19CSE330-Embedded Systems

Evaluation Policy

****L-T-P-C: 3-0-3-4**

Assessment- 65:35	Internal -65	External -35
Mid Term Exam	10 (Online) + 10(Viva)	
Continuous Assessment Theory (CAT)	15	
Continuous Assessment Lab (CAL)	30	
End Semester Exam		15 (Online) + 20 (Viva)

- **Continuous Evaluation Theory -15%**
  - 4 Assignment – 10%
  - 2 Class Test - 5%
- **Continuous Evaluation Lab -30%**
  - 9 Lab Sheet Evaluation – 5%
  - Project – 5%
  - Internal Exam - 10%
  - Final Exam –10%
- **End Semester Exam-35%**

Text Book(s)

1. Furber SB. ARM system-on-chip architecture. pearson Education; 2000.
2. Martin T. The Insider's guide to the Philips ARM7-based microcontrollers. Coventry, Hitex, UK, Ltd. 2005.

Reference(s)

1. Valvano JW. Embedded Systems: Introduction to ARM Cortex-M Microcontrollers.
2. Jonathan W. Valvano; 2016. Valvano JW. Embedded microcomputer systems: real time interfacing. Cengage Learning; 2012
3. https://courses.edx.org/courses/course-v1:UTAustinX+UT.6.10x+1T2017/course/
4. https://courses.edx.org/courses/course-v1:UTAustinX+UT.6.20x+2T2018/course/

Definition

- **Embed**:
  – ***to enclose closely in a surrounding mass.***
- **System:** implicitly a ***controlling*** system.

➢ **System:** Anything which accepts input, processes it and presents the output in the required format can be a system.

Embedded systems (ES) = **information processing systems embedded into a larger product**

It is more than a Computer, It is a “Complete System”

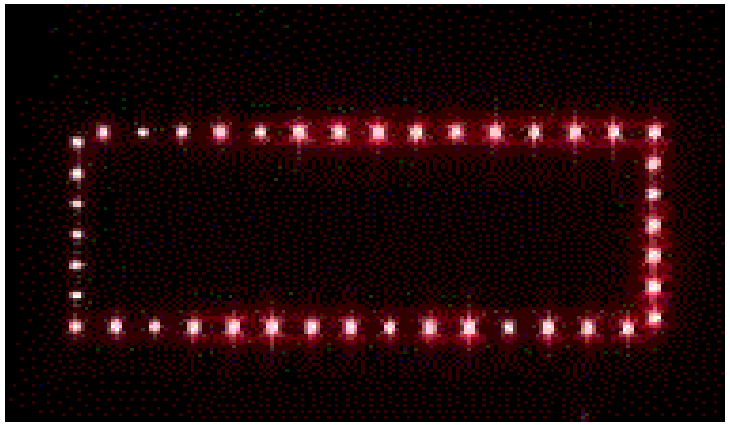
What is an Embedded System?

- “An embedded system can be defined as those control systems which are designed either by microprocessor or microcontroller for a specific tasks. ” OR
- “An embedded system is some combination of computer hardware & software, either fixed in capability or programmable, that is specifically designed for a particular kind of application device. ” OR
- “An embedded system is the one that has computer hardware with software embedded in it as one of its most important components.”

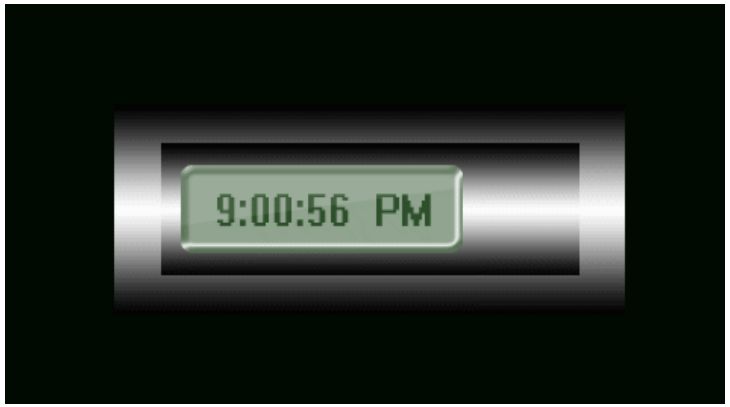
A “short list” of embedded systems

Anti-lock brakes
Auto-focus cameras
Automatic teller machines
Automatic toll systems
Automatic transmission
Avionic systems
Battery chargers
Camcorders
Cell phones
Cell-phone base stations
Cordless phones
Cruise control
Curbside check-in systems
Digital cameras
Disk drives
Electronic card readers
Electronic instruments
Electronic toys/games
Factory control
Fax machines
Fingerprint identifiers
Home security systems
Life-support systems
Medical testing systems
Modems
MPEG decoders
Network cards
Network switches/routers
On-board navigation
Pagers
Photocopiers
Point-of-sale systems
Portable video games
Printers
Satellite phones
Scanners
Smart ovens/dishwashers
Speech recognizers
Stereo systems
Teleconferencing systems
Televisions
Temperature controllers
Theft tracking systems
TV set-top boxes
VCR’s, DVD players
Video game consoles
Video phones
Washers and dryers

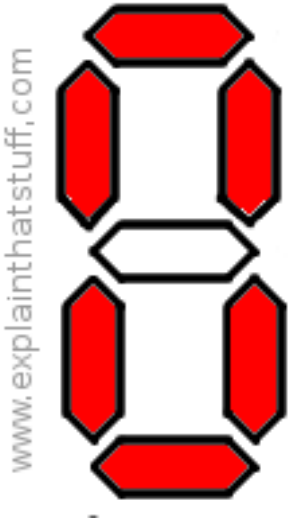
Embedded System Daily Applications



Moving message display



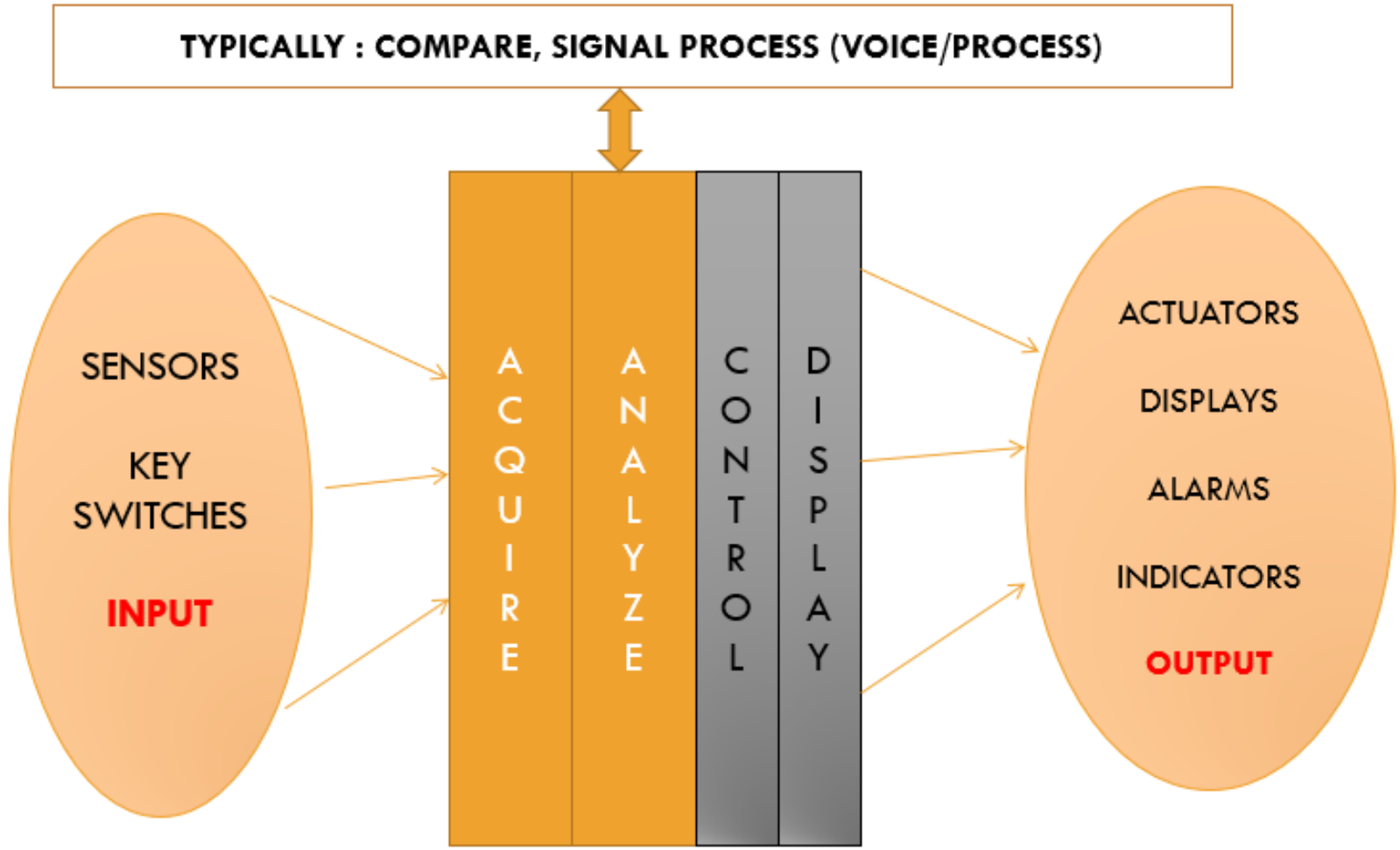
Digital clock



7 segment display

Traffic Light

A Diagrammatic representation of Embedded Systems Architecture – Presented here!



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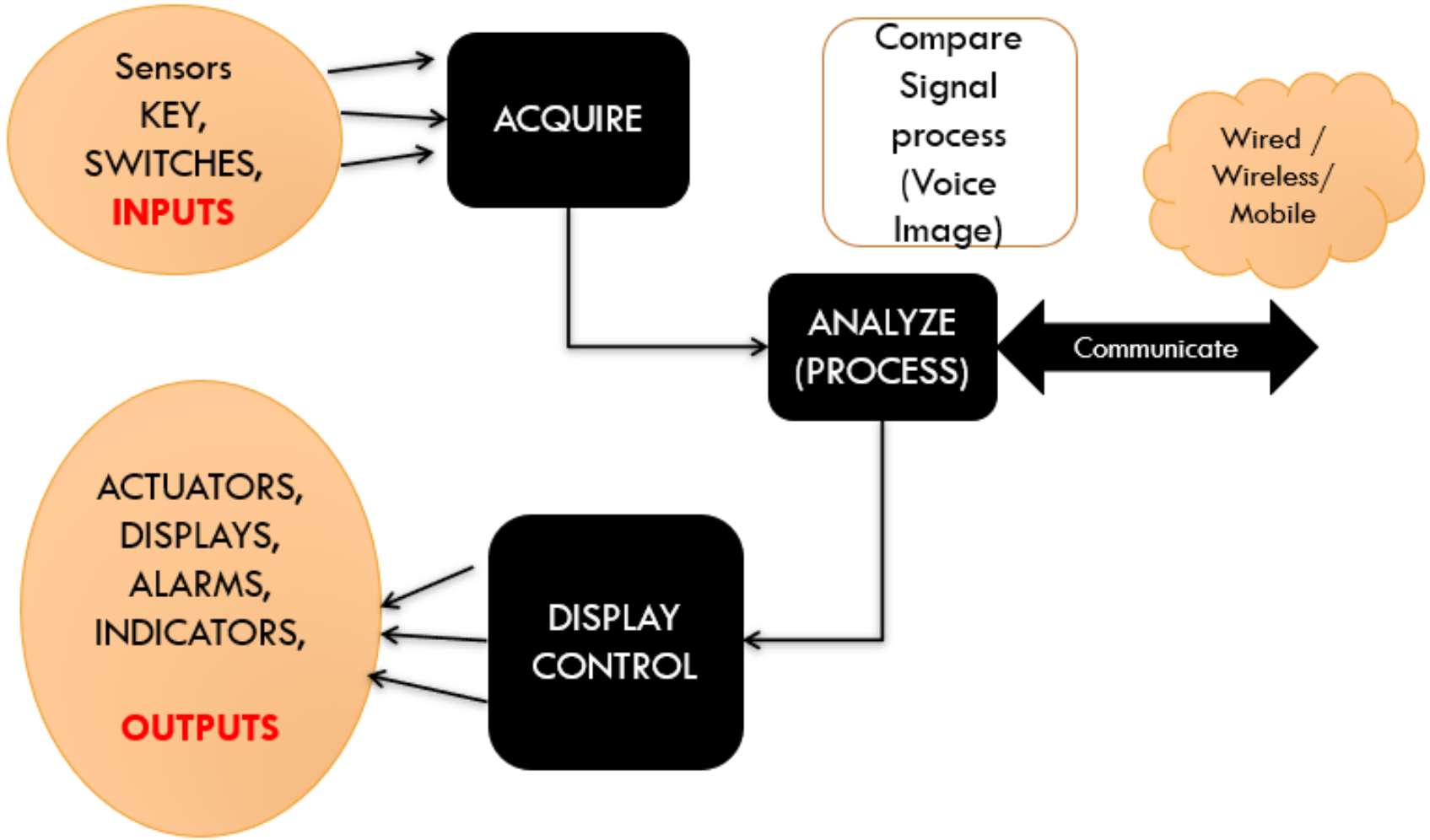


Essential Components of Embedded Systems

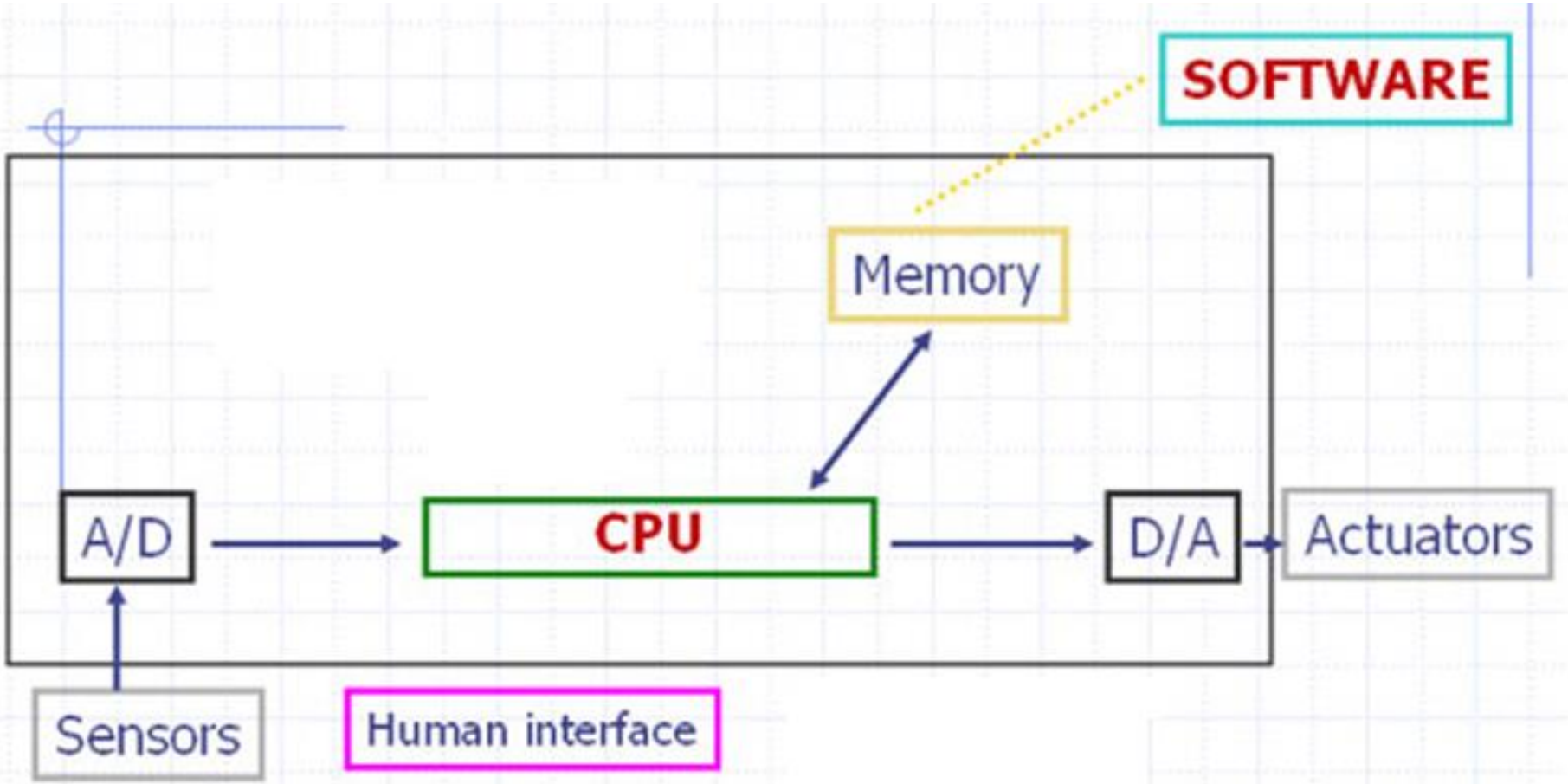
- **The ES has three major components and they are classified as follows:**
  - Hardware
  - Software
  - RTOS (Real Time OS)

- **Hardware:**
  - Microprocessor / Microcontroller
  - Sensors
  - Converters (A/D and D/A)
  - Actuators
  - Memory (On-chip and Off chip)
  - Communication path with the interacting environment

- **Software:**
  - Application software that can perform a series of task.

- **RTOS:**
  - Defines the way the system works
  - Supervises the application software
  - Provides a mechanism to let the processor to run a process as per scheduling (Process scheduling)
  - Perform Context switching between the processes

Block Diagram

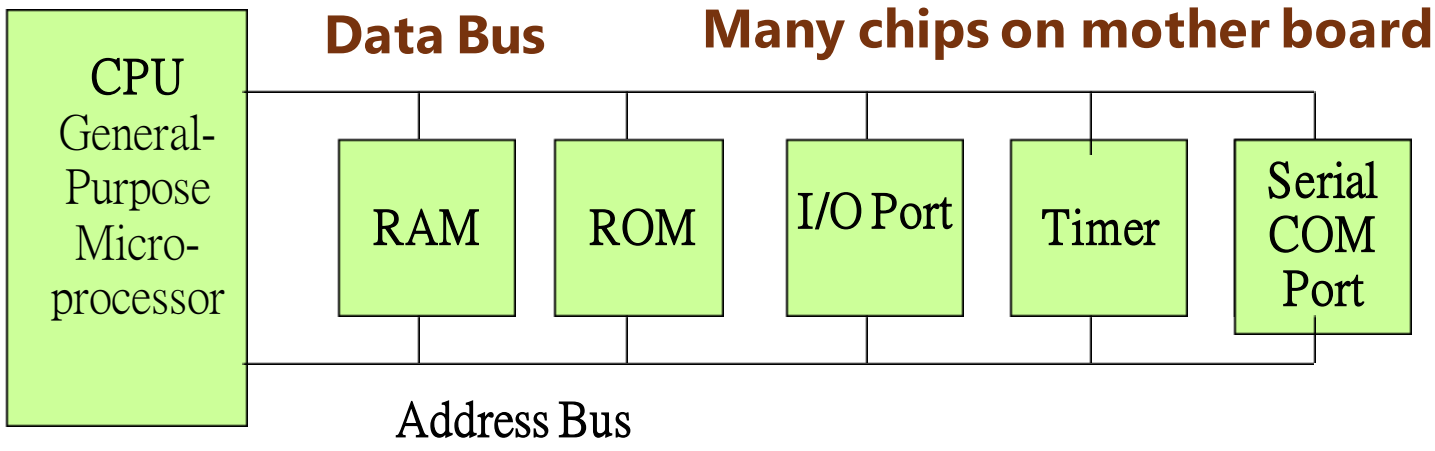


Important Units of microprocessor/controller

- CPU: Central Processing Unit
- I/O: Input /Output
- Bus: Address bus & Data bus
- Memory: RAM & ROM
- Timer
- Interrupt

Microprocessor

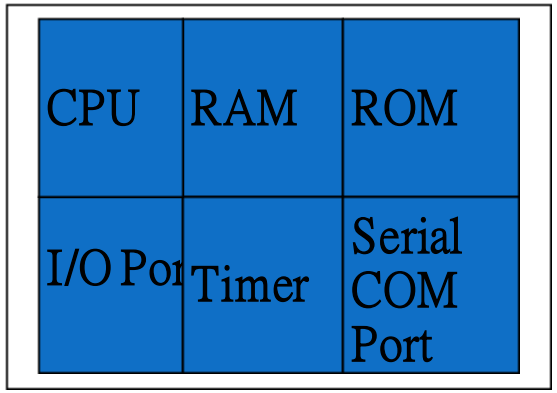
- General-purpose microprocessor
- CPU for Computers
- No RAM, ROM, I/O on CPU chip itself
- Example--Intel's x86: 8086,8088,80386,80486, Pentium



General-Purpose Microprocessor System

Microcontroller

- A smaller computer.
- On-chip RAM, ROM, I/O ports...
- Example:- Motorola's 6811, Intel's 8051 and PIC 16X



A single chip

Microcontroller

Microprocessor v/s Microcontroller

Microprocessor

- CPU is stand-alone, RAM, ROM, I/O, timer are separate
- Designer can decide on the amount of ROM, RAM and I/O ports.
- Expensive
- General-purpose
- Examples:-
  - 8085,8086 microprocessors
  - Motorola6800,
  - Intel's 8086, etc.

Microcontroller

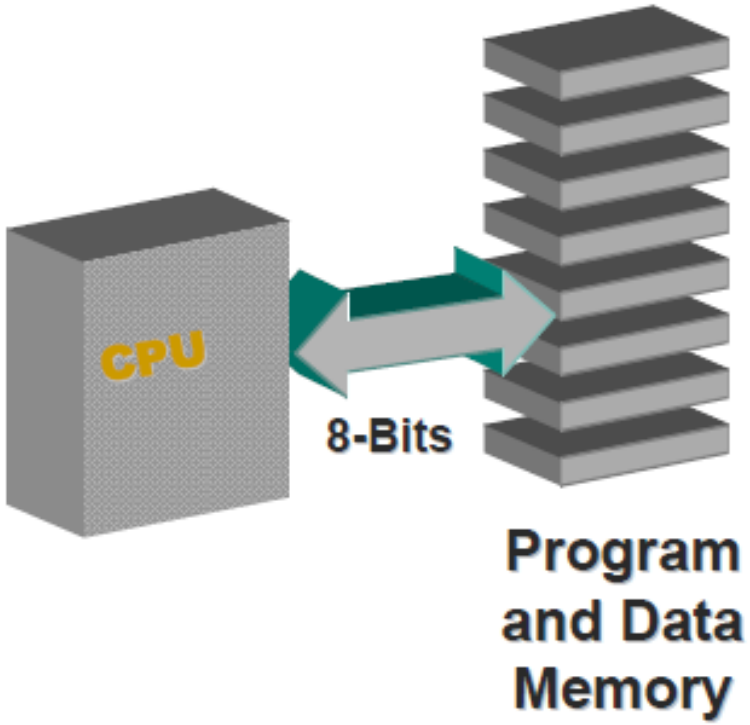
- CPU, RAM, ROM, I/O and timer are all on a single chip
- Fixed amount of on-chip ROM, RAM, I/O ports
- For applications in which cost, power and space are critical
- Single-purpose
- Examples:-
  - 8051,
  - PIC mc,
  - Motorola
  - MC's, Phillips, etc.

Main Architecture

- Embedded processors are constructed into 2 main architecture
  - Von Neumann
  - Harvard

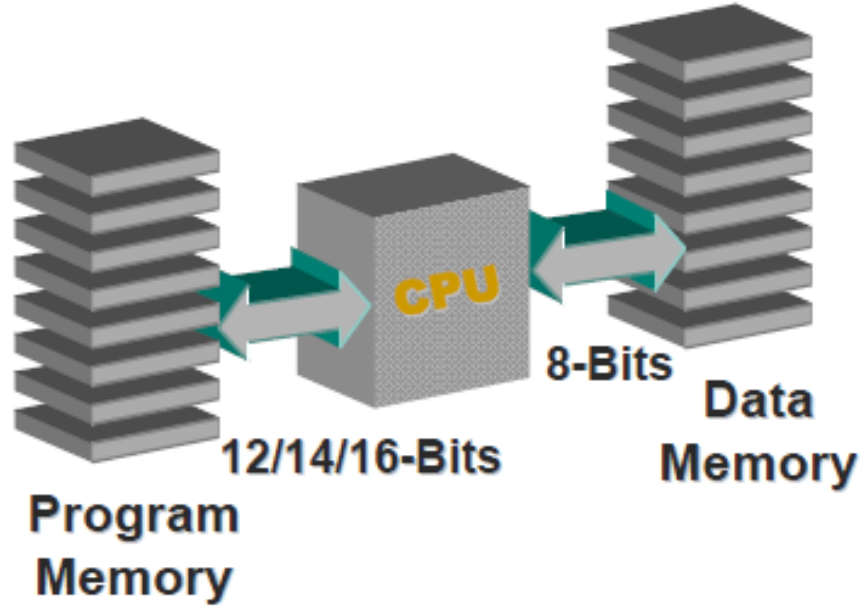
Von Neumann Architecture

- Fetches instructions and data from same memory
- Limits operating bandwidth



Harvard Architecture

- Two separate memory spaces for instruction and data
- Increases throughput
- Different program and data bus widths are possible



Thank You