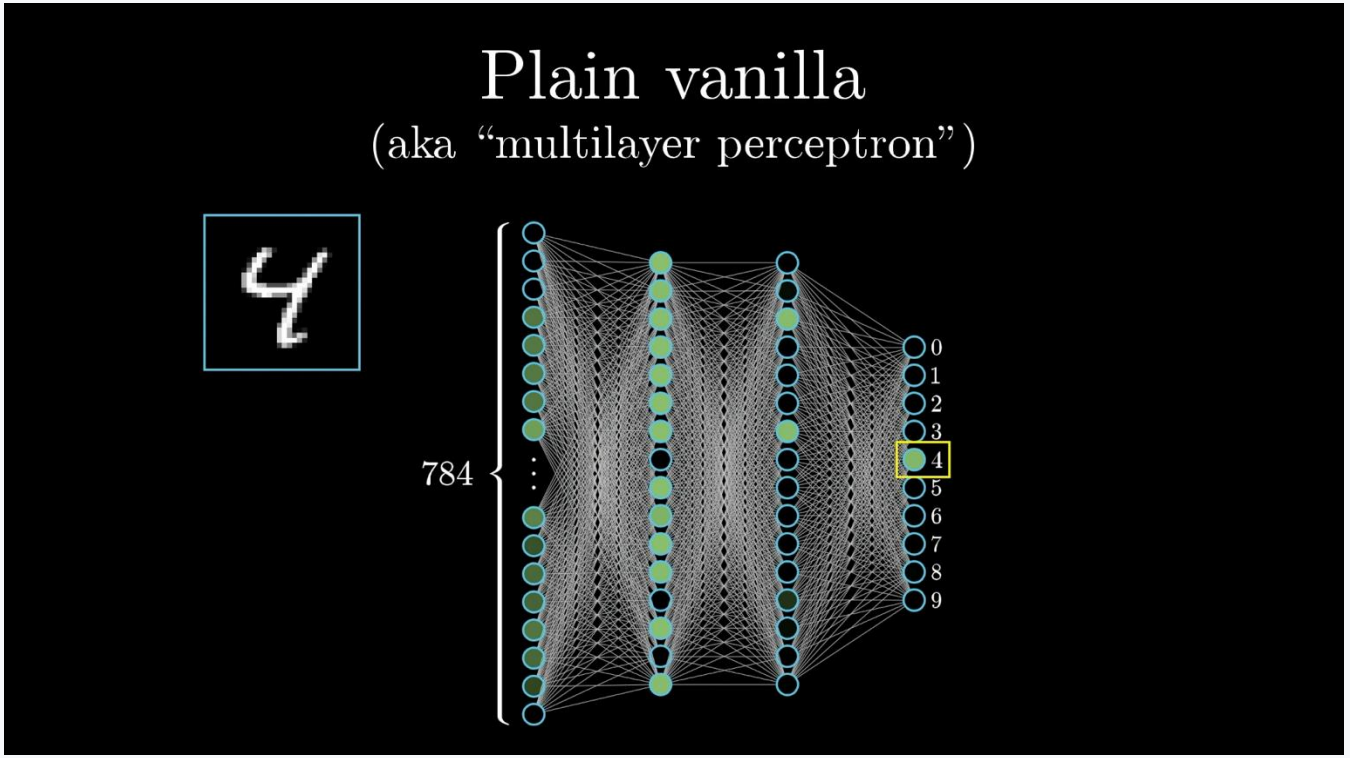
- **Input Layer:** Takes raw data (pixels, numbers, etc.)
- **Hidden Layers:** Apply transformations using weights, biases, and activation functions.
- **Output Layer:** Produces a final prediction or classification.

The network ***learns*** by adjusting weights using backpropagation to minimize error (loss), improving its predictions over time.



NEURAL NETWORKS EXPLAINED

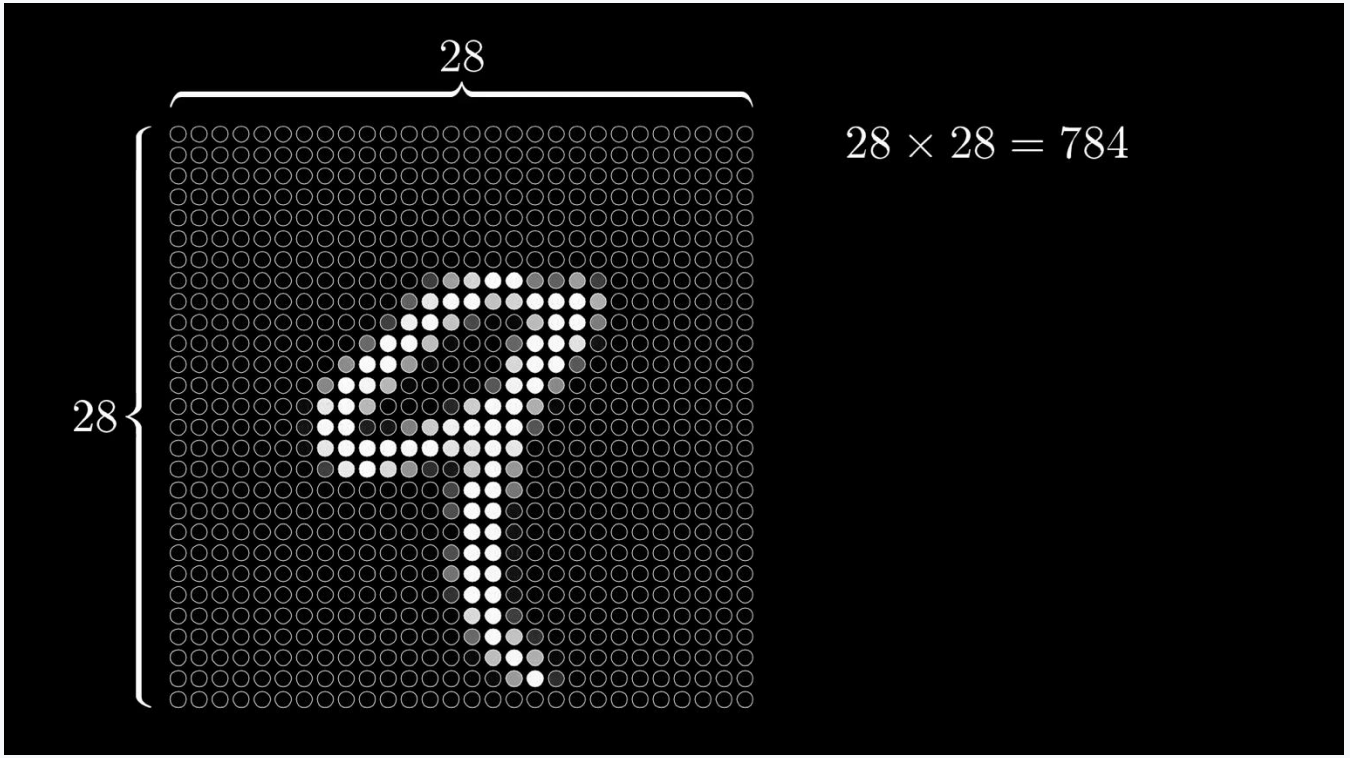
Source: 3blue1brown

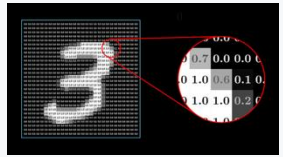


The simple network we're using to identify digits is just a few layers of neurons linked together.

NEURAL NETWORKS EXPLAINED

Source: 3blue1brown

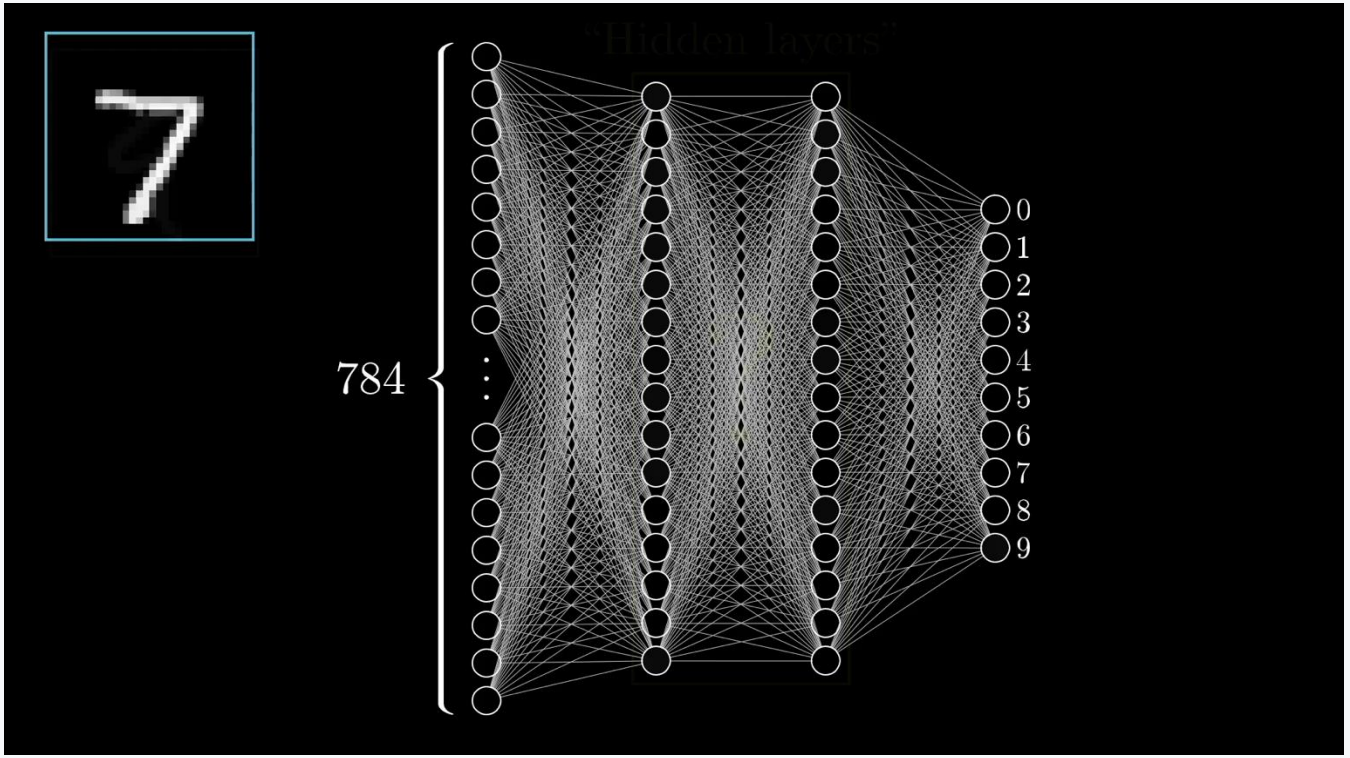




The input layer contains 784 neurons, each of which corresponds to a single pixel in the original image.

NEURAL NETWORKS EXPLAINED

Source: 3blue1brown



Watching the activations in each layer propagate through to determine the activations in the next can be quite mesmerizing.

AGENTIC AI REFERS TO AI SYSTEMS THAT CAN AUTONOMOUSLY **PERCEIVE**, **REASON**, **PLAN**, AND **ACT** TO ACHIEVE GOALS WITH MINIMAL HUMAN INTERVENTION.

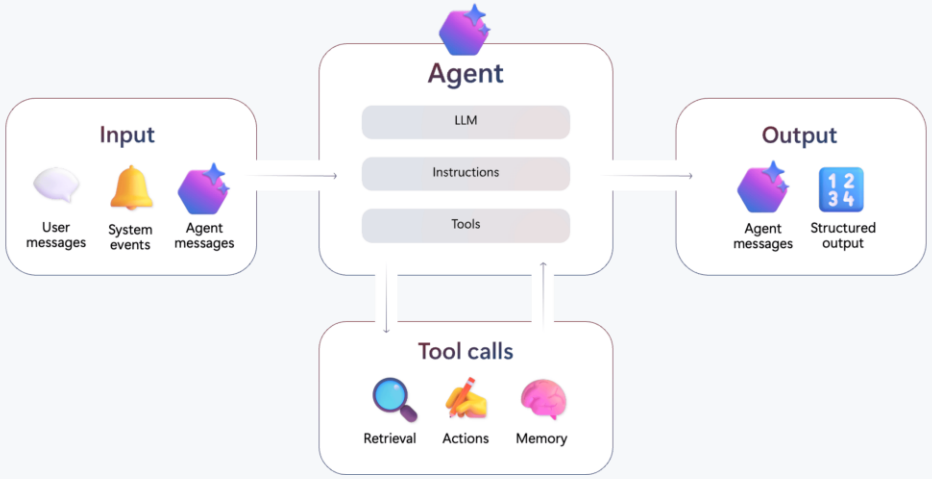
Digital Meld

AGENTIC AI

Agentic AI is like a smart assistant that can not only follow instructions but also figure out what needs to be done, make decisions, and take action on its own to achieve a goal.

Unlike traditional Robotic Process Automation (RPA) bots, AI agents are:

- Designed to pursue high-level objectives
- Able to adapt dynamically to changing conditions and environments
- Capable of nuanced decision-making in complex environments
- Less brittle and able to more effectively

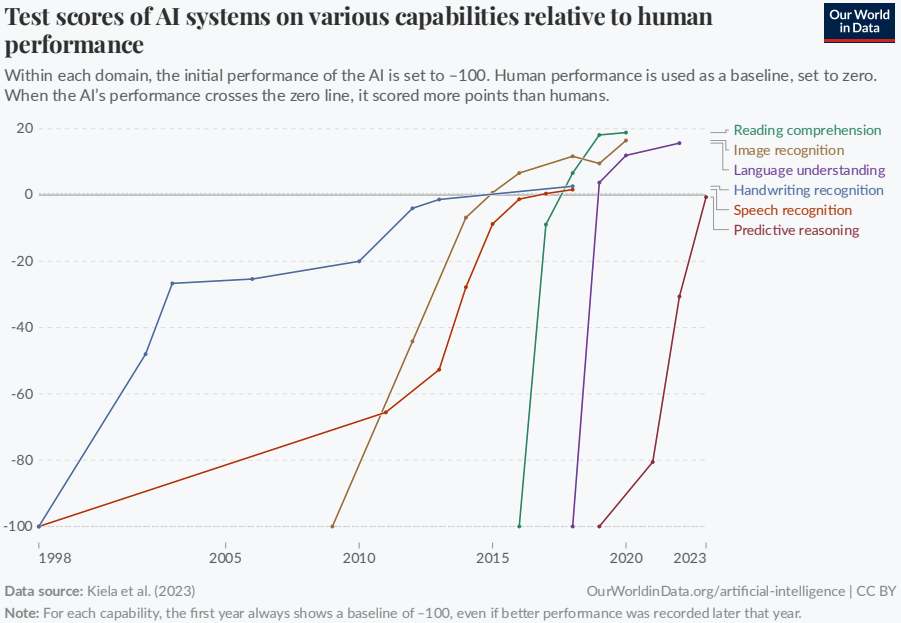


Source: Microsoft

AI PERFORMANCE

Current frontier AI models significantly outperform humans on several domains.

- Superhuman capabilities in reading comprehension, image recognition, language understanding, handwriting recognition, and speech recognition.
- They also outperform experts on most exam-style problems at a fraction of the cost.
- Yet the best AI agents still cannot independently carry out substantial projects or directly replace human labor.
- Capabilities are increasing rapidly in some areas, but it remains unclear how this translates to real-world impact.

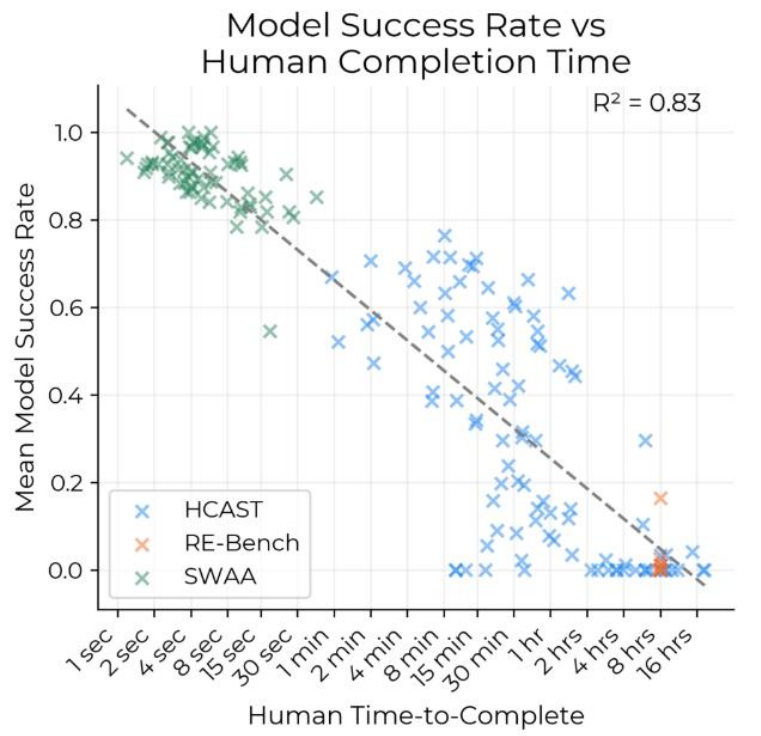


Source: Our World in Data

AI TASK LENGTH

Researchers found that the time taken by human experts is strongly predictive of model success on a given task.

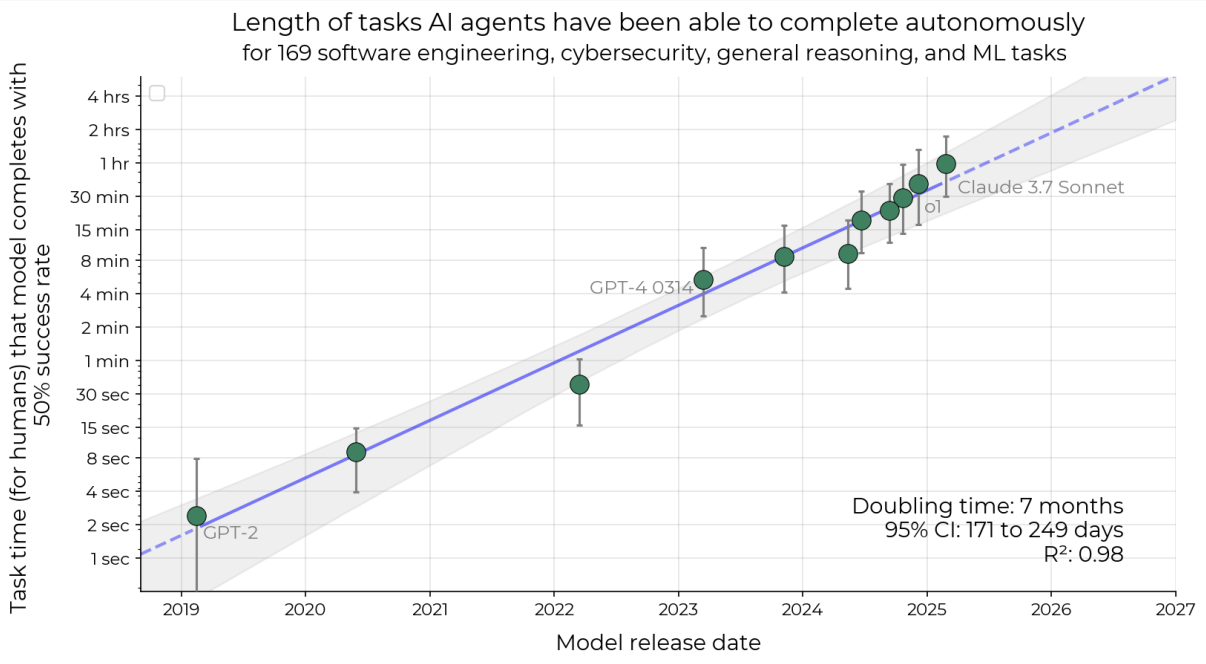
- AI agents struggle more with connecting long sequences of actions than with the skills or knowledge required to solve individual steps.
- Current models achieve nearly a 100% success rate on tasks that take humans less than 4 minutes.
- However, they succeed in less than 10% of tasks that take more than about 4 hours.



Source: Measuring AI Ability to Complete Long Tasks

AI TASK IMPROVMENETS

The length of tasks AIs can do is doubling every 7 months.



Source: Measuring AI Ability to Complete Long Tasks

AGENTIC AI

Promise of Agentic AI:

- Agentic AI is advancing rapidly and is on track to automate complex workflows that currently take hours of human effort.
- These systems will adapt in real time to changing conditions and environments, making them more flexible and resilient than traditional automation tools.
- They will make nuanced decisions in complex, open-ended scenarios where context and judgment are essential.

Reasons for Caution:

- Agentic AI is not yet production-ready.
- It still requires human oversight, making it unsuitable for full autonomy in enterprise settings.
- Current systems may behave unpredictably in edge cases or unfamiliar environments.
- Security and alignment concerns are still unresolved, especially in high-stakes or adversarial contexts.

TRENDS PREDICT THAT IN LESS THAN A DECADE WE'LL SEE AI AGENTS THAT CAN INDEPENDENTLY COMPLETE A LARGE FRACTION OF SOFTWARE TASKS THAT CURRENTLY TAKE HUMANS DAYS OR WEEKS.

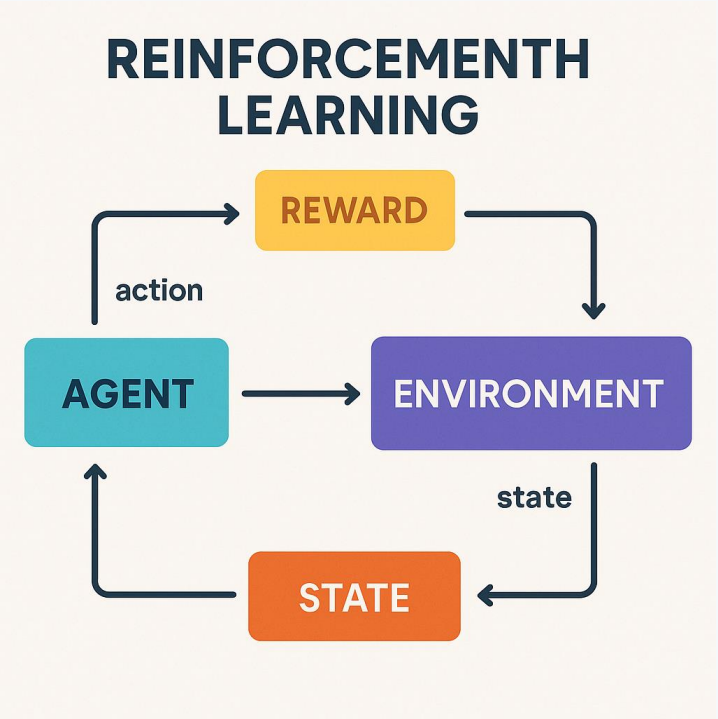
REINFORCEMENT LEARNING

Reinforcement learning (RL) is a type of machine learning where an agent learns to make decisions by interacting with an environment and receiving rewards or penalties based on its actions.

It sits at the crossroads of computer science, engineering, mathematics, economics, psychology, and neuroscience.

It combines algorithms from machine learning, principles from control theory and operations research, and models of decision-making inspired by economic behavior and cognitive processes.

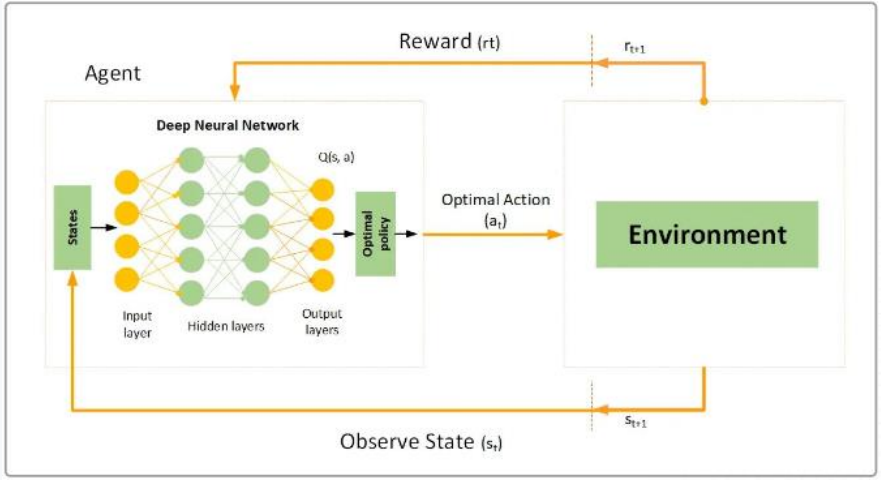
RL also reflects how humans and animals learn through rewards, drawing directly from psychological and neurological studies.



Source: Sora

REINFORCEMENT LEARNING

- Learns through trial and error to maximize cumulative reward.
- Receives sparse, delayed rewards or penalties from the environment.
- No predefined dataset; data is generated through interaction with the environment.
- Involves sequential decision-making where each action affects future states and rewards.
- Must balance trying new actions (exploration) and using known strategies (exploitation).



Source: KungFU AI

AI REINFORCEMENT LEARNING

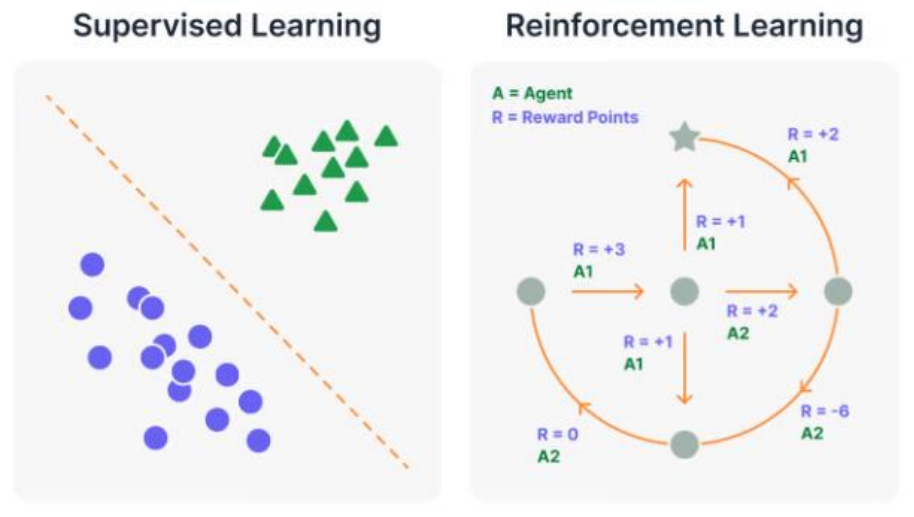
Researcher Andrej Karpathy has noted that there are two main learning paradigms in both children and AI:

1. **Imitation Learning (supervised learning)**
2. **Trial-and-error learning (reinforcement learning)**

He notes that almost all major deep learning breakthroughs have come from the second, reinforcement learning.

Example:
AlphaGo learned from human games (supervised learning) and then became superhuman through trial and error (RL).

- RL creates emergent behaviors like planning, backtracking, and strategy.
- These can't be labeled by humans — they must be discovered. has noted that there are two main learning paradigms in both



REINFORCEMENT LEARNING: ALPHA GO

Google's DeepMind stunned the AI world in 2016 with *AlphaGo*, a groundbreaking AI system that used reinforcement learning to master the game of Go.

- Go was long considered too complex for computers due to its vast search space (it has vastly more possible game states than chess).
- In its second game against world champion Lee Sedol, AlphaGo made a move that shocked experts: "Move 37."
- It placed a stone on an unconventional part of the board, breaking established Go patterns. Human experts initially thought it was a mistake.
- Later, it was recognized as brilliant and strategically sound, shifting the game's momentum.
- It has since changed the game of Go by pushing the boundaries of human intuition and entered the corpus that students of Go will study forevermore.

Source: Sora

AI REASONING MODELS

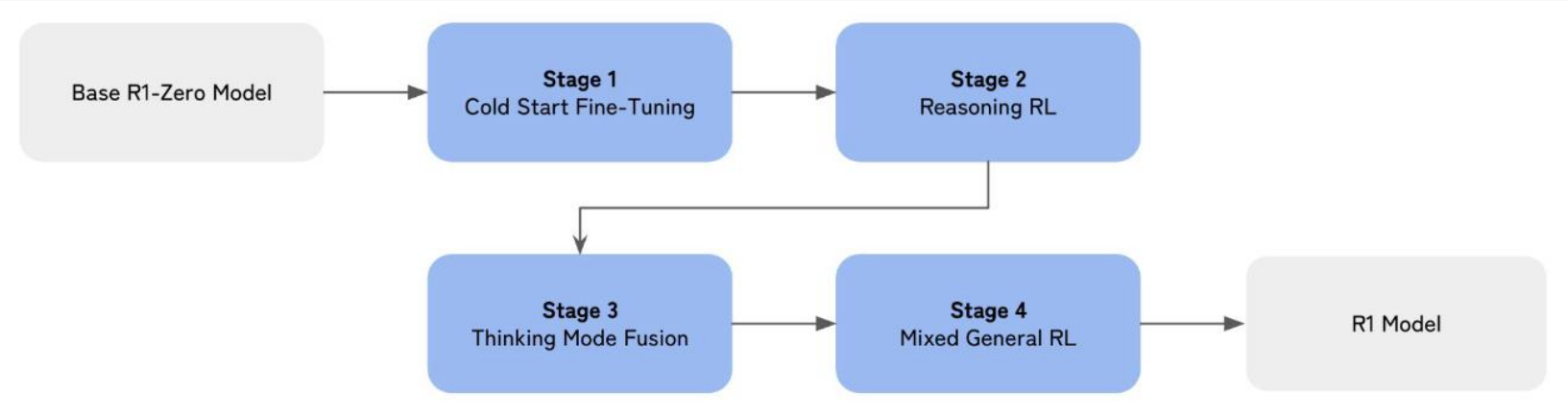
DeepSeek, a Chinese AI laboratory, released R1 in January 2025, a frontier reasoning model.

- Reasoning models are a type of AI system, typically a large language model (LLM), that's optimized to solve problems requiring multi-step thinking, logic, deduction, or structured analysis, rather than just retrieving or rephrasing information.
- R1 is a flagship reasoning models with very impressive benchmark metrics on par with OpenAI's o1 reasoning model, but at a fraction of the cost.
- Released under an MIT license that allows companies and researchers to build upon and train on its outputs (synthetic data).
- The news shocked investors and caused NVIDIA stock to drop 17%, erasing nearly $600 billion in market value.

Source: Reuters

AI REASONING MODELS

DeepSeek R1 was trained in four phases, each designed to progressively scale model capabilities.



AGI WITHIN SIGHT

In the last few months, it's become clear that Artificial General Intelligence (AGI) is near.

Intelligence unfolds on a spectrum:

- Ants may not "think", but dogs certainly seem to.
- However, it's unlikely that dogs are capable of metacognition (thinking about thinking).

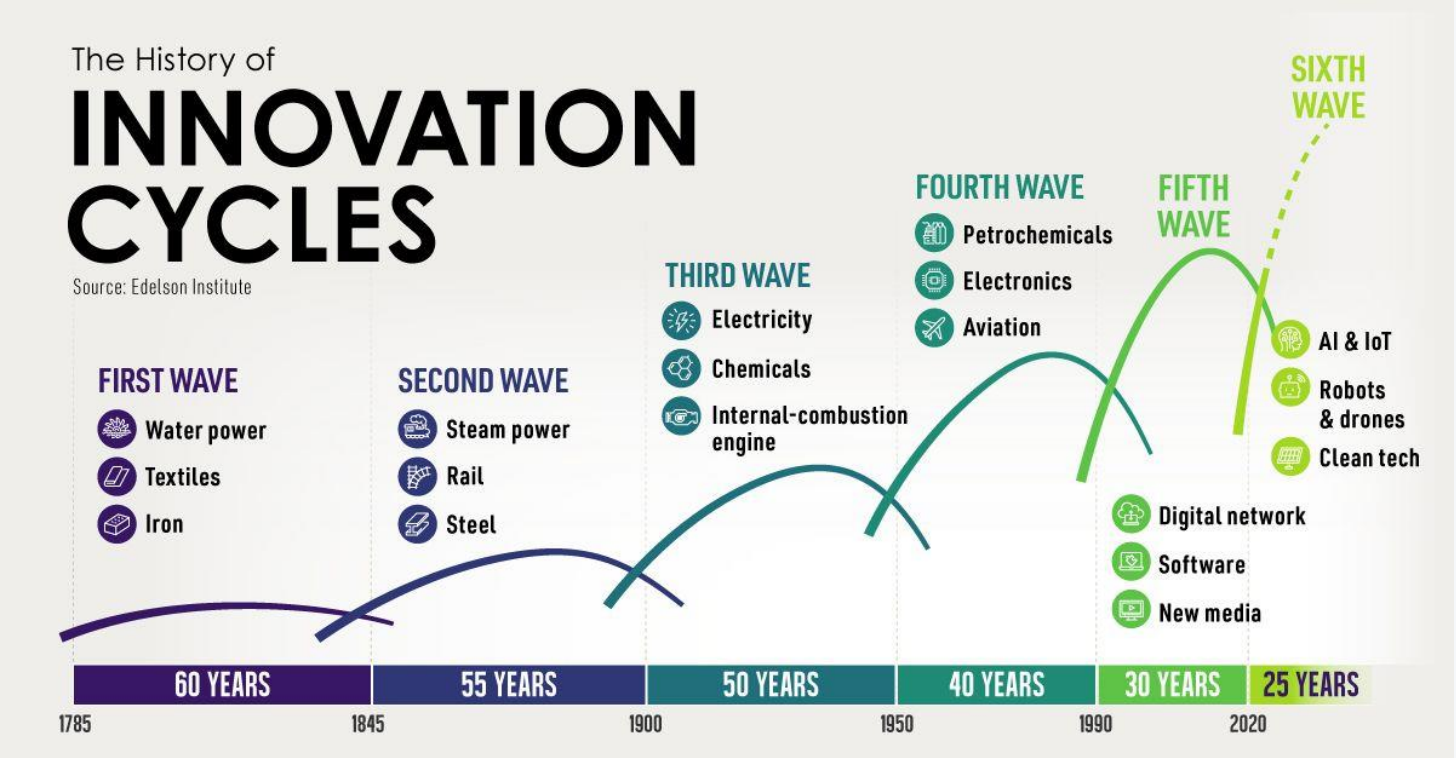
The ability to reflect on our own thoughts, recognize our misconceptions, and learn from them appears to be unique to humans.

Once you can think about thinking, you unlock a recursive process that is limitless. We can think about thinking about thinking, ad infinitum.

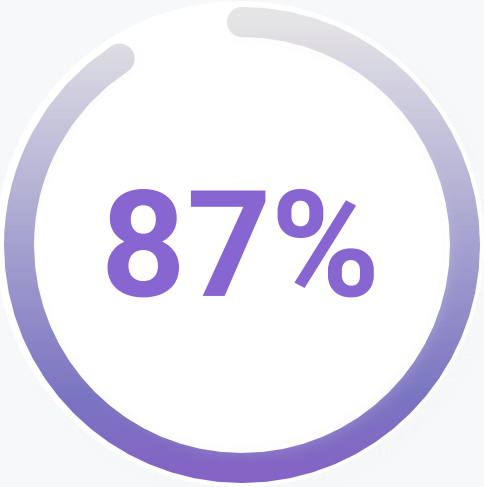
R1 shows that given a sufficiently large and well pre-trained base model, using cold start chain-of-thought training and pure RL on verifiable domains (e.g. math and coding) is sufficient to elicit emergent reasoning abilities.

- This marks a turning point.
- For the first time, we have a clear, documented path to training reasoning models at scale.
- The implications are profound.
- If reasoning ability can be systematically unlocked through reinforcement learning, then AGI is no longer a distant theoretical milestone, it's an **engineering challenge**.

WE'RE IN THE SIXTH WAVE OF INNOVATION



AI ADOPTION



of organizations believe AI will give them a competitive edge

Source: MIT Sloan Management Review

AI-FUELED BUSINESS GROWTH

93%

of respondents agree that data strategy is critical to getting value from generative AI[1]

50%

improvement of employees' creative problem-solving time due to investments in generative AI[2]

57%

of leaders believe that AI and ML will be important in achieving business objectives over the next three years[3]

Sources: [1]GMIT, [2]Forrester, [3]KPMG

AI ROI

51%

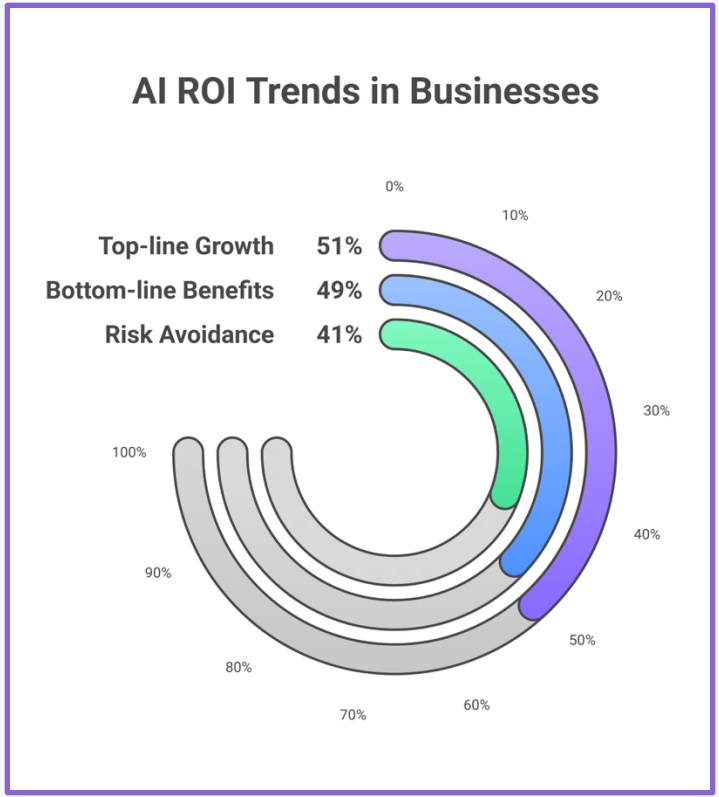
Of businesses report top-line growth through AI
(e.g., revenue and customer acquisition).

49%

Observe bottom-line benefits
(e.g., cost reduction and efficiency).

41%

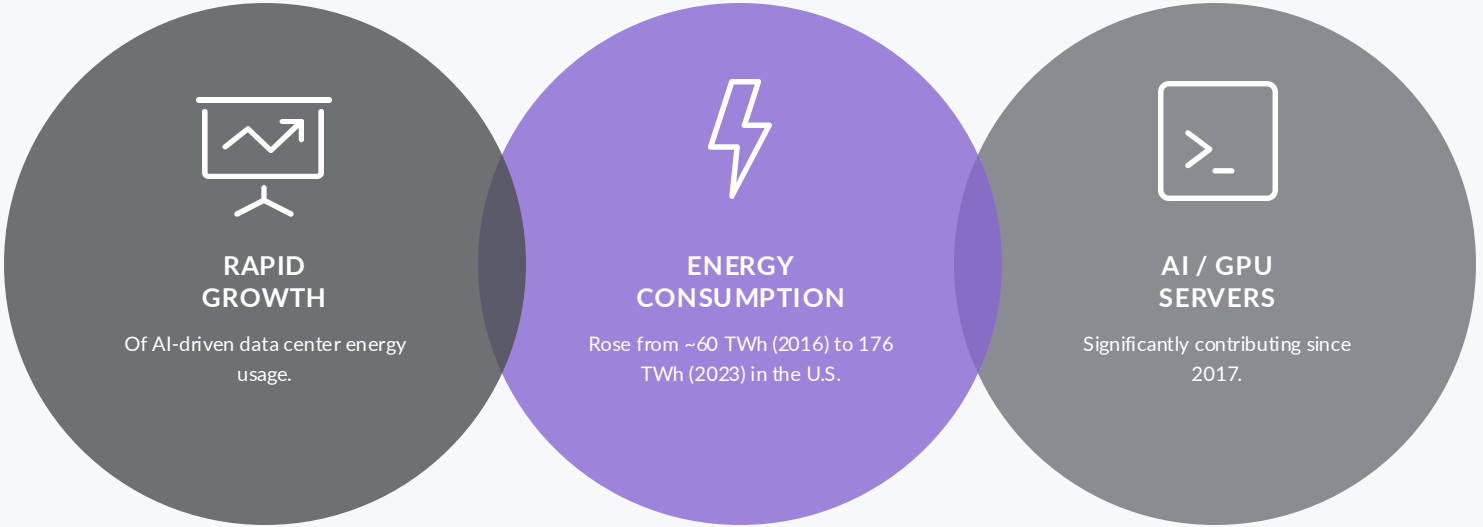
Achieve risk avoidance
(e.g., compliance, predictive maintenance).



Sources: [1]Gartner,[2]Forrester

THE RISE OF AI AND DATA CENTERS

Since 2016, U.S. data center energy usage has nearly tripled—from 60 to 176 TWh in 2023.
Source: 2024 United States Data Center Energy Usage Report



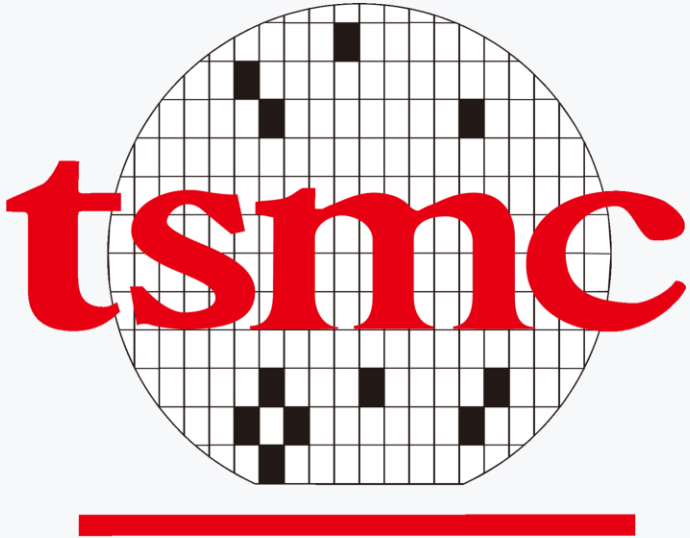
THE IMPORTANCE OF TSMC

Why TSMC Matters

- Chipmaking Powerhouse: TSMC produces more than 90% of the world's most advanced AI chips (3nm and below).
- Supplies AI Leaders: Key chip supplier for Nvidia, Apple, AMD, and even OpenAI's hardware partners.
- Enabling AI Scale: Advanced GPUs and TPUs used for AI training are impossible without TSMC's leading-edge fabs.

Strategic Role in AI's Future

- Bottleneck or Accelerator: The pace of AI advancement hinges on chip availability, TSMC controls the pipeline.
- National Security Asset: Taiwan's chip dominance has become a geopolitical flashpoint in US–China tech competition.
- Innovation Engine: TSMC drives the frontier of chip miniaturization, efficiency, and production scale—directly influencing how fast and far AI can grow.



AI DRIVING POWER DEMAND – CURRENT TRENDS

AI servers aren't just more powerful—they're far more power-hungry.

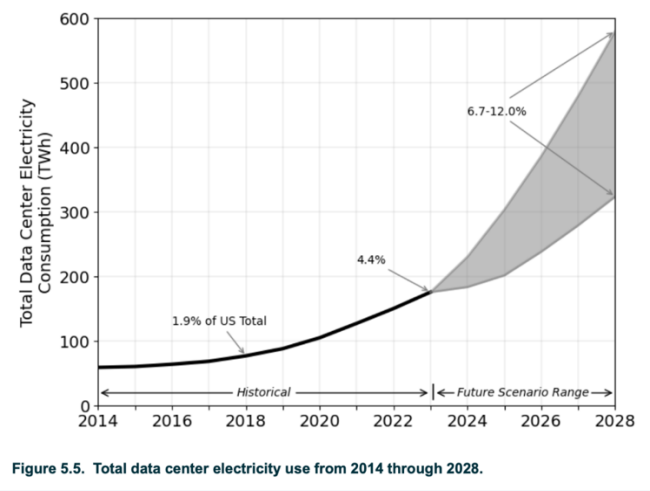


Figure 5.5. Total data center electricity use from 2014 through 2028.

Source: 2024 United States Data Center Energy Usage Report

AI WORKLOADS REQUIRE SPECIALIZED, GPU-INTENSIVE SERVERS.

SIGNIFICANT OPERATIONAL POWER INCREASES (MULTIPLE KW PER SERVER)

U.S. DATA CENTER ENERGY PROJECTED TO REACH 325–580 TWH BY 2028.

NATIONAL SECURITY IMPLICATIONS

THE AI RACE WITH CHINA

AI CAPABILITIES

Increased AI capability is essential for maintaining technological supremacy.

DATA CENTERS

Increased dependency on data centers (including energy and power) elevates vulnerabilities.

STRATEGIC IMPERATIVE

There is a strategic imperative to maintain AI infrastructure leadership.

AI'S IMPACT ON JOBS

- **IT IS TOUGH TO ESTIMATE AI'S TRUE IMPACT ON JOBS, AS WE'RE STILL IN THE EARLY DAYS OF ADOPTION.**

  THE TRANSPORTATION AND MANUFACTURING SECTORS WILL LIKELY BE THE MOST AFFECTED.

- **ONE THING IS CLEAR, LIKE DURING TECHNOLOGICAL REVOLUTIONS OF THE PAST, JOBS WILL BE LOST.**

  THE TRANSPORTATION SECTOR ACCOUNTS FOR 25% OF THE US ECONOMY, AND WAYMO, TESLA, AND AURORA ARE COMING.

- **LIKE WITH PREVIOUS TECHNOLOGICAL ADVANCEMENTS, NEW JOBS WILL ALSO BE CREATED.**

  WITH THE TIME FREED UP FROM AUTOMATION AND AI, BUSINESS LEADERS WILL HAVE MORE TIME TO PLAN BIG PICTURE.

ENERGY DEMAND AND STRATEGIC COMPETITION

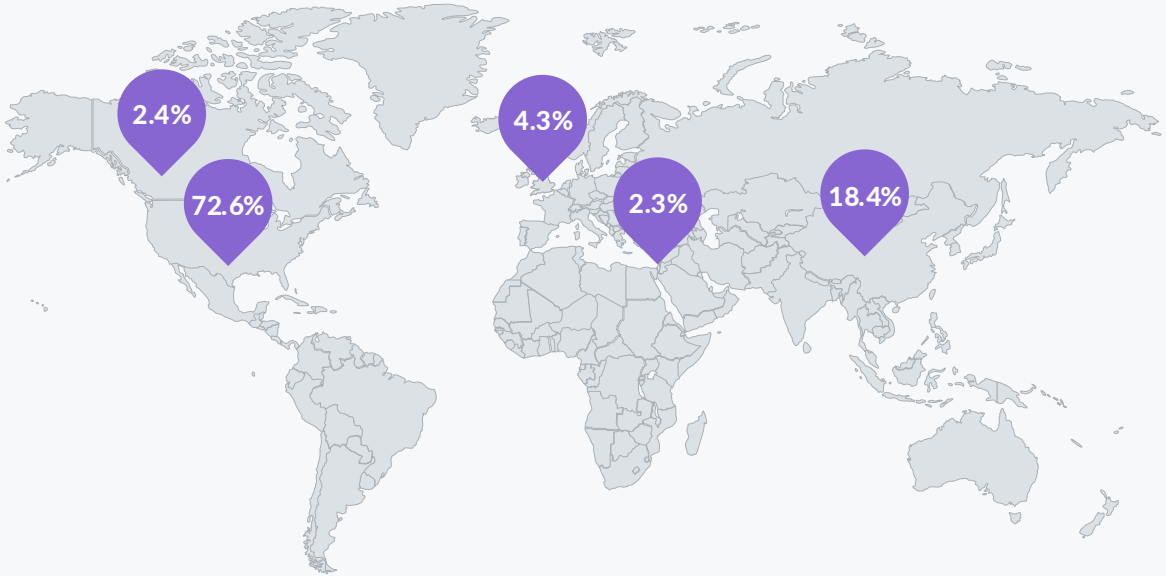
- CHINA'S RAPID EXPANSION OF DATA CENTER INFRASTRUCTURE.
- CRITICAL TO RECOGNIZE AI INFRASTRUCTURE AS NATIONAL SECURITY PRIORITY.
- STRATEGIC INVESTMENT IN SECURE, SUSTAINABLE ENERGY FOR U.S. LEADERSHIP.

CHINA IS SCALING AI INFRASTRUCTURE AGGRESSIVELY USING EVERYTHING FROM SOLAR TO COAL.

NATO ALLIES FALLING BEHIND

- SLOW EUROPEAN INVESTMENT IN DATA CENTER AND AI INFRASTRUCTURE.
- CONSERVATIVE GPU ADOPTION, SLOWER REFRESH CYCLES HINDER COMPETITIVENESS.
- EUROPEAN REGULATORY FOCUS SLOWING PRACTICAL AI DEPLOYMENT.

AI INVESTMENT BY COUNTRY (2013-2024)



UNITED STATES
$470.9 Billion

CHINA
$119.3 Billion

UNITED KINGDOM
$28.2 Billion

CANADA
$15.3 Billion

ISRAEL
$15.0 Billion

Source: Stanford

CONSEQUENCES OF LAGGING ALLIES

- INCREASED EUROPEAN RELIANCE ON U.S. DIGITAL AND ENERGY RESOURCES.
- CHALLENGES TO INTEROPERABILITY AND COLLECTIVE SECURITY POSTURE.
- REDUCED NATO RESILIENCE TO CYBER THREATS AND ADVERSARIES.

CHINA'S APPROACH?

ALL OF THE ABOVE

- CHINA AGGRESSIVELY ADDRESSING ENERGY DEMAND, PRIORITIZING AI LEADERSHIP.
- RAPID CONSTRUCTION OF DATA CENTERS POWERED BY COAL ALONGSIDE RENEWABLES AND NUCLEAR.
- RAISES GLOBAL ENVIRONMENTAL CONCERNS AND GEOPOLITICAL PRESSURES ON SUSTAINABILITY GOALS.

BRIDGING ENERGY DEMAND – NATURAL GAS AND NUCLEAR

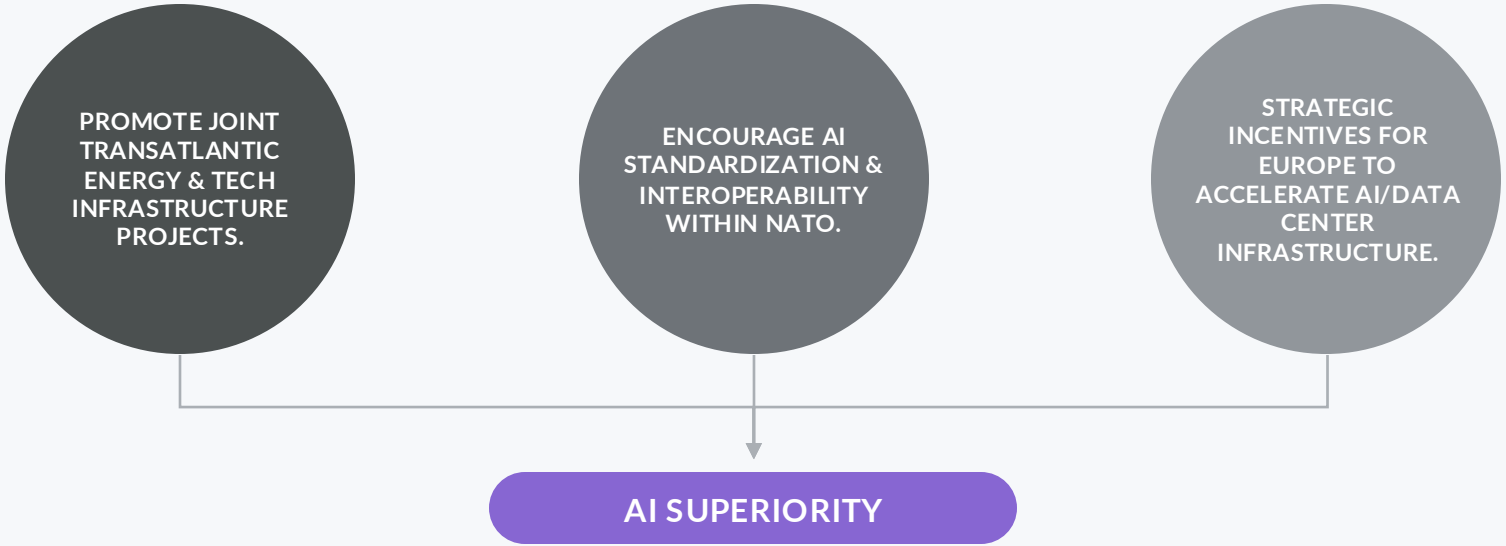
NATURAL GAS

South Dakota planning data centers powered by natural gas, serving as stable, scalable power source.

NUCLEAR

Texas announced plans for new nuclear reactors, providing carbon-free, reliable, large-scale power.

POLICY IMPLICATIONS AND RECOMMENDATIONS



FUTURE SCENARIOS AND STRATEGIC PLANNING

IMPORTANCE OF STRATEGIC, LONG-TERM PLANNING FOR SUSTAINABLE AI OPERATIONS.

PROJECTED SCENARIOS FOR AI-DRIVEN ENERGY DEMAND (OPTIMISTIC VS. PESSIMISTIC).

OPPORTUNITY TO USE ENERGY INFRASTRUCTURE BUILD-OUT TO LEAD GLOBALLY.

THANK YOU! QUESTIONS?

Digital Meld