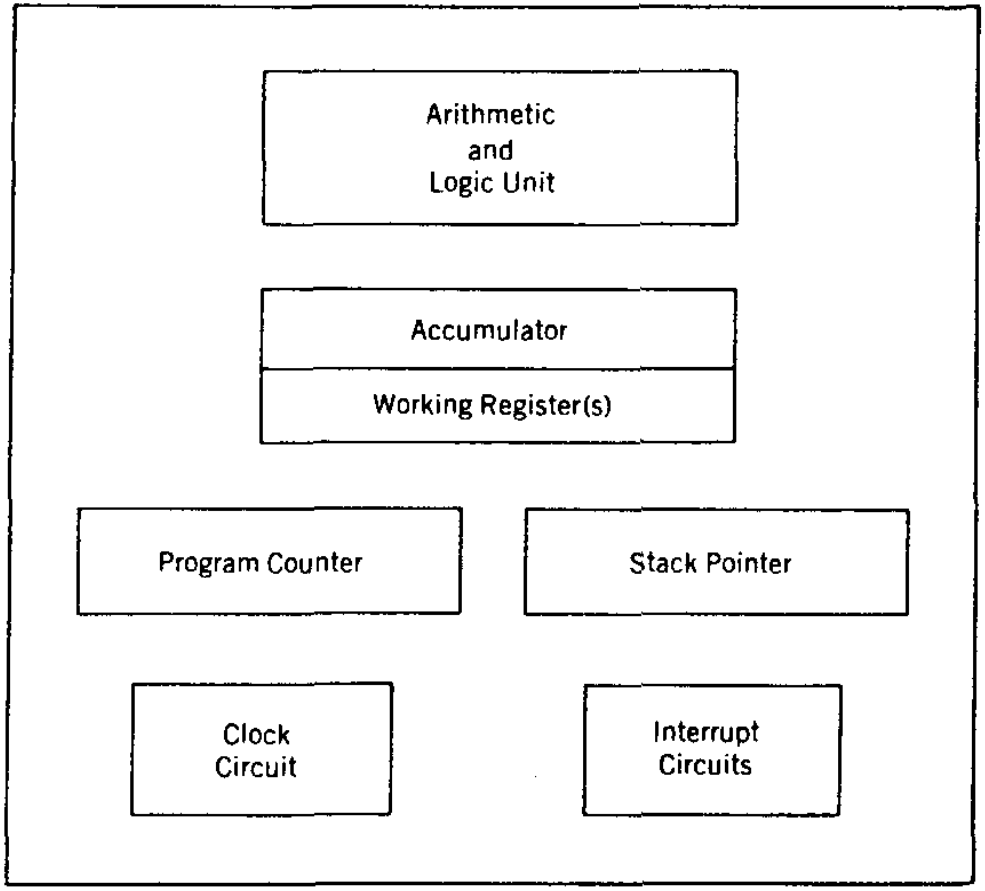
Introduction to 8051 microcontroller

Necessary parts of any Microprocessor/controller

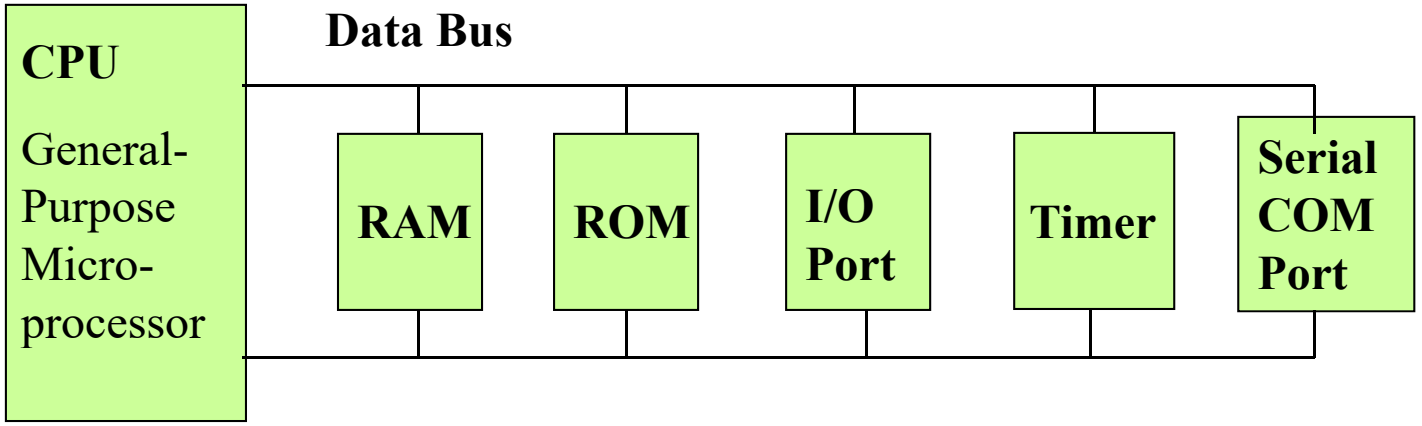
- CPU: Central Processing Unit
- I/O: Input /Output
- Bus: Address bus , Data bus , Control bus
- Memory: RAM & ROM
- Timer
- Interrupt
- Serial Port
- Parallel Port

A Block Diagram of a Microprocessor



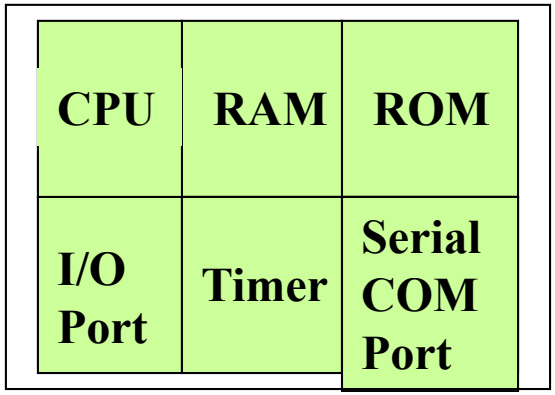
Microprocessor

- General-purpose digital computer Central Processing Unit
- CPU for Computers
- No RAM, ROM, I/O on CPU chip itself
- Example：Intel’s x86, Motorola’s 680x0



Microcontroller

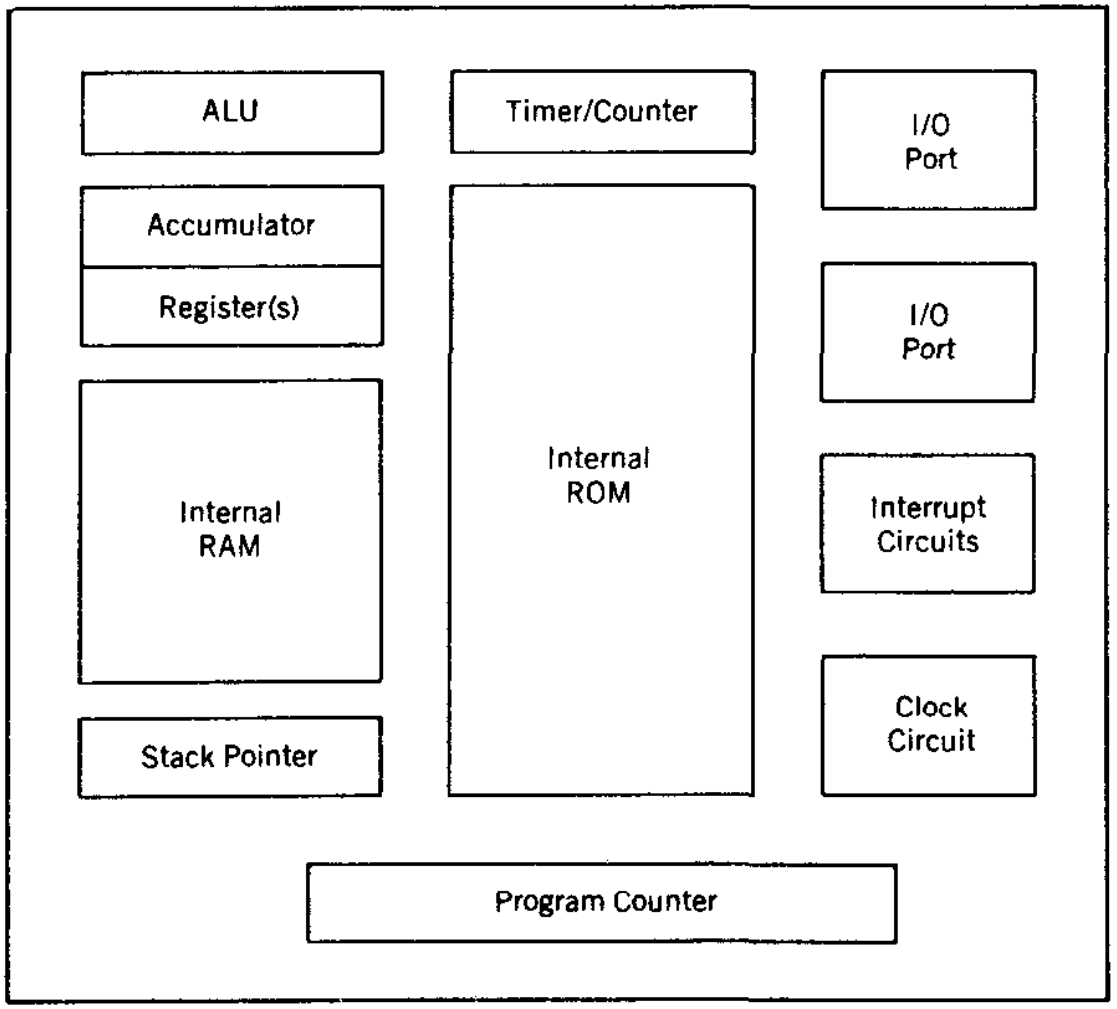
- A smaller computer
- On-chip RAM, ROM, I/O ports...
- Example：Motorola’s 6811, Intel’s 8051, Zilog’s Z8 and PIC 16X



A single chip

Microcontroller

A Block Diagram of a Microcontroller



The fundamental differences between microprocessors and microcontrollers are:

- Microprocessors are intended to be general-purpose digital computers while microcontrollers are intended to be special-purpose digital controllers.
- Microprocessors contain a CPU, memory addressing circuits, and interrupt handling circuits. Microcontrollers have these features as well as timers, parallel and serial I/O, and internal RAM and ROM.
- Microcontroller models vary in data size from 4 to 32 bits. Four-bit units are produced in huge volumes for very simple applications, and 8-bit units are the most versatile. Sixteen- and 32-bit units are used in high-speed control and signal processing applications.
- Many models feature programmable pins that allow external memory to be added with the loss of I/O capability.

Microprocessor Vs. Microcontroller

1. Most microprocessors have many operational codes (opcodes) for moving external memory to the CPU.	1.Micro controllers have one or two.
2. µp have one or two type of bit handling instruction	2.µc have many
3. µp concerned with rapid movement of code and data from external address to chip	3. µc concerned with rapid movement of bits within the chip
4. µp needs many additional parts to become operational	4. µc can function as computer with no additional parts

On the hardware point of view…..

Microprocessor	**Microcontroller**
• CPU is stand-alone	• CPU, RAM, ROM, I/O and timer are all on a single chip
• RAM, ROM, I/O, timer are separate so designer can decide on the amount of ROM, RAM and I/O ports	• Fix amount of on-chip ROM, RAM, I/O ports
• Expansive • Versatility • General-purpose	• For applications in which cost, power and space are critical • Specific - purpose

The comparison of Z80 μp and 8051 μc

	Z80	8051
Pin Configurations		
Total pins	40	40
Address pins	16 (fixed)	16
Data pins	8 (fixed)	8
Interrupt pins	2 (fixed)	2
I/O pins	0	32
Architecture		
8-bit registers	20	34
16-bit registers	4	2
Stack size	64K	128
Internal ROM	0	4K bytes
Internal RAM	0	128 bytes
External memory	64K	128K bytes
Flags	6	4
Timers	0	2
Parallel port	0	4
Serial port	0	1

Micro controller Survey

Four-Bit Micro controllers

Manufacturer : Model	Pins : I/O	Counters	RAM (bytes)	ROM (bytes)
Hitachi : HMCS40	28 : 10	—	32	512
National : COP420	28 : 23	1	64	1K
OKI : MSM6411	16 : 11	—	32	1K
TI: TMS 1000	28 : 23	—	64	1K
Toshiba : TLCS47	42 : 35	2	128	2K

Eight-Bit Micro controllers

Manufacturer : Model	Pins : I/O	Counters	RAM (bytes)	ROM (bytes)	Other Features
Intel : 8048	40 : 27	1	64	1K	External memory to 8K
Intel : 8051	40 : 32	2	128	4K	External memory to 128K; serial port
National : COP820	28 : 24	1	64	1K	Serial bit I/O
Motorola : 6805	28 : 20	1	64	1K	
Motorola : 68HC11	52 : 40	2	256	8K	Serial ports; A/D; watch dog timer (WDT)
Rockwell : 6500/1	40 : 32	1	64	2K	
Signetics : 87C552	68 : 48	3	256	8K	Serial port; A/D; WDT
TI : TMS7500	40 : 32	1	128	2K	External memory to 64K
TI : TMS370C050	68 : 55	2	256	4K	External memory to 112K; A/D; serial ports; WDT
Zilog : Z8	40 : 32	2	128	2K	External memory to 124K; serial port
Zilog : Z8820	44 : 40	2	272	8K	External memory to 128K; serial port

Common Microcontrollers

- Atmel
- ARM
- Intel
  - 8-bit
    - 8XC42
    - MCS48
    - **MCS51**
    - 8xC251
  - 16-bit
    - MCS96
    - MXS296
- National Semiconductor
  - COP8
- Microchip
  - 12-bit instruction PIC
  - 14-bit instruction PIC
    - PIC16F84
  - 16-bit instruction PIC
- Motorola
  - 8-bit
    - 68HC05
    - 68HC08
    - 68HC11
  - 16-bit
    - 68HC12
    - 68HC16
  - 32-bit
    - 683xx
- Texas Instruments
  - TMS370
  - MSP430
- Zilog
  - Z8
  - Z86E02

Why we study Microprocessor / Microcontroller

- The microprocessor is the core of computer systems.
- The microcontroller is the core of embedded systems.
- Nowadays many communication, digital entertainment, portable devices, are controlled by them.
- A designer should know what types of components he needs, ways to reduce production costs and product reliable.
- To increase efficiency of already deployed devices
- Understand computer hardware as a system programmer
- Introduce you to the use of a processor in control systems

Three criteria in Choosing a Microcontroller

1. meeting the computing needs of the task efficiently and cost effectively
   - speed, the amount of ROM and RAM, the number of I/O ports and timers, size, packaging, power consumption
   - easy to upgrade
   - cost per unit
2. availability of software development tools
   - assemblers, debuggers, C compilers, emulator, simulator, technical support
3. wide availability and reliable sources of the microcontrollers.

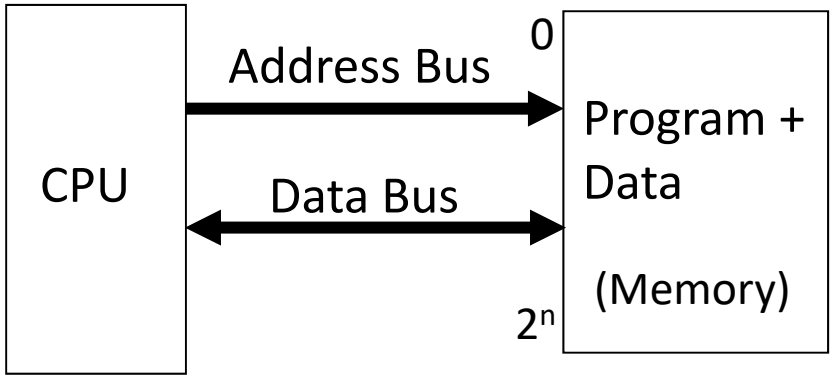
Embedded System

- Embedded system means the processor is embedded into that application.
- An embedded product uses a microprocessor or microcontroller to do one task only.
- In an embedded system, there is only one application software that is typically burned into ROM.
- Special purpose computer system usually completely inside the device it controls
- Has specific requirements and performs pre-defined tasks
- Cost reduction compared to general purpose processor
- Example：printer, keyboard, video game player

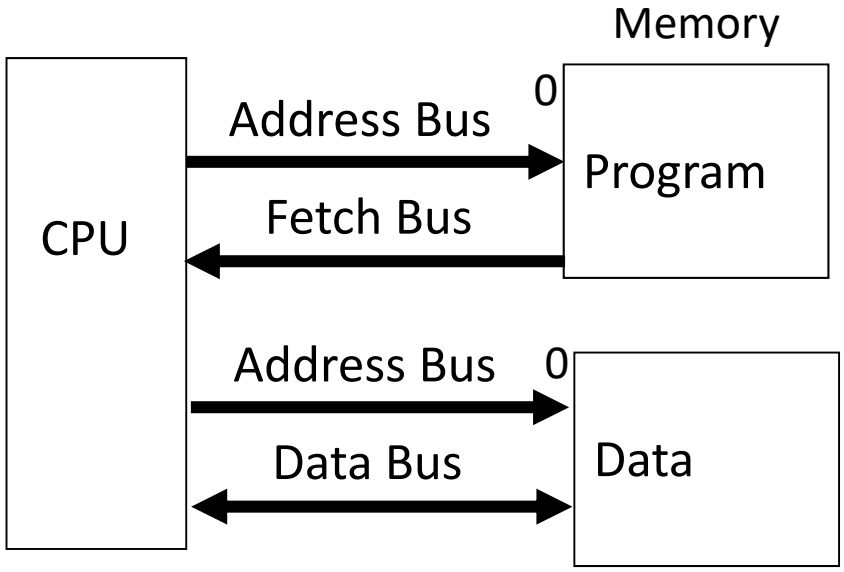
Introduction

- MCS-51 family, originally designed by Intel in the early 1980's
- Used in a large percentage of embedded systems
- Today over fifty companies produce variations of the 8051.
- The most popular microcontroller – about 40% of market share
- 8-bit microcontroller

Microcontroller Architectures



Von Neumann Architecture



Harvard Architecture