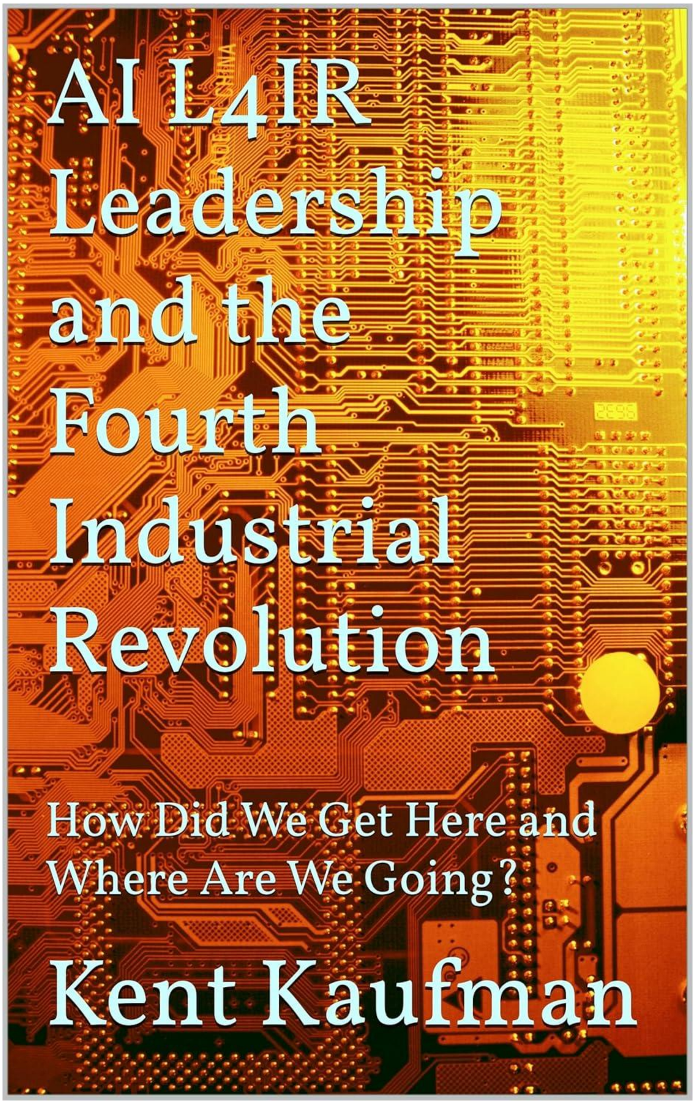

PDF ABSTRACT

The book's purpose is to illuminate AI's multifaceted impact, spotlighting the visionary leaders who are steering this revolution and the ethical considerations that must guide its trajectory. This PDF contains the figures and tables that will help illustrate points throughout the audiobook as you listen to it.

Kent Kaufman
Author

AI L4IR: Leadership and the Fourth Industrial Revolution

How Did We Get Here and Where Are We Going?

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ISBN: 979-8-218-72147-3

DEDICATION

To my mom and dad, who were children of the Great Depression and did not live to see the great changes we are about to experience with the 4th Industrial Revolution, but who did witness the massive changes of the 2nd and 3rd Industrial Revolutions. Remembering my dad, who fought for freedom as a rifleman in the U.S. Army during World War II in Europe and somehow made it home alive, and my mom, who raised my sister and me to study hard and be good. And, to my sons and stepdaughters who will live in this future state of the 4th Industrial Revolution and will have to navigate their age's twists and turns.

CONTENTS

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ACKNOWLEDGMENTS

Thanks to my son Kaden Kaufman, who helped edit and work on this book over his summer break from engineering school. Additionally, I would like to extend my gratitude to all the leaders I have worked with and for, as well as to all my close colleagues over the years who have supported me in my career and on my lifelong learning journey.

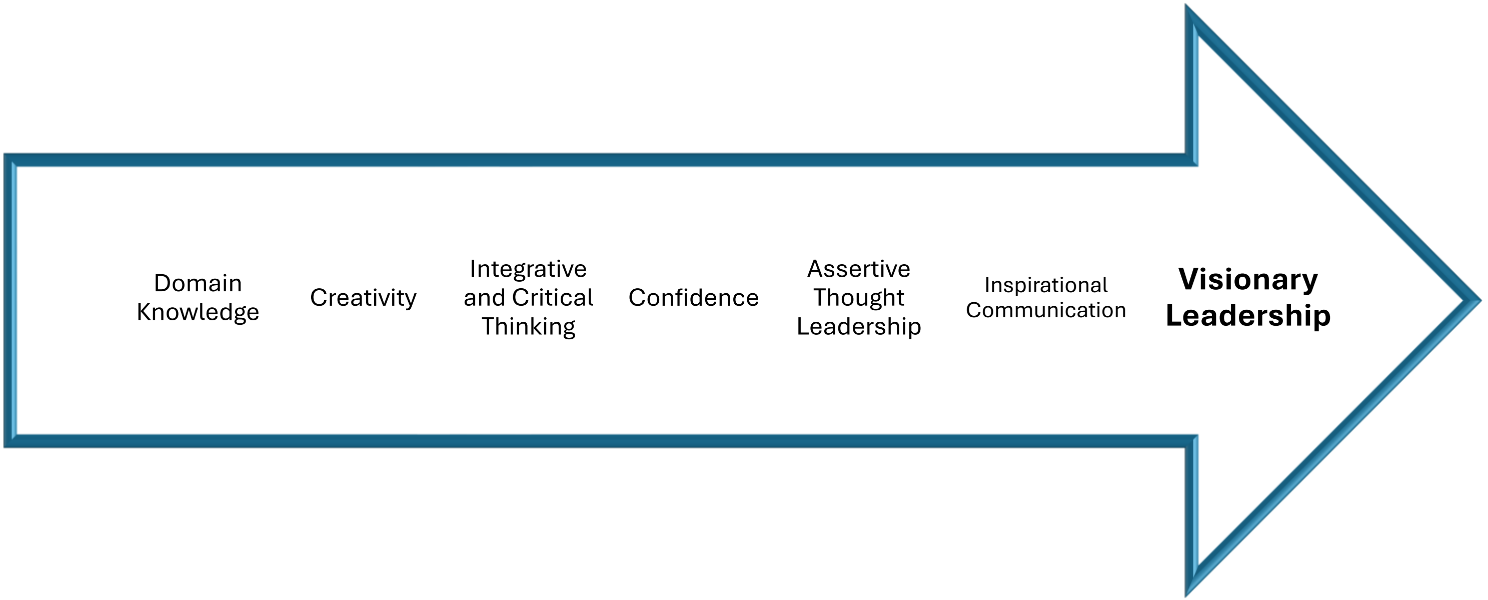

Figure 1: Visionary Leader Concept Model

Key elements of visionary leadership include deep domain knowledge, creativity, integrative and critical thinking, confidence, assertive thought leadership, and inspirational communication (Figure 1).

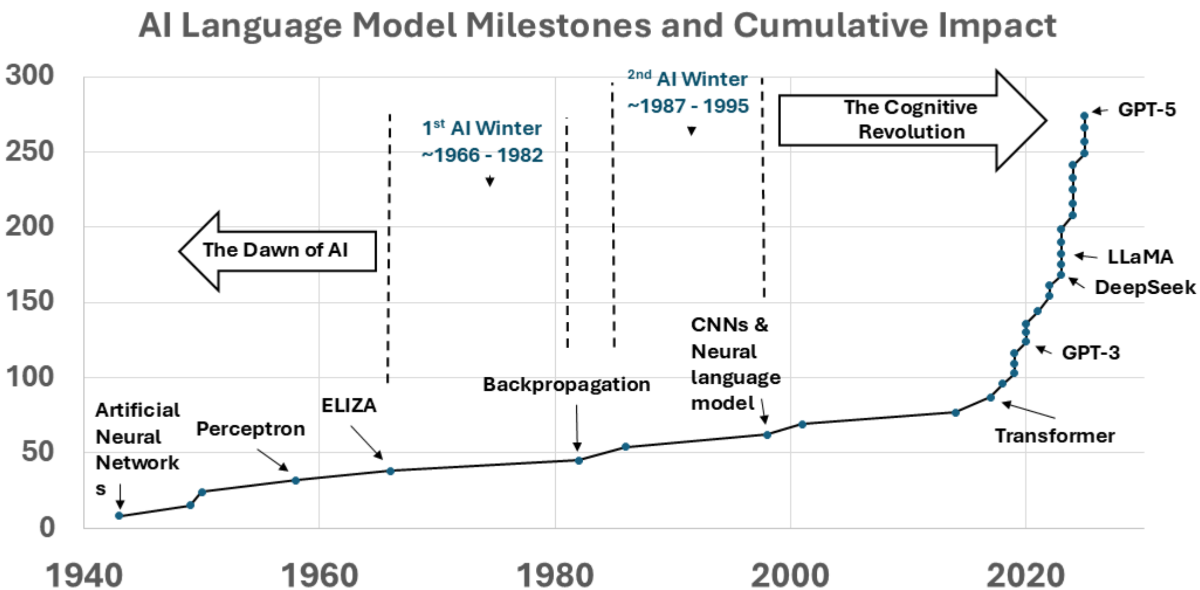

Figure 2: LLM and AI Progression see table in Appendix I

9.11 To summarize the AI use cases across multiple industries, the following table highlights key implementations by leading Fortune 500 companies and their respective cloud platforms:

Company	**AI Use Case**	**Cloud Platform**
Amazon	Biometric payments, review summarization, Rufus, Amazon Lens	AWS
Pfizer	Drug discovery, Scientific Data Cloud, VOX, predictive maintenance	AWS
JPMorgan Chase	LLM Suite, OMNI AI, fraud detection, contract analysis	AWS
Coca-Cola	Customer preference understanding (Freestyle), OCR for loyalty program, generative AI, Copilot	AWS, Azure
Genentech	Generative AI for drug discovery and biomarker validation	AWS
Toyota Motor North America	Unified lakehouses, generative BI, AI/ML for data-driven insights	AWS
Ford Motor	Machine learning, analytics, IoT, computing services	AWS
Walt Disney	Machine learning for Disney+ expansion	AWS
Capital One Financial	Machine-learning innovation using Amazon S3	AWS
Walmart	Generative AI-powered search, personalized shopping, "My Assistant" app	Microsoft Azure

Company	**AI Use Case**	**Cloud Platform**
General Motors	OnStar Interactive Virtual Assistant, chatbots, generative AI exploration	Google Cloud
Various Fortune 500	Potential AI applications (e.g., customer service, analytics)	IBM Cloud
Various Fortune 500	Potential AI applications (e.g., generative AI, machine learning)	Oracle Cloud

You can take the **survey**, which is analyzed in Chapter 8 of this book, as I will be doing a longitudinal study using the longer-term trend data the next edition. It's designed to be relatively painless (~5–10 minutes), and some people have reported that it was even thought-provoking; for the adventurous, the URL can be found in the PDF Attachment:

https://forms.gle/4cLxz31Yf5wEqQFP6

Moving on to actual work, the survey inquires about the extent to which AI is utilized in people's everyday tasks. The distribution is more uniform and skewed toward the low end, with approximately 39% experiencing little impact, 30% experiencing medium impact, and 30% experiencing significant impact. Survey respondents described AI's impact on daily work as ranging from indispensable to irrelevant, reflecting diverse adoption levels and experiences (Figure 3). Many utilize AI daily for tasks like writing, coding, and data analysis, with one stating, "I use it for virtually every work task," while others find it ideal for "busy work" or language tasks like "edit emails, reports, translations." However, some noted limitations, saying AI helps with "small portions" but "the majority still needs to be done by yourself," and others use it sparingly or not at all, citing irrelevance ("not helpful for my role") or a preference to "keep exercising my brain." While some see AI as falling short ("it is not at the level that I want it to be"), others plan to expand its use, such as exploring voice cloning, indicating optimism about its evolving role in work. Overall, AI is a powerful but unevenly adopted tool, excelling in specific tasks but not yet fully transformative for all roles.

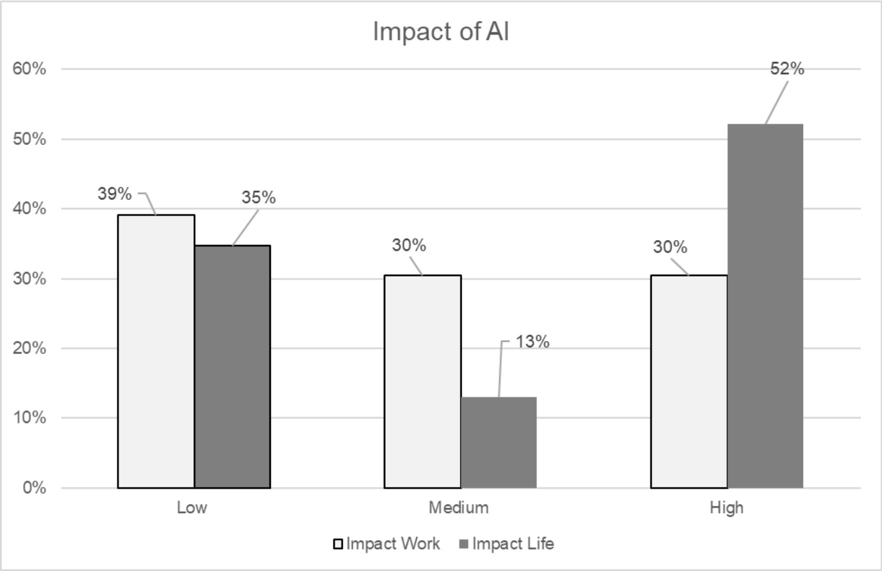

Figure 3: Impact of AI on Respondents

When it comes to AI that may impact a large population in the future, such as autonomous vehicles (AVs), the respondents were generally AI-friendly, at about 60%; see the figure 4 below. Respondents expressed a mix of excitement, cautious optimism, and limited exposure to autonomous vehicles, praising their convenience and potential while noting areas for improvement. Enthusiastic users called Tesla FSD "amazing" and preferred Waymo over Uber, citing safety and smoothness, as in "Felt pretty safe and don't have to deal with quirky drivers." Many saw transformative potential, stating, "It will change the future of driving forever." Still, some felt mixed emotions, with "excitement, curiosity, but also a bit of fear," and noted imperfections, like Tesla FSD being "like a kid learning how to drive." While some found the technology "very convenient," others had no experience, saying, "Have not yet ridden in one," reflecting autonomous vehicles' promise as a revolutionary yet still-evolving technology with uneven adoption.

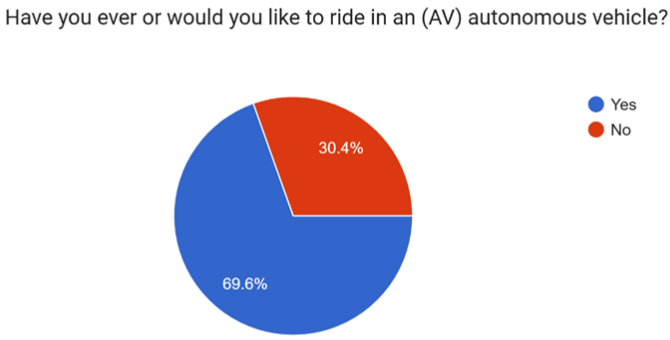

Figure 4: Autonomous Vehicle Openness

The respondents picked their top leaders in AI as the following: Sam Altman, who led ChatGPT development and transformed AI accessibility at OpenAI; Jensen Huang, cofounder of NVIDIA AI Hardware and Software, who called the ChatGPT "iPhone moment"; Andrew Ng, who democratized AI education, co-founded Google Brain and Coursera; and Dario Amodei, who co-founded Anthropic, focusing on safe, interpretable AI. These leaders, as well as a host of others mentioned throughout this book, will be called upon by all of us to lead in a responsible and ethical way to help

these questions, advocating for AI systems that prioritize truth over manipulation and pushing for transparency in communication. This freedom stands in contrast to Orwell's *1984*, where Big Brother uses doublespeak to obscure reality, as seen in the Party's slogan "War is Peace, Freedom is Slavery, Ignorance is Strength," which manipulates citizens into accepting contradictions, eliminating their ability to seek clarity or challenge deception. Similarly, in varying degrees across authoritarian states outside Western democracies, state-controlled AI systems can use doublespeak to manipulate narratives, limiting individual agency to question or resist (Figure 5). How do you think the degree of state control in different countries affects individuals' ability to ensure AI communication remains truthful and transparent? Is sovereign AI a good idea? Will it enable an unprecedented level of propaganda at scale to control the mob? In ancient Rome, controlling the "mob," or in other words, the plebeians (the public or working class), was a multifaceted

Roman authorities and politicians employed various strategies, including appeasement, political maneuvering, The Games, and violence, to manage public opinion and prevent unrest. The concept of "mob" rule was a constant concern, as the collective power of the plebeians was a potent force, either for stability or for disruption.

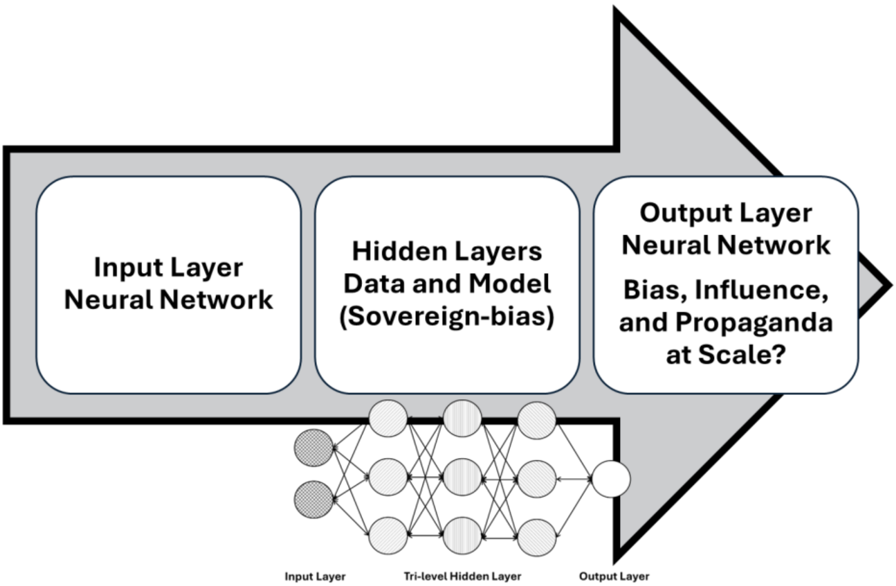

Figure 5: Sovereign AI

Next Challenges for Enhancing Coding Capabilities

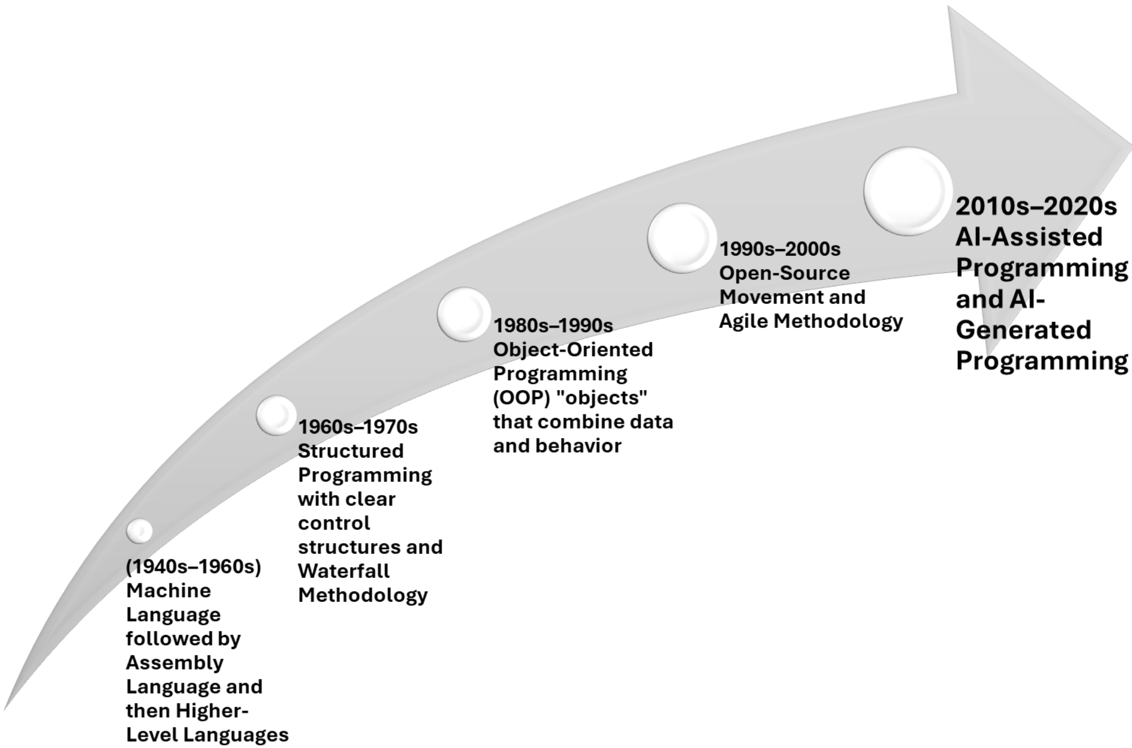

Figure 6: Progression of programming.

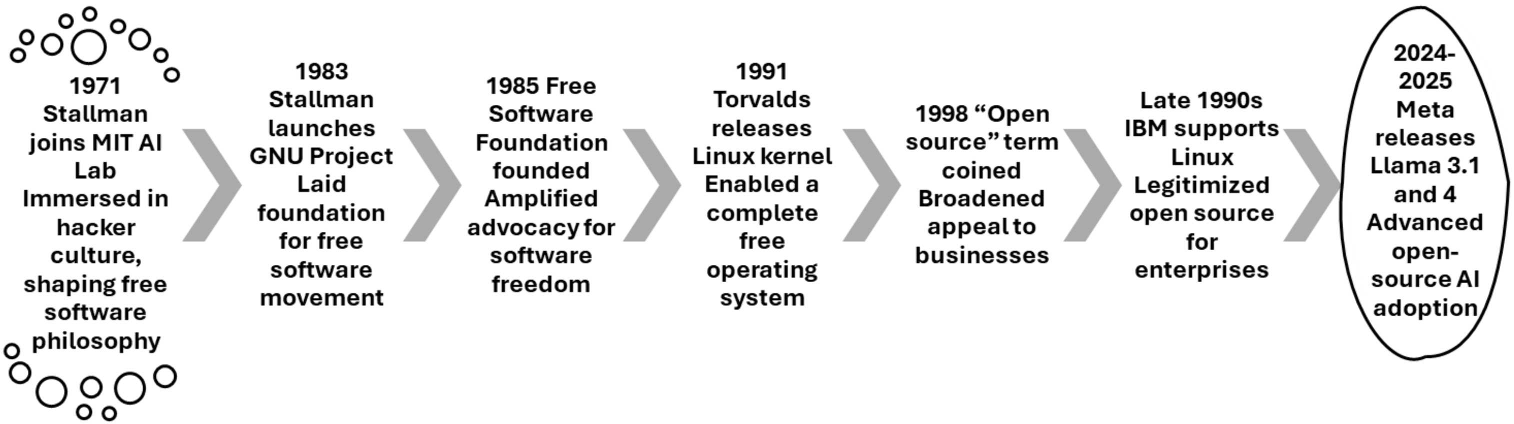

Figure 7: Open source journey.

The Open Source Saga: From MIT's Halls to AI's Frontier

MIT and Harvard University stand as twin pillars of academic excellence, their campuses alive with the hum of brilliant minds. One summer in the 1970s, I got the chance to travel to Boston to meet my sister before we headed off on a summer-long backpacking trip across Europe. We were on summer break, and I spent a few days in the dorms at MIT, where she was

Today, the open source ethos thrives in artificial intelligence, carrying forward the spirit of Stallman and Torvalds (Figure 7). Meta's Llama models, with over 1 billion downloads by March 2025, lead the charge, offering freely accessible AI tools that developers can study, modify, and share [36]. Released in July 2024, Llama 3.1 outperforms several rivals on benchmarks, and Llama 4, introduced in April 2025, pushes boundaries with advanced reasoning capabilities [37]. Mark Zuckerberg, Meta's CEO, champions open source AI, drawing parallels to Linux's success and believing it fosters innovation and democratizes technology [38]. Other models, like Google's Gemma 2 and EleutherAI's Pythia, contribute to a diverse AI ecosystem, echoing the collaborative spirit of the early open source movement.

AI Table of Tools:

Tool Name	Description	Uses	Vendor
GitHub Copilot	AI-powered coding assistant that generates code snippets and suggestions.	Code generation, autocompletion, debugging, refactoring.	Microsoft
Cursor AI	A fast, accurate AI coding tool forked from VS Code, focusing on reasoning.	Code generation, multi-step problem-solving, rapid development.	Anysphere
Codex	OpenAI's first purpose-built coding agent, integrating with code repositories.	Code generation, bug fixing, answering technical questions, suggesting pull requests.	OpenAI
DeepSeek-R1	Research-focused AI model for advanced problem-solving and code generation.	Research, code generation, complex problem-solving, SQL query generation.	DeepSeek
Claude	Conversational AI model with strong reasoning capabilities for coding tasks.	Code generation, debugging, natural language coding assistance.	Anthropic
Gemini	Google's AI model for versatile applications, including coding and reasoning.	Code generation, natural language coding, testing, research assistance.	Google
Llama	Open-source AI model	Code generation, fine-	Meta AI

Tool Name	Description	Uses	Vendor
	optimized for coding and enterprise applications.	tuning for domain-specific tasks, open-source development.	
Perplexity	Smart-search AI tool that assists with code-related queries and research.	Code research, debugging assistance, learning new programming concepts.	Perplexity AI
Qwen	AI model for natural language tasks, with growing use in coding applications.	Code generation, natural language processing, debugging assistance.	Alibaba
Testim	AI-driven testing tool with smart locators for automated QA.	Automated UI testing, test case generation, debugging, ensuring software quality.	Testim
Qodo	AI tool for automated test case generation, focusing on edge cases.	Test case generation, identifying edge cases, improving test coverage.	Qodo
Parasoft	AI-powered testing platform for comprehensive software QA.	Automated testing, code quality analysis, defect detection, compliance testing.	Parasoft
Momentic	AI testing tool for generating and executing test cases with analytics.	Test case generation, execution, defect prediction, QA	Momentic

Tool Name	Description	Uses	Vendor
		analytics.	
CodeGuru	AWS tool for code reviews and performance recommendations.	Code review, performance optimization, bug detection, security analysis.	Amazon Web Services
Tabnine	AI coding assistant with support for multiple IDEs and languages.	Code autocompletion, suggestion generation, team collaboration.	Tabnine
Replit	Collaborative coding platform with AI-powered features for development.	Code generation, collaborative coding, learning, prototyping.	Replit
Codeium	AI-driven coding tool for autocompletion and code generation.	Code autocompletion, generation, debugging, team productivity.	Codeium
Blackbox	AI tool for code generation and optimization across various languages.	Code generation, optimization, debugging, learning new languages.	Blackbox AI
Codium AI	AI-powered tool for code analysis, testing, and quality assurance.	Code analysis, automated testing, bug detection, quality assurance.	Codium AI
Neon	Supports AI agents in creating and managing SQL databases,	Supporting AI agents in creating and managing SQL databases,	Databricks (Neon)

Tool Name	Description	Uses	Vendor
	automated SQL databases.	automated SQL databases.	

This table provides a snapshot of tools that new software engineers should explore and monitor as they evolve, reflecting the dynamic landscape of AI in software development. Tracking these tools will help engineers stay informed about advancements that can enhance their productivity, improve software quality, and shape their career trajectories.

Types of Reasoning in AI

AI systems leverage a diverse array of reasoning types, each tailored to specific tasks and challenges. The table below provides a comprehensive comparison, detailing their definitions, strengths, limitations, implications, and examples in AI applications, setting the stage for a deeper exploration of their historical and modern significance.

Reasoning Type	Definition	Strengths	Limitations	Examples in AI
Deductive	Draws specific conclusions from general premises, ensuring certainty if premises are true [1].	Logical certainty; ideal for rule-based systems.	Requires complete, accurate premises; brittle if incorrect.	Expert systems for benefits eligibility, medical diagnosis.
Inductive	Generalizes from specific observations, yielding probabilistic outcomes [2].	Identifies patterns in data; adaptable to new information.	Prone to overfitting; errors if samples are unrepresentative.	Predicting customer behavior, image recognition.
Abductive	Infers the best explanation from incomplete	Handles uncertainty; effective for hypothesis generation.	Computationally complex; risks incorrect hypotheses from biased	Medical diagnostics (e.g., hypothesizing influenza from

Reasoning Type	Definition	Strengths	Limitations	Examples in AI
	data [3].		data.	symptoms), system fault detection.
Commonsense	Makes everyday assumptions based on implicit knowledge [4].	Mimics human intuition; enhances natural interactions.	Struggles with context-dependent nuances; hard to encode comprehensively.	Conversational agents using ConceptNet for intuitive responses.
Probabilistic	Assesses likelihoods under uncertainty [5].	Manages uncertainty rationally; versatile across domains.	Computationally intensive; sensitive to data quality.	Bayesian networks for market trend prediction, collision risk in autonomous driving.
Defeasible	Allows revisable conclusions based on new evidence [6].	Adapts to exceptions; flexible in dynamic settings.	Requires deep contextual understanding; complex to evaluate.	Legal AI revising rulings, medical diagnosis updates.
Dialectical	Resolves contradictions through dialogue and	Synthesizes conflicting viewpoints; promotes balanced	Subjective resolution criteria; complex dialogue structures.	AI for case analysis, policy debate systems.

Reasoning Type	Definition	Strengths	Limitations	Examples in AI
	synthesis [7].	solutions.		
Temporal	Focuses on time-dependent relationships and processes [8].	Plans actions and predicts future states effectively.	Complex with vague or overlapping timeframes.	Robotic task scheduling, narrative generation in storytelling AI.
Spatial	Understands and navigates physical or abstract spaces [9].	Enables navigation and visualization; supports robotics.	Struggles with 3D complexity, occlusions, or scale variations.	Autonomous vehicle path planning, augmented reality visualization.

Managerial Balancing Act

Managers in 2025 navigate a high-stakes balancing act. Technical leadership optimizes FLOPs—choosing low-reasoning inference for high-volume tasks or reasoning-heavy models for precision. Business acumen guides budgeting, weighing training's long-term benefits against inference's immediate returns. Market analysis identifies where quality drives advantage.

Domain	FLOPs per Task	Time (1 A100)	Cost per Task	Cost (1,000 Tasks)	Multiple
Training (175B parameters)	5.25 × 10^15	19.4 days (1,000 A100s)	$745,000 (total)	N/A	N/A
Inference (Low Reasoning, DeepSeek 2023)	2.8 × 10^15	15 minutes	$0.35	$350	1.0×
Inference (Medium Reasoning, 2023)	7.0 × 10^17	37.4 minutes	$0.87	$870	2.5×
Inference (High Reasoning, 2025)	1.4 × 10^18	74.8 minutes	$1.75	$1,750	5.0×

Assumptions

- **Model**: 175B parameters, transformer-based, GPT-3-like.
- **Hardware**: NVIDIA A100 (40 GB, 312 teraflops FP16), $2/GPU-hour in cloud.
- **Tokens**: Training: 500B tokens; inference: 1,000 tokens/query.
- **FLOPs**: Training: 6 FLOPs/parameter/token; low-reasoning (DeepSeek): 1.6 FLOPs; medium-reasoning: 4 FLOPs; high-reasoning: 8 FLOPs (CoT/ToT iterations).

- **Optimizations**: 20% reduction for training, 30% for inference (FP16, sparse matrices).
- **Scope**: Costs cover compute and GPU rental, excluding data prep or labor.

In 2025, AI’s balancing act echoes human pragmatism, with managers as its architects.

Encryption Challenge:

Today, the stakes are colossal. Modern RSA encryption uses 1443-bit numbers to safeguard online banking, medical records, and national security systems. For a classical computer, factoring such a number is a monumental struggle, requiring roughly 1 billion years, even with a supercomputer processing a quadrillion operations per second (Figure 8). A quantum computer, however, could crack it in 30 to 50 minutes, possibly under 30 with cutting-edge hardware. The digital barriers protecting our most sensitive data could collapse faster than a briefing in Langley's ops room.

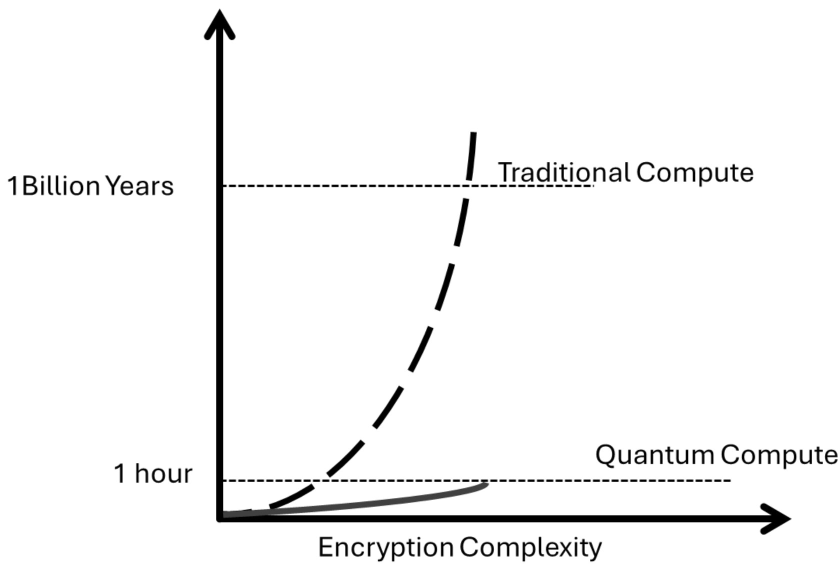

Figure 8: Quantum vs Traditional Computing.

The Top 26 AI leaders

The top 26 AI leaders recognized in this book, have a profound responsibility to embrace their roles as leaders of the Fourth Industrial Revolution. To shape a future where AI serves humanity's best interests, they must hone their skills in thought leadership, inspiring new ideas and ethical frameworks; leading peers and colleagues, fostering collaboration across disciplines; people and team leadership, building inclusive and innovative teams; policy leadership, advocating for equitable and responsible AI governance; and leading thinking machines, guiding the development and integration of AI systems with wisdom and foresight.

Table: Top 26 AI Leaders

Name	Impact Description	Company/Organization
Altman, Sam	Led ChatGPT development, transformed AI accessibility.	OpenAI
Amodei, Dario	Founded Anthropic, focuses on safe, interpretable AI.	Anthropic
Bengio, Yoshua	2018 Turing Award, advanced deep learning neural networks.	University of Montreal
Brin, Sergey	Advanced Google AI research, developed AlphaGo, TensorFlow.	Google
Crawford, Kate	Shapes AI ethics, authored *Atlas of AI*.	USC Annenberg
Dean, Jeff	Co-developed TensorFlow, MapReduce, scaled AI infrastructure.	Google

Name	Impact Description	Company/Organization
Gebru, Timnit	Promotes AI equity, exposes biases in systems.	Black in AI
Goodfellow, Ian	Invented Generative Adversarial Networks, advanced generative AI.	Google
Hassabis, Demis	Led DeepMind’s AlphaFold, revolutionized drug discovery.	DeepMind
Hinton, Geoffrey	2018 Turing Award, pioneered deep learning neural networks.	University of Toronto, left Google
Huang, Jensen	Co-founder NVIDIA AI Hardware/Software and called ChatGPT “iPhone moment.”	NVIDIA
Karp, Alex	Leads Palantir’s AI-driven data analytics for defense and enterprise.	Palantir Technologies
LeCun, Yann	2018 Turing Award, advanced deep learning, computer vision.	Meta AI
Li, Fei-Fei	Pioneered computer vision, founded World Labs for AI.	World Labs
Luckey, Palmer	Founded Anduril, develops AI-driven autonomous weapons for U.S. military.	Anduril Industries
Musk, Elon	Co-founded OpenAI, xAI, advanced AI in Tesla autonomy.	xAI, Tesla
Nadella, Satya	Embedded AI in Microsoft, Azure, Copilot, ethical initiatives.	Microsoft

Name	Impact Description	Company/Organization
Ng, Andrew	Democratized AI education, co-founded Google Brain, Coursera.	Coursera
Page, Larry	Integrated AI into Google, led Waymo autonomous vehicles.	Google
Pichai, Sundar	Oversaw Google's AI-first strategy, responsible AI advocate.	Google
Smola, Alex	Directs AWS machine learning, scales deep learning solutions.	Amazon Web Services (AWS)
Srinivas, Aravind	Co-founder and CEO of Perplexity AI focus on Accurate knowledge engine worked at OpenAI, Google Brain, and DeepMind.	Perplexity AI
Su, Lisa	Advanced AMD's AI hardware with Instinct accelerators.	AMD
Suleyman, Mustafa	Co-founded DeepMind, leads Microsoft AI consumer efforts.	Microsoft AI
Wenfeng, Liang	Founded DeepSeek, developed cost-efficient R1 model.	DeepSeek
Zuckerberg, Mark	Steered Meta's AI for social platforms, VR/AR tech.	Meta

Appendix I

Defined Weightings by Time Period: I've divided the timeline into three periods to reflect the evolving importance:

1. Early (Pre-2000: Foundational era, primarily affecting science): S = 0.7 (most important), E = 0.2, C = 0.1. Focus on theoretical advancements with minimal user/economic/societal reach.
2. Mid (2000-2019: Emerging applications era): S = 0.4, E = 0.4 (growing user/economic relevance), C = 0.2. Balances science with practical/economic uses like NLP tasks.
3. Late (2020+: Widespread adoption era): S = 0.3, E = 0.3, C = 0.4 (societal impact dominates). Emphasizes broad accessibility, ethics, and societal integration.

Weights sum to 1.0 per period. The overall rating is calculated as: (S_weight * S_rating) + (E_weight * E_rating) + (C_weight * C_rating), then rounded to the nearest whole number to match the given Impact Rating (S: Science, E: Economic, C: Comprehensive).

Year	Cumulative Impact	Model/Development	People/Org.	Description	Impact Rating	Rating Explanation
1943	8	Artificial neural networks	McCulloch and Pitts	Early computational model of the brain	8	Laid the foundation for neural network theory, essential for all later models.
1949	15	Hebbian learning	Hebb	Learning rule based on synaptic plasticity	7	Introduced key learning mechanism for neural networks, influencing training methods.
1950	24	Machine intelligence	Turing	Explored the concept of thinking machines	9	Established the theoretical basis for AI, inspiring language modeling research.
1958	32	Perceptron	Rosenblatt	Early neural network for pattern recognition	8	Pioneered neural networks for pattern recognition, a precursor to modern models.
1966	38	ELIZA	Weizenbaum	Early NLP program simulating conversation	6	Demonstrated potential for machine-human dialogue, a core aspect of language modeling.
1982	45	Hopfield network	Hopfield	Recurrent neural network with associative memory	7	Advanced recurrent networks, important for sequence tasks in language modeling.
1986	54	Backpropagation	Hinton, Rumelhart, Williams	Algorithm for training neural networks	9	Enabled efficient training of deep networks, critical for modern language models.
1998	62	CNNs (LeNet-5)	LeCun	Developed CNNs, foundational for image and later NLP tasks	8	Introduced CNNs, later adapted for text classification and other NLP tasks.

Year	Cumulative Impact	Model/Development	People/Org.	Description	Impact Rating	Rating Explanation
2021	144	GitHub Copilot	Brockman, Sutskever, et al. (OpenAI, GitHub)	AI-powered code completion tool integrated into IDEs	8	Transformed coding workflows by providing real-time code suggestions, significantly boosting developer efficiency.
2022	154	InstructGPT	Altman, Musk, Brockman, Sutskever, et al. (OpenAI)	Instruction-tuned model for better user alignment	10	Aligned models with user intents, crucial for practical applications like ChatGPT.
2022	161	PaLM	Chowdhery, Narang et al. (Google)	Large language model with 540B parameters	7	Pushed the boundaries of model size, exploring scaling limits.
2023	168	DeepSeek	Yang, Dai, et al. (DeepSeek AI)	Series of efficient, high-performance language models for coding and general tasks	7	Provided accessible, high-performance models for coding and reasoning, enhancing AI tool integration in development platforms.
2023	175	Grok	Musk, et al. (xAI)	Conversational AI model designed for truth-seeking and helpful responses	7	Introduced a novel conversational AI focused on truth and reasoning, contributing to diversity in language model applications.
2023	182	LLaMA	Touvron, Lavril et al. (Meta)	Open-source language model for research	7	Promoted accessibility and research in large language models.
2023	190	GPT-4	Altman, Musk, Brockman, Sutskever, et al. (OpenAI)	Advanced language model with enhanced capabilities	8	Continued the trend of scaling and improving model capabilities.
2023	199	Gemini 1.0	Pichai, Hassabis et al. (Google DeepMind)	Multimodal LLM integrating text, image, audio, and video	9	Revolutionized multimodal AI, enabling integrated processing across data types for broader applications.

Year	Cumulative Impact	Model/Development	People/Org.	Description	Impact Rating	Rating Explanation
2024	208	Claude 3	Amodei et al. (Anthropic)	Family of models (Haiku, Sonnet, Opus) with superior reasoning and safety features	9	Advanced ethical AI with state-of-the-art performance in reasoning and complex tasks, outperforming GPT-4 in benchmarks.
2024	216	Llama 3	Zuckerberg, Touvron et al. (Meta)	Open-source LLM series with enhanced multilingual and coding capabilities	8	Boosted open-source AI accessibility, fostering global research and customization.
2024	225	GPT-4o	Altman, Murati et al. (OpenAI)	Multimodal model with real-time voice, vision, and text integration	9	Enabled seamless human-like interactions, expanding AI to real-time applications like assistants and education.
2024	233	OpenAI o1	Altman, Sutskever et al. (OpenAI)	Reasoning model with internal chain-of-thought for complex problem-solving	8	Improved AI's logical deduction and multi-step tasks, bridging toward general intelligence.
2024	241	Llama 3.1	Zuckerberg, Touvron et al. (Meta)	Largest open-source model at 405B parameters with tool-use capabilities	8	Democratized high-scale AI, enabling advanced fine-tuning and deployment for diverse users.
2025	249	DeepSeek R1	Yang, Dai et al. (DeepSeek AI)	671B parameter open-weight model with efficient reasoning comparable to proprietary models	8	Provided cost-effective, high-performance open alternatives, accelerating AI adoption in resource-limited settings.
2025	257	GPT-4.5	Altman, Murati et al. (OpenAI)	Enhanced scaling with better efficiency and multimodal refinements	8	Pushed efficiency boundaries, improving accessibility for enterprise and creative tasks.
2025	266	Llama 4	Zuckerberg, Touvron et al. (Meta)	Mixture-of-experts architecture with multimodal expansions	9	Advanced hybrid expertise for specialized tasks, enhancing open-source innovation and performance.
2025	274	GPT-5	Altman, Murati et al.	Smarter, faster, human	8	Advanced hybrid expertise for specialized tasks, enhancing open-source innovation and performance.

Explanation of Index Items

A

Abductive Reasoning Inferring the best explanation from incomplete data, used in AI for hypothesis generation

AI Agents (AIA) Autonomous assistants performing tasks like customer service or data analysis

AlphaGo DeepMind's AI that defeated Go champion Lee Sedol, showcasing reinforcement learning

Altman, Sam OpenAI CEO, pivotal in ChatGPT and GPT development

Amazon Leverages AI for supply chain optimization and customer personalization

Amodei, Dario Co-founder of Anthropic, focused on AI safety

Anthropic AI safety-focused company founded by ex-OpenAI researchers

Apple Integrates AI in Siri and Vision Pro, advancing personal computing

Aristotle Ancient Greek philosopher whose logic systems influenced AI reasoning frameworks

Artificial General Intelligence (AGI) AI systems capable of performing any intellectual task a human can

Artificial Superintelligence (ASI) Hypothetical AI surpassing human intelligence across all domains

Attention Mechanisms Core to transformers, enabling focus on relevant data in NLP

Augmented Reality Technology overlaying digital information onto the physical world

B

Bengio, Yoshua AI pioneer, advanced neural networks and NLP, co-authored key deep learning papers

BERT (Bidirectional Encoder Representations from Transformers) Google's NLP model for contextual language understanding

Blockchain Decentralized ledger technology with potential AI applications

Bohr, Niels Physicist whose work on quantum mechanics influences quantum AI

Brain-Computer Interfaces Direct communication pathways between the brain and external devices

Brooks, Rodney MIT roboticist, pioneered humanoid robots and behavior-based robotics

C

Chain of Thought (CoT) Prompting technique to improve AI reasoning by breaking down problems

ChatGPT OpenAI's conversational AI, revolutionized NLP applications

Cisco Leader in AI-driven network security and real-time operations

Cognitive Industrial evolution– 4IR the fourth industrial revolution

Cognitive Science Influences AI through understanding human cognition

Comet browser Built on the Chromium framework, Comet leverages "agentic search" to enable users to interact with web content

Computer Vision AI field for image processing, used in facial recognition and autonomous vehicles

Convolutional Neural Networks (CNNs) Key for image recognition tasks in computer vision

CrowdStrike Cybersecurity firm using AI for threat detection and response

Cybersecurity Protecting systems from digital attacks, increasingly AI-driven

D

DARPA U.S. agency funding AI research, notably autonomous vehicle challenges

Deep Blue IBM's chess-playing computer that defeated Garry Kasparov

Deep Learning AI technique using neural networks for complex pattern recognition

DeepMind Google's AI research lab, developed AlphaGo and health AI applications

DeepSeek R1 Efficient AI model for language tasks, emphasizing low-resource training

Deductive Reasoning Logical reasoning from general rules to specific conclusions in AI

Dialectical Reasoning AI method for resolving contradictions, used in ethical decision-making

E

Einstein, Albert Physicist whose theories influence quantum computing and AI

ELIZA Early NLP program, simulated human-like conversation using rule-based responses

Encryption Securing data, critical in quantum computing discussions

EPR Paradox Quantum mechanics concept influencing quantum AI research

Error Correction Techniques to improve quantum computing reliability

Ethics in AI Addressing bias, privacy, and societal impacts of AI

EU AI Act Regulatory framework for AI in the European Union

F

Facial Recognition AI technology for identifying faces, raising privacy concerns

Feigenbaum, Edward Stanford AI researcher, developed expert systems like MYCIN

Feynman, Richard 1982 proposal of quantum systems

G

GANs (Generative Adversarial Networks) AI models for generating realistic images, used in creative applications

Generative AI Creates content like text, images, and code

GitHub Platform for code collaboration, integrated AI tools like Copilot

Global AI Safety Framework International agreement to ensure responsible AI development and deployment

Goodfellow, Ian Invented GANs, advancing computer vision and generative AI

Google Tech giant advancing AI through BERT, DeepDream, and autonomous vehicles

Google's Quantum Supremacy Experiment Demonstrated quantum computing's potential to outperform classical computers

GPT (Generative Pre-trained Transformer) OpenAI's NLP model for text generation and reasoning

Grover's Algorithm Quantum algorithm for searching unsorted databases faster than classical methods

H

Hassabis, Demis Co-founder of DeepMind, advancing AI research....368

Hidary, Jack Leader at SandboxAQ, advancing quantum AI applications

Hinton, Geoffrey Deep learning pioneer, advanced neural networks at University of Toronto

Huang, Jensen NVIDIA CEO, drove GPU adoption for AI computing

Hybrid Reasoning Combining deductive, inductive, and abductive reasoning for robust AI systems

Hybrid Systems Systems combining classical and quantum computing for AI applications

I

IBM Pioneered AI with Deep Blue and Watson, now focuses on enterprise AI and quantum computing

IBM's Quantum Roadmap IBM's plan for advancing quantum computing technology

Inclusivity in AI Ensuring AI systems are designed to be equitable and accessible to diverse populations

Inductive Reasoning Generalizing from specific data, used in machine learning

K

Karp, Alex Palantir CEO, applied AI to data analytics and security

Kasparov, Garry Chess champion defeated by IBM's Deep Blue

L

Leadership Visionary and strategic leadership in AI and technology

LeCun, Yann AI pioneer, developed convolutional neural networks for computer vision

Linux Open-source operating system, shaped by Torvalds' collaborative leadership

LLaMA Meta's open-source AI model, widely adopted for research and applications

M

Machine Learning Core AI method for

such as qubits and quantum gates

Quantum Internet Future network using quantum entanglement for secure communication

Quantum Machine Learning Combining quantum computing with machine learning techniques

Quantum Neural Networks Neural networks leveraging quantum computing principles

Quantum Policy Regulatory and strategic policies for quantum technology development

Quantum Resistant Ledger (QRL) Blockchain designed to resist quantum computing attacks

Quantum Software Software designed to run on quantum computers

Quantum Supremacy Point at which quantum computers outperform classical computers

Qubits Quantum bits, the fundamental units of quantum computing

R

RAG, Retrieval-Augmented Generation AI technique combining retrieval of relevant documents with generative models to improve response accuracy and context

Reinforcement Learning AI learning through trial and error, used in AlphaGo

Robotics AI-driven automation for manufacturing, healthcare, and autonomous systems

S

Safety in AI Focus on mitigating risks and ensuring responsible AI use

Salesforce Uses AI in Agentforce for autonomous business operations

SandboxAQ Company focuses on quantum AI applications

Shor's Algorithm Quantum algorithm for factoring large numbers, threatening current encryption

Simon, Herbert Cognitive science pioneer, influenced AI reasoning

Socrates Greek philosopher whose questioning method influenced AI reasoning approaches

Spatial Reasoning AI capability for understanding spatial relationships, used in robotics and vision

Superintelligence Hypothetical AI surpassing human intelligence, raising ethical concerns

T

Technological Singularity Point at which AI surpasses human intelligence, leading to unpredictable advancements

Tesla Advances autonomous driving with AI and vision systems

Torvald, Linus Created Linux, exemplifying open-source leadership

Transformers NLP architecture using self-attention, foundational for BERT and GPT

Tree of Thought (ToT) Advanced prompting technique for complex AI problem-solving

Acronyms

A

5G Fifth-Generation Mobile Network: High-speed wireless communication standard essential for real-time data processing in AI applications.
AGI Artificial General Intelligence: AI systems capable of understanding, learning, and performing any intellectual task that a human can.
AIA AI Agents: Autonomous assistants for tasks in business, healthcare, and personal productivity, used in AI applications.
AI-GRC AI Governance, Risk, and Compliance: Frameworks for managing AI ethics, risks, and regulatory compliance.
AR Augmented Reality: Technology that overlays digital information onto the physical world.
ASI Artificial Superintelligence: Hypothetical AI that surpasses human intelligence across all domains.
AV Autonomous Vehicles: AI-driven systems for self-driving cars, enhancing mobility and safety.

B

BCI Brain-Computer Interface: Direct communication pathway between the brain and external devices.
BERT Bidirectional Encoder Representations from Transformers: A Google-developed NLP model for tasks like question answering and language inference, leveraging bidirectional context.

C

CI/CD Continuous Integration/Continuous Deployment: Software development practice for automating code integration and delivery, enhanced by AI on platforms like GitHub.
CNN Convolutional Neural Network: A type of neural network designed for image processing, using convolutional and pooling layers to detect visual features.
CoT Chain of Thought: Prompting technique to enhance AI reasoning by breaking down complex problems into steps.
CPU Central Processing Unit: A semiconductor chip serving as the primary processor in a computer, used for general-purpose computing tasks.
CRM Customer Relationship Management: A system for managing business-customer interactions, enhanced by AI in companies like Salesforce.
CV Computer Vision: The AI field focused on enabling machines to interpret and process visual data, such as images and videos.

D

DALL-E A generative AI model by OpenAI that creates images from text prompts, advancing applications in creative industries.
DL Deep Learning: A subset of machine learning using multilayered neural networks to uncover complex patterns in large datasets.

E

EHR Electronic Health Records: Digital systems for managing patient health data, integrated with AI for diagnostics and treatment.

G

GAN Generative Adversarial Network: An AI model with two networks (generator and discriminator) competing to create realistic data, used in image generation like DeepDream.
Gen AI Generative AI: Technologies that create content, such as images, text, or music, including models like GANs and DALL-E.
GloVe Global Vectors for Word Representation: A word embedding technique that captures semantic relationships in text, used in NLP tasks.
GPU Graphics Processing Unit: A semiconductor chip designed for parallel computing tasks, accelerating neural network training and inference.
GPT Generative Pre-trained Transformer: An OpenAI-developed NLP model for text generation and completion, foundational for large language models.

I

IA Intelligent Augmentation: Technologies that enhance human capabilities through AI, integrating machine intelligence with human decision-making.
ILSVRC ImageNet Large Scale Visual Recognition Challenge: A 2010–2017 competition that advanced computer vision, notably won by AlexNet in 2012.
IoT Internet of Things: Network of interconnected devices collecting and exchanging data, often integrated with AI.

L

LLM Large Language Model: Advanced NLP models, like GPT and BERT, trained on massive datasets for tasks such as text generation and understanding.
LQM Large Quantum Model: AI models leveraging quantum computing principles, explored for future advancements in computational efficiency.
LSTM Long Short-Term Memory: A type of recurrent neural network that preserves long-term patterns, used in sequential data tasks like speech recognition.

M

ML Machine Learning: A subset of AI where systems learn from data to improve performance without explicit programming.

N

NER Named Entity Recognition: An NLP task to identify and classify entities in text, such as names, dates, or locations.
NLP Natural Language Processing: The AI field focused on enabling machines to understand and generate human language.
NPU Neural Processing Unit: A semiconductor chip optimized for neural network computations, enhancing efficiency in edge devices.

P

PyTorch An open-source deep learning framework widely used for building, training, and deploying neural networks.

Q

QC Quantum Computing: Computing paradigm using quantum bits (qubits) for complex calculations.
QML Quantum Machine Learning:

Emerging field combining quantum computing with machine learning.
QRL Quantum Resistant Ledger: Blockchain designed to resist quantum computing attacks.

R

RAG Retrieval-Augmented Generation: An AI technique combining retrieval of relevant documents with generative models to improve response accuracy and context, used in NLP applications.
ReLU Rectified Linear Unit: An activation function in neural networks that filters negative signals to enhance learning speed.
RL Reinforcement Learning: An AI approach where agents learn by interacting with environments, used in robotics and game-playing.
RNN Recurrent Neural Network: A neural network for sequential data, using hidden states to maintain context, applied in tasks like language modeling.

S

SAGE Semi-Automatic Ground Environment: A 1950s IBM project for real-time data processing, precursor to distributed computing.

T

TAO Test-time Adaptive Optimization: A technique for optimizing AI models during inference to improve performance on specific tasks.
TF Transformer: An NLP architecture using self-attention mechanisms, foundational for models like BERT and GPT.
ToT Tree of Thought: Advanced prompting technique for AI to explore multiple reasoning paths in problem-solving.
TPU Tensor Processing Unit: A semiconductor chip optimized for deep learning and AI workloads, accelerating tensor operations.

U

UBI Universal Basic Income: A proposed economic system to address job displacement caused by AI automation.

V

VAE Variational Autoencoder: Generative model for creating synthetic data.
VR Virtual Reality: Technology creating immersive simulated environments.

W

Word2Vec Word to Vector: A word embedding technique that represents words as vectors, capturing semantic similarities for NLP applications.

X

XAI Explainable AI: AI systems designed to provide transparent and understandable decision-making processes, addressing bias and fairness.
XMSS eXtended Merkle Signature Scheme: NIST-approved cryptographic signature scheme resistant to quantum attacks.

Y

YOLO You Only Look Once: A real-time object detection model used in computer vision applications.

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ABOUT THE AUTHOR

Kent Kaufman has over 30 years of experience in executive roles, management consulting, and executive coaching. He has long been interested in and studied leadership, organizational development, and change (OD/OC). Kent has coached and mentored many Silicon Valley CEOs and top management teams. As the CEO of the Growth and Leadership Center and a frequently utilized leadership consultant for Korn Ferry International, Kent has worked with companies and executives at all levels, including CEOs, boards of directors, vice presidents, and directors. These companies range from Fortune 500 firms to small startups and span multiple market verticals, such as high tech, internet/software, life sciences/healthcare, manufacturing/supply chain, construction, legal services, aerospace/defense, oil and gas, and financial services. He has consulted for NVIDIA, Amazon, Google, Intel, Hewlett-Packard, Chevron, Abbott Labs, Medtronic, Network Appliance, Barclays, BlackRock, Bank of New York Mellon, Cisco, Northrop Grumman, and Apple. Kent's clients value his keen insights and strategic perspective. In addition to his leadership work, Kent is a managing partner at BEEC Capital, and he is the CEO and chairman of the board of Blackhawk Acquisition Corporation, a NASDAQ-listed SPAC (Special Purpose Acquisition Company). Finally, he serves on the San Jose State University Advisory Board for the Silicon Valley Center for Operations and Technology Management.

Kent's consulting expertise includes accelerating business growth, go-to-market strategies, change management, team dynamics, decision theory, strategic planning, and development (vision, strategy, measurement, and execution – VSME), and executive coaching. Kent began his management career at IBM and was a key leader in helping the startup StorMedia go public through an IPO. His hands-on business experience enables him to relate to his clients' challenges and needs. Earlier in his career, Kent worked as a materials scientist and received the prestigious Outstanding Innovation Award from IBM. He has contributed to several major hardware and internet-software product releases and is a U.S. patent holder.

Kent earned his Bachelor of Science in Materials Science from the University of Washington and his Master of Science in Materials Science from Stanford University.