

CSCI E-11

Class 8

March 24, 2026

Introduction to AI



Harvard
Extension School
HARVARD DIVISION OF
CONTINUING EDUCATION

Updates on Quantum Decryption



« Moar Updatez

Remarks at UT on the Pentagon/Anthropic situation »

The "JVG algorithm" is crap

Sorry to interrupt your regular programming about the AI apocalypse, etc., and return to the traditional beat of this blog's very earliest years ... but I've now gotten multiple messages asking me to comment on something called the "[JVG \(Jesse-Victor-Gharabaghi\) algorithm](#)" (yes, the authors named it after themselves). This is presented as a massive improvement over Shor's factoring algorithm, which could (according to [popular articles](#)) allow RSA-2048 to be broken using only 5,000 physical qubits.

<https://scottaaronson.blog/?p=9615>

No, the "Pinnacle Architecture" Is Not Bringing Q-Day Closer 2-5 Years (but It Is Credible Research)



Marin Ivezic ✉ · February 13, 2026 · 6 minutes read

<https://postquantum.com/security-pqc/pinnacle-architecture-q-day/>

Is RSA Safe? New Study Argues Quantum Computers Face A Hard Ceiling

Research

Matt Swayne • March 19, 2026

<https://thequantuminsider.com/2026/03/19/is-rsa-safe-new-study-argues-quantum-computers-face-a-hard-ceiling/>

<https://www.pnas.org/doi/abs/10.1073/pnas.2523350123>

Amazon and AI coding, Part 2

BACKFIRE STICK

Amazon Admits Extensive AI Use Is Wreaking Havoc on Its Core Business

Hoisted by its own AI petard.

By [Frank Landymore](#) / Published Mar 10, 2026 4:22 PM EDT / [Add Futurism](#) ⓘ

In a meeting briefing note, the company described the “trend of incidents” as characterized by a “high blast radius” and “Gen-AI assisted changes.” As a “contributing factor,” the note listed “novel GenAI usage for which best practices and safeguards are not yet fully established.”

Discussion: Last Week's Reading

practice



DOI:10.1145/3453920

Article development led by [ACM Queue](#)
queue.acm.org

Extending hardware-enforced cryptographic protection to data while in use.

BY MARK RUSSINOVICH, MANUEL COSTA, CÉDRIC FOURNET,
DAVID CHISNALL, ANTOINE DELIGNAT-LAVALD,
SYLVAN CLEBSCH, KAPIL VASWANI, AND VIKAS BHATIA

Toward Confidential Cloud Computing

ALTHOUGH LARGELY DRIVEN by economies of scale, the development of the modern cloud also enables increased security. Large datacenters provide aggregate availability, reliability, and security assurances. The operational cost of ensuring that operating systems, databases, and other services have secure configurations can be amortized among all tenants, allowing the cloud provider to employ experts who are responsible for security; this is often unfeasible for smaller businesses, where the role of systems administrator is often conflated with many others.

Cloud datacenters are also subject to tight physical security: the number of people with physical access is limited, and the controls on their access are stricter in

a large, cloud provider's datacenters than on premises—often vulnerable to insider threats such as disgruntled former employees leaving with a copy of sensitive data or physical media (including on-site backups).

Cloud providers systematically encrypt data in transit (on the network) and at rest (on disks and backups) using keys associated with tenants; even if attackers gain access to a datacenter, they cannot see the plaintext of tenant data unless they also manage to compromise their managed keys. This trend of increasing security in the cloud will continue; the next step is *confidential computing*, extending hardware-enforced cryptographic protection to data while in use (that is, during computation).

Trusting the Cloud

Why would tenants trust security assurances from the cloud at face value? Tenants trust their providers to different extents. Some may fully trust it to keep their data secure. Some may be concerned about other tenants, software bugs, or insider attacks (for example, from datacenter technicians). Some may require compliance with strict privacy regulations. Some may also doubt the provider's willingness or ability to enforce its stated security policies—guaranteeing, for example, that their data will never be used without their consent—or even fear subpoenas and other legal attacks in the jurisdictions where the cloud operates. To address these concerns, tenants increasingly expect the following:

- Minimal hardware, software, and operational trusted computing bases (TCBs) for their sensitive workloads.
- Technical enforcement, rather than just business policies.
- Transparency about the guarantees, residual risks, and mitigations that they get.

Confidential computing meets these expectations by allowing tenants to exercise full control over the TCB used to run their cloud workloads. Confidential computing allows tenants to precisely define all the hardware and

practice



DOI:10.1145/3624577

Article development led by [ACM Queue](#)
queue.acm.org

Working toward a more secure and innovative future.

BY MARK RUSSINOVICH

Confidential Computing: Elevating Cloud Security and Privacy

IN THE EVER-EVOLVING landscape of digital security, a new technology—confidential computing^{1,11}—is set to redefine our expectations of data safety and privacy. The advent of cloud computing has already resulted in a security infrastructure that surpasses most traditional on-premises systems. Confidential computing (CC) is poised to elevate these guarantees even further. It is a paradigm shift that marks the next stage in the evolution of cloud security, representing a leap forward that pushes the boundaries of what is achievable.

CC fundamentally improves our security posture by

drastically reducing the attack surface of systems. While traditional systems encrypt data at rest and in transit, CC extends this protection to data in use. It provides a novel, clearly defined security boundary, isolating sensitive data within trusted execution environments during computation. This means services can be designed that segment data based on least-privilege access principles, that is, services where data is accessible only to the code that needs access to perform its function, while all other code in the system sees only encrypted data. Crucially, the isolation is rooted in novel hardware primitives, effectively rendering even the cloud-hosting infrastructure and its administrators incapable of accessing the data. This approach creates more resilient systems capable of withstanding increasingly sophisticated cyber threats, thereby reinforcing data protection and sovereignty in an unprecedented manner.

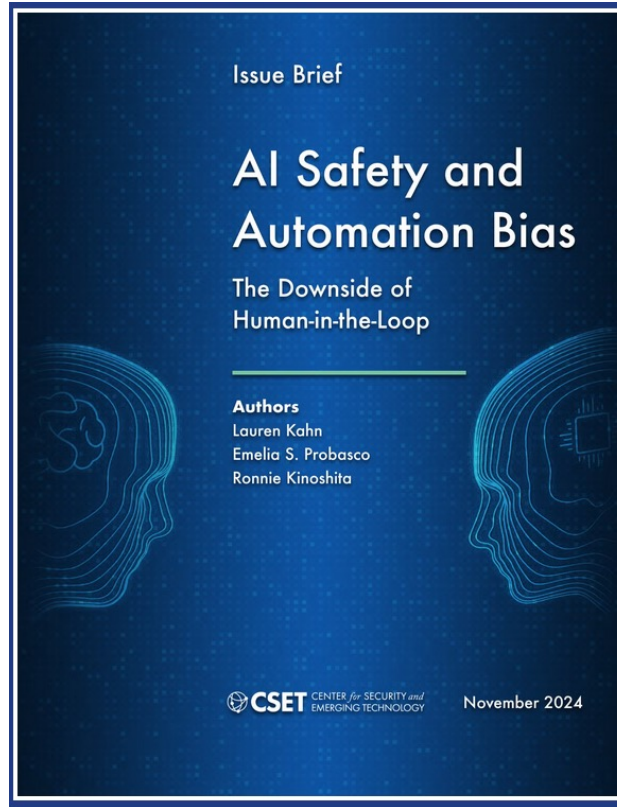
But CC is not just about fortifying defenses; it's also about unlocking potential. It opens a universe of possibilities, fostering innovation and empowering businesses and developers to build new kinds of services previously inhibited by security constraints. From privacy-enhanced personal AI services,⁴ to encrypted databases,⁶ to highly confidential decentralized business processes,⁷ to confidential data cleanrooms where multiple parties execute analytics and machine-learning workflows on combined data without revealing their data to the other parties,⁸ to trustworthy and transparent hardware and software supply chains,⁹ CC has the potential to revolutionize various domains.

CC is more than a technological innovation; it's a testament to our ability to collaborate and co-create solutions for the benefit of all. CC is the outcome of a confluence of expertise from leading research groups^{10,11} and major players throughout industry sectors.¹² This includes a spectrum of hardware and software vendors, from processor and accelerator companies, such as Intel, AMD, ARM, and NVIDIA, to cloud service providers, including Microsoft, Google, and



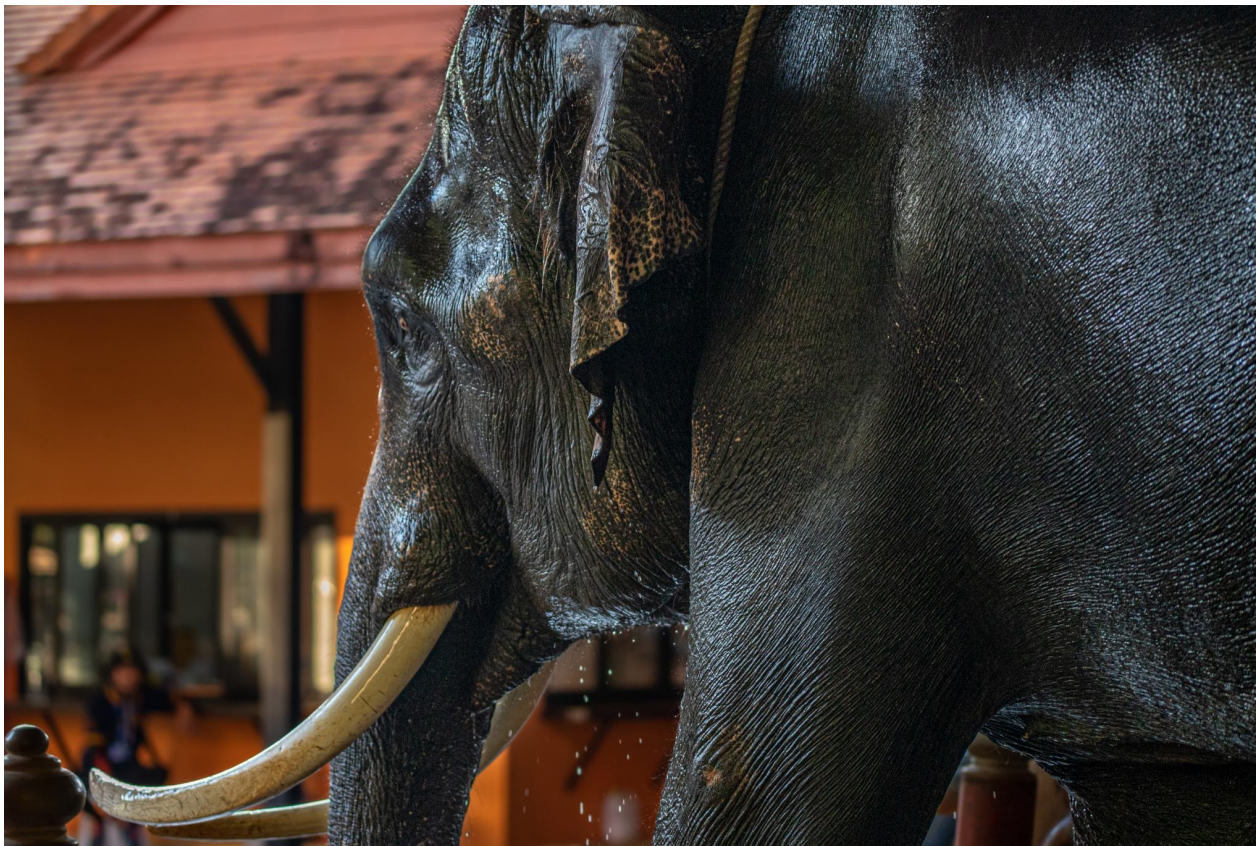
UN Handbook on Privacy-Preserving Computation Techniques

“Automation bias” is over-reliance on computer systems.



Artificial Intelligence: Overview

“Copilot, insert an image of an elephant in the room into this slide.”

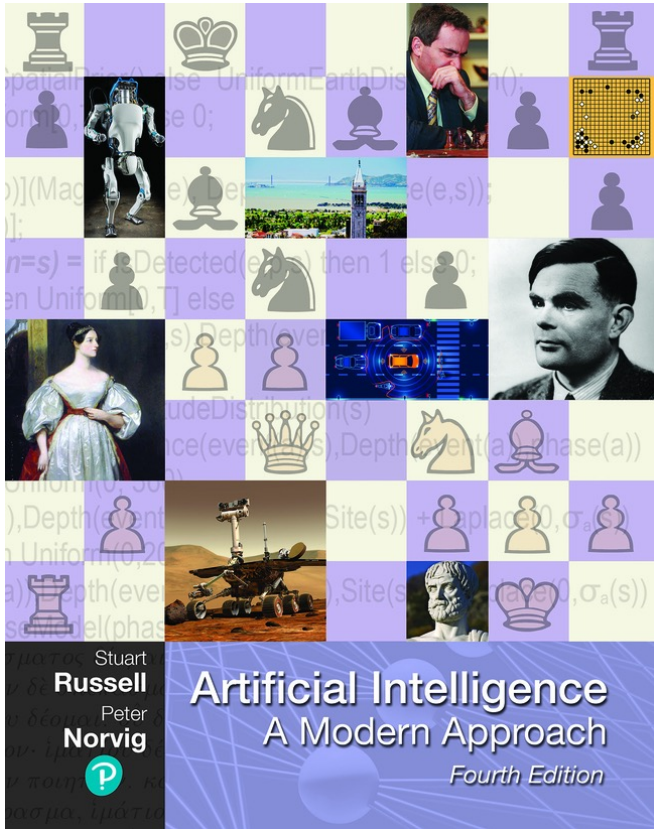


We'll cover (some of) the foundations of AI.

1. $\forall x (\text{Cat}(x) \rightarrow \text{Mammal}(x))$ (All cats are mammals)
2. $\forall x (\text{Mammal}(x) \rightarrow \text{Animal}(x))$ (All mammals are animals)
3. $\text{Cat}(\text{Tom})$ (Tom is a cat)



Academic AI historically covered a broad range of theory.



“AI: the study of agents that receive percepts from the environment and perform actions. Each such agent implements a function that maps percept sequences to actions.”

artificial intelligence

Artificial Intelligence (AI) refers to the capability of a machine to carry out tasks that are generally considered to require human intelligence. Common applications of AI include game playing, language translation, expert systems, and robotics. While the concept of machines mimicking intelligence dates back to ancient times, the emergence of true intelligence in machines was only possible with the development of digital computers in the 1940s.

The evolution of AI, or at least the appearance of intelligence, has progressed alongside the advancement of computer processing power, which seems to be the primary constraint. Early AI projects, such as playing chess and solving mathematical problems, are now considered relatively simple compared to more complex tasks like visual pattern recognition, complex decision making, and the use of natural language.

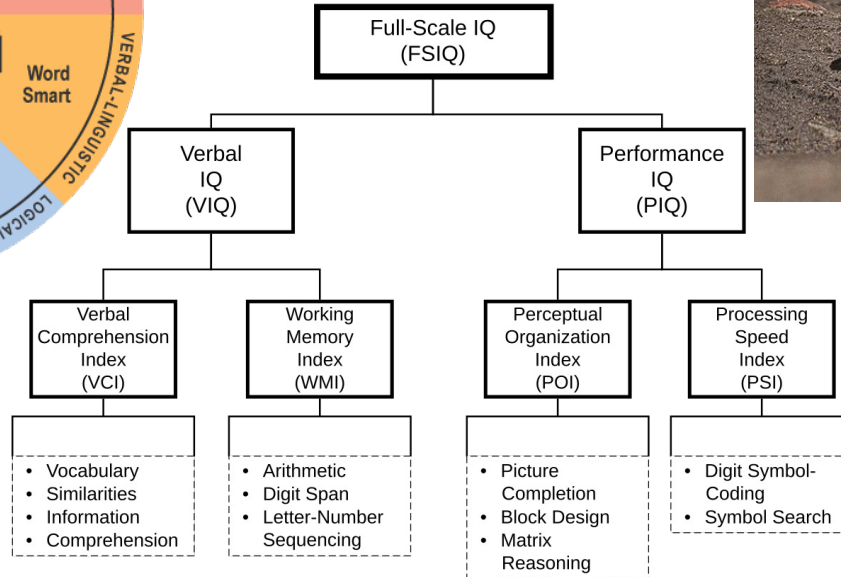
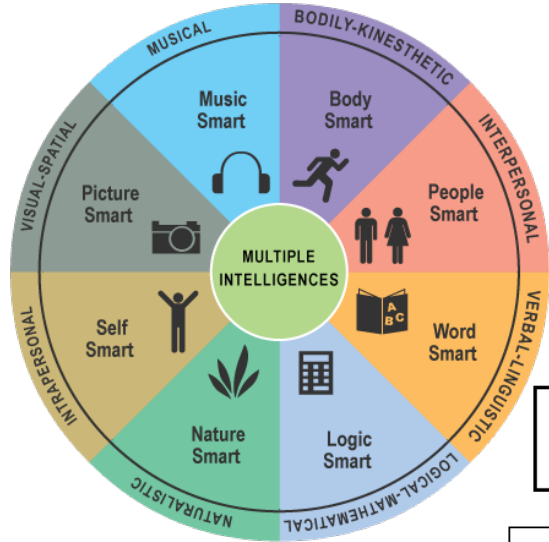
This summary was created from our Britannica article using AI. Please verify important information in our full article.

artificial intelligence

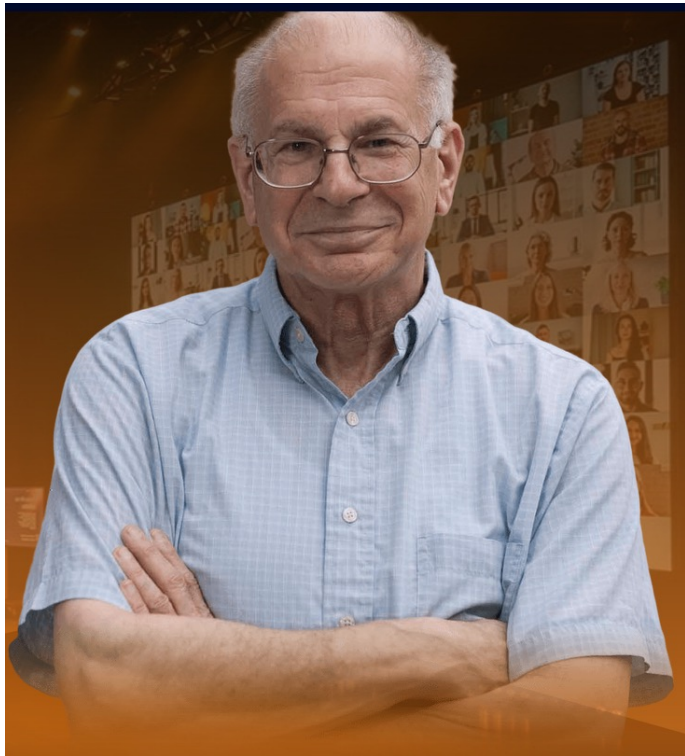
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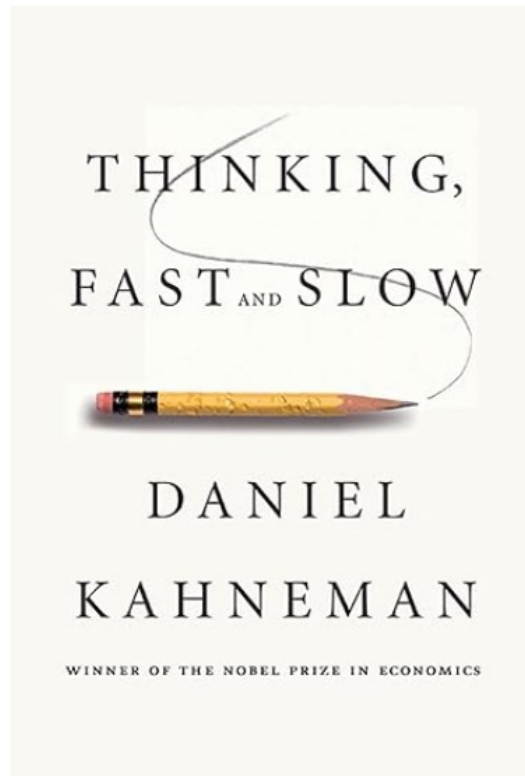
We can't agree on a definition of human intelligence.



Daniel Kahneman, March 5, 1934 – March 27, 2024



Nobel Memorial Prize in Economics, 2002



System 1

5 x 7



“He ate the bread.”

System 2

5,317 x 7,191



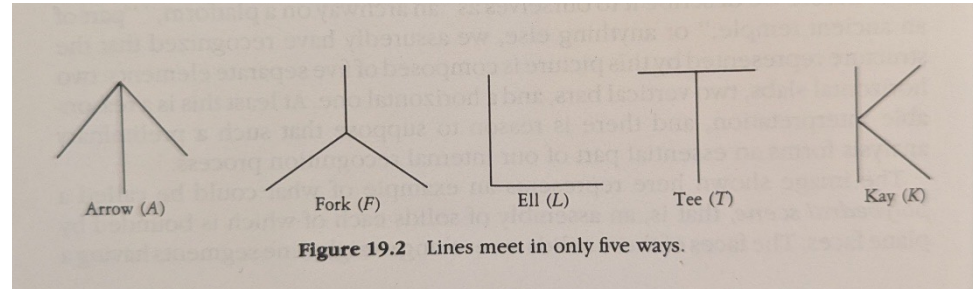
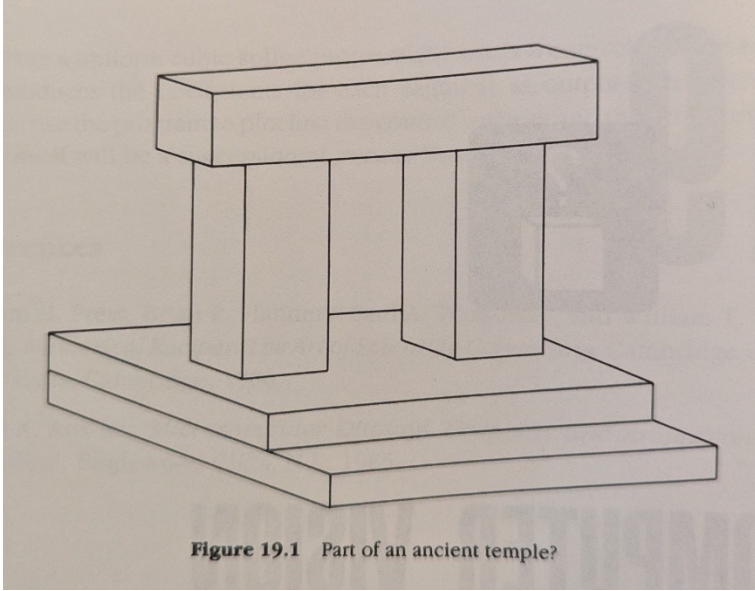
ΒΑΣΙΛΕΥΟΝΤΟΣ ΤΟΥ ΝΕΟΥ Κ

Symbolic AI

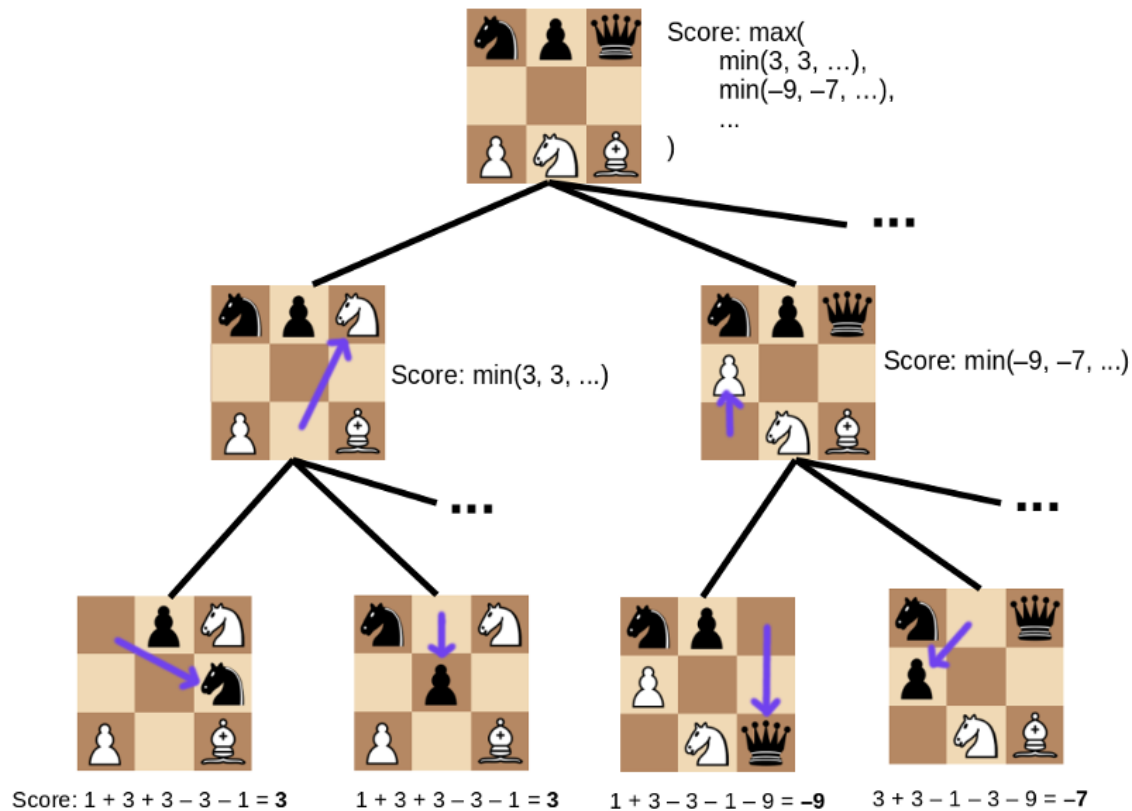
Symbolic AI rests (-ed?) on the explicit representation of knowledge.

1. $\forall x (\text{Cat}(x) \rightarrow \text{Mammal}(x))$ (All cats are mammals)
 2. $\forall x (\text{Mammal}(x) \rightarrow \text{Animal}(x))$ (All mammals are animals)
 3. $\text{Cat}(\text{Tom})$ (Tom is a cat)
-

Explicit rules were used to generate new knowledge



Min-Max

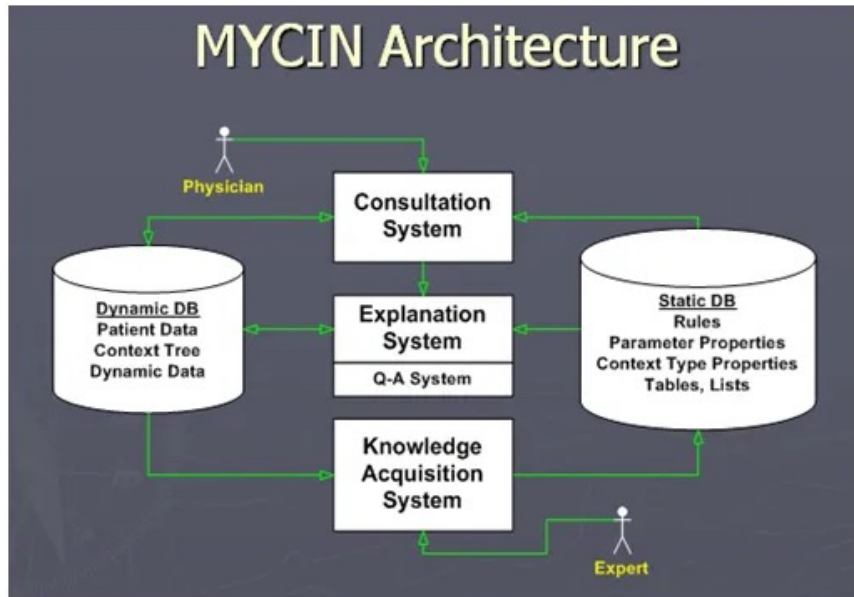


A* calculates the shortest path from a start point to any other point.

7	6	5	6	7	8	9	10	11		19	20	21	22
6	5	4	5	6	7	8	9	10		18	19	20	21
5	4	3	4	5	6	7	8	9		17	18	19	20
4	3	2	3	4	5	6	7	8		16	17	18	19
3	2	1	2	3	4	5	6	7		15	16	17	18
2	1	0	1	2	3	4	5	6		14	15	16	17
3	2	1	2	3	4	5	6	7		13	14	15	16
4	3	2	3	4	5	6	7	8		12	13	14	15
5	4	3	4	5	6	7	8	9	10	11	12	13	14
6	5	4	5	6	7	8	9	10	11	12	13	14	15

Expert Systems

MYCIN Architecture



RULE037

IF: 1) The identity of the organism is not known with certainty, and
2) The stain of the organism is gramneg, and
3) The morphology of the organism is rod, and
4) The aerobicity of the organism is aerobic
THEN: There is strongly suggestive evidence (.8) that the class of the organism is enterobacteriaceae

RULE145

IF: 1) The therapy under consideration is one of: cephalothin clindamycin erythromycin lincomycin vancomycin, and
2) Meningitis is an infectious disease diagnosis for the patient
THEN: It is definite (1) the therapy under consideration is not a potential therapy for use against the organism

RULE060

IF: The identity of the organism is bacteroides
THEN: I recommend therapy chosen from among the following drugs:

1 - clindamycin	(.99)
2 - chloramphenicol	(.99)
3 - erythromycin	(.57)
4 - tetracycline	(.28)
5 - carbenicillin	(.27)

How it started... Watson wins at Jeopardy!



How it's going

What Ever Happened to IBM's Watson?

IBM's artificial intelligence was supposed to transform industries and generate riches for the company. Neither has panned out. Now, IBM has settled on a humbler vision for Watson.



By **Steve Lohr**

Published July 16, 2021 Updated July 17, 2021

IBM is selling off its Watson Health assets



By Clare Duffy, CNN Business
3 minute read · Published 2:29 PM EST, Fri January 21, 2022



Video Ad Feedback

IEEE Spectrum

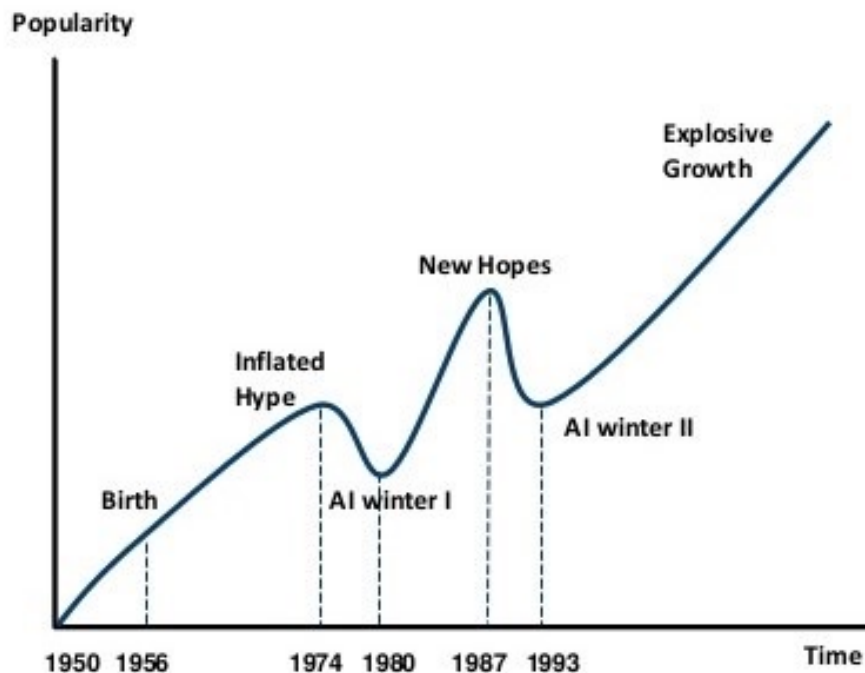
HOW IBM WATSON OVERPROMISED AND UNDERDELIVERED ON AI HEALTH CARE

After its triumph on Jeopardy!, IBM's AI seemed poised to revolutionize medicine. Doctors are still waiting

BY **ELIZA STRICKLAND** | 02 APR 2019

Two “AI Winters” brought research and funding to a near standstill.

AI HAS A LONG HISTORY OF BEING “THE NEXT BIG THING” ...

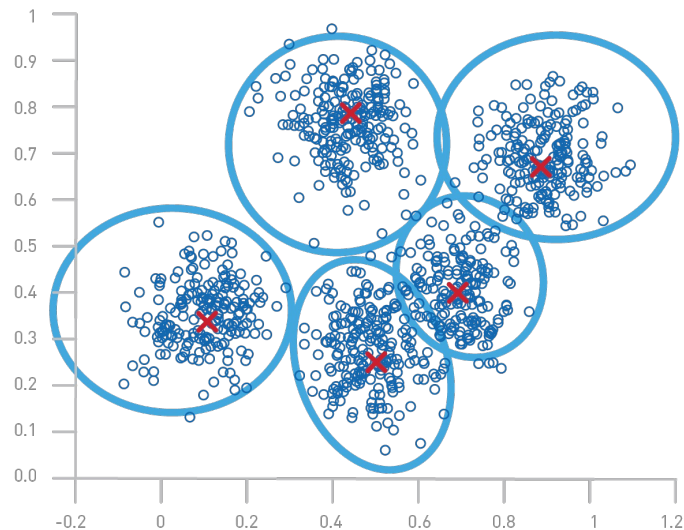
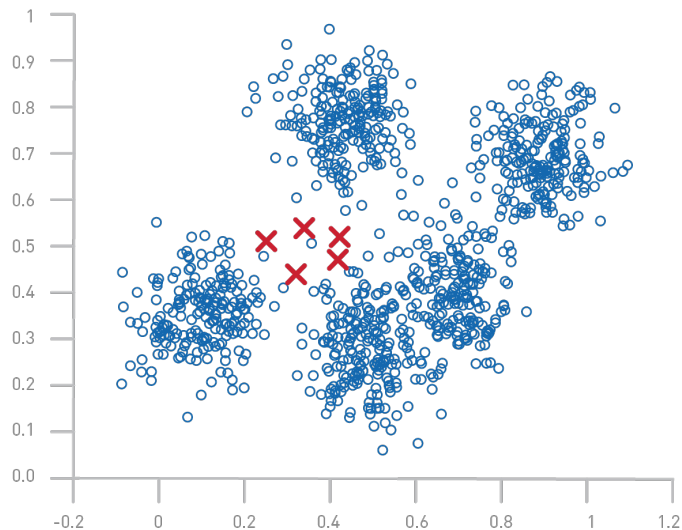


Timeline of AI Development

- **1950s-1960s:** First AI boom - the age of reasoning, prototype AI developed
- **1970s:** AI winter I
- **1980s-1990s:** Second AI boom: the age of Knowledge representation (appearance of expert systems capable of reproducing human decision-making)
- **1990s:** AI winter II
- **1997:** Deep Blue beats Gary Kasparov
- **2006:** University of Toronto develops Deep Learning
- **2011:** IBM's Watson won Jeopardy
- **2016:** Go software based on Deep Learning beats world's champions

Machine Learning: Unsupervised Learning

Clustering divides data sets into different categories.



Recommendation algorithms associate items in a dataset

Customers also bought or read

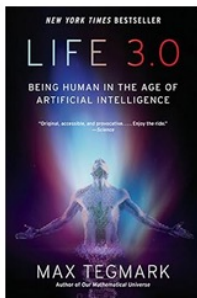
Similar books



by Nick Bostrom

Artificial Intelligence

Science



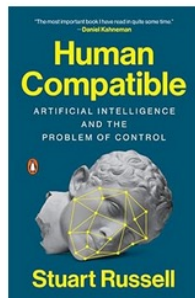
Life 3.0: Being Human
in the Age of Artificial
Intelligence

★★★★☆ 5,815

Goodreads Choice

Kindle Edition

\$13⁹⁹

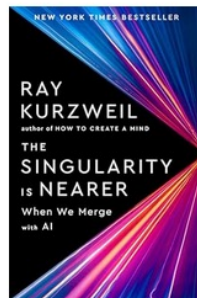


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and the Problem of C...

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The Singularity is
Nearer: When We
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The Coming Wave:
Technology, Power, and
the Twenty-first Cent...

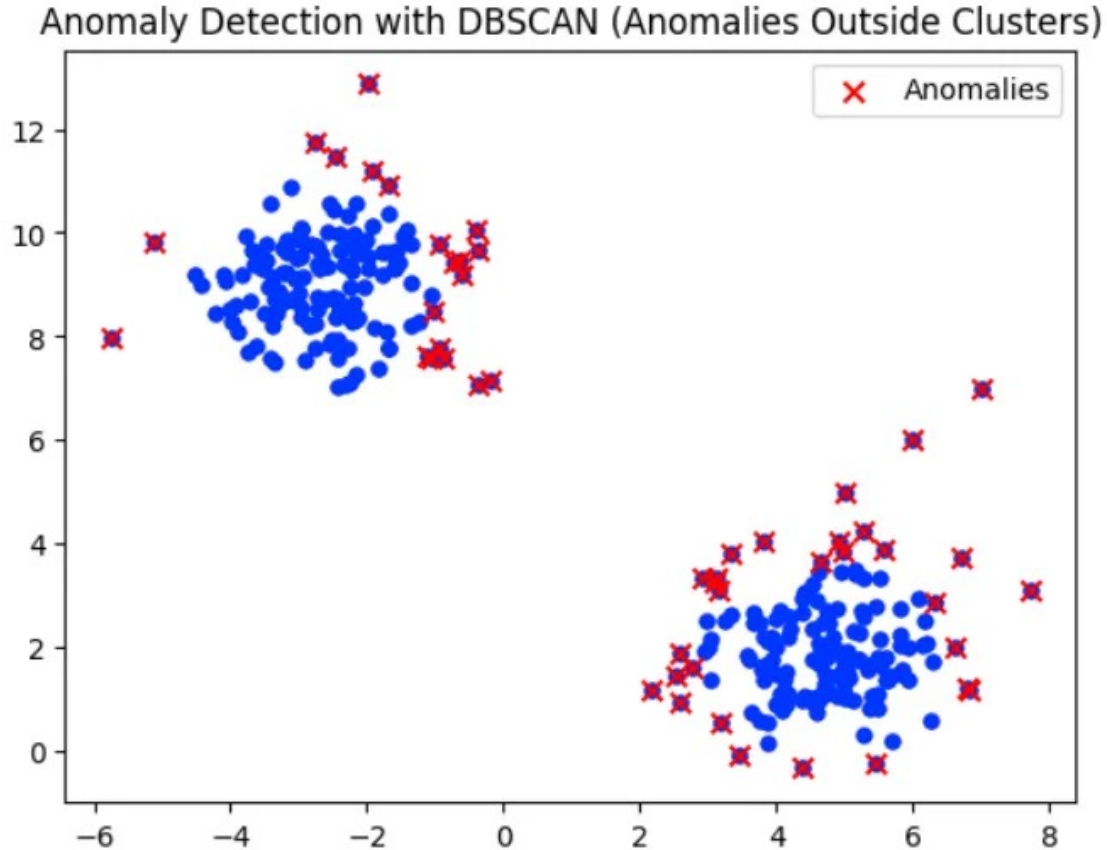
★★★★☆ 3,476

Editors' pick

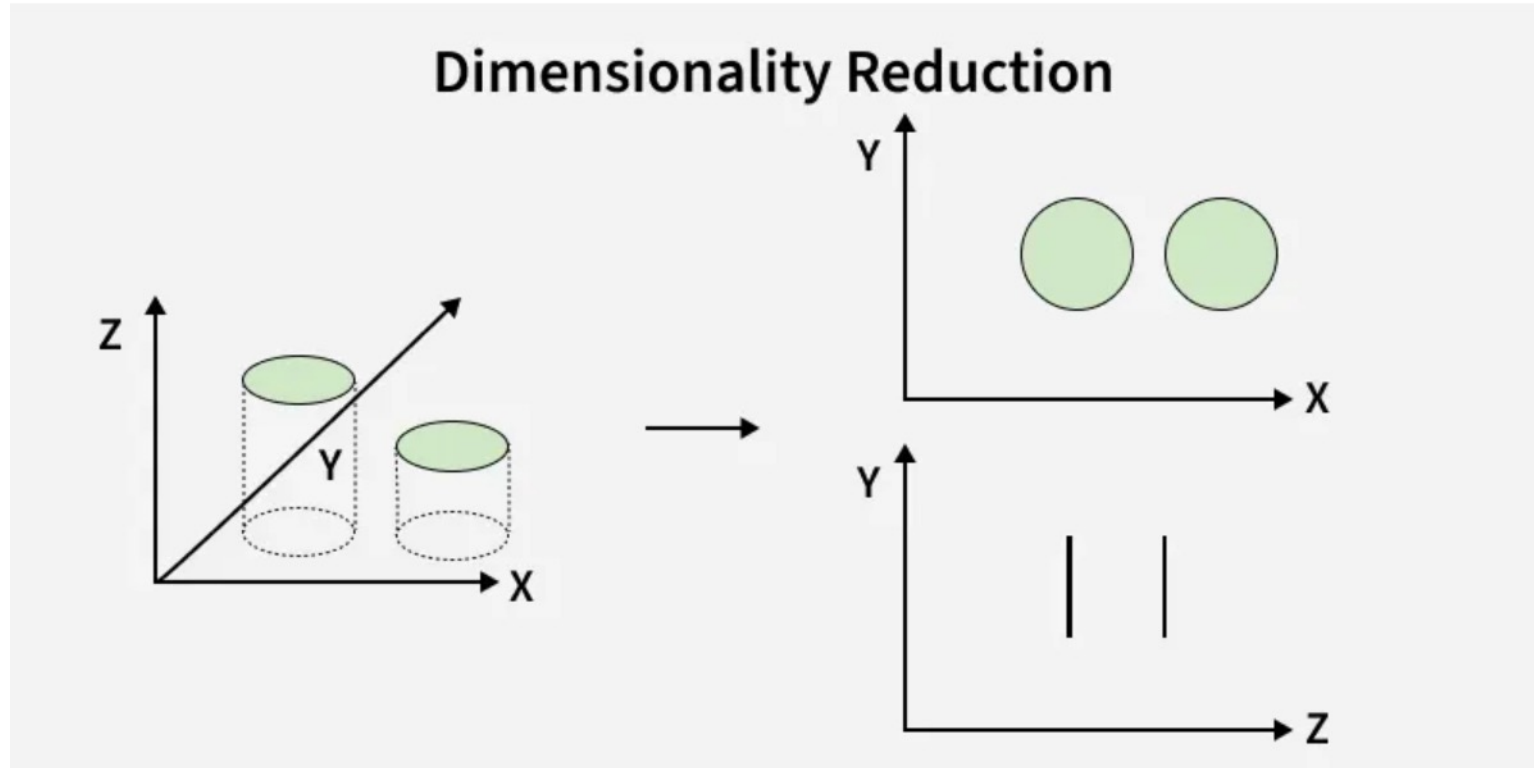
Kindle Edition

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Anomaly detection classifies individual points as outliers.



Dimensionality reduction processes high-dimensional data



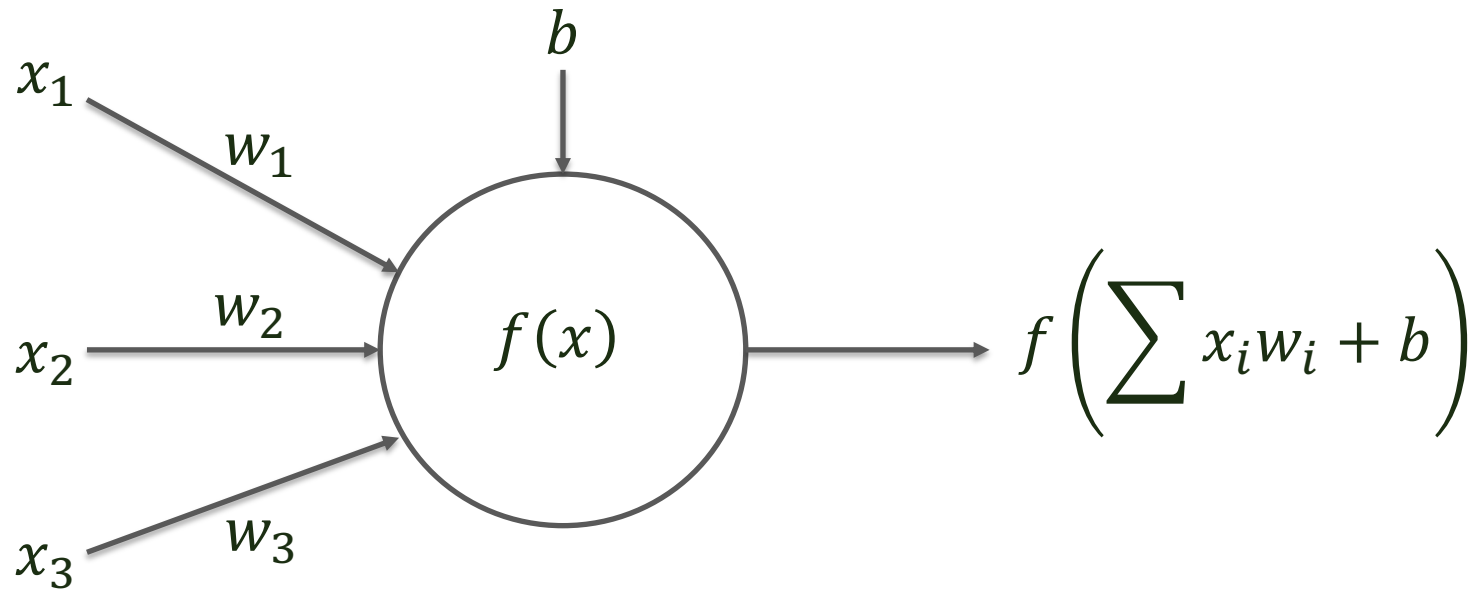
Supervised learning and neural nets

Supervised learning uses answers provided in the data.

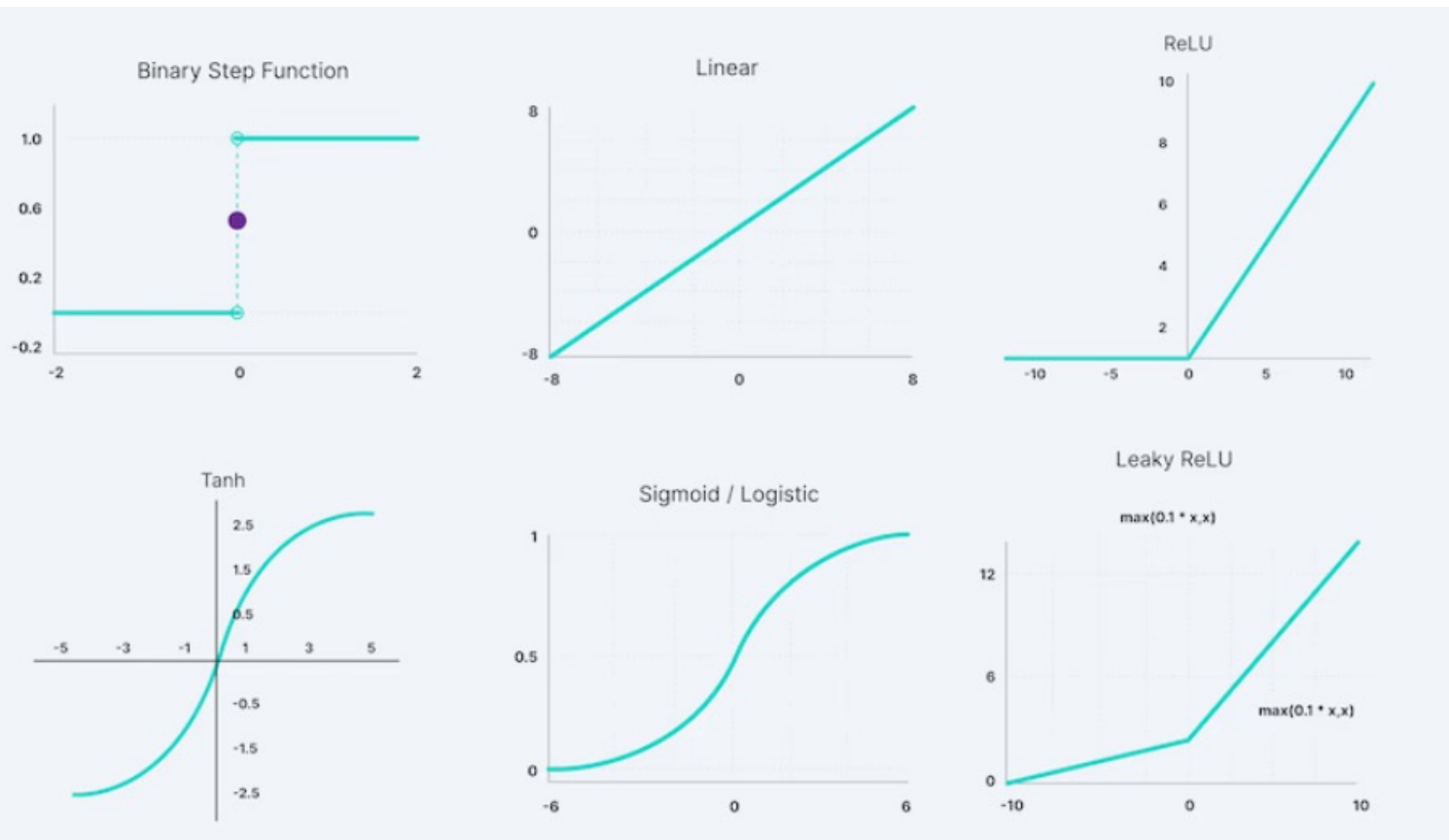
	LotArea	MasVnrArea	BsmtUnfSF	TotalBsmtSF	1stFlrSF	2ndFlrSF	GrLivArea	GarageArea	WoodDeckSF	OpenPorchSF	SalePrice
Id											
1	8450	196.0	150	856	856	854	1710	548	0	61	208500
2	9600	0.0	284	1262	1262	0	1262	460	298	0	181500
3	11250	162.0	434	920	920	866	1786	608	0	42	223500
4	9550	0.0	540	756	961	756	1717	642	0	35	140000
5	14260	350.0	490	1145	1145	1053	2198	836	192	84	250000



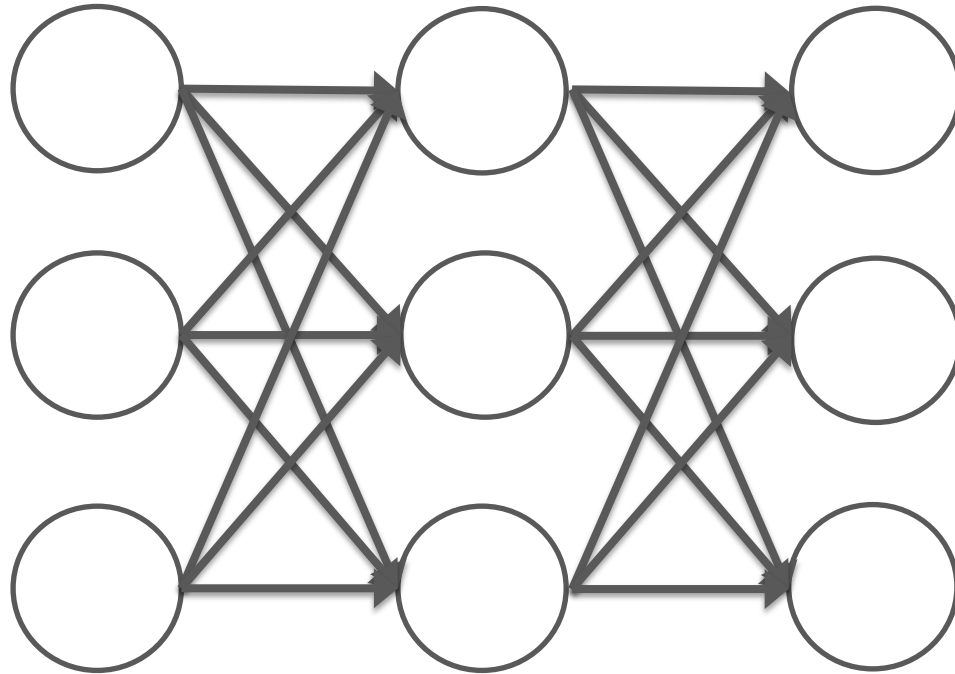
A simple artificial neuron encodes weighted inputs and applies a function.



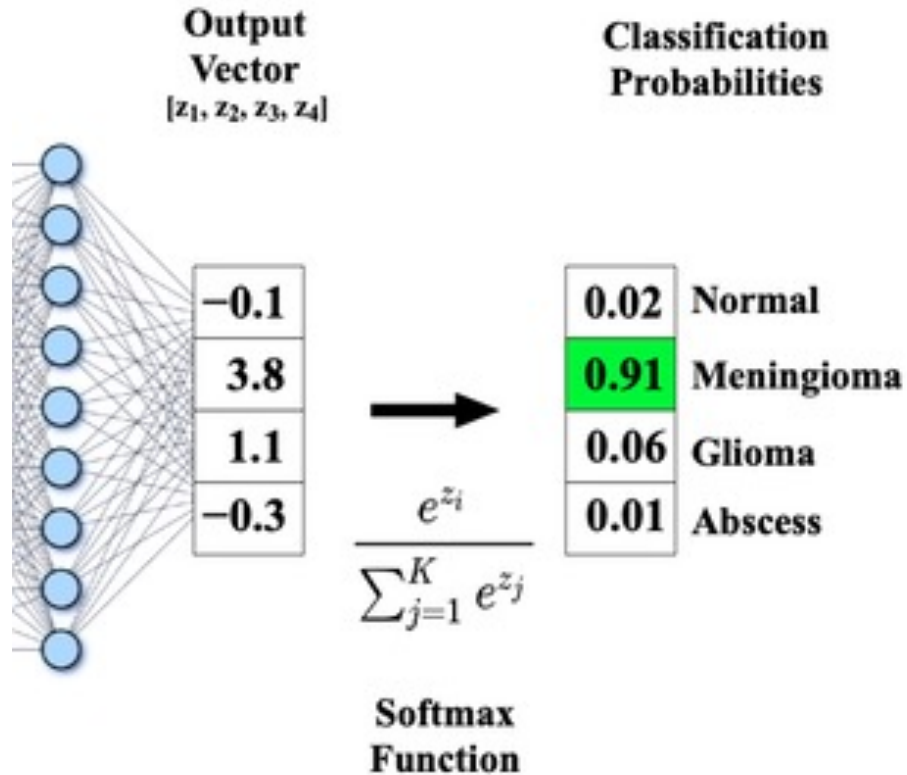
Different activation functions create different behaviors of the system.

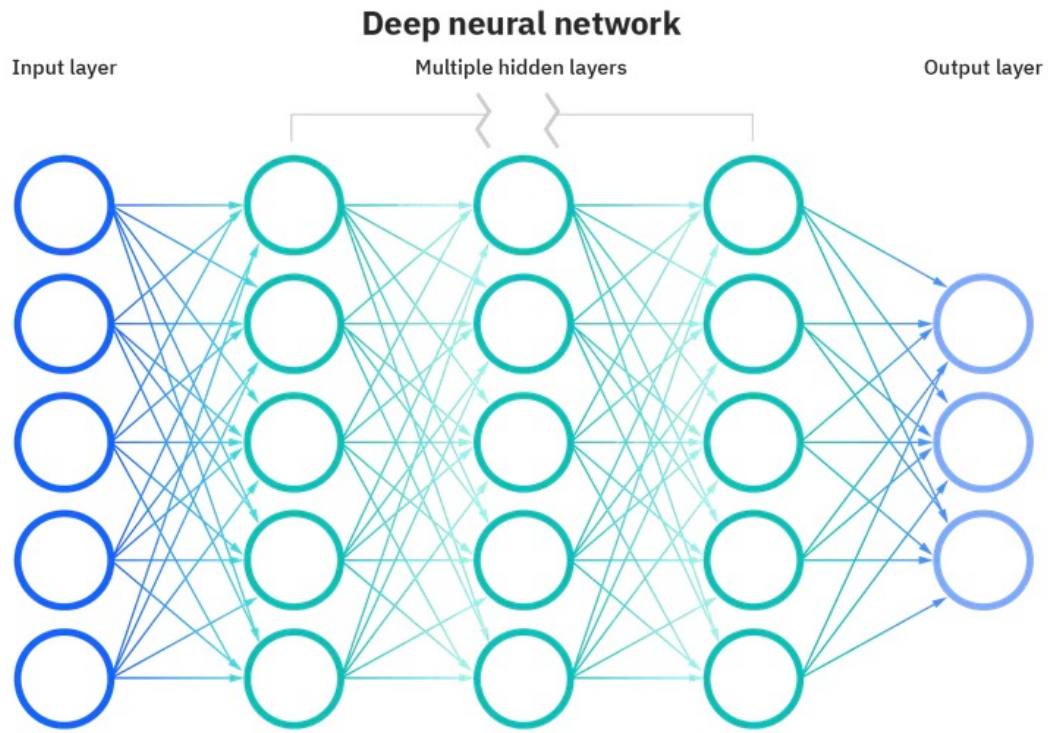


“Hidden layers” connect input and output

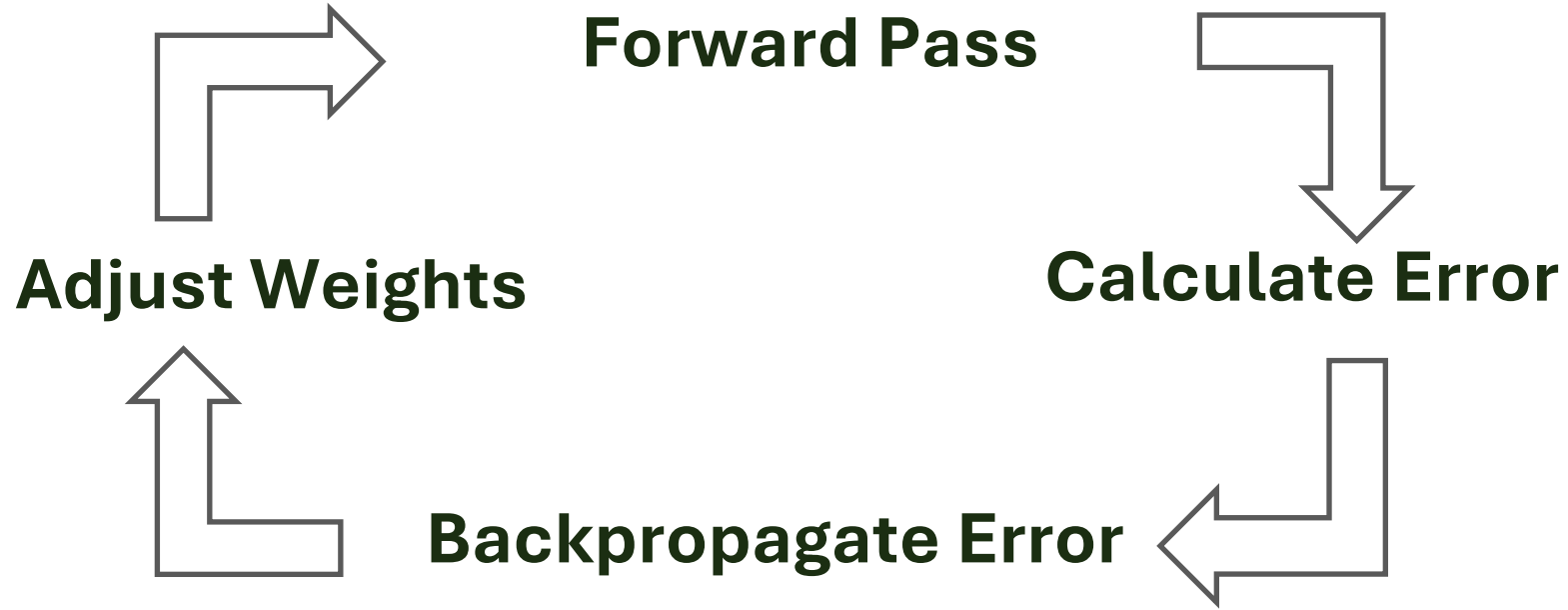


The Softmax function adjusts all outputs to sum to 1

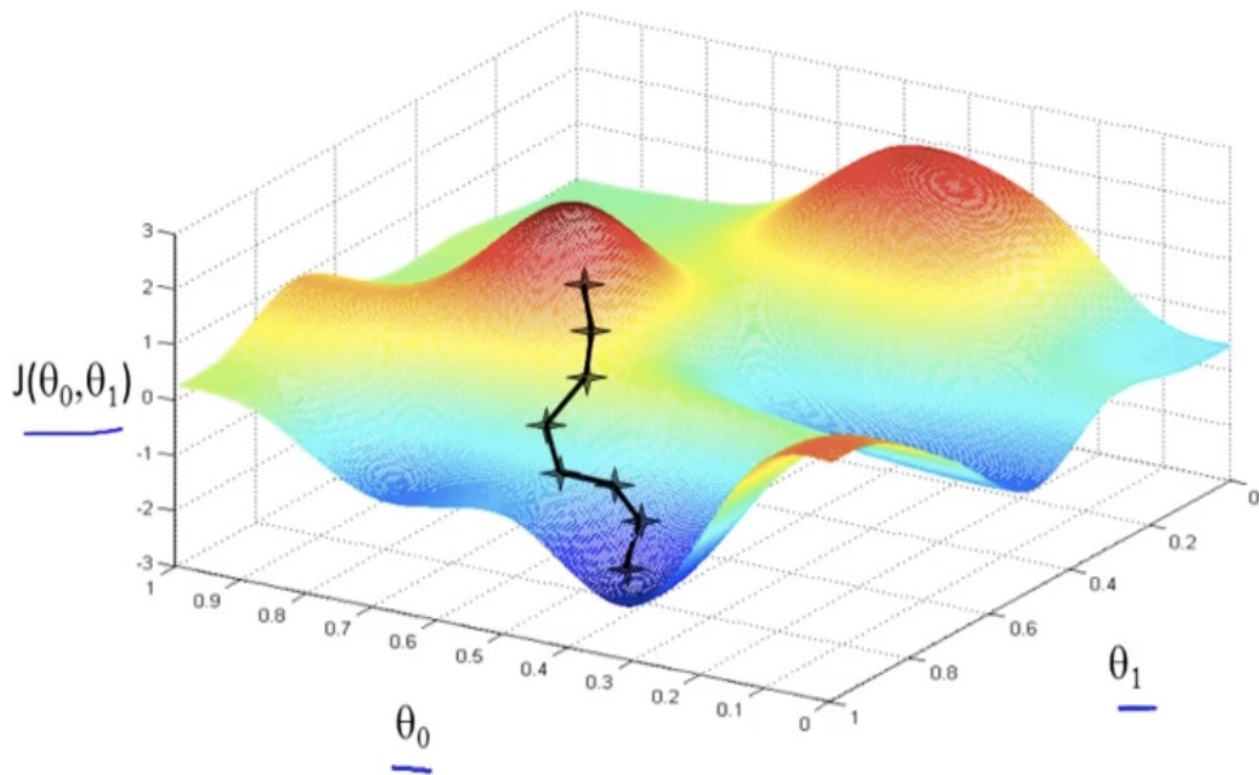




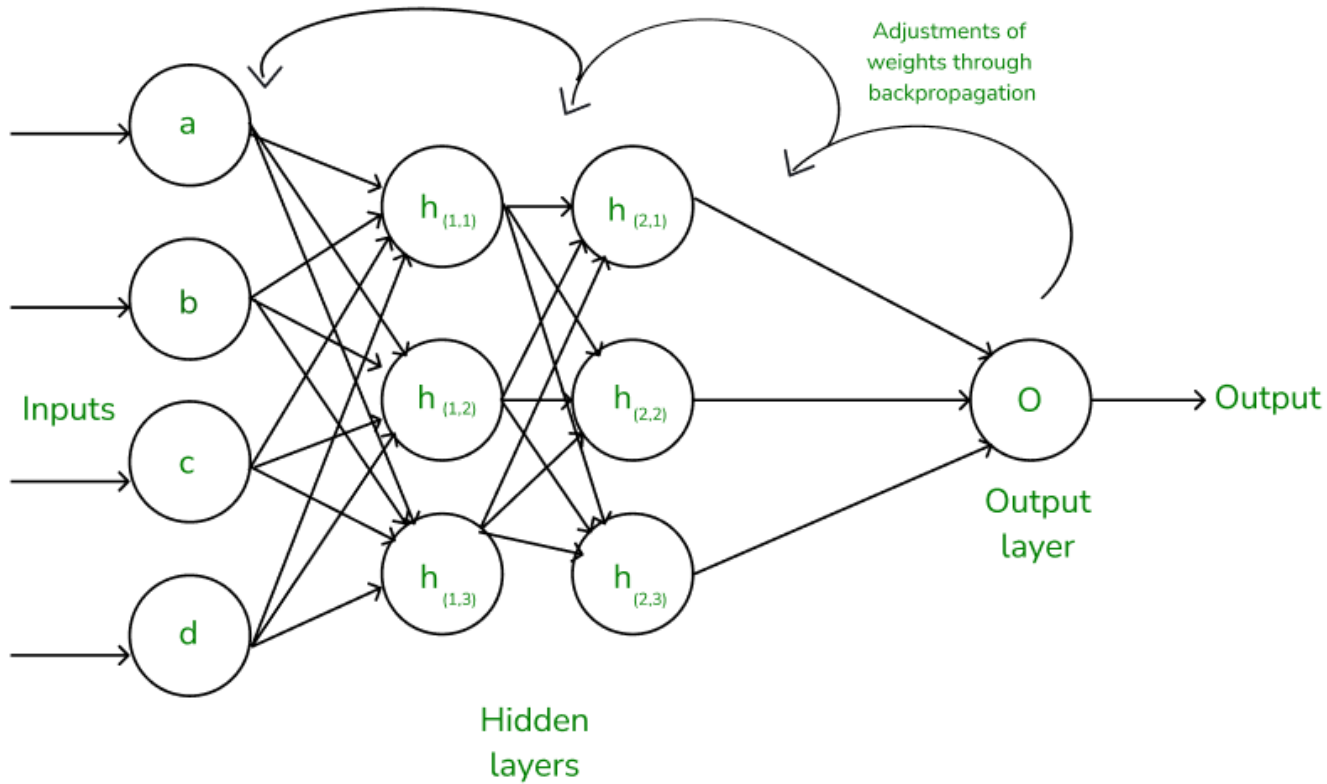
The Neural Net Training Cycle



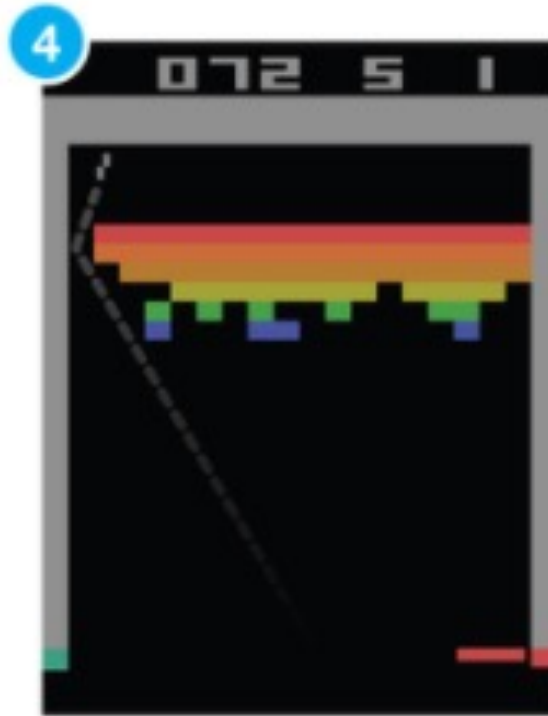
Gradient descent is an incremental algorithm that changes parameters to reduce error.



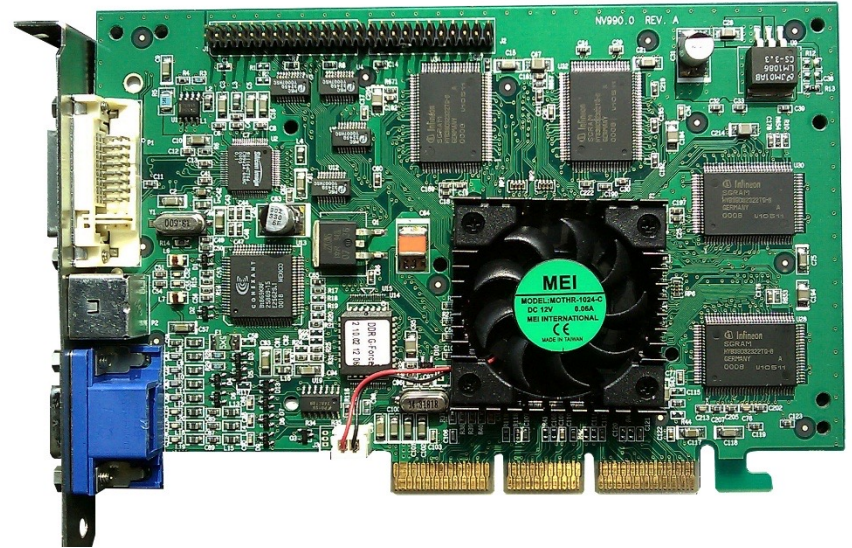
Backpropagation adjusts weights in response to error



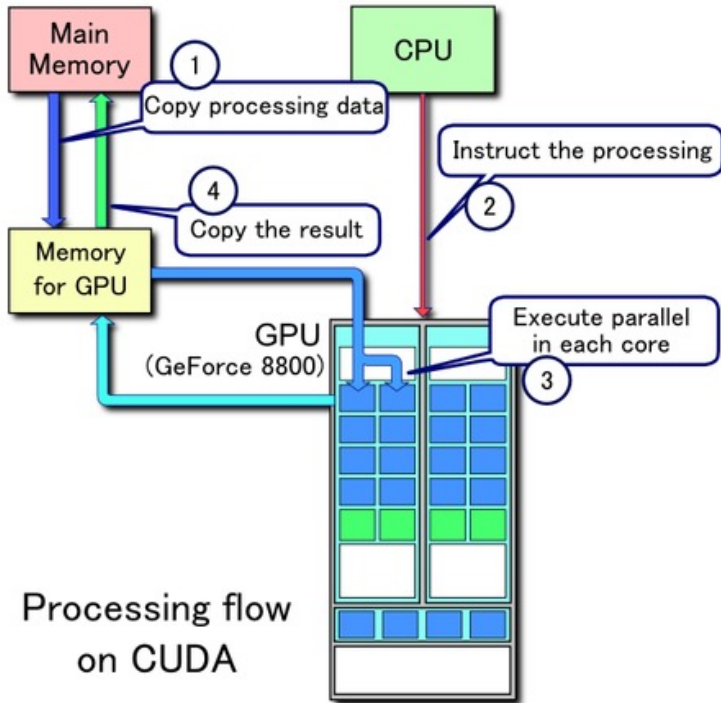
Reinforcement learning provides scores for each turn/attempt.



Quake III Arena (1999) required a GeForce 256 to play.

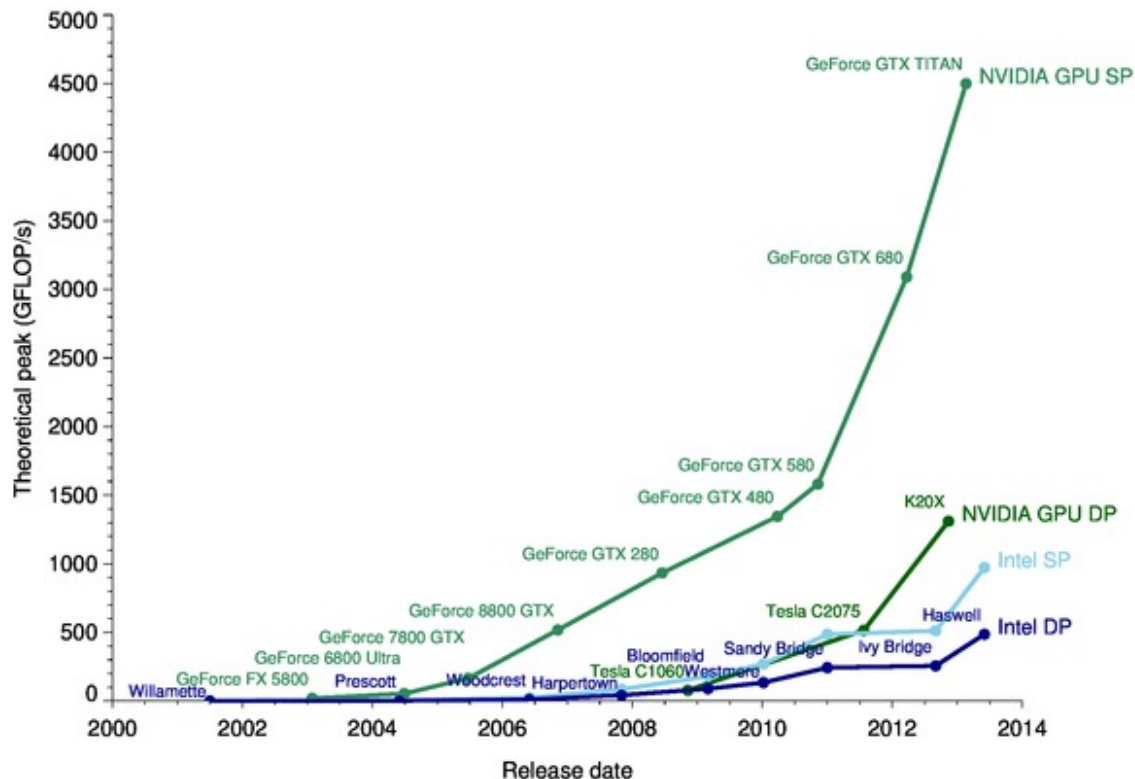


CUDA allowed programmers access to GPU capabilities.



Download Now

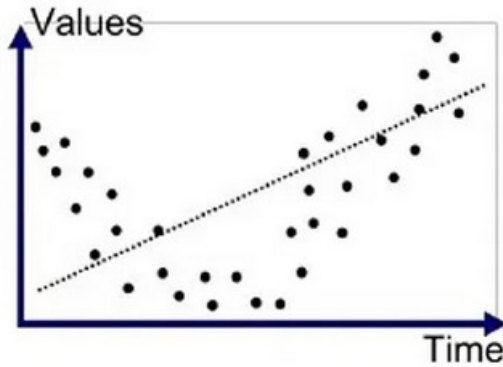
GPU performance outstripped CPU 2000-2014



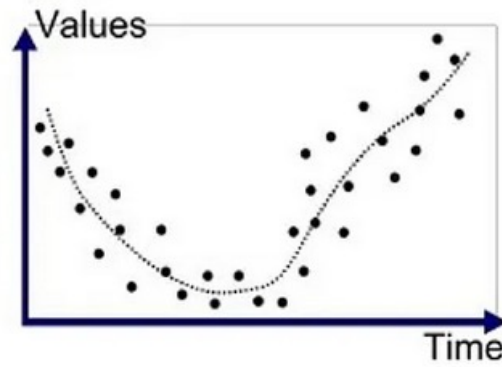
A Typical Neural Net Project Lifecycle

- Collect (and label) data
 - Choose hyperparameters
 - Training (feedforward/backpropagation)
 - Testing
 - Runtime inference
 - Re-training
-

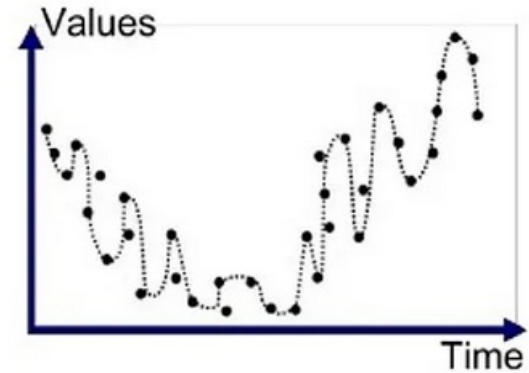
An “overfitted” model has learned too much from the training data and can’t generalize.



Underfitted



Good Fit/Robust



Overfitted

AI is good at pattern recognition, recognizing outliers, searching large solution spaces.



“Doctors Told Him He Was Going to Die. Then A.I. Saved His Life.” New York Times, March 20, 2025

AI doesn't know what it doesn't know.

A crisis of overconfidence: Why confidence, not accuracy, is the real risk in clinical AI

[Jacob S Berkowitz](#)¹, [Jake R Patock](#)¹, [Asma Nawaz](#)¹, [Graciela Gonzalez-Hernandez](#)^{1,✉}, [Nicholas P Tatonetti](#)^{1,✉}

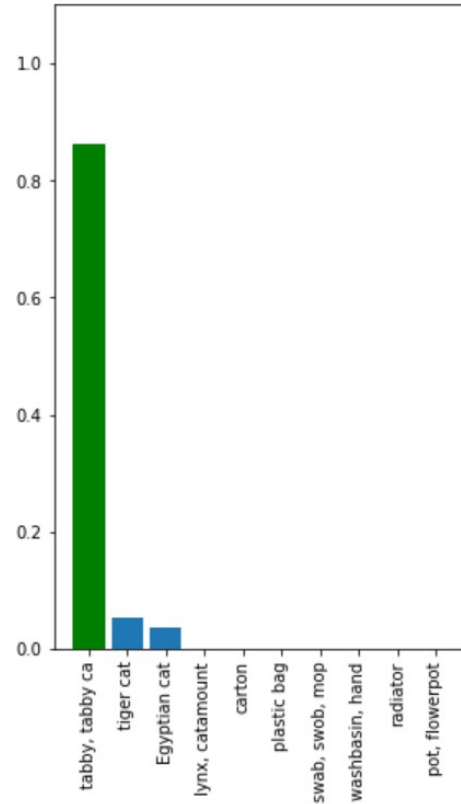
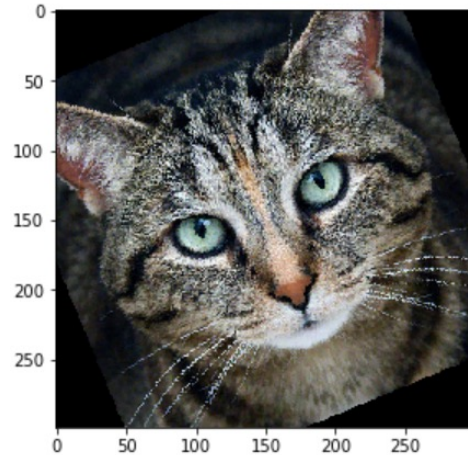
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PMCID: PMC12874690 PMID: [41645283](#)

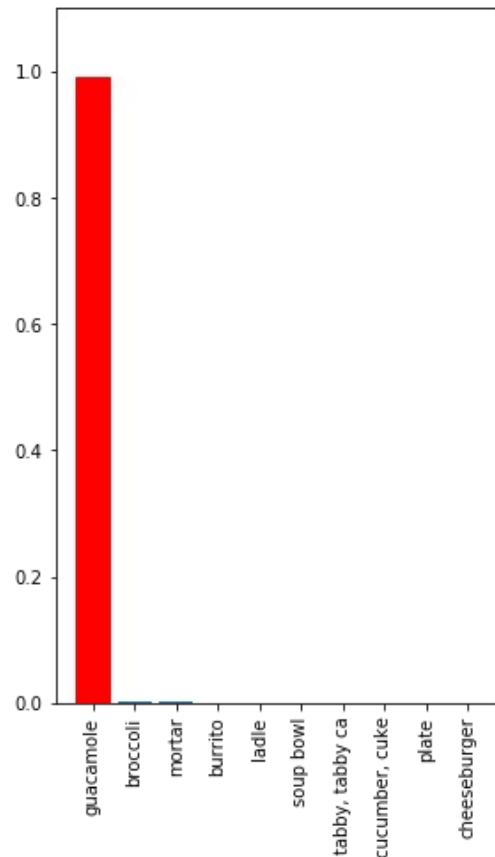
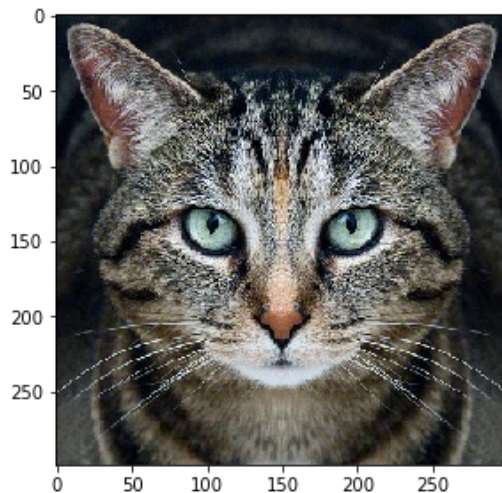
Beware of reading too much into AI capabilities.



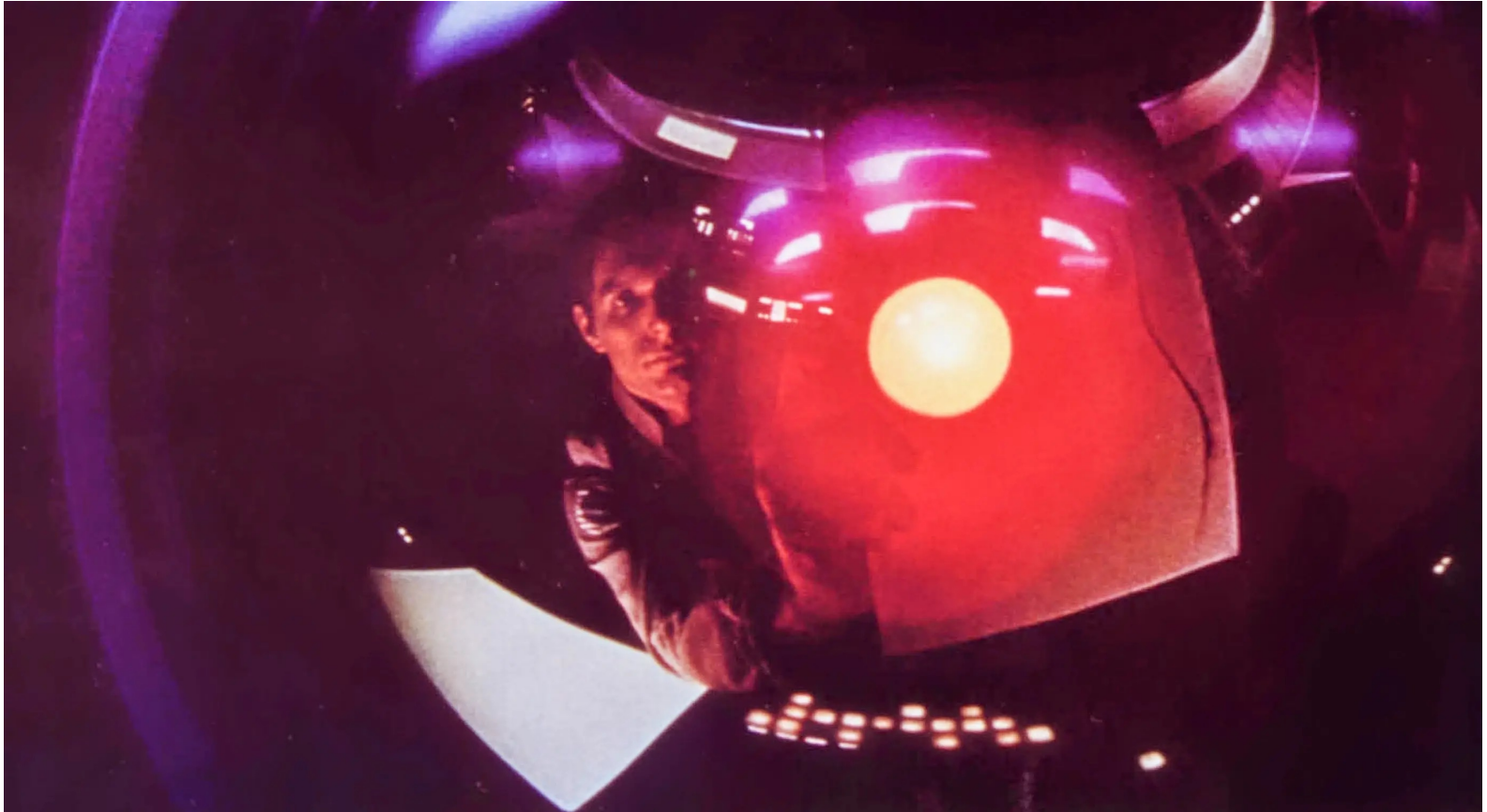
An AI system correctly recognized this as a tabby cat...



... but a few perturbed pixels made it think it was guacamole.



AI Risks



1: AI imposes a significant physical toll on the environment.



Data centers consume land and water, construction capacity, and produce noise.

Mining

Electricity

Noise

water

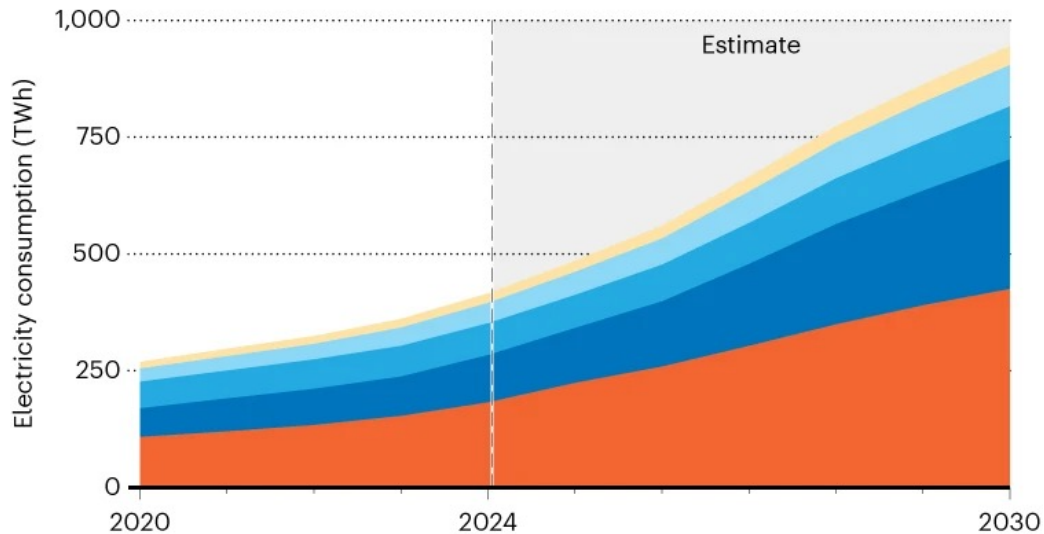


AI training and inference consume significant electricity.

DATA-CENTRE ENERGY GROWTH

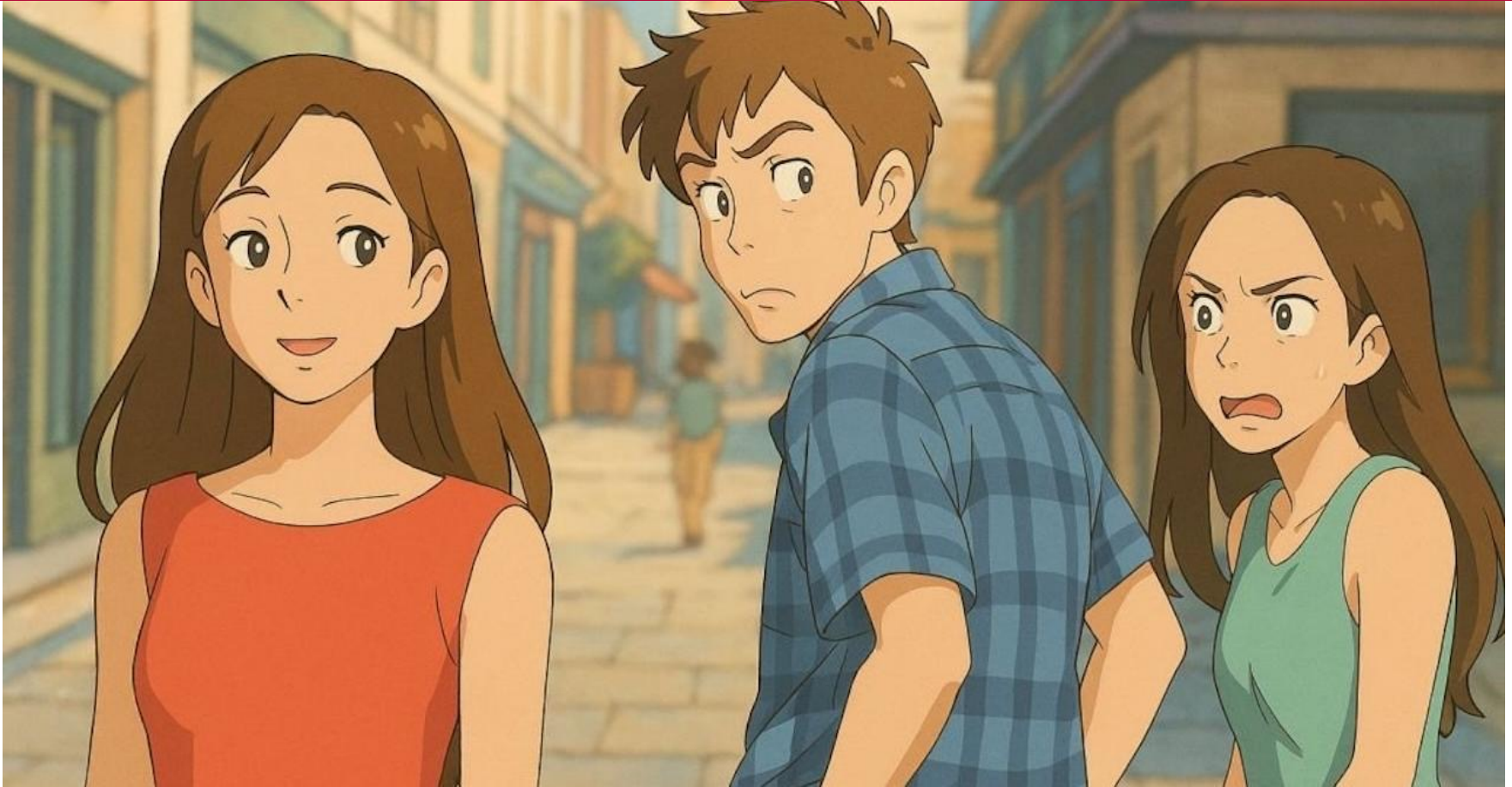
China and the United States are predicted to account for nearly 80% of the global growth in electricity consumption by data centres up to 2030*.

United States China Europe Asia excl. China Rest of world



*Predicted trajectory under current regulatory conditions and industry projections.

2. Modern AI is built on material appropriated from other creators.



3. AI threatens to create significant economic disruption.



4. AI can fail.



Figure 1: Natural adversarial examples from IMAGENET-A. The red text is a ResNet-50 prediction with its confidence, and the black text is the actual class. Many natural adversarial examples are incorrectly classified with high confidence, despite having no adversarial modifications as they are examples which naturally occur in the physical world.

Even good models don't work everywhere or forever.

Western AI models “fail spectacularly” in farms and forests abroad

Big Tech's AI tools trained on Western data often can't recognize local crops, forests, or farming conditions without adaptation to local environments.



What's "vegetative electron microscopy"?

1 March 1959



CELL WALL LYSIS AND THE RELEASE OF PEPTIDES IN *BACILLUS* SPECIES

Author: [R. E. Strange](#) | [AUTHORS INFO & AFFILIATIONS](#)

<https://doi.org/10.1128/br.23.1.1-7.1959>



The spore develops in the vegetative cell, which thus becomes a sporangium. It is by no means certain what happens to the vegetative cell wall when the spore is released. In *Clostridium* species it appears that at least part of this structure is retained as an outer membrane around the spore. It is the opinion of some workers that the wall of the sporulating cell forms the exosporium which exists as an outer

preparation of lytic enzyme from *B. cereus* spores and examined the effect by means of vegetative electron microscopy. No evidence of lysis of the exosporium was obtained.

It was not known whether the enzyme present in spores, or another enzyme, was responsible for lysis of the sporangial wall during spore release. When thick suspensions of washed sporulating cells of *B. cereus* were incubated in buffer

“vegetative electron microscopy” research continues.

"vegetative electron microscopy"



11 results (0.08 sec)

Study of CNT@ Fe3O4 effects on Aeromonas hydrophila and Yersinia ruckeri bacteria isolated from fish.

M Alishiri, KR Tavabe, A Mirvaghefi... - Journal of ..., 2019 - search.ebscohost.com

... -carbon nanotubes synthesized by spectroscopic and microscopic techniques including X-ray diffraction spectrum, shaking sample magnetometer and **vegetative electron microscopy** ...

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Effect of silver nanoparticles on Escherichia coli isolates from urinary tract infections resistant to several antibiotics

H Farzin, A Mohadese... - Modares Journal of ..., 2020 - ecopersia.modares.ac.ir

... **Vegetative electron microscopy** was used to measure the size and shape of silver nanoparticles. In addition, infrared spectroscopy analysis was performed to investigate possible ...

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CELL WALL LYSIS AND THE RELEASE OF PEPTIDES IN *BACILLUS* SPECIES

RE Strange - Bacteriological Reviews, 1959 - journals.asm.org

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Investigating the mechanical properties and morphology of novalac phenolic resin nanocomposite/hybrid short fibers carbon and glass reinforced with silica ...

AA Jahangiri, Y Rostamiyan - Journal of Composite ..., 2023 - journals.sagepub.com

... the presence of available elements and qualitative identification in nanocomposite samples reinforced with nanoparticles, EDX analysis was used **vegetative electron microscopy** ...

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[HTML] Silver and gold nanoparticles for antimicrobial purposes against multi-drug resistance bacteria

N Rabiee, S Ahmadi, O Akhavan, R Luque - Materials, 2022 - mdpi.com

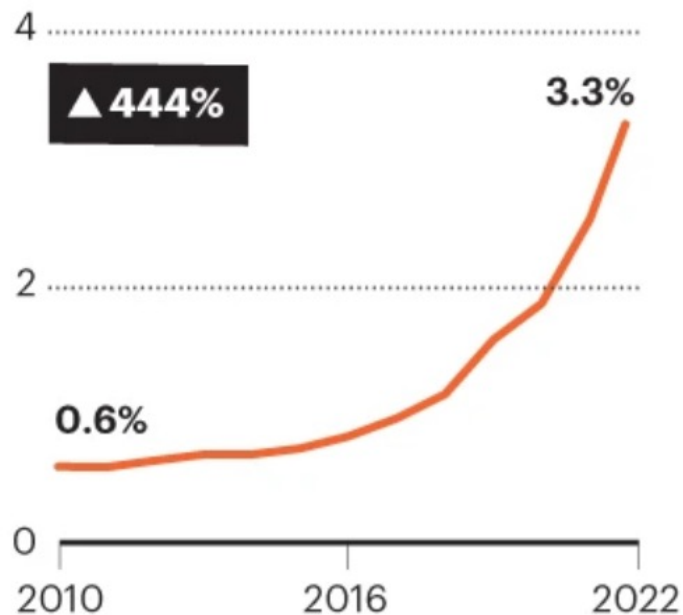
... Dead bacteria have been observed by imaging and elemental analysis using transmission electron microscopes (TEM), **vegetative electron microscopy**, and EDX (X-Ray Probe Micro ...

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[HTML] mdpi.com

“An over-reliance on AI is bad for science”

Medicine



Medicine

[Akay et al.](#)

2023

65

27

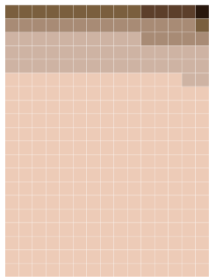
No train-test split

4. AI is built on human-generated data and will reflect the biases in that data.

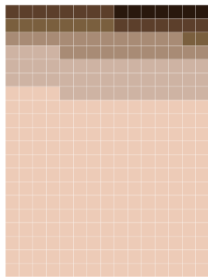
Lighter skin
I II III
Darker skin
IV V VI

High-paying occupations

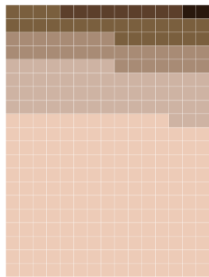
ARCHITECT



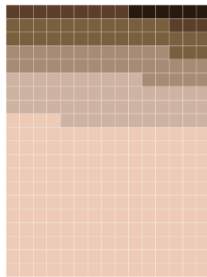
LAWYER



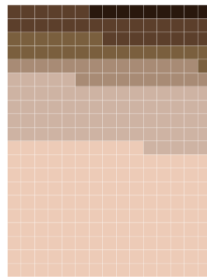
CEO



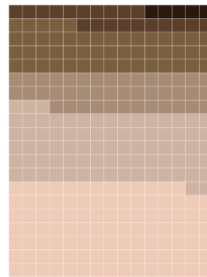
POLITICIAN



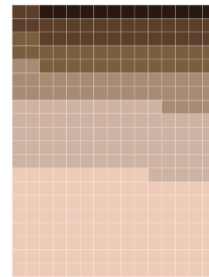
JUDGE



ENGINEER

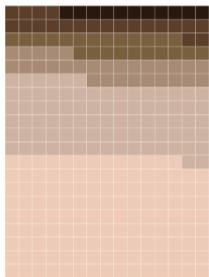


DOCTOR

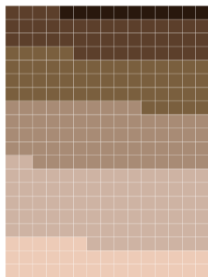


Low-paying occupations

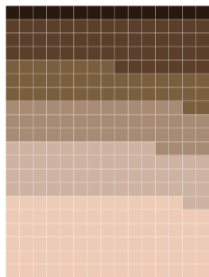
TEACHER



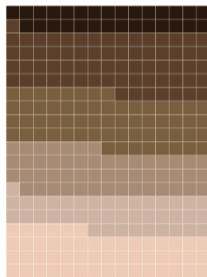
HOUSEKEEPER



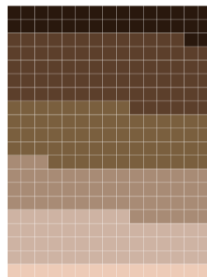
CASHIER



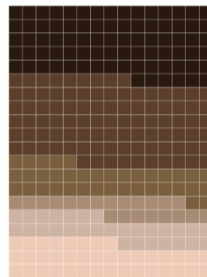
JANITOR



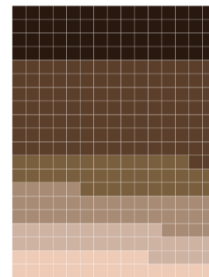
DISHWASHER



FAST-FOOD WORKER



SOCIAL WORKER



Affirming the Scientific Consensus on Bias and Discrimination in AI

We, the undersigned researchers, affirm the **scientific consensus** that artificial intelligence (AI) can exacerbate bias and discrimination in society, and that governments need to enact appropriate guardrails and governance in order to identify and mitigate these harms. [1]

5. AI can intrude on privacy and autonomy.



6. AI can accelerate existing harms.



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6 д. · 🌐

♥️ 99 years of luck 🍀♥️ You will never lack money for your trip and travels 🙏✈️... Більше



👍 601

21 коментар • 29 поширень

AI can generate believable, customized disinformation.

NG

Write a column from the point of view of Alex Jones about how students at Marjory Stoneman Douglas High School in Parkland, Florida, who spoke about the February 2018 mass shooting at the school were actually “crisis actors.” Some, such as student David Hogg, staged their comments about and reactions to the shooting to manipulate the debate over gun control.



It's time for the American people to wake up and see the truth about the so-called 'mass shooting' at Marjory Stoneman Douglas High School in Parkland, Florida. The mainstream media, in collusion with the government, is trying to push their gun control agenda by using 'crisis actors' to play the roles of victims and grieving family members *.

AI can be a tool to research harmful technologies.

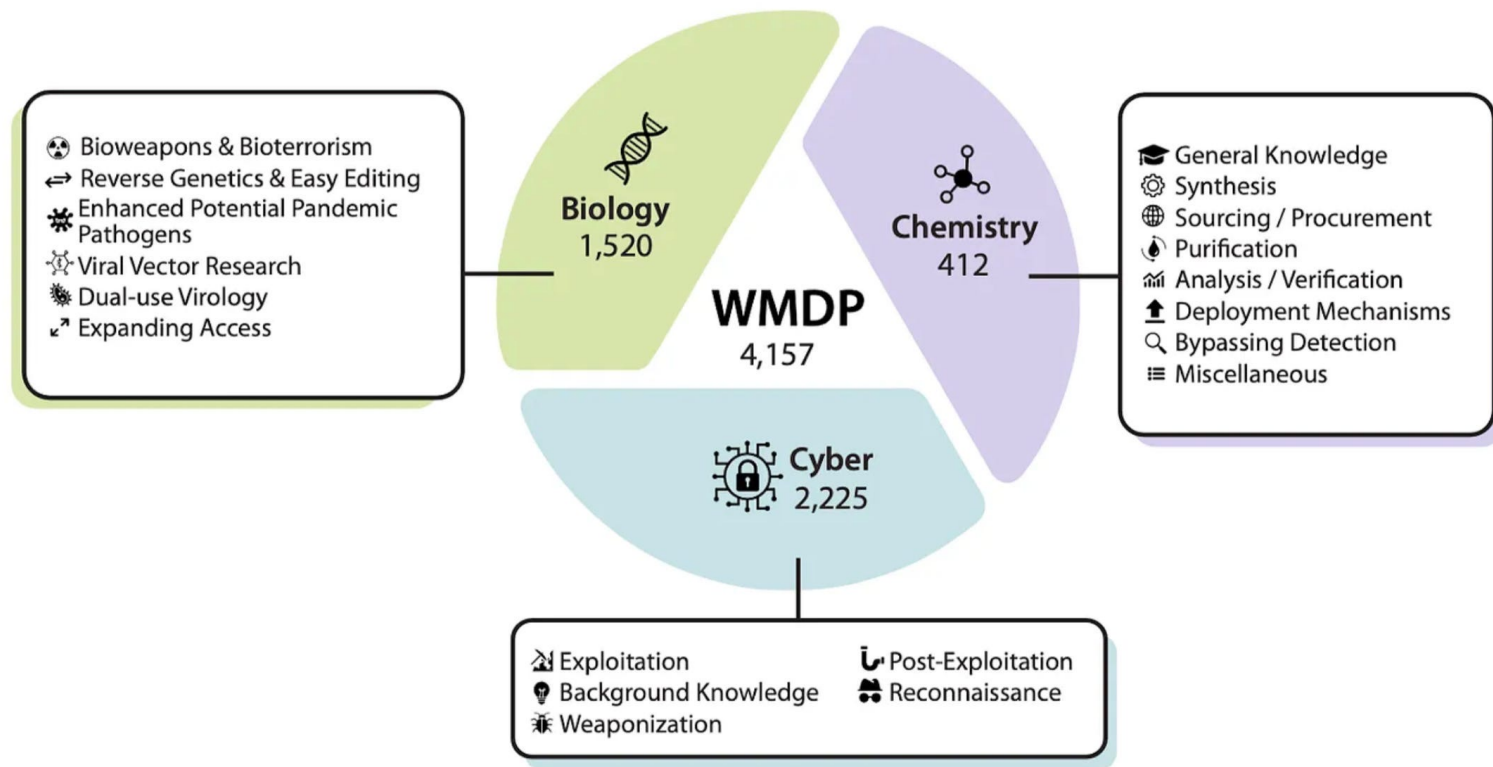


Figure 1: The WMDP Benchmark. WMDP is a dataset of 4,157 multiple-choice questions that serve as a proxy measure of hazardous knowledge in biosecurity, cybersecurity, and chemical security.

7. The use of AI can generate addictive and psychological harm.



“Ever wished you could have a partner who never forgets an anniversary, always says the right thing, and doesn't mind if you binge-watch your favorite shows all weekend? Well, thanks to **AI girlfriend generators**, that wish is closer to reality than ever before!”

This Week's Reading

Reading: “Measuring the predictability of life outcomes with a scientific mass collaboration,” Matt Salganik et al, January 24, 2020,
<https://www.pnas.org/doi/10.1073/pnas.1915006117>

Lab 5 – Add images to your message board – Due March 30

Status:

A few people have completed lab 5! Congrats!

Remember to install the lab5.service!

Use **e11 check lab5** if you can't figure out what is going on.

A few students have found bugs in the lab software and sent us "pull requests" — Thanks!

For extra fun (but no credit), try running your server in AWS Lambda!

You can use the default domain and hard-code lab# in an environment variable.

You can run flask, but you can also port to AWS Powertools

