비교 연산자

- Relational Operators

기호	뜻	예제	값
>	큰가	6 > 4	참(1)
>=	같거나 큰가	7 >= 6	참(1)
<	작은가	9 < 8	거짓(0)
<=	작거나 같은가	5 <= 5	참(1)
==	같은가	3 == 4	거짓(0)
!=	같지않다	8.0 != 8	거짓(0)

참 = 1

거짓 = 0

if (1) 이어지는 중괄호 안에 있는 작업수행 { }

if (0) 이어지는 중괄호 건너 뛴다 { }

2) Digital input 2 : Push button

Push button

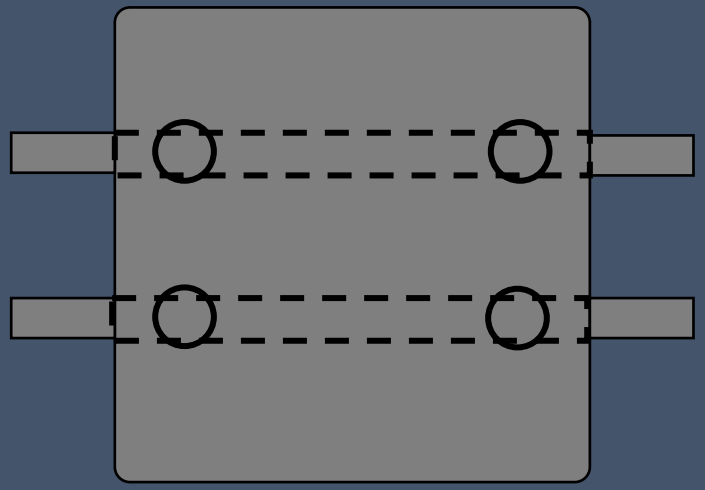
2) Digital input 2 : Push button

준비물 :

아두이노 보드 1개
버튼 스위치 1개
LED 1개
220 Ω 저항 1개, 10K Ω 저항 1개
브래드 보드 1개
점퍼선

시리얼 모니터
풀다운
풀업

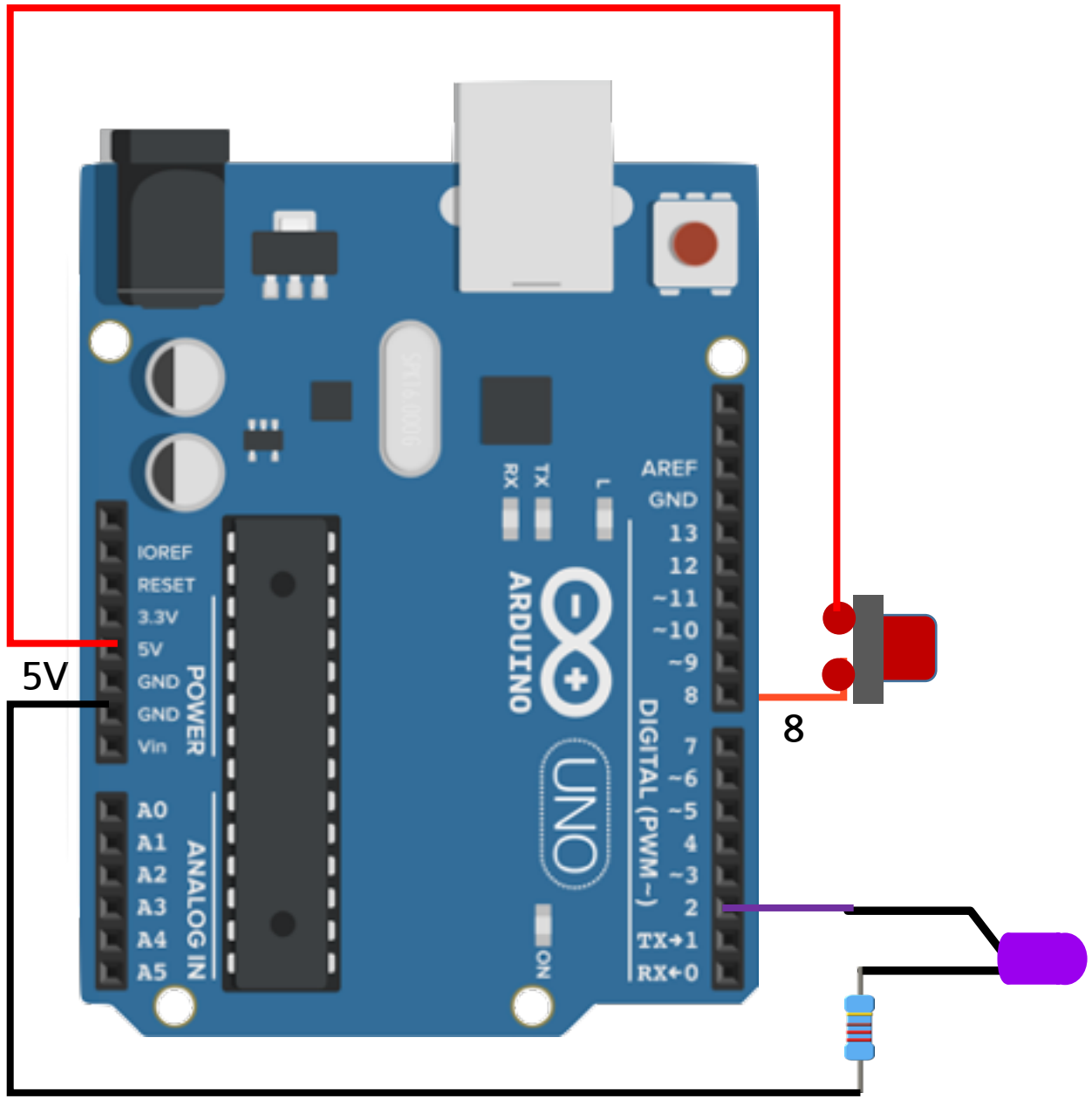
Digital input



푸시 버튼

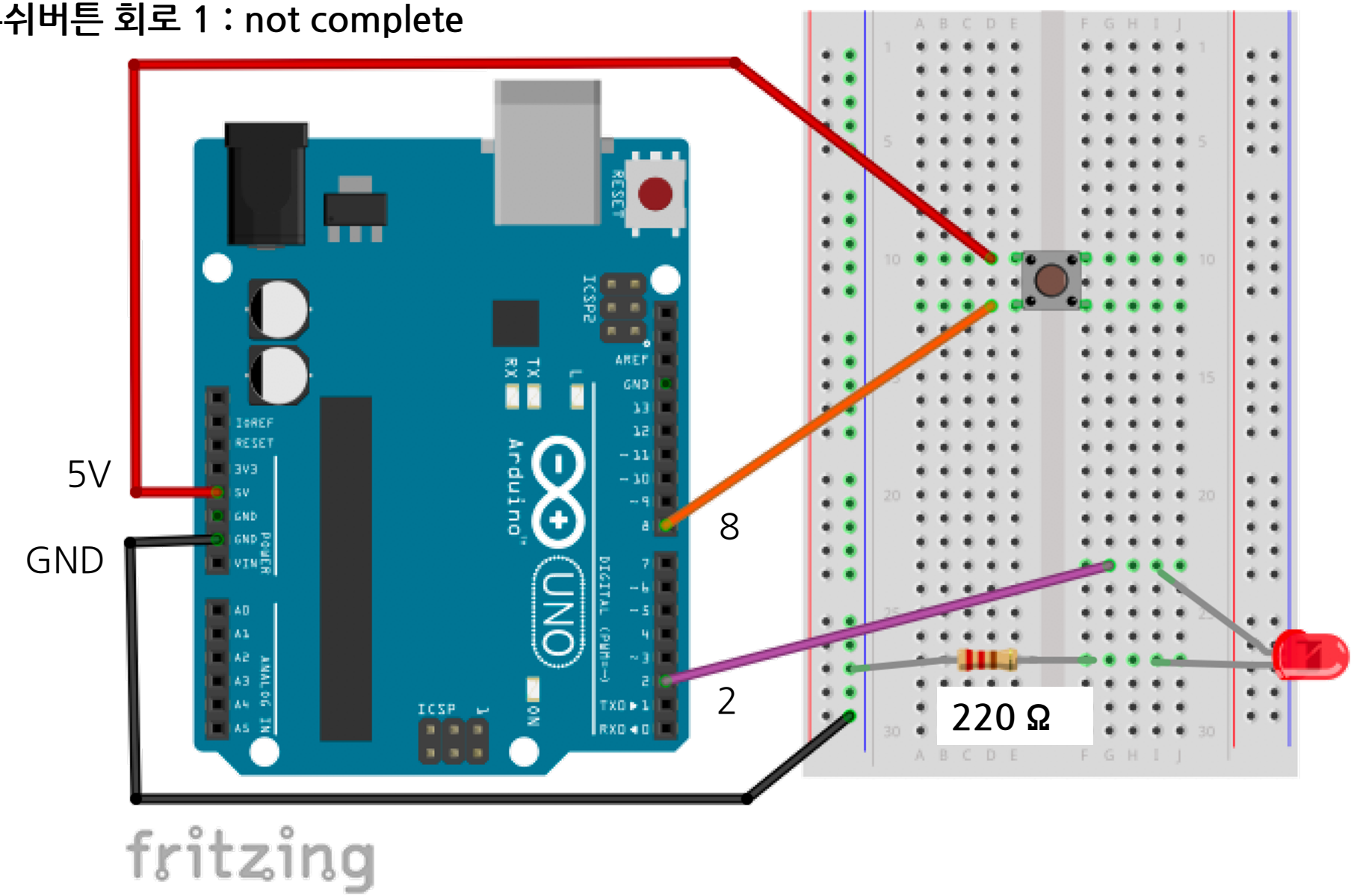
Digital input 2 : Push button

푸쉬버튼 회로 1 : not complete

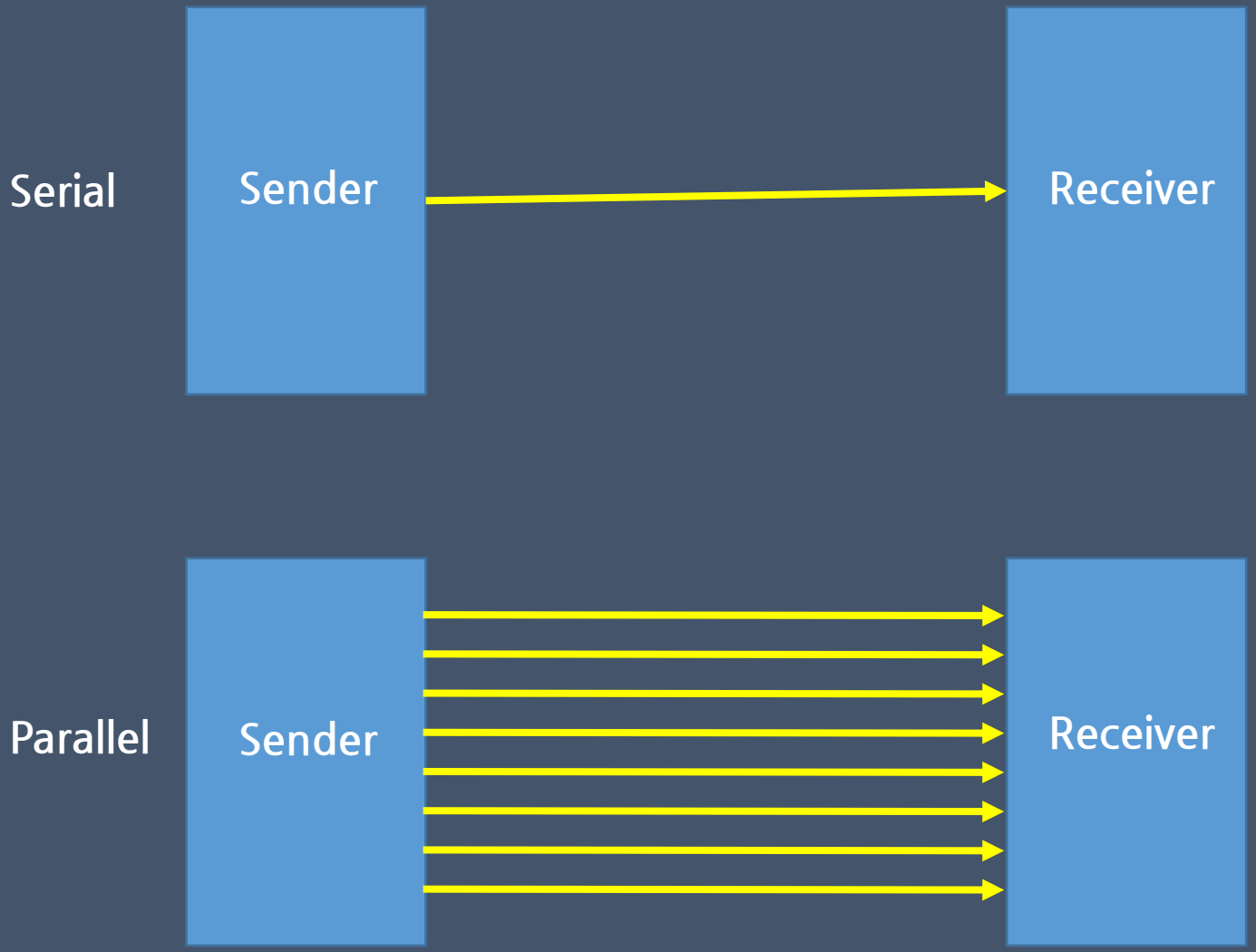


Digital input 2 : Push button

푸쉬버튼 회로 1 : not complete



Serial vs Parallel : 장단점



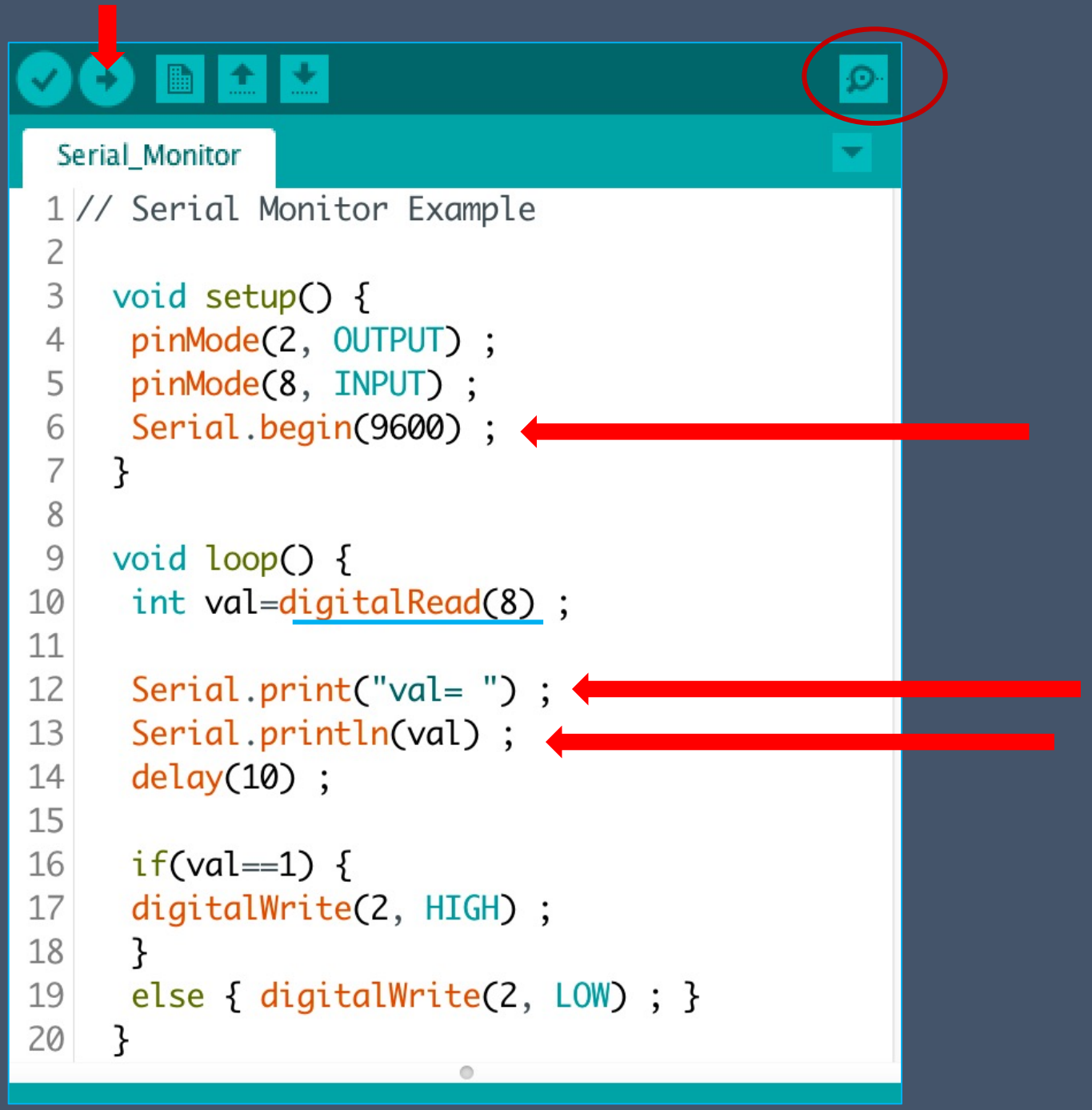
Baud Rate vs bps

Baud Rate : Number of signal change per second

Baud Rate ≃ bps

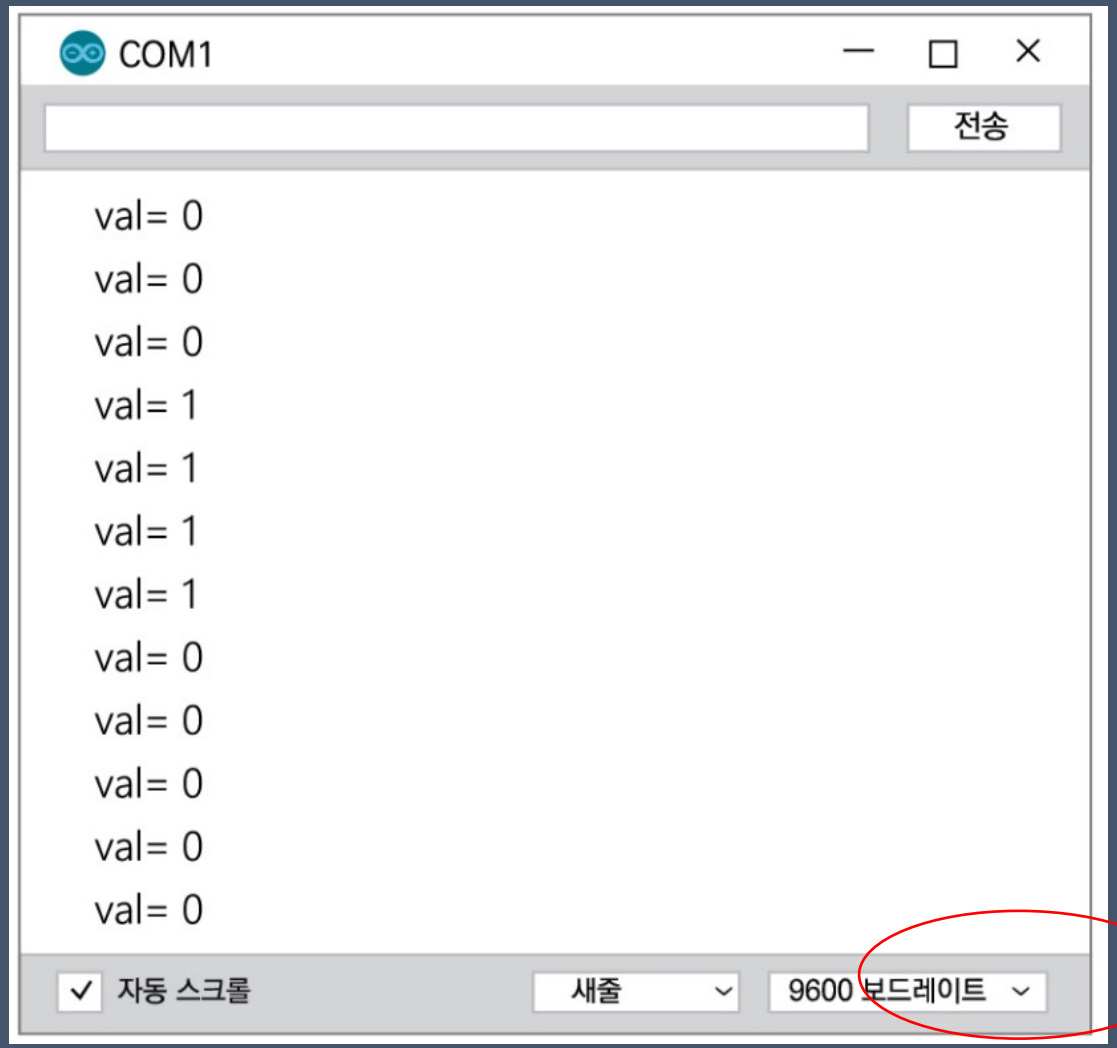
2) Digital input 2 : Push button

Sketch with Serial print

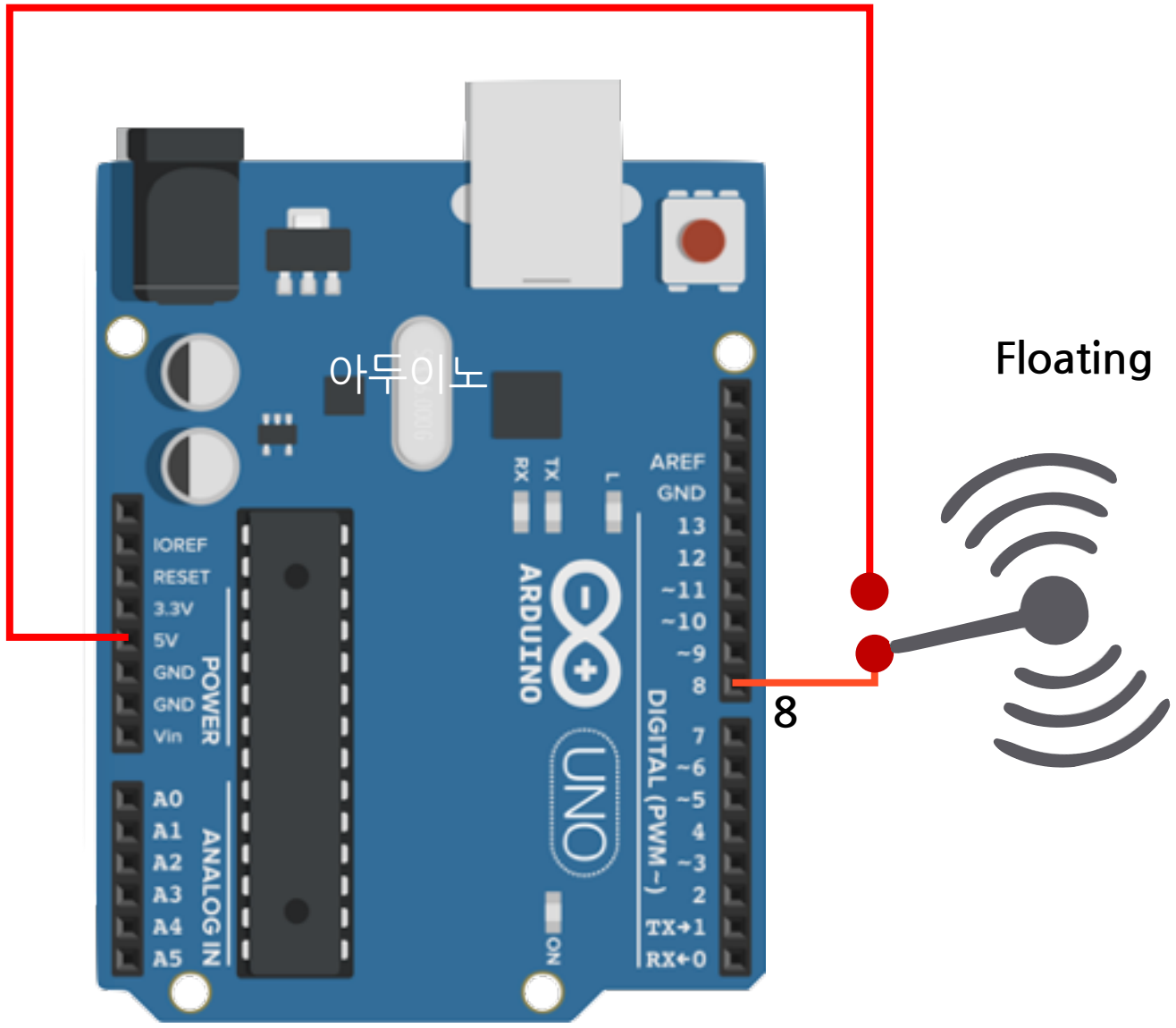


2) Digital input 2 : Push button

버튼을 누르지도 않았는데 1 이 프린트 되는 현상 발생



2) Digital input 2 : Push button



2) Digital input 2 : Push button

28.2 DC Characteristics

T_A = -40°C to 85°C, V_{CC} = 1.8V to 5.5V (unless otherwise noted)

Symbol	Parameter	Condition	Min.	Typ.	Max.	Units
V_{IL}	Input Low Voltage, except XTAL1 and $\overline{\text{RESET}}$ pin	V_{CC} = 1.8V - 2.4V V_{CC} = 2.4V - 5.5V	-0.5 -0.5		$0.2V_{CC}$ (1) $0.3V_{CC}$ (1)	V
V_{IH}	Input High Voltage, except XTAL1 and $\overline{\text{RESET}}$ pins	V_{CC} = 1.8V - 2.4V V_{CC} = 2.4V - 5.5V	$0.7V_{CC}$ (2) $0.6V_{CC}$ (2)		V_{CC} + 0.5 V_{CC} + 0.5	V
V_{IL1}	Input Low Voltage, XTAL1 pin	V_{CC} = 1.8V - 5.5V	-0.5		$0.1V_{CC}$ (1)	V
V_{IH1}	Input High Voltage, XTAL1 pin	V_{CC} = 1.8V - 2.4V V_{CC} = 2.4V - 5.5V	$0.8V_{CC}$ (2) $0.7V_{CC}$ (2)		V_{CC} + 0.5 V_{CC} + 0.5	V
V_{IL2}	Input Low Voltage, $\overline{\text{RESET}}$ pin	V_{CC} = 1.8V - 5.5V	-0.5		$0.1V_{CC}$ (1)	V
V_{IH2}	Input High Voltage, $\overline{\text{RESET}}$ pin	V_{CC} = 1.8V - 5.5V	$0.9V_{CC}$ (2)		V_{CC} + 0.5	V
V_{IL3}	Input Low Voltage, $\overline{\text{RESET}}$ pin as I/O	V_{CC} = 1.8V - 2.4V V_{CC} = 2.4V - 5.5V	-0.5 -0.5		$0.2V_{CC}$ (1) $0.3V_{CC}$ (1)	V
V_{IH3}	Input High Voltage, $\overline{\text{RESET}}$ pin as I/O	V_{CC} = 1.8V - 2.4V V_{CC} = 2.4V - 5.5V	$0.7V_{CC}$ (2) $0.6V_{CC}$ (2)		V_{CC} + 0.5 V_{CC} + 0.5	V

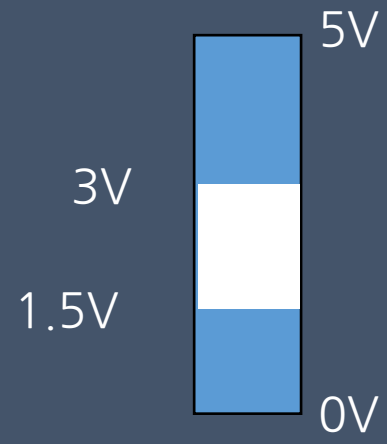
Atmega328 Datasheet

2) Digital input 2 : Push button

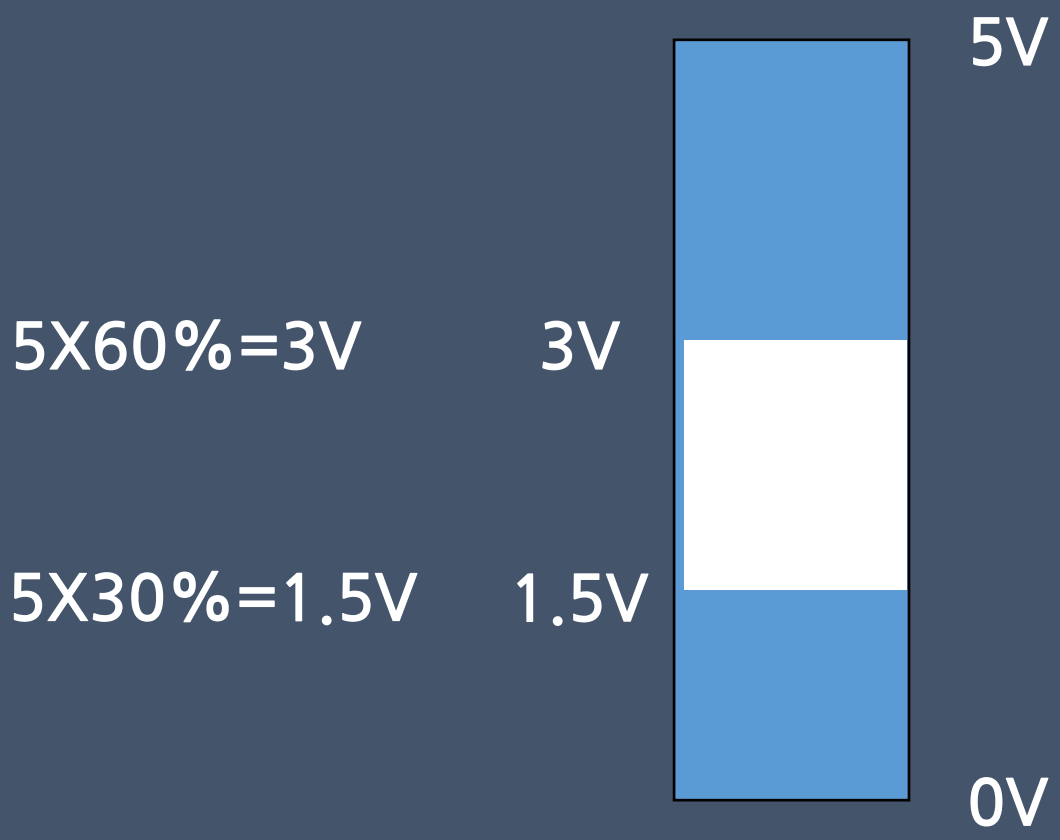
Symbol	Parameter	Condition	Min.	Typ.	Max.
V_{IL}	Input Low Voltage, except XTAL1 and RESET pin	V_{CC} = 1.8V - 2.4V V_{CC} = 2.4V - 5.5V	-0.5 -0.5		$0.2V_{CC}$ (1) $0.3V_{CC}$ (1)
V_{IH}	Input High Voltage, except XTAL1 and RESET pins	V_{CC} = 1.8V - 2.4V V_{CC} = 2.4V - 5.5V	$0.7V_{CC}$ (2) $0.6V_{CC}$ (2)		V_{CC} + 0.5 V_{CC} + 0.5

Input Low Voltage = 0.3X5V=1.5V : Low MAX

Input HIGH Voltage = 0.6X5V=3.0V : High Min

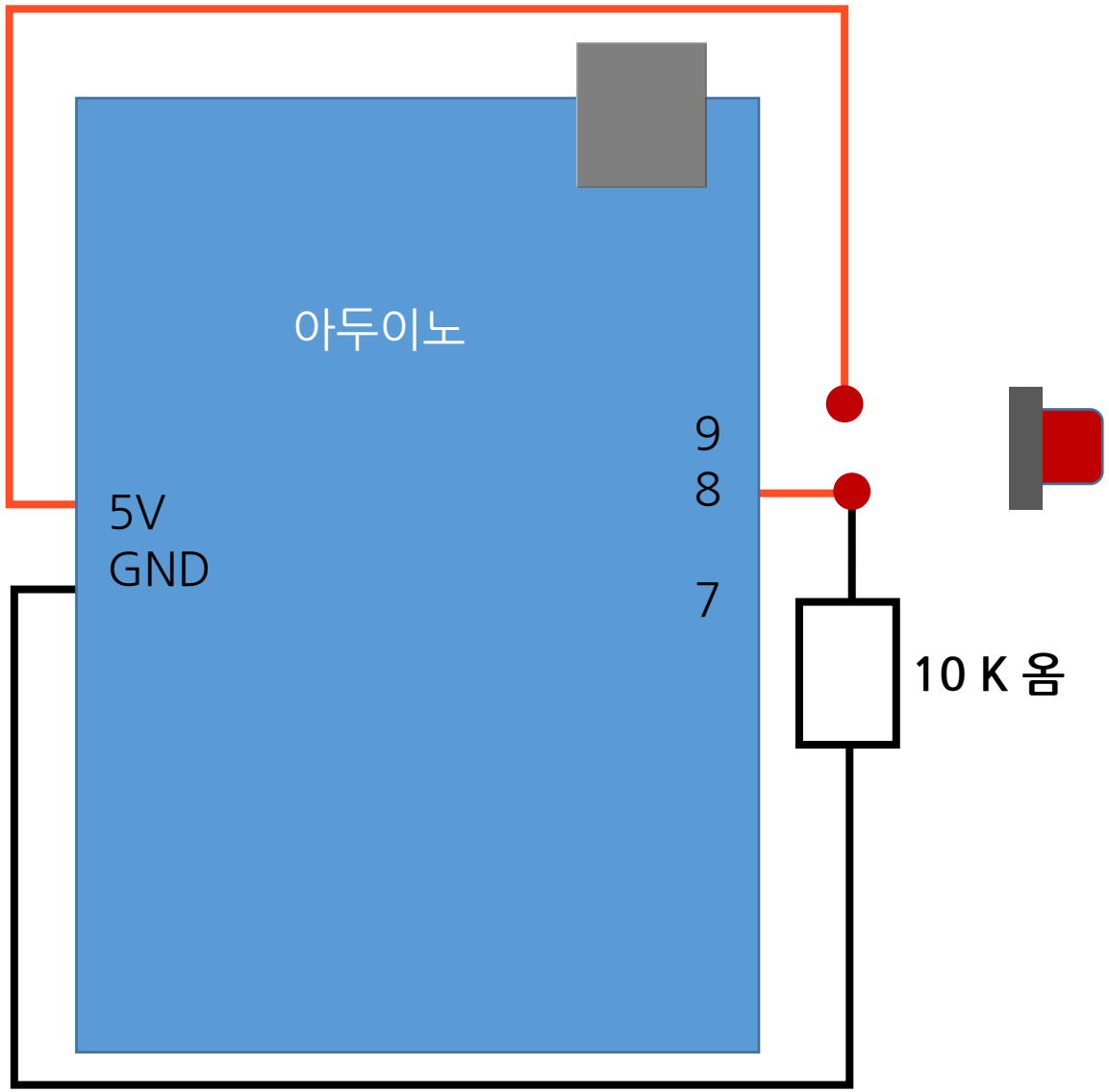


2) Digital input 2 : Push button

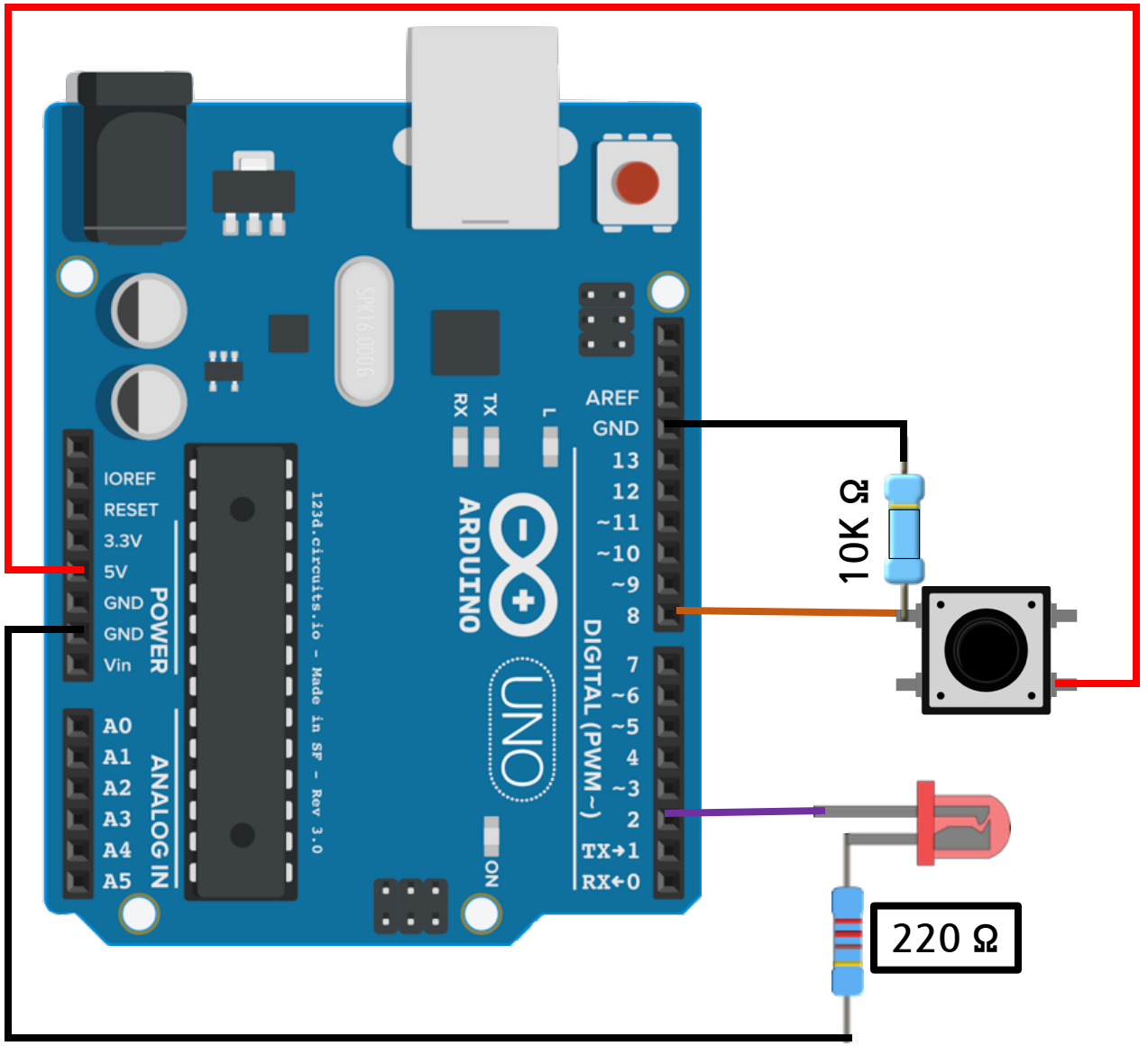


2) Digital input 2 : Push button

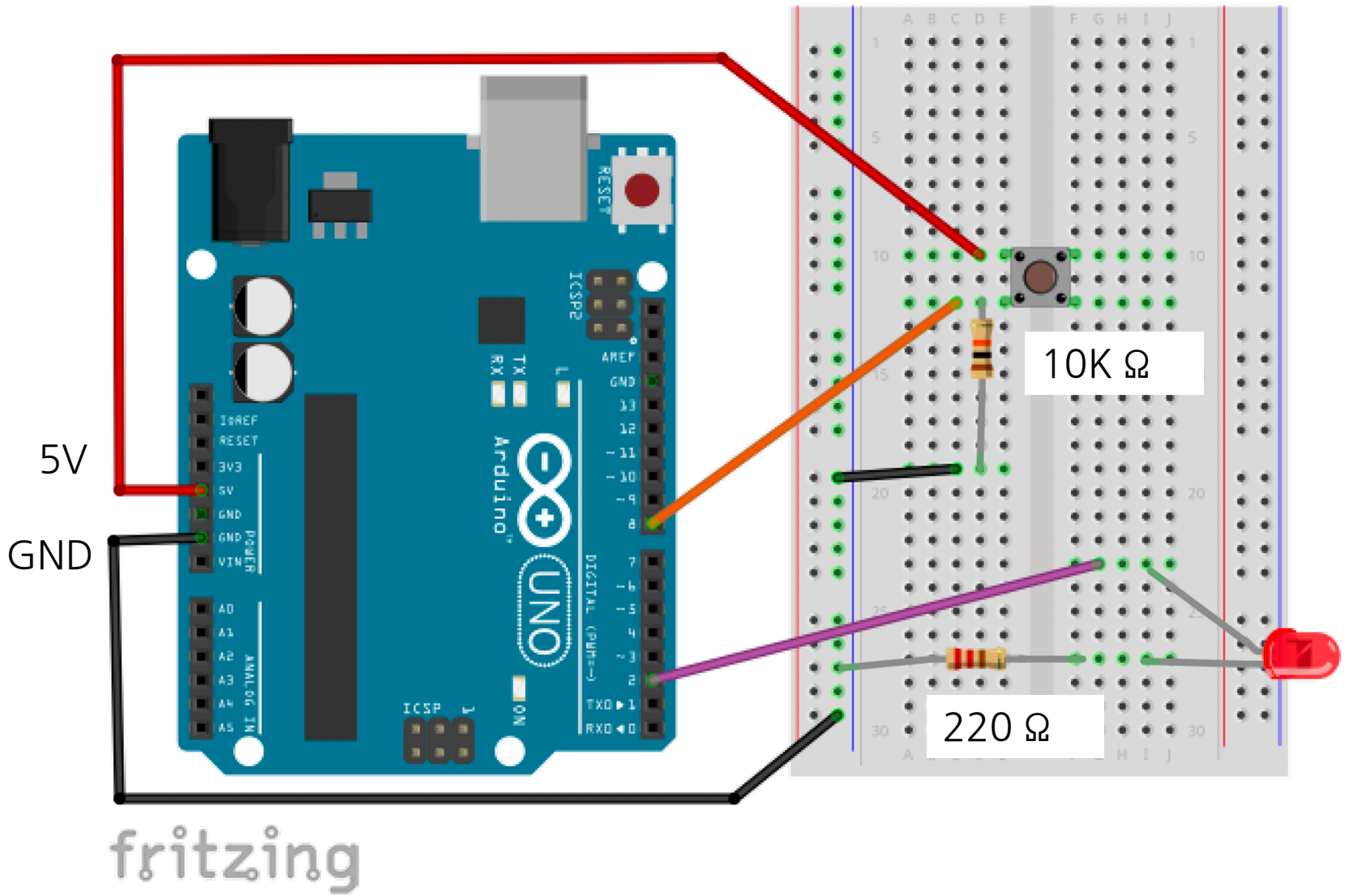
Pull Down 회로



PULL Down circuit

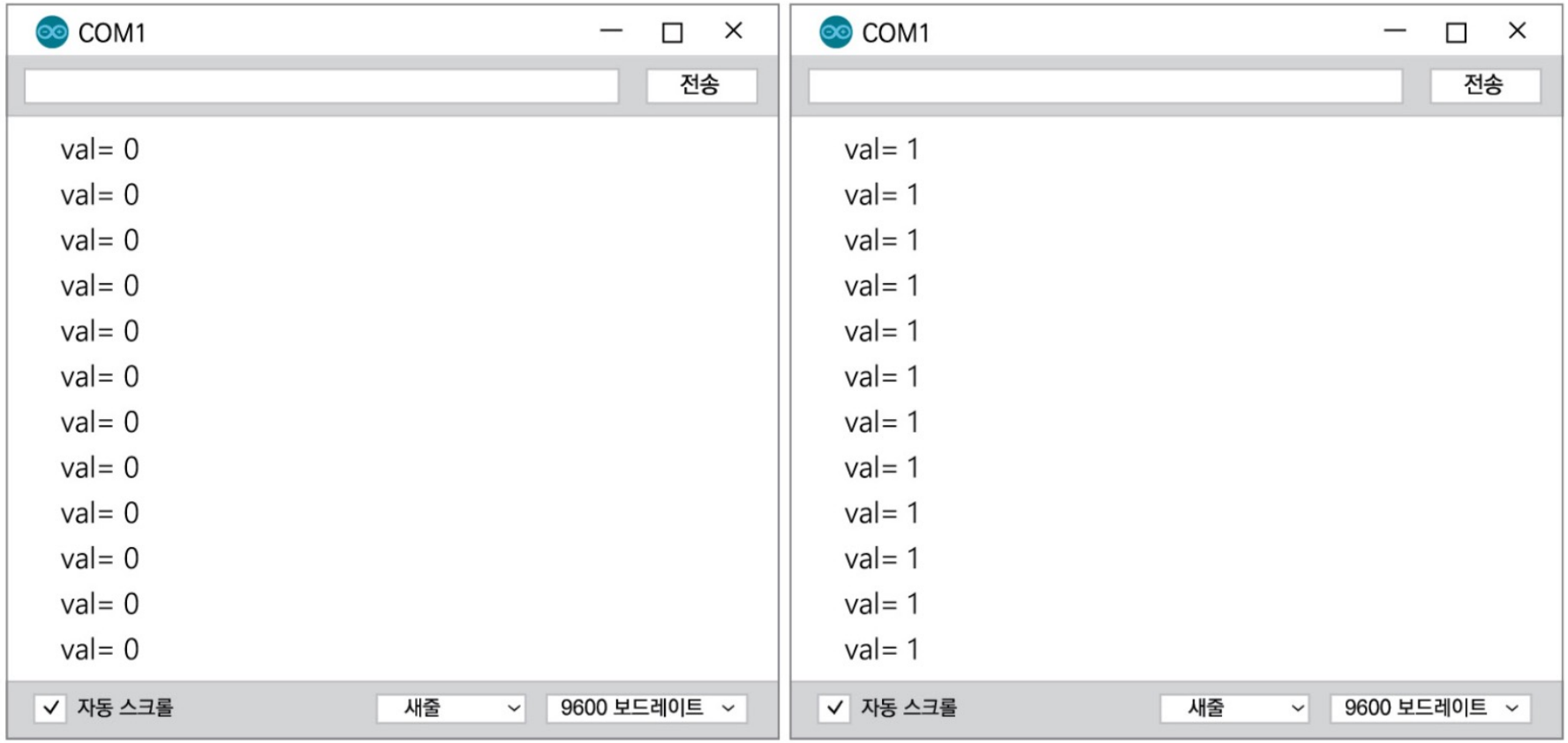


PULL Down circuit



2) Digital input 2 : Push button

Serial monitor

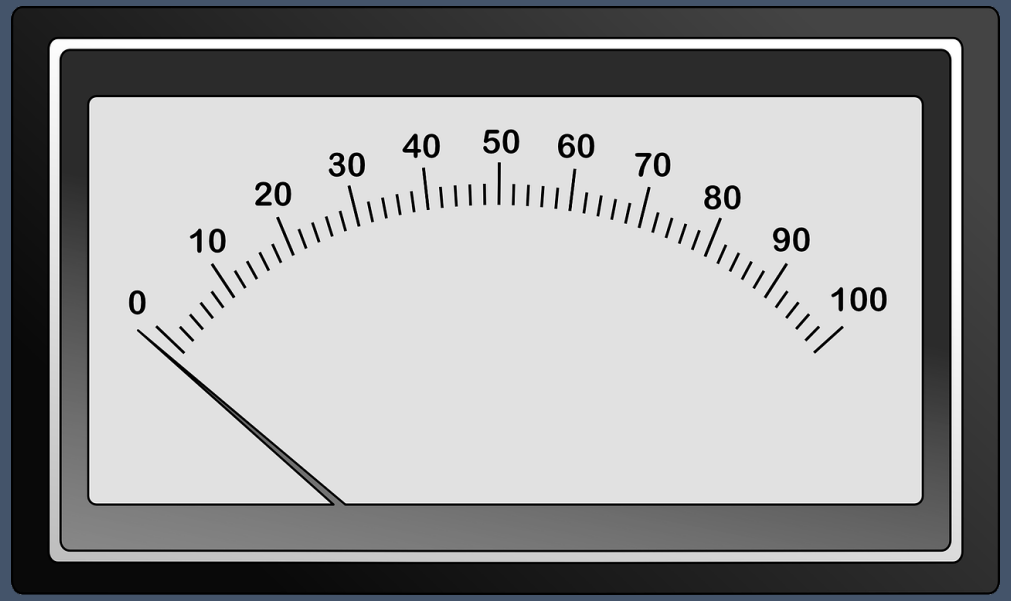


Ch3. Digital INPUT/Analog INPUT

1) Digital INPUT

2) Analog INPUT

2) Analog INPUT



3) Analog INPUT

3-1) Analog INPUT 1 : Potentiometer :

준비물 :

아두이노 보드 1개

포텐시오미터 1개

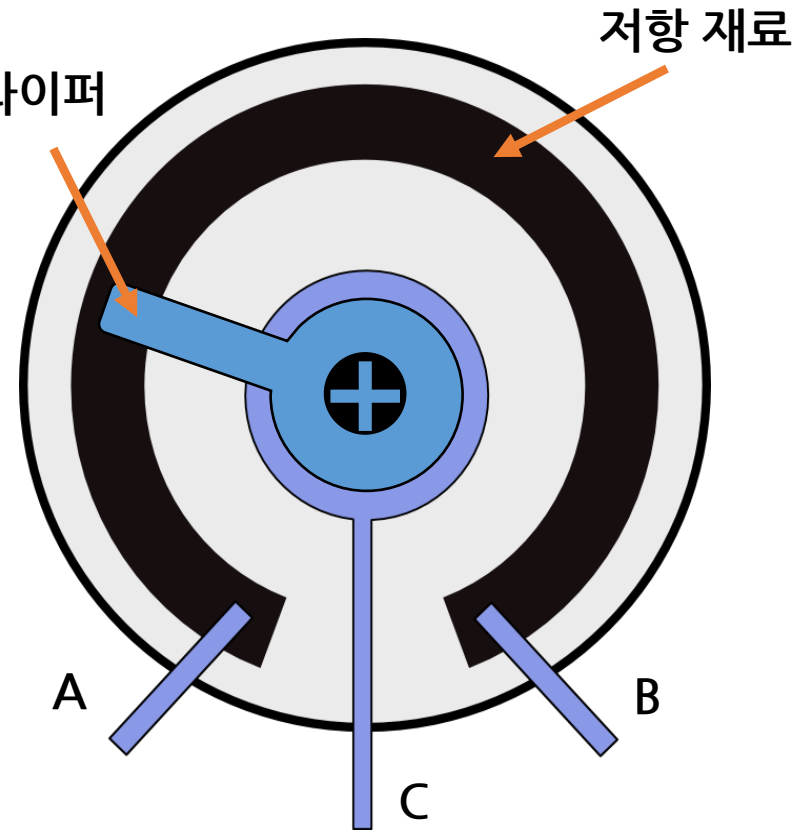
LED 1개

220 Ω 저항 1개

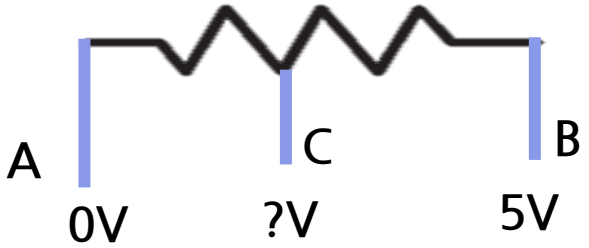
브래드 보드 1개

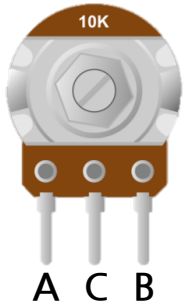
점퍼선

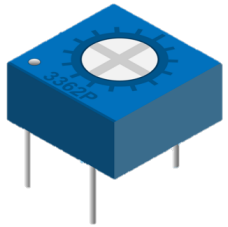
3-1) Analog INPUT 1 : potentiometer



Potentiometer (가변저항) 내부



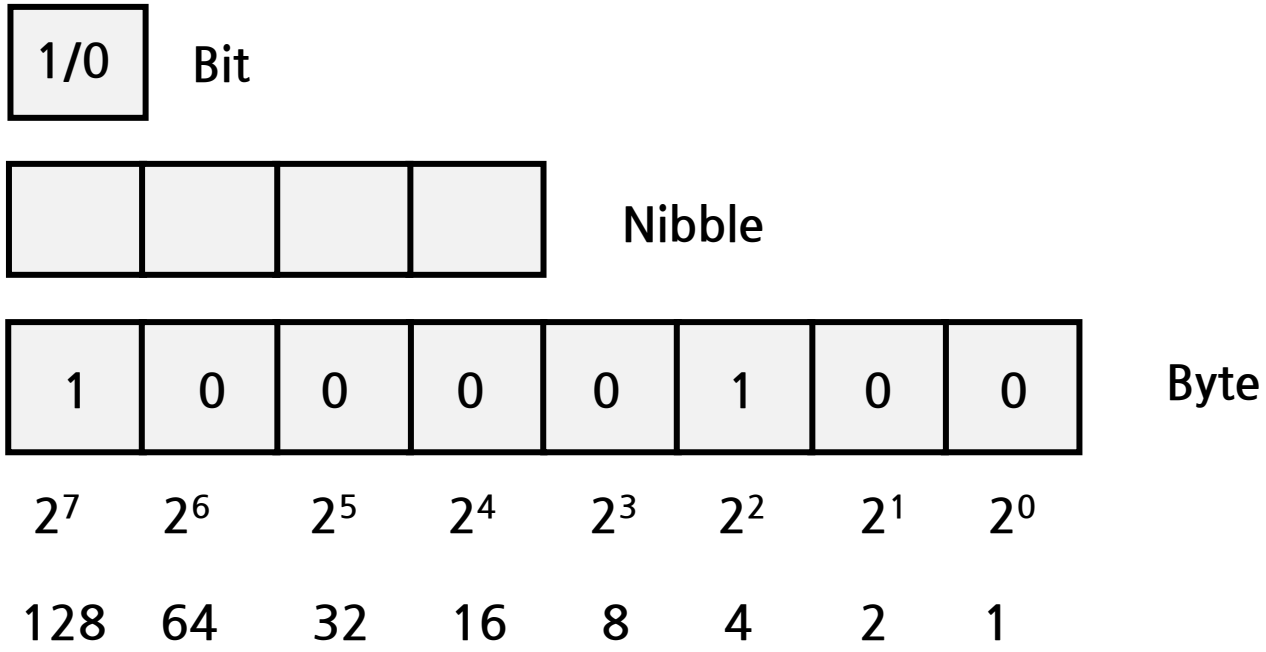




심볼

3-1) Analog INPUT 1 : potentiometer

10 bit Analog register

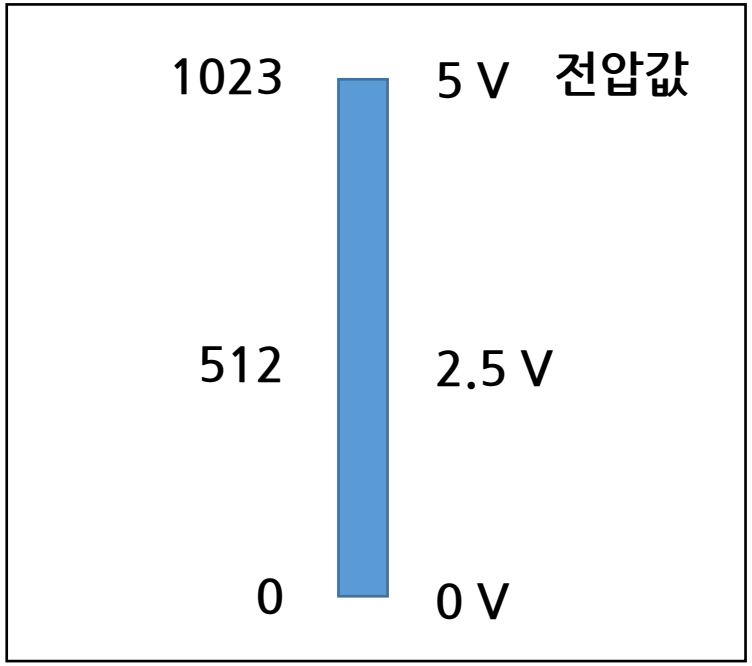


8 비트로 나타낼수 있는 최대 10 진수 숫자는 ?

10 비트로 나타낼수 있는 최대 10 진수 숫자는 ?

3-1) Analog INPUT 1 : potentiometer

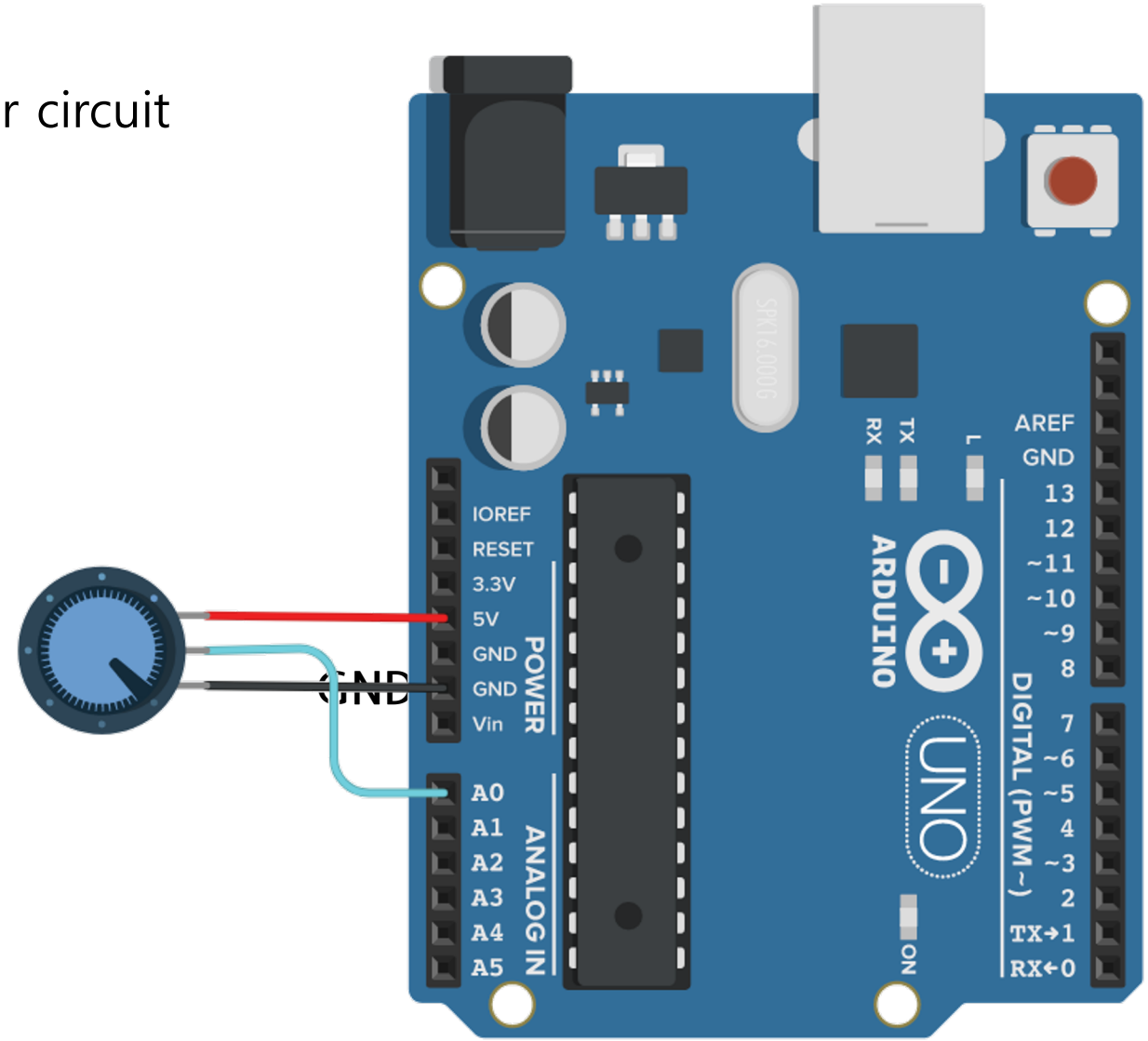
Analog number vs voltage



Volt= (anlog input/1023)X5

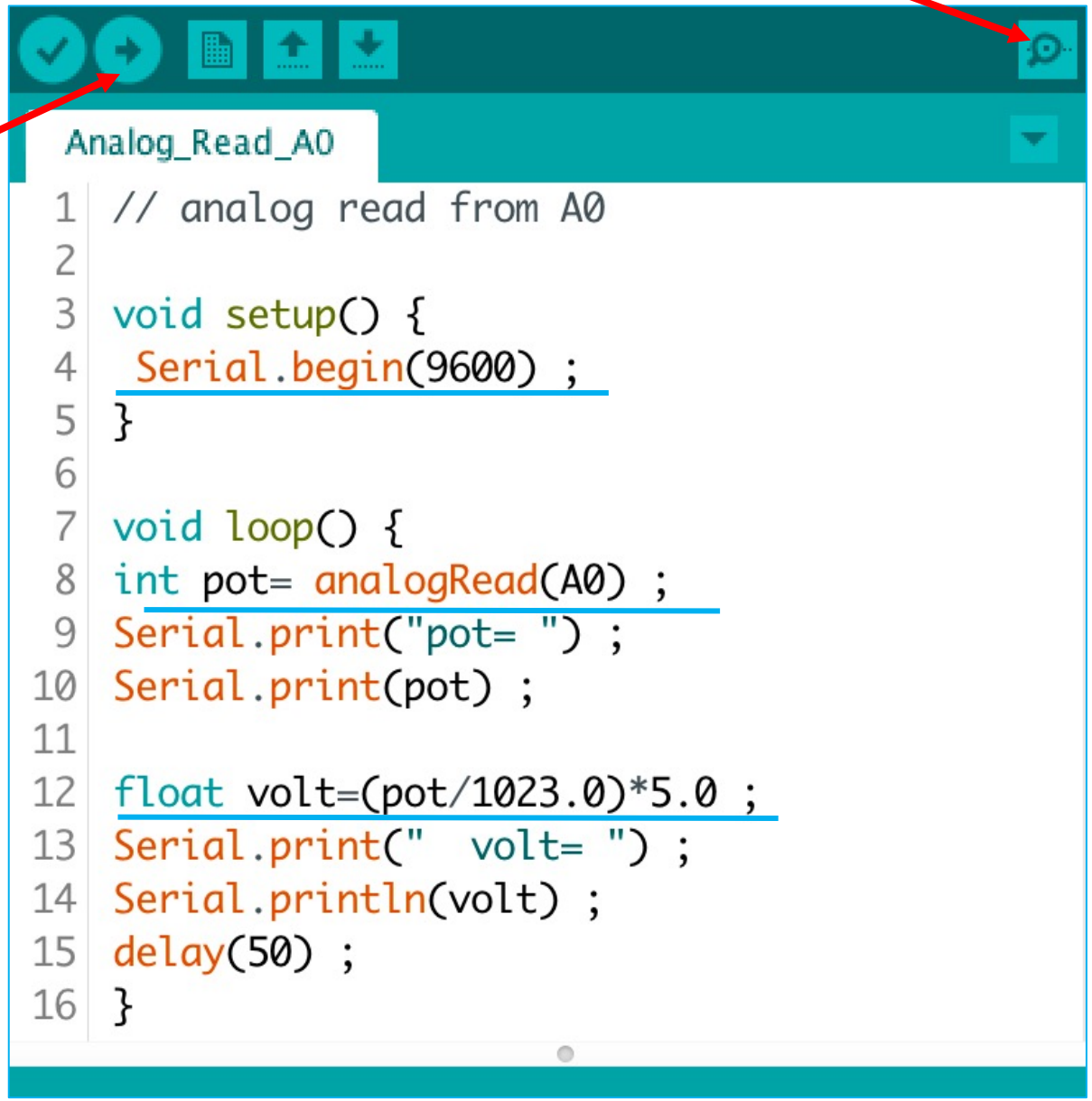
3-1) Analog INPUT 1 : potentiometer

Potentiometer circuit

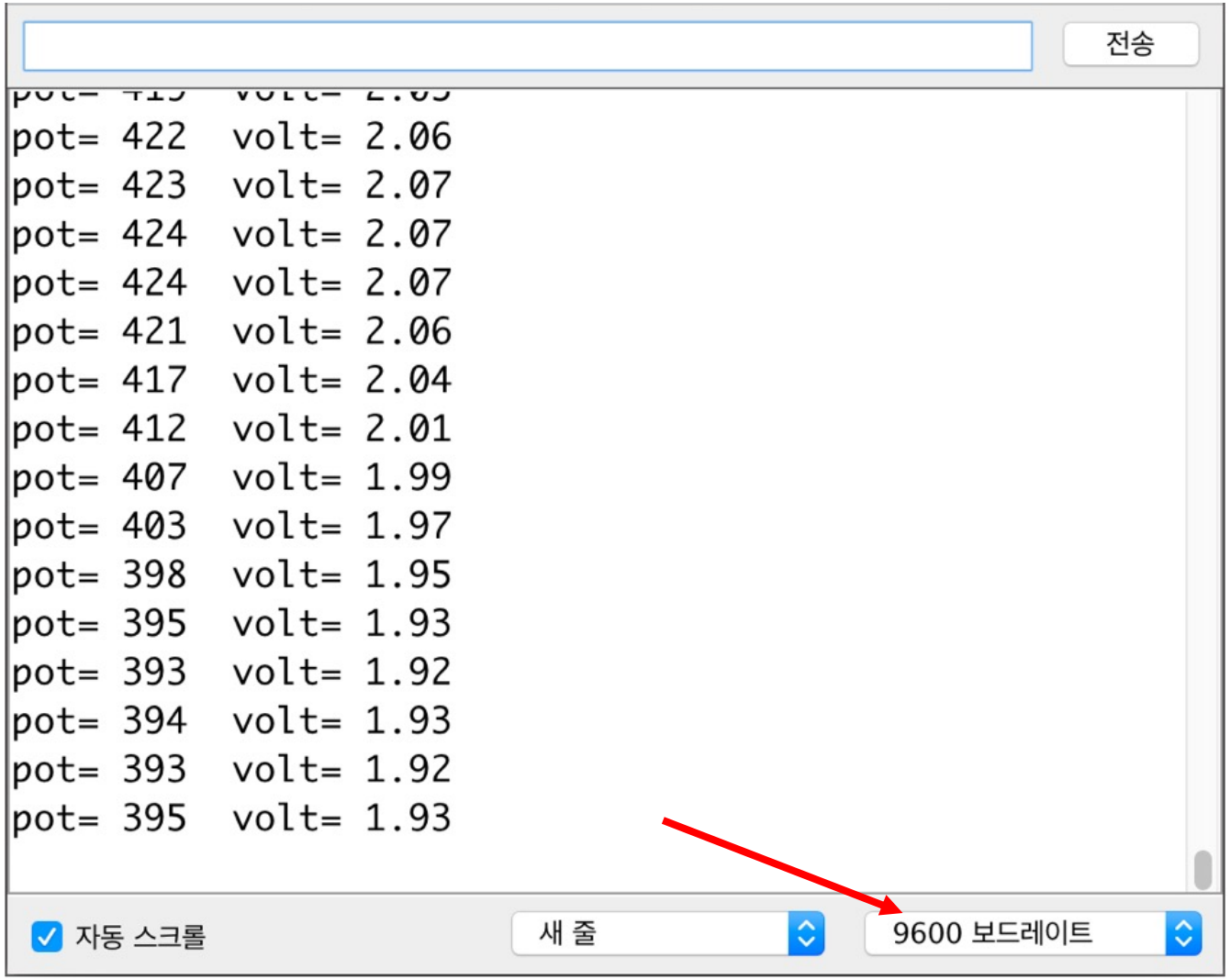


3-1) Analog INPUT 1 : potentiometer

Potentiometer Sketch

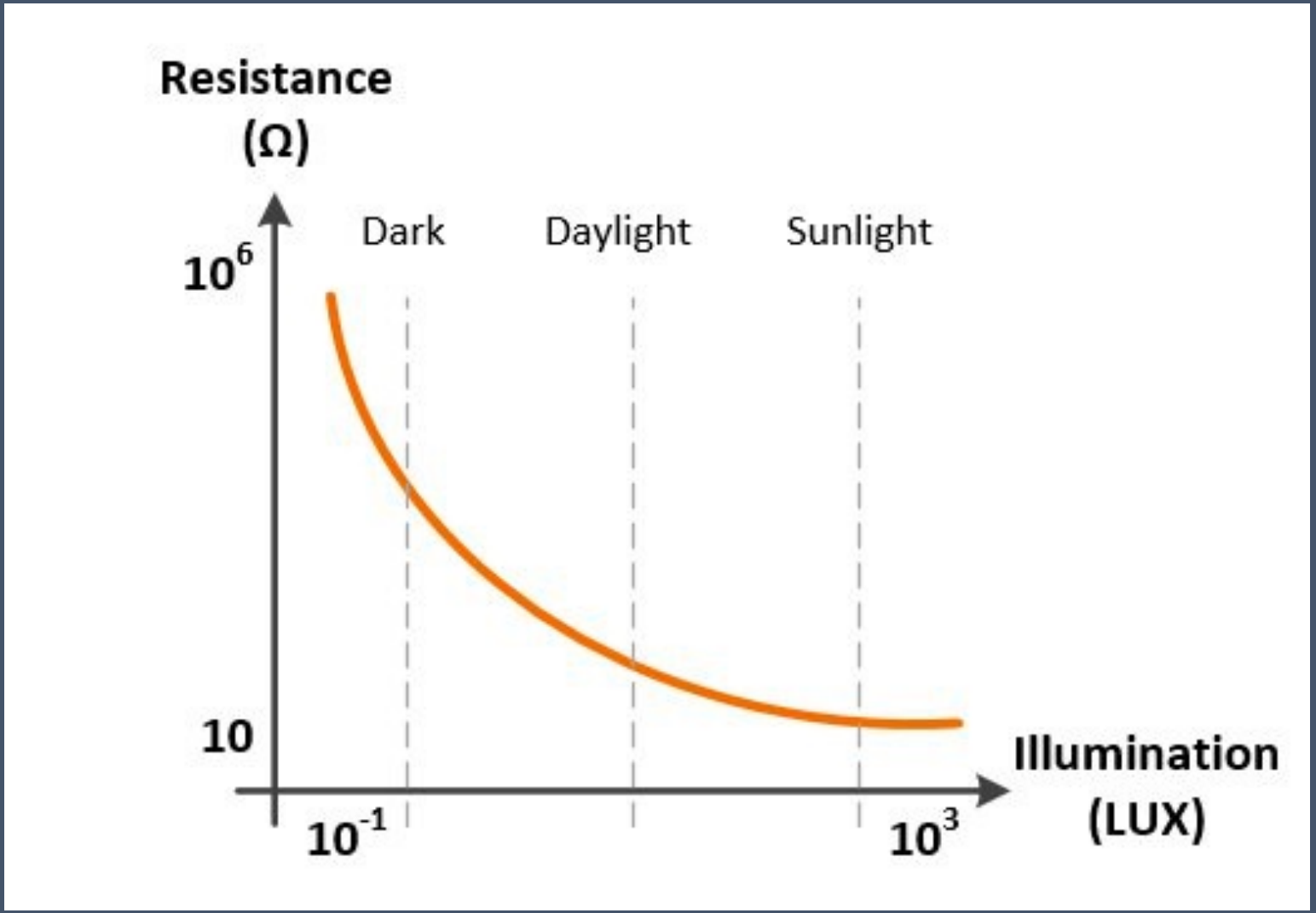


3-1) Analog INPUT 1 : potentiometer



2-2) Analog INPUT 2 : Light sensor

3-2) Analog INPUT 2 : Light sensor



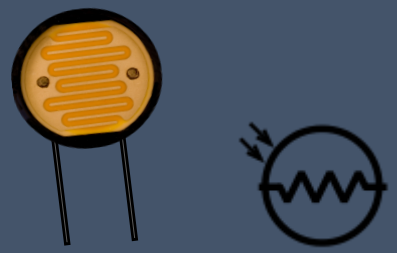
Illumination vs resistance of LDR

3-2) Analog INPUT 2 : Light sensor

빛 의 세기에 따라 저항값 이 변하는 센서

준비물 :

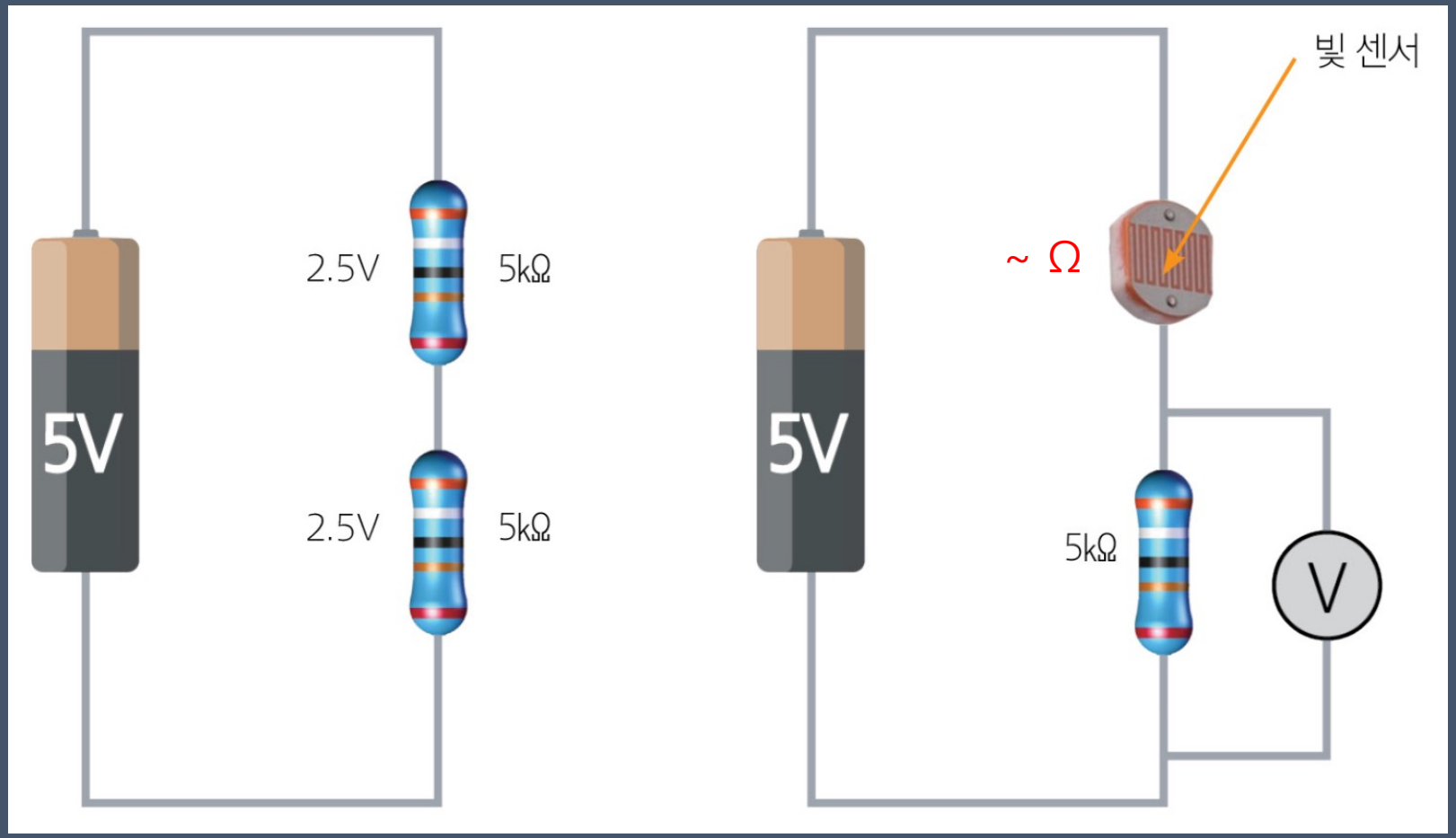
아두이노 보드 1개
CDS sensor 1개
LED 1개
220 Ω, 2K Ω 저항 각 1개
포텐시오미터 1개
브래드 보드 1개
점퍼선



CDS 빛 센서 심볼

3-2) Analog INPUT 2 : Light sensor

Voltage divider



3-2) Analog INPUT 2 : Light sensor

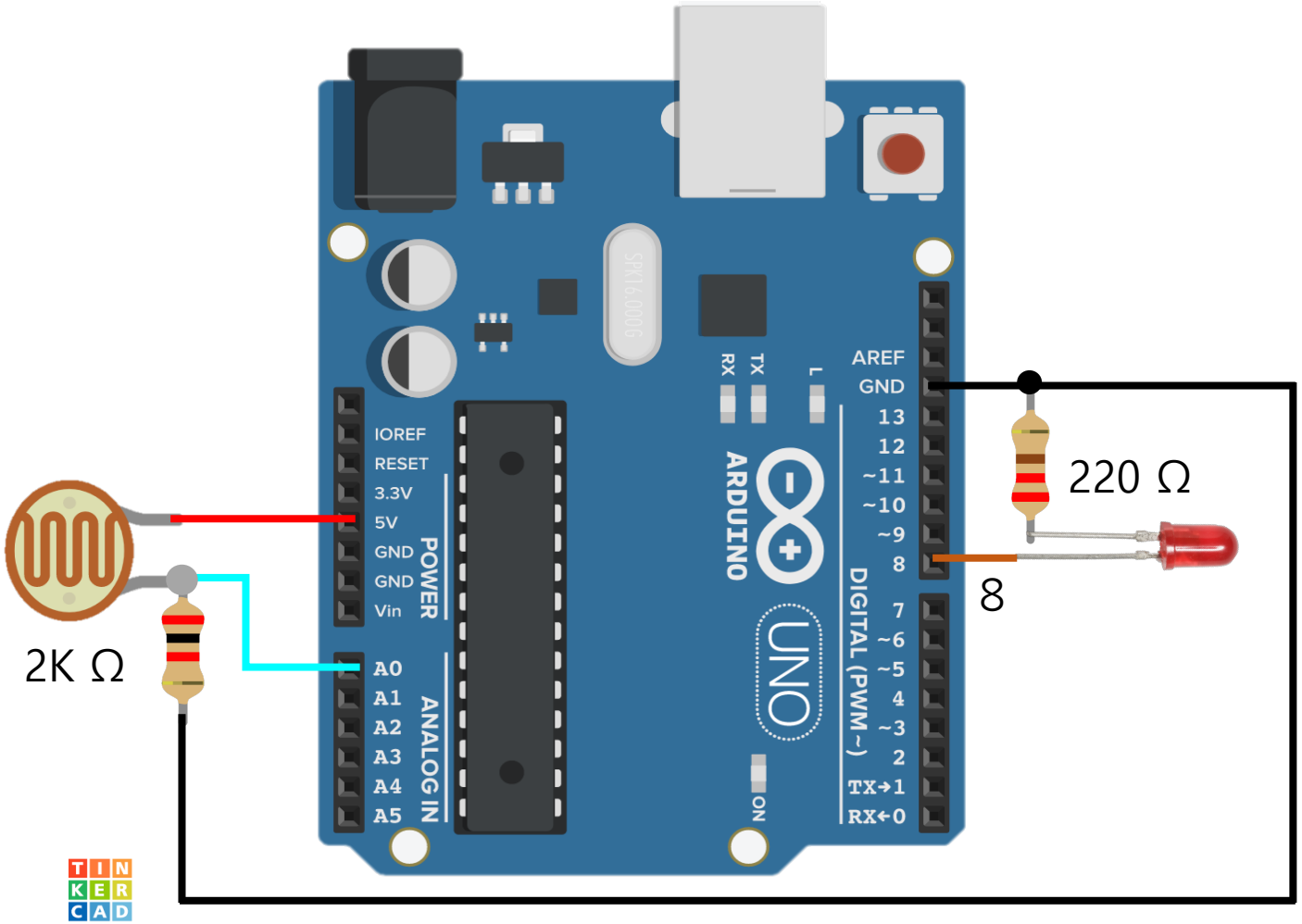
Task 2 :

빛 센서 시그널을 아날로그 A0 에서 받고, 아날로그 값과 환산된 Volt 값을 Serial monitor 에 프린트한다,

그리고 2.5 V 이하 일때 디지털 9 번핀에 연결된 LED 를 켜는 회로와 스케치를 만든다.

3-2) Analog INPUT 2 : Light sensor

LDR circuit



3-2) Analog INPUT 2 : Light sensor

LDR Sketch

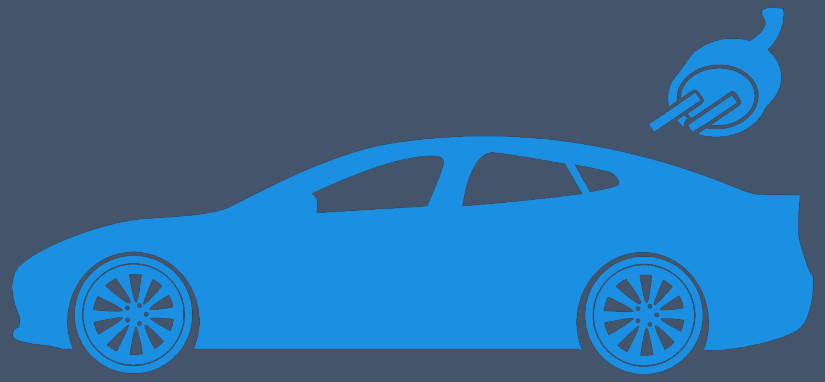
CDS_LED

```
// analog read from A0 then LED at 8

int LED = 8 ;

void setup() {
 pinMode(LED,OUTPUT) ;
 Serial.begin(9600) ;
}

void loop() {
int pot= analogRead(A0) ;
Serial.print("pot= ") ;
Serial.print(pot) ;

float volt=(pot/1023.0)*5.0 ;
Serial.print("  volt= ") ;
Serial.println(volt) ;

 if(volt <=2.5) {
 digitalWrite(LED, HIGH) ;  }
 else { digitalWrite(LED, LOW) ; }
 delay(50) ;
}
```

Ch.4 Analog output,
Library 활용

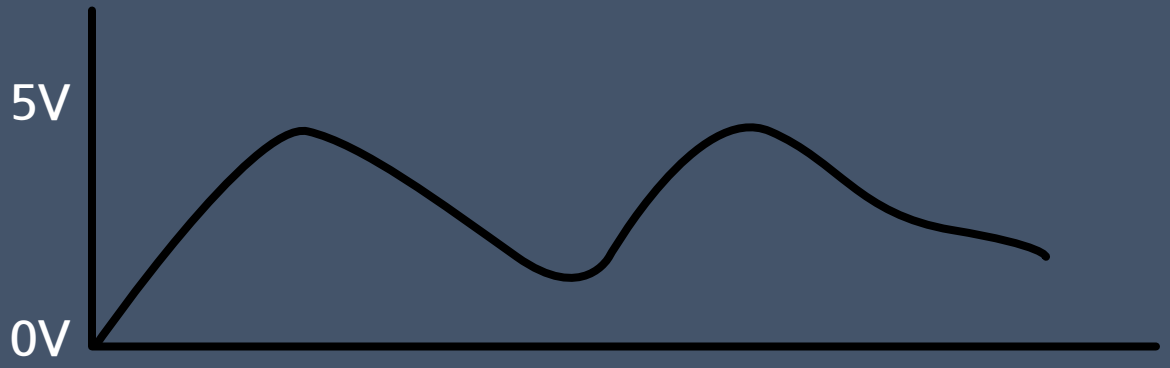
Ch4. Analog OUTPUT

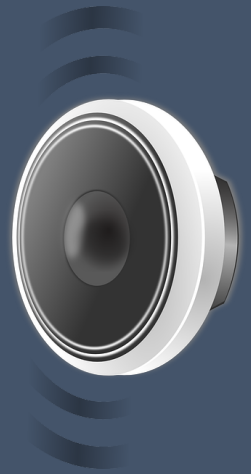
1) Principle of PWM
2) PWM 1 LED



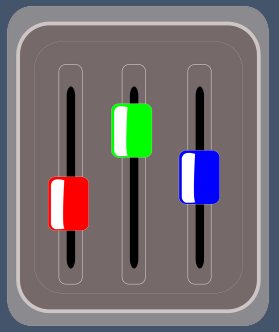
1) Analog Output

How to make analog volt from Arduino





Convert digital volt to analog volt



2) Principle of PWM

PWM(Pulse Width Modulation)

펄스

준비물 :

아두이노 우노 1개

LED 1개, 220 Ω 저항 1개

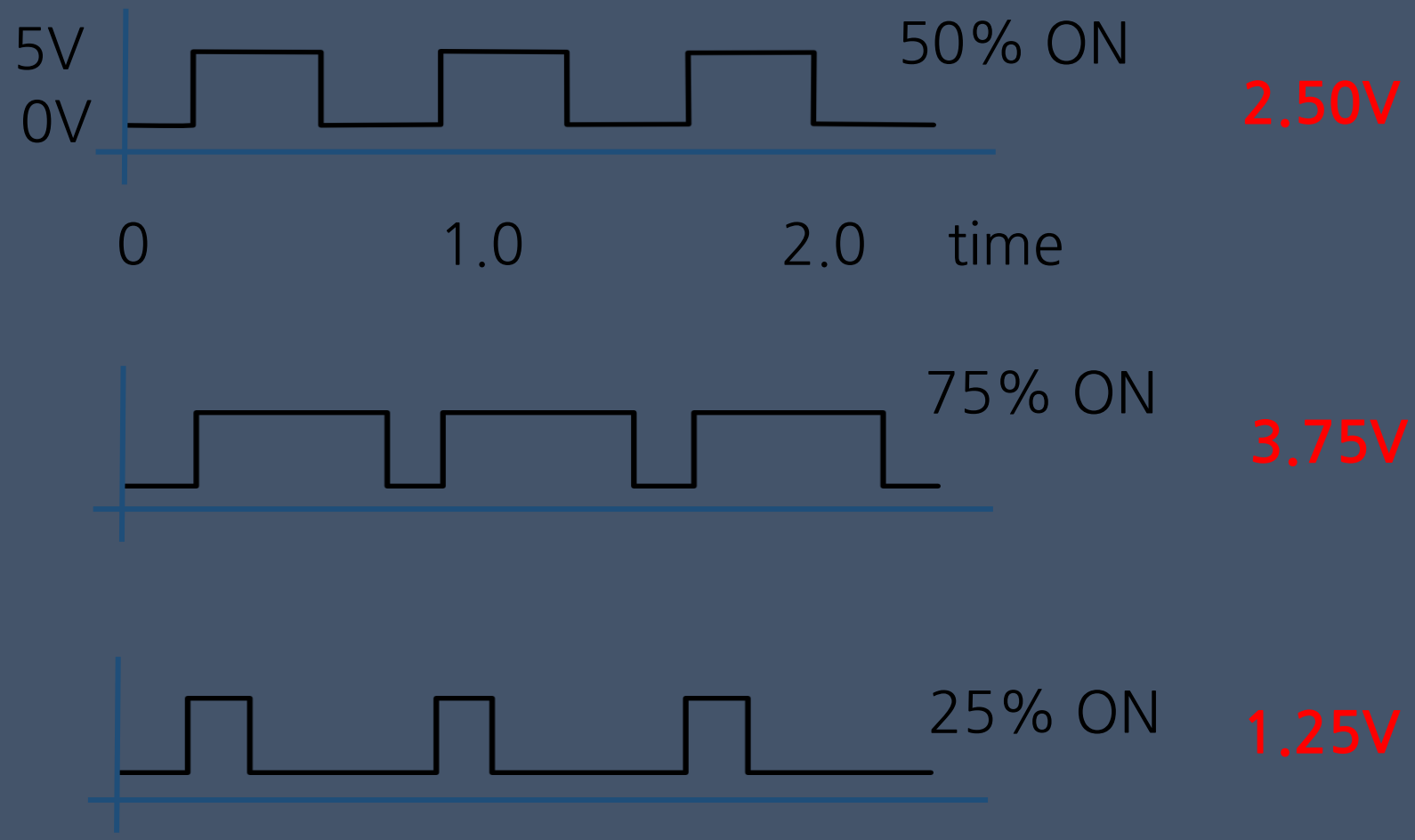
점퍼 케이블

브래드보드

아두이노 디지털 핀은 8 비트

8 비트를 10 진수로 표시하면 ?

2) Principle of PWM



2) Principle of PWM

analogWrite(9, 255) 를 하면 9 번 핀에서 5V 가 출력된다.

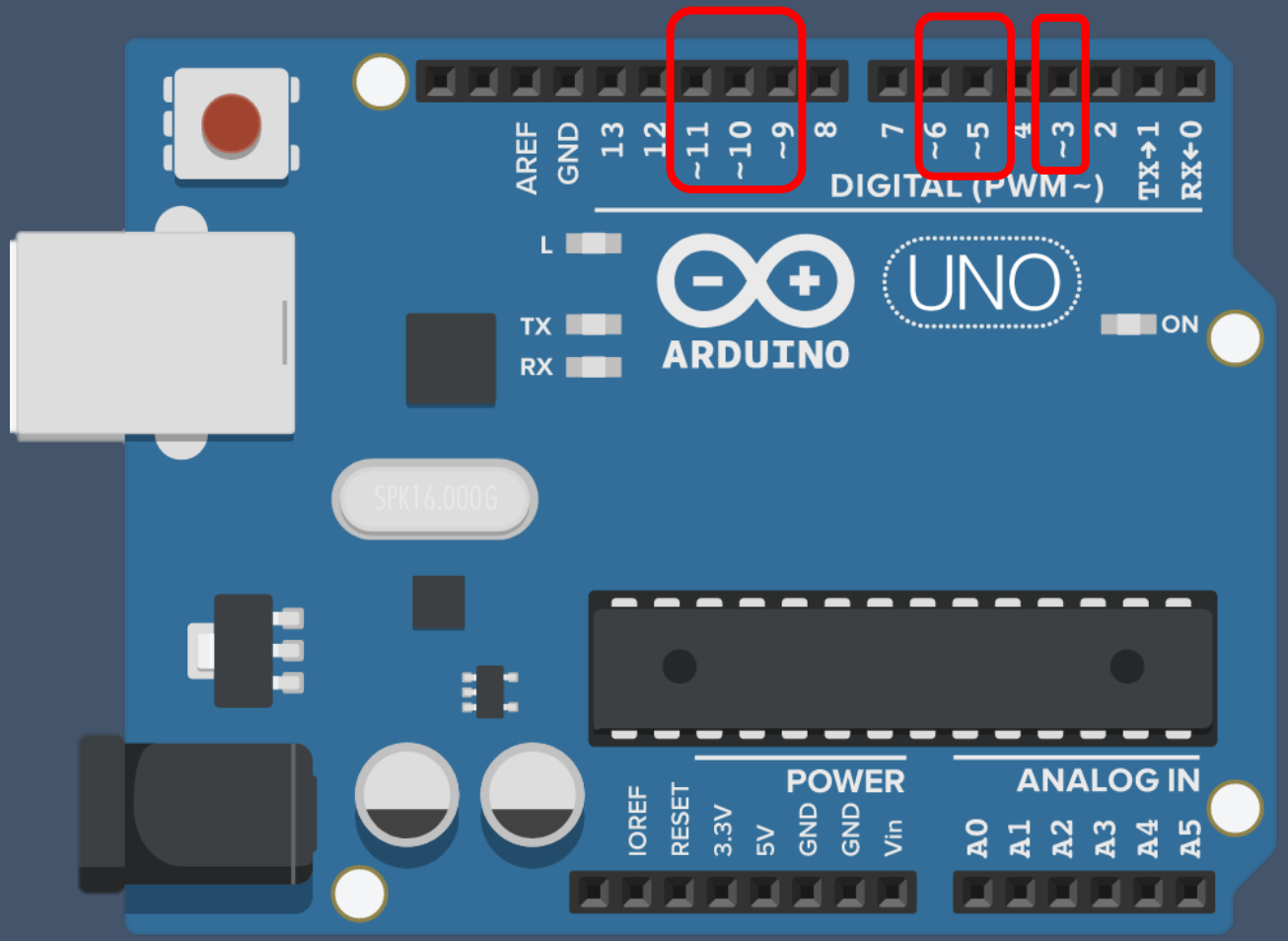
255 의 50% 는 127.5, 정수로 표시하면 128 이다.
analogWrite(9, 128) 를 하면 9 번 핀에서 2.5V 가 출력된다.

analogWrite(9, 0) 를 하면 9 번 핀에서 0V 가 출력된다.

2) Principle of PWM

아날로그 출력을 할 수 있는 핀 앞에는 ~ 표시가 있다.

우노는 3, 5, 6, 9, 10, 11 핀이다.



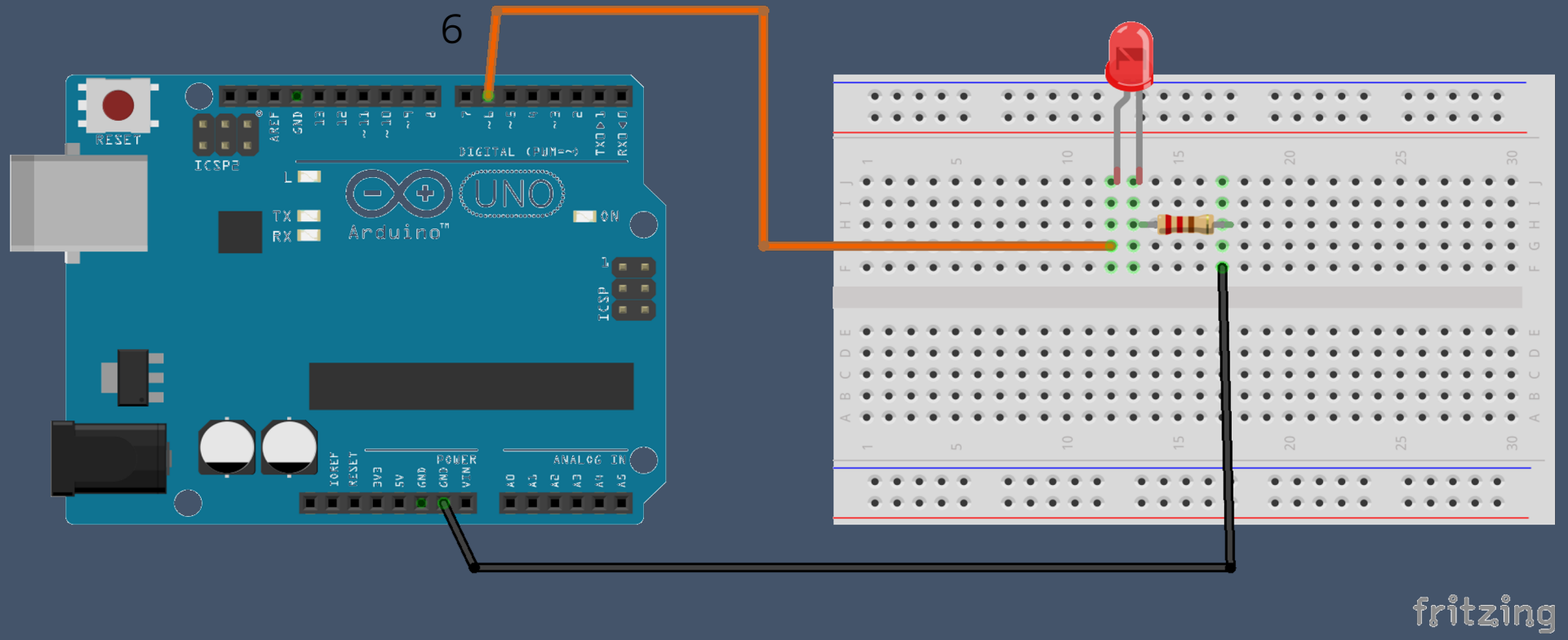
2) PWM 1 LED

프로젝트 :

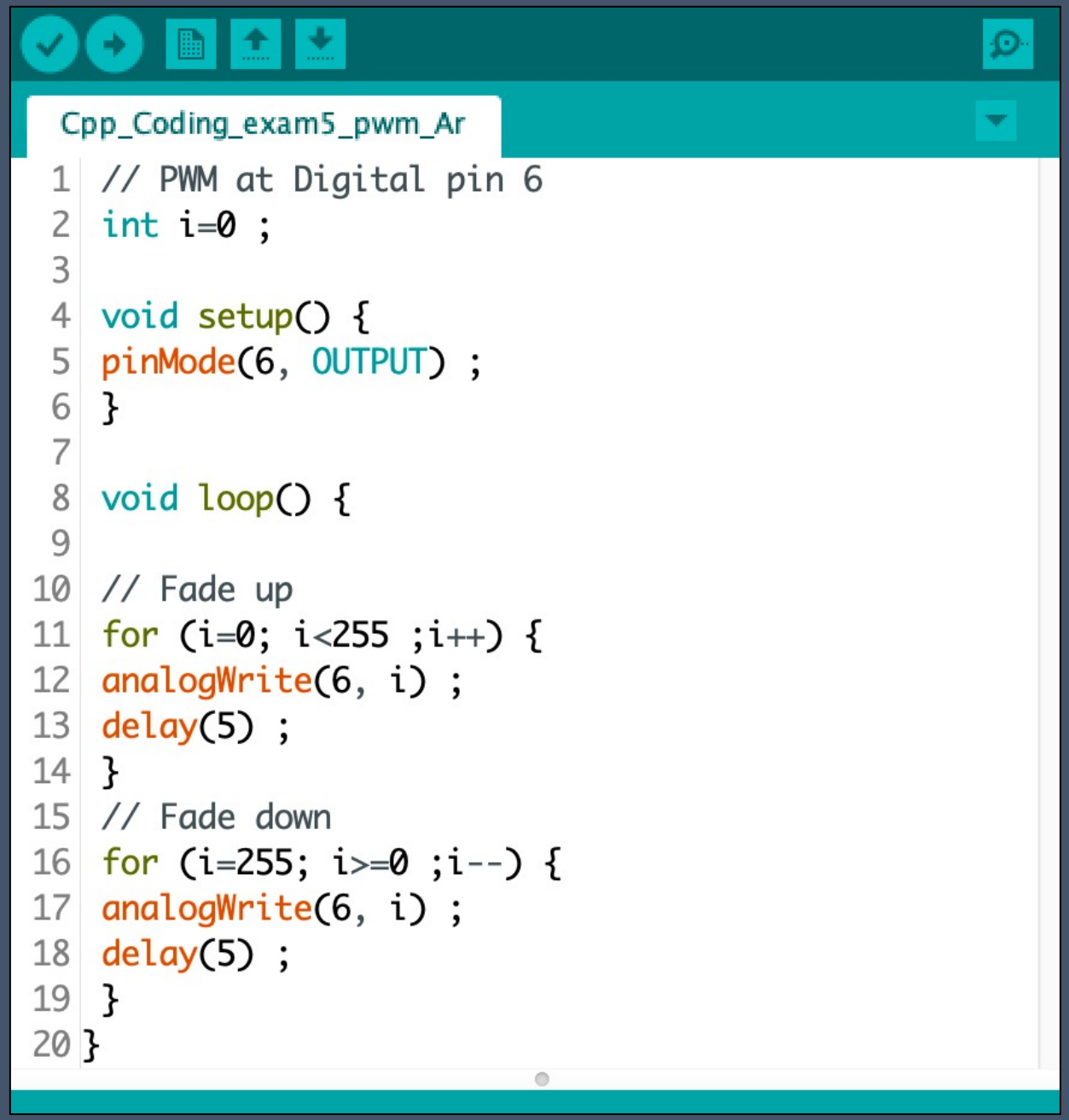
PWM 을 사용하여 디지털 6번 핀에 연결한 LED 의 밝기를 0 부터 최대까지 점진적으로 밝게하고 어둡게 하기를 반복한다.

2) PWM 1 LED

PWM at D6



2) PWM 1 LED



i++ 는 i=i+1 의 줄임

i-- 는 i=i-1 의 줄임

Ch4. Analog OUTPUT

1) Principle of PWM
2) PWM 1 LED
3) PWM 3 LED

Ch5. Library 활용

1) 초음파 센서
2) 온도/습도 센서

3) PWM 3 LED

프로젝트 :

3 개의 LED 를 순차적으로 밝고 어둡게 한다.

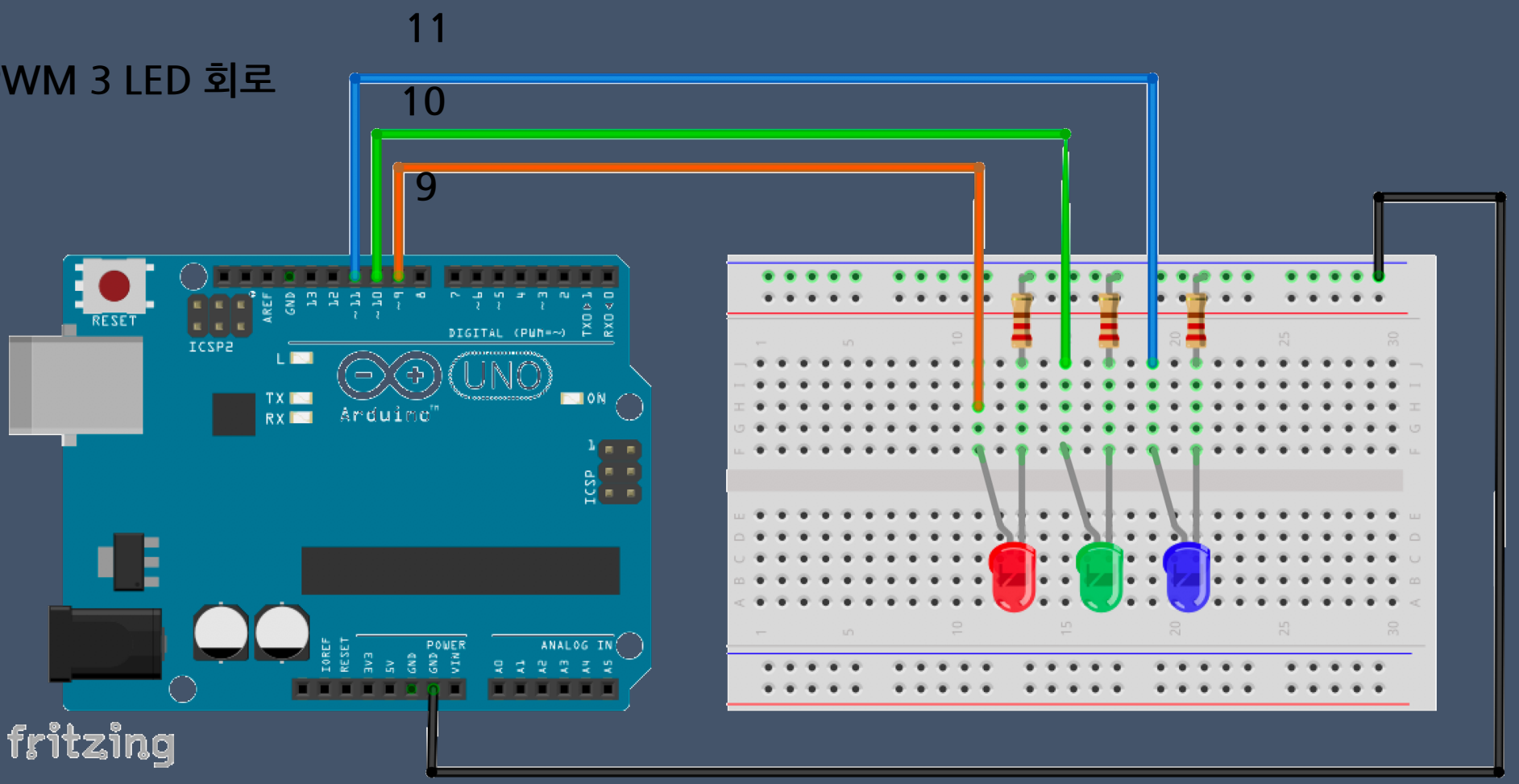
코딩에서

function 개념 소개,

New Tap 소개

3) PWM 3 LED

PWM 3 LED 회로



3) PWM 3 LED

PWM 3 LED 스케치

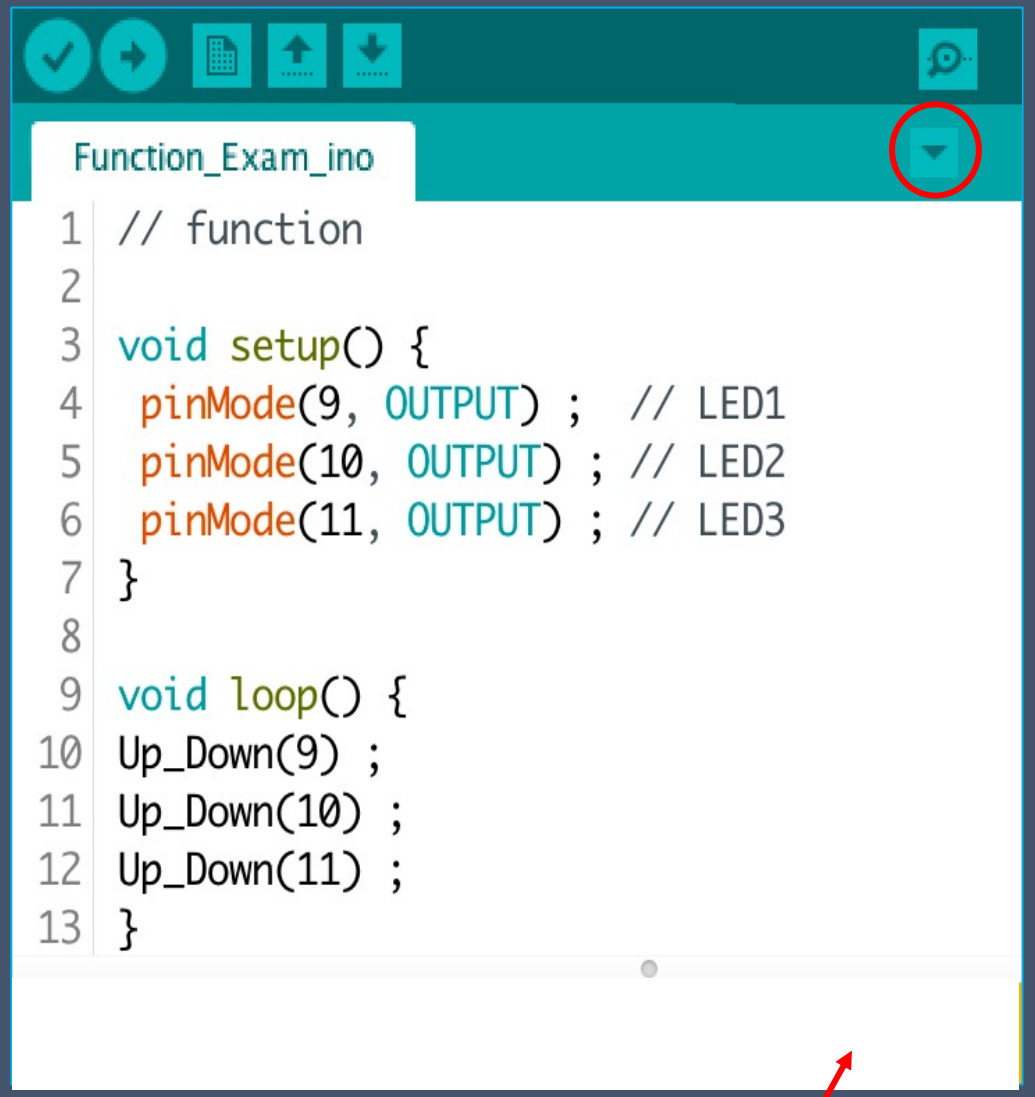
with function

fuction_Exam_ino

```
1  // function
2
3  void setup() {
4  pinMode(9, OUTPUT) ;  // LED1
5  pinMode(10, OUTPUT) ; // LED2
6  pinMode(11, OUTPUT) ; // LED3
7  }
8
9  void loop() {
10 Up_Down(9) ;
11 Up_Down(10) ;
12 Up_Down(11) ;
13 }
14
15 //------ 만든 함수 ----------
16 void Up_Down(int pin) {
17  for (int i=0; i<=255; i++) {
18  analogWrite(pin,i);
19  delay(5);
20  }
21  for (int i=255; i>=0; i--) {
22  analogWrite(pin,i);
23  delay(5) ;
24  }
25 }
26
```

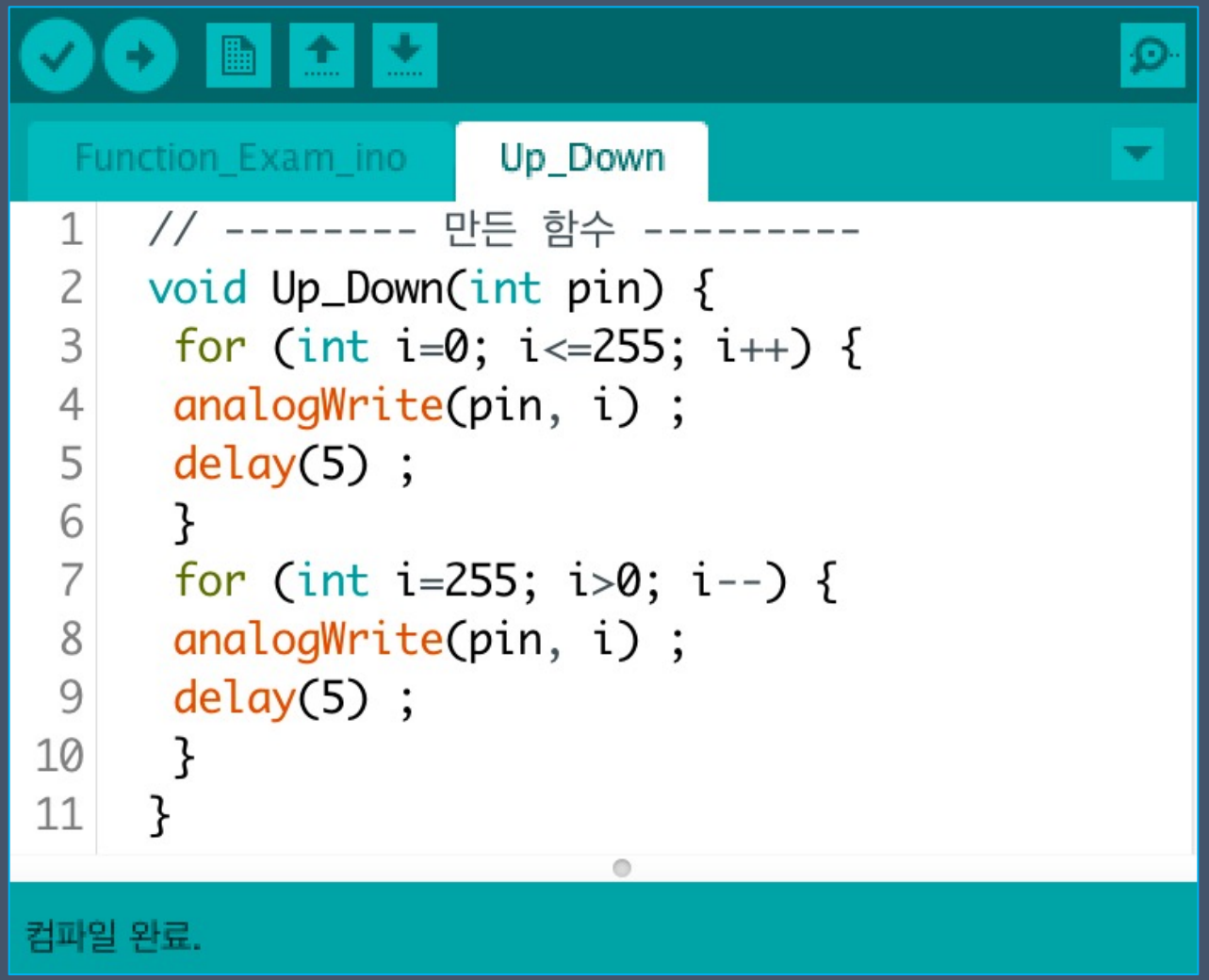
3) PWM 3 LED

New Tap icon



Function_Exam_ino

```
// function

void setup() {
 pinMode(9, OUTPUT) ;  // LED1
 pinMode(10, OUTPUT) ; // LED2
 pinMode(11, OUTPUT) ; // LED3
}

void loop() {
Up_Down(9) ;
Up_Down(10) ;
Up_Down(11) ;
}
```



Function_Exam_ino | Up_Down

```
// -------- 만든 함수 ---------
void Up_Down(int pin) {
 for (int i=0; i<=255; i++) {
 analogWrite(pin, i) ;
 delay(5) ;
 }
 for (int i=255; i>0; i--) {
 analogWrite(pin, i) ;
 delay(5) ;
 }
}
```

컴파일 완료.