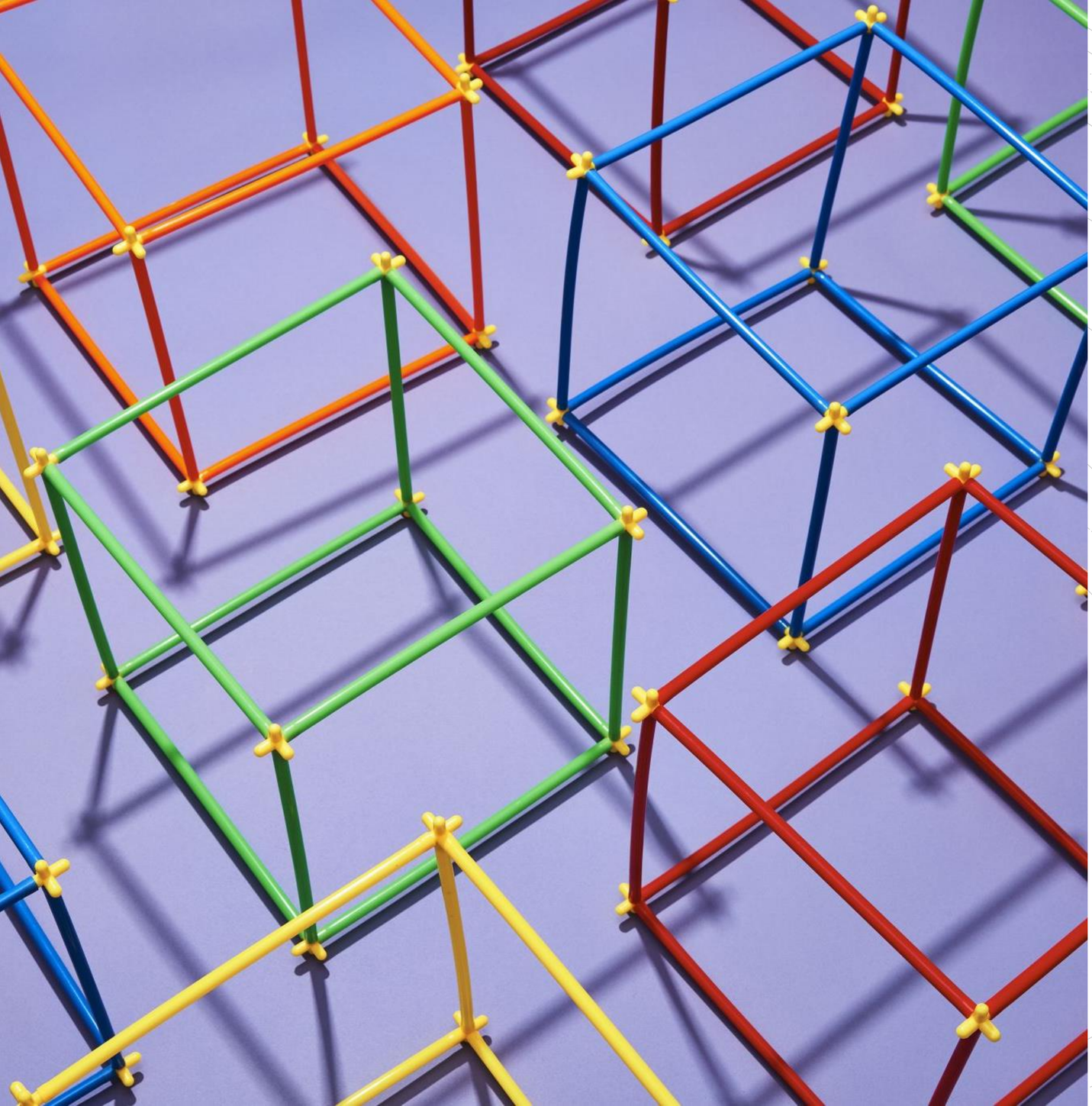


Essentials of Computer Organization and Architecture IN 2300

Chamalka Rajapaksha

2 ASSIGNMENTS

40% CA

80% ATTENDANCE

Outline Syllabus

- Evolution of computers
- Machine level representation of data and codes
- Harvard architecture and von Neumann architecture
- Instruction set architecture
- Processor structure and organization
- Input-Output organization
- Memory & storage organization
- Introduction to hierarchical bus interfaces and data flow

Evolution of Computers

- A history of computers

Eras of Computer Development

- **Pre-History**
- **Electronics**
- **Mini**
- **Micro**
- **Network**

Pre History Era
4th century B.C. to 1930s

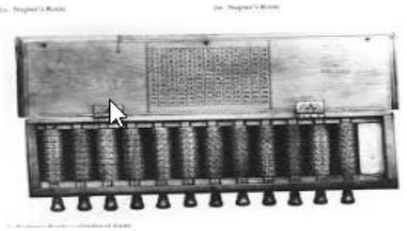
- The abacus is believed to have been invented in 4th century B.C.

- The Antikythera mechanism, a device used for registering and predicting the motion of the stars and planets, is dated to 1st century B.C.

- Arabic numerals were introduced in Europe in the 8th and 9th century A.D. and was used until the 17th century.

Pre History Era

- John Napier of Scotland invents logs in 1614 to allow multiplication and division to be converted to addition and subtraction.



- Wilhelm Schickard, a professor at the University of Tubingen, Germany builds a mechanical calculator in 1623 with a 6-digit capacity. The machine worked, but it never makes it beyond the prototype stage.

Pre History Era

- Leonardo Da Vinci is now given credit for building the first mechanical calculator around 1500. Evidence of Da Vinci's machine was not found until papers were discovered in 1967.
- Blaise Pascal builds a mechanical calculator in 1642 with an 8-digit capacity.
- Joseph-Marie Jacquard invents an automatic loom controlled by punchcards in the early 1800s.

Pre History Era

- Charles Babbage designs a "Difference Engine" in 1820 or 1821 with a massive calculator designed to print astronomical tables. The British government cancelled the project in 1842; Babbage then conceives the "Analytical Engine", a mechanical computer that can solve any mathematical problem and uses punchcards.
- Augusta Ada Byron, Countess of Lovelace and daughter of English poet Lord Byron, worked with Babbage and created a program for the Analytical Engine. Ada is now credited as being the 1st computer programmer.

Pre History Era

- Samuel Morse invents the Electric Telegraph in 1837.
- George Boole invents Boolean Algebra in the late 1840s. Boolean Algebra was destined to remain largely unknown and unused for the better part of a century, until a young student called Claude E. Shannon recognized its relevance to electronics design.
- In 1857, only twenty years after the invention of the telegraph, Sir Charles Wheatstone (the inventor of the accordian) introduced the first application of paper tapes as a medium for the preparation, storage, and transmission of data.

Pre History Era

- The first practical typewriting machine was conceived by three American inventors and friends, Christopher Latham Sholes, Carlos Glidden, and Samual W. Soule who spent their evenings tinkering together.
- The friends sold their design to Remington and Sons, who hired William K. Jenne to perfect the prototype, resulting in the release of the first commercial typewriter in 1874.
- Herman Hollerith's Tabulating Machines were used for the 1890 census; the machines used Jacquard's punched cards.

Electronic Era 1900-1964

- In 1926, Dr. Julius Edgar Lilienfield from New York filed for a patent on a transistor.
- Konrad Zuse, a German engineer, completes the 1st general purpose programmable calculator in 1941.
- Colossus, a British computer used for codebreaking, is operational by the end of 1943.
- ENIAC (Electronic Numerical Integrator Analyzer and Computer) is developed by Ballistics Research Lab in Maryland and built by the University of Pennsylvania and completed in 1945.
  - weighed 30 tons, contained 18,000 vacuum tubes, 70,000 registers, 10,000 capacitors and required 150,000 watts of electricity

Electronic Era

- The transistor is developed by Bell Telephone Laboratories in 1947.
- UNIVAC (Universal Automatic Computer) is developed in 1951 and can store 12,000 digits in random access mercury-delay lines.
- EDVAC (Electronic Discrete Variable Automatic Computer) is completed for the Ordinance Department in 1952.
  - Rapid access to both data and instructions
  - Take logical decisions internally

Limitations of 1st Generation Computers

The operating speed was quite slow.

Power consumption was very high.

It required large space for installation.

The programming capability was quite low.

Electronic Era

- Texas Instruments and Fairchild Semiconductor both announce the integrated circuit in 1959.
- The IBM 360 is introduced in April of 1964 and quickly becomes the standard institutional mainframe computer. By the mid-80s the 360 and its descendents have generated more than $100 billion in revenue for IBM.

Mini Era (1959-1970)

- The Mini Era began with the development of the integrated circuit in 1959 by Texas Instruments and Fairchild Semiconductor.
- Ivan Sutherland demonstrates a program called Sketchpad (makes engineering drawings with a light pen) on a TX-2 mainframe at MIT's Lincoln Labs in 1962.
- By 1965, an integrated circuit that cost $1,000 in 1959 now costs less than $10.

Mini Era

- Doug Engelbart demonstrates a word processor in 1968.
- Also in 1968, Gordon Moore and Robert Noyce founded a company called Intel.
- Xerox creates its Palo Alto Research Center (Xerox PARC) in 1969.
- Fairchild Semiconductor introduces a 256-bit RAM chip in 1970.
- In late 1970 Intel introduces a 1K RAM chip and the 4004, a 4-bit microprocessor. Two years later comes the 8008, an 8-bit processor.

Second Generation Computers

- Transistor replaced the bulky electric tubes in the first generation computer.
  - Smaller than electric tubes and have higher operating speed.
  - No filament and require no heating
  - Manufacturing cost was also very low.
  - Size of the computer got reduced considerably.
- The concept of Central Processing Unit (CPU), memory, programming language and input and output units were developed.
- The programming languages such as COBOL, FORTRAN were developed during this period.
- Some of the computers of the Second Generation were
  - IBM 1620: Its size was smaller as compared to First Generation computers and mostly used for scientific purpose.
  - IBM 1401: Its size was small to medium and used for business applications.
  - CDC 3600: Its size was large and is used for scientific purposes.

Third Generation Computers

- The third generation computers were introduced in 1964.
  - Used Integrated Circuits (ICs).
  - A single IC has many transistors, registers and capacitors built on a single thin slice of silicon
  - The size of the computer got further reduced
  - Some of the computers developed during this period were IBM-360, ICL-1900, IBM-370, and VAX-750
  - Higher level language such as BASIC (Beginners All purpose Symbolic Instruction Code) was developed during this period.
- Computers of this generations were small in size, low cost, large memory and processing speed is very high.

Micro Era (1971-1989)

- Bill Gates and Paul Allen form Traf-O-Data in 1971 to sell their computer traffic-analysis sytems.
- Gary Kildall writes PL/M, the first high-level programming language for the Intel Microprocessor.
- Steve Jobs and Steve Wozniak are building and selling “blue boxes” in Southern California in 1971.
- Intel introduces the 8008, the first 8-bit microprocessor in April of 1972.

Micro Era

- Jonathan A. Titus designs the Mark-8 and is featured in the July 1974 Radio Electronics.
- In January 1975 Popular Electronics features the MITS Altair 8800; it is hailed as the first “personal” computer.
- Micro Instrumentation Telemetry Systems
- Intel 8080
- Paul Allen and Bill Gates develop BASIC for the Altair 8800. Microsoft is born!!!

Micro Era

- Apple is selling its Apple II for $1,195, including 16K of RAM but no monitor by 1977.
- Software Arts develops the first spreadsheet program, Visicalc by the spring of 1979. 500 copies per month are shipped in 1979 and sales increase to 12,000 per month by 1981.
- By 1980 Apple has captured 50% of the personal computer market.

Micro Era

- In 1980 Microsoft is approached by IBM to develop BASIC for its personal computer project. The IBM PC is released in August, 1981.
- The Apple Macintosh, featuring a simple graphical interface using the 8-MHz, 32-bit Motorola 68000 CPU and a built-in 9-inch B/W screen, debuts in 1984.
- Microsoft Windows 1.0 ships in November, 1985.
- Microsoft's sales for 1989 reach $1 billion.

Fourth Generation Computers

- The fourth generation computers evolved around 1975.
- Uses large scale Integrated Circuits (LSIC) built on a single silicon chip called microprocessors.
- Due to the development of microprocessor it is possible to place computer's central processing unit (CPU) on single chip.
- These computers are called microcomputers
- Later very large scale Integrated Circuits (VLSIC) replaced LSICs.
- Thus the computer which was occupying a very large room in earlier days can now be placed on a table.

Fifth Generation Computers

- The research and development evolved near 1990s are said to be Fifth Generation computers.
- The speed is extremely high in fifth generation computer.
- Apart from this it can perform parallel processing.
- The concept of Artificial intelligence has been introduced to allow the computer to take its own decision.
- It is still in a Further developmental stage.

Network Era (Late 50s to present)

- Timesharing, the concept of linking a large numbers of users to a single computer via remote terminals, is developed at MIT in the late 50s and early 60s.
- Paul Baran of RAND develops the idea of distributed, packet-switching networks.
- Advanced Research Projects Agency Network (ARPANET) goes online in 1969.
- Bob Kahn and Vint Cerf develop the basic ideas of the Internet in 1973.

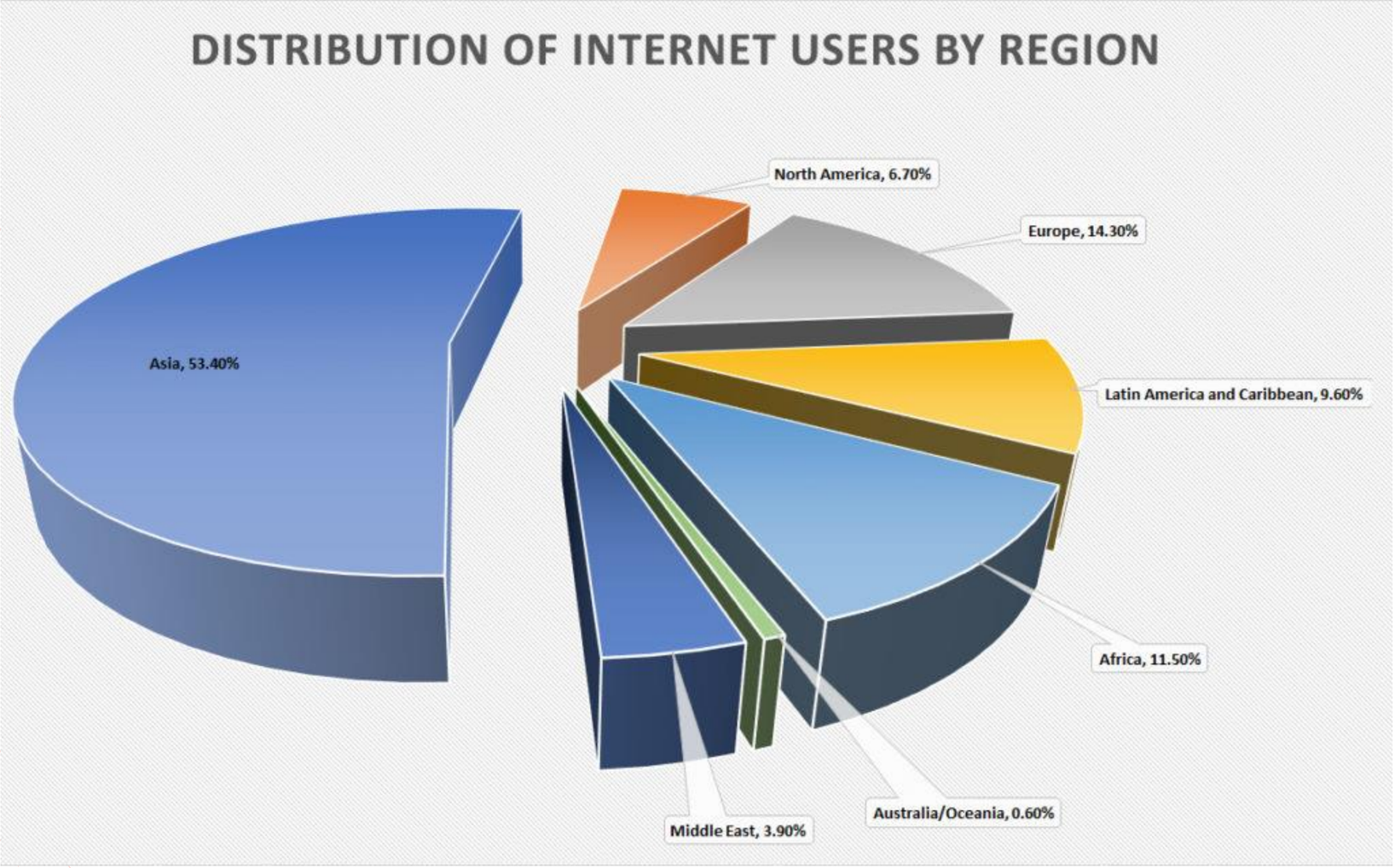
Network Era

- In 1974 (Bolt, Beranek and Newman)BBN opens the first public packet-switched network –Telenet.
- A UUCP link between the University of North Carolina at Chapel Hill and Duke University establishes USENET in 1979.
- TCP/IP (Transmission Control Protocol and Internet Protocol) is established as the standard for ARPANET in 1982.

Network Era

- The number of network hosts breaks 10,000 in 1987; two years later, the number of hosts breaks 100,000.
- Tem Berners-Lee develops the World Wide Web.
- Organisation Européenne pour la Recherche Nucléaire (CERN) releases the first Web server in 1991.
- By 1992, the number of network hosts breaks 1,000,000.

Network Era


DISTRIBUTION OF INTERNET USERS BY REGION
North America, 6.70%
Europe, 14.30%
Asia, 53.40%
Latin America and Caribbean, 9.60%
Africa, 11.50%
Australia/Oceania, 0.60%
Middle East, 3.90%

Characteristics of Computer

Speed

- Can work very fast - Takes only few seconds for calculations that we take hours to complete
- Can perform millions (1,000,000) of instructions and even more per second. Therefore, we determine the speed of computer in terms of microsecond (10-6 part of a second) or nano-second (10-9 part of a

Accuracy

- Higherlevel precision can be gained
- Degree of accuracy of computer is very high and every calculation is performed with the same accuracy. The accuracy level is determined on the basis of design of computer.

Diligence

- Computer is free from tiredness, lack of concentration, fatigue, etc.
- But heat is generated

Characteristics of Computer

Versatility

- Capacity to perform completely different type of work simultaneous

Power of Remembering

- Computer has the power of storing any amount of information or data
- Information can be stored and recalled as long as you require it

No Intelligence Quotient

- Computer is a dumb machine and it cannot do any work without instruction
- Performs the instructions at tremendous speed and with accuracy.
- Computer is not an autonomous body

Characteristics of Computer

No Feeling

- Does not have feelings or emotion, taste, knowledge and experience.

Storage

- Computer has an in-built memory where it can store a large amount of data
- Can store data in secondary storage devices such as floppies, Flash, CD which can be kept outside your computer and can be carried to other computers.

Questions?