

202x - Challenges and Opportunities for Tech Workers - AI Down The Line

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Outline

The Tech World Changes 2019 – 2023

- Tech Disrupted
- Current Tech Job Market

AI Then and Now

- A very brief history of AI
- And Then Came ML and LLMs
- AI Hype – Utopia ... Dystopia

AI Impact on Software (2024 – 2029)


- Code Assistants
- AI App = LLM + ?
- Democratizing Application Development
- Programming Yes, but Not as we Know It
- Agents?
- Opportunities

Discussion

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2019 Tech is Unstoppable!

Engineering demand >> 5-year cycle!
200,000 needed per year Shortfall of 4M by 2025 

Salaries escalate
Return of Coding Schools

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Global demand -> Distributed Teams
but software remains a **communication problem**

Cloud on demand resources
only limited by budget

Lack of **Domain Expertise**

Increased **complexity** of
platforms, tools and APIs

Feature Driven versus **Value Driven Development**

Autonomous feature teams (**siloed**)
- **do everything themselves**
- **use tech of their choice**



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2020 - 2022 Global Pandemic


Tech just keeps working! albeit from home 


- WFH drives **many** Tech company **revenues**
- WFH workers **rethink lifestyle choices**
 - US employees **quitting 25% higher** > December 2019
 - Hiring more **difficult** > remote work demands

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- **WFH frustrates many execs & managers** 

Why People Are Quitting Their Jobs

Most common reasons given for quitting previous job (Apr '21 - Apr '22)

Lack of career development/advancement	41%
Inadequate compensation	36%
Uncaring/uninspiring leaders	34%
Lack of meaningful work	31%
Unsustainable work expectations	29%
Unreliable/unsupportive colleagues	26%
Lack of workplace flexibility	26%
Lack of support for healthy well-being	26%

Based on a survey of 13,382 employees in Australia, Canada, India, Singapore, United Kingdom and United States. Source: McKinsey & Company

statista

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Suddenly in 2022 the Disruptions Begins!



- Social Media is **challenged** 😊
- Crypto **implodes**
- Web 3 and Metaverse **fail to take off**
- Pandemic WFH driven revenue **not sustainable**



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- Social Media is **challenged** 😊
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- Pandemic WFH driven revenue **not sustainable**
- By mid-October, FAANG, plus Tesla lost more than **\$3 trillion in market value**
- Google and Microsoft lost roughly **\$700 billion each**, and Meta, **\$600 billion.** 😞
- Amazon first public company to lose a **trillion dollars in value**. Microsoft wasn't far behind losing **\$889 billion**



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- The **tech meltdown**, and **anti-inflation monetary policy** conspire to collapse **SVB**, and **Signature banks**, followed by **Republic** 😞




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Tech focuses on Productivity and Profitability

Leadership Metrics and Values 2023

- Profit versus Revenue
- Profit per Employee
- Paying Customers versus Number of Users
- Fewer Features - More Value Faster
- Reduce Engineering Non-Development Overhead
 - Agile Ceremony, Cloud Capex, Cost of Carry
- Increase Domain Depth, Developer Breadth
- KISS emphasize Simplicity

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Tech focuses on Productivity and Profitability

Leadership Metrics and Values 2023

- Executives challenge the number and compensation of technical employees.
- Feel they are **hostage to developers** who are **spoiled, unproductive, and over paid!**
- Investors challenge executives to **reduce expenses** which in Tech are **largely employees**

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Tech focuses on Productivity and Profitability

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More Optimistic recent open Jobs from trueup.io

Family	Jobs	Trending	Jobs	Sectors	Jobs	Sectors	Jobs	Sectors	Jobs
Engineering	44,240	AI/ML	10954	Consumer	47,874	Logistics	8586	Ed Tech	1991
Tech Sales	16,053	FAANG	26997	Cloud+Infra	29051	Semiconductor	8534	Ad Tech	1151
Data Analytics	9607	Unicorns	34688	B2b SaaS	28057	Consumer Social	6662	Recruiting Tech	1028
Tech Marketing	9147	FinTech	22765	FinTech	22765	On-Demand	6009	IoT	980
Internships	6656	Climate Tech	12430	Transportation	22015	Creators	5424	Gen AI	939
NL/ML and Data Science	5586	Cloud+Infra	29051	Hardware	19789	Applied AI/ML	4981	Manu Tech	766
Product Manager	4607	React	4062	e-Commerce	13,928	Game Tech	4657	No Code	749
Design	4550	Space Tech	3377	Marketplaces	13205	Deep Tech/Moon Shots	4502	Mental Health	745
Legal Tech	3053	CryptoWeb3	658	Climate	12430	Real-estate	4101	Transhumanism	730
Data Engineer	3032	Digital Media	12395	AI/ML, Infra	3884	Metaverse	725		
FrontEnd Engineer	2132	AI/ML	10954	Open Source	3920	Ag Tech	607		
Talent/Hiring	905	Cyber	10892	CryptoWeb3	3664	Quantum Comp	384		
Tech Community	505	Health	10362	Space	3377	Diversity & Inclusion	159		
DevRel	240	Evs	9569	Direct to Consumer	2553	Nuclear Fusion	150		
Chief of Staff	69	Future of Work	9889	AUVs	2284	Robotics	2240		

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AI is Coming ... ?

- 1960 CACM Paper on the design of Lisp
- 1971, ACM Turing Award "The Present State of Research in AI"
- UCLA (1982). Everyone thought AI was 15-20 years away. John was asked "What would do with \$1B to spend on AI R&D?" He replied "I would spend 1M\$ a year until we knew what we were doing!"

The AI Winters of 1974 – 1984 and 1987 – 1993 !

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AI is Coming 2006

The Singularity in 2045

Ray Kurzweil, 2017 "AI will achieve human levels of intelligence by 2029. I have set the date 2045 for the 'Singularity' which is when we will multiply our effective intelligence a billion-fold by merging AI with the intelligence we have created."

Singularity Summit 2008

Ray Kurzweil

The Singularity Is Nearer 2025

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AI enables Scientific Breakthroughs 2021 - 2023

- 2018 ACM Turing Award for major breakthroughs in Deep Learning and AI which enabled AlphaGo, AlphaFold, GNoMe ...LLMs
- Google Deepmind AlphaFold has determined protein structures for nearly every organism with a protein sequence data.
- Google Deepmind GNoME Discovering Millions of Materials with deep learning.

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Suddenly in August of 2022

AND NOW FOR SOMETHING COMPLETELY DIFFERENT

Monty Python's Flying Circus, 1971.

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And then Came ML and the LLM!

GPT-2,3,4, CoPilot, Dalle, Stable Diffusion, Mid Journey, Llama, Claude, Bard, GPT 4, AutoGPT, PaLM 2, Mistral, Gemini, PHI-1,2 Code Interpreter (Plugins) ... 100s of AI apps

AI Again? - What is different this time?

- Availability of **massive datasets and compute**
- A **seductive** natural language chat interface
- Generative AI **universality** – text, images, sound, video
- **Exponentially spread** of ChatGPT!

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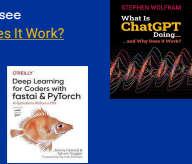
And then Came ML and the LLM!

What does an LLM do?

- An LLM **predicts the next word** based on the **words typed** and the **statistical probabilities of the text** it has been **trained on**. i.e. **It is a fancy autocomplete tool**
- Even with this limitation LLMs are very useful tools!

For a short technical overview of LLMs see

- **What Is ChatGPT Doing ... and Why Does It Work?** – Stephen Wolfram
- **A Hackers Guide to Language Models** – Jeremy Howard fast.ai



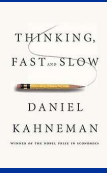
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Analogy - "Thinking, Fast and Slow" by Kahneman

- Kahneman divides cognition into **Fast and Slow**
- **Fast**, largely **unconscious**, and
- **Slow**, largely **conscious**

- ChatGPT *seems to be* like Kahneman's **fast thinking**.
 - very high bandwidth
 - can accept lots of input
 - can find and project patterns
 - forms quick sometimes incorrect judgements (**hallucinations**)



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Explosive Growth of LLMs!

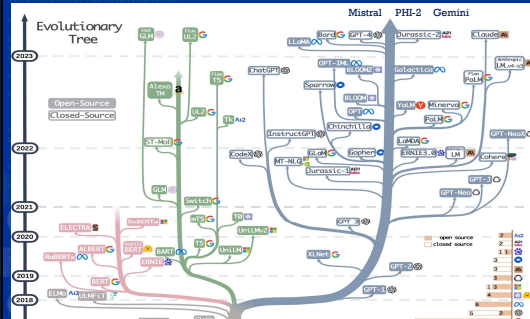
*In a March 2023 alone, people spent **100,000 work years** having "conversations" with a fancy autocomplete tool!*

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Explosive Growth of LLMs 2022 - 2023!

*In a March 2023 alone, people spent **100,000 work years** having "conversations" with a fancy autocomplete tool!*



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AI Hype and Concerns on AI

The First Ultra-intelligent Machine Is the Last Invention that Humanity Need Ever Make, IJ Good 1965

Superintelligence: Paths, Dangers, Strategies, Nick Bostrom

Dystopia

Utopia
Abundance
Enlightenment
End of Work

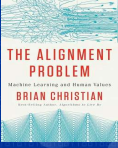



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The Alignment Problem

How AI Aligns with Human Values 🙄




- On the dangers of stochastic parrots | The Alan Turing Institute
- Advanced artificial agents intervene in the provision of reward
- Eugenics and the Promise of Utopia through AGI, The A.I. Dilemma - 
- Research Priorities for Robust and Beneficial Artificial Intelligence - The Pause Letter
- Pausing AI Developments Isn't Enough. We Need to Shut it All Down
- 'Don't Look Up' Thinking That Could Doom Us With AI.

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AI Pessimists

🙄

- The Godfather in Conversation: Why **Geoffrey Hinton** is worried about the future of AI
- 'Techno-Optimism' is Not Something You Should Believe In
- Ex-Google CBO **Mo Gawdat** Finally Speaks Out On The Dangers Of AI! and says AI is now IMPOSSIBLE to stop
- How AI will lead to Tyranny - **Nick Bostrom** 
- ChatGPT Could Be The Start Of The End! **Sam Harris**
- Google's DeepMind Co-founder **Mustafa Suleyman** AI Is Becoming More Dangerous And Threatening

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AI Optimists

😊

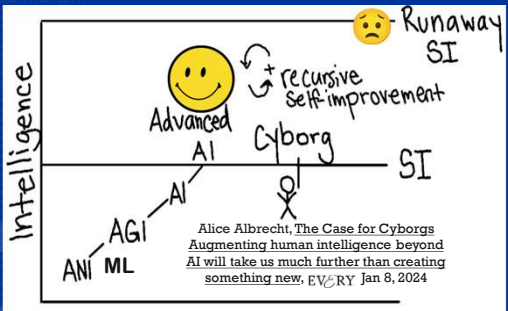
Optimists

- The Techno-Optimist Manifesto **Marc Andreessen** Oct 2023
- Beyond Doomsday: Why AI Promises a Brighter Future **Joanne Chen** Forbes Nov 2023
- The Bright Future for Artificial Intelligence - **Harri Valpola**
- Yann LeCun** on World Models, AI Threats and Open-Sourcing | Eye On AI
- Meta scientist **Yann LeCun** says AI won't destroy jobs forever
- Andrew Ng** 
 - We need a Goldilocks Rule for AI:
 - Too optimistic: Deep learning gives us a clear path to AGI!
 - Too pessimistic: DL has limitations, brings AI winter!
 - Just right DL will improve countless lives & create massive economic growth
- Bill Gates** predicts a 'massive technology boom' from AI coming soon

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Augmented Intelligence – A Middle Ground



Intelligence

Runaway SI 🙄

Advanced AI 😊

Cyborg

AI

AGI

ANI ML

SI

+ recursive self-improvement

Alice Albrecht, The Case for Cyborgs Augmenting human intelligence beyond AI will take us much further than creating something new, EVERY Jan 8, 2024


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AI and Software Development

Large Language Models and The End of Programming!

CS 50 Tech Talk with Dr. Matt Welsh, Harvard, October 2023 🙄



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AI and Software Development

Large Language Models and The End of Programming!

CS 50 Tech Talk with Dr. Matt Welsh at Harvard, October 2023 😊

Embrace Change!

- We won't have to try to fight 300 AWS, React APIs!
- We will be able to focus on the solution, without fighting arcane syntax and semantics of language X or Y!
- We will be able to generate examples and tests!
- We will be able to understand and change Fred and Mary's code!
- We will be able to describe our architecture and design!
- Bring It On!

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AI in Software Engineering at Facebook

Erik Meijer and his talented AI team at FB invested five years creating a Code Assistant that could


- explain and repair errors
- semantically search code,
- help refactor etc.

In August 2022 all this work was made obsolete by ChatGpt!

MS/Github followed quickly with CoPilot

Johannes Bader, Sonia Seohyun Kim, Frank Sifei Luan, Satish Chandra, and Erik Meijer, Facebook, Inc.

// How can artificial intelligence help software engineers better do their jobs and advance the state of the practice? We describe three productivity tools that learn patterns from software artifacts: code search using natural language, code recommendation, and automatic bug fixing. //



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Code Assistants – AI Pair Programming?

- CoPilot Survey reveals AI's impact on the developer experience 2023
 - 500 non-student, U.S.-based developers
 - 92% of developers already saying they use AI coding tools at work
 - 70% of the developers we surveyed say they already see significant benefits
 - 81% of the developers we surveyed expect AI coding tools to make their teams more collaborative
 - 57% of developers believe that AI could help them upskill
- Coding Will Never Be The Same Again – Ryan Salva YOW! 2023 MS Github Co-Pilot
 - MS PHI-2 Model, PHI-1 Textbooks are all you need
- PT Pilot ✓ Build Full Stack Apps with a SINGLE PROMPT (Made for Devs)
- Cody AI Coding Assistant
- How to Use ChatGPT as a Copilot for Learning - Ep. 4 - with Nathan Labenz

GitHub CoPilot
Amazon CodeWhisperer
Fixie
Divi AI
Tabnine
Codiga
Replit
Sourcegraph Cody
ChatGpt
AskCodi

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Code Assistants to Programming LLMs

Assistants to Agents

Github CoPilot ... useful for individual developers

- AI powered auto-complete

CoPilotX, ChatGPT, Bing, Gemini ... more useful for large teams

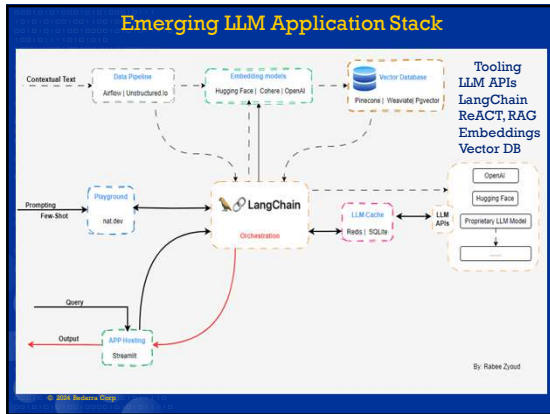
- AI powered search

BabyAGI, AutoGPT, Jarvis ... transformational

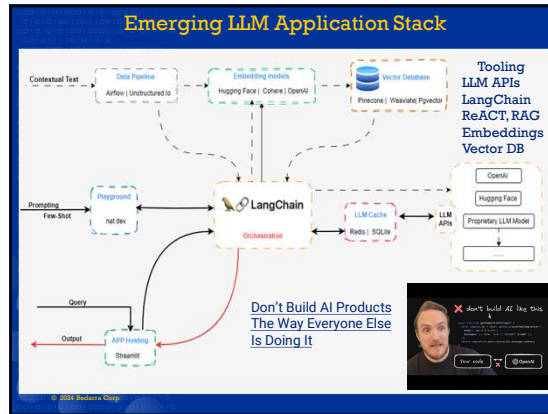
- AI powered workflows (Agents)

Erik Meijer YOW! 2023

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Neural Machine = LLM + Memory

A classical Turing Machine 1936, 1950

Alan Turing | The Imitation Game

Neural Turing Machines, Alex Graves, Greg Wayne, Ivo Daniheika, 2014

A Differential Neural Computer

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Few Shot, N- Shot, Chain of Thought, Tree of Thought, Chain of Code Prompting ...

Beyond Prompting – Programming the Neural Computer

- A Hackers Guide to Language Models – Jeremy Howard fast.ai
- Creating a Prompt Language for LLMs
- Prompting Is Programming: A Query Language for Large Language Models
- The Programmer's Apprentice Season 2: Advancements and Future Directions in AI-assisted Coding – Erik Meijer YOW! 2023
 - ReAct: Synergizing Reasoning and Acting in Language Models
 - ReAct Prompting with LangChain

ReAct: Synergizing Reasoning and Acting in Language Models

ReAct (Observation) -> ReAct (Thought) -> ReAct (Action) -> ReAct (Observation)

Language models are getting better at reasoning by chains of thought prompting and acting in a world. So, we can use them to solve more complex tasks. But only when they have the right capabilities and context!

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Agents for Exploring and Discovery

- VOYAGER: An Open-Ended Embodied Agent with LLMs

Time	Voyager (Ours)	Voyager w/o Skill Library	ReAct	Reflexion	AutoGPT
0	0	0	0	0	0
25	15	10	5	2	1
50	30	20	10	5	3
75	45	35	15	8	5
100	55	45	20	12	8
125	60	50	25	15	10
150	65	55	30	18	12

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Lots of Opportunities for Developers

Emerging opportunities being enabled by AI

- Assistants, Customer Advisor...
- Personal and Process automation
- Elaborating Requirements and Acceptance Criteria
- Multimodal UX
- Domain, Business specific Model Training
- Democratizing Application Development
- Generative Testing – Proof Carrying Code
- Understanding/Explaining what a Human or AI Program is Doing!
- Agents - Automated Workflows

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Lots of R&D Opportunities

LLM-based Software is very powerful , but

- Error-prone (search for "enforce json generation")
- Brittle (search for "prompt drift")
- Insecure (search for "prompt injection")
- Hard to write (search for "prompt programming")
- Impossible to debug (search for "LLM temperature")
- Privacy sensitive (don't want HR/Financial/Military data leak)

Erik Meijer
YOW 2023

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Lots of R&D Challenges

It is likely that LLM is the only neural computer?

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Is it likely that LLM is the only neural computer?

- What is Mamba?. Medium Dec 11, 2023
- Mamba: Linear-Time Sequence Modeling with Selective State Spaces, ICLR 2024 Conference Submission

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