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# Maker Space Lecture

## 1. What is Arduino?

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YONSEI, where we make *history*

<http://bitly.kr/2ivIS8k>



연세대학교  
Yonsei Where we make History



**YONSEI**, where we make *history*

## CONTENTS

1. Introduction to Arduino
2. Arduino Grammar
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4. References



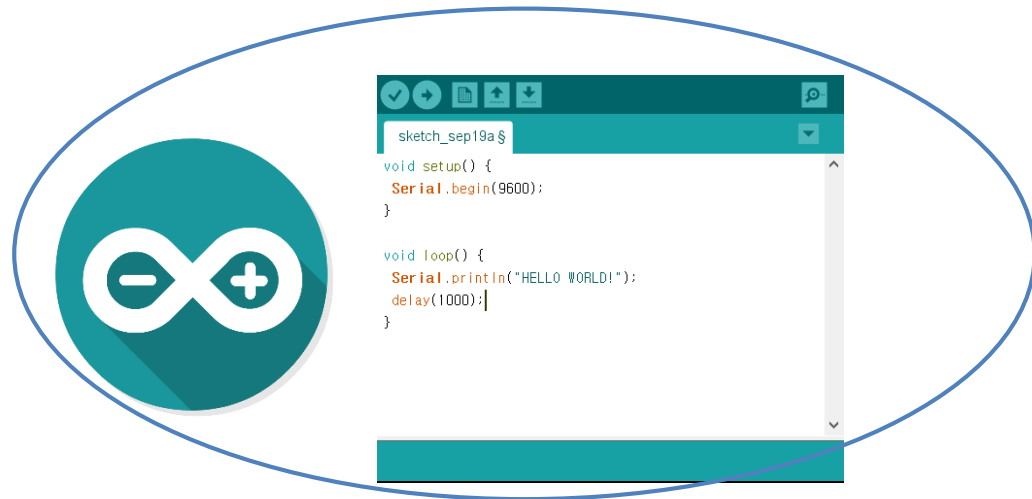
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## Definition of Arduino

Easy to share code, library, and even hardware!

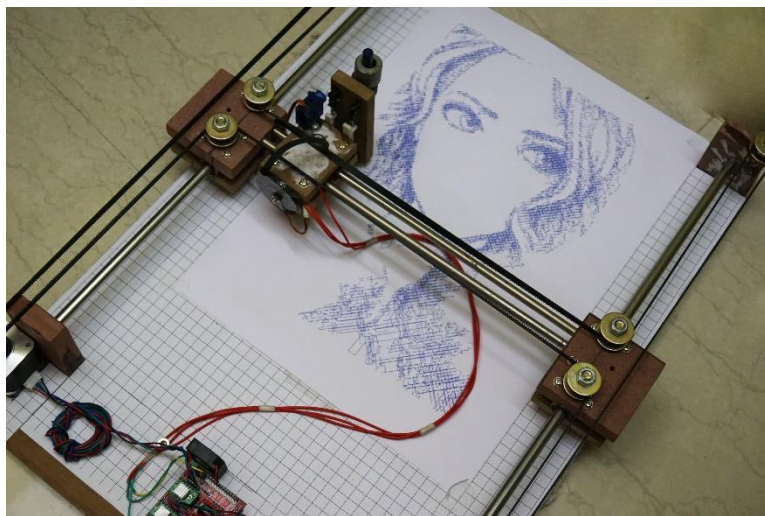
Arduino is an **open-source** electronics platform based on easy-to-use **hardware** and **software**.

To use it, you use the Arduino programming language, and the Arduino Software(IDE).

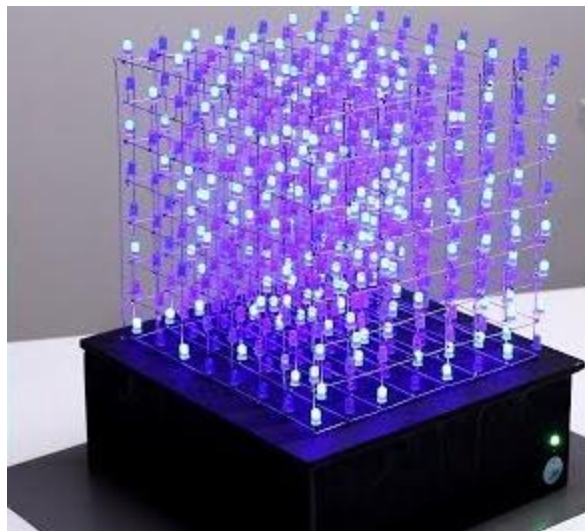


# 1 2 Applications of Arduino

3  
4 <https://www.youtube.com/watch?v=swoiluHrq4c&t=167s>



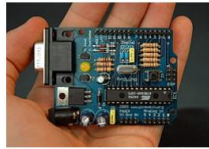
Arduino CNC Drawing Machine



8x8x8 LED CUBE

<http://www.arnabkumardas.com/product/arduino-cnc-drawing-machine/>

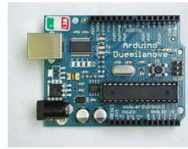
## Types of Arduino



Arduino RS232<sup>[32]</sup>  
(male pins)



Arduino Diecimila



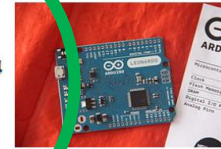
Arduino Duemilanove<sup>[34]</sup>  
(rev 2009b)



Arduino Uno R2<sup>[35]</sup>



Arduino Uno SMD  
R3<sup>[37]</sup>



Arduino Leonardo<sup>[38]</sup>



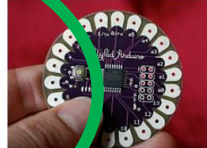
Arduino Pro<sup>[39]</sup>  
(No USB)



Arduino Mega<sup>[40]</sup>



Arduino Nano<sup>[41]</sup>  
(1.8V, 50  
footprint  
)



Arduino LilyPad 00<sup>[42]</sup>  
(rev 2007) (No USB)



Arduino Robot<sup>[43]</sup>



Arduino Esplora<sup>[44]</sup>



Arduino Ethernet<sup>[45]</sup>  
(AVR + W5100)



Arduino Yun<sup>[46]</sup>  
(AVR + AR9331)



Arduino Due<sup>[47]</sup>  
(ARM Cortex-M3 core)



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## Arduino Download



The screenshot shows the Arduino website's 'Download' page. The header includes the Arduino and Genuino logos, a search bar, and navigation links: Home, Buy, Download, Products, Learning, Forum, Support, Blog, and a LOG IN button. Below the header, there's a 'DOWNLOAD' section with a language dropdown set to 'ENGLISH'. The main content area is titled 'Download the Arduino Software'. On the left, there's a large Arduino logo and text for 'ARDUINO 1.6.8', describing it as open-source software for writing code and uploading to boards. On the right, there's a list of download options: 'Windows Installer' (highlighted with a red box and a red arrow pointing to it with the text '클릭해서 다운로드합니다'), 'Windows ZIP file for non admin install', 'Mac OS X 10.7 Lion or newer' (highlighted with a purple box and a purple arrow pointing to it with the text 'For Mac OS'), 'Linux 32 bits', 'Linux 64 bits', 'Release Notes', 'Source Code', and 'Checksums'.

Step 1.

<https://www.arduino.cc/en/Main/Software>



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## Arduino Download



### Support the Arduino Software

Consider supporting the Arduino Software by contributing to its development. (US tax payers, please note this contribution is not tax deductible) [Learn more on how your contribution will be used](#)



Share



Step 2.  
'JUST DOWNLOAD' 클릭

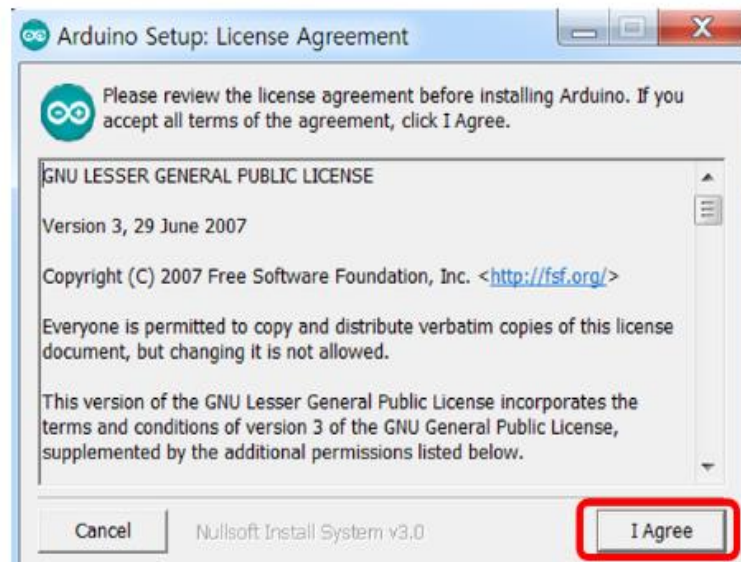
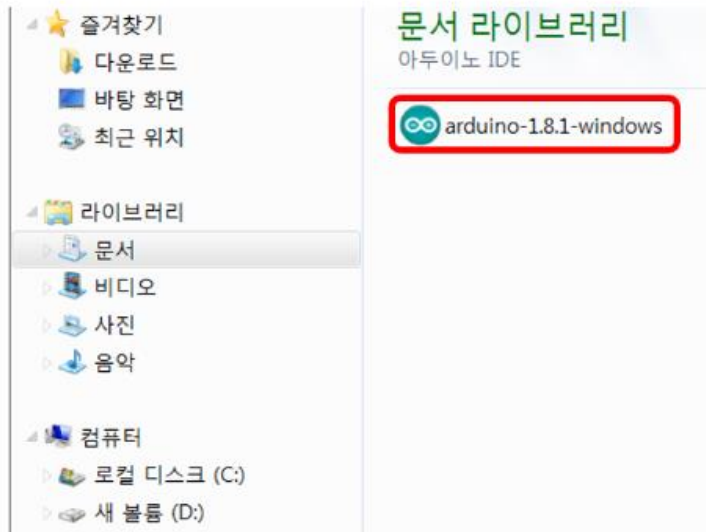




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## Arduino Download

Step 4.  
Double click the icon and click 'I Agree'

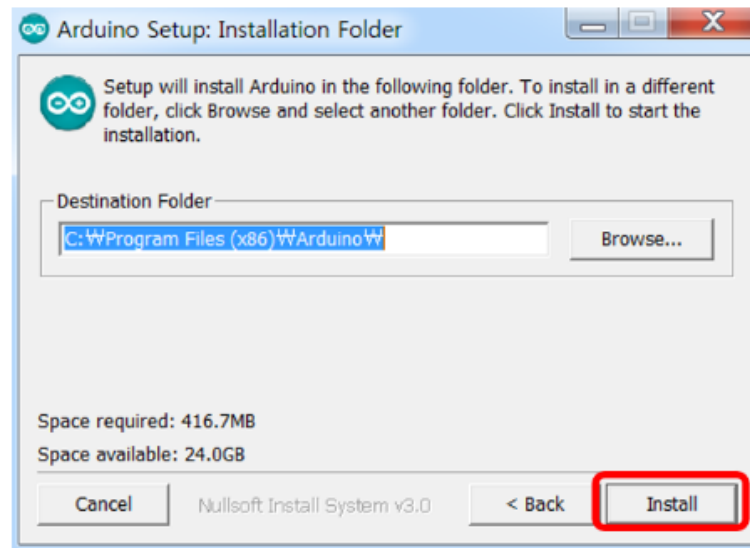
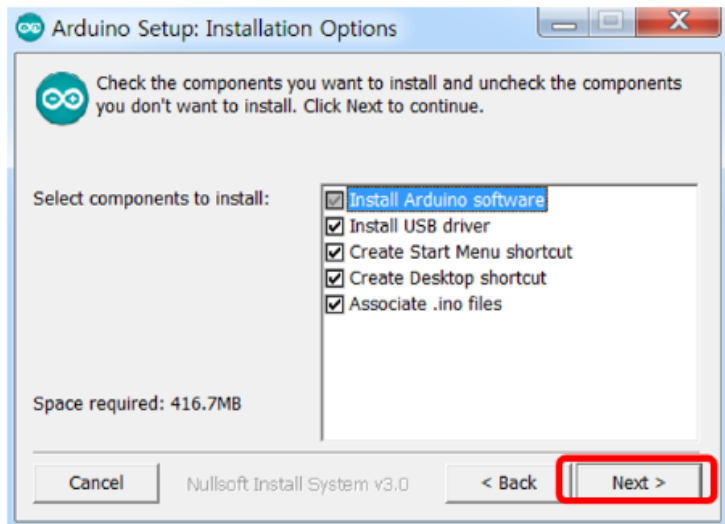




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## Arduino Download

### Step 4. Click 'Next' and Install

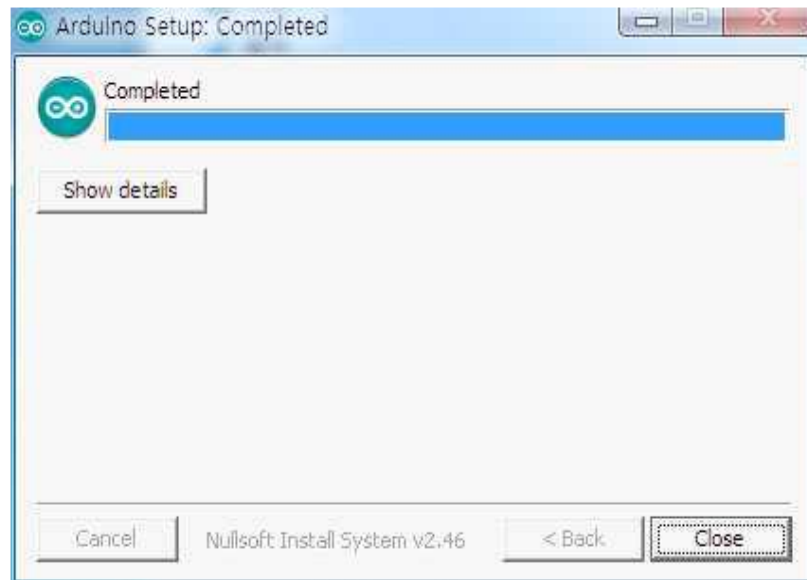
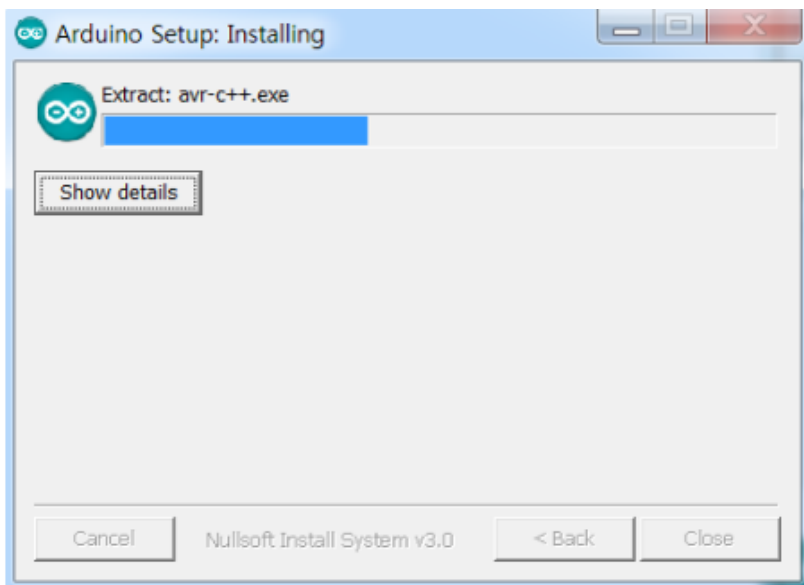




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## Arduino Download

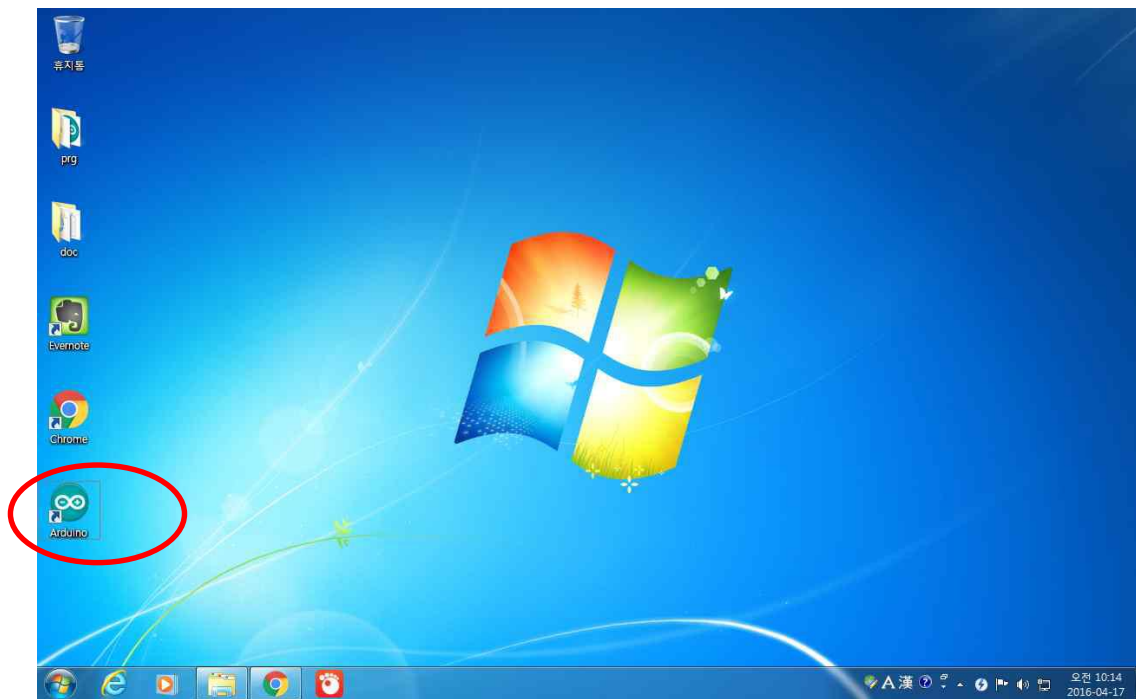
Step 5.  
Click 'Close'



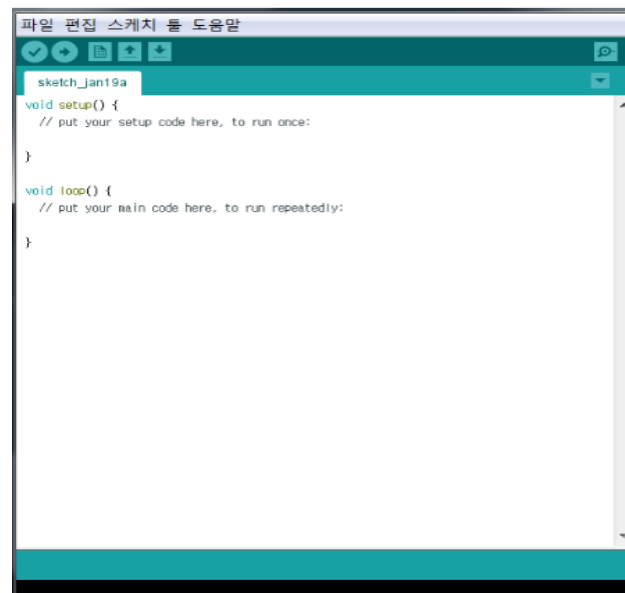


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## Arduino Download



Step 6.  
Double Click Arduino icon

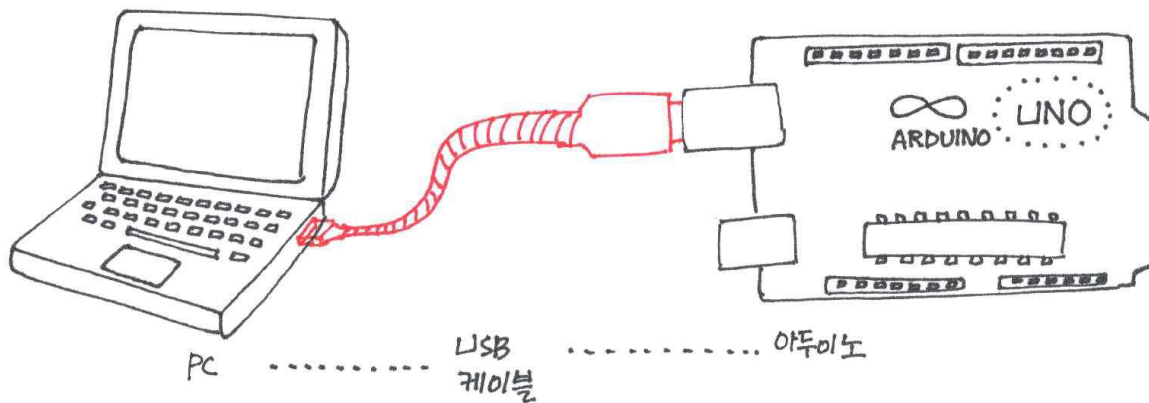


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## Arduino Connection

### Step 1.

그림과 같이 연결한다.

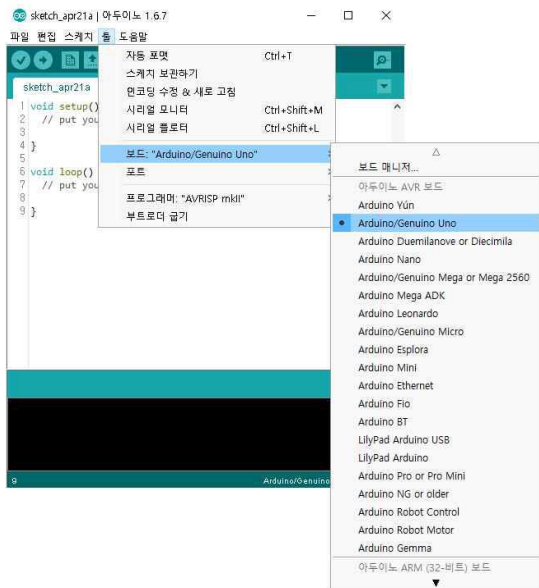


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## Arduino Connection

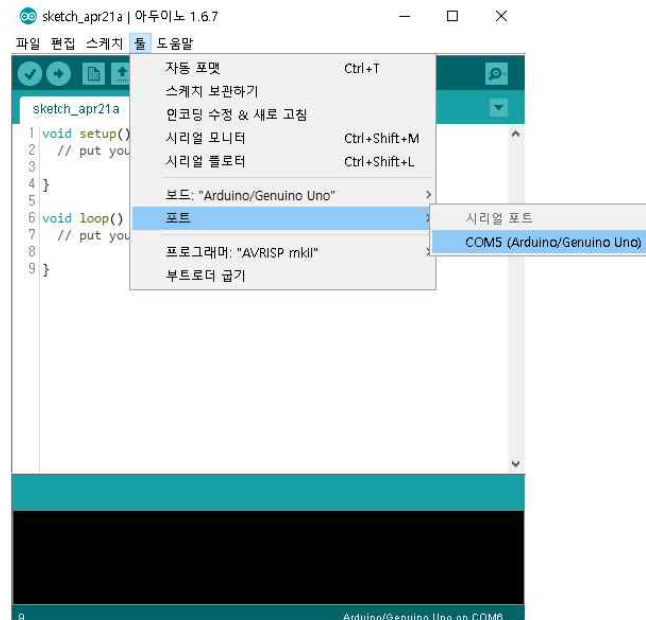
## Step 2.

상단 메뉴 '툴'에서 '보드' 설정



### Step 3.

상단 메뉴 '툴'에서 '포트'설정





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## Basic Structure

```
void setup() {  
  // put your setup code here, to run once:  
}  
  
void loop() {  
  // put your main code here, to run repeatedly:  
}
```

**setup()**

: 최초 1회 실행, 초기 설정 함수

**loop()**

: 반복 실행, 동작 함수



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## Practice 1 - HELLO WORLD!



```
sketch_sep19a $  
  
void setup() {  
  Serial.begin(9600);  
}  
  
void loop() {  
  Serial.println("HELLO WORLD!");  
  delay(1000);  
}
```

### Serial.begin()

: Serial 포트 초기화, 통신의 시작을 선언

### Serial.println("string")

: Serial 모니터에 **string**을 출력하고  
"Wn"을 출력한다.

"Wn"은 새 줄로 입력함을 의미

### delay()

: ( ) milli seconds 동안 대기

-> 1초마다 "HELLO WORLD!" 출력

Serial Communication?

<https://m.blog.naver.com/yuyyulee/220301424499>





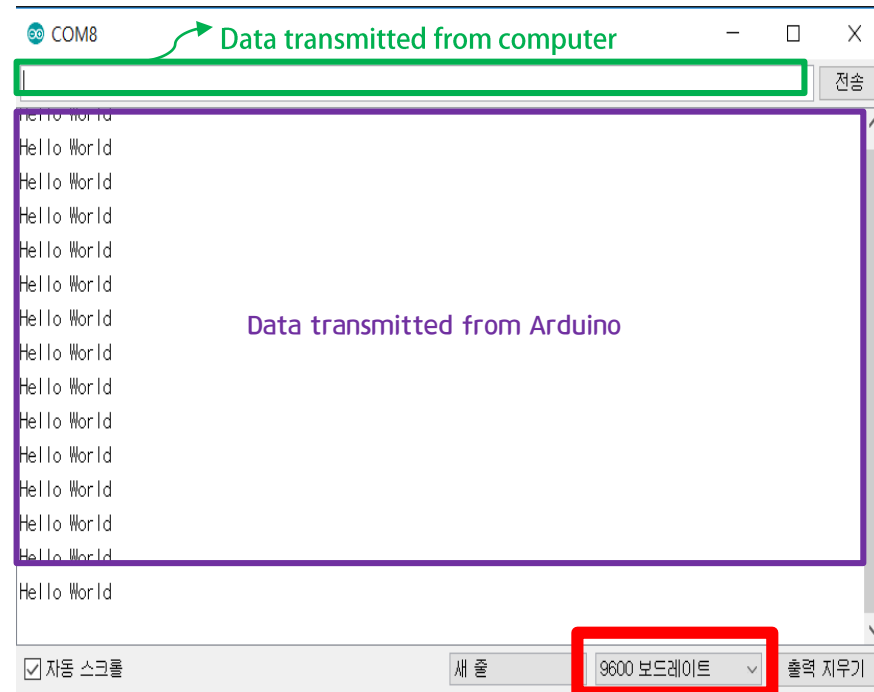
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## 1 : Upload

## 2 : Click Serial monitor



## 3 : Set the baud rate

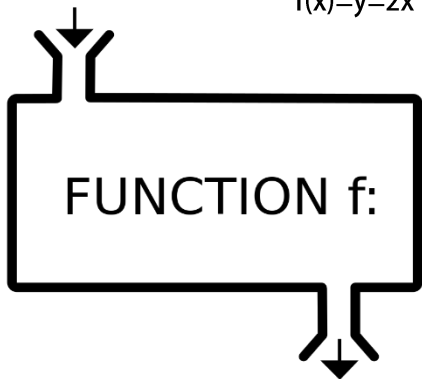


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## Function

INPUT  $x$

E.g. 두배함수  
 $f(x)=y=2x$



OUTPUT  $f(x)$

```

sketch_apr22a $
나가는값의자료형 함수이름(들어오는값){
  처리를 위한 명령문들...
}
    
```

```

sketch_apr16a $
void happy() {
  //주석이여서 아무 효과 없어요~
  /*
   이렇게 쓰면
   여러 줄을 주석으로 쓸 수 있습니다.
   */
  Serial.println("HELLO WORLD!");
}
    
```

`{ }` Paragraph

`;` End a statement

주석

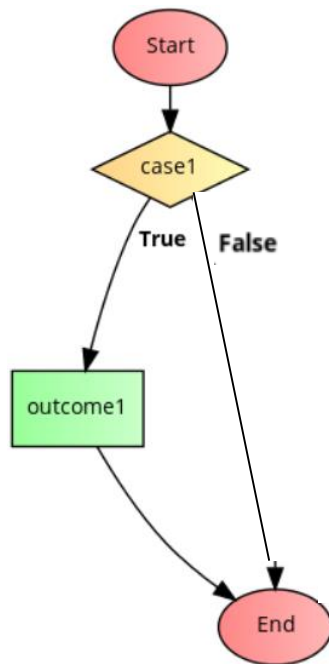
`//` for one line

`/* */` for multiple lines

1  
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## if statement

```
if(case1){
    outcome1
}
```



-if문은 () 안의 참 거짓을 판별한다. 참이라면 {} 안의 내용을 실행한다.

-if문 뒤의 **else**, **else if** 는 생략해도 된다.

-**else if**는 무수히 많이 사용할 수 있다.

cf.

1 means 'ON', 'True', and 'HIGH'

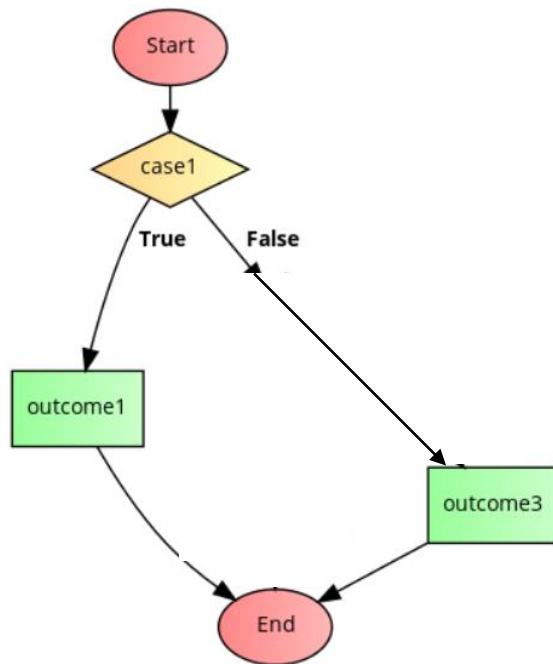
0 means 'OFF', 'False', and 'LOW'

1  
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## if statement

```
if(case1){
    outcome1
}
```

```
else(){
    outcome3
}
```



-if문은 () 안의 참 거짓을 판별한다. 참이라면 {} 안의 내용을 실행한다.

-if문 뒤의 **else**, **else if** 는 생략해도 된다.

-**else if**는 무수히 많이 사용할 수 있다.

cf.

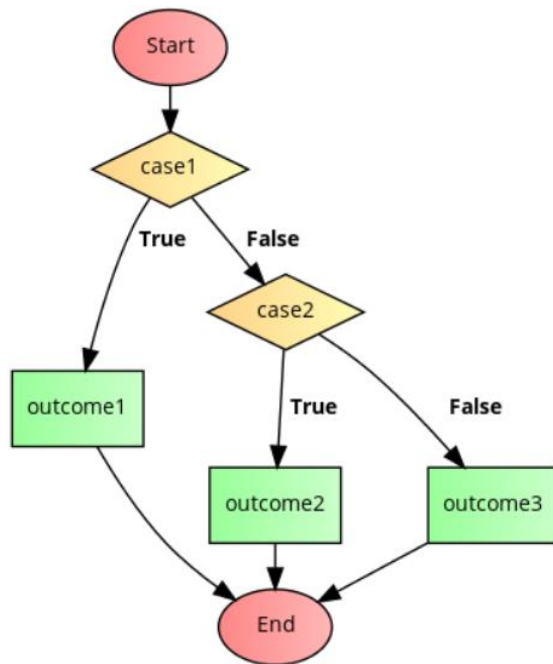
1 means 'ON', 'True', and 'HIGH'

0 means 'OFF', 'False', and 'LOW'

1  
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3  
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## if statement

```
if(case1){
    outcome1
}
else if(case2){
    outcome2
}
else(){
    outcome3
}
```



-if문은 () 안의 참 거짓을 판별한다. 참이라면 {} 안의 내용을 실행한다.

-if문 뒤의 **else**, **else if** 는 생략해도 된다.

-**else if**는 무수히 많이 사용할 수 있다.

cf.

1 means 'ON', 'True', and 'HIGH'

0 means 'OFF', 'False', and 'LOW'



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## Variable (변수)

-변수는 데이터를 저장하는 공간이며, **name**, **value**, **type**을 가지고 있다.

예를 들어, `int pin = 13;` 는 일반적인 변수 선언 방식이다.

이름은 **pin**, 값은 **13**이고 자료형은 **int**인 변수를 선언한 것이다.

-변수의 이름은 A~Z, a~z, 0~9, \_ (숫자가 제일 앞에 올 수는 없음) 으로 쓸 수 있다.

-변수의 자료형	<b>integer(정수형)</b>	: <b>int, long</b> (변수에 맞춰 적절한 자료형을 입력하여야 한다.)
	<b>real number(실수형)</b>	: <b>float</b>
	<b>character(문자형)</b>	: <b>char</b>

Type?

<http://www.3demp.com/community/boardDetails.php?cbID=212>



1  
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## Practice 2

```
practice2 $  
void setup() {  
  Serial.begin(9600);  
}  
  
void loop() {  
  if(Serial.available()>0){  
    char c = Serial.read();  
    if(c=='a'){  
      Serial.println("You typed a");  
    }  
    else{  
      Serial.println("You didn't type a");  
    }  
  }  
}
```

업로드 완료.

### Serial.available()

: Serial 포트에 유의미한 값이 있는지 확인.

: If data does exist, then its value is more than zero

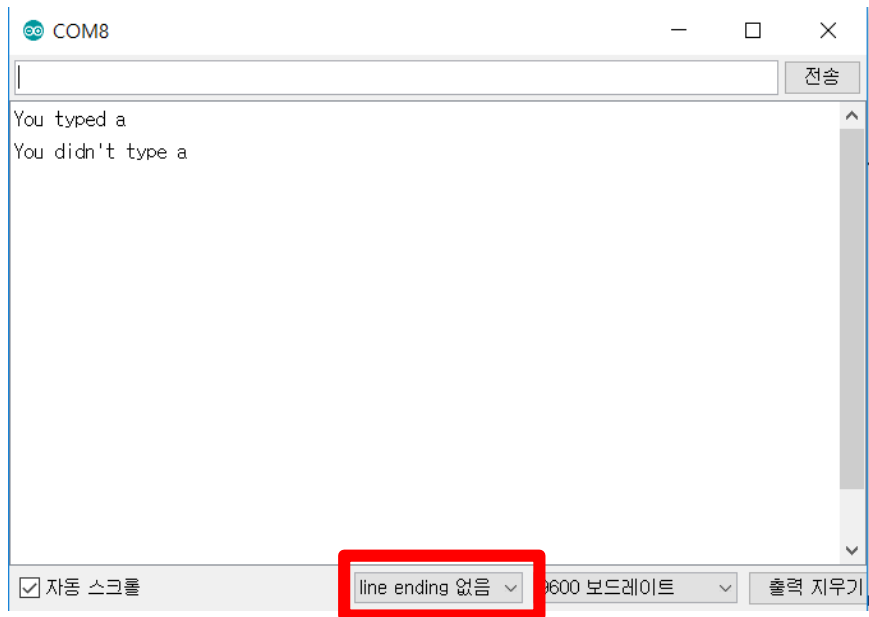
### Serial.read()

: Serial 통신으로 들어온 데이터의 맨 앞의 1바이트를 읽어와 그 값을 반환한다.  
(or -1 if no data is available)



1  
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## Practice 2



### Error case :

-한글자만 입력을 때, 2회 출력이 될 경우  
line ending 없음 으로 설정할 것.

New line으로 설정되어 있는 경우, 아스키코드 10에 해당하는  
line feed가 `Serial.available()`을 통과하며 빈 명령이 출력된다.





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## Practice 3 – About Numbers



```
sketch_apr21a
void setup() {
  Serial.begin(9600);
}
void loop() {
  if(Serial.available()){
    long c = Serial.parseInt();
    long d = Serial.parseInt();
    Serial.println(c*d);
  }
}
```

업로드 완료.

### Serial.parseInt()

: 정수를 읽을 때 사용

**Serial** 모니터로 받은 값은 무조건 문자형으로 인식하기 때문에, 정수형으로 읽기 위해 **read** 대신 사용한다.

: 다수의 입력을 할 때에는 **Space**로 구분하여 입력한다.

: 숫자가 아닐 경우, 0을 반환한다.



1  
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## Practice 3 — About Numbers

COM8

15 8

전송

120

☒ 자동 스크롤

line ending 없음 ▾

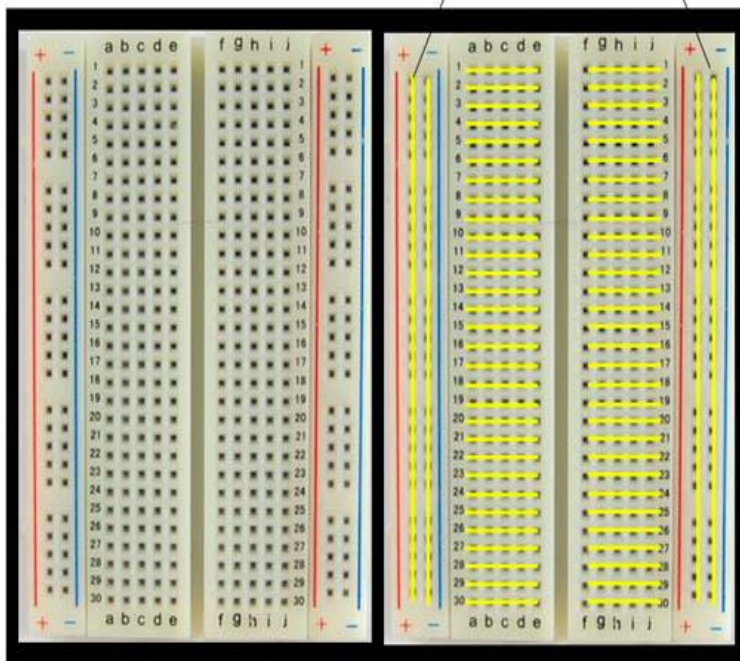
9600 보드레이트 ▾

출력 지우기

## Breadboard(빵판)

Power bus

Ground bus



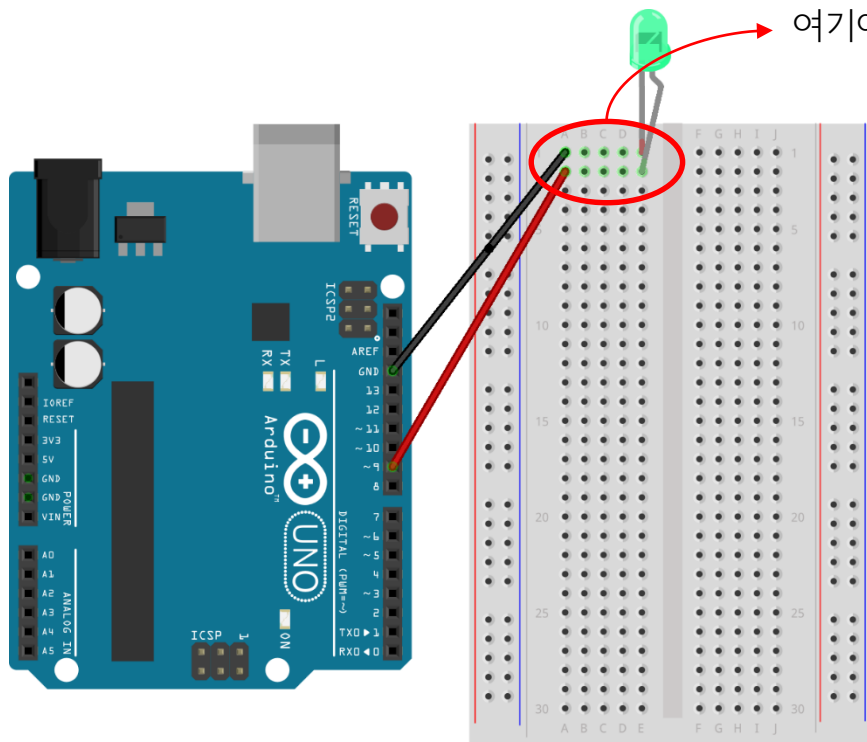
## Directions for the use

### Connection

: Always disconnect an Arduino from external power sources (laptop, battery, etc.) before making an electrical circuit.

: 가장자리의 2줄은 세로, 나머지는 가로로 연결되어 있다.

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여기에 저항을 연결해야 함

## LED 사용하기

Long lead : + (plus)

Short lead : - (minus)

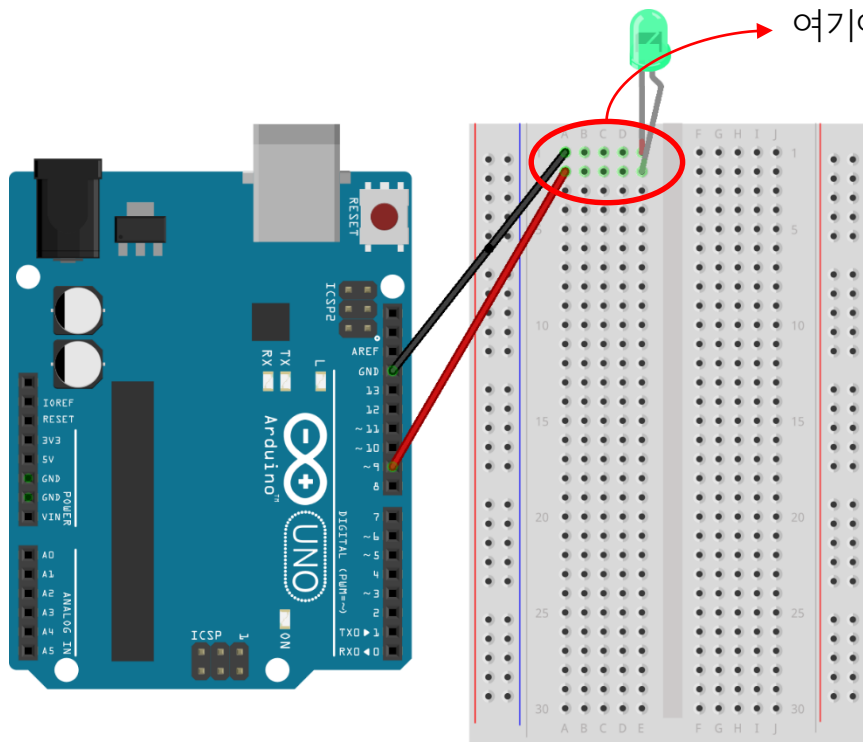
LED 색상에 맞는 정격 전압이 있음

붉은색 : 1.8~2.2 V, 20 mA

초록색 : 3~3.4 V, 20 mA

파란색 : 3~3.4 V, 20 mA

1  
2  
3  
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여기에 저항을 연결해야 함

필요 저항(R) 계산하기

아두이노 출력 : 5V

정격 전압 : x V

정격 전류 : y mA

$$R = (5-x) / y$$

붉은색 : 1.8~2.2 V, 20 mA

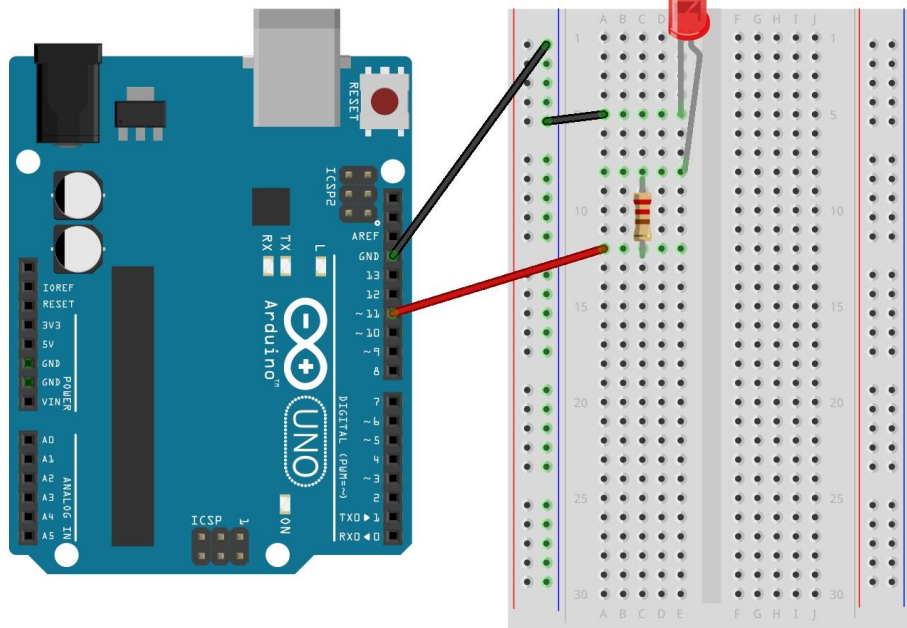
-> R = 140 ~ 160  $\Omega$

초록색 : 3~3.4 V, 20 mA

파란색 : 3~3.4 V, 20 mA

-> R = 80 ~ 100  $\Omega$

1  
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왼쪽 그림과 같이 연결!

붉은색 LED는 150  $\Omega$  저항을 쓴다.



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## Practice 4 – Blink

4\_LED\_Blink

```
#define LED 11

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

void loop() {
  digitalWrite(LED, HIGH);
  Serial.println("LED ON");
  delay(2000);
  digitalWrite(LED, LOW);
  Serial.println("LED OFF");
  delay(2000);
}
```

업로드 완료.

### #define

: Give a name to a constant  
: **#define** constantName value

### pinMode()

: Configures the specified pin to behave either as an input or an output

: pinMode(pin, mode)

pin – the number of the pin whose mode you wish to set

mode – **INPUT** or **OUTPUT**

### digitalWrite()

: Write a HIGH or a LOW value to a digital pin

: digitalWrite(pin, mode)

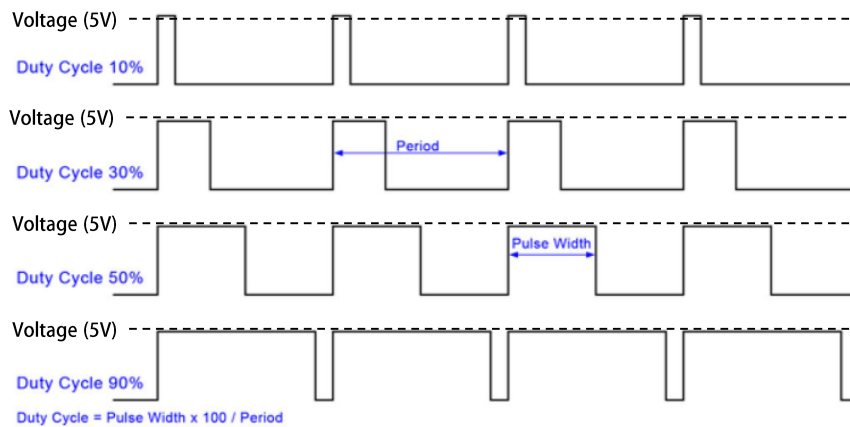
pin – the pin number

value – **HIGH** or **LOW**

## PWM (Pulse Width Modulation)

1. 한 주기(Period)안에서 신호가 'ON' 상태인 시간을 지속시간 (Pulse Width)
2. 'ON'시간과 'OFF'시간의 비율을 Duty Cycle.

\*\* 주기의 경우(t) 1/f 로 표현된다.  $t=1/f$ (주파수)



### Digital signals

: ON or OFF (interpreted in shorthand as 1 or 0)

### Analog signals

: infinite number of positions between 0 and 1

### PWM

: A way to control analog devices with a digital output. You can output a modulating signal from a digital device such as an Arduino to drive an analog device.







1  
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## for statement

- for 문은 {}로 묶인 블록을 반복하는 데에 사용한다.
- for(초기식; 조건식; 증감식){명령}의 구조

초기 시작값을 지정하고 그 값이 조건식을 불만족할 때 종료된다.  
시작값은 증감식에 의해 조정된다.

```
: for(initialization; condition; increment){  
    statement (s);  
}
```

### Examples

```
: for(int i=0; i<=255; i++){  
    statement (s);  
}
```

```
: for(int i=255; i>=0; i--){  
    statement (s);  
}
```

cf.  
i++ is equal to i=i+1;  
i-- is equal to i=i-1;



1  
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## Practice 5 – Brightness

5\_LED\_Brightness \$

```
#define LED 11

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

void loop() {
  // 점점 밝아진다.
  for(int i=0; i<=255; i++){
    analogWrite(LED, i);
    Serial.print("LED : \t");
    Serial.println(i);
    delay(10);
  }
}
```

### analogWrite()

: Writes an analog value (PWM wave) to a pin. Can be used to light a LED at varying brightnesses or drive a motor at various speeds

: analogWrite(pin, value)

pin – the pin to write to

value – the duty cycle between 0 (always off) and 255 (always on)

### Serial.print("")

: Print sentence on the serial monitor (no new line)



1  
2  
3  
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## Practice 5 – Brightness

```
5_LED_Brightness $
```

```
#define LED 11

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

void loop() {
  // 점점 밝아진다.
  for(int i=0; i<=255; i++){
    analogWrite(LED, i);
    Serial.print("LED : \t");
    Serial.println(i);
    delay(10);
  }
}
```

점점 어두워지게 하려면?

초기식, 조건식, 증감식을 수정한다.



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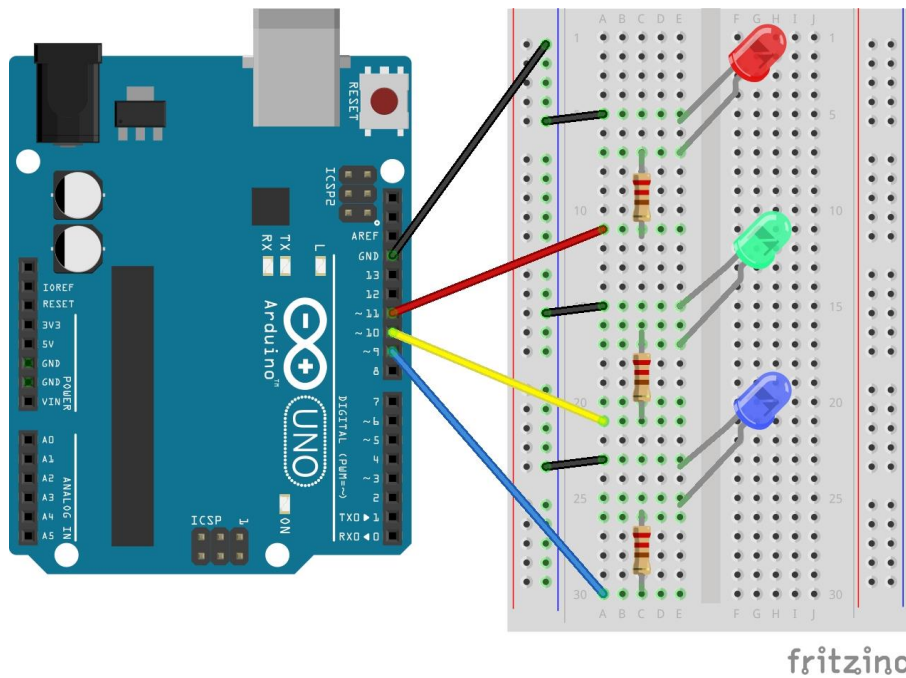
## Practice 5 – Brightness

```
5_LED_Brightness $  
  
#define LED 11  
  
void setup() {  
  pinMode(LED, OUTPUT);  
  Serial.begin(9600);  
  Serial.println("Start");  
}  
  
void loop() {  
  // 점점 어두워진다.  
  for(int i=255; i>=0; i--){  
    analogWrite(LED, i);  
    Serial.print("LED : \t");  
    Serial.println(i);  
    delay(10);  
  }  
}
```

점점 어두워지게 하려면?

for(int i=255; i>=0; i--)

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왼쪽 그림과 같이 연결!

붉은색 LED는 150 Ω 저항을 쓴다.

녹색, 파란색은 100 Ω 저항을 쓴다.



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## Practice 6 – LED 3개 제어하기

6\_3LED

```
#define Blue 9
#define Green 10
#define Red 11

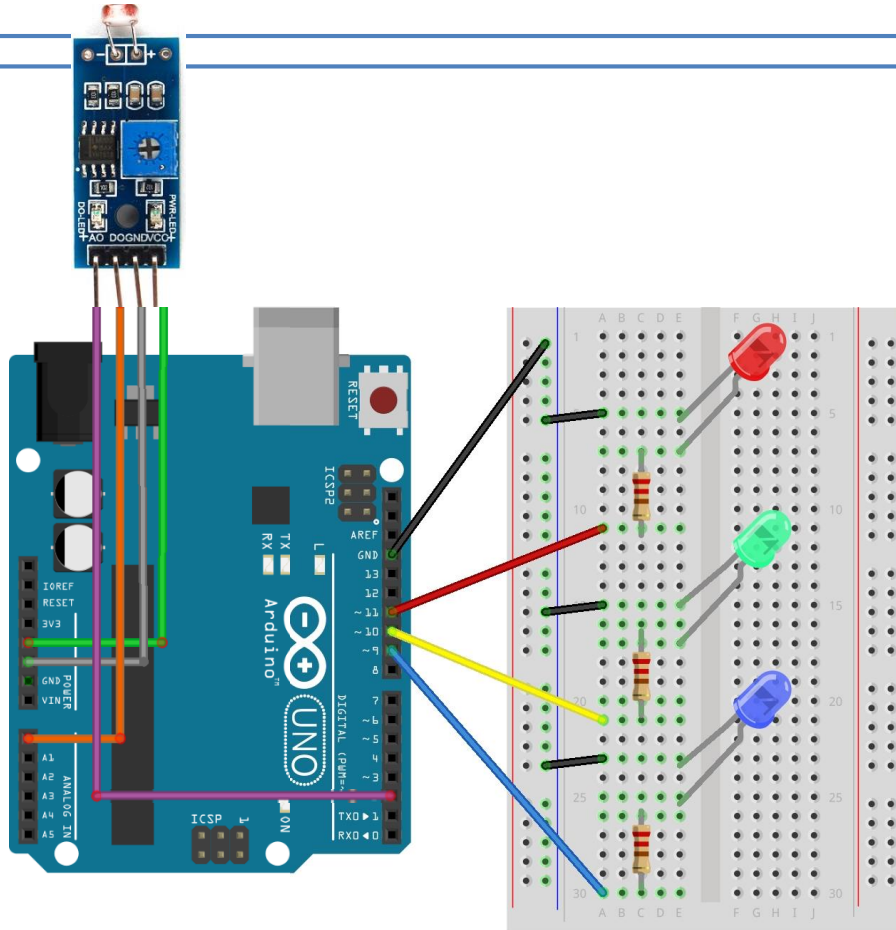
void setup() {
  pinMode(Blue, OUTPUT);
  pinMode(Green, OUTPUT);
  pinMode(Red, OUTPUT);
  digitalWrite(Blue, LOW);
  digitalWrite(Green, LOW);
  digitalWrite(Red, LOW);
  Serial.begin(9600);
  Serial.println("Start");
}

void loop() {
  digitalWrite(Blue, HIGH);
  delay(3000);
  digitalWrite(Blue, LOW);
  digitalWrite(Green, HIGH);
  delay(1000);
  digitalWrite(Green, LOW);
  digitalWrite(Red, HIGH);
  delay(3000);
  digitalWrite(Red, LOW);
}
```

1개를 연결할 때와 동일하게,

Pin 번호만 바꿔서 작성하면 된다.

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Light sensor?

<https://cafe.naver.com/mechawiki/37>



## Practice 7 – Light sensor

```
7_LightSensor_only

#define D_sensor 2
#define A_sensor A0

void setup() {
  pinMode(D_sensor, INPUT);
  pinMode(A_sensor, INPUT);

  Serial.begin(9600);
  Serial.println("Start");
}

int light_digital=0;
int light_analog=0;

void loop(){
  light_digital = digitalRead(D_sensor);
  light_analog = analogRead(A_sensor);
  Serial.print("Digital : \t");
  Serial.print(light_digital);
  Serial.print("\tAnalog : \t");
  Serial.println(light_analog);
}
```

cf. in print function,  
\t is equal to tab  
\n is equal to new line

### digitalRead()

: Reads the value from a specified digital pin, either HIGH or LOW. It returns HIGH or LOW

: digitalRead(pin)  
pin – the number of the digital pin you want to read

### analogRead()

: Reads the value from the specified analog pin. It will map input voltages between 0 and the operating voltage(5V or 3.3V) into integer values between 0 and 1023. It returns the analog reading on the pin (int) (0~1023)

: analogRead(pin)  
pin – the name of the analog input pin to read from (A0 to A5)





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## Practice 8 – Light sensor blink

8\_LightSensor\_LED

```
#define Blue 9
#define Green 10
#define Red 11
#define D_sensor 2
#define A_sensor A0

void setup() {
  pinMode(Blue, OUTPUT);
  pinMode(Green, OUTPUT);
  pinMode(Red, OUTPUT);
  pinMode(D_sensor, INPUT);
  pinMode(A_sensor, INPUT);

  digitalWrite(Blue, LOW);
  digitalWrite(Green, LOW);
  digitalWrite(Red, LOW);

  Serial.begin(9600);
  Serial.println("Start");
}

int light_digital=0;
int light_analog=0;
```

```
void loop() {
  light_digital = digitalRead(D_sensor);
  light_analog = analogRead(A_sensor);
  Serial.print("Digital : \t");
  Serial.print(light_digital);
  Serial.print("\tAnalog : \t");
  Serial.println(light_analog);

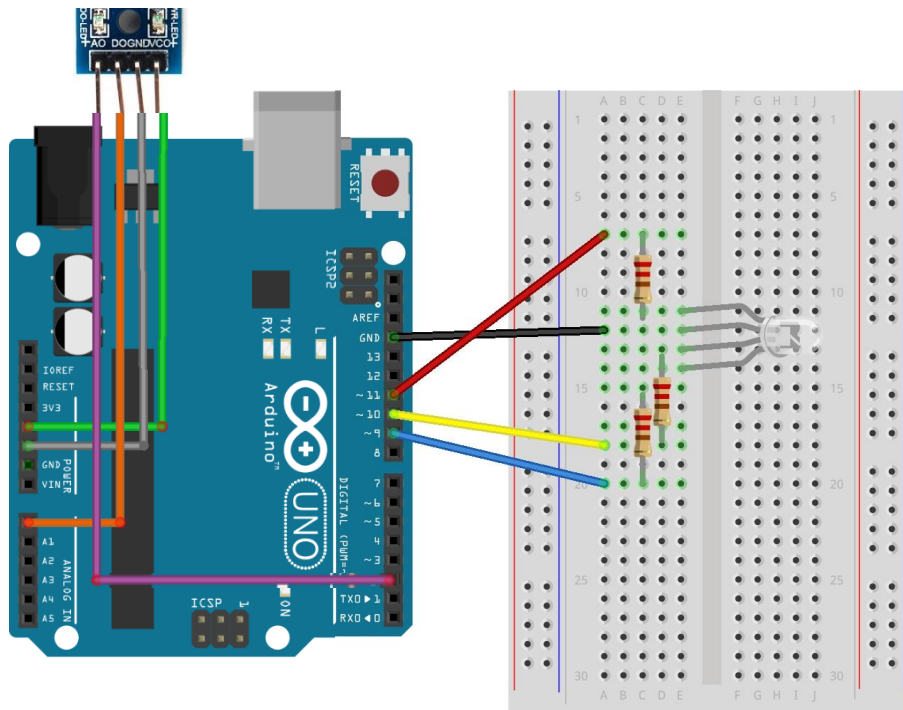
  LED_Digital(Blue);
  LED_Digital(Green);
  LED_Digital(Red);
  /*LED_Analog(Blue);
  LED_Analog(Green);
  LED_Analog(Red);*/
}

void LED_Digital(int LED) {
  digitalWrite(LED, light_digital);
}

void LED_Analog(int LED) {
  analogWrite(LED, map(light_analog, 0, 1023, 0, 255));
}
```

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## Practice 9 – RGB LED



**Cathode 타입 RGB LED**  
가장 긴 2번째 핀이 – 다.

1번째 핀 = RED  
3번째 핀 = GREEN  
4번째 핀 = BLUE



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## Practice 9 – RGB LED

```
9_RGB_Color

#define Blue 9
#define Green 10
#define Red 11

void setup() {
  pinMode(Blue,OUTPUT);
  pinMode(Green,OUTPUT);
  pinMode(Red,OUTPUT);

  digitalWrite(Blue,LOW);
  digitalWrite(Green,LOW);
  digitalWrite(Red,LOW);

  Serial.begin(9600);
  Serial.println("Start");
}

void loop() {
  for(int i=0; i<=255;i++){
    analogWrite(Blue, i);
    analogWrite(Green, i);
    analogWrite(Red, i);
    delay(10);
  }
}
```

R, G, B 모두 점점 밝아진다.

이 때 백색으로 보인다.



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## Practice 9 – RGB LED

```
10_RGB_Serial$  
  
#define Blue 9  
#define Green 10  
#define Red 11  
int R = 0, G = 0, B = 0;  
  
void setup() {  
  pinMode(Blue, OUTPUT);  
  pinMode(Green, OUTPUT);  
  pinMode(Red, OUTPUT);  
  
  digitalWrite(Blue, LOW);  
  digitalWrite(Green, LOW);  
  digitalWrite(Red, LOW);  
  
  Serial.begin(9600);  
  Serial.println("Start");  
}  
  
void loop() {  
  if(Serial.available() > 0) {  
    R = Serial.parseInt();  
    G = Serial.parseInt();  
    B = Serial.parseInt();  
    Serial.println((String) "R:" + R + "\tG:" + G + "\tB:" + B);  
  
    analogWrite(Blue, B);  
    analogWrite(Green, G);  
    analogWrite(Red, R);  
    delay(10);  
  }  
}
```

Serial 통신으로 R, G, B 값을 읽어 들여  
각각의 밝기로 빛나며 색을 띄게 된다.



## Practice 9 – RGB LED

### RGB 색상표 참고

red	#ff0000	(255, 0, 0)	red	#40e0d0	(064, 224, 208)
crimson	#dc143c	(220, 020, 060)	darkturquoise	#00ced1	(000, 206, 209)
firebrick	#b22222	(178, 034, 034)	aqua	#00ffff	(000, 255, 255)
maroon	#800000	(128, 000, 000)	cyan	#00ffff	(000, 255, 255)
darkred	#8b0000	(139, 000, 000)	deepskyblue	#00bfff	(000, 191, 255)
brown	#a52a2a	(165, 042, 042)	dodgerblue	#1e90ff	(030, 144, 255)
sienna	#a0522d	(160, 082, 045)	cornflowerblue	#6495ed	(100, 149, 237)
saddlebrown	#8b4513	(139, 069, 019)	royalblue	#4169e1	(065, 105, 000)
indianred	#cd5c5c	(205, 092, 092)	blue	#0000ff	(000, 000, 255)
rosybrown	#bc8f8f	(188, 143, 143)	mediumblue	#0000cd	(000, 000, 205)
lightcoral	#f08080	(240, 128, 128)	navy	#000080	(128, 000, 000)
salmon	#fa8072	(250, 128, 114)	darkblue	#00008b	(000, 000, 139)
darksalmon	#e9967a	(233, 150, 122)	midnightblue	#191970	(025, 025, 112)
coral	#ff7f50	(255, 127, 080)	darkslateblue	#483d8b	(072, 061, 139)
tomato	#ff6347	(255, 099, 071)	slateblue	#6a5acd	(106, 090, 205)
sandybrown	#f4a460	(244, 164, 096)	mediumslateblue	#7b68ee	(123, 104, 238)
lightsalmon	#ffa07a	(255, 160, 122)	mediumpurple	#9370db	(147, 112, 219)
peru	#cd853f	(205, 133, 063)	darkorchid	#9932cc	(153, 050, 204)
chocolate	#d2691e	(210, 105, 030)	darkviolet	#9400d3	(148, 000, 211)
orangered	#ff4500	(255, 069, 000)	blueviolet	#8a2be2	(138, 043, 226)
orange	#ffa500	(255, 165, 000)	mediumorchid	#ba55d3	(186, 085, 211)
darkorange	#ff8c00	(255, 140, 000)	plum	#dda0dd	(221, 160, 221)
tan	#d2b48c	(210, 180, 140)	lavender	#e6e6fa	(230, 230, 250)
peachpuff	#ffdab9	(255, 218, 185)	thistle	#d8bfd8	(216, 191, 216)
bisque	#ffe4c4	(255, 228, 196)	orchid	#da70d6	(218, 112, 214)
moccasin	#ffe4b5	(255, 228, 181)	violet	#ee82ee	(238, 130, 238)
navajowhite	#ffdead	(255, 222, 173)	indigo	#4b0082	(075, 000, 130)
wheat	#f5deb3	(245, 222, 179)	darkmagenta	#8b008b	(139, 000, 139)
burlywood	#deb887	(222, 184, 135)	purple	#800080	(128, 000, 128)
darkgoldenrod	#b8860b	(184, 134, 011)	mediumvioletred	#c71585	(199, 021, 133)
goldenrod	#daa520	(218, 165, 032)	deeppink	#ff1493	(255, 020, 147)
gold	#ffd700	(255, 215, 000)	fuchsia	#ff00ff	(255, 000, 255)
yellow	#ffff00	(255, 255, 000)	magenta	#ff00ff	(255, 000, 255)
lightgoldenrodyellow	#fafad2	(250, 250, 210)	hotpink	#ff69b4	(255, 105, 180)
palegoldenrod	#eee8aa	(238, 232, 170)	palevioletred	#db7093	(219, 112, 147)
khaki	#f0e68c	(240, 230, 140)	lightpink	#ffb6c1	(255, 182, 193)
darkkhaki	#bdb76b	(189, 183, 107)	pink	#ffc0cb	(255, 192, 203)



Q & A

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들어주셔서 감사합니다.