Opportunities and Challenges from the Milestones of Information Technology (IT)

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Outline

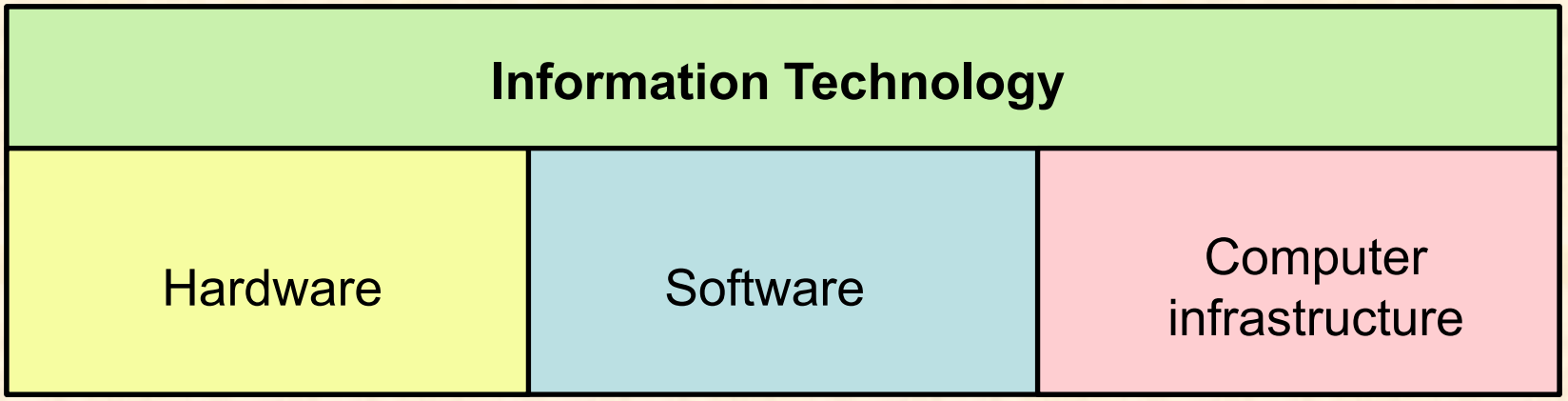
1. Introduction
2. Milestones of computer software/infrastructure
3. Milestones of computer hardware
4. Possible future milestones of IT
   - ❑ IoT (Internet of Things)
   - ❑ Autonomous systems
   - ❑ 6G or above networks
5. An IT career
6. Summary

Milestones of Information Technology (IT)

Every milestone in IT history radically changes the human lives, and creates many opportunities, challenges, and positions for people. For example, the WWW helped the dotcom boom, which has created millions of jobs and numerous business and research opportunities, but it also produces many challenges (like digital divide) at the same time. This talk gives an overview of the opportunities and challenges from the past milestones of IT. Based on the observation, the author then proposes the possible next IT milestones, and introduces their opportunities and challenges.

Information Technology (IT)

Information technology is the use of computers to store, retrieve, transmit, and manipulate data or information for business operations, and an IT system is generally a computer system including all hardware, software, and computer infrastructure for the system.



Milestones of Computer Software/Infrastructure

1957: Fortran

1969: Unix

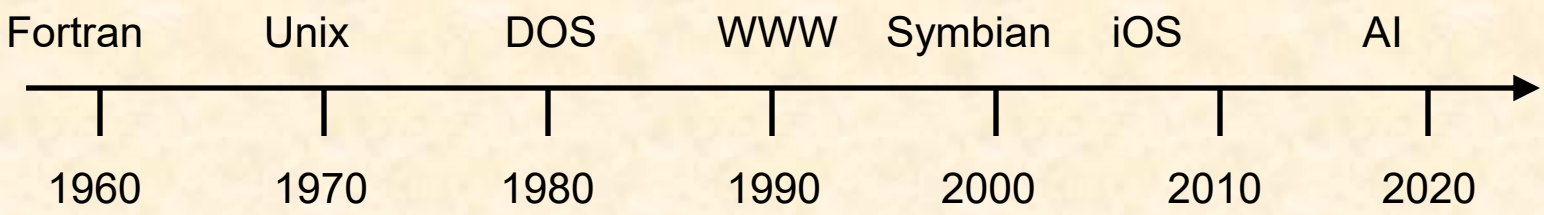
1981: DOS (Disk Operating System)

1993: WWW (World Wide Web)

2007: iOS (before Nokia Symbian)

2018: AI (artificial intelligence)

20xx: IoT | autonomous systems | 6G or above



1957: Fortran (Formula Translation)

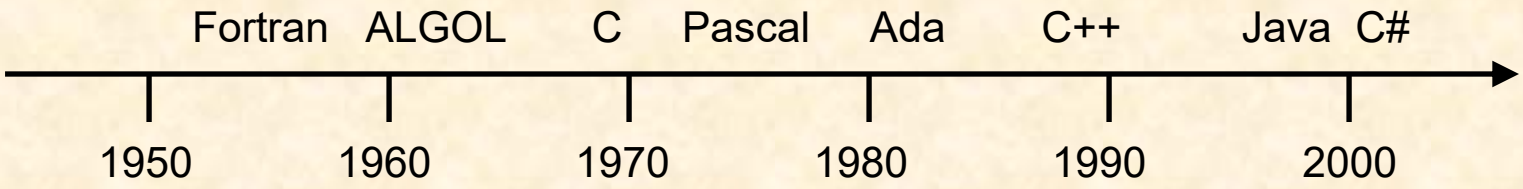
Fortran is the first high-level programming language.

Opportunities: Many problems could be solved easily and the need for programmers was suddenly increased.

```
C  FIND THE AREA OF A TRIANGLE.

   READ *, S1 , S2 , S3
   S = ( S1 + S2 + S3 ) / 2
   P = S * (S-S1) * (S-2)
   P = (S-S3) * P
   A = SQRT( P )
   PRINT *, "AREA = ", A
   STOP
   END
```

Challenges: Fortran is not a true general-purpose language. It is mainly used for scientific calculation.



1969: Unix Operating System

Unix is a family of multitasking, multiuser OS developed at the Bell Labs.

Opportunities: Unix made the OS be portable for many kinds of computers.

Challenges: It is not user-friendly and the learning curve is high.

	Unix	DOS	MacOS
Primary use	Servers	PCs	Mac
Major feature	Multiusers	Single-user	Multitasking
Evolved to	Linux	Windows	iOS

1981: DOS (Disk Operating System)

The DOS was the main operating system for IBM PC compatible personal computers during the 1980s.

Opportunities: The PCs brought the personal computing to individuals.

Desktop OS Market Share Worldwide (August 2025)				
Windows	**macOS**	**Unknown**	**Linux**	**Chrome OS**
69.75%	13.48%	11.48%	3.93%	1.36%

Challenges: The Windows missed the chance of being a competitive mobile OS like iOS and Android.

1993: WWW (World Wide Web)

The creation of the Internet may be the most critical milestone of IT history.

Opportunities: So far, 69% of world population are able to access computers and Internet.

	2005	2010	2015	2020	2025
# of users (million)	938	1,966	3,270	4,833	5,650
% world population	14.6%	28.7%	45.0%	62.0%	68.7%

Challenges: There are still 31% of people not able to access computers and the Internet (digital divide).

2007: iOS

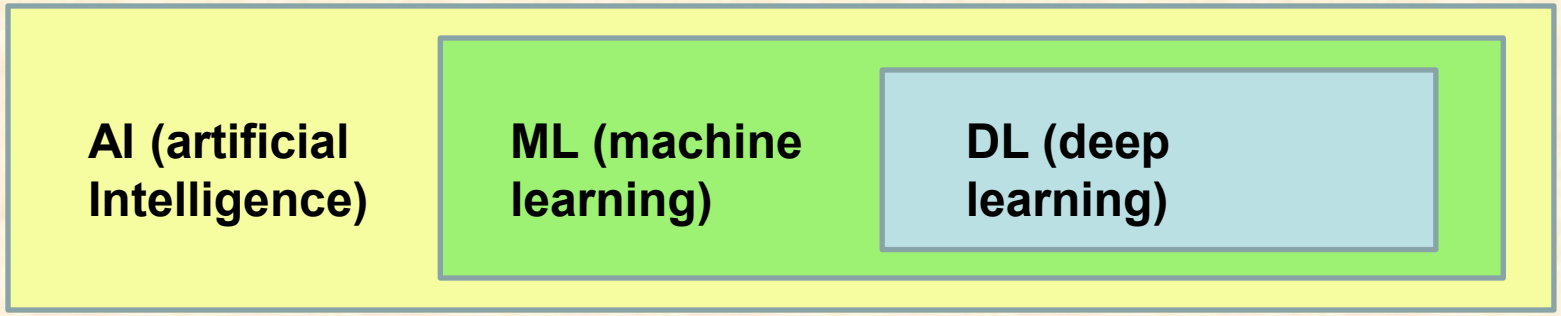
iOS is the first full-function mobile operating system (MOS), and it redefines the definition of MOS.

Opportunities: It changes the landscape of smartphones and brings more power to smartphones.

Challenges: The functions of smartphones seem unlimited, and more functions are added every day.

Year	Android	iOS	# of units sold in million
2024	72.47%	27.11%	1,220
2023	70.26%	29.02%	1,167
2022	71.47%	27.85%	1,395

2018: AI (Artificial Intelligence)



	AI	ML	DL
What	Simulating intelligence	Learning by experience	Using neural networks
Aim	Thinking like humans	Learning through data	Knowledge discovery
Example of applications	Playing games	Medical diagnosis	Speech recognition

AI (Cont.)

Booming

- The global AI market was valued at around $391 billion in 2025 and is projected to reach $1.81 trillion by 2030, with a compound annual growth rate (CAGR) of 35.9%.
- Corporate AI investment reached $581.7 billion in 2025. Private investment in generative AI reached $344.7 billion in 2025.
- 88% of companies now use AI in at least one business function.

AI (Cont.)

Hype?

- $450 billion invested vs. $185 billion in revenue in 2025
- Datacenter spending ($40 billion in annual depreciation costs) vs. revenue ($15–$20 billion)
- Minimal return on investment (ROI): Companies investing in generative AI pilots have not yet seen a measurable financial return

Despite bubble concerns, the AI market is experiencing staggering growth driven by heavy investment and increased adoption.

AI (Cont.)

Forecast

- AI is similar to the dot-com era, where many companies with little or no revenue commanded high prices.
- The performance of the S&P 500 has been heavily reliant on a small number of AI-driven tech stocks.
- Huge capital into AI investments is fueled by venture capital, large tech companies, and speculation.

While the current statistics show many signs of a speculative bubble, a crash is not guaranteed.

AI (Cont.)

AI-generated Apps

- 95% of generative AI projects yield zero measurable impact.
- 92% of AI startups fail.
- 80% or more of general AI projects collapse.
- 74% of corporate AI initiatives lose money or break even.

Recent data from Gartner shows that nearly three-quarters of CIOs report their AI infrastructure investments are actively losing money or barely breaking even.

AI (Cont.)

AI Replacing Programmers?

Partially, AI actually replaces:

- *The "Code Monkey" Role*: Writing basic syntax, boilerplate functions, and simple tests.
- *Entry-Level "Typist" Tasks*: Junior developers who only take tickets and type out basic code because AI can handle those entry-level tasks.

Companies that rely solely on AI-generated apps often face higher failure rates. Instead of replacing engineers, AI acts as a productivity multiplier.

AI (Cont.)

Recent Mass IT Layoffs Related to AI?

Partially because

- Many companies use “AI washing” to mask post-pandemic over-hiring, cost-cutting, shifting financial priorities, and misleading the public into believing the company is more technologically advanced.
- While some companies replace specific human roles with automated systems, the broader reality of the ongoing IT talent shift is highly nuanced.
- Layoffs help free up the massive cash flow required to fund AI chips and building data centers.

AI (Cont.)

Entry-level AI Job Markets

While aggregate AI hiring remains robust, companies rarely hire entry-level engineers to build or train custom core models. Companies are aggressively prioritizing mid-to-senior talent. Data indicates that entry-level AI/ML hiring dropped a staggering 73.4% as companies seek engineers who can deliver immediate value without intensive oversight.

Instead, the modern entry-level landscape has shifted toward Applied AI Engineering, agentic workflow building, and data/evaluation operations.

AI (Cont.)

Senior-level AI Job Markets

While overall hiring remains below pre-pandemic peaks, emphasize that senior-level roles accounted for 71% of the increase in software development job postings. However, breaking into pure AI research or core framework development at companies like Google and Meta is incredibly difficult for fresh graduates, as these roles are heavily sought after by PhDs and seasoned researchers. A dramatic shift toward senior-level hiring has constricted traditional entry-level pathways.

Milestones of Computer Hardware

1945: ENIAC

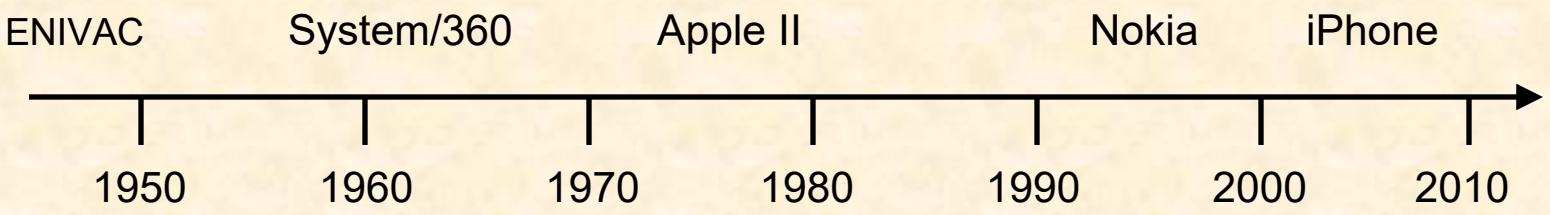
1964: IBM System/360

1977: Apple II

1996: feature phones (Nokia, Blackberry, etc.)

2007: iPhone

20xx: autonomous systems



1945: ENIAC

The ENIAC (Electronic Numerical Integrator and Calculator) was the world's first general-purpose electronic computer.

Opportunities: It was the pioneer of today's prevailing computers, which are used for almost anything and anywhere.

Challenges: Its functions were limited and its capability was small compared to today's computers. In addition, its physical size was huge, its speed was slow, and still used vacuum tubes that require replacements from time to time.

1964: IBM System/360

In 1964, IBM announced the System/360 mainframe with various models after investing $5 billion. It was a huge success for IBM since many of them were sold.

Opportunities: The mainframe made the data-intensive or complicated processing such as weather forecasting, census, and enterprise resource planning possible.

Challenges: It was only for corporation use because of the high price and limited applications available.

1977: Apple II

The Apple II was the first computer for low cost, high volume, and high reliability. The machine usually was equipped with 64 KB RAM, a mouse, floppy disk drives, and a backport accessible DE-9 joystick connector.

Opportunities: The Apple II made the personal computing possible.

Challenges: The functions provided by Apple II were limited, and it was mainly used for hobbies.

1996: Feature Phones

A feature phone is a mobile phone but lacks the advanced features such as navigation and media streaming that are provided by a full-function smartphone like iPhone or Android phone.

Opportunities: They paved the way for the extremely popular smartphones to launch.

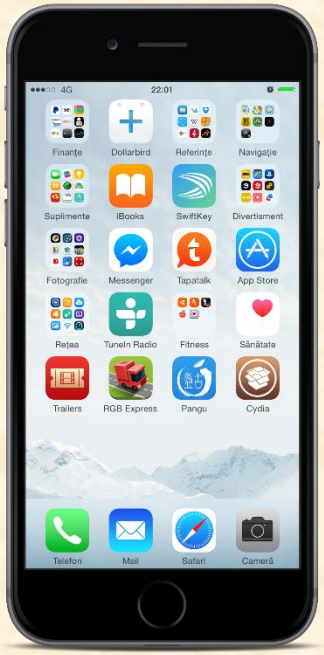
Challenges: They lacked the advanced functions, so they were mainly for phone calls and short messages.

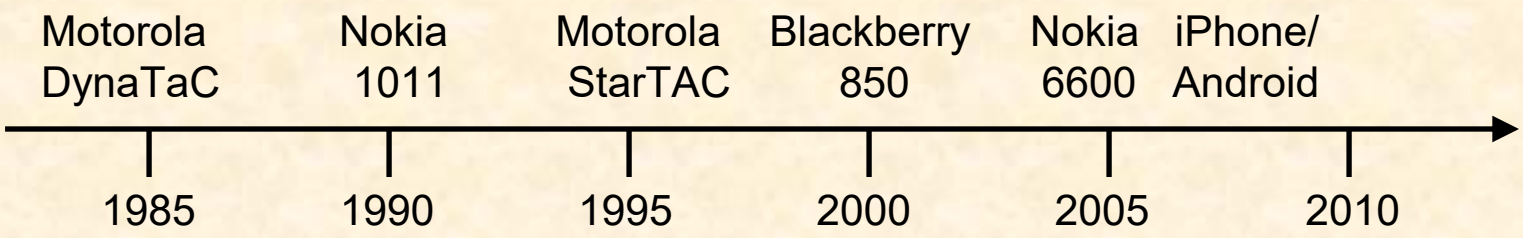
2007: iPhone

iPhone is the first full-function smartphone, and it is the most popular smartphone.

Opportunities: Since 2007, smartphones started to replace feature phones.

Challenges: The low data transmission rate limits the functions it can provide.





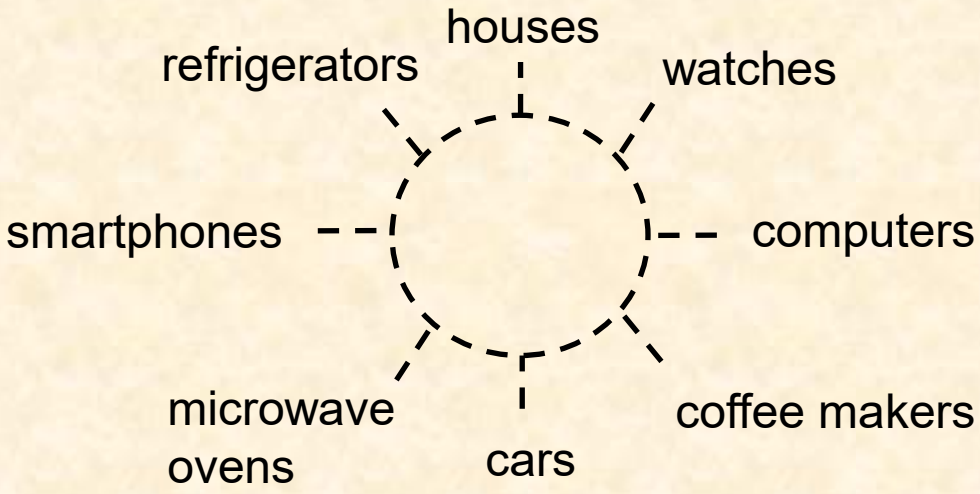
Possible Next Milestones of IT

The IT milestones did not happen instantly. Instead, they were normally created by the gradual development. Since the last milestone of AI (artificial intelligence) launched in 2018, there is no clear picture of what the next milestone will be. Nevertheless, the author gives the possible next milestones of IT as follows:

- IoT (Internet of Things),
- autonomous systems, and
- 6G or above neworks.

IoT (Internet of Things)

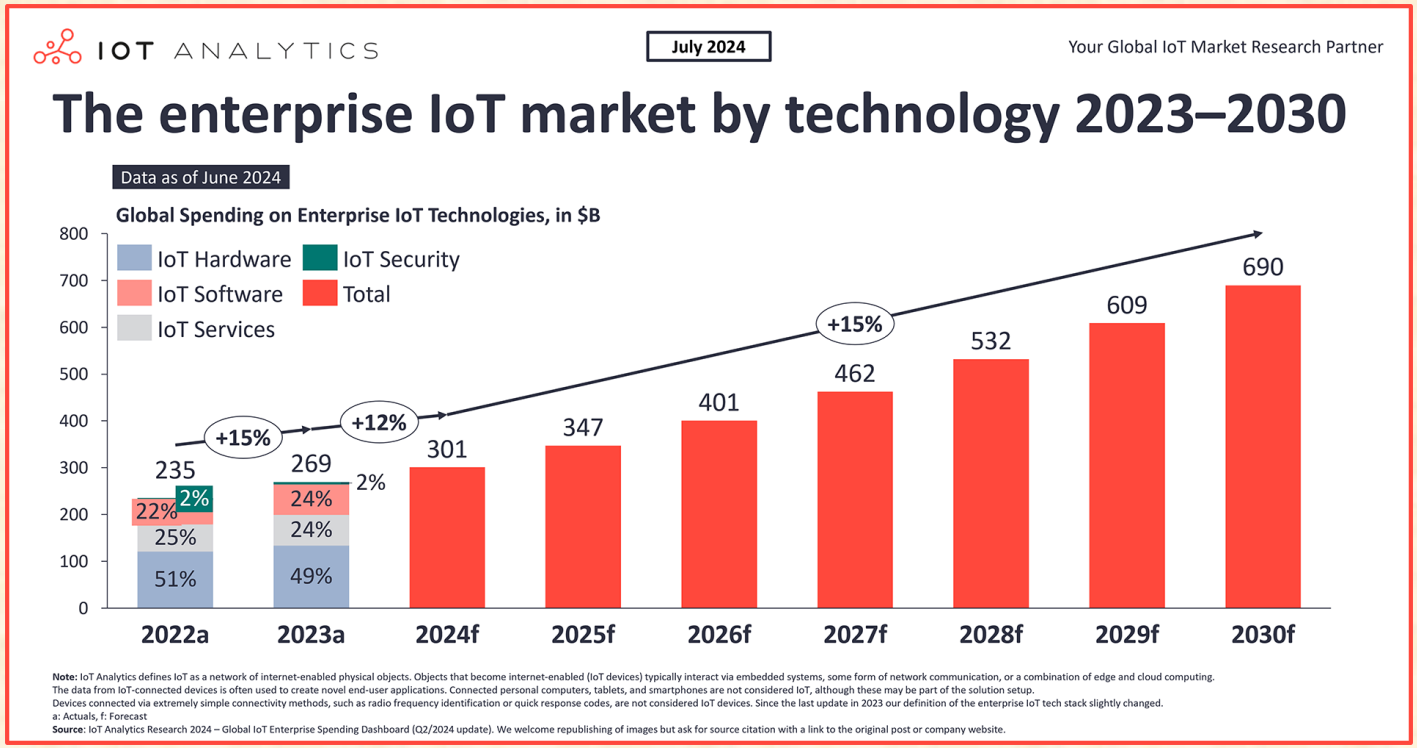
The IoT is a system of connected computing, digital, and mechanical devices/machines in which each is provided with a unique identifier. The devices in an IoT are able to share and transfer data without requiring human-to-human or human-to-device interaction.



IoT (Cont.)

Opportunities

Enterprise IoT market growth rate is over 15% from 2024:



IoT (Cont.)

Challenges

- High cost of implementation because of its high complexity
- Security and privacy issue because IoT connects your devices to the networks
- Technology over-reliance; e.g., people unable to respond if the system crashes
- Risk of unemployment as some jobs like security personnel may be eliminated

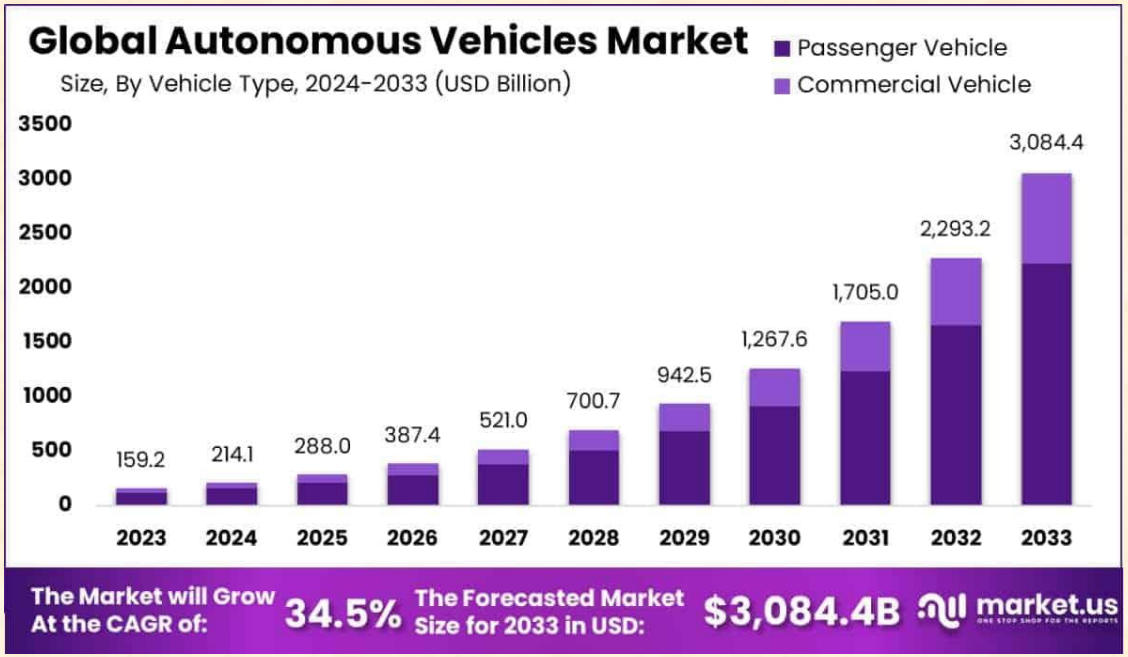
Autonomous Systems

Autonomous systems use software that sends out the instructions automatically based on real world conditions. They differ from traditional automation that operates based on predictable conditions. Examples of autonomous systems include:

- Autonomous robots
- Self-driving cars, trucks, and aircrafts
- Collaborative production assistants
- Socially-enabled domestic robots
- Non-physical work such as customer services

Autonomous Systems (Cont.)

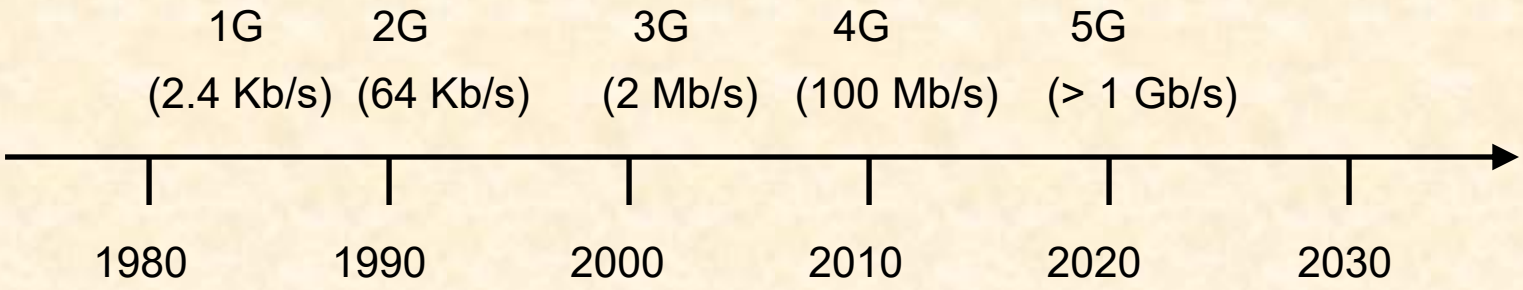
Opportunities
Global autonomous vehichles market (market.us, Dec 2024):



Challenges
Autonomous systems are not yet trustworthy completely, and they usually require human supervision.

6G or Above Networks

Network use has been a part of our daily lives, but the claim for higher speed never stops. 5G wireless technology is to solve the problem. It promises to deliver higher multi-Gb/s peak data speeds, ultra-low latency, more reliability, enormous network capacity, expanded availability, and better user experience to users.



6G or Above Networks (Cont.)

Opportunities

The ultra-high speed of 5G has great potentials. For example, it is able to connect virtually everyone and everything together including machines, objects, and devices. It also makes businesses more efficient and allows consumers to access more information quickly. In addition, many of the advanced technologies like connected cars, smart communities and homes, IoT, immersive education all will rely on 5G.

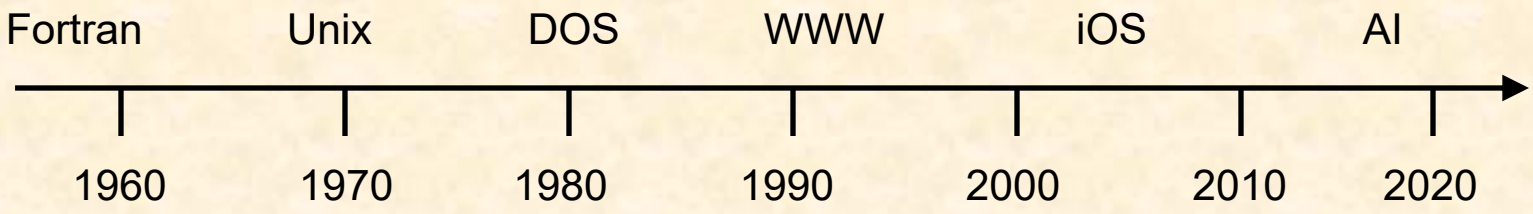
6G or Above Networks (Cont.)

Challenges

- The 5G concepts are ready but its technology and research are still in progress.
- The claiming speed of 5G has not yet been achieved mostly because complete technological support is needed in order to achieve the speed.
- Old devices may not work for 5G.
- Infrastructure needed could be costly.
- Potential security and privacy issues may exist.

Summary of IT Milestones

Every IT milestone has great impacts on human lives both in opportunities and challenges, and a milestone happened about every 12 years. However, since the last milestone AI were launched in 2018, there is no clear picture what the next milestone will be. The long drought of milestones may be because the IT has become a mature discipline and new discovery is difficult to come by.



Outline (An IT Career)

1. The best and popular IT jobs
2. IT job jargon clarification
3. IT jobs
4. Research promoted by the government

High Demand IT Developers (VERIIPRO, 8/05/2026)

1. Software Developer: $133K
2. Front-end developer: $91K
3. Back-end developer: $133K
4. Full-stack developer: $95K
5. Mobile application developer: $?
6. (Experienced) Data scientist: $113K
7. (few) Machine learning engineer: $141K
8. DevOps Engineer: $145K
9. (few) Cybersecurity programmer: $125K
10. (few) Game developer: $98K

The Most Popular IT Jobs

Jobs related to data are popular because every organization requires to store and process data.

- **Webpage developers**: Frontend like GUI and backend like database-driven pages
- **Mobile app developers**: Frontend like mobile GUI and backend like database-driven apps
- **Data/database processing**: Programming languages embedded with SQL, databases, SQL
- **DevOps (software developers)**: Programming languages, data structures, algorithms, …

IT Jobs of Different Degrees

IT training is more like a professional school (such as culinary schools), which emphasizes practical works because many IT companies want the new recruitees to start contributing immediately. The major tasks for the people with different computer degrees are

- **Bachelors**: Software development for all companies,
- **Masters**: Advanced software development for medium and large -size companies, and
- **PhDs**: R&D (research and development) for corporations, but emphasis still on development.

IT Job Jargon

Most small or medium -size businesses are looking for

- **Webpage developers**, not networks developers,
- **Mobile app developers**, not mobile computing developers,
- **(Few) Networks (cloud computer) architects**, not networks (cloud computer) developers,
- **(Few) Security analysts**, not security developers, and
- The cutting-edge research like AI, high-performance computer, and big data has a small job market.

IT Job Markets

There are three kinds of computer personnel: developers, practitioners, and researchers:

Developers:

- *Positions (plenty)*: Developers of front-end and back-end web pages, mobile apps, and all kinds of software
- *Skills (more stable)*: Programming languages (such as C++ and Java), web programming, mobile app development, data processing and management including databases, and data structures & algorithms

IT Job Markets (Cont.)

There are three kinds of computer personnel: developers, practitioners, and researchers (cont.):

Practitioners:

- *Positions (not many)*: Experienced personnel like data scientists, database or system administrators, security analysts, and network architects (more applications & configuration and less development)
- *Skills (based on the needs of companies)*: Databases, data warehousing, data lake, Hadoop, MapReduce, Linux, SPSS, SAS, Cogno, Matlab, Tableau, etc.

IT Job Markets (Cont.)

There are three kinds of computer personnel: developers, practitioners, and researchers (cont.):

Researchers:

- *Industrial positions (few and based on the needs of corporations)*: High quality personnel required for the advanced areas like AI, security, computer vision, autonomous driving, and speech recognition
- *Academic positions/trends (few and changed according to the government policies)*: ❓ ⇐ AI ⇐ big data ⇐ high-performace computing ⇐ security ⇐ (mobile) networks

Research Promoted by Government

The government (NSF) proposes a focused topic for CISE (Computer and Information) every 5-6 years:

- **(Mobile) Networks (1995)**: The Web started.
- **Security (2001)**: Was caused by 9/11.
- **High-performance computing (2007)**: The group of parallel and distributed computing is aggressive.
- **Big data (2012)**: It emphasizes more on HPC.
- **Artificial intelligence (2018)**: AI is not new.
- **? (2027)**: The topic does not need to be advanced or creative. It is a choice by the government.

Summary of an IT Career

Unless you have an impressive resume or a strong connection, practicing tens or hundreds of questions posted at LeetCode (https://leetcode.com/) is a must in order to secure a job at corporations (like Google and Facebook). Otherwise, your chance of answering the questions correctly is low because of their high difficulty and time constraint. In addition, you need to create LinkedIn pages to show your achievements, and may consider uploading your projects to GitHub (https://github.com/) to showcase them.