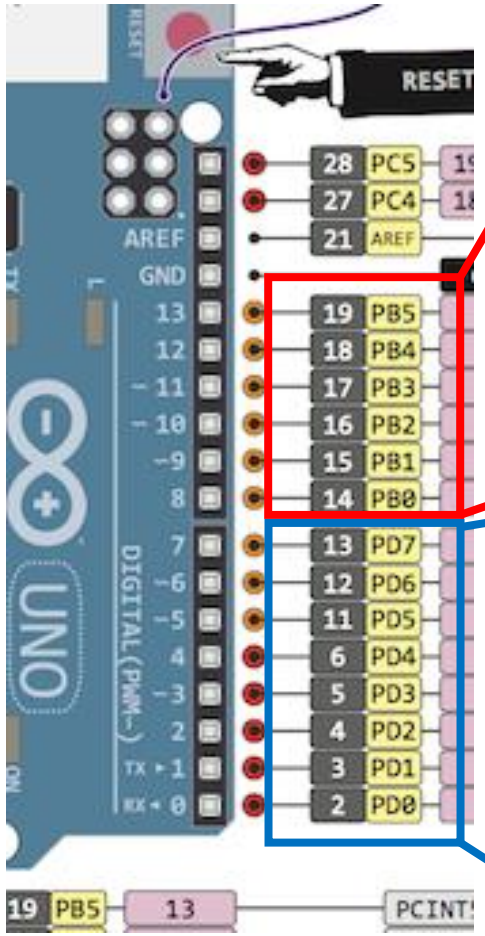
“수업자료는 여기”

입출력(IO) 포트 실험
LED 컨트롤 실험

마이크로프로세서 종합 설계

IO 포트 관련 레지스터

- Port



13.4.2 PORTB – The Port B Data Register

Bit	7	6	5	4	3	2	1	0	
0x05 (0x25)	PORTB7	PORTB6	PORTB5	PORTB4	PORTB3	PORTB2	PORTB1	PORTB0	PORTB
Read/Write	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	
Initial Value	0	0	0	0	0	0	0	0	

13.4.3 DDRB – The Port B Data Direction Register

Bit	7	6	5	4	3	2	1	0	
0x04 (0x24)	DDB7	DDB6	DDB5	DDB4	DDB3	DDB2	DDB1	DDB0	DDRB
Read/Write	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	
Initial Value	0	0	0	0	0	0	0	0	

13.4.4 PINB – The Port B Input Pins Address

Bit	7	6	5	4	3	2	1	0	
0x03 (0x23)	PINB7	PINB6	PINB5	PINB4	PINB3	PINB2	PINB1	PINB0	PINB
Read/Write	R	R	R	R	R	R	R	R	
Initial Value	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	

13.4.8 PORTD – The Port D Data Register

Bit	7	6	5	4	3	2	1	0	
0x0B (0x2B)	PORTD7	PORTD6	PORTD5	PORTD4	PORTD3	PORTD2	PORTD1	PORTD0	PORTD
Read/Write	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	
Initial Value	0	0	0	0	0	0	0	0	

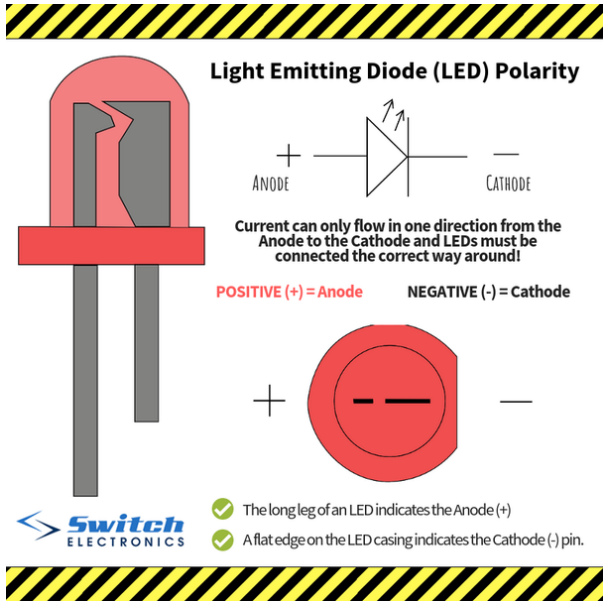
13.4.9 DDRD – The Port D Data Direction Register

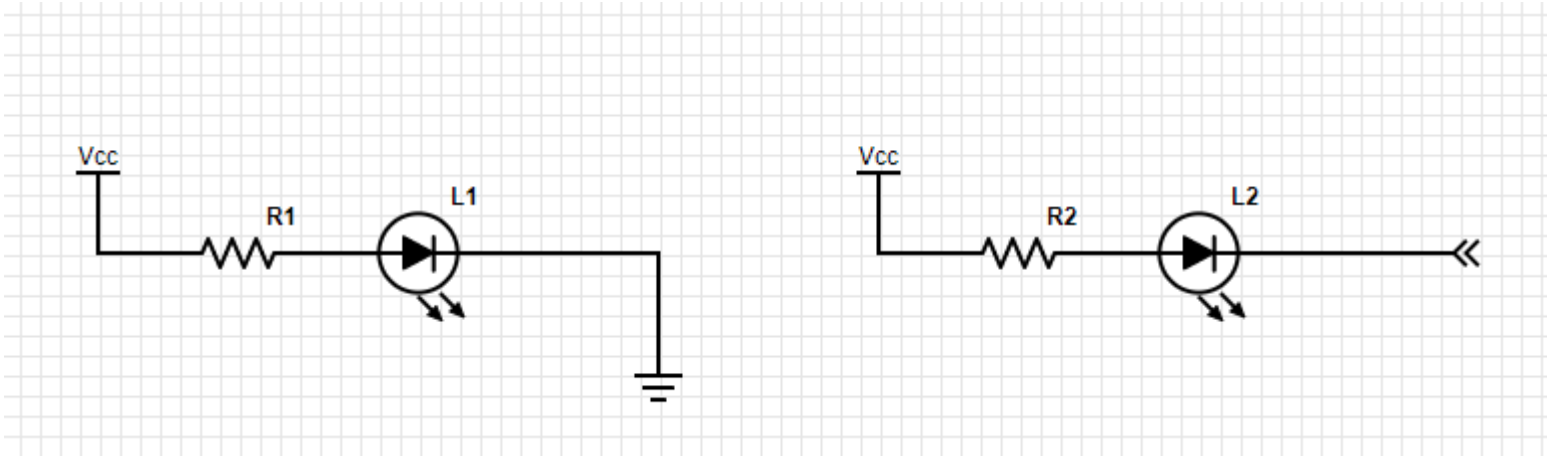
Bit	7	6	5	4	3	2	1	0	
0x0A (0x2A)	DDD7	DDD6	DDD5	DDD4	DDD3	DDD2	DDD1	DDD0	DDRD
Read/Write	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	
Initial Value	0	0	0	0	0	0	0	0	

13.4.10 PIND – The Port D Input Pins Address

Bit	7	6	5	4	3	2	1	0	
0x09 (0x29)	PIND7	PIND6	PIND5	PIND4	PIND3	PIND2	PIND1	PIND0	PIND
Read/Write	R	R	R	R	R	R	R	R	
Initial Value	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	

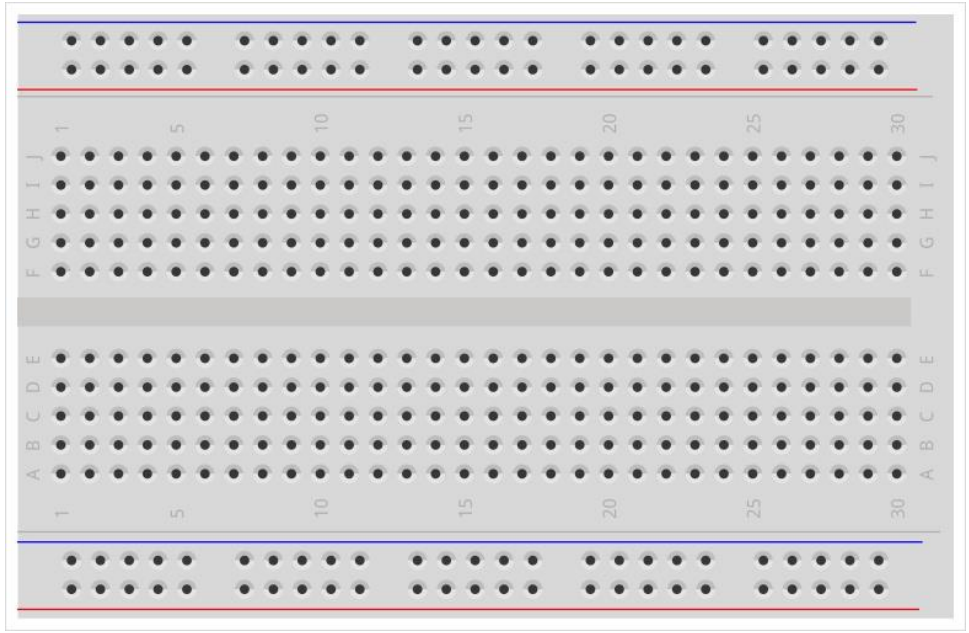
LED

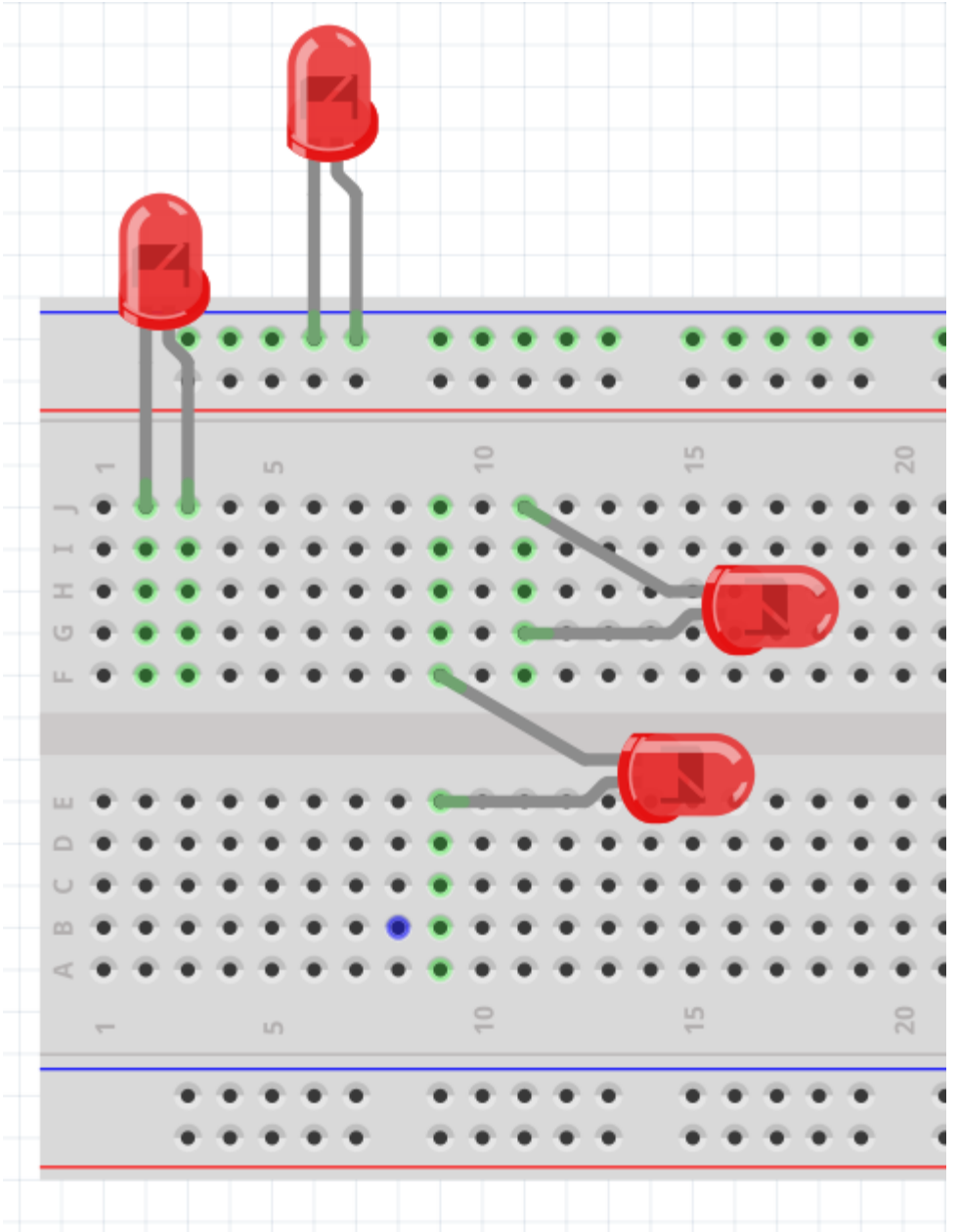

Light Emitting Diode (LED) Polarity
+
ANODE
—
CATHODE
Current can only flow in one direction from the Anode to the Cathode and LEDs must be connected the correct way around!
POSITIVE (+) = Anode
NEGATIVE (-) = Cathode
+
—
Switch ELECTRONICS
The long leg of an LED indicates the Anode (+)
A flat edge on the LED casing indicates the Cathode (-) pin.


Vcc
R1
L1
Vcc
R2
L2

IO 포트 관련 레지스터

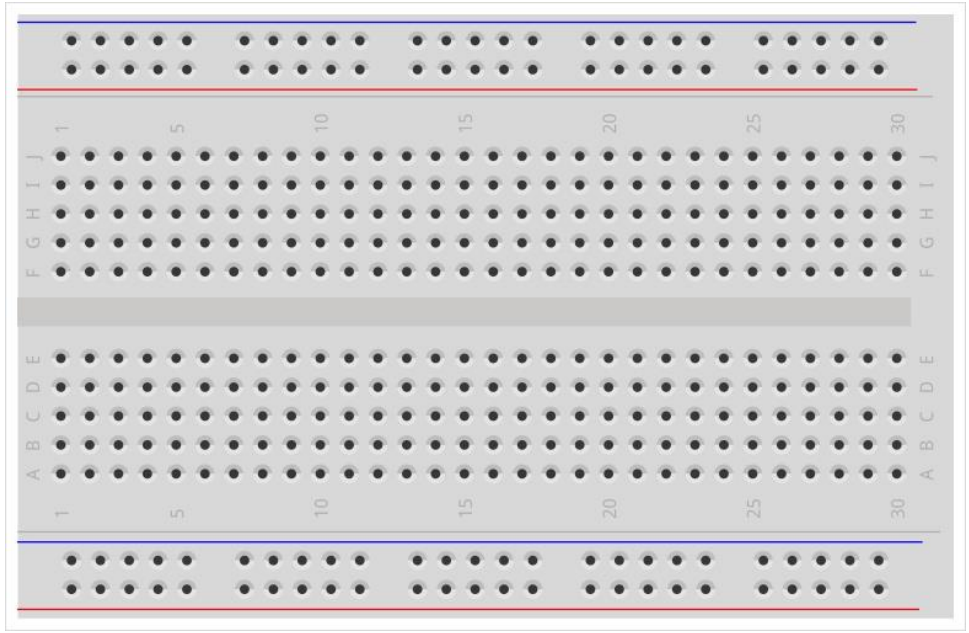
- 빵판 사용법(브레드보드)

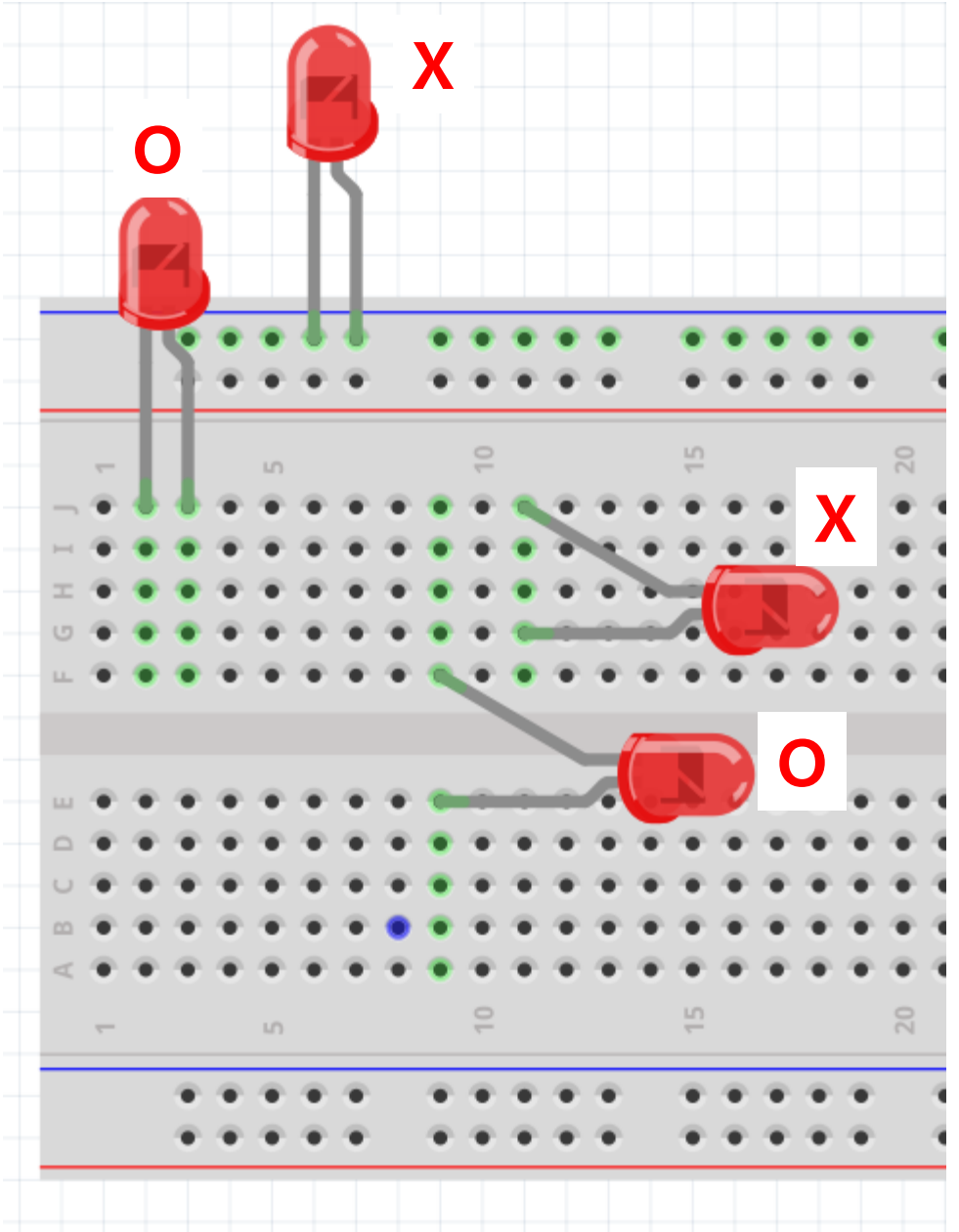




IO 포트 관련 레지스터

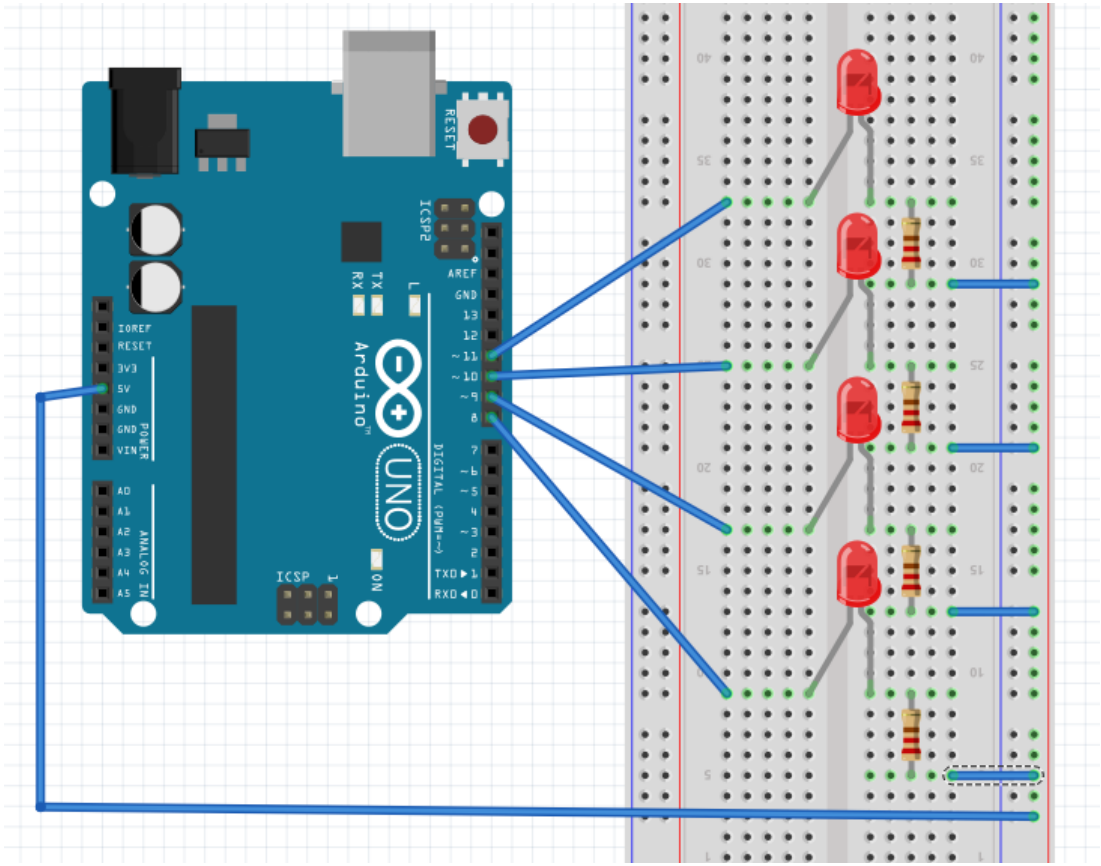
- 빵판 사용법(브레드보드)

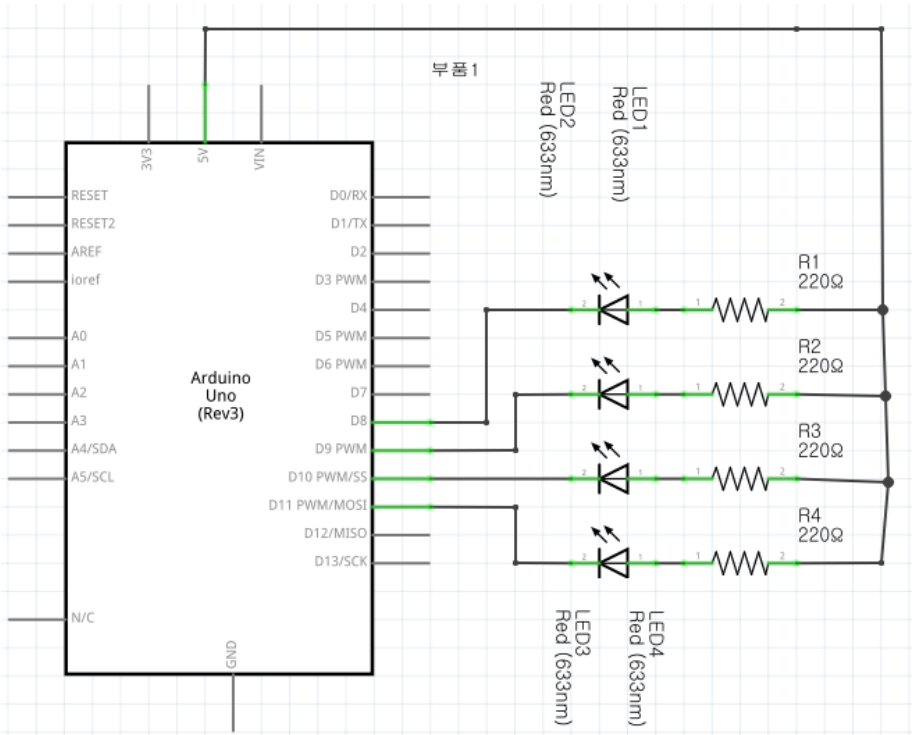




LED를 이용한 포트 제어 실험

- 4개의 LED를 연결해서 포트를 제어 해보자.

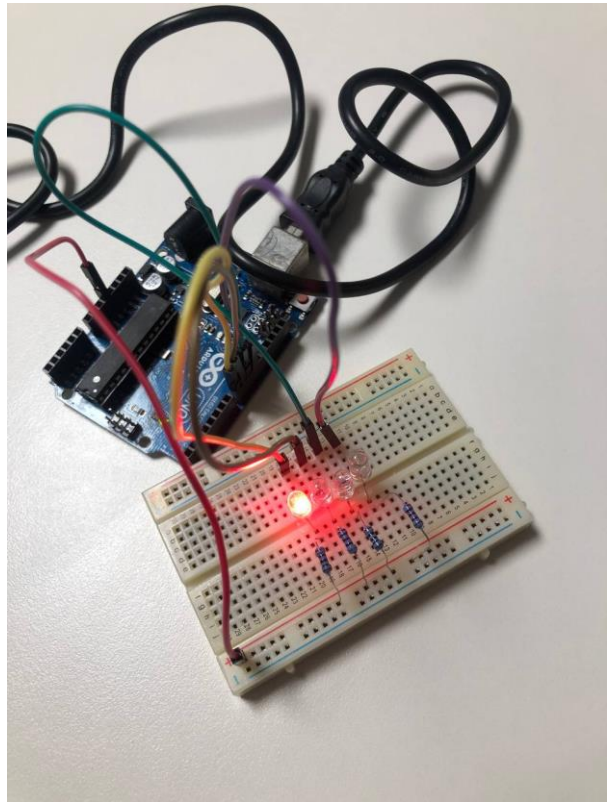




LED를 이용한 포트 제어 실험

- 예제15

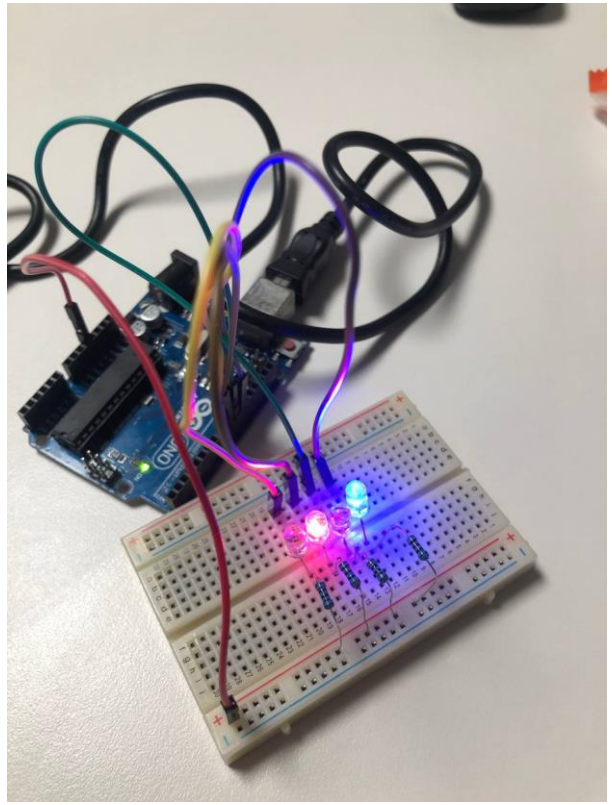
```
void setup() {
  DDRB = B00001111 ;
  PORTB = B00000000 ;

}

void loop() {
  PORTB = B00001111 ;
  delay(1000) ;
  PORTB = B00000000 ;
  delay(1000) ;
}
```



LED를 이용한 포트 제어 실험

- 예제16

```
void setup() {
  DDRB = 0x0F ;
  PORTB = 0x0A ;

}

void loop() {
  PORTB = 0x0A ;
  delay(500) ;
  PORTB = 0x05 ;
  delay(500) ;
}
```

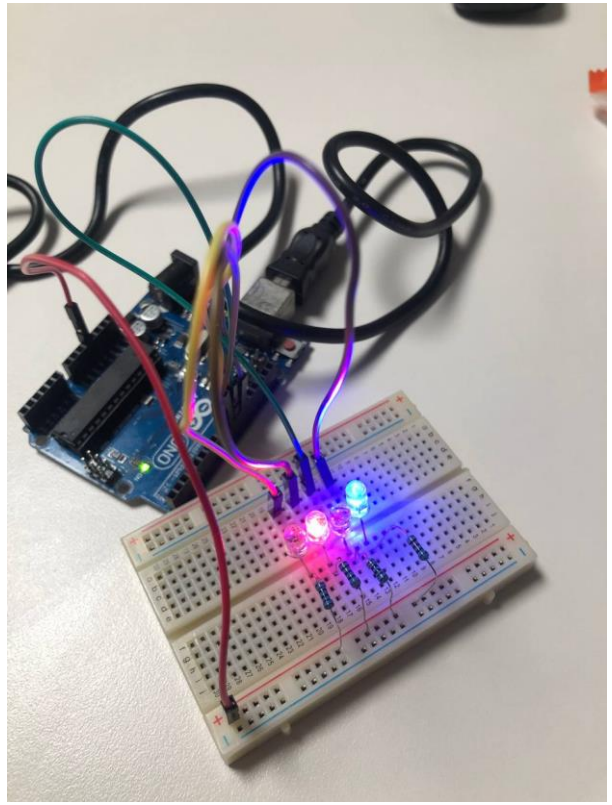


LED를 이용한 포트 제어 실험

- 예제17

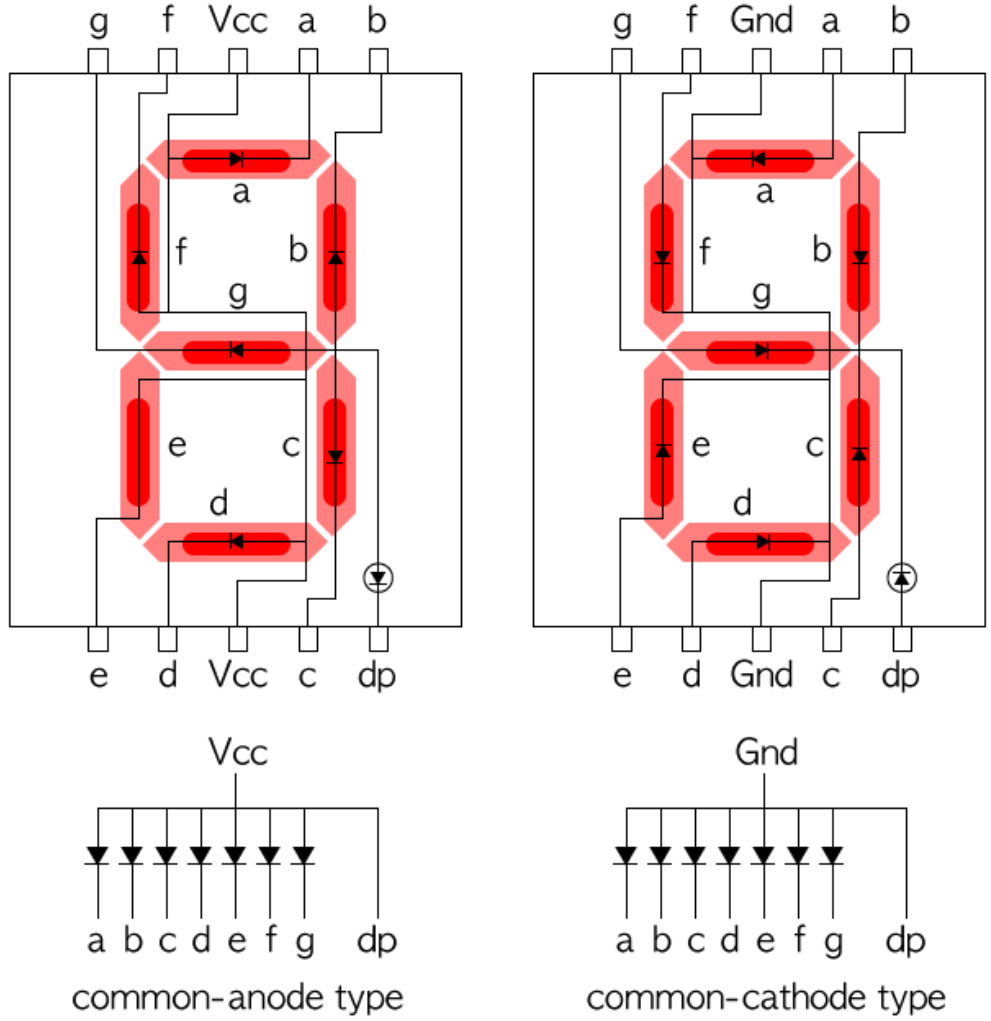
```
void setup() {
  DDRB = B00001111 ;
  PORTB = B00000000 ;

}

void loop() {
  int i= 0 ;
  int led = B00000001 ;
  for(i=0 ; i<4 ; i++ )
  {
    PORTB = led << i ;
    delay(1000) ;
  }
}
```

```
void setup() {
  DDRB = B00001111 ;
  PORTB = B00000000 ;

}

void loop() {
  int i= 0 ;
  int led = B00000001 ;
  for(i=0 ; i<4 ; i++ )
  {
    PORTB = ~(led << i) ;
    delay(1000) ;
  }
}
```



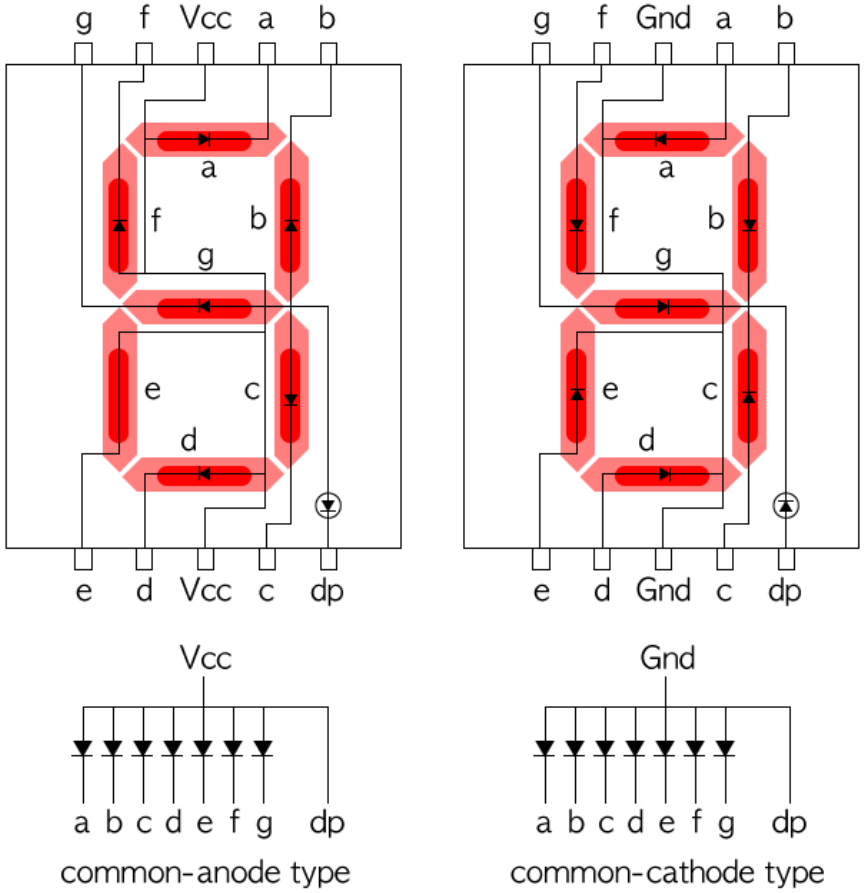
LED를 이용한 포트 제어 실험

- 7-segment 실험



LED를 이용한 포트 제어 실험

- 7-segment 실험



Common-anode type

0 = a(0) b(0) c(0) d(0) e(0) f(0) g(1) DP(1)

1 = a(1) b(0) c(0) d(1) e(1) f(1) g(1) DP(1)

2 = a(0) b(0) c(1) d(0) e(0) f(1) g(0) DP(1)

3 = a(0) b(0) c(0) d(0) e(1) f(1) g(0) DP(1)

4 = a(1) b(0) c(0) d(1) e(1) f(0) g(0) DP(1)

5 = a(0) b(1) c(0) d(0) e(1) f(0) g(0) DP(1)

6 = a(0) b(1) c(0) d(0) e(0) f(0) g(0) DP(1)

7 = a(0) b(0) c(0) d(1) e(1) f(0) g(1) DP(1)

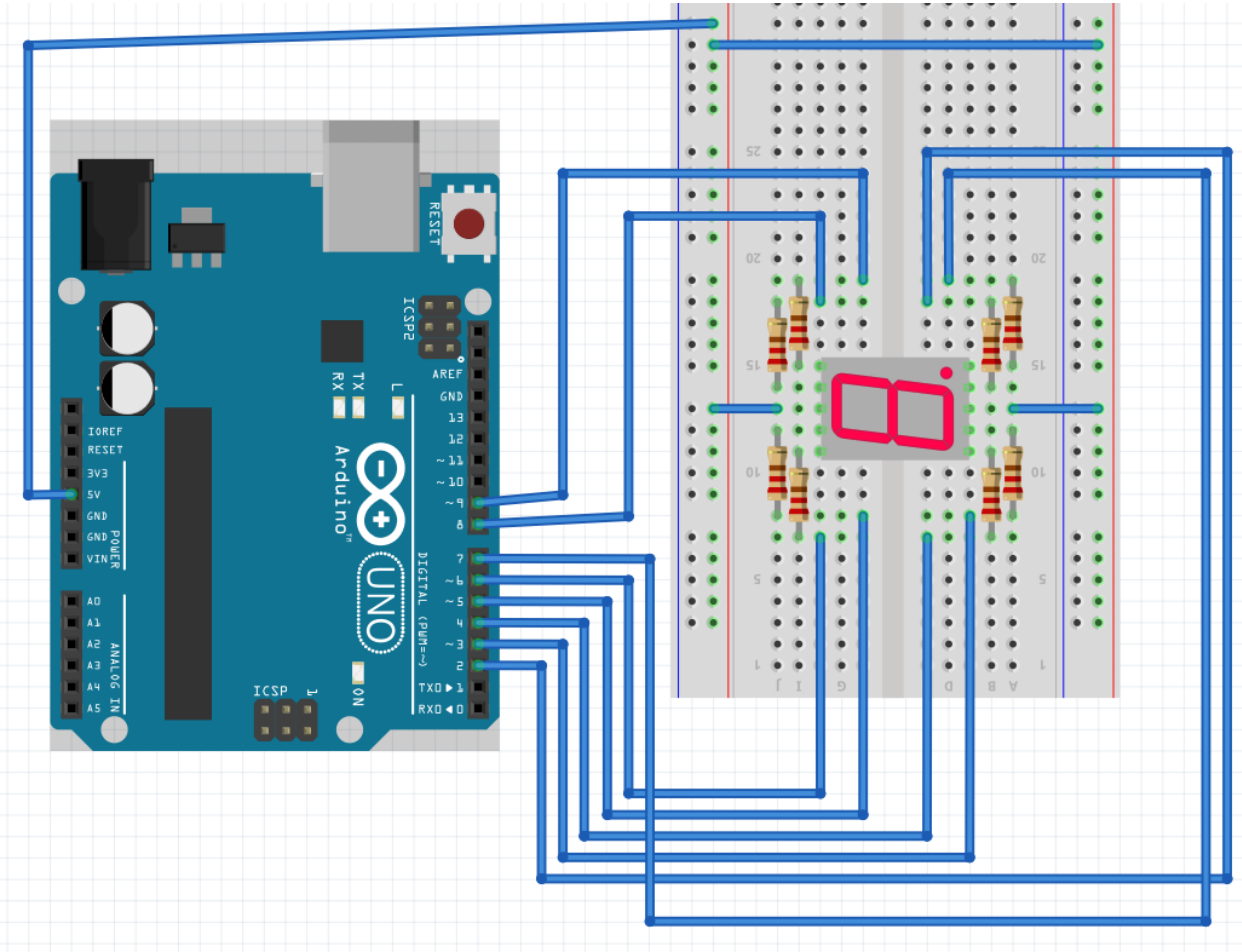
8 = a(0) b(0) c(0) d(0) e(0) f(0) g(0) DP(1)

9 = a(0) b(0) c(0) d(0) e(1) f(0) g(0) DP(1)

. = DP(0)

LED를 이용한 포트 제어 실험

- 7-segment 실험



a	→	PB0
b	→	PB1
c	→	PD2
d	→	PD3
e	→	PD4
f	→	PD5
g	→	PD6
DP	→	PD7

LED를 이용한 포트 제어 실험

- 7-segment 실험

0 = a(1) b(1) c(1) d(1) e(1) f(1) g(0) DP(0)

1 = a(0) b(1) c(1) d(0) e(0) f(0) g(0) DP(0)

2 = a(1) b(1) c(0) d(1) e(1) f(0) g(1) DP(0)

3 = a(1) b(1) c(1) d(1) e(0) f(0) g(1) DP(0)

4 = a(0) b(1) c(1) d(0) e(0) f(1) g(1) DP(0)

5 = a(1) b(0) c(1) d(1) e(0) f(1) g(1) DP(0)

6 = a(1) b(0) c(1) d(1) e(1) f(1) g(1) DP(0)

7 = a(1) b(1) c(1) d(0) e(0) f(1) g(0) DP(0)

8 = a(1) b(1) c(1) d(1) e(1) f(1) g(1) DP(0)

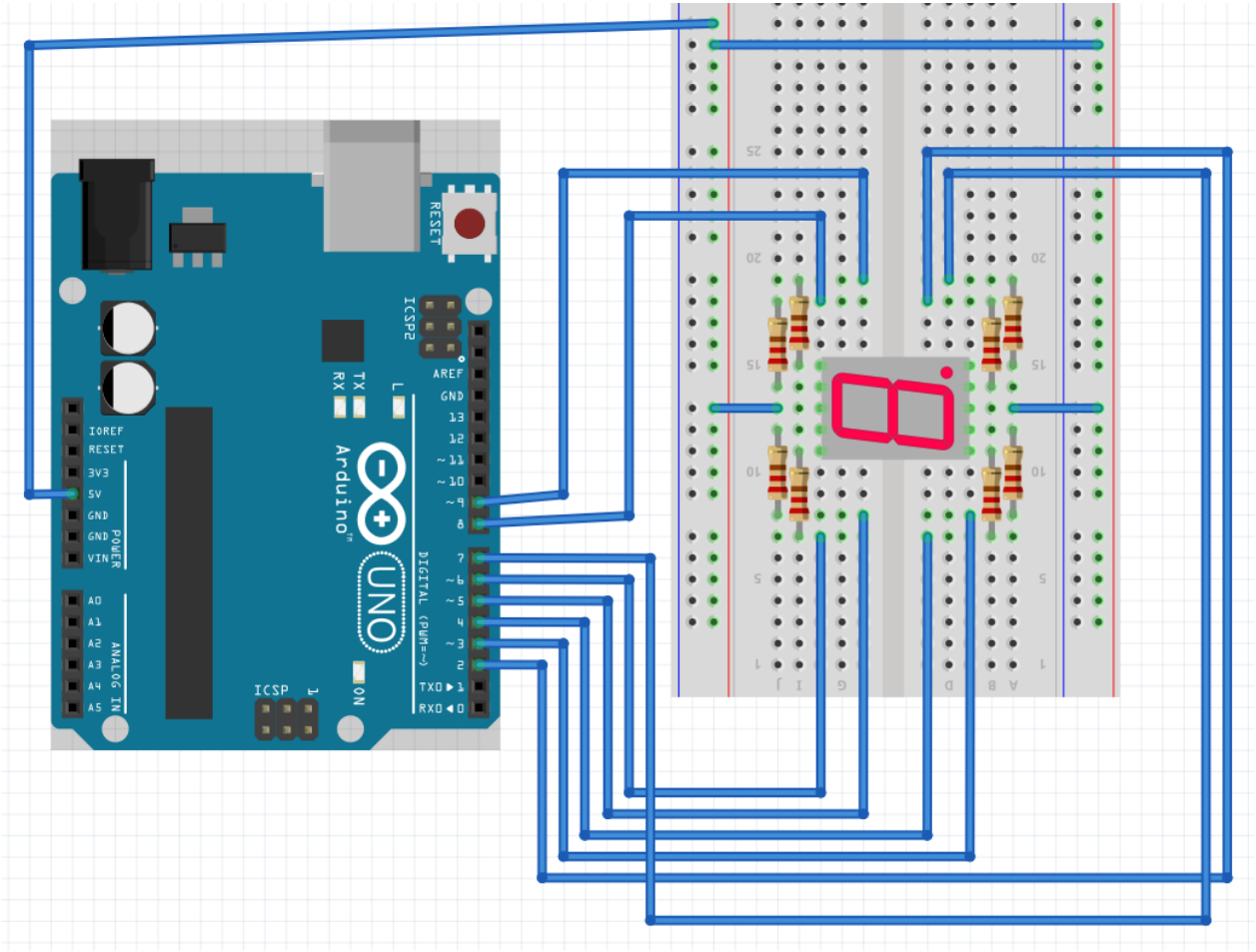
9 = a(1) b(1) c(1) d(1) e(0) f(1) g(1) DP(0)

. = DP(1)

		a	b	c	d	e	f	g	DP
		PB0	PB1	PD2	PD3	PD4	PD5	PD6	PD7
0	→	1	1	1	1	1	1	0	0
1	→	0	1	1	0	0	0	0	0
2	→	1	1	0	1	1	0	1	0
3	→	1	1	1	1	0	0	1	0
4	→	0	1	1	0	0	1	1	0
5	→	1	0	1	1	0	1	1	0
6	→	1	0	1	1	1	1	1	0
7	→	1	1	1	0	0	1	0	0
0	→	1	1	1	1	1	1	1	0
9	→	1	1	1	1	0	1	1	0

LED를 이용한 포트 제어 실험

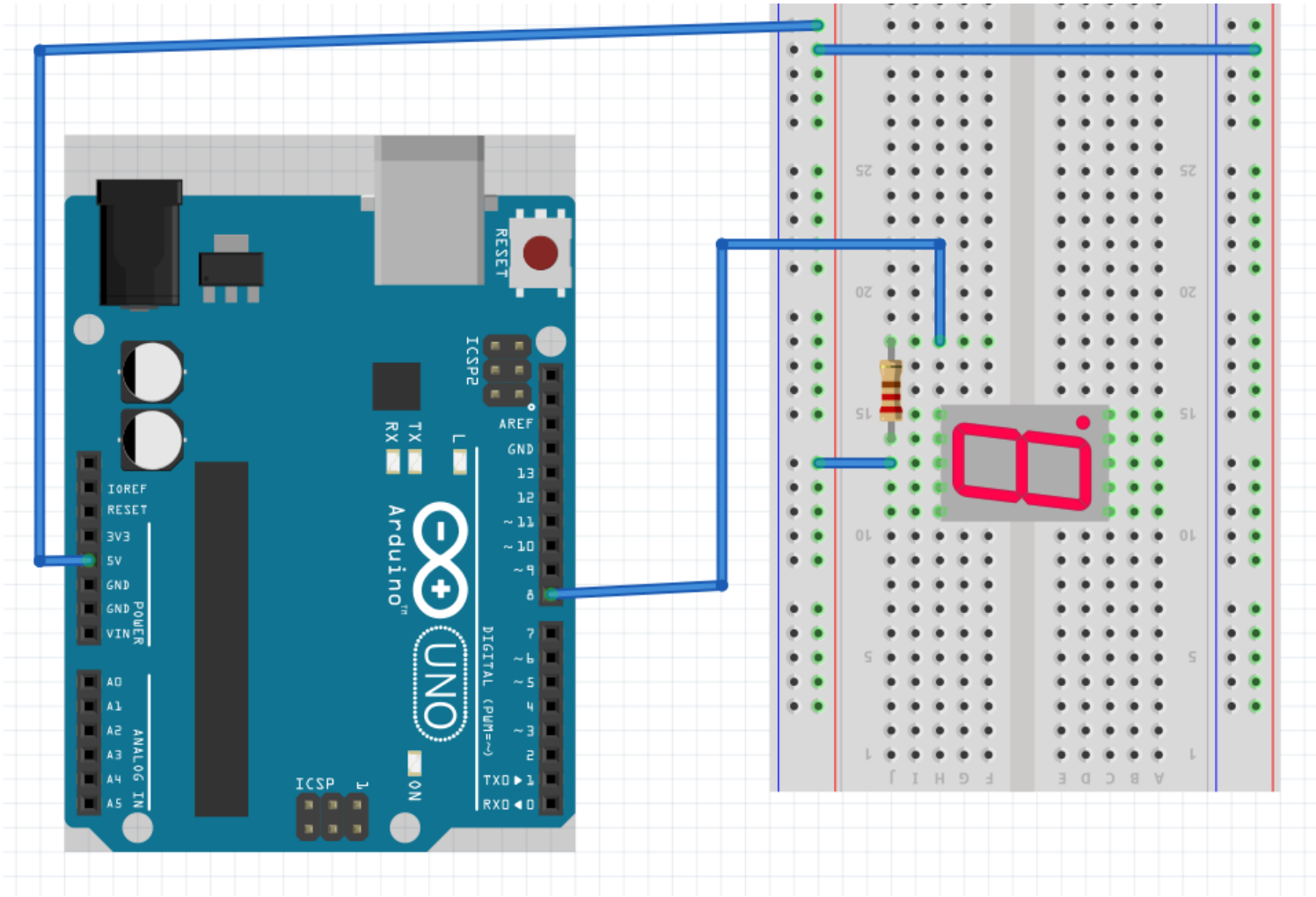
- 7-segment 실험



LED를 이용한 포트 제어 실험

- 7-segment 실험

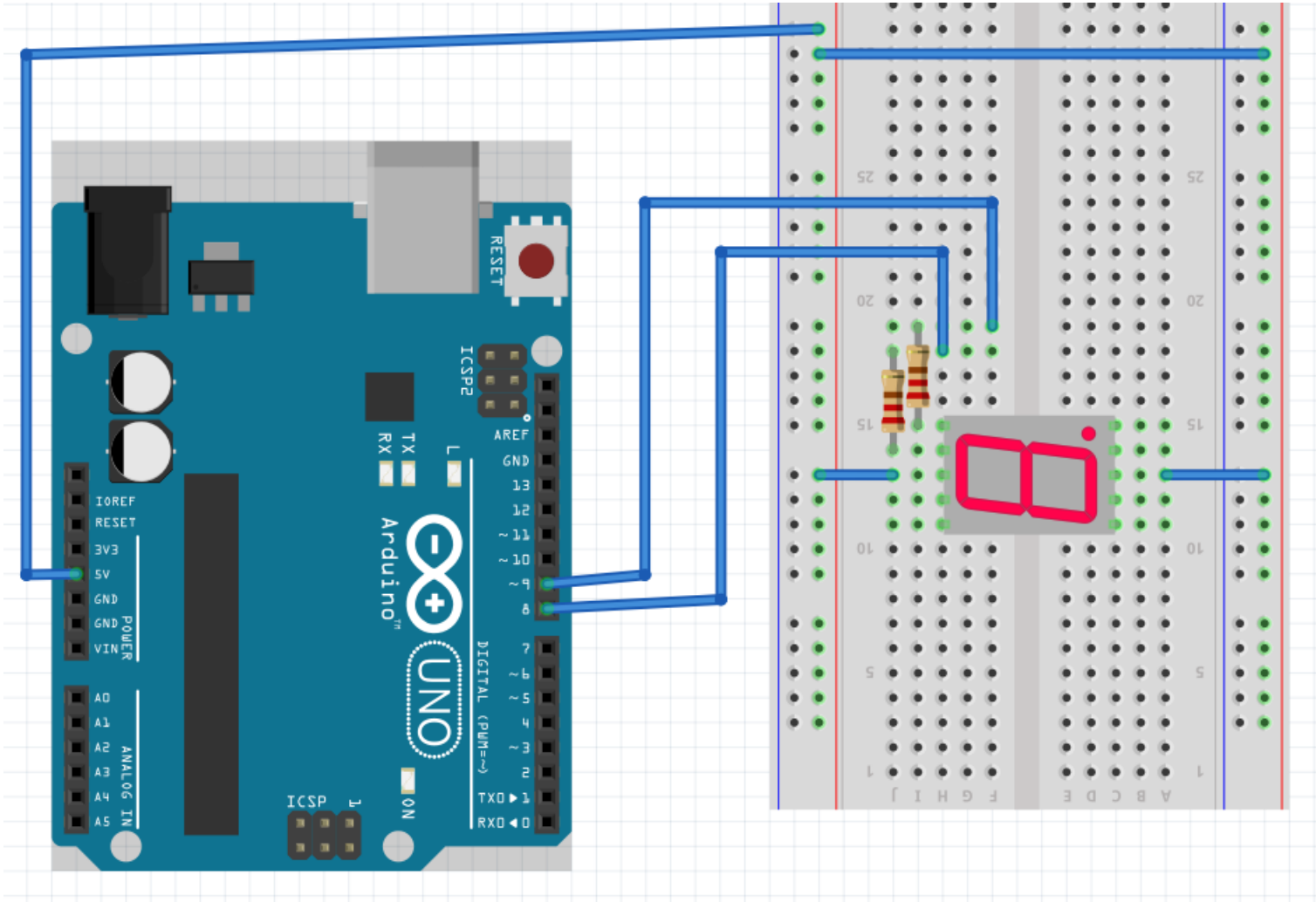
```
void setup() {
  DDRB = B00000001 ;
}

void loop() {
 PORTB = B00000000 ;
}
```



LED를 이용한 포트 제어 실험

- 7-segment 실험

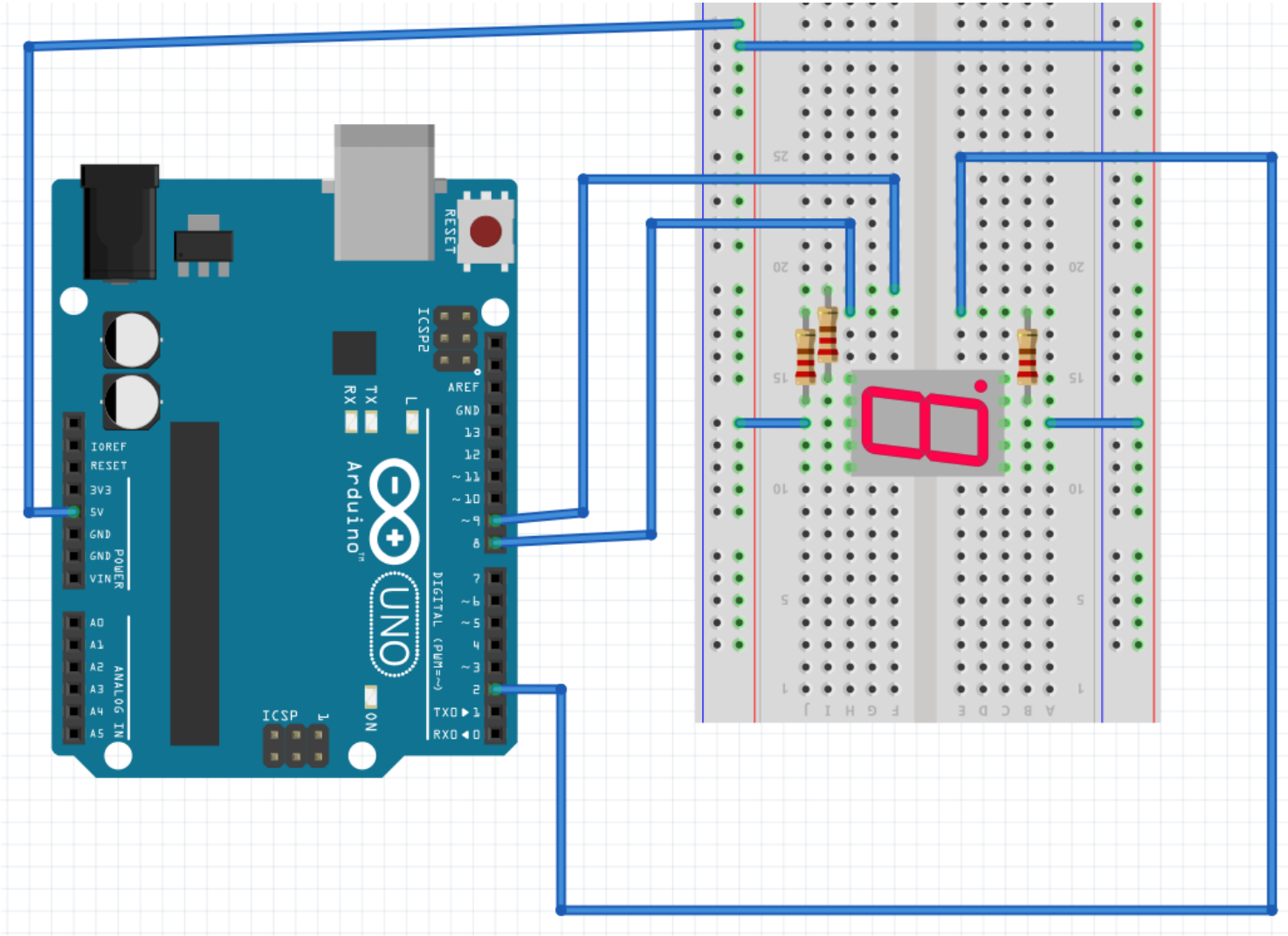
```
void setup() {
  DDRB = B00000011 ;
}

void loop() {
 PORTB = B00000000 ;
}
```



LED를 이용한 포트 제어 실험

- 7-segment 실험

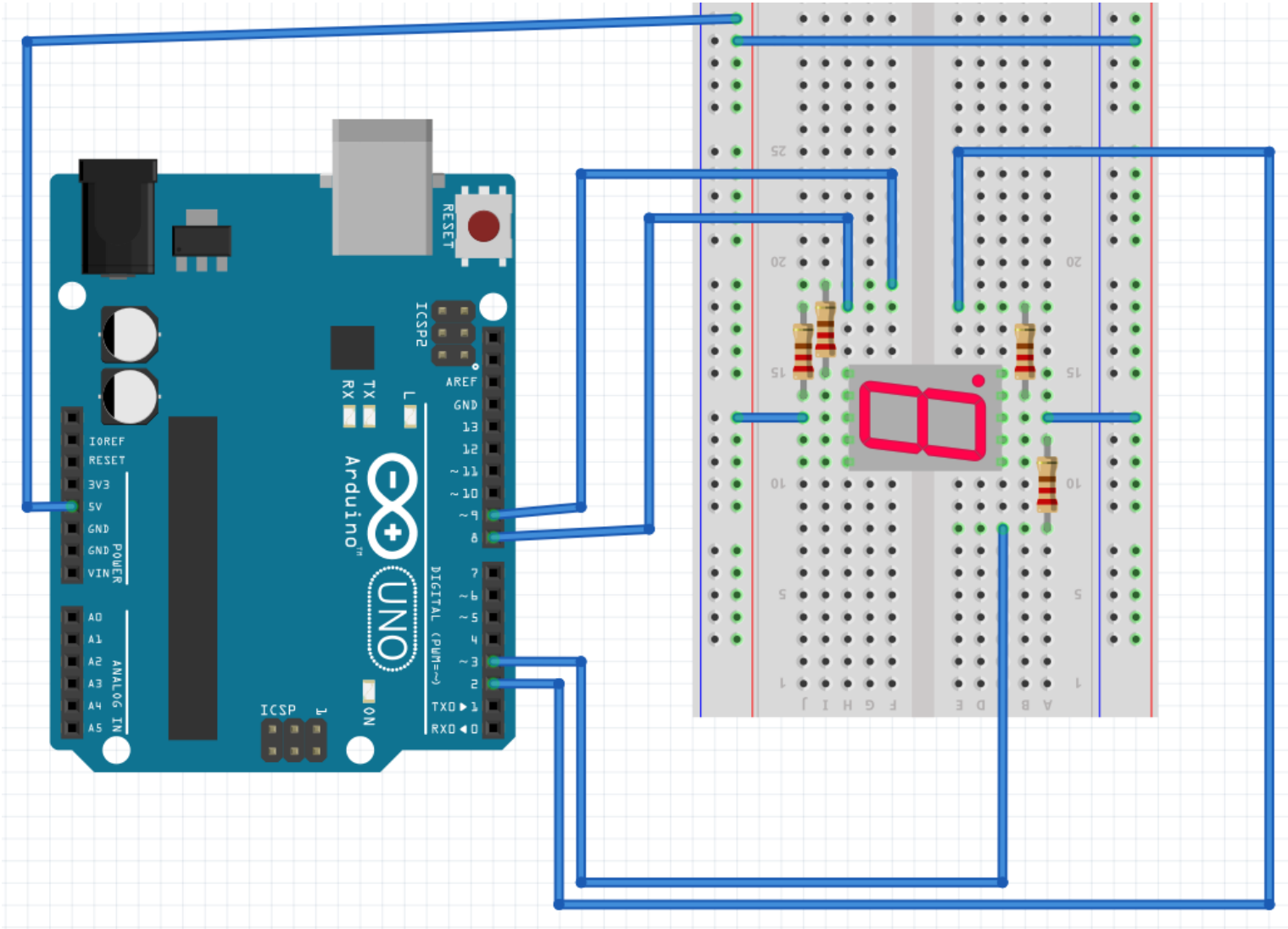
```
void setup() {
  DDRB = B00000011 ;
  DDRD = B00000100 ;
}

void loop() {
  PORTB = B00000000 ;
  PORTD = B00000000 ;
}
```



LED를 이용한 포트 제어 실험

- 7-segment 실험

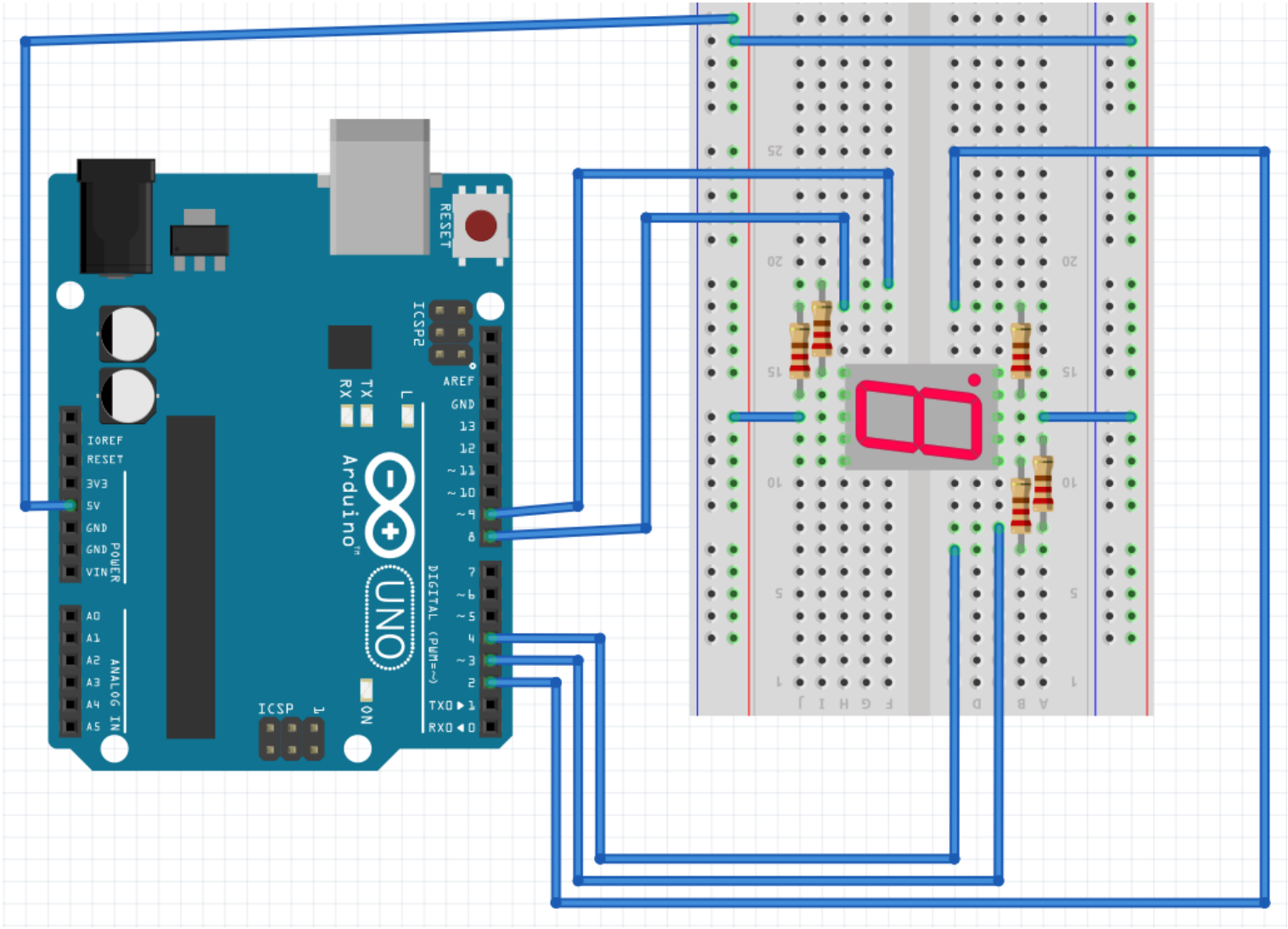
```
void setup() {
  DDRB = B00000011 ;
  DDRD = B00001100 ;
}

void loop() {
  PORTB = B00000000 ;
  PORTD = B00000000 ;
}
```



LED를 이용한 포트 제어 실험

- 7-segment 실험

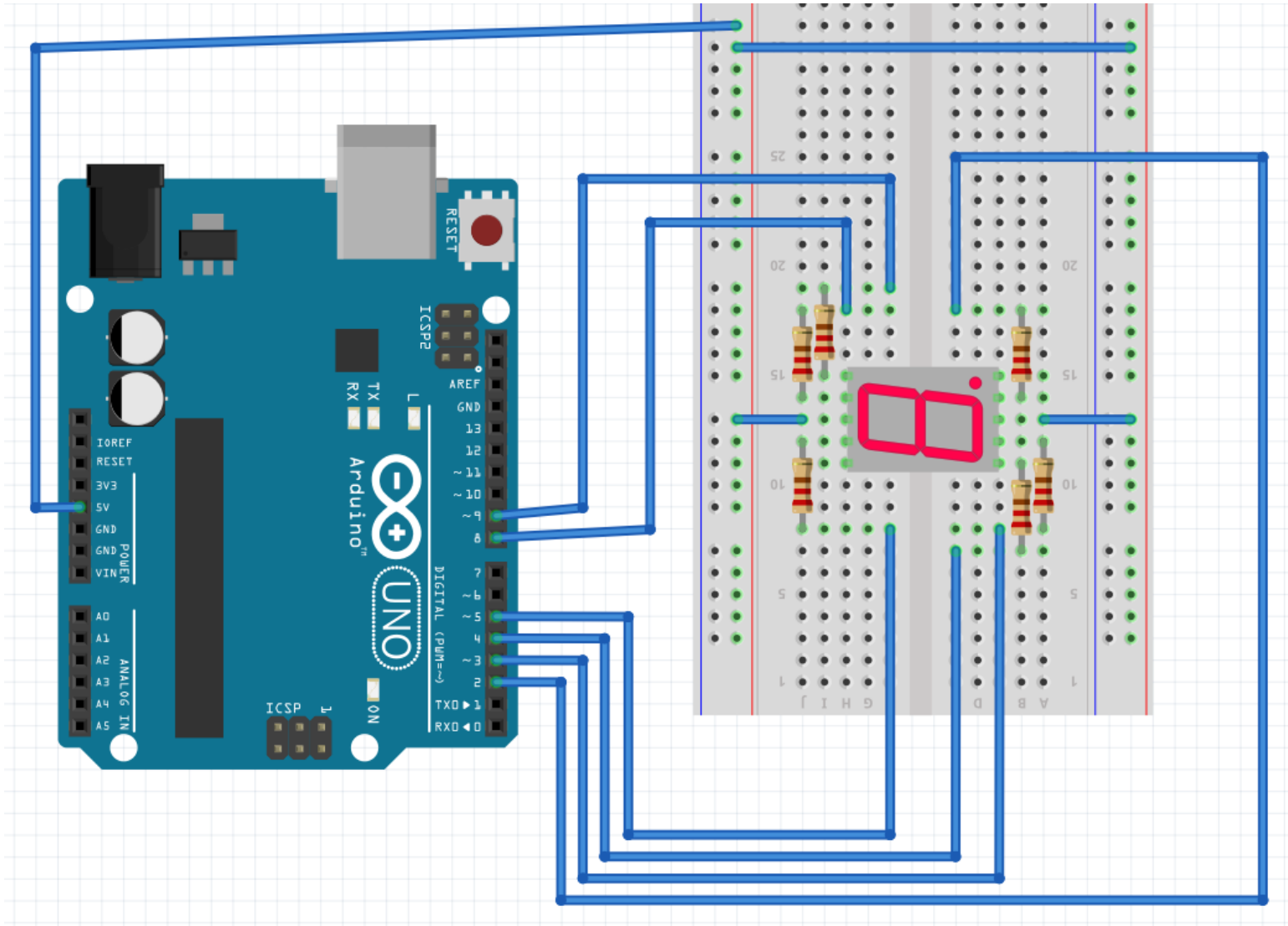
```
void setup() {
  DDRB = B00000011 ;
  DDRD = B00011100 ;
}

void loop() {
  PORTB = B00000000 ;
  PORTD = B00000000 ;
}
```



LED를 이용한 포트 제어 실험

- 7-segment 실험

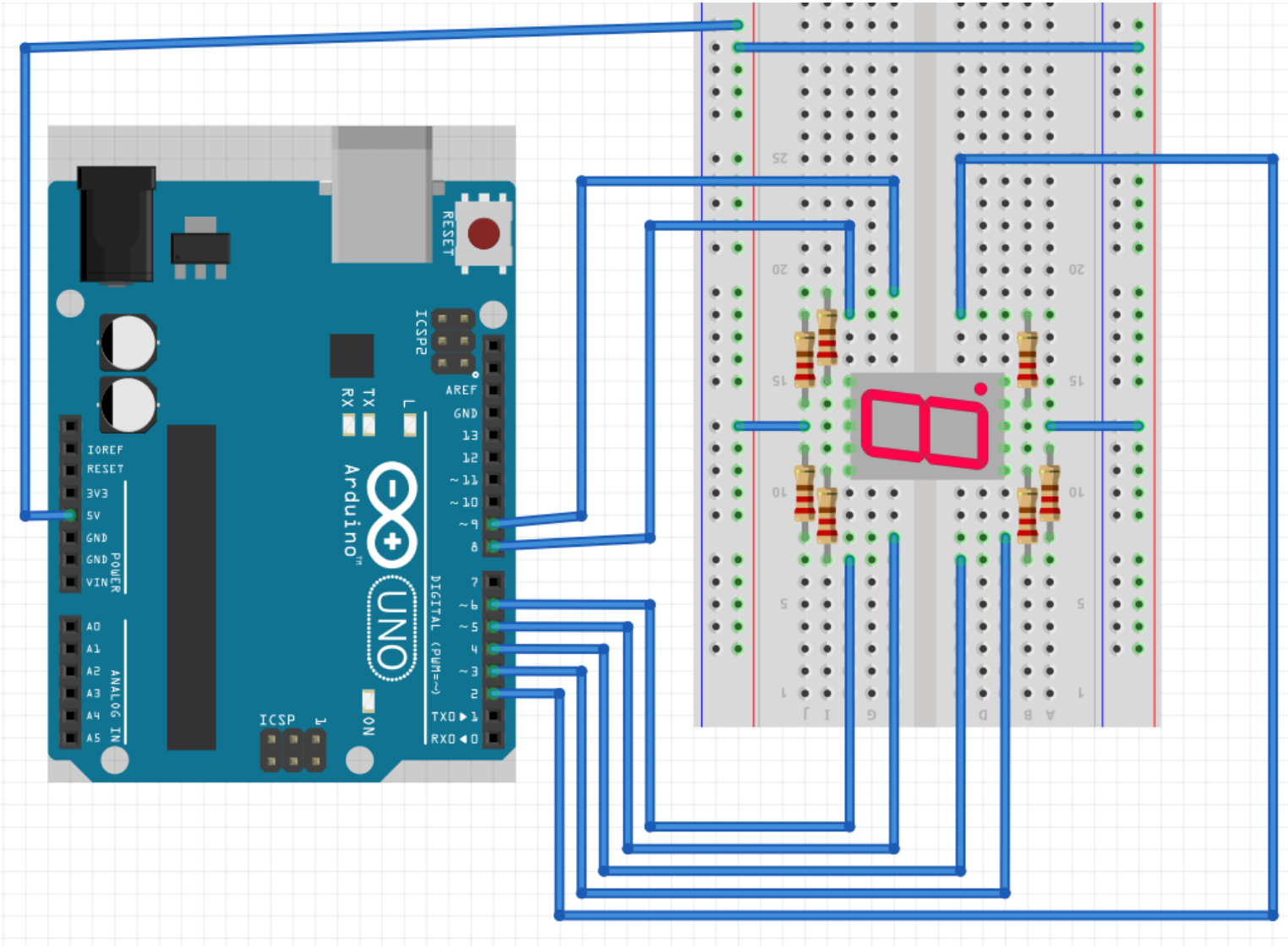
```
void setup() {
  DDRB = B00000011 ;
  DDRD = B00111100 ;
}

void loop() {
  PORTB = B00000000 ;
  PORTD = B00000000 ;
}
```



LED를 이용한 포트 제어 실험

- 7-segment 실험

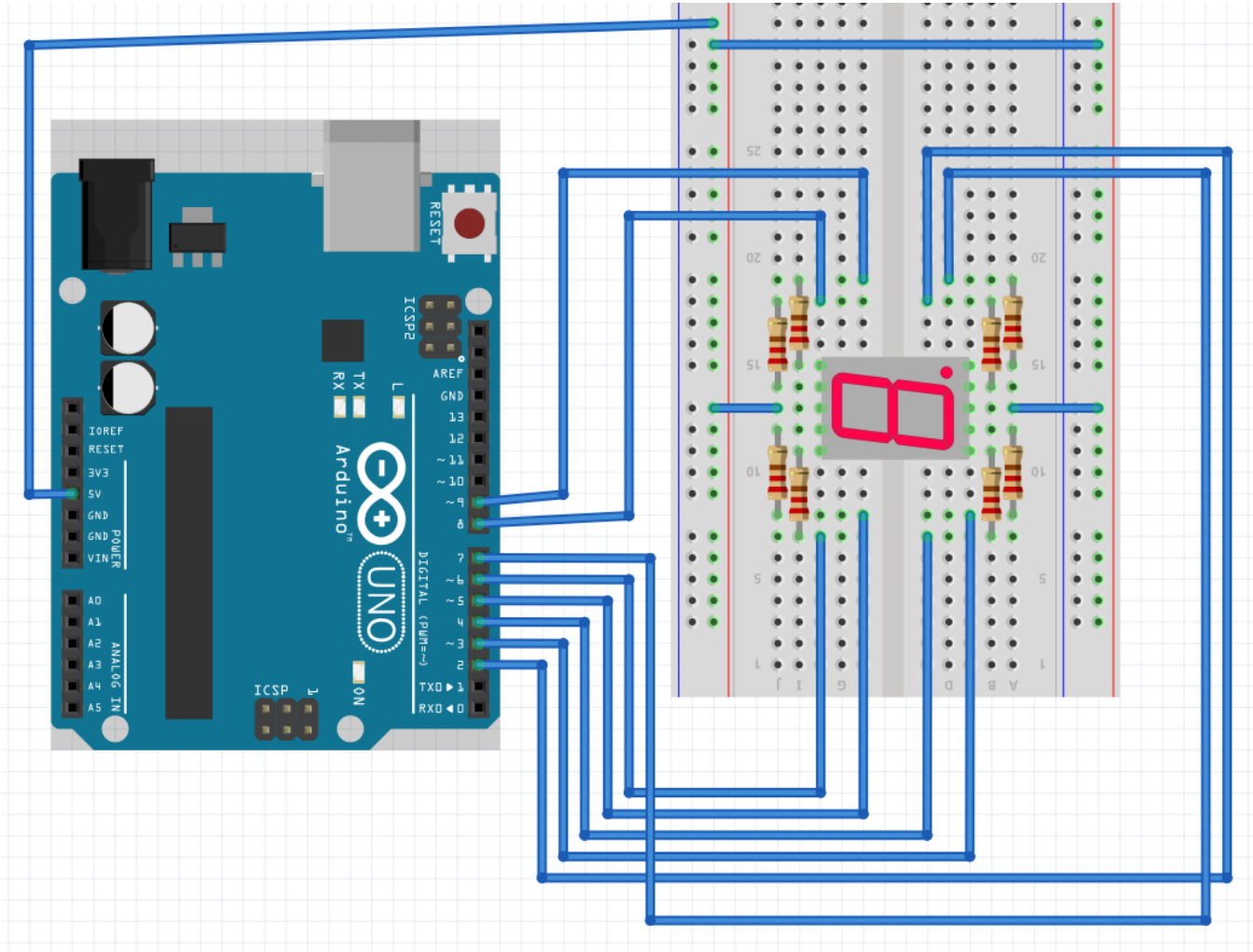
```
void setup() {
  DDRB = B00000011 ;
  DDRD = B01111100 ;
}

void loop() {
  PORTB = B00000000 ;
  PORTD = B00000000 ;
  delay(1000) ;

  PORTB = B00000011 ;
  PORTD = B01111100 ;

  delay(1000);
}
```



LED를 이용한 포트 제어 실험

- 7-segment 실험

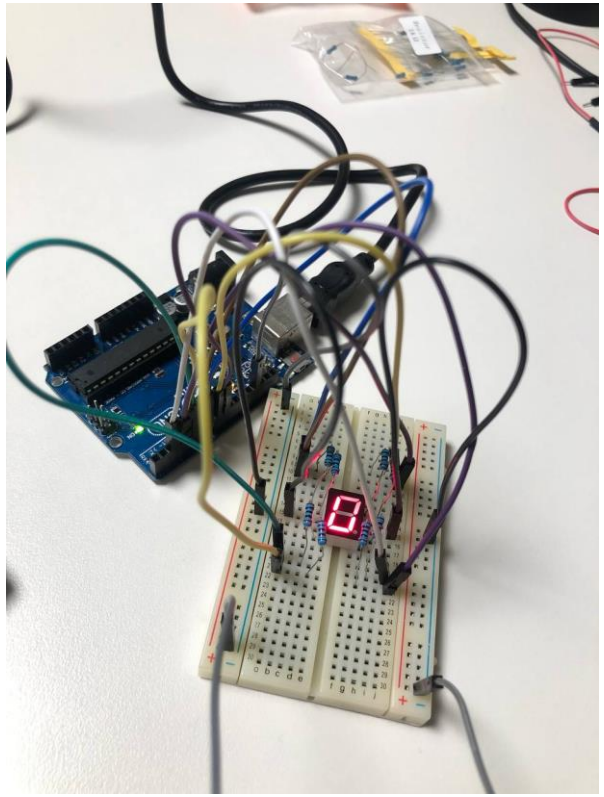
```
void setup() {
  DDRB = B00000011 ;
  DDRD = B11111100 ;
}

void loop() {
  PORTB = B00000000 ;
  PORTD = B00000000 ;
  delay(1000) ;

  PORTB = B00000011 ;
  PORTD = B11111100 ;

  delay(1000);
}
```

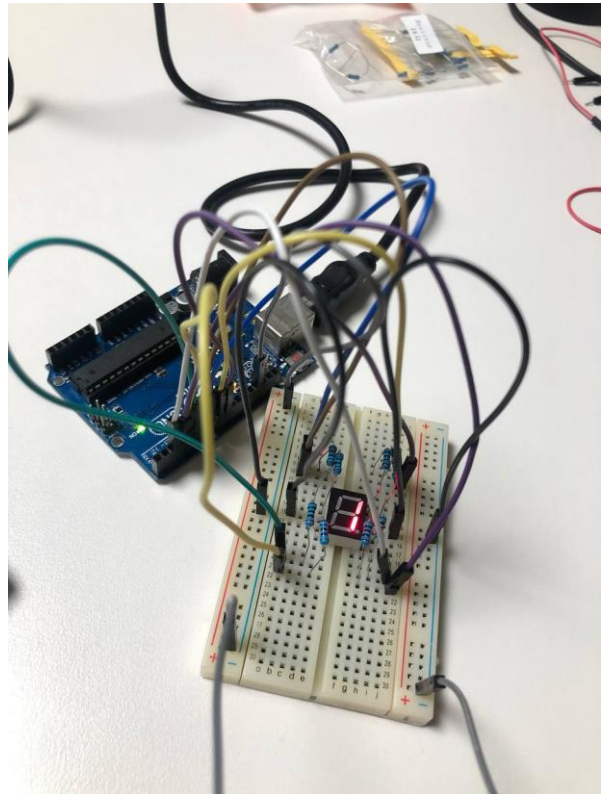


LED를 이용한 포트 제어 실험

- 예제18

```
void setup() {
  DDRB = B00000011 ;
  DDRD = B11111100 ;

  PORTD = B00000000 ;
  PORTB = B00000000 ;
}

void loop() {
  int led_0 = B01110111 ;
  int led_1 = B00000110 ;

  PORTB = led_0 ;
  PORTD = led_0 ;
  delay(1000) ;

  PORTB = led_1 ;
  PORTD = led_1 ;
  delay(1000) ;
}
```





LED를 이용한 포트 제어 실험

- 예제19

```
void setup() {
  DDRB = B00000011 ;
  DDRD = B11111100 ;

  PORTD = B00000000 ;
  PORTB = B00000000 ;

  Serial.begin(9600) ;
}

void loop() {
  int led_0 = B01110111 ;
  int led_1 = B00000110 ;

  int incomingByte = 0 ;
  if (Serial.available())
  {
    // read the incoming byte:
    incomingByte = Serial.read();

    if( incomingByte == '0' )
    {
      PORTB = led_0 ;
      PORTD = led_0 ;
    }
    else if( incomingByte == '1' )
    {
      PORTB = led_1 ;
      PORTD = led_1 ;
    }
  }
}
```