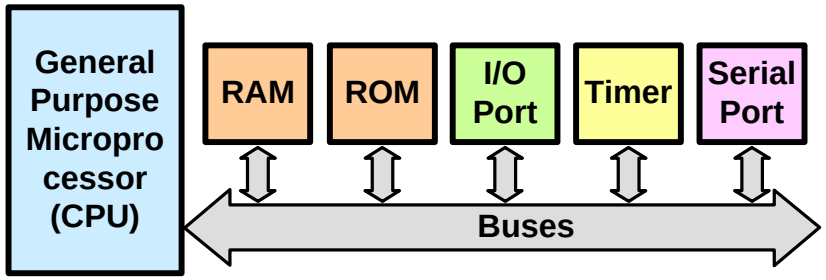
EMBEDDED SYSTEMS CMPE-453

Department of Computer Engineering

"Microcontrollers & AVR"

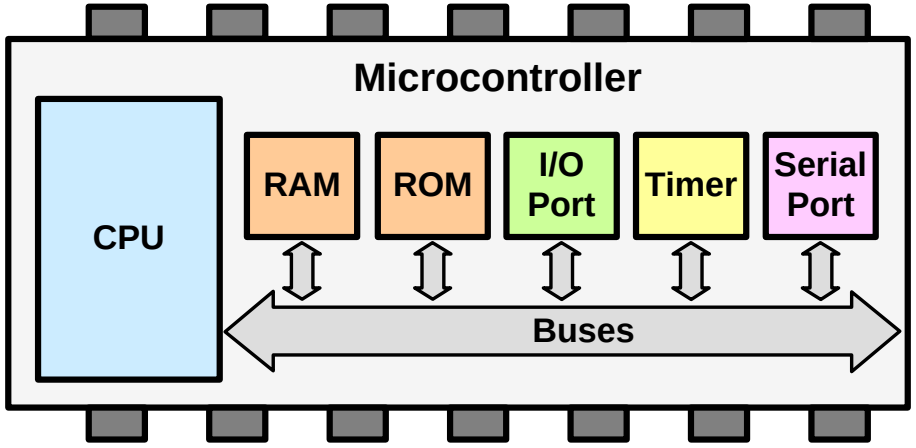
Microprocessor vs Microcontroller

- *General Purpose Microprocessors*



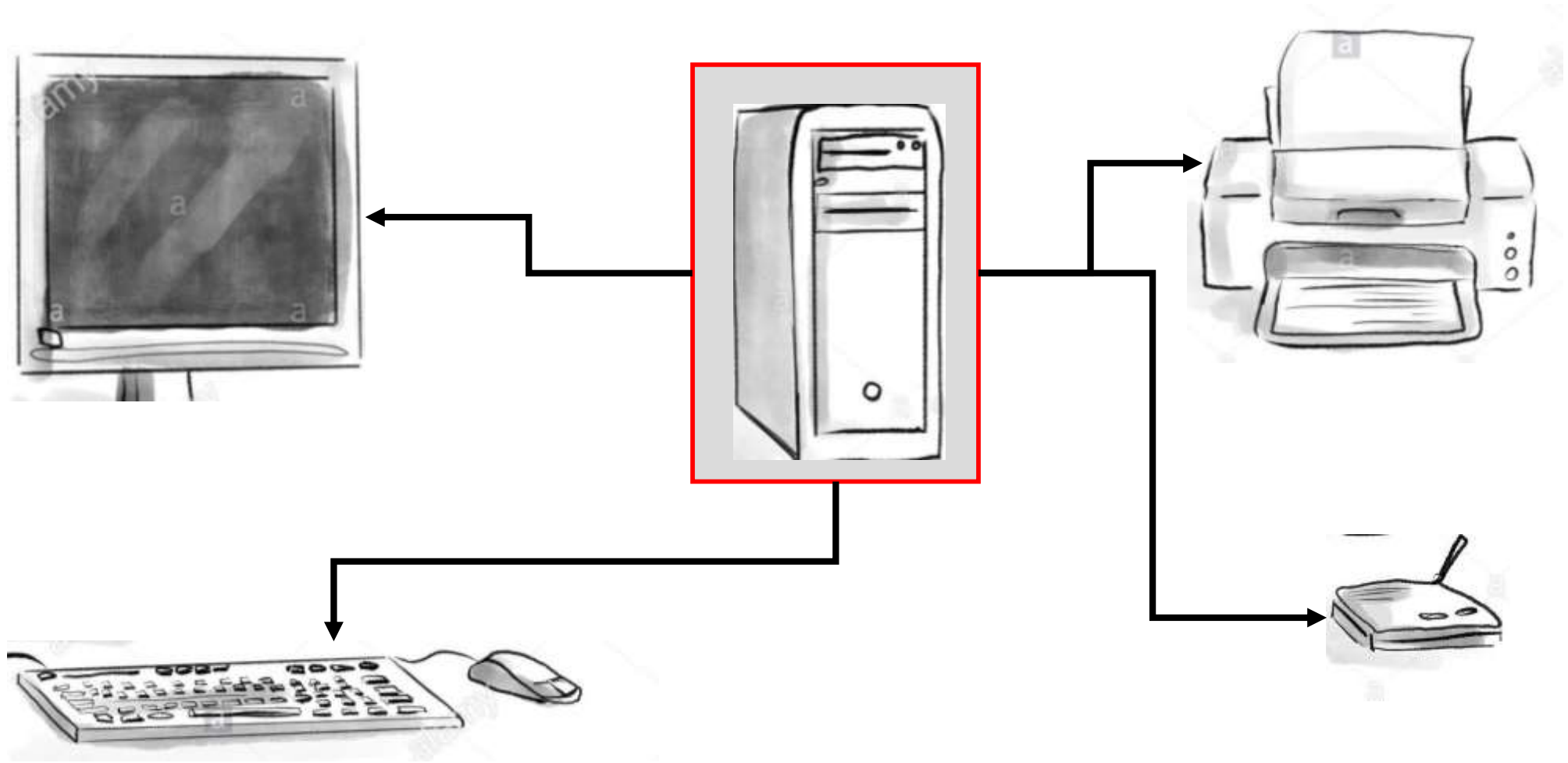
- Used for general purpose computing.
- Supports much larger amount of RAM and ROM
- Ex: Pentium, Power PC
- Advantages & Disadvantages

- *Microcontrollers*



- Used in (embedded) sytems designed to perform a single task.
- Ex: TV remote control, Printer, etc.

Microprocessor vs Microcontroller



About AVR Microcontoller

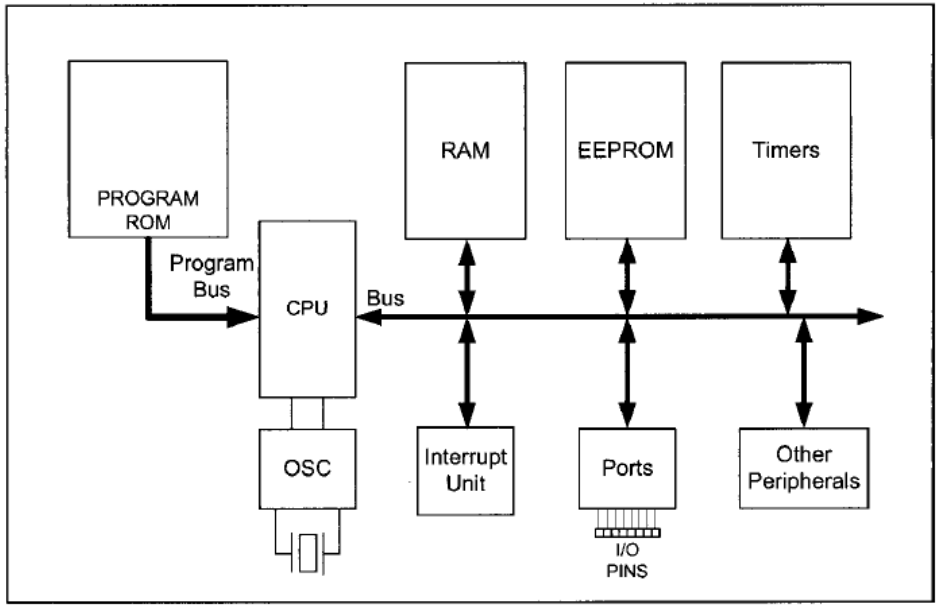
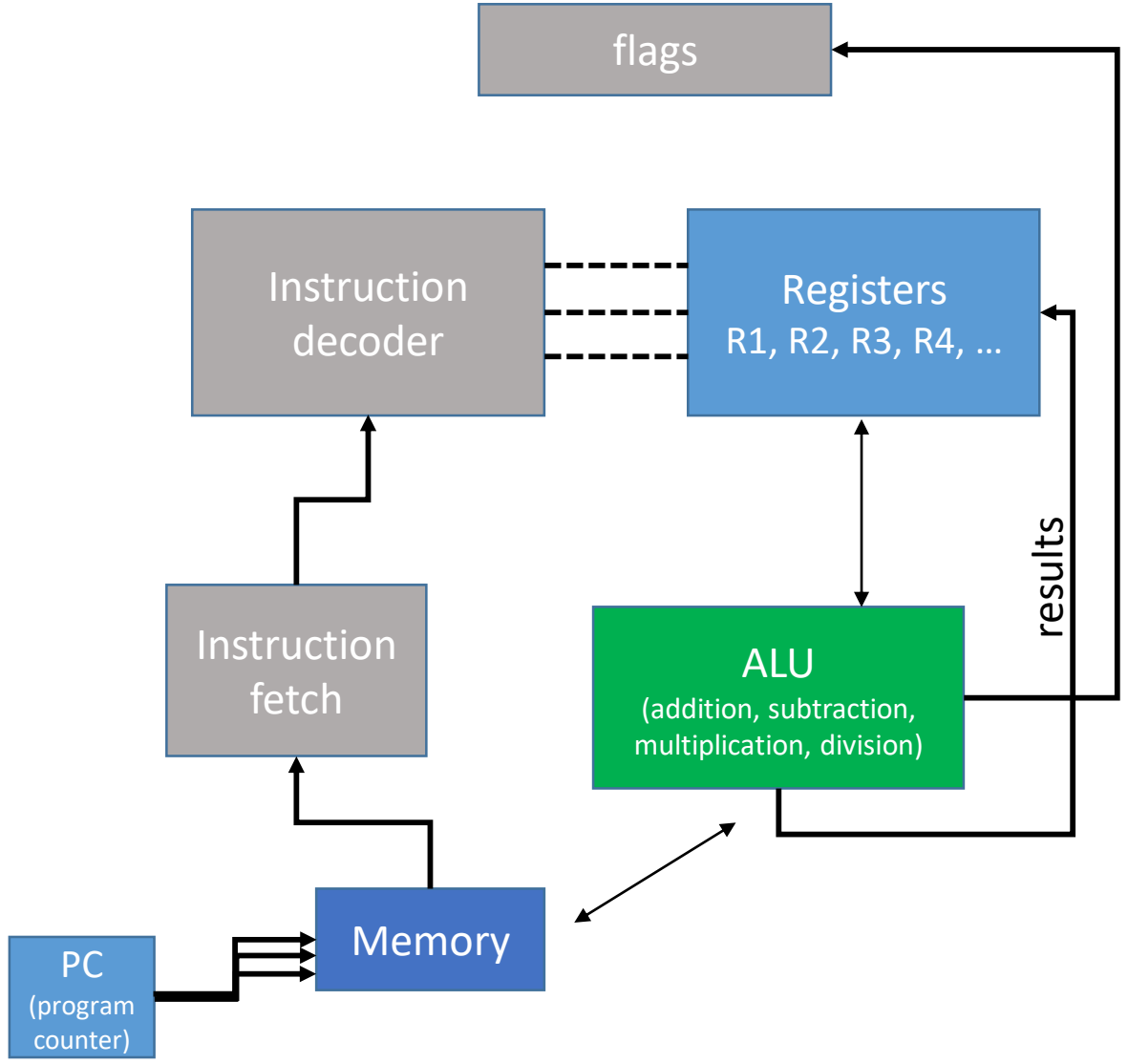


Figure 1-2. Simplified View of an AVR Microcontroller

- CPU
  - Bunch of predefined logical and mathematical operations built in
  - Where to find a list of operations to follow
  - Where to get the data it needs to execute



About AVR Microcontoller

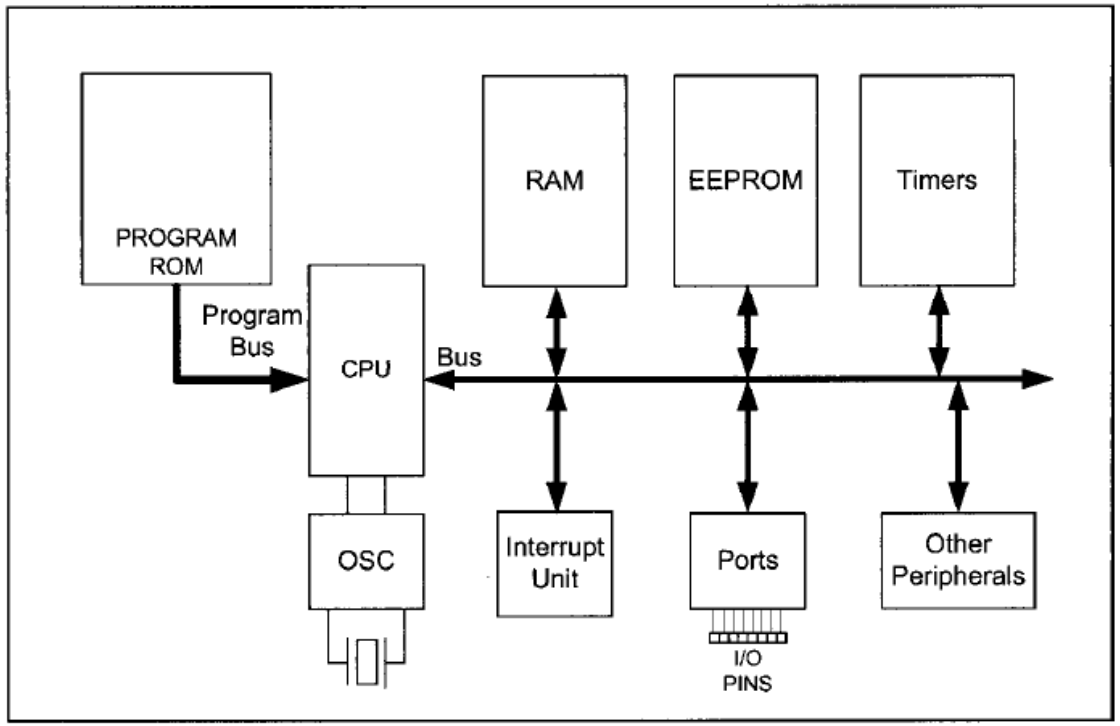


Figure 1-2. Simplified View of an AVR Microcontroller

Memory

- Program/Code ROM
  - Storing compiled program.
  - 1K-256K
  - Flash memory
- RAM
  - Storing data (max.64K)
  - Temporary data, calculations, etc.
- EEPROM
  - for storing permanent data (1K)
  - Electrically Erasable Programmable ROM

- Clocks
  - Master clock (e.g internal oscillator at 8 MHz).
  - CPU clock derived from master clock, by default 1 MHz
  - Peripheral clocks derived from CPU clock

About AVR Microcontoller

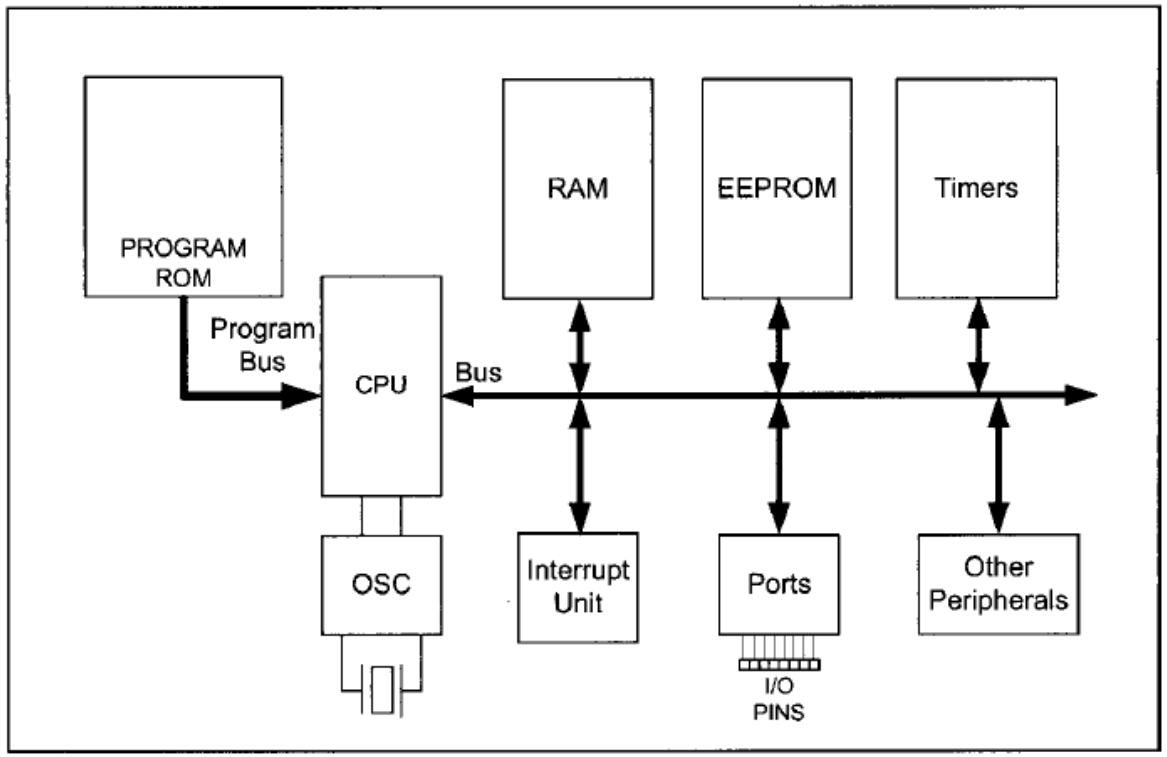


Figure 1-2. Simplified View of an AVR Microcontroller

- I/O
  - Almost all pins can be confgiured as input or output
  - Output:
    - logic 1=supply voltage
    - Logic 0= ground
  - Input:
    - Logic 1 > Vcc/2
    - Logic 0 < Vcc/2

- Serial Communications
  - USART: typically for communication with PC
  - SPI: Ultra-fast com over short distance (e.g with memories, ADC, DAC).
  - I2C: For interfacing upto 128 sensors/devices with microcontroller
  - All three can be used at the same time

- Timers/counters
  - T/C 0: 8-bit
  - T/C 1: 16-bit
  - T/C 2: 8-bit
  - Can be used for counting events, or measuring time of events or PWM

About AVR Microcontoller

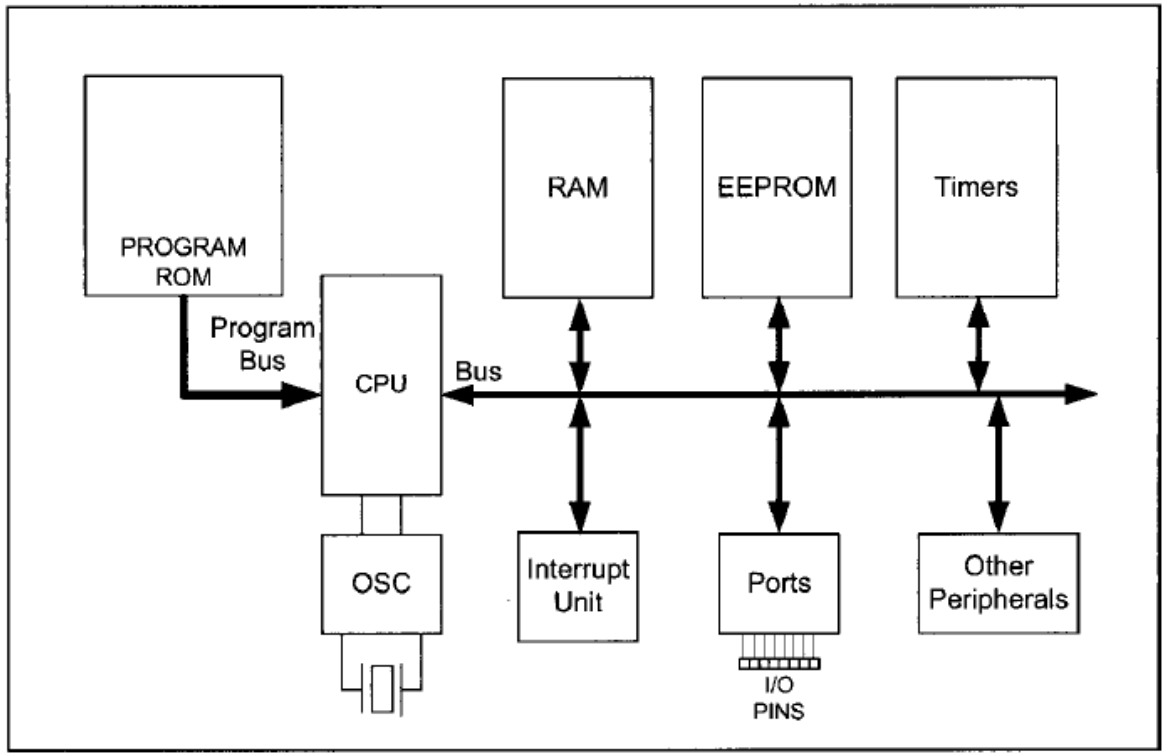
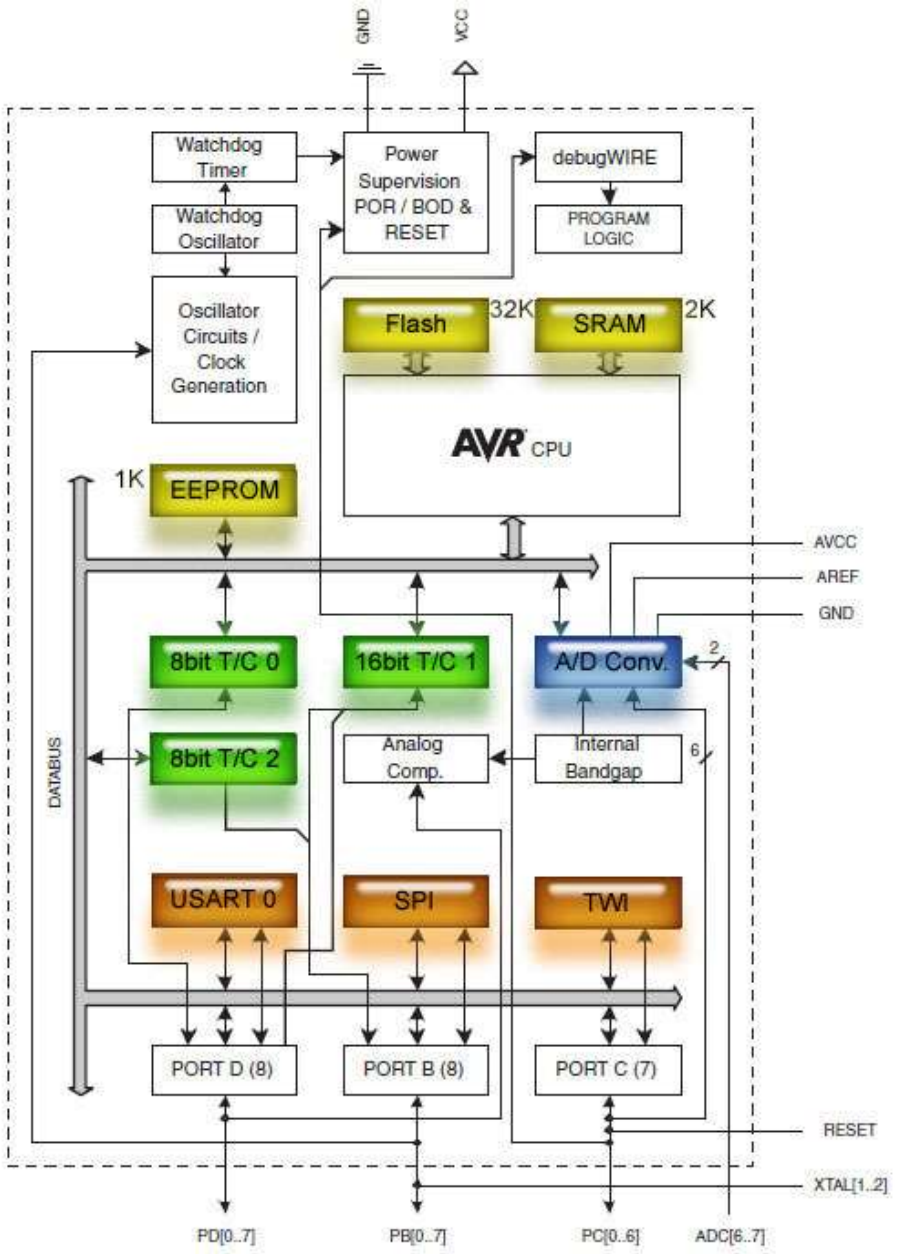
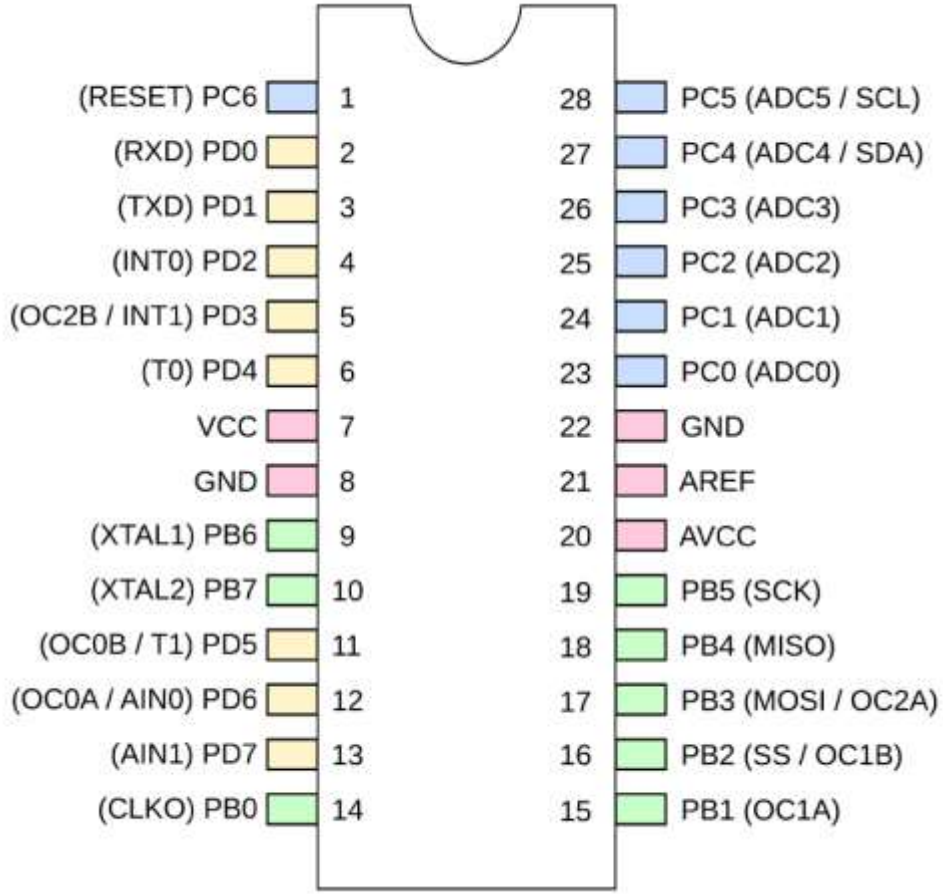


Figure 1-2. Simplified View of an AVR Microcontroller

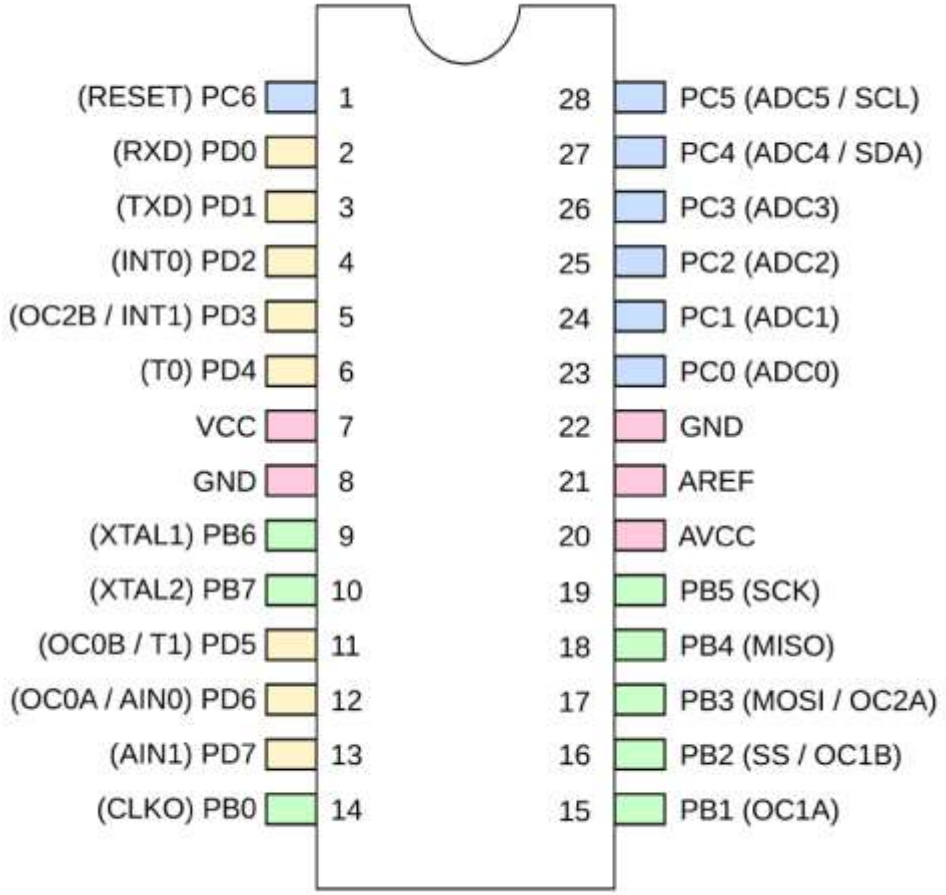
- ADC:
  - Speaking with voltage
  - 10 bit resolution
  - 6 channels
- Interrupts:
  - Events that trigger specific piece of code (interrupt service routine).
  - Hardware and software interrupts.
  - Free microcontroller for other useful tasks.
  - Examples:
    - Press on the reset button
    - A changing input value
    - An internal clock tick
    - A counter value being reached
    - Data coming in on the serial port
    - An analog-to-digital conversion finishing

ATmega328P: Overview





ATmega328P: Overview



- Pins arranged in banks of 8-pins
- CPU can process 8-bit data
- Most pins are dual purpose e.g. RXD/PD0, TXD/PD1
- Can be accessed using 8-bit registers
- Reading:

  thePins = PINB;
- Writing:

  PORTB = 42;

Learn how to use datasheet by refering datasheet of ATmega328P frequently.