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The future of Artificial Intelligence: Challenges, Trends and Opportunities

With the support of

1

Artificial Intelligence in the Movies

2

Artificial Intelligence in Real Life

ChatGPT Copilot Gemini Meta Claude

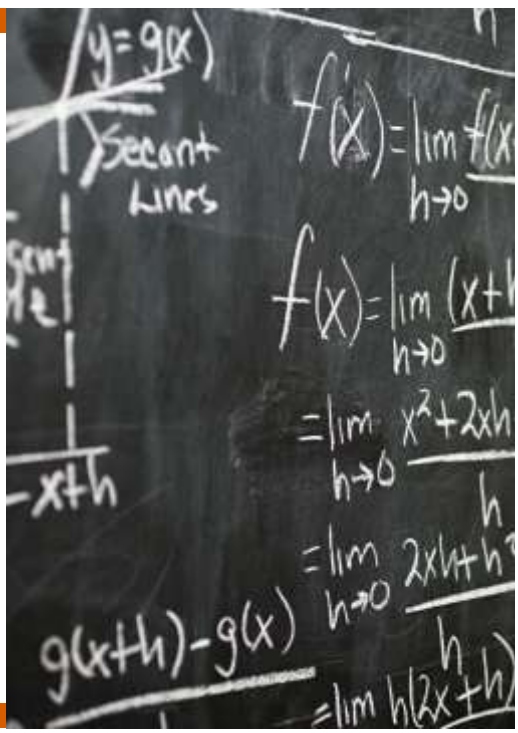
Face detection

Formal verification

3

The foundations of AI

Philosophy	Introducing the idea of the mind as a machine and its inner workings
Mathematics	computation, logic and probability
Psychology	How do humans think and act?
Computer Engineering	Provides the artefact that makes the AI application possible
Control theory and Cybernetics	How can artefacts function under their own control?
Linguistics	To understand natural languages



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Brief History and Evolution

The evolution of AI began in the 1950s with Alan Turing's work on machine intelligence. Significant milestones include the development of expert systems in the 1980s and the resurgence of deep learning in the 2010s, leading to today's advanced AI applications.

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A brief history of AI

Years 1940-1950 — 1

McCulloch & Pitts: Boolean circuit model of brain
Turing's "Computing Machinery and Intelligence"
Dartmouth (1956)

2 — **First programs**

Early AI programs, including Samuel's checkers program,
Newell & Simon's Logic Theorist, Gelernter's Geometry Engine

Years 1960-1970 — 3

Robinson's complete algorithm for logical reasoning
AI discovers computational complexity
Neural network research almost disappears

4 — **Early development of knowledge-based systems**

AI becomes an industry (1980 -)

Years 1980-2000 — 5

Neural networks return to popularity
1987-- AI becomes a science
1995-- The emergence of intelligent agents

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The Turing Test
(Can Machine think? A. M. Turing, 1950)

- Requires
  - Natural language
  - Knowledge representation
  - Automated reasoning
  - Machine learning
  - (vision, robotics) for full test

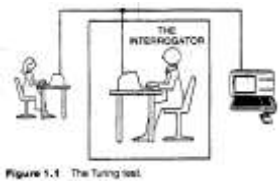

Figure 1.1 The Turing test.

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Définition of Artificial Intelligence

Artificial intelligence is the simulation of human intelligence processes by machines, especially computer systems

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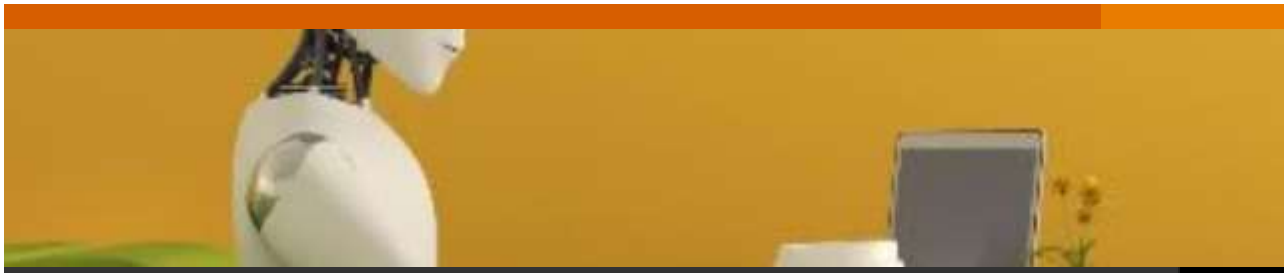

What is Artificial Intelligence ?

Making computers that think?

Automatisation Human mental activities?

The Art of creating machines that perform human functions?

To execute intelligent functions?

To Study mental faculties?

Using computational models?

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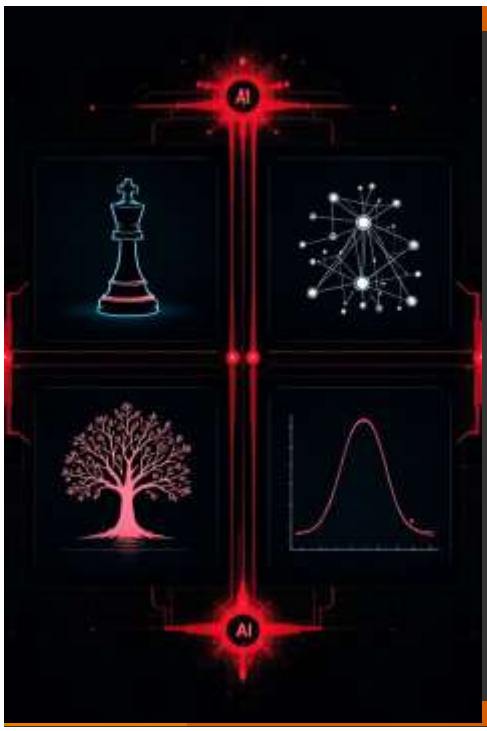

Defining Artificial Intelligence

Human

Miming human thinking or behavious

Rational

Acts optimally, based on logic.

Thinking

Focuses on cognitive processes.

Behaviour

Focuses on observable actions.

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What is Artificial Intelligence ?

Thought processes

"Make computers think... machines with minds." (Haugeland, 1985)

Intelligent behaviour

"... make computers do things at which, at the moment, people are better." (Rich, and Knight, 1991)

Understanding and creating

Understand concepts, generate new knowledge.

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Systems that act like humans

1. **Natural language processing**
   Effective communication with humans.
2. **Knowledge representation**
   Efficient storage of knowledge.
3. **Automated reasoning**
   Answer questions using stored knowledge.
4. **Automatic learning**
   Adapting to new situations.

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Systems that think like humans: Cognitive modelling

Inside view

How do humans think?

Discovery methods

Introspection and psychological experiments.

Cognitive science

Making computers think, automating human thought.

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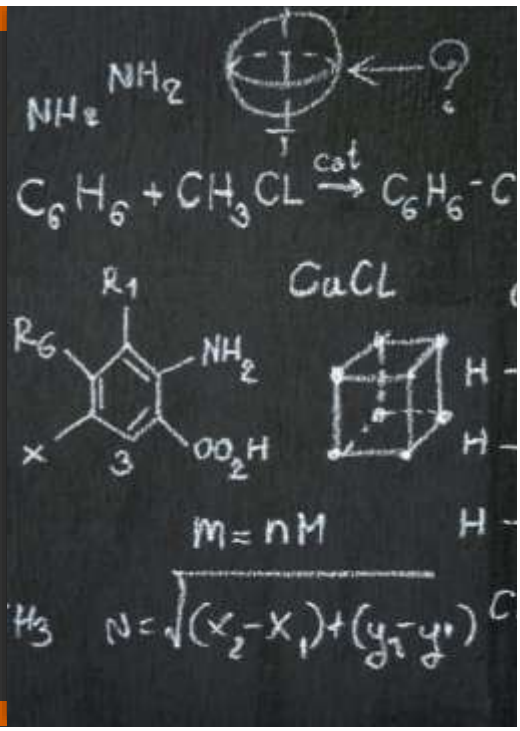
Systems that think ‘rationally’ "laws of thought"



Humans vs. Rationality

People are not always rational.

The limits of logic

Logic cannot express everything, especially uncertainty.

Computational challenges

The logical approach is often impractical in terms of computing time.

“The exciting new effort to make computers think … machines with minds in the full and literal sense” (Haugeland, 1985)

“[The automation of] activities that we associate with human thinking, activities such as decision-making, problem solving, learning …” (Bellman, 1978)

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https://www.linkedin.com/pulse/real-intelligence-platform-causal-data-engine-narrow-ai-abdoullaev/

THERE IS NO INTELLIGENCE IN ARTIFICIAL INTELLIGENCE (AI)

Today's AI
- statistical "learning" models
- mathematical algorithms

The result
- impressive at outperforming routine
- Regularized
- labor-intensive narrow tasks

Useless at taking over any **creative and non-standardized processes**.

Collaborating with humans is NOT imitative, weak and narrow artificial intelligence (Fake AI).

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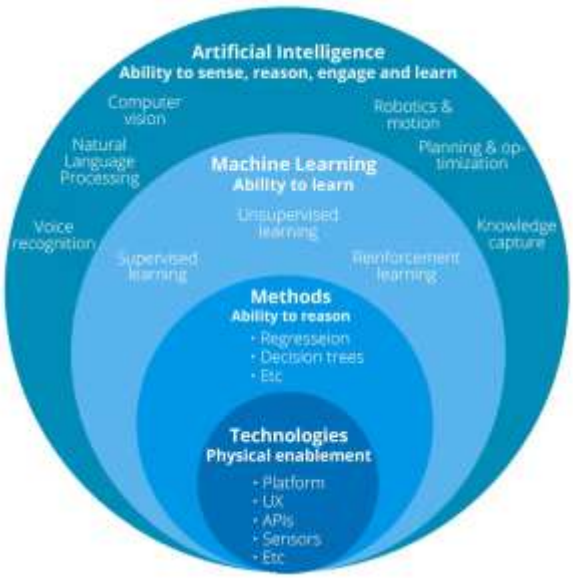
The AI family

Mainly algorithms



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So what's the buzz about Machine Learning?

17

ML is a subset of AI

- Machine learning is an application of artificial intelligence (AI) that provides systems the ability to automatically learn and improve from experience without being explicitly programmed. Machine learning **focuses on the development of computer programs that can access data and use it learn for themselves**.– ExpertSystem

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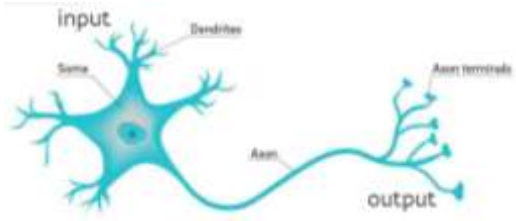
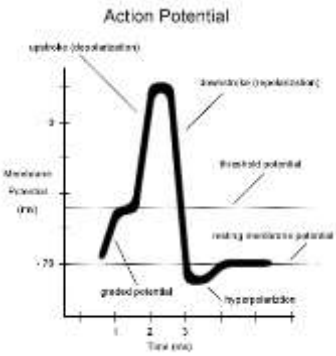
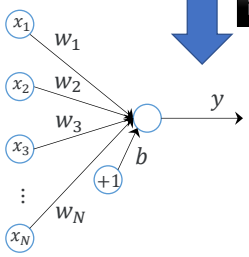
From neurons to ANNs

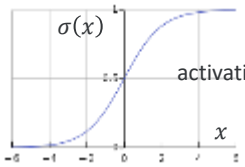




inspiration



$$y = \sigma\left(\sum_{i=1}^{N} w_i x_i + b\right)$$



activation function

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Common ML Algorithms

- Linear Regression
- Logistic Regression
- Decision Tree
- SVM
- Naive Bayes
- kNN

https://www.analyticsvidhya.com/blog/2017/09/common-machine-learning-algorithms/

- K-Means
- Random Forest
- Dimensionality Reduction Algorithms
- Gradient Boosting algorithms
  - GBM
  - XGBoost
  - LightGBM
  - CatBoost

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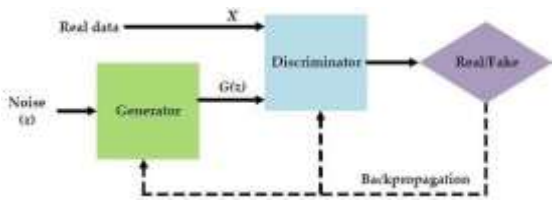
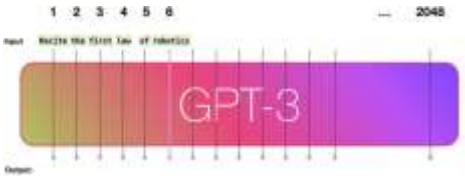
GANs, LLMs & Diffusers

Generative Adversarial Networks (2014)
The Generator creates deep fakes to train the Discriminator.



[This Person Does Not Exist]

Large language models perform sequence-to-sequence prediction and generate the next word in a sentence. (Transformer networks, since 2018)



Diffusers (since 2020) – Example from DALLE2 (Open AI, 2022)
"*Teddy bears mixing sparkling chemicals as mad scientists in a steampunk style*" – create images from text and by de-noising.

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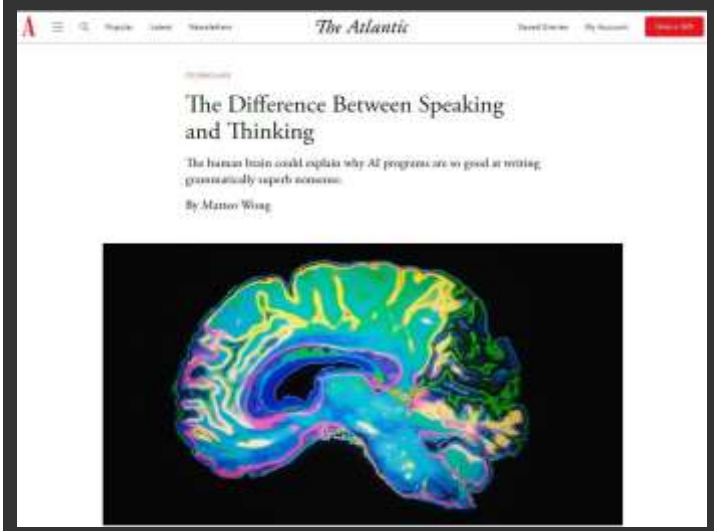
Taking Stock – LLMs today

Generative AI (Detlef Nau



https://www.theatlantic.com/technology/archive/2023/01/chatgpt-ai-language-human-computer-grammar-logic/672902/

- Capabilities in a nutshell
  - Statistical text prediction.
  - Impressive text generation capabilities.
  - Interesting applications scenarios if carefully controlled.
- Caveats in a nutshell
  - Foundation models are expensive to build and run.
  - Built from largely uncurated training data.
  - No control over output quality (hallucinations, bias).
  - Outputs must be validated.

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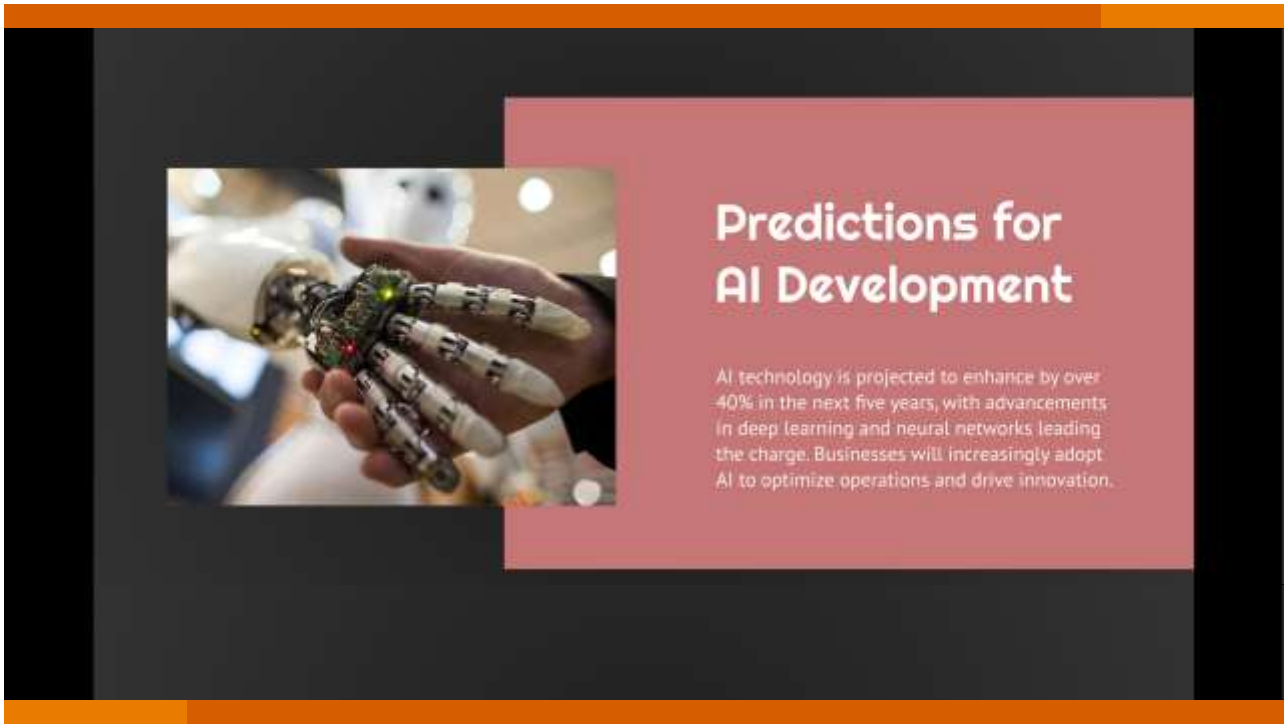
Future of AI
35
30%
20%
10%

23


Predictions for AI Development
AI technology is projected to enhance by over 40% in the next five years, with advancements in deep learning and neural networks leading the charge. Businesses will increasingly adopt AI to optimize operations and drive innovation.

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The Role of AI in Society

AI is expected to play a pivotal role in sectors like healthcare, education, and transportation, improving outcomes and efficiency. Its integration into daily life raises significant questions about ethics and social responsibility.

25

Preparing for an AI-Driven Future

Organizations must prepare for an AI-driven future by incorporating AI strategies into their business models. This includes investing in research, fostering innovation, and developing robust data infrastructures.

26

Skills Needed for Future Workforce

The future workforce will require skills in data literacy, programming, and critical thinking. Continuous learning and adaptability will be essential as AI technology evolves rapidly.

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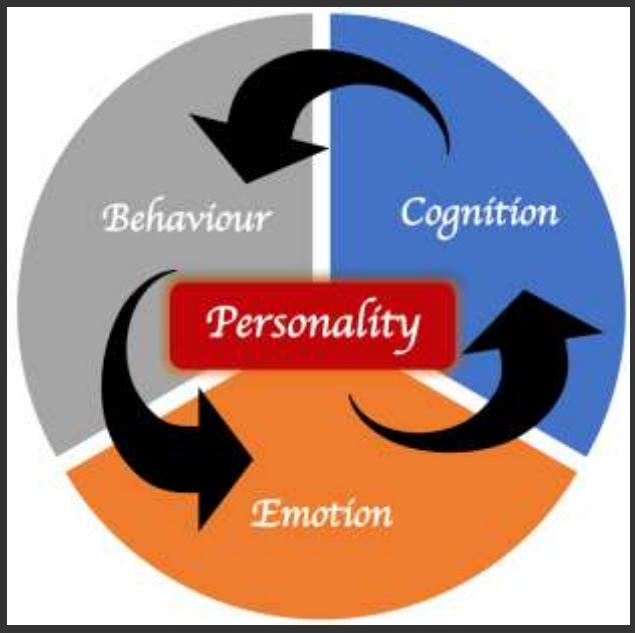
Towards cognitive systems



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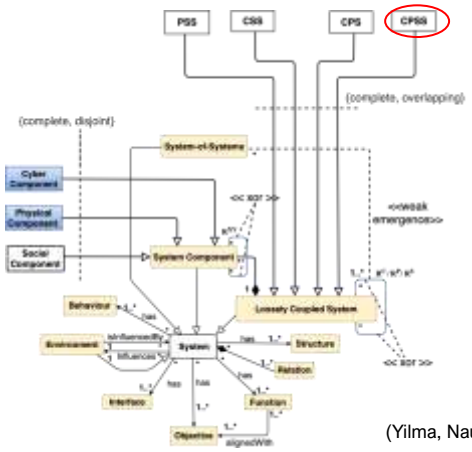
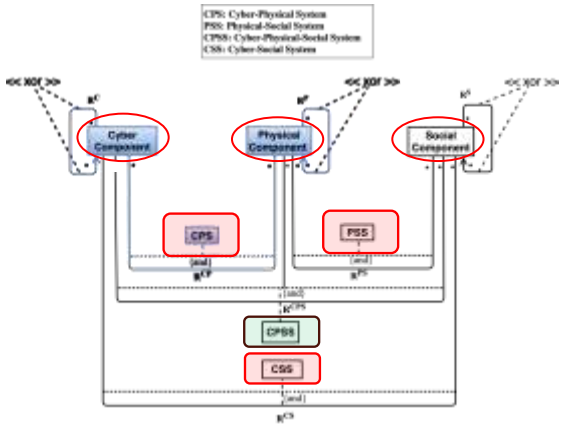
Towards a « social » interaction with humans

- Concept of Cyber-Physical-Social Systems





(Yilma, Naudet, Panetto, 2021)

Bereket Abera Yilma, Hervé Panetto, Yannick Naudet (2021).
Systemic formalisation of Cyber-Physical-Social System (CPSS): A systematic literature review
Computers in Industry, 2021, 129:103458, (10.1016/j.compind.2021.103458)

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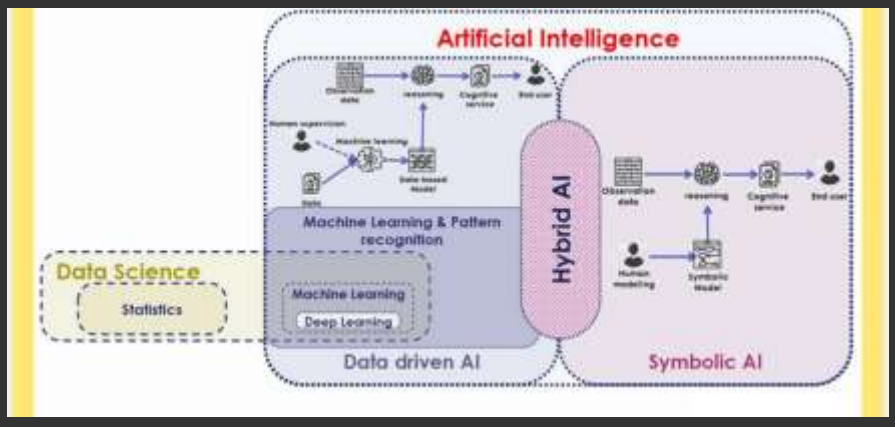

Hybrid AI

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Challenges facing AI

Image created by Microsoft Copilot

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Regulation and Compliance

Governments and organizations are grappling with how to regulate AI technologies effectively. Establishing comprehensive regulatory frameworks is crucial to ensure ethical development, address societal concerns, and promote innovation while safeguarding public interests.

32

Ethical Concerns

The deployment of AI raises ethical dilemmas such as accountability for AI decisions, transparency in algorithms, and the moral implications of autonomous systems. These concerns demand rigorous ethical standards and guidelines for development and implementation.

33

EU Artificial Intelligence Act

EU AI ACT

https://digital-strategy.ec.europa.eu/en/policies/regulatory-framework-ai

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Data Privacy Issues

AI systems often require vast amounts of data, raising significant privacy concerns about data collection, storage, and potential misuse. Ensuring compliance with privacy regulations is vital to safeguarding individuals' rights and maintaining public trust.

35

Algorithmic Bias

Bias in AI algorithms can perpetuate existing prejudices, leading to unfair outcomes in areas such as hiring, policing, and lending. Addressing this issue requires diverse datasets and continuous monitoring to ensure fairness and equity in AI applications.

36

Job Displacement Effects

AI implementation can lead to job displacement across various sectors, particularly in routine and manual jobs. Preparing the workforce for this transition through reskilling and upskilling initiatives is essential to mitigate the adverse impacts.

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Winter is coming...

Matthew S. Smith,
The hidden scale behind every AI answer,
IEEE Spectrum, October 2025

Consumption	CO_2e (lbs)
Air travel, 1 passenger, NY↔SF	1984
Human life, avg, 1 year	11,023
American life, avg, 1 year	36,156
Car, avg incl. fuel, 1 lifetime	126,000
Training one model (GPU)	
NLP pipeline (parsing, SRL)	39
w/ tuning & experimentation	78,468
Transformer (big)	192
w/ neural architecture search	626,155

Table 1: Estimated CO_2 emissions from training common NLP models, compared to familiar consumption.[1]

Strubell, E., Ganesh, A., & McCallum, A. (2019, July). ***Energy and Policy Considerations for Deep Learning in NLP.*** *In Proceedings of the 57th Annual Meeting of the Association for Computational Linguistics (pp. 3645-3650).*

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Environmental Concerns Linked to AI

Environmental degradation due to the energy consumption of data centers

- focus on minimizing the ecological footprint
- technology that supports environmental goals.

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Current Trends in AI

Image created by Microsoft Copilot

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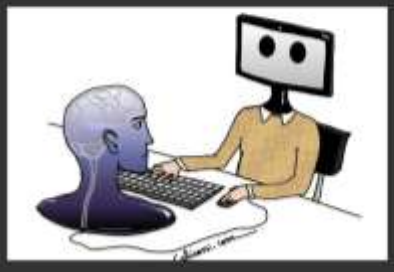
Machine Learning Advances

Recent advancements in machine learning, such as deep learning and reinforcement learning, have enhanced the ability of AI systems to learn from data. These techniques allow AI to perform complex tasks like image and speech recognition with high accuracy, shaping industries such as autonomous vehicles and virtual assistants.



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Natural Language Processing

Natural Language Processing (NLP) continues to evolve, enabling machines to understand and generate human language. Tools like chatbots and virtual assistants are being enhanced with NLP, allowing for more natural and context-aware interactions with users.

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AI in Robotics

AI is transforming robotics by enabling machines to process data and make real-time decisions. Applications range from robotic arms in manufacturing to autonomous drones, allowing for safer and more efficient operations across various fields, including logistics and agriculture.

43

AI in Healthcare

AI technologies are increasingly applied in healthcare, enhancing diagnostics and patient care. Machine learning algorithms can analyze medical images and predict disease outcomes, streamlining treatment plans and improving patient outcomes in various medical fields.

44

AI in Finance

The finance sector is leveraging AI for fraud detection, risk assessment, and algorithmic trading. AI systems can analyze vast amounts of financial data at unprecedented speeds, enabling timely decision-making and improved operational efficiencies for financial institutions.

45

AI in Industry

The industry sector is leveraging AI for enhancing Human-AI collaboration where AI systems learn from humans and help in difficult tasks

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Opportunities created by AI

Image created by Microsoft Copilot

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Enhanced Decision Making

AI algorithms improve decision-making processes by analyzing vast datasets to uncover insights and trends. This capability not only increases efficiency but also reduces human error, leading to more informed and strategic choices.

48

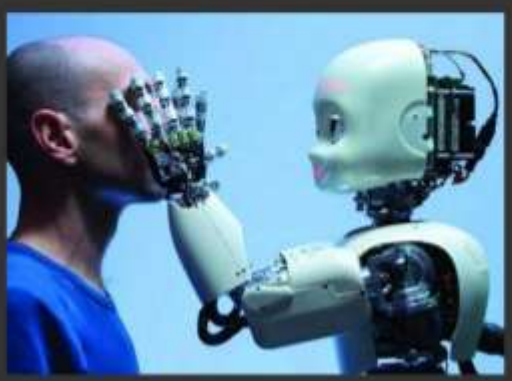
Innovation in Industries

AI drives innovation by automating processes and fostering new product development. Industries such as healthcare and automotive are leveraging AI to create cutting-edge solutions, enhancing their competitive edge.

49

Improved Customer Experiences

AI enhances customer experiences through personalized recommendations and streamlined interactions. By analyzing user behavior, businesses can tailor services, boosting satisfaction and loyalty.



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New Markets and Business Models

AI enables the emergence of new markets by creating entirely new business models, such as subscription-based services and on-demand delivery platforms, fostering economic growth and diversification.

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Collaboration between Humans and AI

The integration of AI into the workforce emphasizes collaboration, where machines augment human capabilities. This partnership can increase productivity and foster a more creative work environment, combining strengths.

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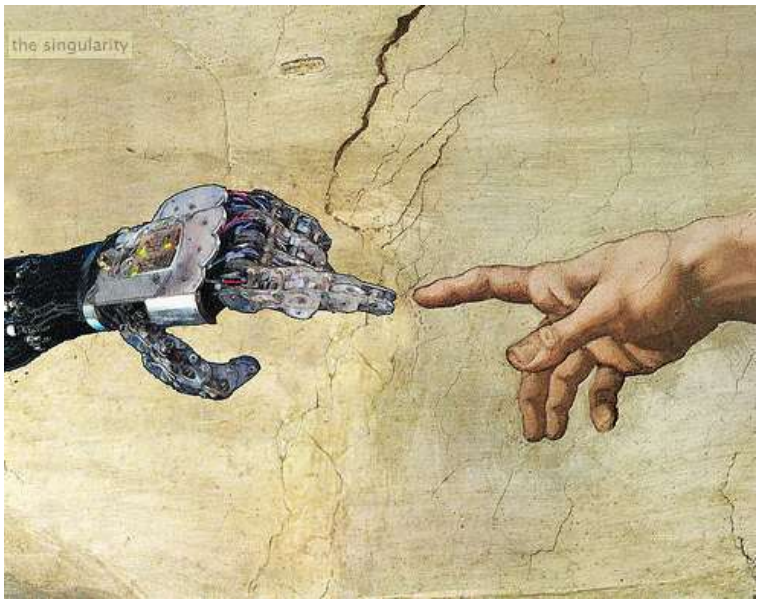
AI MEETS HUMANITY?

The Singularity



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The future of Artificial Intelligence: Challenges, Trends and Opportunities

https://u2l.fr/future-ai

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