IT Profession, Next 25 Years

What hired you now will not hire you then

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Abstract

Since its inception, humanity depended on the skills of individuals and groups. Over millennia, humanity and skills evolved differentiating those who would prosper from those who did not. From gatherers to hunters, from agriculture to industry, and from IT to AI, the complexity and rate of change have increased exponentially, driven by language, curiosity, and communication. IT skills and a variety of IT professions have dominated the past twenty-five years.

At this juncture, advances in AI have altered the technology landscape, causing tectonic shifts in many professions. How will IT professions evolve and how should IT professionals adapt? We contend that, first, required skill sets will rapidly change, increasing the importance of continuing education. Second, with the increased adoption of AI, the importance of data will also increase, demanding an ever-growing need for data science skills. Finally, many IT activities will be automated, requiring IT professionals to collaborate with AI assistants and take more strategic roles.

Introduction

In 25 years, Information Technology (IT) Professionals, if they exist at all, will have completely different roles. Technological innovations are dramatically changing not only the way we work but the work itself. Will the IT Professional be part of the 40% of roles eliminated due to automation as predicted by Oxford University economists Dr. Carl Frey and Dr. Michael Osborne [1]?

Job destruction, and conversely job creation, are not new. Throughout history, roles and industries have been destroyed through technological innovations. 120 years ago most people worked in agriculture (72.1% was the world average, with 77.9% in developing countries and 59.4% in developed countries [2]). By 2020 the world average decreased to 27% of the population [3] (and only about 3% of the US workforce [4]). Further, the work of the remaining 27% differs from 120 years ago due to the tools used, knowledge required, and skills applied. While less than one in three people anchoring the food supply chain is no longer a concern due

to leveraging effects of automation, the shift to automation and industrialization has led to the loss of species and habitat, the rise of monocultures, reliance on artificial pesticides and fertilizers, and increase of diet-related chronic illnesses.

We expect this trend to extend to the IT sector. Historically, technology has been used to replace routine, manual, repetitive work with automation and logic-based algorithms. Now, with even more sophisticated technology such as artificial intelligence, machine learning, high performance computing, and smart sensors, this shift is no longer confined to routine, manufacturing tasks. Technology innovation impacts more cognitive-intensive, adaptive, higher-skilled workers, including IT professionals, software engineers, and data scientists.

Further, this transformation will not take a century but will likely happen in twenty-five (or fewer) years because of the accelerating pace of technological evolution. As happened with agriculture, technology will be both the enabler and villain of this transformation. The reasons for the transformation are also similar: the drive to increase efficiency to super-human levels and the impossibility of managing the increased yield using old tools and old processes.

Let's look at the forces at play in the IT world.

Historical Perspective

To think about the future of IT, take a step back and consider a bit of IT history. When looking at the major technology transitions over the last 30 years, two major shifts include the internet revolution (1990-2010) and the mobile revolution (2005-2020) which have followed the traditional "S-curve" of adoption. The role of IT has faithfully followed these transitions over time.

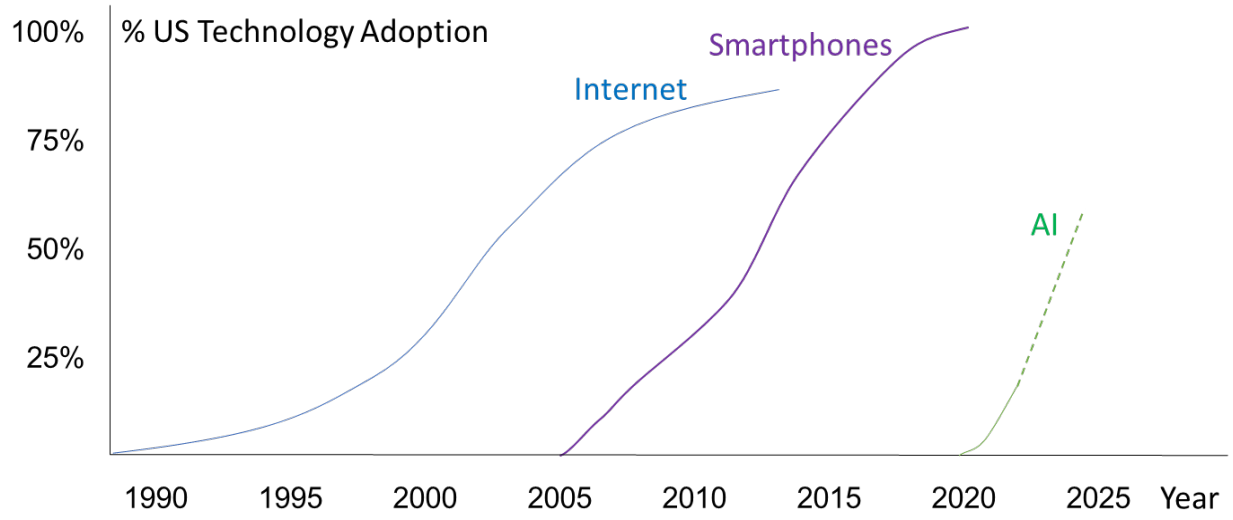

Figure 1. Technology Adoption (derived from World Bank and Statista, November 2023)

With the advent of the internet and the world-wide web, the need for new skills emerged, such as web infrastructure development, programming, and website conceptualization, development,

and maintenance. Additionally, e-commerce and related new technologies (e.g., database systems, inventory management, shipping logistics, online payment processing, security management, etc.) generated new IT roles dealing with far more complex IT environments than traditional on-premise, mainframe-based computing.

This trend implied managing and understanding novel networking technologies (e.g., LANs and WANs), which culminated in the cloud computing revolution towards the end of the 1990s. Cloud computing completely shifted the IT focus from managing an on-premise world to a hybrid environment, composed of a combination of virtualized IT infrastructure in the cloud and local resources, a mix of traditional ISV software, IaaS environments, and a growing ecosystem of Software-as-a-Service choices (starting from productivity software, email, and documents, and then moving to full-fledged functions, like customer relationship management and human resources). The internet also had a significant effect on the career evolution of IT professionals. In the mainframe era, IT information used to be in the hands of a few vertically integrated players that also controlled education and training. While originally conceived as a complement to the mainframe, the advent of the PC and its productivity software ecosystem brought a diverse set of professionals into IT and the migration of PCs from office to home engendered the first generation of computing natives. Ethernet had been connecting the office and enterprise for two decades, but it was widespread Internet adoption that made IT information much more broadly available, and online collaboration far easier, creating a new generation of self-taught, continuously learning, located-anywhere professionals.

The mobile revolution around 2010 was the second major cause of transformation for the IT profession. From a world of desktops, servers, and a fairly office-stationary workforce, the world shifted due to an explosion of devices and mobility options for workers. The ubiquitous adoption of smartphones and mobile apps created a set of new needs for different user interfaces and testing processes. The “BYOD” (bring-your-own-device) revolution came with an order-of-magnitude higher complexity and a new set of security concerns, resulting in creative ideas to address them. IT professionals found themselves having to maintain an acceptable level of security and protection of company resources to enable a flexible workforce, with diverse needs, using many different devices (from smartphones to tablets), and accessing information from unsecured locations (from homes to coffee shops).

Since its origins in the 1960s AI has always been a potentially transformative technology. But unfilled expectations leading to the “AI Winters” of the 1970s and 1980s likely caused many pundits to miss the invisible paradigm shift that was occurring. Hence, the Generative AI disruptive revolution, which began at the end of 2022, with its broad and profound applicability to diverse areas of disciplines and UIs (textual, voice, image, video, math, writing, music, art, and many more) left everyone surprised. The use of Large Language Models initially came with a significant cost of training that only few can afford both in terms of cost and availability of GPUs, but the community is starting to address this problem. It is the speed and time-to-adoption that improved compared to previous technology disruptions we discussed in this section. Many skills that we perceived only humans can have could potentially be replaced by AI.

Need for IT Professionals

Given the increasing complexity and increasing demand due to the near-universal integration of the internet, mobile systems, and increasing sensor-based data and AI in our daily lives, does the world need more IT professionals? Remember the wave of IT professionals in the 90s driven by the dot-com boom? Individuals from other professions were re-tooling and re-training to become website developers because, in those days, everything had to be hand-coded in HTML. Similar to the 1930s, when the world seemed to have an insatiable demand for switch operators due to the growth and proliferation of voice technology.

There was a boom period in the number of switchboard operators and IT professionals, respectively. Human skill and adaptability powered the initial wave of scaling the novel technology but soon the limitations of even the most skilled individual operators and the total training capacity threatened to cap future growth. However, technology quickly adapted and advanced so that individuals could complete long-distance calls on their own and websites are now almost self-generating through graphical tools. Those trained in narrowly specific skills in either case were not ill-prepared for the next wave of technological change.

Over the last few years, the unmet demand for IT professionals has pushed the industry to create tools enabling self-service while maintaining compliance and security. Until recently you had to learn a bit of HTML programming to create a website, now you can use tools that allow its creation through an intuitive interface. If you can use a laptop or smartphone you can create a website with the user experience and graphic design crafted by a new professional class of content creators.

Likewise, where in the past you had to hire an IT professional to create an e-commerce site, process data (data analytics) to create diagrams, to set up a database, you now have tools that are easy to use (through a graphical interface). By drawing what you want, the tool(s) produce the required coding.

This evolution is not just enabling those with little to no experience in programming to create code, it also enables programmers to enhance their productivity by using automation in code generation. A whole new area, called low code/no code, is progressing rapidly, and as the name suggests, it aims to enable the production of applications with no need to manually write the required software.

Additionally, generative AI and its conversational interfaces like ChatGPT are also supporting the creation of software with limited-to-no IT knowledge. At the same time, we are seeing that software is becoming pervasive in most STEM (and even standard) curricula so that most people in primary school can generate basic software applications.

Auto-generation works fine today at creating a stand-alone application. It does not work as well to extend an existing application because extension requires knowledge of what exists and what it takes to extend it. The more complex the system you need to change, the more knowledge is

required. In other words: coding activity is rapidly shifting from programmers to tools but the system activity is still in the hands of IT professionals.

In the coming years, we can expect novel software architectures to support easier plug-ins of new applications and to handle the systems' activity, which means that the need for IT system professionals will decrease.

Emerging Technologies

In addition to auto-code generation and other automated tools, the following are some of the trends in information technology affecting the role and skills required of the IT professional [5, 6, 7]:

- Artificial Intelligence
- Internet of Things
- Machine Learning
- Edge Computing
- Blockchain
- Homomorphic Encryption

What is of particular note with these trends is that they defy the conventional boundaries of the IT profession: they are enabled by the curation of massive data rather than proprietary code bases, they operate largely outside of the data center and in fact beyond just physically distributed they are inherently distributed in design, governance, and operations. Together they point away from individual workloads to be crafted and maintained over a lifecycle towards edge-to-cloud to core dynamic workflows that are continuously orchestrated and operated at super-human levels of efficiency.

If we look at the new “AI revolution” commencing in the last couple of years, a few differences emerge from the previous tectonic shifts. First, adoption is much faster and with far more reach than previous transitions. If we look at the time to reach 50% of US users, it took PCs 20 years, the internet 12 years, and smartphones 6 years, but just 3 years for generative AI. This means that the time for IT professionals to catch up with the new trends is much shorter, and might require a training ecosystem different from traditional educational institutions (e.g., universities), which tend to be slow to adapt to new trends.

Second, the AI revolution is fueled by data, which is creating a blur between the IT and the data scientist profession. Data analysis tools and data-driven insights are growing fundamental across a wide variety of areas such as healthcare, marketing, science, and finance. This new data economy is mandating new IT skills that understand the role of data in ML, can reason around responsible and trustworthy AI, understand the technology landscape to position the correct guardrail without inhibiting innovation, and so on.

Third, AI is going to automate several IT tasks, ranging from simple IT support questions and answers to complex coding co-pilots, or even automated IT control and optimization with

minimal human-in-the-loop intervention. This will cause a generational shift, in the sense that the IT professionals who know how to use the new AI tools and technology will likely replace those who don't know, and this may happen very fast, given the speed at which the field is evolving.

Global Trends

In addition to the rapidly changing technology landscape, cultural changes are impacting the IT professional. Recently, some of us wrote a comprehensive report on the global future of the workforce, especially in the context of the COVID pandemic and the technological shifts described above [8, 9]. The push towards automation is strong not only in the IT sector but almost in every work sector, from physical labor to creative- and knowledge-based industries.

One trend that garnered significant attention during the pandemic was that of remote and hybrid work, fueled by IT, with remote work tools and technologies for coordination, security, and communications. Although this trend increased the need for IT infrastructure and shaped some of the latest developments in IT, it did not dramatically increase the demand for IT professionals.

In a related trend, we are witnessing an increasing globalization of the workforce, with a larger pool of talent available to companies even far away from their physical locations. This globalization trend, largely enabled by IT, is also affecting the IT sector in particular, since almost by definition, IT professionals are native users of the IT technologies that enable this decentralized work model. Concomitantly, it enables the decentralization of the IT infrastructure as well, which is no longer always tied to the physical location of its owners.

Taking this trend further, an increasing reliance on Cloud-based service providers for IT infrastructure eliminates even the ever-shrinking of on-site IT operators that were needed to maintain these sites. A final factor is the rise of open source as the dominant development model in both cloud and AI/ML segments, which has permitted this new global workforce to both directly contribute to software packages consumed globally as well as to localize leading software packages to language and usage, further enabling diverse participation.

Future Perspective

As we know, advancing technology and changing behaviors will affect the IT professional. The question is how much and how fast. So what can one do?

To remain competitive, IT professionals will need to increasingly focus on delivering solutions rather than horizontal technologies, be multi-skilled in bringing together cross-disciplinary ideas/concepts, continuously learn about emerging technologies, and enhance non-technical skills to work with diverse teams, to work virtually and across cultures, and to have the intuition to challenge the tools and experts intelligently.

For example, consider that “AI won’t replace you, but a person using AI will.” Generative AI can help in three ways: reducing cognitive load by automating structured tasks; increasing cognitive capacity for unstructured tasks; and improving the learning process [10]. Quite a bit was written about the influence of COVID on the future of work and it can be found in many references [11, 12, 13].

To remain competitive, IT professionals should look at the evolution trend of core skills, the focus areas for future technology impact, and needed skills as highlighted in the tables below.

Table 1. Evolution Trends of Some of the Key IT Profession Skills

Skills	Evolution Trend
AI Programmers	↑
Data scientists	↗
Solution Architects	→
Support	↘
System Administrators	↓

Table 2. Evolution of IT Profession Technologies: From Past 25 Years towards Next 25 Years

Technologies	Examples of IT Profession Technologies Evolution	
	Past 25 Years	Next 25 Years
device, UI	monitor, keyboard, mouse	immersive, gesture, intent
computer	mainframe, mini, micro, laptop, phone	post-Moore, heterogeneous, quantum
connectivity	modem, wireless, broadband	satellite, global
tools	Office, search-based	personal assistants
information source	libraries, WWW	real-time
Development	SCCS, RCS, git	composability

Table 3. Evolution of IT Profession Skills: From Past 25 Years towards Next 25 Years

Skills	Examples of IT Profession Skills Evolution	
	Past 25 Years	Next 25 Years
editing	text, HTML, audio, image	all-modalities
designing	chips, hardware, software, apps	customized solutions
databases	DB2, Oracle	immersed knowledge bases
DevOps	compilers, linkers, loaders, GitHub, Jenkins, Puppet, Ansible, Chef, etc.	critical thinking/intuition/ability to recognize deep fakes

Conclusion

The IT professional has been the critical scaling factor that has enabled the pervasive adoption of information technology across the globe and the range of human pursuits. But even with the expansion of the professional base to a global and distributed workforce, the advent of generative AI/ML and edge-to-cloud to core workflows are demanding more than the traditional training capacity and industry response can provide. The operational roles are outstripping the capabilities of even the most skilled individual practitioners.

The solution lies in the IT professional aggressively adopting these same technologies so that now expansive and distributed infrastructure can be operated dynamically with super-human levels of efficiency. The limits of individual productivity can be eclipsed by enabling end-user self-sufficiency through workflow orchestration. Like the technology adoption cycles of the past, this will necessitate a transformation of the skills and tools utilized by the profession with the shift from low-level implementation and operational knowledge to systems architecture, distributed orchestration, and user experience design.

This is a repetition of the previous cycle of technology adoption, human adaptability and skills start as the enabler of new technology adoption but eventually become the bottleneck to continued growth which then necessitates automation to increase equitable availability and lower cost to further expand adoption.

Those who remain in the profession, whether it is agriculture, manufacturing, or IT, evolve their skills toward systems architecture and design and those who move on are free to employ the benefits of the technology adoption while they begin the search for what will come next. As the IT Profession embraces these novel technologies to continue to scale IT adoption, we should also remember the hard learned lessons of prior industries, automation and industrialization yield efficiencies but at the costs of increased risks from monoculture and loss of diversity and robustness in the supply chain.

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ORIGINAL INPUT BELOW

How the IT profession might look like in 20 years

Short answer: there will be no more IT professionals. Just kidding, but not that much.
Think about agriculture. 120 years ago most people were working in agriculture (72.1% world average, with 77.9% in developing countries and 59.4% in developed -at that time- Countries).

By 2020 the world average decreased to 27% (with the percentage in developed Countries in the single digits, Germany at 3%, whilst underdeveloped Countries still have a majority of their workforce toiling in agriculture - Burundi topping the list at 86%). More than that. Farmers today are quite different from yesterday's farmers in terms of tools used, knowledge, and skills.

Behold: it goes both ways. Today's farmers would be at a loss if they were asked to farm as farming was 100 years ago, and obviously, 100 years ago farmers would be unable to use today's tools and would lack the knowledge required in modern farming.

We expect this to be the same in the IT profession. And this will happen not in a hundred years but in 20 (actually less!) because evolution is accelerating.

As it happened with agriculture, technology is both the culprit and the enabler of the transformation. The reasons for the transformation are also similar: the drive to increase

efficiency and the impossibility of managing the increased yield using old tools and old processes.

Let's take a look at the forces at play in the IT world.

More and more companies need IT professionals because software is becoming ubiquitous and the production of IT professionals by technical schools and universities does not meet demand. Remember the prediction in the 1930ies that all people would have to work as switch operators to manage the increasing demand? Well, it partly turned out to be true in the sense that starting in the 1960ies all people learned to use long-distance access codes to route their calls, and telecom switchboard operators disappeared.

The unmet demand for IT professionals has pushed the industry to create tools enabling the do-it-yourself. Until yesterday you had to learn a bit of HTML programming to create a website, now you can use tools that allow its creation through an intuitive interface. If you can use a laptop you can create your website.

Likewise, where in the past you had to hire an IT professional to create an e-commerce site, process data (data analytics) to create diagrams, to set up a database… now you can have tools that are easy to use (through a graphic interface). You describe what you want and the tool(s) that produce the required coding.

This evolution is not just enabling lay people with no experience in programming to create code, they are also enabling programmers to enhance their productivity by using automation in code production. A whole new area, called low code/ no code, is progressing rapidly and, as the name suggests, it aims to enable the production of applications with no need to manually write the required software. Generative AI, and its conversational interfaces like ChatGPT, are also supporting the creation of software with limited/no IT knowledge.

This works fine, today if you aim at creating a stand-alone application. It does not work, or it gets tricky if you need to extend an existing application since at that point you need to know what is there and what it takes to extend it. The more complex the system you need to change the more knowledge is required. In other words: the coding activity is rapidly shifting from programmers to tools but the system activity is still in the hands of IT professionals.

However, in the coming years, we can expect novel software architectures to support easier plug-ins of new applications. This means that also the need for IT system professionals will decrease.

At the same time, we are going to see that software culture will become pervasive in most STEM (and even humanistic) curricula so that most people that today are in primary school will be IT-enabled professionals in 10 to 20 years.

STEM educators face a number of challenges due to the mind-blowing speed at which some of the new technologies, such as AI are progressing. For example, any attempt to produce an AI textbook through a traditional editor is likely to produce something that is completely obsolete before it even hits the bookstore! The new tools required for IT professionals in the age of AI require a blend of programming skills, new AI/ML frameworks, data science expertise, understanding data privacy and security, understanding responsibility, trustworthiness, and ethics of AI, and so on. These are interdisciplinary skills that cut across the traditional organization of colleges and universities and require a deep rethinking of academic curricula at a speed that is incompatible with the historical cadence of the education world.

Most people today are fine with using a laptop (and more than most in using a smartphone). Tomorrow most people will be fine with creating the software they may need in their profession as well as in everyday life.

So what about the true IT professionals? Well, IT gurus will still be around, mostly working backstage to develop tools that others will use to create software-supported entities (both applications and physical products) and to design software architectures and platforms to support those creations. There will be fewer of them, but each of them will have advanced skills (and will be using advanced AI tools). Most likely they will be at a loss if they were asked to code in assembler (or Phyton) but their value will be crucial to sustaining a world where software is ubiquitous.

Technologies

Technologies	Examples of IT Profession Technologies Evolution	
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device, UI	monitor, keyboard, mouse	immersive, gesture, intent
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information source	libraries, WWW	real-time
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Skills

Skills	**Examples of IT Profession Skills Evolution**

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databases	DB2, Oracle	immersed knowledge bases
DevOps	compilers, linkers, loaders	critical thinking/intuition/ability to recognize deep fakes

Outside of the scope

- Technologies, skills, and professions outside of the IT domain
- Economic, social, and ecological aspects
- ….

How things will change--general observations

1) It will be increasingly more about delivering solutions rather than horizontal technologies, this requires….tec
    a) Let's not undermine the role of building horizontal infrastructure, from the hardware to AI/ML. I don't see the ratio of infrastructure-to-applications work changing that dramatically because infra moves fast too.
2) IT professionals will have to be multi-skilled
3) Skills will have to be perpetually sharpened, acquired, and revisited throughout a career.
4) Positions in industry, academia, and government will also be intertwined as positions may cross the boundaries or will be collaborative
5) (Phil) I think as tools become more sophisticated IT professional skills needed will be less technical and softer. The ability to work with diverse teams, to work virtually and across cultures, and to have the intuition to challenge the tools and experts intelligently will be of paramount importance.
6) (Eitan) "AI won't replace you, but a person using AI will." Generative AI can help in three ways: reducing cognitive load by automating structured tasks; increasing cognitive capacity for unstructured tasks; and improving the learning process [https://hbr.org/2023/11/how-generative-ai-will-transform-knowledge-work].

Skills	Evolution Trend
AI Programmers	↑

Data scientists	↗
Solution Architects	→
Support	↘
System Administrators	↓

[Paolo - a few more observations]

- AI is likely to accelerate the IT shift to the cloud. This is because of the complexity of managing the accelerated infrastructure needed to train, tune, and serve AI models, as well as the cloud-only availability of required tools and frameworks. Also, if the AI world is moving (as it seems today) towards a small number of large players controlling trained foundation models, building AI apps will require proficiency in the emerging cloud APIs and their related ecosystem.
- Building AI-power applications requires understanding ethical considerations, data security and privacy, explainability, human-AI collaboration, and in general a far broader expertise in areas that are not in the traditional repertoire of IT professionals. It is unclear at this point if a new professional profile of “AI IT elites super-experts” will emerge, or whether we’re moving towards a more complex IT governance organization that requires bringing in expertise from far apart fields, like legal, ethics, compliance, cyber, or data science
- Increasingly, we are going to see regulators attempting to create guardrails for AI-enhanced IT systems, so a big part of the IT profession may end up being the enforcer of these regulations across the board. While some of it is true today in related areas (such as data protection or cyber), we expect the new AI regulations to be potentially much more far-reaching and require a complex system of checks and balances that IT professionals will need to understand and master.

Recommendations

(Phil) Let’s look at history. I think the wave of IT professionals of the 90s was driven by the dot com boom. Anecdotally, I remember many students in our (PSU) IT master’s program who were retraining from other professions to essentially earn the degree to become Web developers and earn big bucks. These were the days when corporate websites cost millions to build and had to be hand-coded in HTML. But it wasn’t long until tools allowed for faster and cheaper development of Web sites and Web commerce capabilities. Soon, these same types of “IT Professionals” were looking to learn Java, Javascript, and related technologies. Those trained (and by trained I mean those both earning degrees and those who were only certificate holders or self-taught) in “IT” were not ill-prepared for the next wave of technological change. In yet another technological wave, security became of paramount importance. Again, those who had learned only the technology du jour were not well prepared for this new challenge. In the early days of IT degree programs colleagues and I often debated the merits of an IT degree versus a

CS degree. Generally speaking, it was of immediate practical value (IT degree) versus harder learning concepts, but also timeless and adaptable to new technologies.

I argue the same for AI-type degrees. How is an AI degree different from a pure CS degree? The answer is a more direct focus on AI-specific algorithms. But a CS student can master these. So why shouldn't we go back to learning basic concepts of CS that are adaptable to the technology du jour whether it is Web development languages or AI algorithms? The answer is probably that it is harder to learn CS than some tool-empowered technology du jour.

These tools have become very sophisticated due to new technologies such as generative AI, which relieve the developer of having to do much more than drag and drop or enter a few keywords to generate impressive content, whether human language writing, art, code, or sophisticated Web commerce sites. Thus, the more sophisticated intelligent tools become, and the more reality becomes "questionable" due to AGI, deep fakes, etc., the more important one's critical thinking (intuition) becomes. This skill is necessary for everyone, but especially technology professionals and engineers. I would argue that these kinds of skills (i.e. critical thinking) can be taught and are natural byproducts of a classical CS education with its emphasis on logic, proof, and justification of every step. Whereas, in IT-type training and education the emphasis is mastery of (current) toolsets.

I am reminded of two anecdotes from popular American culture. The first is from the 1960s "The Jetson's", a cartoon comedy about a future society. George Jetson, the hapless everyman, works as a computer operator (let's call him an IT Professional) at "Spacely's Sprockets" a manufacturing company. He often complains to his wife about the stress of work (where he sits back and watches a computer screen) and complains about having to "push the button three times today."

The other anecdote comes from Scott Adam's fiction novel, the *Hitchhiker's Guide to the Galaxy* (1979), where a high performance computer (supercomputer, perhaps using generative AI, has been processing for millions of years to determine "the meaning of life, the universe, and everything." The protagonist comes along just as the computer is about to reveal the answer – "you are not going to like it" the computer announces. But the protagonist is insistent, but disappointed when the computer yields as the answer a single, useless number – 42.

Without critical thinking involved, with increasingly powerful tools, and without a deep understanding of the underlying mathematics of computation, could IT be heading in this direction?

(eitan) I'll add to Phil's insights two skill recommendations: learning to learn effectively and understanding uncertainty (statistics). All three recommendations have curricular implications from middle school through graduate school.

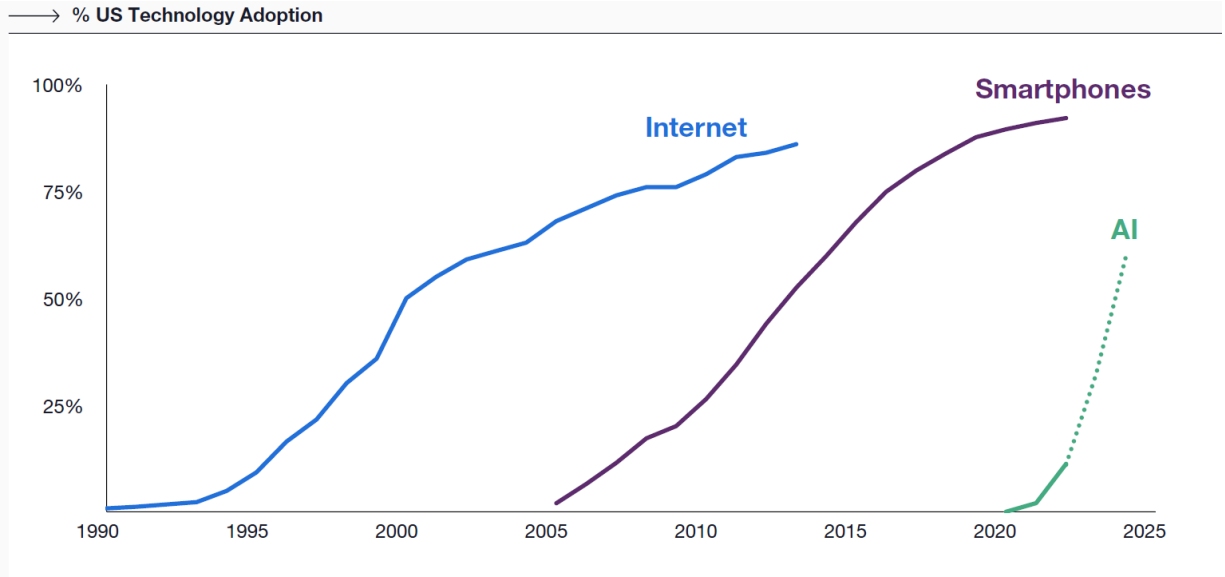
(paolo) While I agree that "going back to basics" is in general a great recommendation, especially for a rapidly moving field such as IT + AI, I think AI brings in a new dimension that we

have not seen before. In the past, for new computer systems, new programming languages, internet, cloud, or mobile, there was always an underlying assumption that the machine was under direct control of the human programming it and wasn't going to attempt to (intentionally or unintentionally) fool you. With generative AI, that is no longer the case. Look at hallucinations for example: a gen AI system now can give you information that appears to be quite legitimate, but can be very wrong. This requires the IT professional using any AI system to develop critical thinking skills in a way that isn't common today (unless someone decided to pursue a PhD degree). This critical thinking, the ability to evaluate and question answers, and preserve the human-in-the-loop in any important AI-enhanced automation is going to be a key element of education in the future.

Historical IT Transitions (Paolo)

<Paolo's note - I wrote this offline, I now realize some of this overlaps with what's already there - we need some dedup and organization>

To learn about the future of IT, it helps to take a step back and consider a bit of history. If we look at the major technology transitions of the last 30 years, the two major shifts have been the internet revolution (1990-2010) and the mobile revolution (2005-2020) which have followed the traditional "S-curve" of adoption. The role of IT has faithfully followed these transitions over time.



[Picture to be redrawn, sources: World Bank and Statista, 9/2023]

With the advent of the internet and the WWW, the need for new skills emerged, such as web development, programming, maintaining websites, and the corresponding infrastructure. Managing e-commerce and related new technologies (online payments, security, etc.) generated new IT roles that had to deal with a far more complex IT environment than traditional on-premise, mainframe-based computing. This implied managing and understanding novel networking technologies (LANs and WANs), which culminated into the cloud computing revolution towards the end of the 1990s. Cloud computing completely shifted the IT focus from

managing an on-premise world to a hybrid environment, composed of a combination of virtualized IT infrastructure in the cloud and local resources, a mix of traditional ISV software, IaaS environments, and a growing ecosystem of SaaS choices (starting from productivity software, email, documents, and then moving to full-fledged functions, like CRM and HR). The internet also had a significant effect on the career evolution of IT professionals. In the mainframe era, IT information used to be in the hands of a few vertically integrated players that also controlled education and training. The Internet made IT information much more broadly available, and online collaboration far easier, creating a new generation of self-taught, continuously learning professionals around the world.

The mobile revolution of ca. 2010 was the second major cause of transformation of the IT profession, from a world of desktops and servers, and a fairly office-stationary workforce, to an explosion of devices and mobility options for workers. The ubiquitous adoption of smartphones and mobile apps created a set of new needs for different user interfaces and testing processes. The “BYOD” (bring-your-own-device) revolution brought an order of magnitude higher complexity and a whole new set of security concerns and creative ideas to address them. IT professionals that were faster to adapt to the mobile world found themselves having to enable a very flexible workforce, with diverse needs, all sorts of devices (from smartphones to tablets), and access from unsecured locations (from homes to coffee shops), while maintaining an acceptable level of security and protection of company resources and data.
If we look at the new “AI revolution” that has just started in the last couple of years, a few differences emerge from the previous tectonic shifts. First, **adoption is much faster** and far more reach than previous transitions. If we look at the time to reach 50% of US users, It took PCs 20 years, the internet 12 years, smartphones 6 years, but just 3 years for generative AI. This means that the time for IT professionals to catch up with the new trends is much shorter, and might require a training ecosystem different from traditional educational institutions (e.g., universities), which tend to be slow to adapt to new trends. Second, **the AI revolution is fueled by data**, which is creating a blur between the IT and the data scientist profession. Data analysis tools and data-driven insights are becoming fundamental across a wide variety of areas such as healthcare, marketing, science, and finance. This new data economy is mandating new IT skills that understand the role of data in ML, can reason around responsible and trustworthy AI, understand the technology landscape to position the correct guardrail without inhibiting innovation, and so on. Third, **AI is going to automate several IT tasks**, ranging from simple IT support questions and answers to complex coding co-pilots, or even automated IT control and optimization with minimal human-in-the-loop intervention. This will cause a generational shift, in the sense that the IT professionals who know how to use the new AI tools and technology will likely replace those who don’t know, and this may happen very fast, given the speed at which the field is evolving.