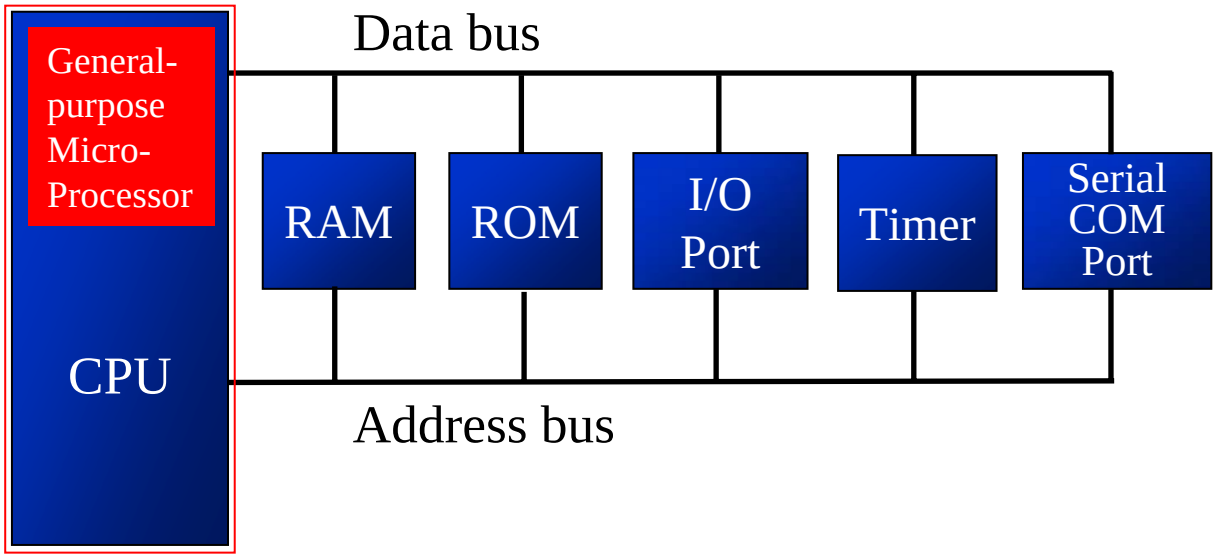
# MICRO-CONTROLLERS AND EMBEDDED PROCESSORS

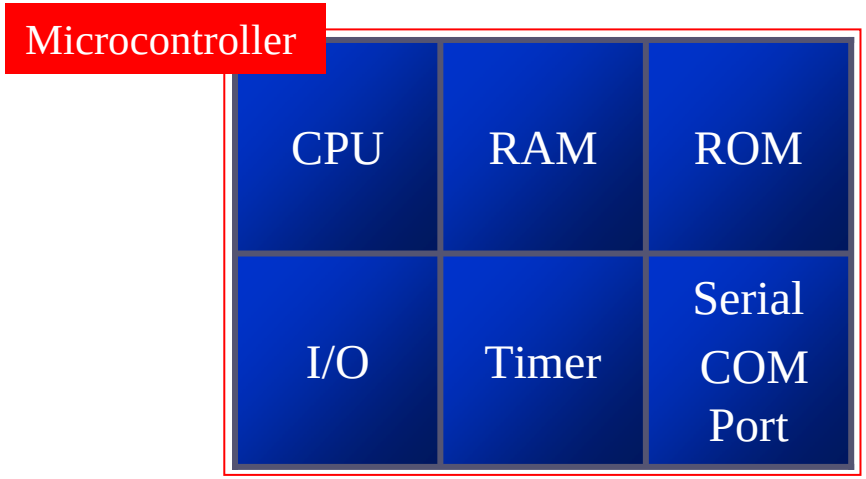
## Microcontroller vs. General-Purpose Microprocessor

- General-purpose microprocessors contains
  - No RAM
  - No ROM
  - No I/O ports
- Microcontroller has
  - CPU (microprocessor)
  - RAM
  - ROM
  - I/O ports
  - Timer
  - ADC and other peripherals

# MICRO-CONTROLLERS AND EMBEDDED PROCESSORS

## Microcontroller vs. General-Purpose Microprocessor (cont')



MICRO-CONTROLLERS AND EMBEDDED PROCESSORS

Microcontroller vs. General-Purpose Microprocessor (cont')

- General-purpose microprocessors
  - Must add RAM, ROM, I/O ports, and timers externally to make them functional
  - Make the system bulkier and much more expensive
  - Have the advantage of versatility on the amount of RAM, ROM, and I/O ports
- Microcontroller
  - The fixed amount of on-chip ROM, RAM, and number of I/O ports makes them ideal for many applications in which cost and space are critical
  - In many applications, the space it takes, the power it consumes, and the price per unit are much more critical considerations than the computing power

MICRO-CONTROLLERS AND EMBEDDED PROCESSORS

Microcontrollers for Embedded Systems

- An embedded product uses a microprocessor (or microcontroller) to do one task and one task only
  - There is only one application software that is typically burned into ROM
- A PC, in contrast with the embedded system, can be used for any number of applications
  - It has RAM memory and an operating system that loads a variety of applications into RAM and lets the CPU run them
  - A PC contains or is connected to various embedded products
    - Each one peripheral has a microcontroller inside it that performs only one task

# MICRO-CONTROLLERS AND EMBEDDED PROCESSORS

## Microcontrollers for Embedded Systems (cont')

- Home
  - Appliances, intercom, telephones, security systems, garage door openers, answering machines, fax machines, home computers, TVs, cable TV tuner, VCR, camcorder, remote controls, video games, cellular phones, musical instruments, sewing machines, lighting control, paging, camera, pinball machines, toys, exercise equipment
- Office
  - Telephones, computers, security systems, fax machines, microwave, copier, laser printer, color printer, paging
- Auto
  - Trip computer, engine control, air bag, ABS, instrumentation, security system, transmission control, entertainment, climate control, cellular phone, keyless entry

# MICRO-CONTROLLERS AND EMBEDDED PROCESSORS

## x86 PC Embedded Applications

- Many manufactures of general-purpose microprocessors have targeted their microprocessor for the high end of the embedded market
  - There are times that a microcontroller is inadequate for the task
- When a company targets a general-purpose microprocessor for the embedded market, it optimizes the processor used for embedded systems
- Very often the terms *embedded processor* and *microcontroller* are used interchangeably

# MICRO-CONTROLLERS AND EMBEDDED PROCESSORS

## x86 PC Embedded Applications (cont')

- One of the most critical needs of an embedded system is to decrease power consumption and space
- In high-performance embedded processors, the trend is to integrate more functions on the CPU chip and let designer decide which features he/she wants to use
- In many cases using x86 PCs for the high-end embedded applications
  - Saves money and shortens development time
    - A vast library of software already written
    - Windows is a widely used and well understood platform

MICRO-CONTROLLERS AND EMBEDDED PROCESSORS

Choosing a Microcontroller

- 8-bit microcontrollers
  - Motorola's 6811
  - Intel's 8051
  - Zilog's Z8
  - Microchip's PIC
- There are also 16-bit and 32-bit microcontrollers made by various chip makers

MICRO-CONTROLLERS AND EMBEDDED PROCESSORS

Criteria for Choosing a Microcontroller

- Meeting the computing needs of the task at hand efficiently and cost effectively
  - Speed
  - Packaging
  - Power consumption
  - The amount of RAM and ROM on chip
  - The number of I/O pins and the timer on chip
  - How easy to upgrade to higher-performance or lower power-consumption versions
  - Cost per unit

MICRO-CONTROLLERS AND EMBEDDED PROCESSORS

Criteria for Choosing a Microcontroller (cont')

- Availability of software development tools, such as compilers, assemblers, and debuggers
- Wide availability and reliable sources of the microcontroller
  - The 8051 family has the largest number of diversified (multiple source) suppliers
    - Intel (original)
    - Atmel
    - Philips/Signetics
    - AMD
    - Infineon (formerly Siemens)
    - Matra
    - Dallas Semiconductor/Maxim