# CD4002/CN4002
# Computer Systems and Networks

## Week 1 – The Evolution of Computing Devices

- Computer  Architecture and Taxonomy

University of East London
Pioneering Futures Since 1898

# Agenda

- Introductions
- Module aims & overview
  - Module organisation
  - Module content
  - Essential and recommended reading
  - Assessment
- A brief history of Computing
- Computer  Architecture and Taxonomy

# Module Team

**Lecturers**

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Our contact details can be found in the module study guide.

# What is the module about?

- The module aims to provide you:
  - with a basic understanding of computer architecture and the relationship between the hardware and software components of a computer system.
  - with an understanding of the fundamentals of computer networking.

# Module Organisation

- Term 2 (Weeks 1 – 12) from 31st January 2022
  - Lectures = 1 hour a week ( **Pre-recorded lecture on Moodle**)
  - Q&A session = 1 hour a week Q&A online session via Teams
  - Tutorials = weekly 2 hours Face to Face **classes on Campus**
    - (Please check your personal Timetable for details)
    - Tutorials starts in week 1
- A schedule of topics is outlined in the module study guide
- Please check your Moodle account regularly for slide handouts, tutorial and lab exercises and more information.

# Module Content

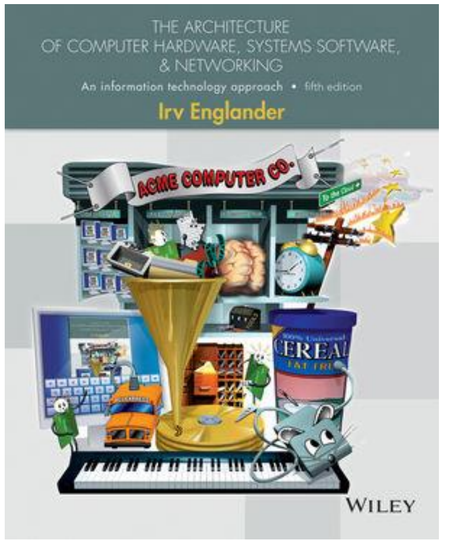
| Weeks 1 - 6 | Weeks 7 - 12 |
| --- | --- |
| The Evolution of Computing Devices | Network Fundamentals |
| Number Systems | Network Protocols and Models |
| The CPU and Memory Subsystem | Network Access |
| Input / Output Methods | Ethernet |
| Peripheral Devices | IPv4 Addressing |
| Operating Systems | Subnetting IP Networks |

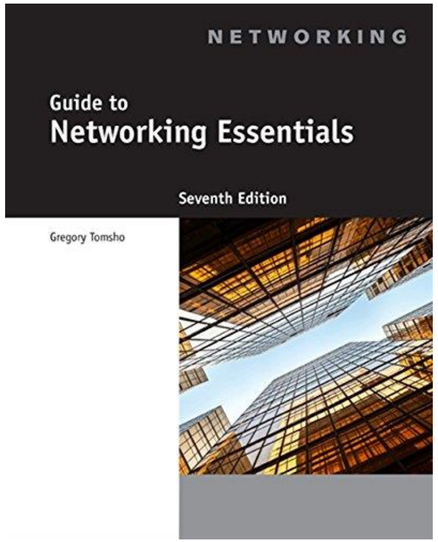
# Assessment

- Based upon 2 time-constrained assessments (TCAs)
  - **TCA1** (weighting 50%, 90 minutes) This will be based on lecture slides, tutorials and practical exercises presented in the first six weeks of Term 2.
  - Monday 21 March 2022
  - **TCA2** (weighting 50%, 90 minutes) This will be based on lecture slides, tutorials and practical exercises presented in the second six weeks of Term 2.
  - Monday 6 June 2022
- The above TCAs are equally weighted
- You must achieve an overall module mark of 40%

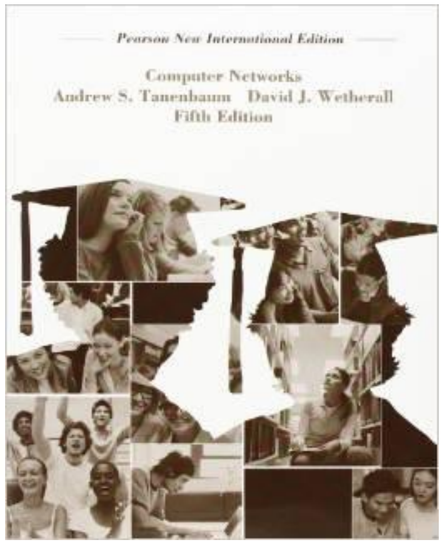
# Reading

- **Essential Reading**
  - Englander, I. S. (2013) The Architecture of Computer Hardware, Systems Software and Networking: An Information Technology Approach. 5th edn. Oxford: Wiley-Blackwell.
  - Tomsho, G. (2016) Guide to Networking Essentials. 7th edn. Boston: Course Technology, Cengage Learning.
- **Highly Recommended Reading**
  - Stallings, W. (2015) Computer Organisation and Architecture: Designing for Performance. 10th edn. London: Pearson Education
  - Tanenbaum, A. and Wetherall, D.J. (2013) Computer Networks. 5th Edition, Pearson New International Edition







# Quiz Time

Q. Why do IT professionals need an understanding of computer architecture and networking? (Choose ALL that apply.)

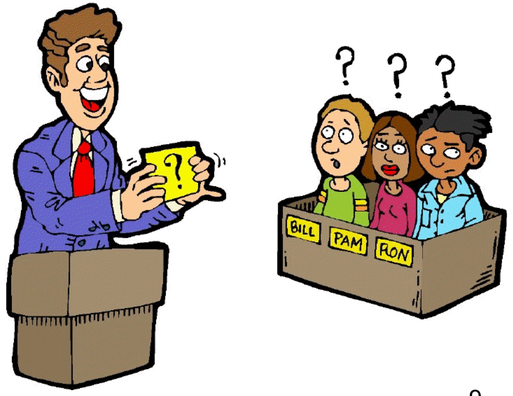
A. To help them understand system capabilities and limitations.

B. To facilitate effective communication with other IT professionals and end users.

C. To ensure system security and maximise system availability.

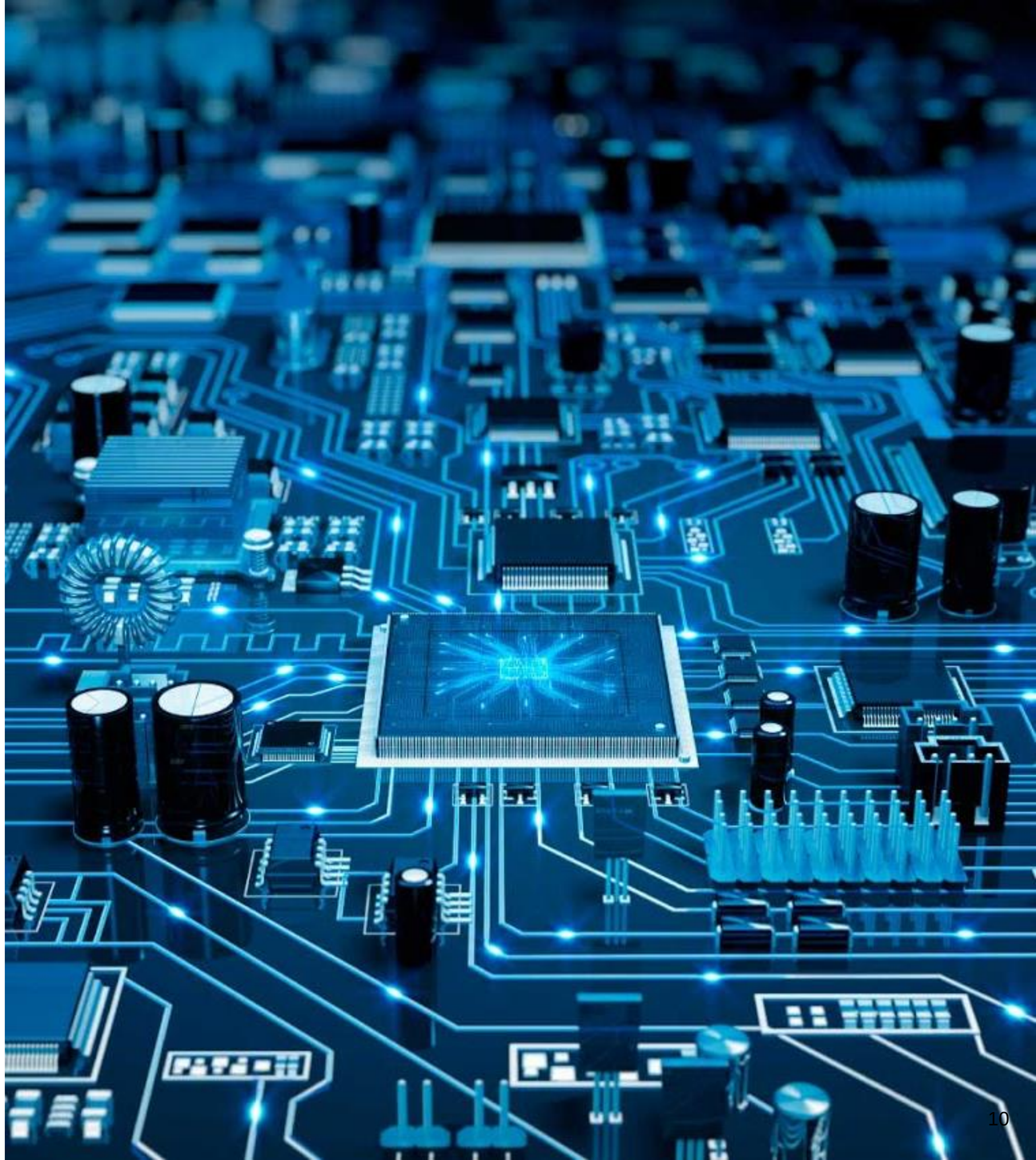
D. To install, configure, maintain and upgrade computer systems.

E. All of the above.



# The Evolution of Computing Devices

- A brief history of computer systems
  - The contribution of John Neumann to the development of modern computer systems
- The Input-Process-Output Model
- Von Neumann Architecture



# Computer Architecture and Networks

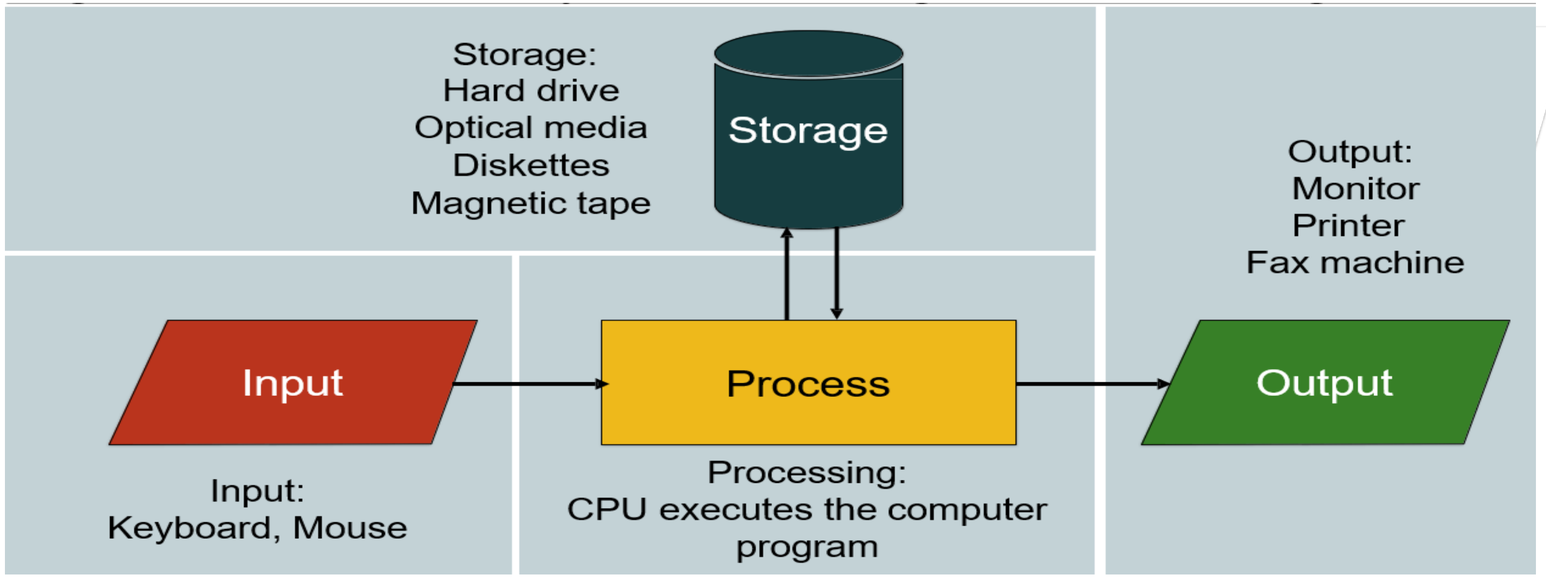
## What is Computer System?

A system is a collection of components linked together and organized in such a way as to be recognizable as a **single Processing unit**.

**A Computer** is an electrical and electronic device, that is used for computation in order to achieve goals or solve problems based on sequence of instructions (i.e., programs)

A **computer** is electrical device that can be instructed to carry out sequences of arithmetic or logical operations automatically via **computer** programming

## Basic Computer System:- Input-Process-Output Model (IPO) Architecture

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# Early History of Types of Computer Systems

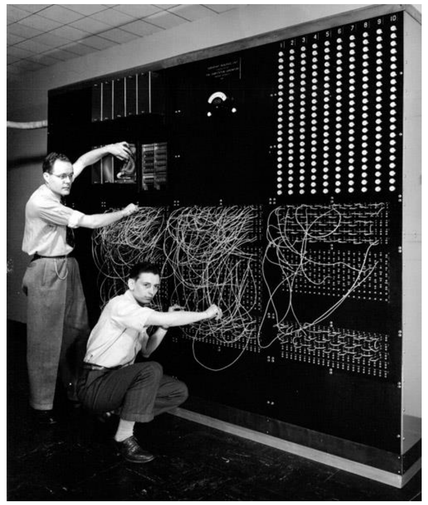
- **1642: Blaise Pascal** invents a calculating machine
- **1801: Joseph Marie Jacquard** invents a loom that **uses punch cards**
- 1800's:
  - **Charles Babbage** attempts to build an analytical engine (mechanical computer)
  - **Augusta Ada Byron** develops many of the fundamental concepts of programming
  - **George Boole** invents Boolean logic

Pascalina/Arithmetique

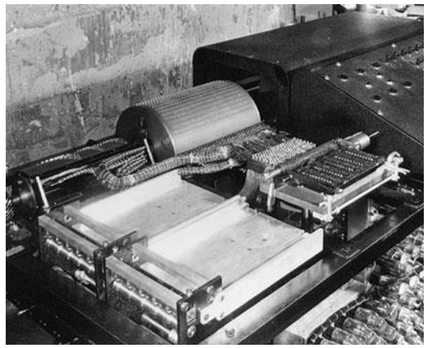
1642 — 1800

# Types of Modern Computer Development

- 1939: Atanasoff–Berry Computer (ABC) is built
  - First fully electronic digital computer. Used vacuum tubes.
    - create electrical signals by controlling movement of electrons in low pressure space



- 1937: Mark I is built (Aiken, Harvard University, IBM).
  - First electronic computer using relays.
    - Mechanical binary switches controlled by electrical currents

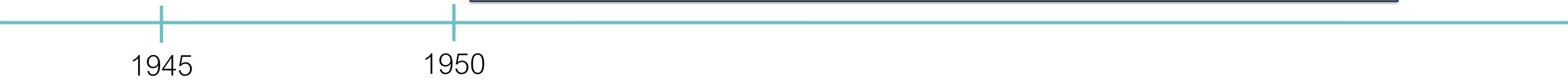


1935

1940

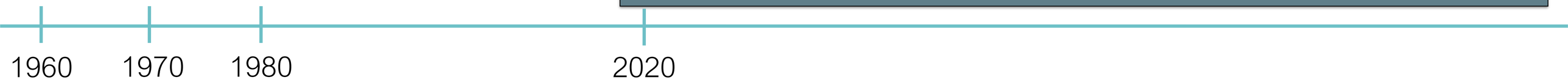
# Types of Modern Computer Development

- 1943-46: Electronic Numerical Integrator And Computer (ENIAC) (Mauchly, Eckert, University of Pennsylvania)
  - First general purpose digital computer
- 1945: Von Neumann architecture proposed
  - Still the standard for present day computers
- 1947: Creation of transistor
  - (Bardeen, Shockley, Brattain, Bell Labs)
- 1951: UNIVersal Automatic Computer (UNIVAC)
  - First commercially available computer



# Types of Modern Computer Development - VLSIC

- 1960: Invention of the integrated circuit (IC) - **Very Large Scale I C**
  - Led to smaller, faster, more powerful computers and compact, inexpensive RAM – **From Transistors and Diode to VLSIC**
- 1972: Design of the Intel 8008 microprocessor, predecessor to the x86 CPU family – **Intel Processors**
- 1981: Development of the first widely accepted PC by IBM – **Personal Computers**
- 2019: IBM unveils its first commercial quantum computer, the IBM Q System One – **Multi-core**



# CPU Performance

| Year | Processor / System | MIPS and Frequency |
|---|---|---|
| 1951 | UNIVAC 1 | 0.002 MIPS at 2.25 MHz |
| 1971 | Intel 4004 | 0.092 MIPS at 0.740 MHz |
| 1978 | Intel 8086 | 0.330 MIPS at 5.000 MHz |
| 1985 | Intel i386DX | 2.15 MIPS at 16 MHz |
| 1996 | Intel Pentium Pro | 541 MIPS at 200 MHz |
| 2008 | Intel Core i7 920 (4-core) | 82,300 MIPS at 2.93 GHz |
| 2017 | AMD Ryzen 7 1800X | 304,510 MIPS at 3.6 GHz |

(https://en.wikipedia.org/wiki/Instructions_per_second)

# Quiz Time

Q. The performance of Apple's Bionic A12 chip

A. lags behind the performance of the best desktop CPUs.

B. roughly matches the performance of the best desktop CPUs.

C. exceeds the performance of the best desktop CPUs.

(Choose ONE answer.)

(https://appleinsider.com/articles/18/10/05/apples-a12-bionic-comes-close-to-desktop-cpu-performance-in-benchmarks)

# Architecture Components of Modern Computers

- **Hardware**
  - Processes data by executing instructions
  - Provides input and output
- **Software**
  - Are instructions executed by the system
- **Data**
  - Are fundamental representation of facts and observations
- **Communications**
  - Are sharing data and processing among different systems

# Hardware Components

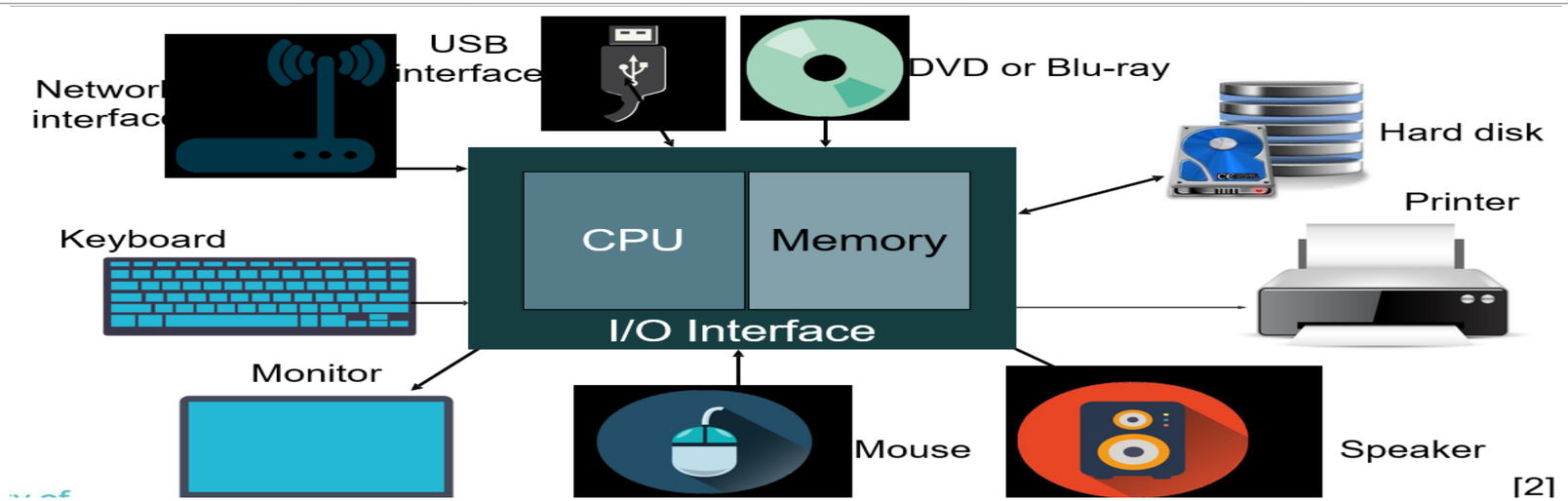
- **Central Processing Unit (CPU)**

- 1. The **Arithmetic/Logic Unit (ALU)** where arithmetic and Boolean logical calculations are performed.
- 2. The **Control Unit (CU)**, which controls the processing of instructions and the movement of internal CPU data from one part of the CPU to another.
- 3. The **Interface Unit**, which moves program instructions and data between the CPU and other hardware components.

- **Input/Output devices**
- Storage Devices
- Peripherals

- **Memory**
  - Short-term storage for CPU calculations
  - **Medium-term storage** for CPU and **Long-term storage as** Peripheral

# Typical Personal Computer System

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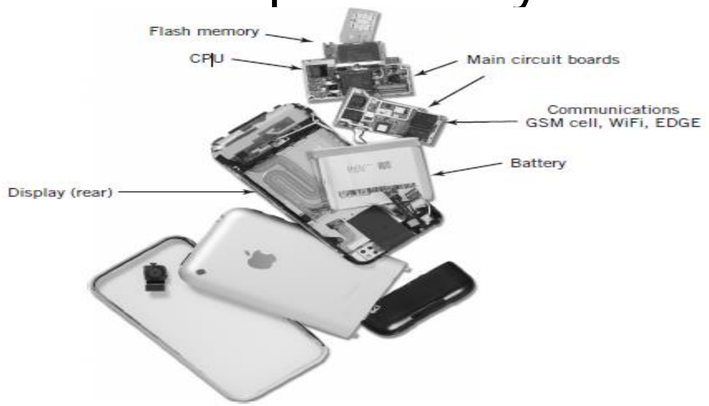
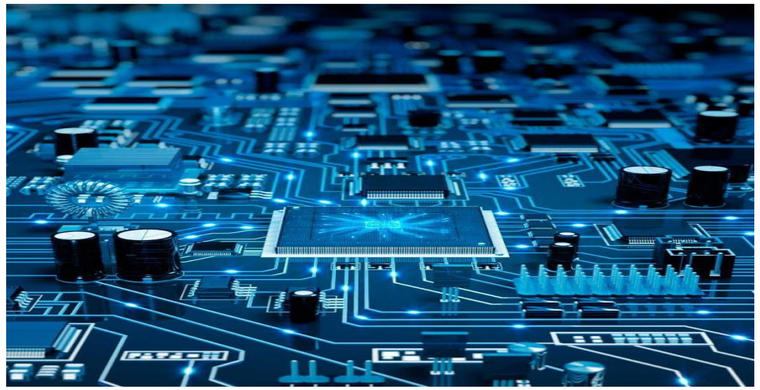
# Computer System – iPhone Components



# Von Neumann Computer Architecture

Basic concepts of this architecture:

1. **Main memory** stores programs and data (the stored program concept)
2. An **Arithmetic and Logic Unit** (ALU) operates **on binary data**
3. A **Control Unit (CU)** interprets the instructions from memory and executes them
4. **Input and output devices** are managed by the Control Unit

# CPU: Central Processing Unit and Memory

- **ALU: arithmetic/logic unit**
  - Performs arithmetic and Boolean logical calculations etc
- **CU: control unit :-** Controls the processing of instructions
  - Controls movement of data within the CPU
- **Interface unit**
  - Moves instructions and data between the CPU and other hardware components


  - Bus: bundle of wires that carry signals and power between different components

**RAM (Random Access Memory)**

- primary storage, is a working storage or physical memory,
- Consists of bits, each of which hold a value of either 0 or 1
- (8 bits = 1 byte – smallest addressable size)
  - 8 bits hold 256 different patterns
- Holds both instructions and data of a computer program (stored program concept)

# VON NEUMANN ARCHITECTURE

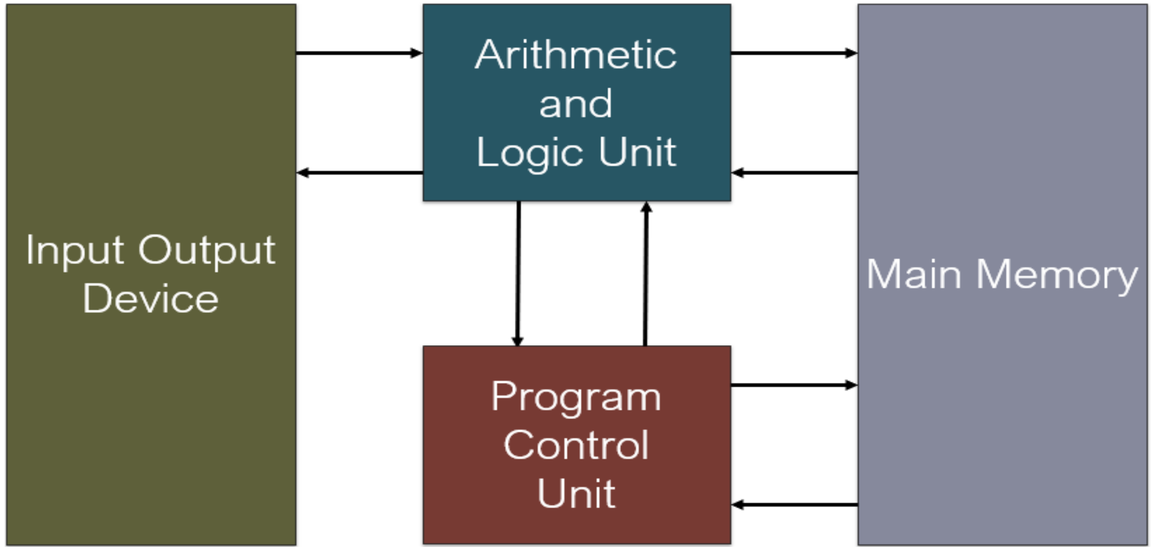
Main Components of von Neumann  Architecture - I/O;  ALU; CPU; Main Memory

**There are 3 major units in a computer tied together by buses:**

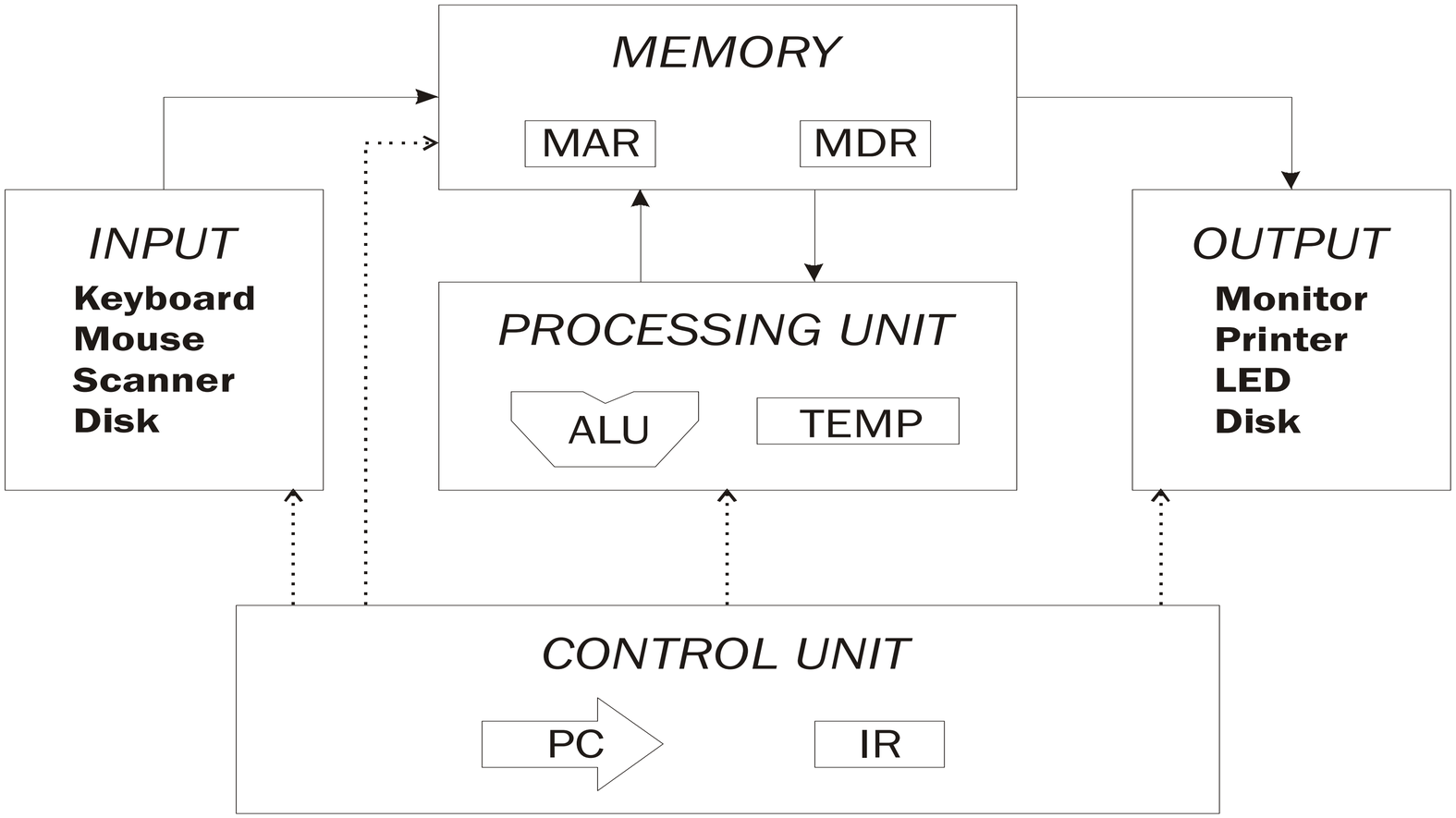
1) **Memory The unit that stores and retrieves instructions and data.**
2) **Processor: The unit houses two separate components:**

- **The control unit: Repeats the following 3 tasks repeatedly, Fetches an instruction from memory, Decodes the instruction, Executes the instruction**
- **The arithmetic/logic unit (ALU): Performs mathematical and logical operations.**

**3) Input/Output (I/O) Units: Handles communication with the outside world.**



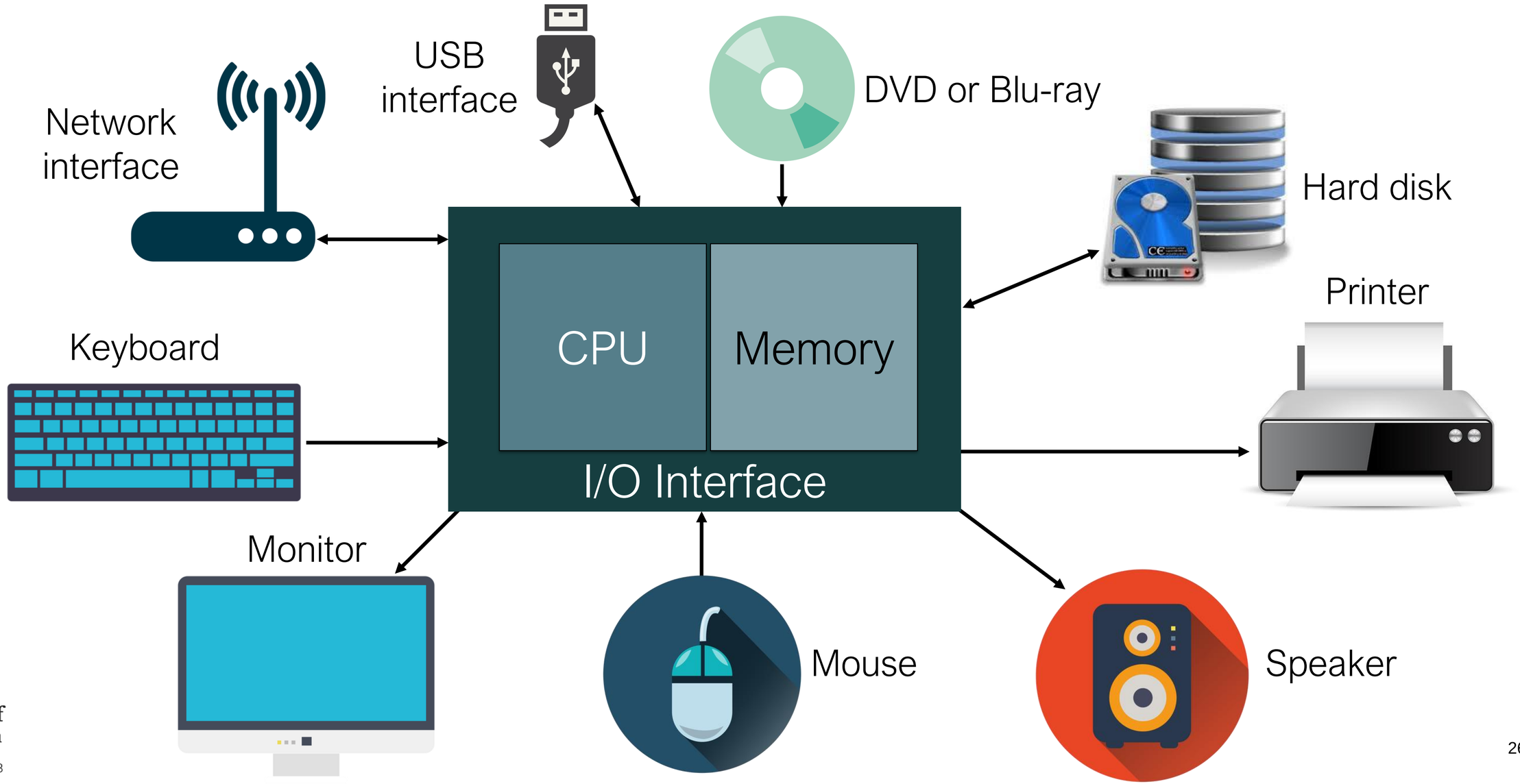
# Von Neumann Model



# Main Components of all modern Computer Systems

- No matter how complex or simple, all computer systems are made up of the following:
  - At least one CPU
  - Memory to hold programs and data
  - I/O devices
  - Long-term storage

# A Typical Modern Personal Computer



# Quiz Time

Q. The function of the Control Unit (CU) within the CPU is to

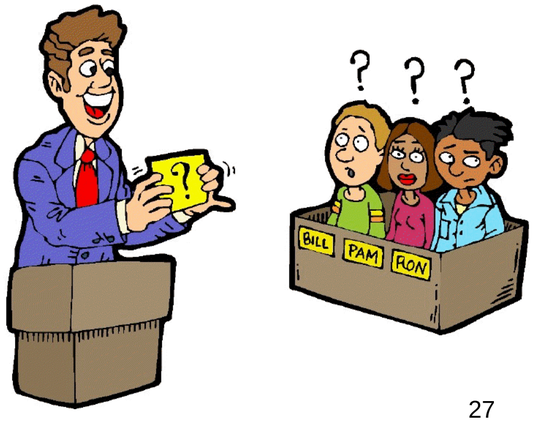
A. perform arithmetic and Boolean logic calculations.

B. move instructions and data between the CPU and other hardware components.

C. carry signals and power between different computer components.

D. control the processing of instructions and the movement of data within the CPU.

(Choose ONE answer.)



# Quiz Time

Q. Regardless of the type of work to be performed, the function of a computer system is

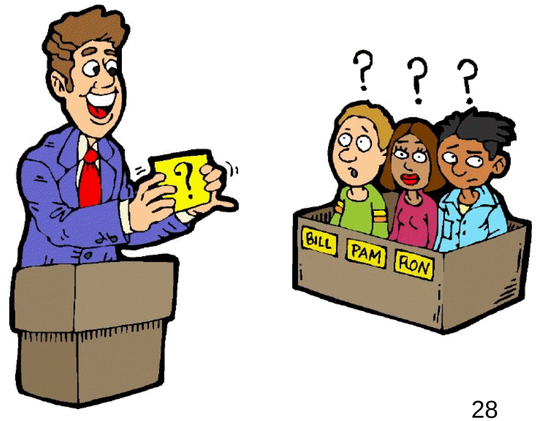
A. to entertain its users.

B. to reduce the number of employees required by companies.

C. to transform inputs into outputs.

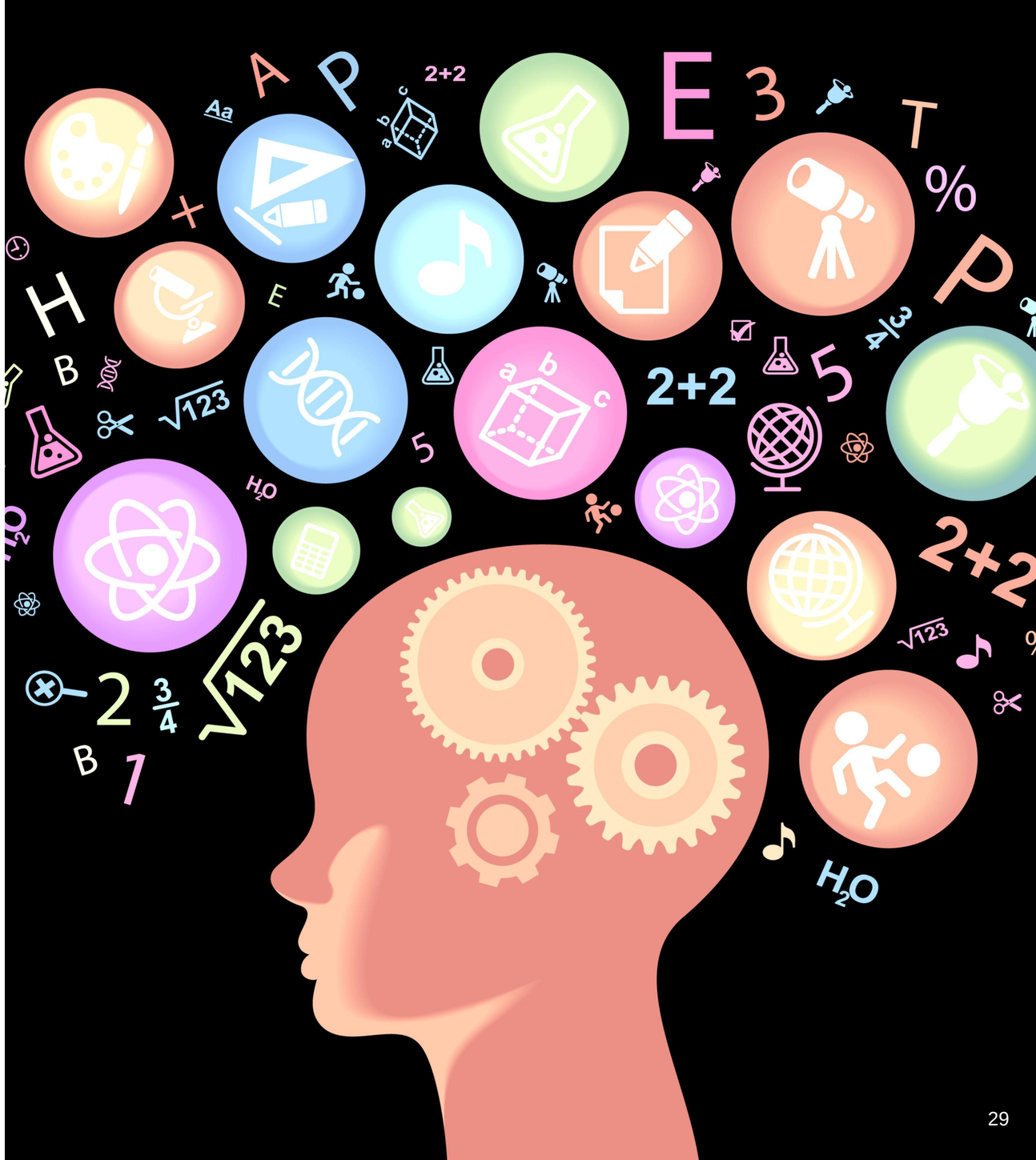
D. to increase company profits.

(Choose ONE answer.)



# Learning Objectives

- On completion of this topic, you will be able to:
  - Explain the overall aims of this module
  - Explain why an understanding of computer architecture and networking is important to IT professionals
  - Identify some of the most important milestones in the development of computing devices
  - Explain the basic principles of the Von Neumann architecture
  - Identify the key characteristics that all computing devices share



# Reading

- Essential reading
  - Englander, Chapter 1
  - Module study guide
- Recommended reading
  - Stallings, Chapters 1 and 2