

LECTURER: TAI LE QUY

ARTIFICIAL INTELLIGENCE

TOPIC OUTLINE

History of Artificial Intelligence

1

Early Systems in Artificial Intelligence

2

Neuroscience and Cognitive Science

3

Modern Artificial Intelligence Systems

4

Applications of Artificial Intelligence

5

UNIT 4.1-2

MODERN ARTIFICIAL INTELLIGENCE SYSTEMS



On completion of this unit, you will have ...

- ... awareness of recent advancements in computing technologies.
- ... basic understanding of Cloud Computing and Quantum Computing.
- ... knowledge of Narrow and General Artificial Intelligence.



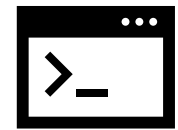
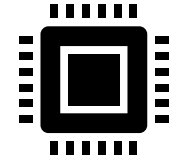
1. Explain the concept of Quantum Computing using your own words.
2. Define the term of Narrow Artificial Intelligence. How does it differ from General Artificial Intelligence?
3. Describe Moore's Law. Is it still applicable today?

RECENT DEVELOPMENTS IN HARDWARE AND SOFTWARE

- In the 1950s computing technology developed into an industry
- Alan Turing (1950) also published the seminal paper “Computing Machinery and Intelligence” proposing the concept of machine intelligence
- In the 1960s the rate of change accelerated with an emphasis on computing capacity and integrated circuit design rather than vacuum tubes, networks, and operating systems

RECENT DEVELOPMENTS IN HARDWARE AND SOFTWARE

- 1960's: Moore's Law = complexity, as measured by the number of transistors on a chip, doubles every two years.
- 1970's: Microsoft and Apple founded
- 1980's: CERN research developed protocol of HTTP & concept of "WWW"
- In the 1990s, hyperlinks became popular as a mechanism for connecting web pages
- 1990's: rise of Windows operating system

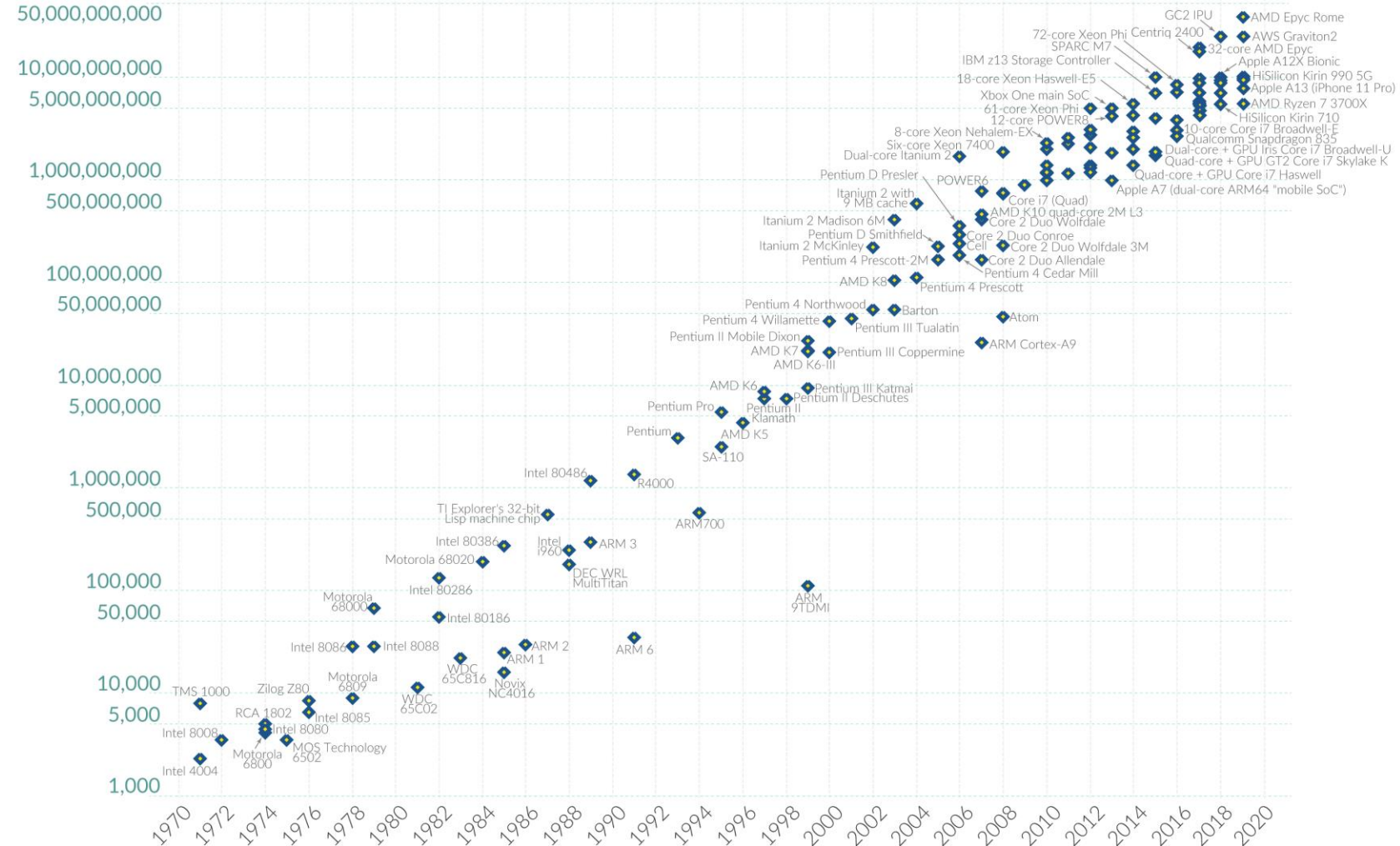


MOORE'S LAW

Moore's Law: The number of transistors on microchips doubles every two years

Our World
in Data

Moore's law describes the empirical regularity that the number of transistors on integrated circuits doubles approximately every two years. This advancement is important for other aspects of technological progress in computing – such as processing speed or the price of computers.



Source of image: Wikipedia

Data source: Wikipedia (wikipedia.org/wiki/Transistor_count)

OurWorldinData.org – Research and data to make progress against the world's largest problems.

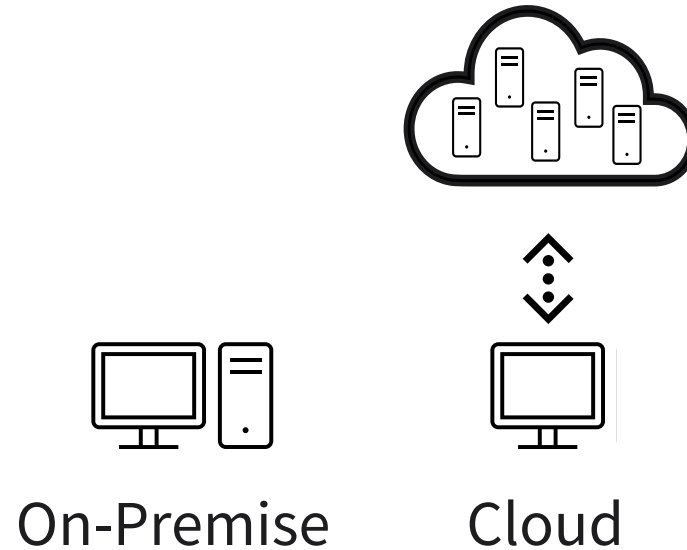
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RECENT DEVELOPMENTS IN HARDWARE AND SOFTWARE

- Since the year 2000, hardware and software have become more integrated, producing new products and services.
- Wearable devices and augmented reality (AR)
- Bitcoin, a cryptocurrency, was announced

CLOUD COMPUTING

Cloud Computing = parallel, geographically distributed and virtualized computing



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Reasons for emergence:

Need for computational and data storage resources due to, e.g., artificial intelligence

Economic opportunity for businesses offering cloud computing capabilities such as Amazon, IBM, and Microsoft

CLOUD COMPUTING

- Virtual computers
 - Created inside a server environment or cloud facility to serve a single client as needed
- Grid computing
 - Parallel and geographically distributed architecture consisting of heterogenous nodes that perform different workloads or applications
 - Resources may be owned by multiple entities.
- Cluster computing systems
 - Parallel and geographically distributed with resources available at runtime, perform the same task
- Benefit of cloud computing for AI
 - Highly scalable computational and data storage resources.

CLOUD CASE—ARTIFICIAL INTELLIGENCE IN SUPPLY CHAINS

- The cloud is a physically immense server installation, be located anywhere to provide communication and information exchange between worldwide supply chain partner firms.
- Artificial intelligence ensuring that supply chains operate more efficiently
 - Natural language processing (NLP): scan contracts, retrieve chat logs and orders, and speed up payments along the chain.
 - Machine learning:
 - Confirm trends, quantifying the flow of goods along the chain
 - Forecasts the demand for specific products and shares this information with all partners
 - Optimizes warehouse operations: ending, receiving, picking, and storing products
 - Operates autonomous transportation vehicles

CLOUD CASE—ARTIFICIAL INTELLIGENCE IN SUPPLY CHAINS

- The challenge: data
 - Must be complete, descriptive, accurate, and available in real time
- Introduction of cloud computing and artificial intelligence into a business's IT management system
 - Convince participants along the supply chain
 - Address risk, governance cloud technology, and artificial intelligence applicable to the new IT environment
 - Thinking with respect to costs and benefits
 - Working with stakeholders (all member companies in the supply chain, including major customers)

CLOUD ARTIFICIAL INTELLIGENCE SERVICE SPECIALIZATION

- Advanced analytics and artificial intelligence constitute major application areas of cloud computing
- Google, Microsoft, and Amazon have integrated machine learning and artificial intelligence offerings into their portfolios.
- The fees are based on usage volume, storage space, proprietary data, frequency
- Artificial intelligence libraries:
 - Chatbot
 - NLP technology (website translation)
 - Visual content classification services (on client images)
 - Documents (text graphics or photography): plagiarism or style detection

QUANTUM COMPUTING

- Current chip designs are approaching the physical limits of the semiconductor-based hardware paradigm
- Solutions:
 - Parallel and distributed technologies
 - Quantum computing
- Quantum computing is a new technology that could significantly increase our ability to process information

Regular Computing = classic information representation, consists of 0 and 1, e.g., *hi* is 01101000 01101001 (= bits)

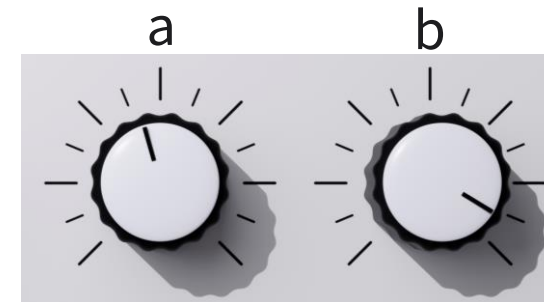
Quantum Computing = novel computational paradigms to represent information, classical bit + superposition of these states (= quantum bit/qubit)

Classical Bit



Qubit

$$a|0\rangle + b|1\rangle$$



- A quantum computer has quantum bits or qubits
- A bit can store either 0 or 1, a qubit can store 0, 1, both 0 and 1 or an infinite number of values in between at the same time
- It is still too early to be able predict the time horizon for a practical quantum computer
- <https://www.youtube.com/watch?v=qU86m98y7Aw>

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Quantum Computing = novel computational paradigms to represent information, classical bit + superposition of these states (= quantum bit/qubit)

Potential of Quantum Computing: increase of ability to process information such as cryptography

Cloud Computing

- Cloud data storage
- Business processes
- Big data analytics via cloud providers
- Communication platforms, such as WhatsApp

Quantum Computing

- Faster research and development of molecular structures and drug design
- Optimization of larger autonomous fleets

Narrow AI

- Specialized functions in controlled environments
- One domain/task at a time
- Facial recognition, sales forecasting

General AI

- Open-ended, flexible, domain independent
- Replicates full range of human cognitive abilities simultaneously

GENERAL AI

- The cognitive ability to learn and function in several domains
- The possession of human-level intelligence across all domains
- The possession of multi-domain problem-solving abilities at the average human level
- Independent problem-solving ability
- The ability to think abstractly without direct reference to past experience
- The ability to perceive the whole environment in which it operates
- The ability to entertain hypotheticals for which it has no prior experience
- The ability to motivate itself and the possession of self-awareness



You now have ...

- ... awareness of recent advancements in computing technologies.
- ... basic understanding of Cloud Computing and Quantum Computing.
- ... knowledge of Narrow and General Artificial Intelligence.

SESSION 4

TRANSFER TASK

TRANSFER TASK

Think about advantages and challenges that Cloud Computing offers for businesses in the field of Artificial Intelligence.

TRANSFER TASK

- Choose a specific scenario (e.g. a website using machine learning to predict the demand of customers/suggest the products to customers)
- Discuss the advantages/disadvantages of an on-premise solution, or a cloud computing approach

TRANSFER TASK
PRESENTATION OF THE RESULTS

Please present your
results.

The results will be
discussed in plenary.





1. Characterize the relationship between computer science and artificial intelligence.
 - a) The two fields are unrelated and are separate fields of study.
 - b) Progress in high performance computing and data storage are major drivers for the current wave of progress in artificial intelligence.
 - c) Both fields of study date back several hundred years.
 - d) While computer science benefits from artificial intelligence, artificial intelligence does not benefit from computer science.



2. Cloud computing implies

- a) that the unknowns in computing become known or less cloudy.
- b) that the unknowns of data become known or less cloudy.
- c) an on-demand computer and data storage for customers.
- d) that individual servers are not needed any longer.

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