Mobile System Engineering, Dankook University
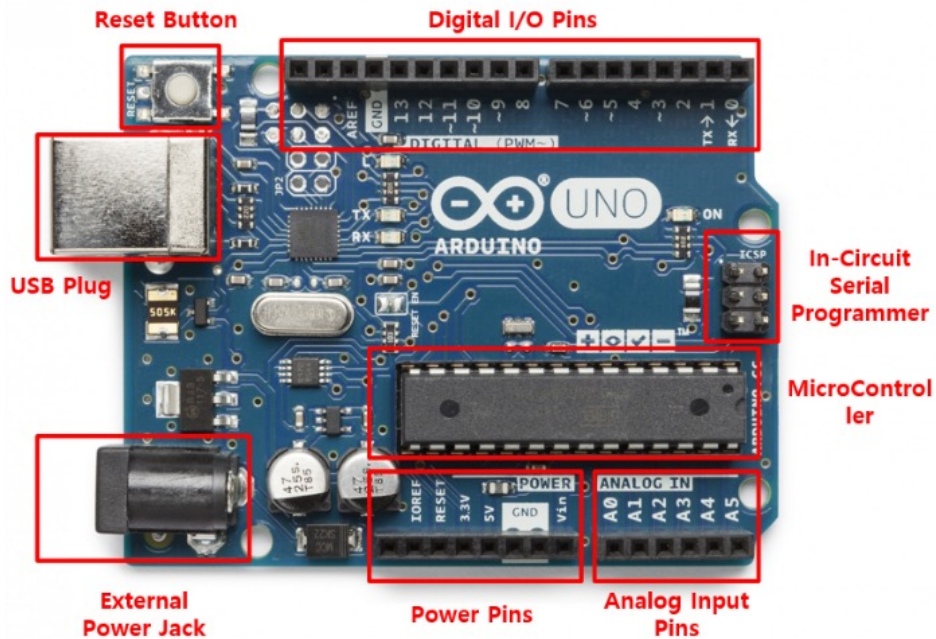
Basic Mobile Lab II

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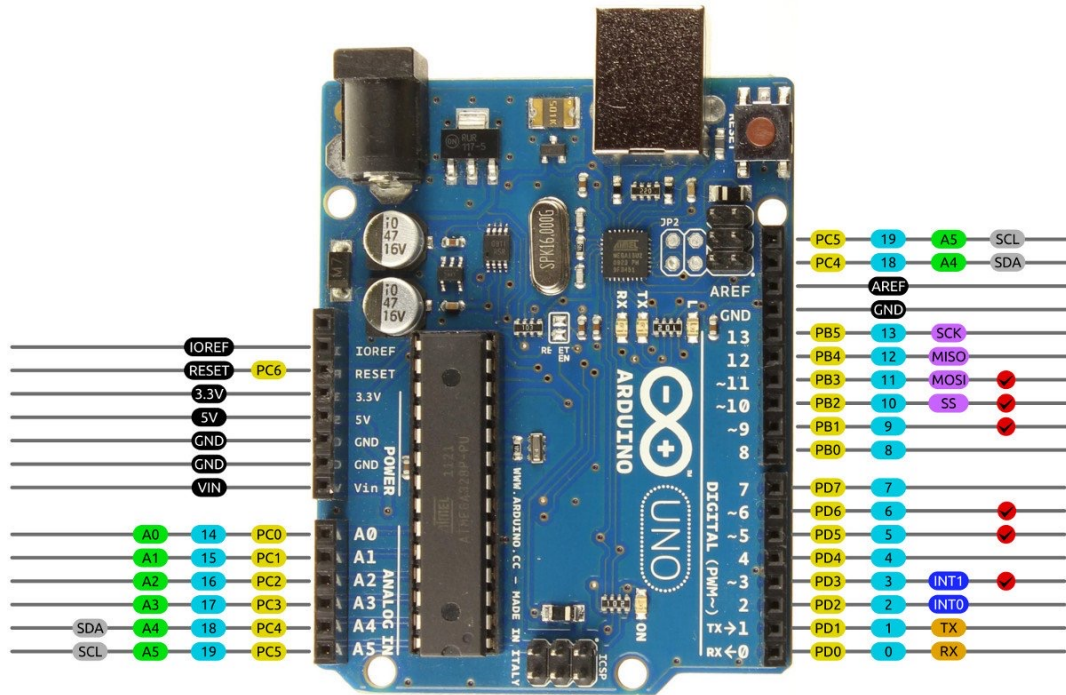# 1 Arduino UNO Rev3

Part	Explanation
USB Plug	• Connect PC and Arduino device by USB. • It can be applied directly to Arduino by compiling the code on PC(Arduino IDE). • USB connector type: Type B(UNO), Mini-A, Micro-B
Power Jack	Use 6-20V as an external power source, but if you use too much power, the Arduino board may be damaged. So, it uses a power supply between 7-12V and usually uses 9V.
Power Pins	The power is supplied to the sensor through the power pin. Arduino boards supply 5V and 3.3V.

3.3V	3.3 Voltage Power Pin
5V	5 Voltage Power Pin
GND	Ground Pins
Vin	• Voltage In • Use to input external power supply. • Vin (or RAW or 9V)

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Arduino Uno R3 Pinout

Part	Explanation
Digital I/O Pins	• Digital Pin • read 0 or 1 • D0, D1: Serial communication • D2-D13: read the voltages(0-5V) coming into the digital pins and also output the voltage through this pin. • D2, D3: Interrupt pin

D0	RX(Serial In)
D1	TX(Serial Out)
D2~D13	Digital I/O Pins
GND	Digital Ground
AREF	Analog Reference Pin

Part	Explanation
Analog Input Pins	• Analog Pin • read 0-1023 value • A0-A5(or A7): Analog INPUT • ~D(N): Analog OUTPUT(PWM)

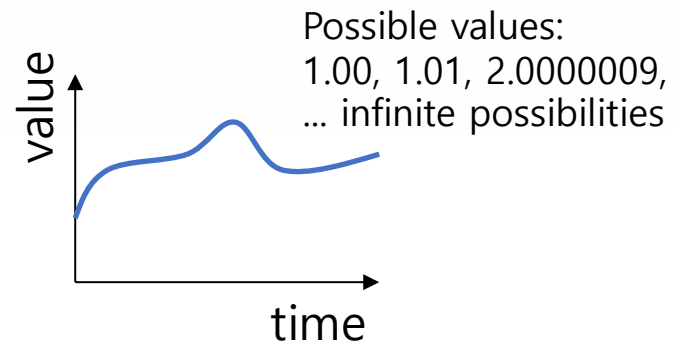| A4	SDA (Serial Data) Data transmission
A5	SCL (Serial Clock) Clock signal

Analog

infinite possible values

- Human voice in air
- Analog electronic devices

Sound waves

move the membrane,

which moves the magnet,

microphone

which creates current in the nearby wire

analog signal

Possible values:
1.00, 1.01, 2.0000009,
... infinite possibilities

value

time
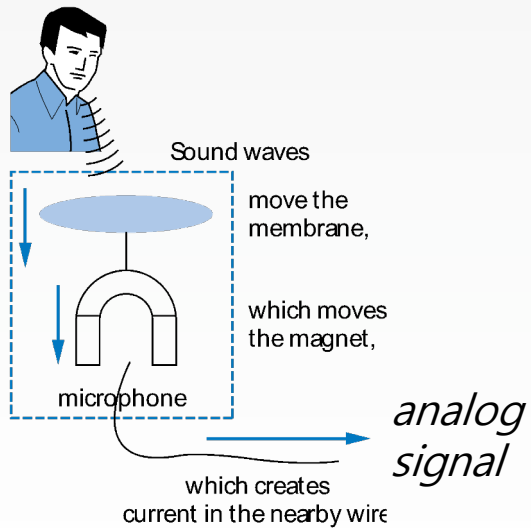
Digital

finite possible values

- Computers
- CD, DVD
- Digital electronic devices

1 2 3 4

2

digital signal

value 4 3 2 1 0

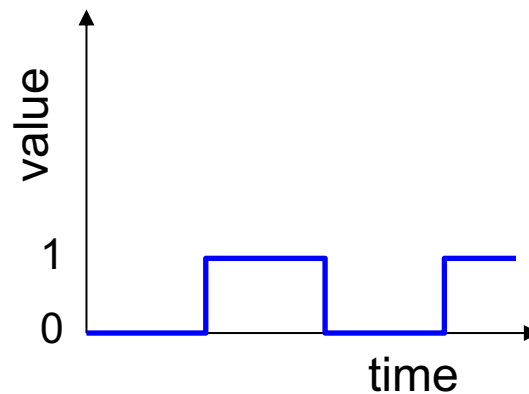time

Possible values:
0, 1, 2, 3, or 4.
That's it.

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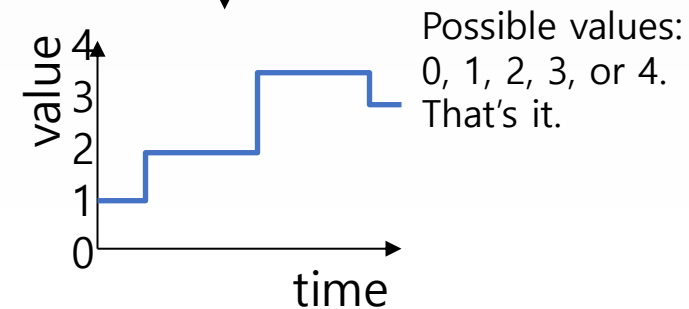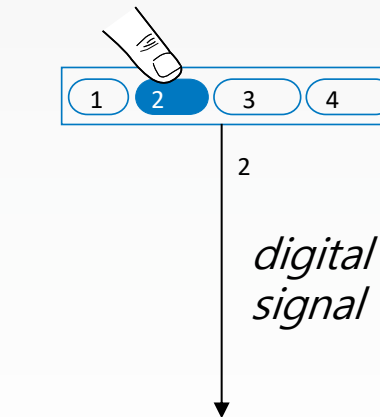
Digital signal: Binary

- **Binary: signal with two values**

  ✓ present as 0 or 1

  ✓ Bit: One binary digit

  ✓ Transistors, one of the key electronic parts, operate with two voltage values.

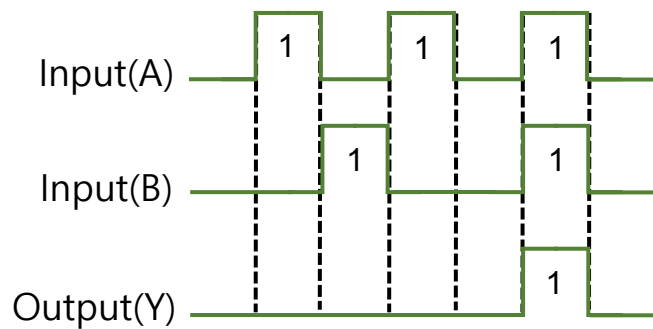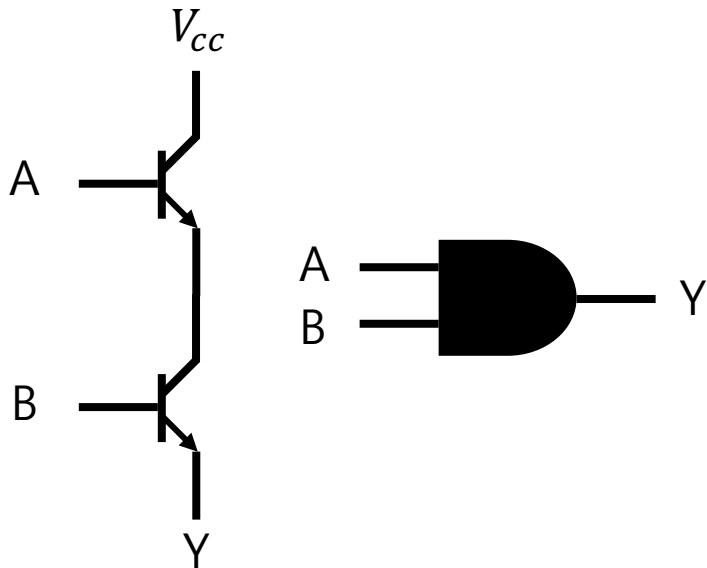 ✓ Transmitting one of two values(0,1) is easier than sending three or more.

Transistor in logic circuit
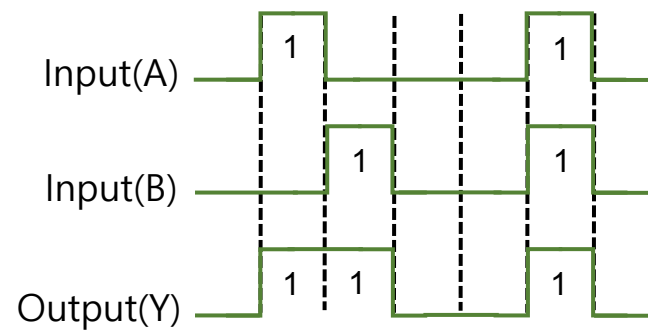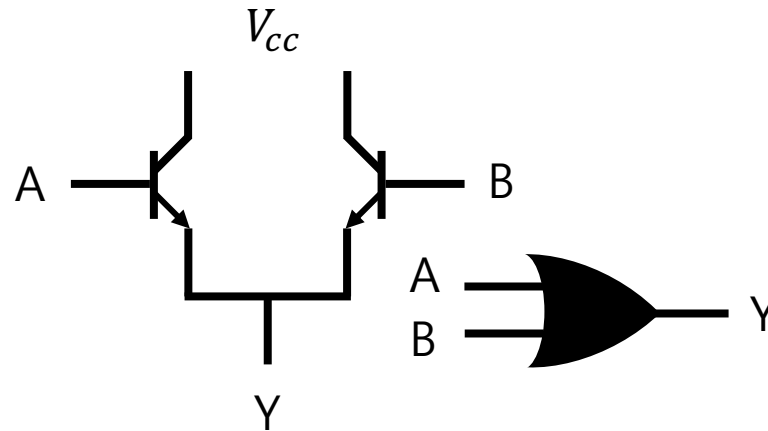
Steps

Analog signal

V

t

1. Sampling

V

t

3. Coding

V

10: 1010

7: 0111

3: 0011

t

2. Quantization

V

t
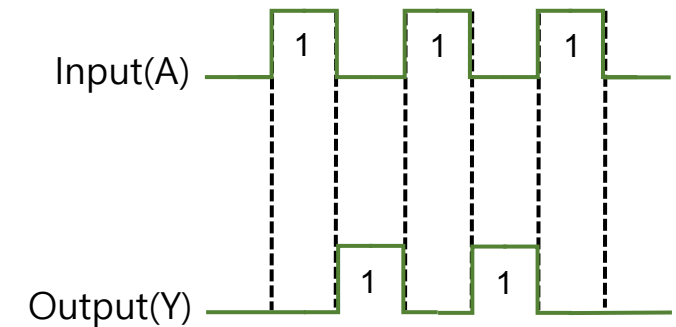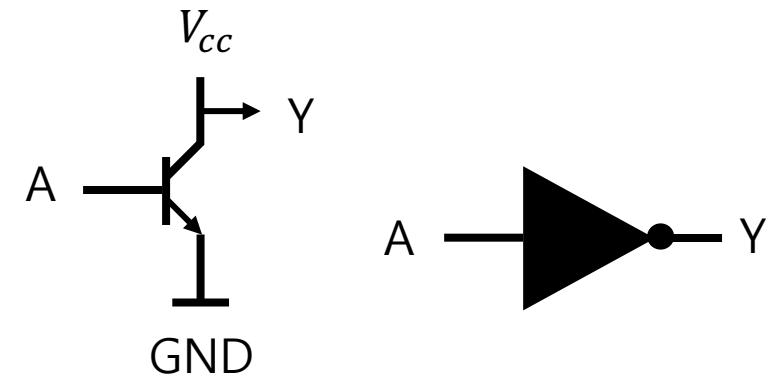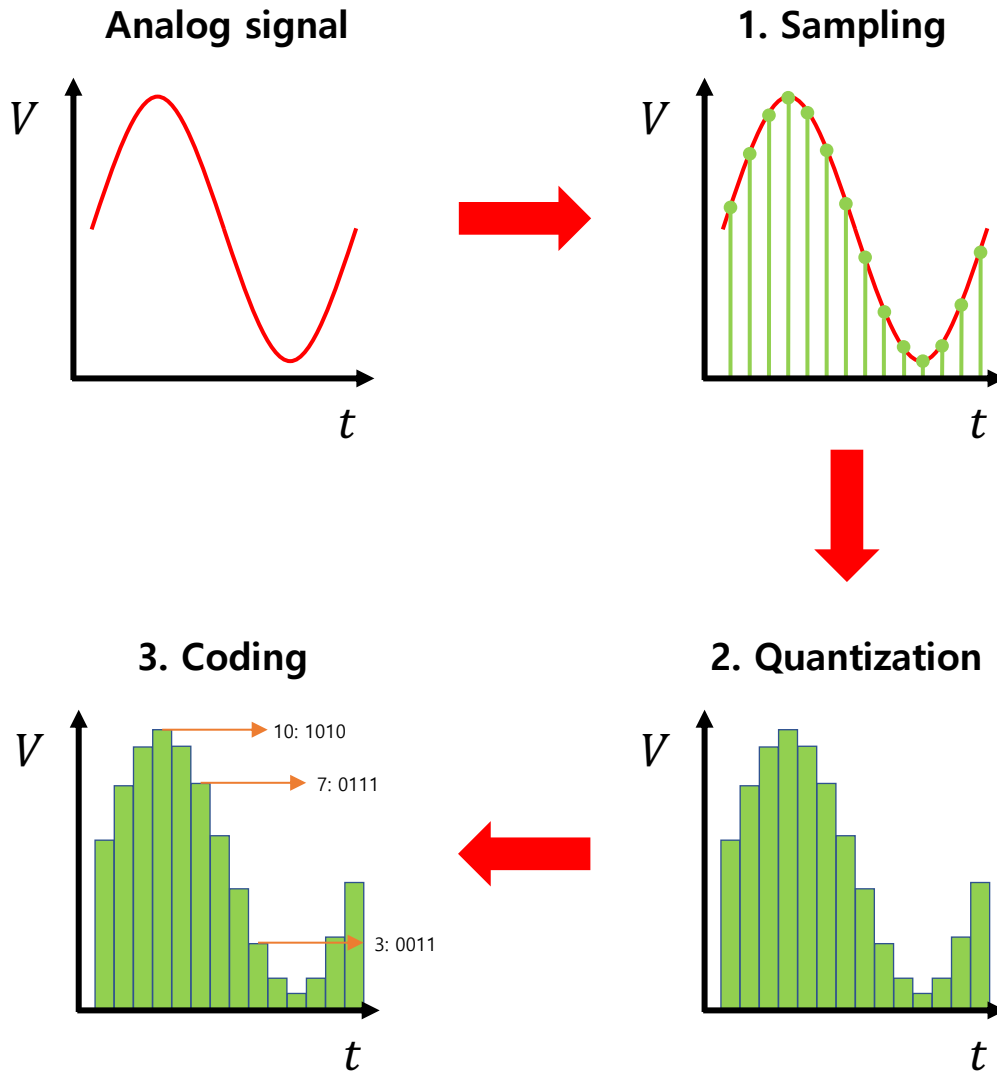
ADC

: converts a continuous-time and continuous-amplitude analog signal to a discrete-time and discrete-amplitude digital signal.

Steps

1. Sampling

sampling the value of the input at discrete intervals in time.
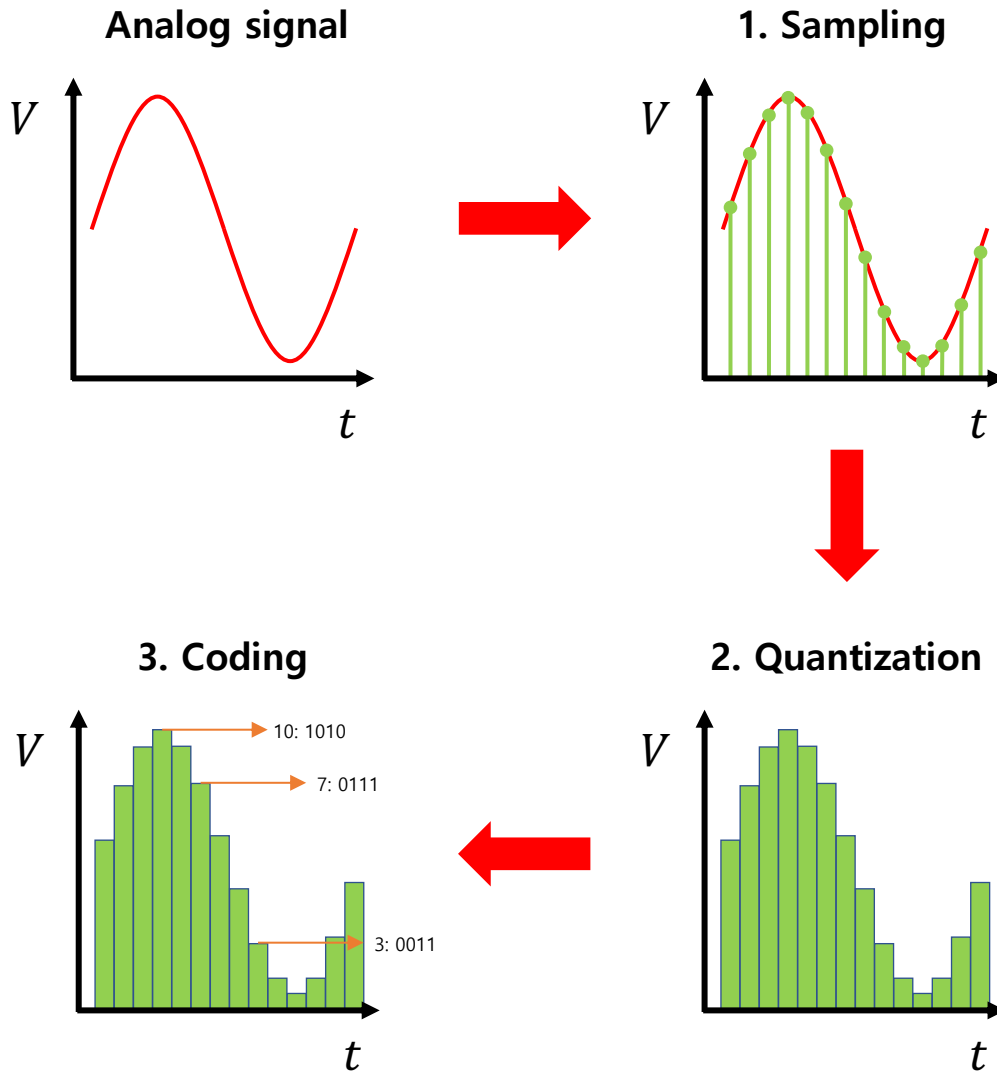
Sampling rate ↑ ➡ Clear wave

- Nyquist-Shannon sampling theorem
  : the principle to accurately reproduce a pure sine wave measurement, or sample, rate, which <u>must be at least twice its frequency</u>

$$f = f_s/2$$

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Steps

Analog signal

1. Sampling

3. Coding

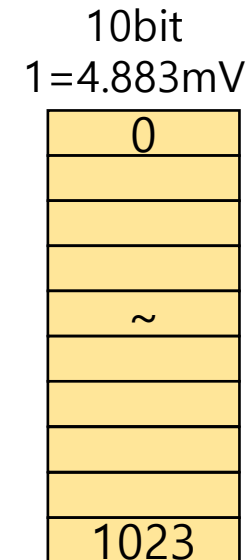10: 1010

7: 0111

3: 0011

2. Quantization

2. Quantization
replaces each real number with an approximation from a finite set of discrete values.

- Resolution
  ex) Arduino UNO: 8-Channel 10bit ADC

10bit
1=4.883mV
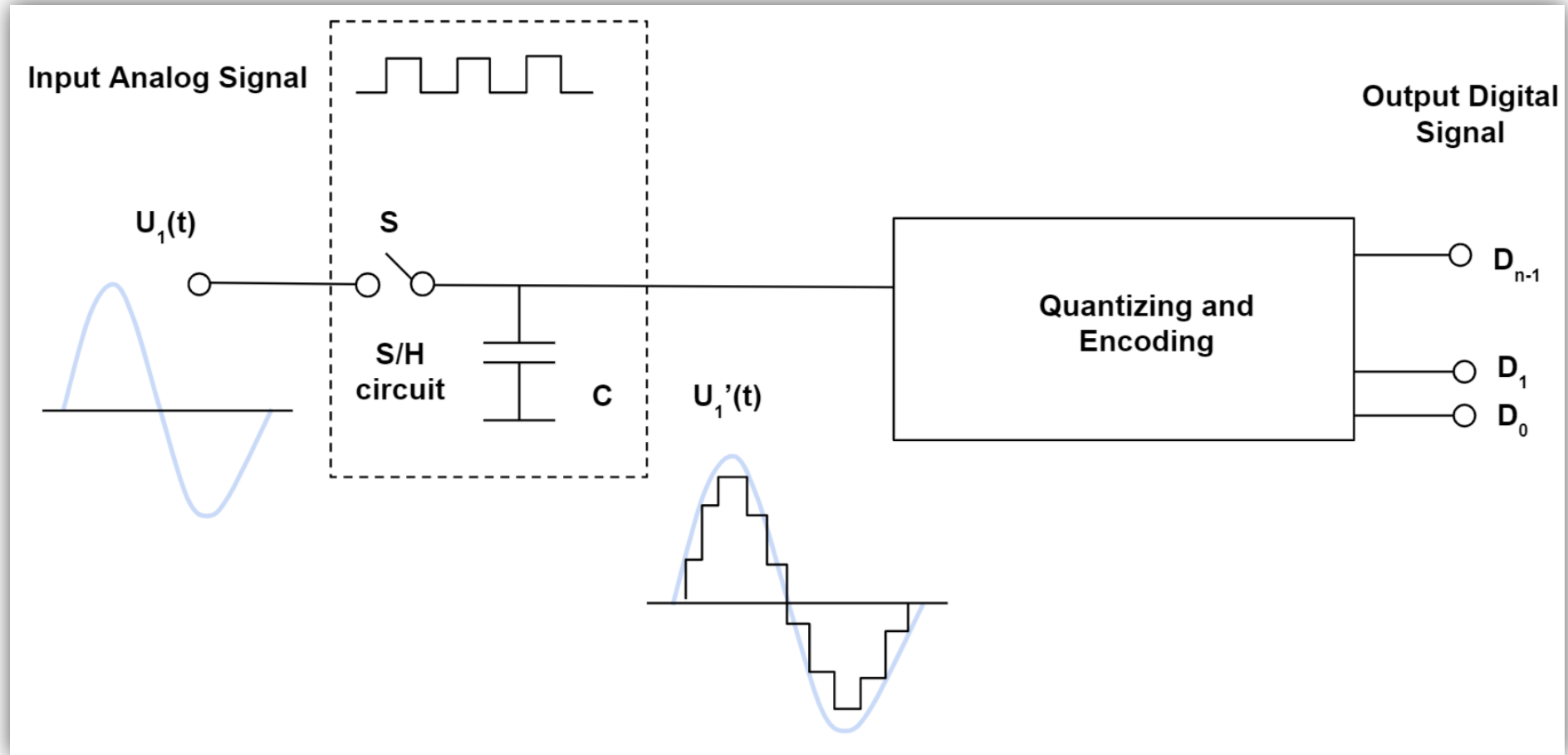
0V	
~	
5V	

0
~
1023

$2^{10} = 1024$

3. Coding
convert discrete values to binary code

Switch open and close
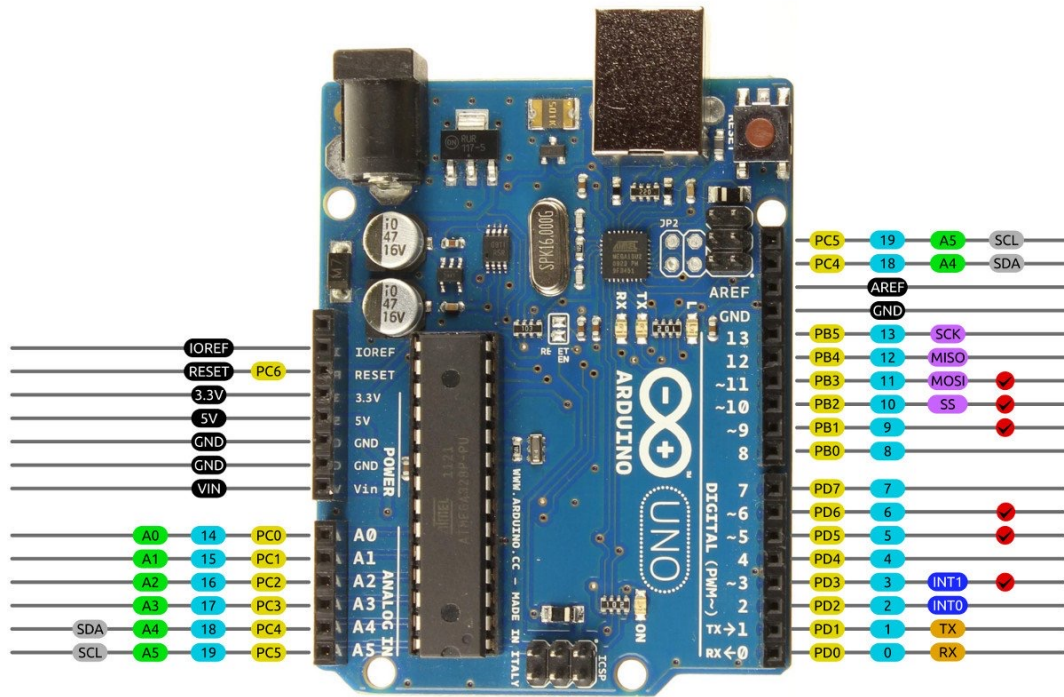
Arduino Uno R3 Pinout

Only Analog input pin in Arduino

The LED has only ON(1) or OFF(0) state.
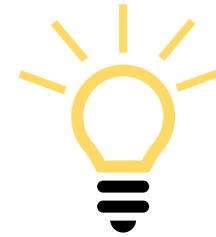
ON(1)   OFF(0)

How to control the brightness of an LED?

->**PWM(Pulse Width Modulation)**

0% Duty Cycle

5V

0V

25% Duty Cycle

5V

0V

50% Duty Cycle

5V

0V

75% Duty Cycle

5V

0V

100% Duty Cycle

5V

0V
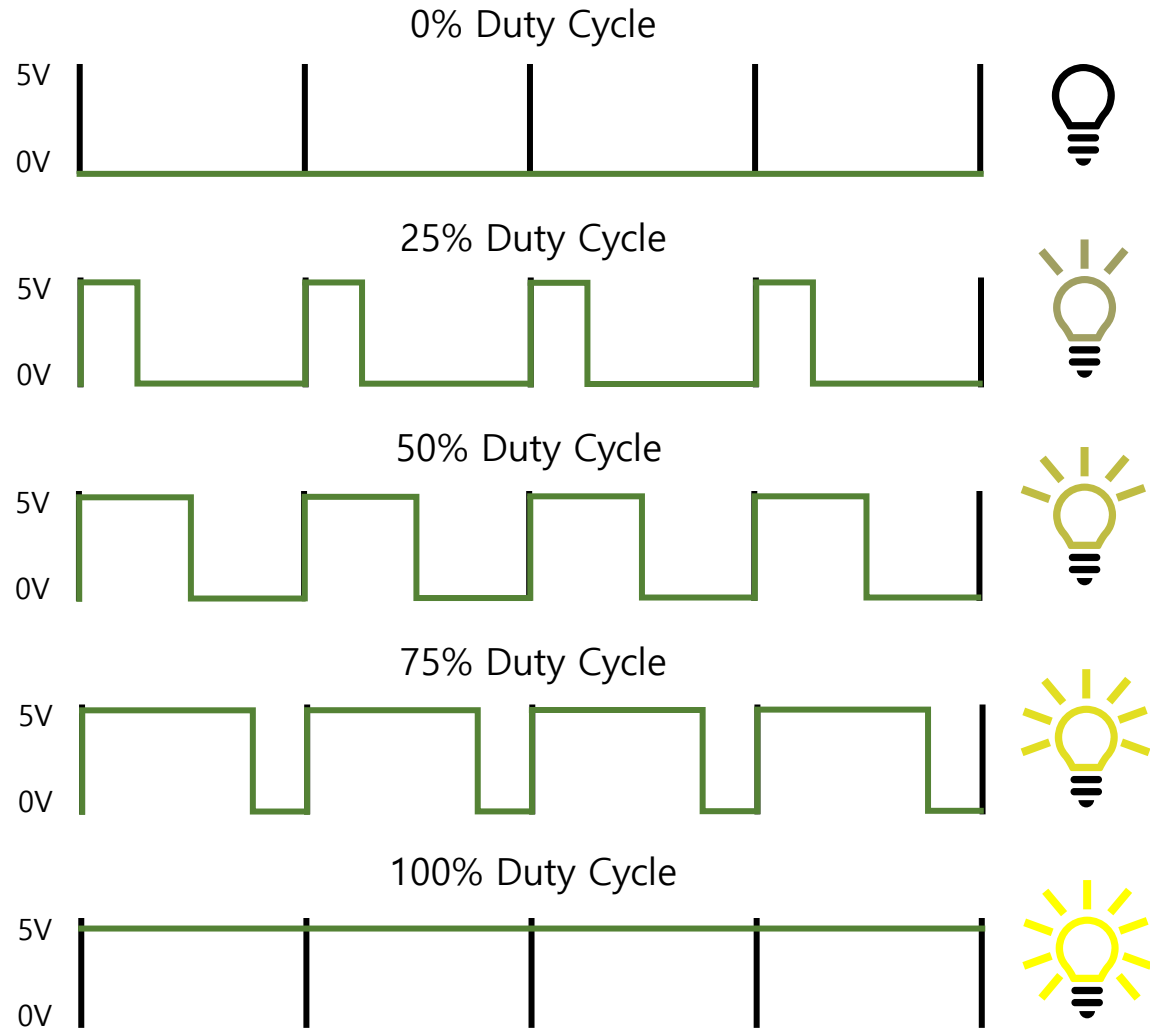
PWM(Pulse Width Modulation)
: A method of reducing the average power delivered by an electrical signal, by effectively chopping it up into discrete parts.

It looks like an analog output, but it actually uses PWM to mimic an analog signal. In the case of LED, the blinking rate(Frequency) is so fast that we can't recognize the blinking.

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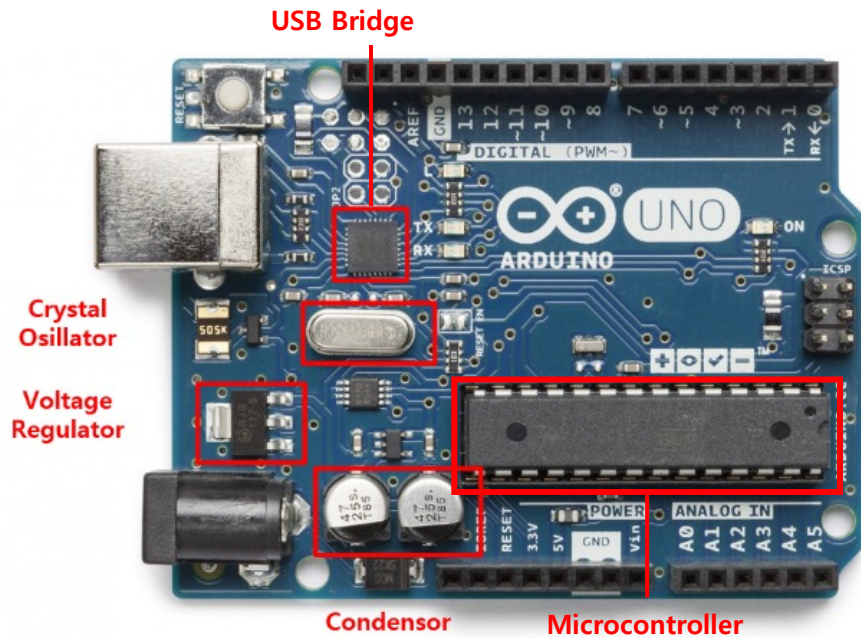
Part	Explanation
Crystal Ocillator	• Use to keep track of time • Provide a stable clock signal for digital integrated circuit
Microcontroller	ATmega328 8bit MCU(Microcontroller unit)
USB Bridge	ATmega16U2
Condenser	Capacitor
Flash memory	32KB (bootloader 0.5KB)
SRAM	2KB
EEPROM	1KB
Clock speed	16MHz