

“수업자료는 여기”

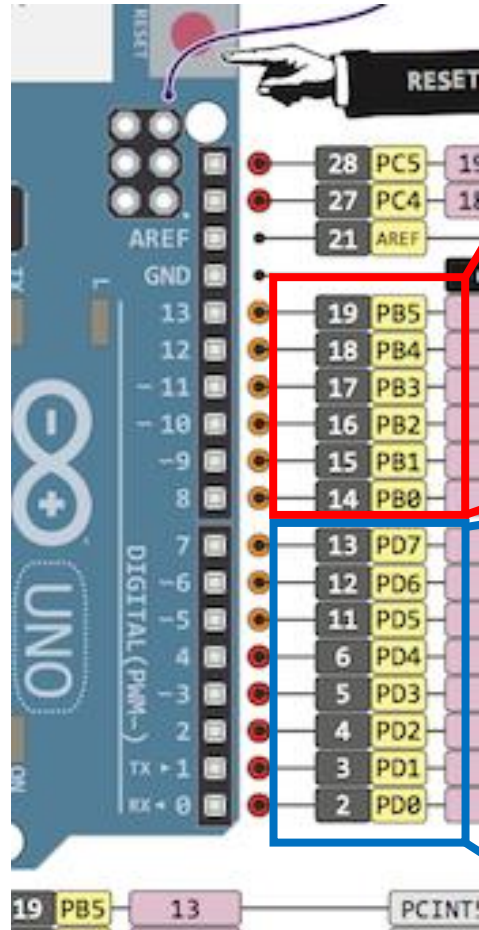
입출력(IO) 포트 실험 LED 컨트롤 실험

마이크로프로세서 종합 설계



10 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
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
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

[illegible]

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
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

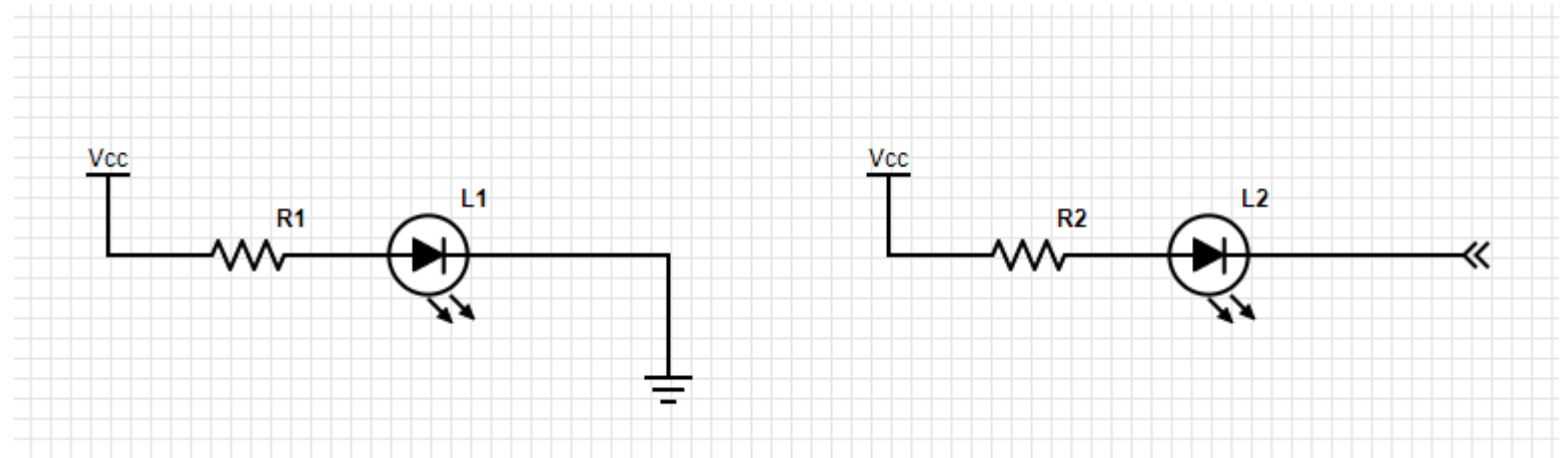
13.4.9 DDRD – The Port D Data Direction Register

Bit	7	6	5	4	3	2	1	0
0x0A (0x2A)	DDD7	DDD6	DDD5	DDD4	DDD3	DDD2	DDD1	DDD0
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

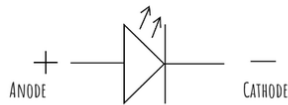
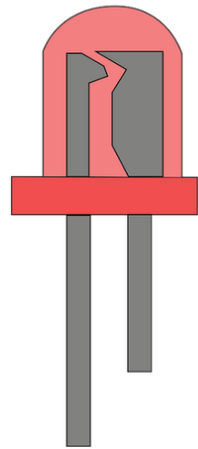
13.4.10 PIND – The Port D Input Pins Address

[illegible]

LED



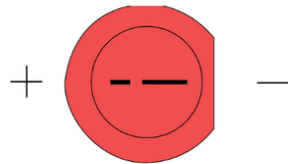
Light Emitting Diode (LED) Polarity



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



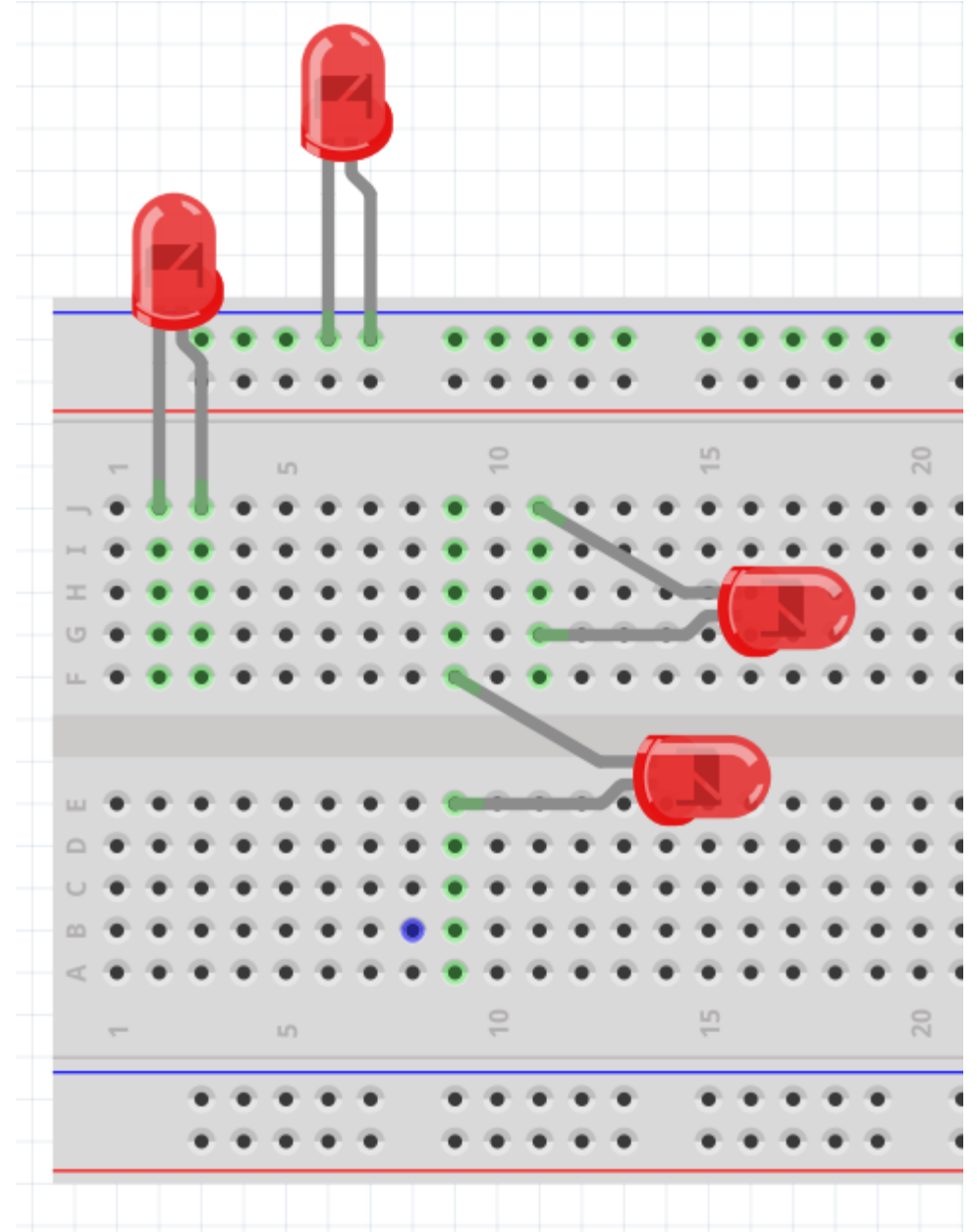
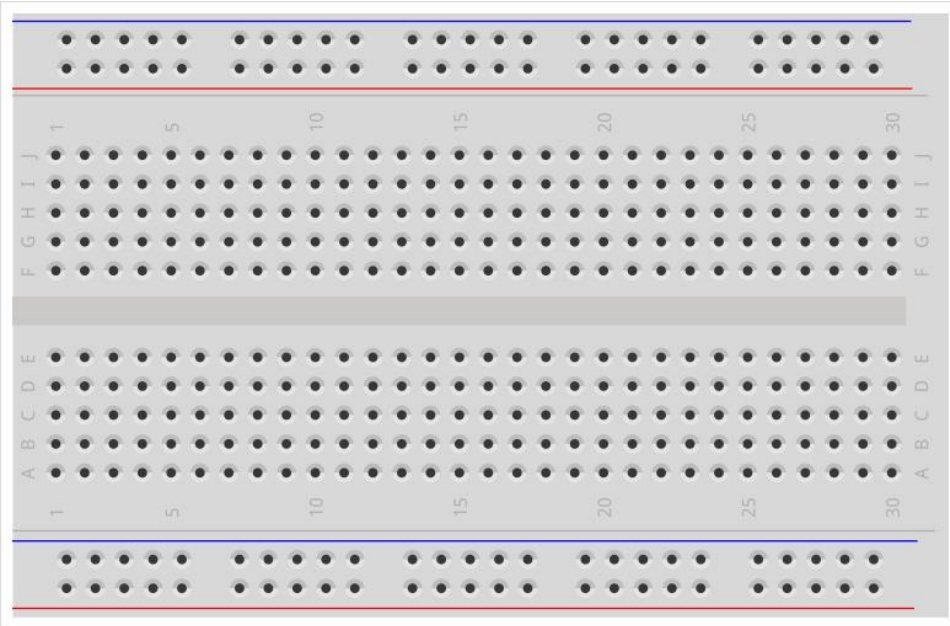
✓ The long leg of an LED indicates the Anode (+)

✓ A flat edge on the LED casing indicates the Cathode (-) pin.



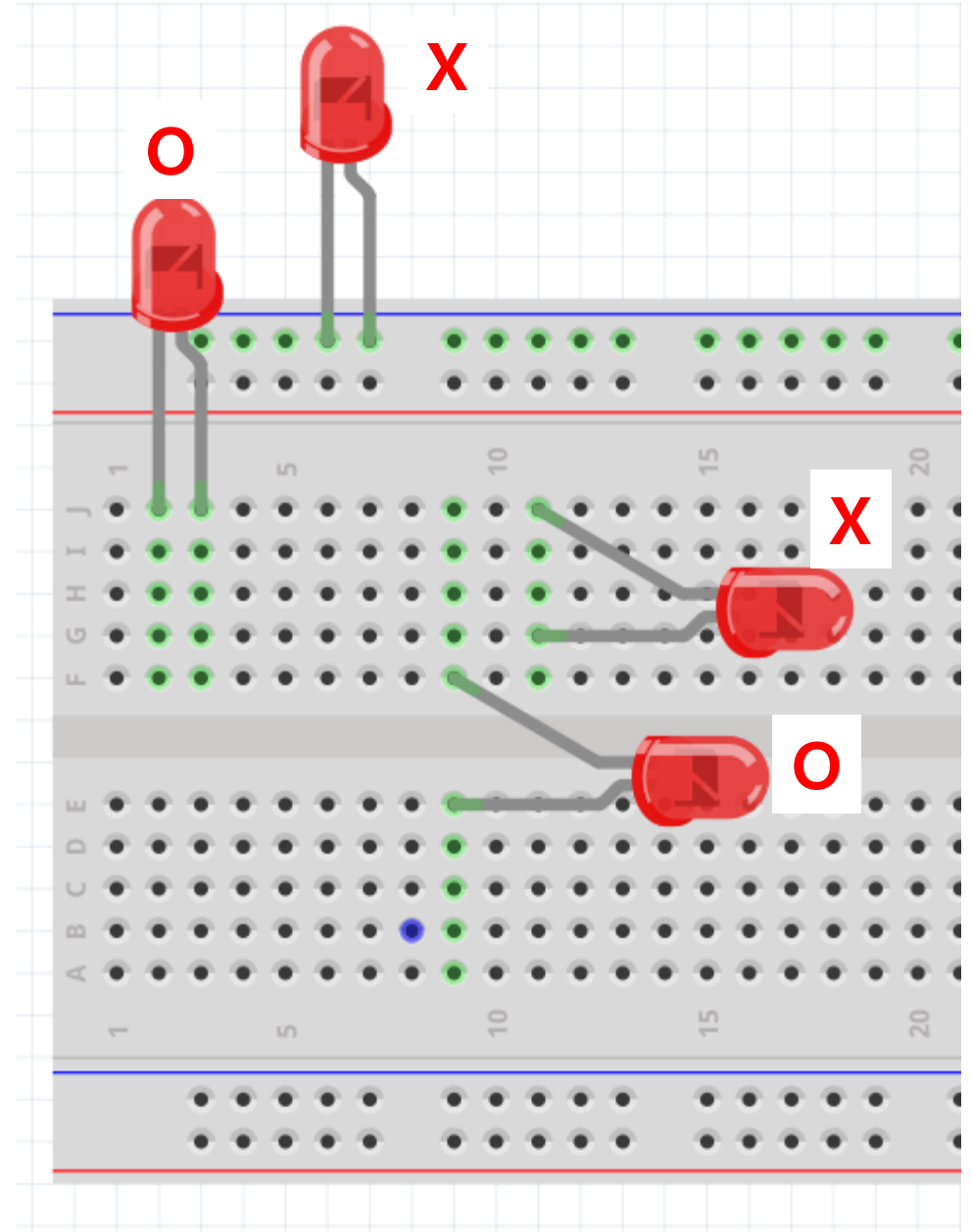
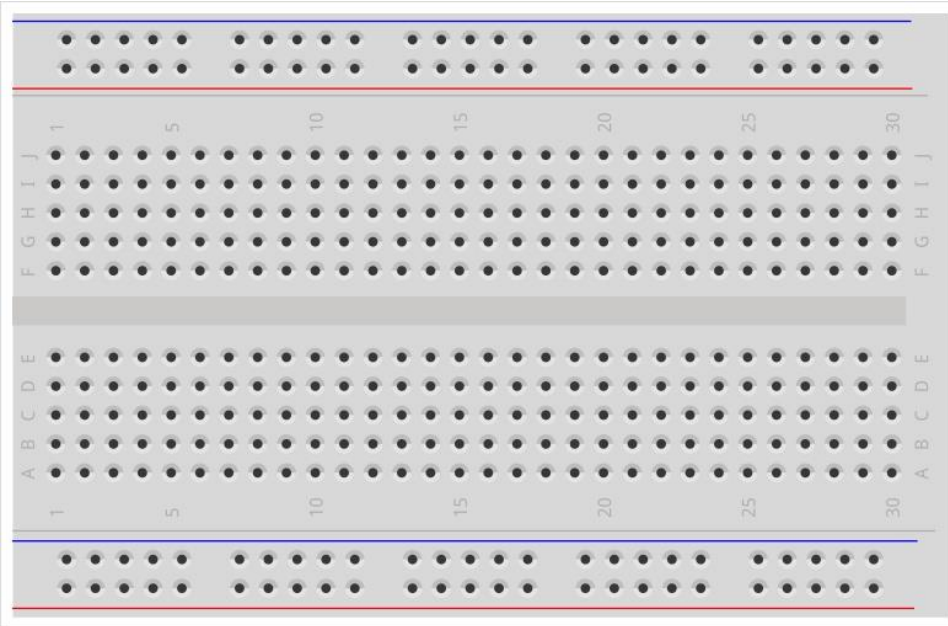
IO 포트 관련 레지스터

- 빵판 사용법(브레드보드)



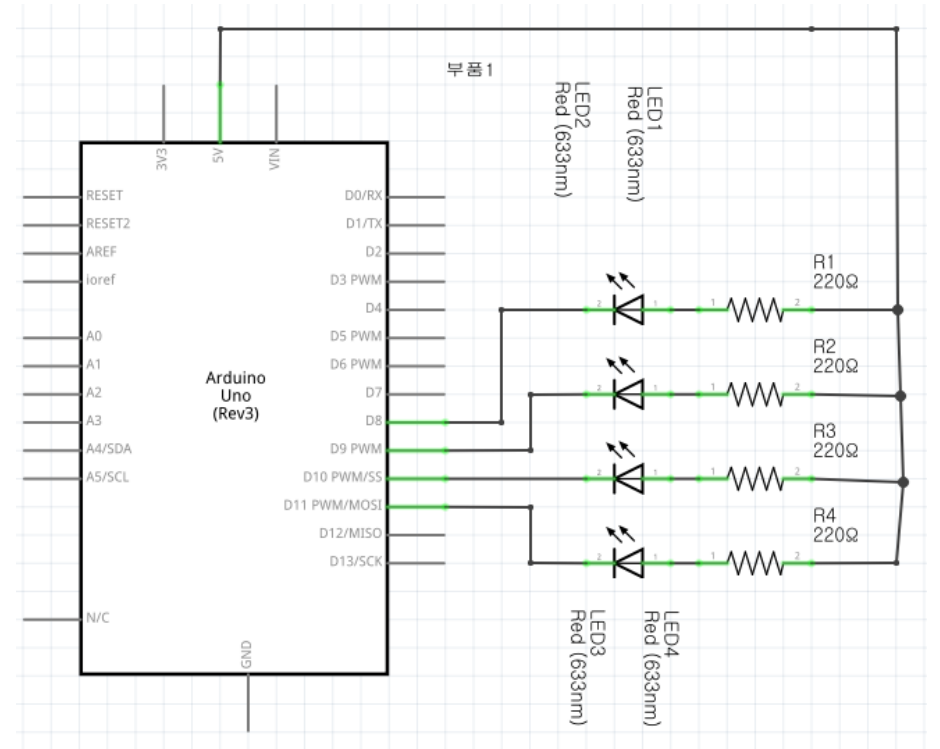
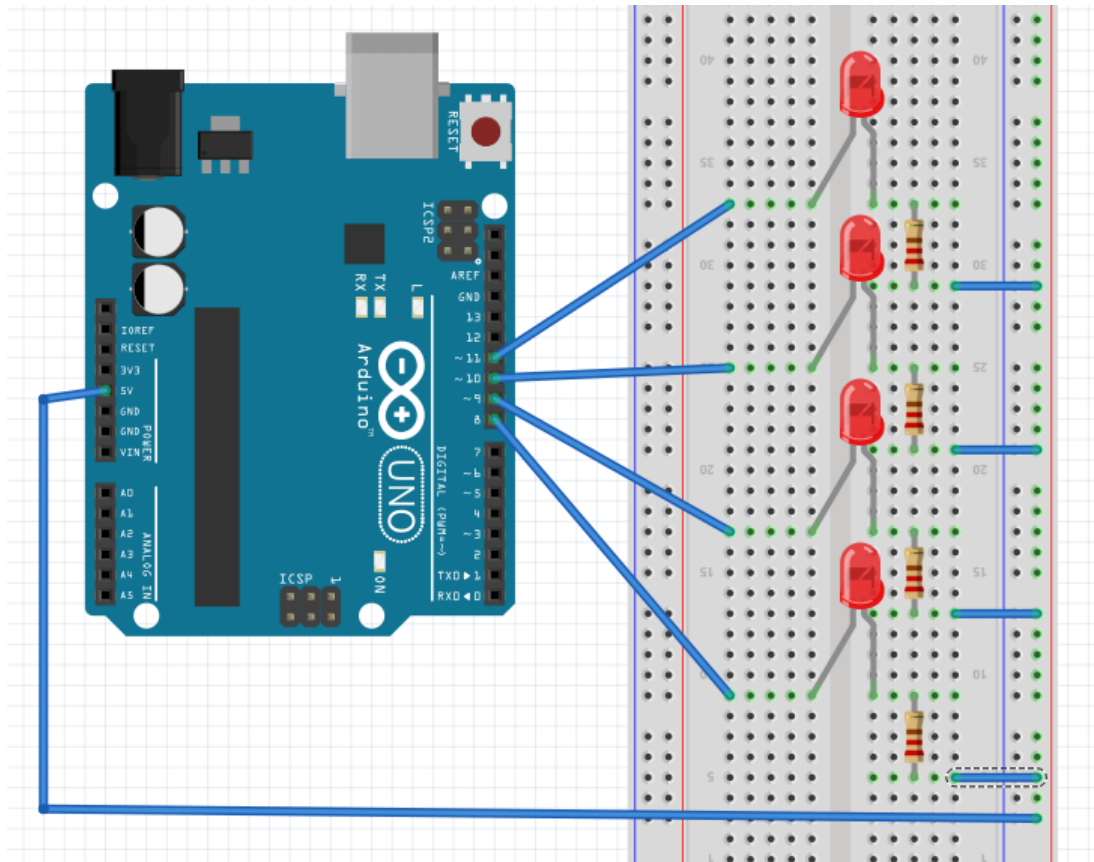
IO 포트 관련 레지스터

- 빵판 사용법(브레드보드)



LED를 이용한 포트 제어 실험

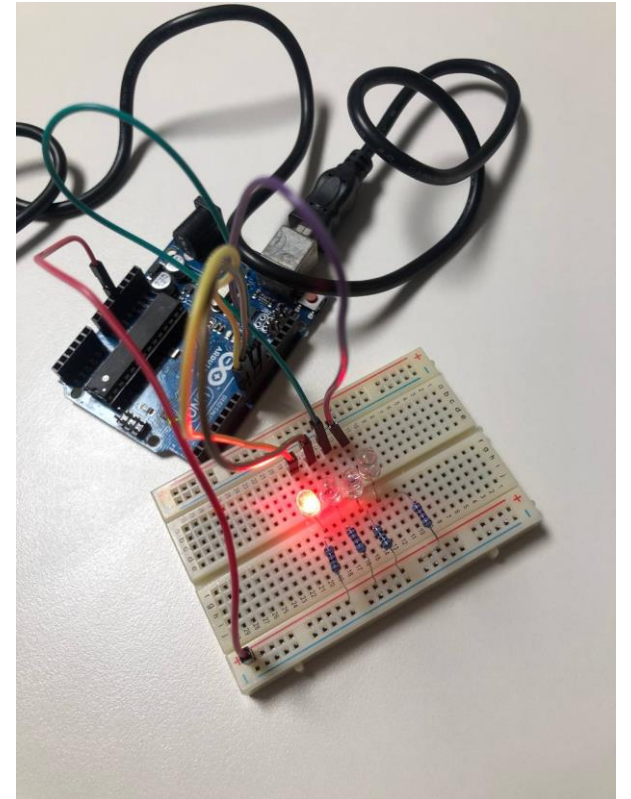
- 4개의 LED를 연결해서 포트를 제어 해보자.



LED를 이용한 포트 제어 실험

- 예제15

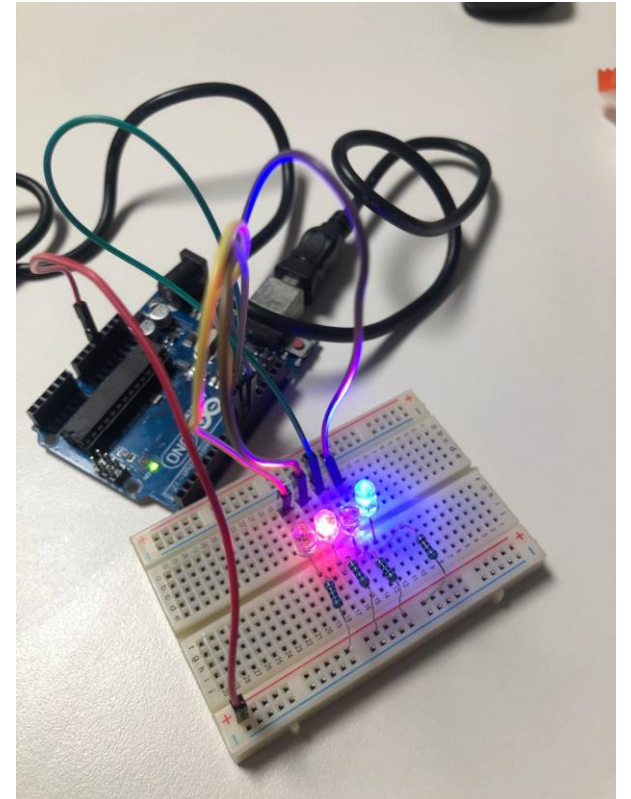
```
void setup() {  
    DDRB = B00001111 ;  
    PORTB = B00000000 ;  
}  
  
void loop() {  
    PORTB = B00001111 ;  
    delay(1000) ;  
    PORTB = B00000000 ;  
    delay(1000) ;  
}
```



LED를 이용한 포트 제어 실험

- 예제 16

```
void setup() {  
    DDRB = 0x0F ;  
    PORTB = 0x0A ;  
}  
  
void loop() {  
    PORTB = 0x0A ;  
    delay(500) ;  
    PORTB = 0x05 ;  
    delay(500) ;  
}
```

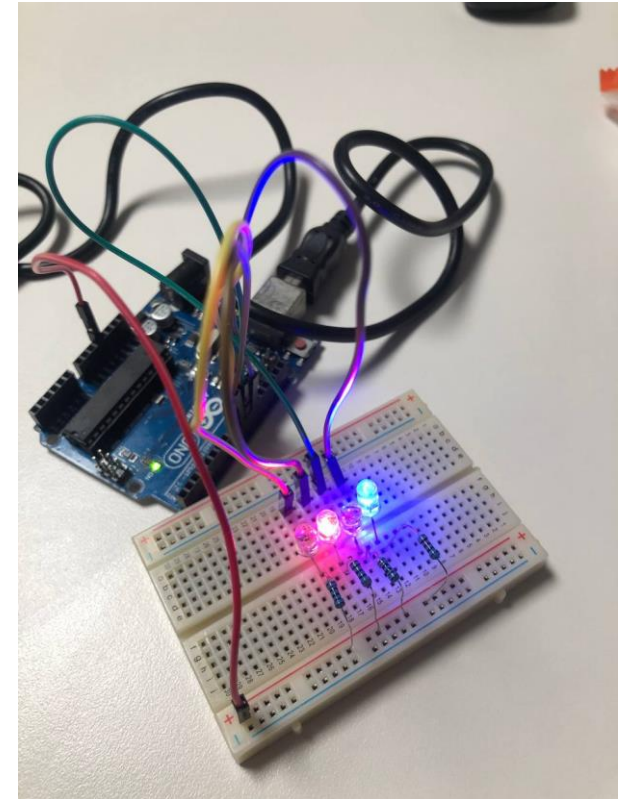


LED를 이용한 포트 제어 실험

• 예제 17

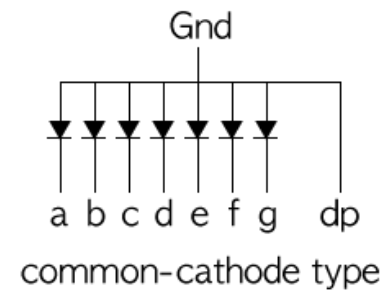
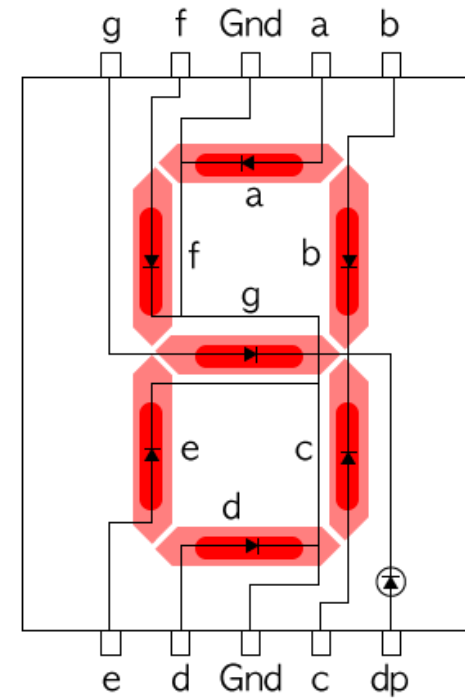
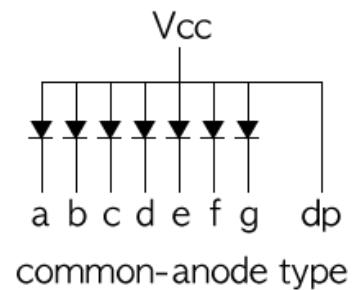
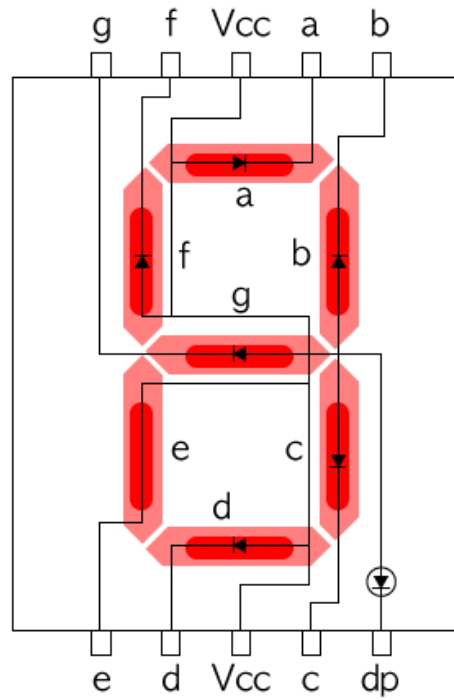
```
void setup() {  
    DDRB = B00001111 ;  
    PORTB = B00000000 ;  
  
}  
  
void loop() {  
    int i= 0 ;  
    int led = B00000001 ;  
    for(i=0 ; i<4 ; i++ )  
    {  
        PORTB = led << i ;  
        delay(1000) ;  
    }  
}
```

```
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) ;  
    }  
}
```



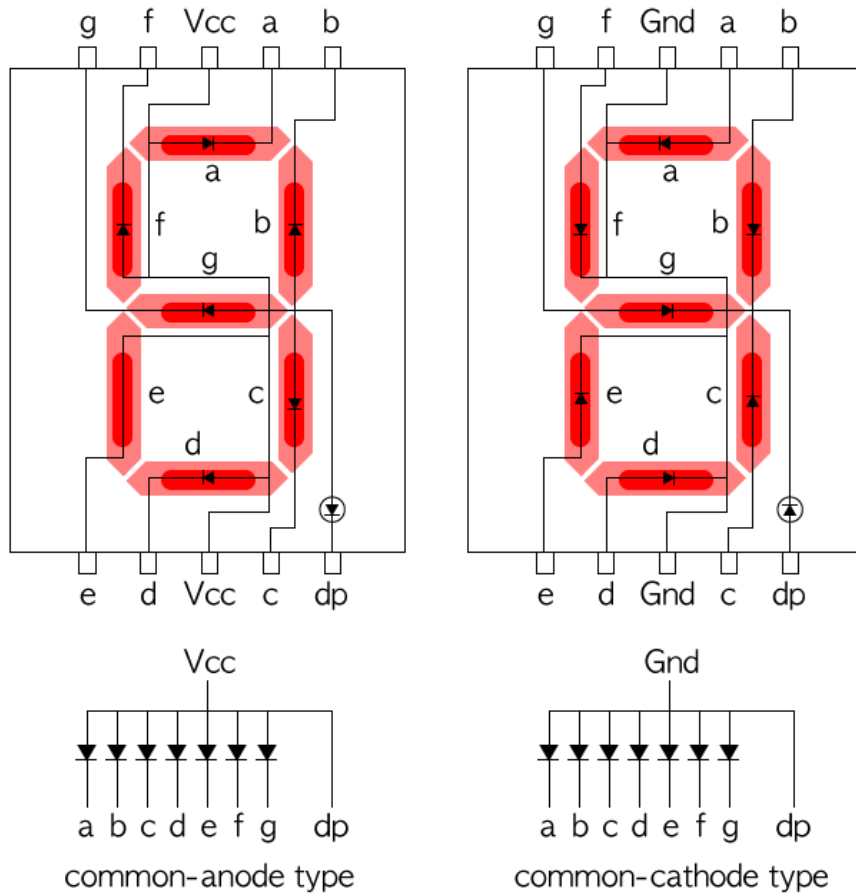
LED를 이용한 포트 제어 실험

- 7-segment 실험



LED를 이용한 포트 제어 실험

• 7-segment 실험

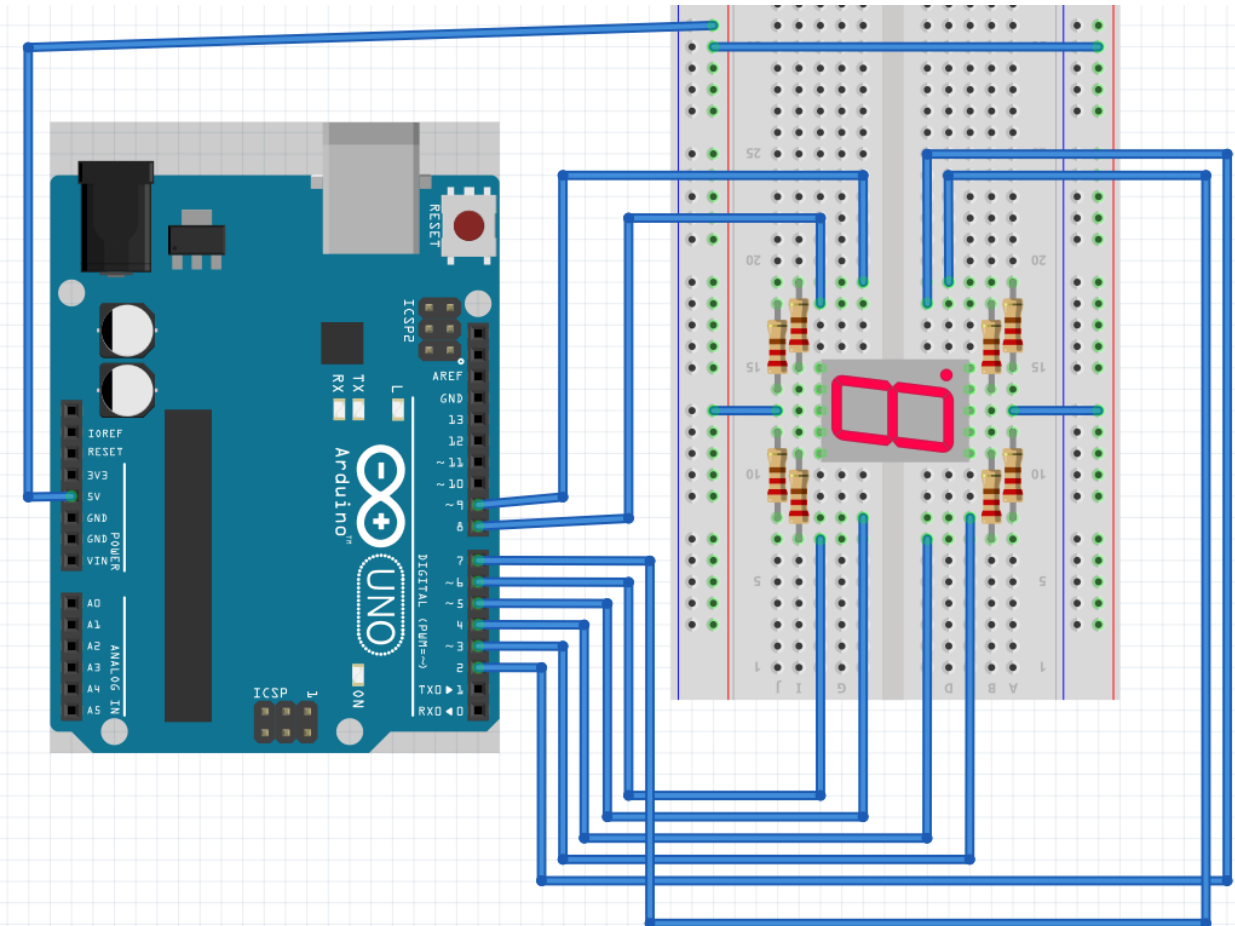


Common-anode type

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

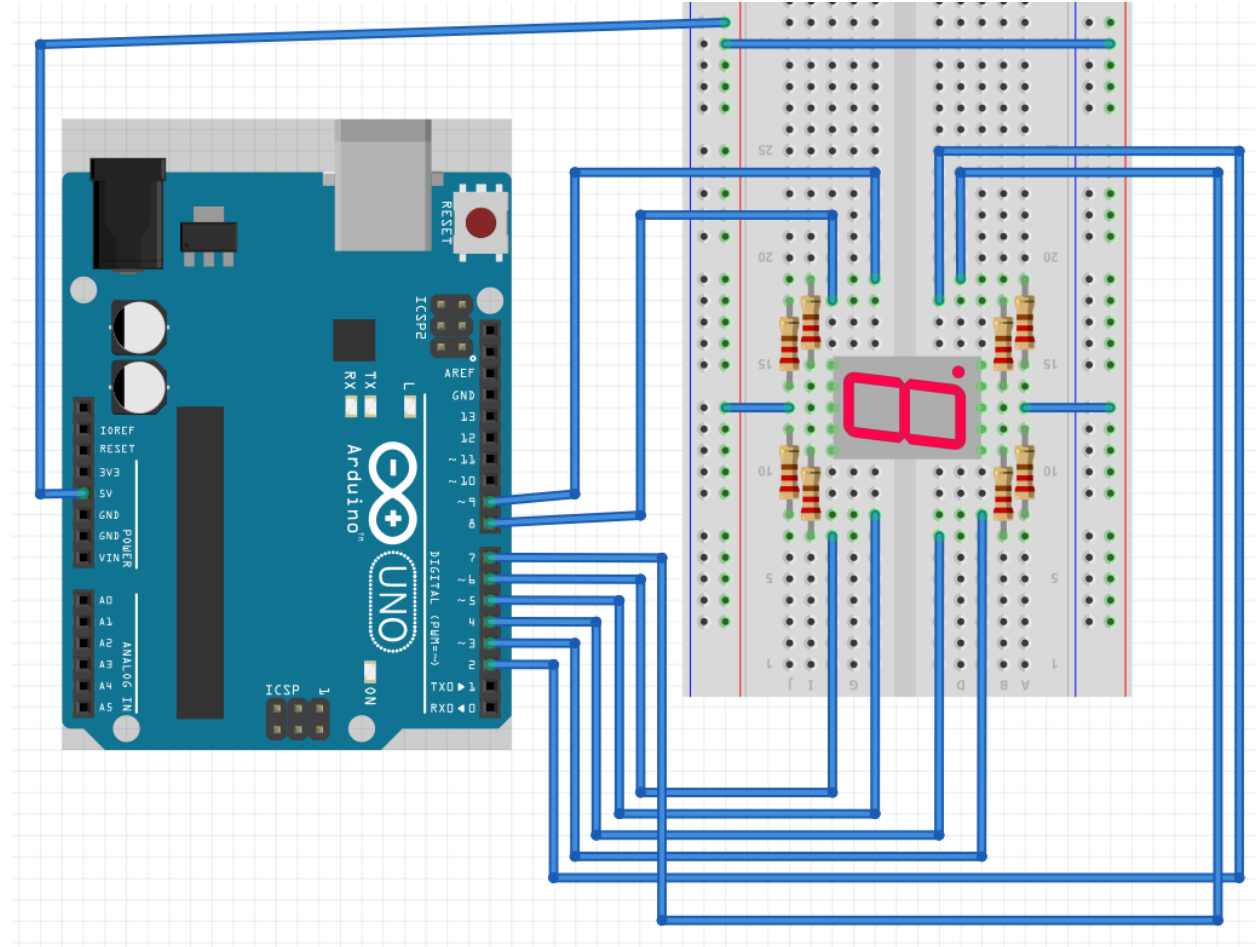
• 7-segment 실험

0 = a(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)

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

LED를 이용한 포트 제어 실험

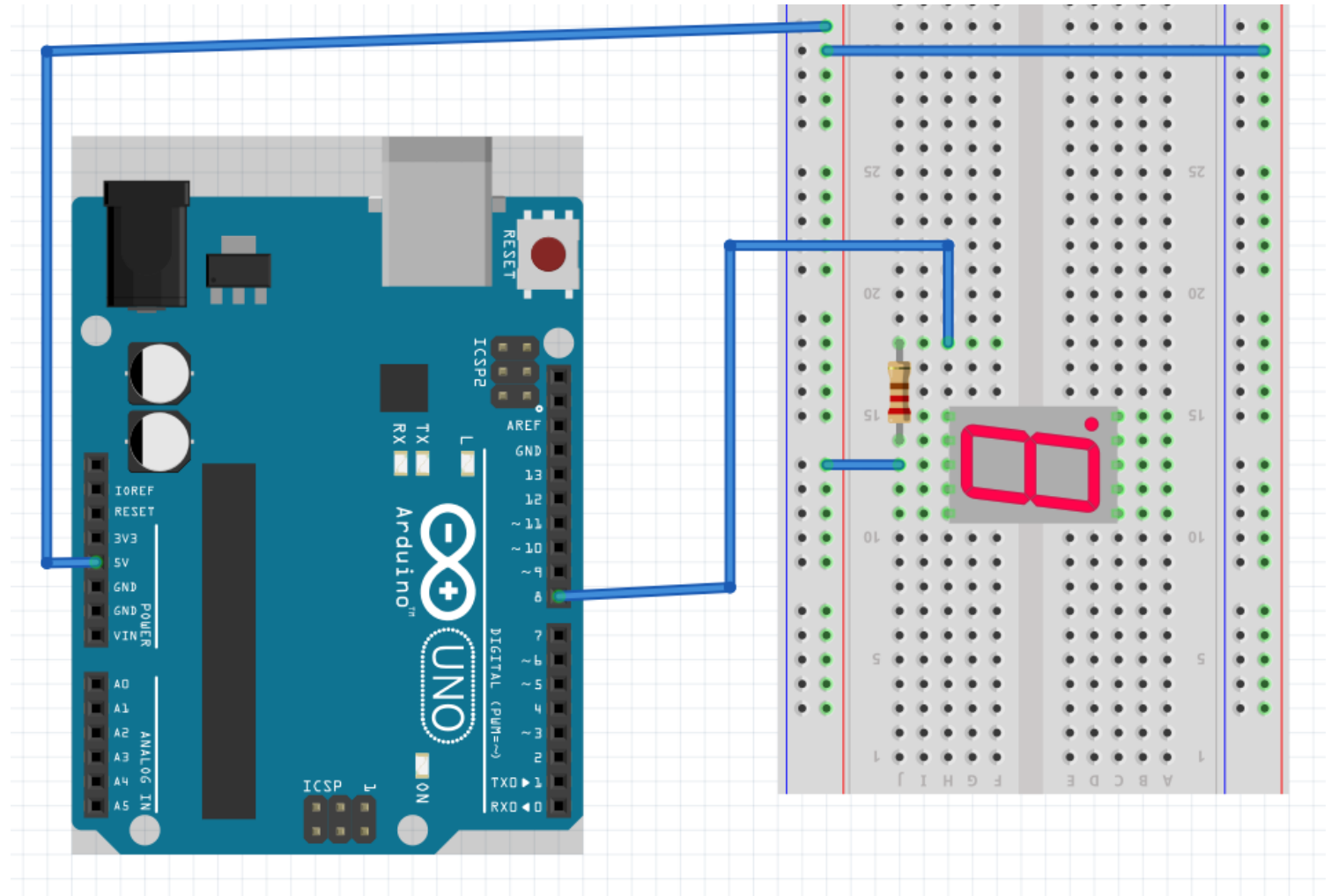
- 7-segment 실험



LED를 이용한 포트 제어 실험

- 7-segment 실험

```
void setup() {  
  DDRB = B00000001 ;  
}  
  
void loop() {  
  PORTB = B00000000 ;  
}
```

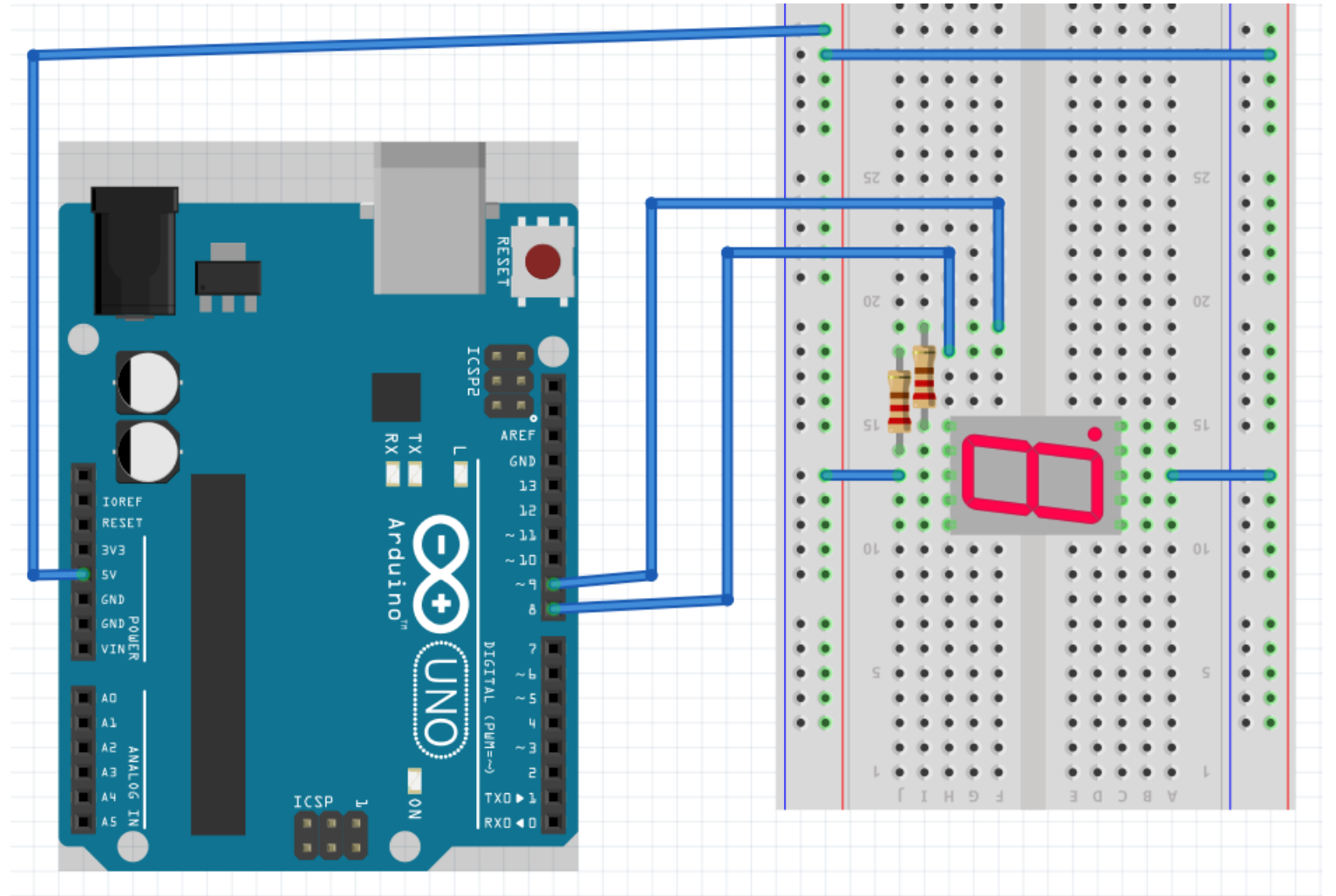


LED를 이용한 포트 제어 실험

- 7-segment 실험

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

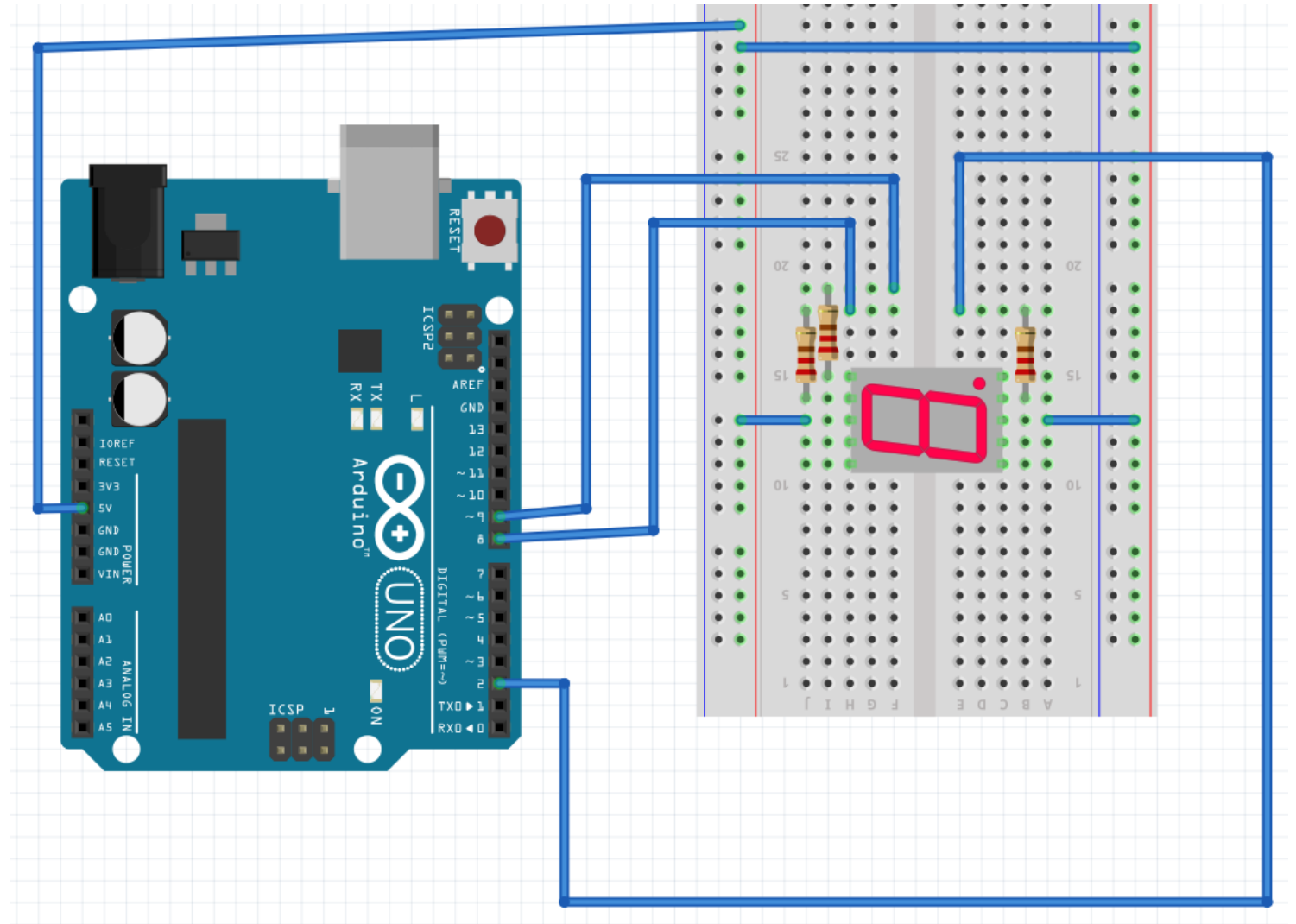
void loop() {
    PORTB = B00000000 ;
}
```



LED를 이용한 포트 제어 실험

• 7-segment 실험

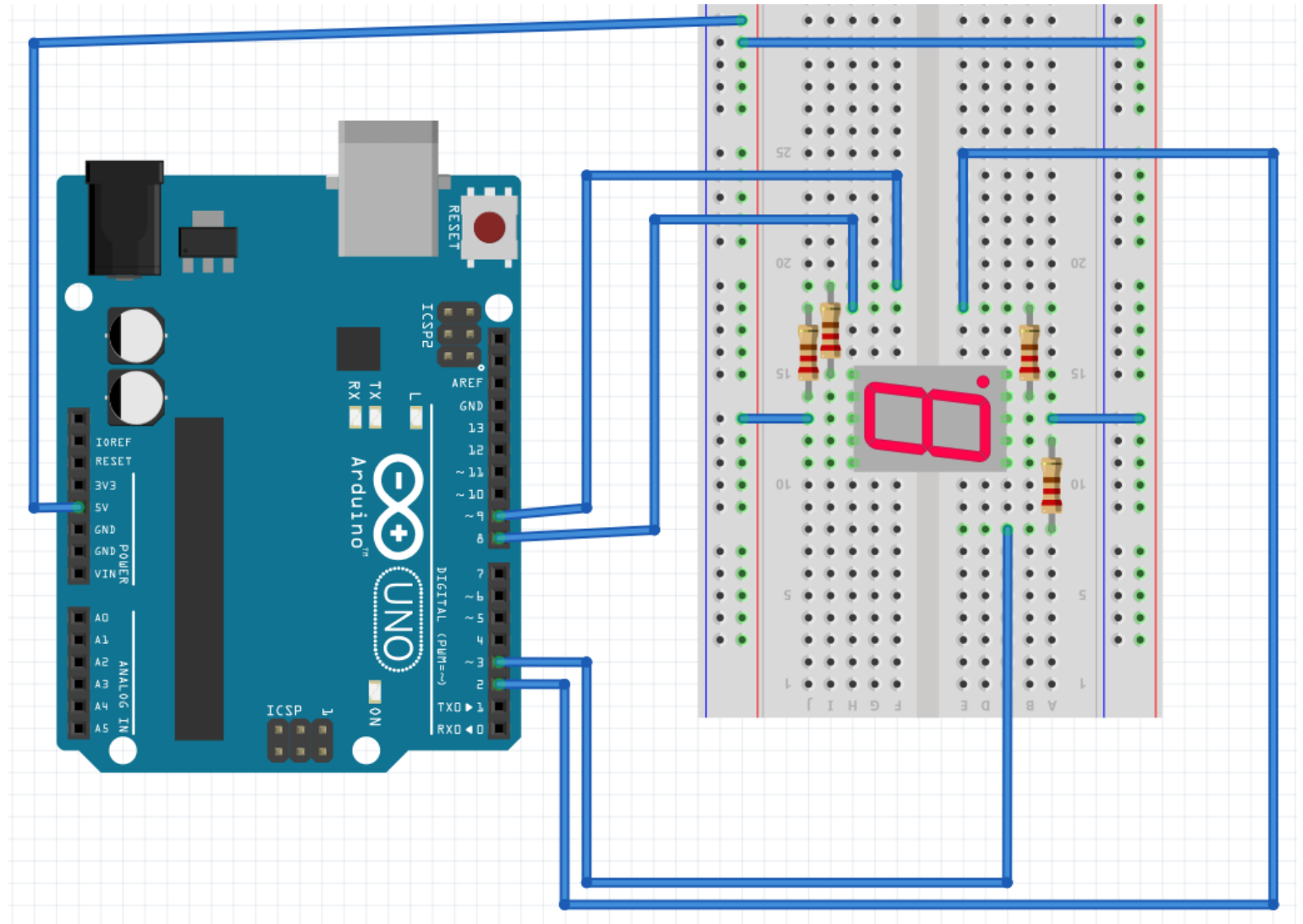
```
void setup() {  
  DDRB = B00000011 ;  
  DDRD = B00000100 ;  
}  
  
void loop() {  
  PORTB = B00000000 ;  
  PORTD = B00000000 ;  
}
```



LED를 이용한 포트 제어 실험

• 7-segment 실험

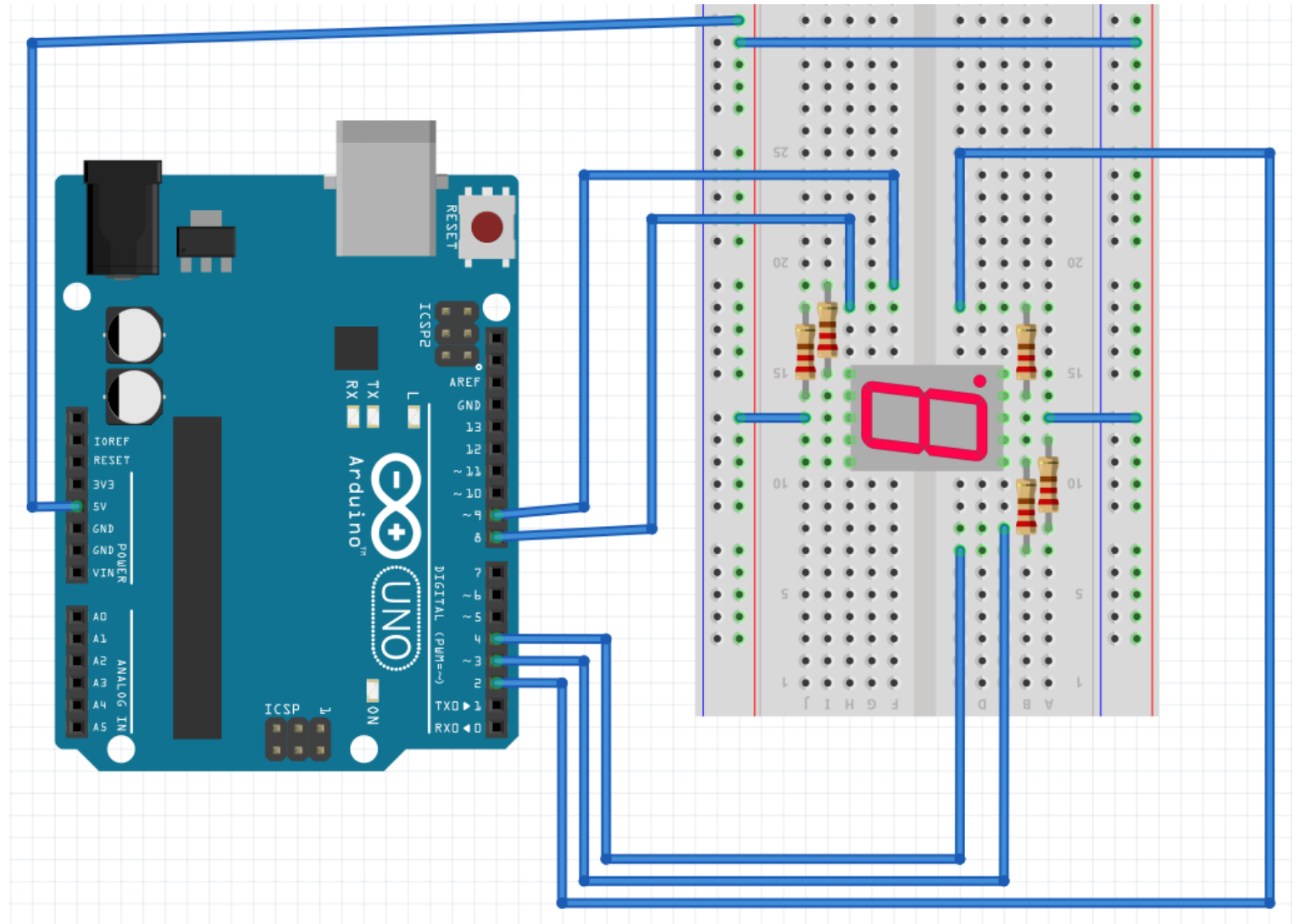
```
void setup() {  
  DDRB = B00000011 ;  
  DDRD = B00001100 ;  
}  
  
void loop() {  
  PORTB = B00000000 ;  
  PORTD = B00000000 ;  
}
```



LED를 이용한 포트 제어 실험

• 7-segment 실험

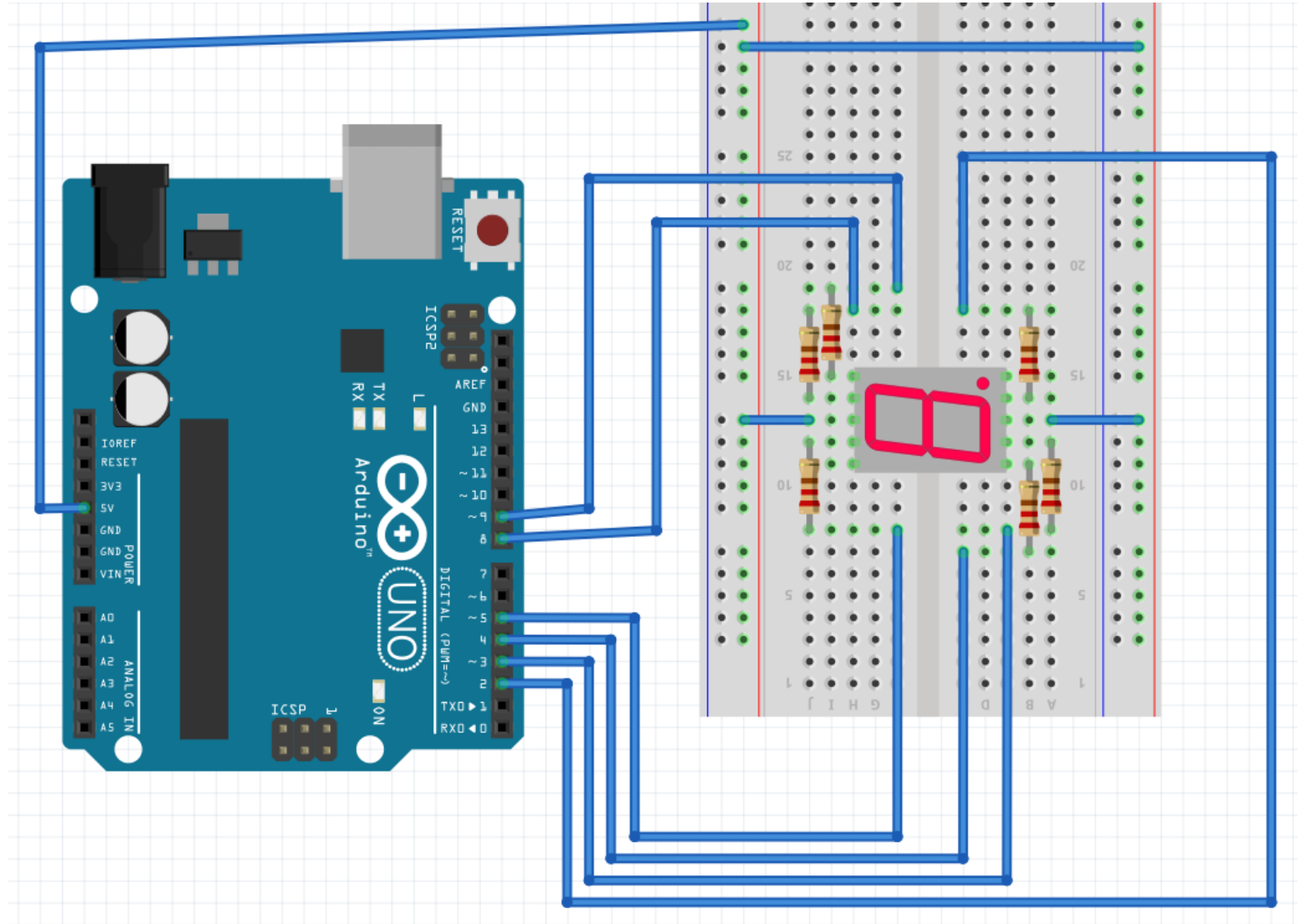
```
void setup() {  
  DDRB = B00000011 ;  
  DDRD = B00011100 ;  
}  
  
void loop() {  
  PORTB = B00000000 ;  
  PORTD = B00000000 ;  
}
```



LED를 이용한 포트 제어 실험

• 7-segment 실험

```
void setup() {  
  DDRB = B00000011 ;  
  DDRD = B00111100 ;  
}  
  
void loop() {  
  PORTB = B00000000 ;  
  PORTD = B00000000 ;  
}
```

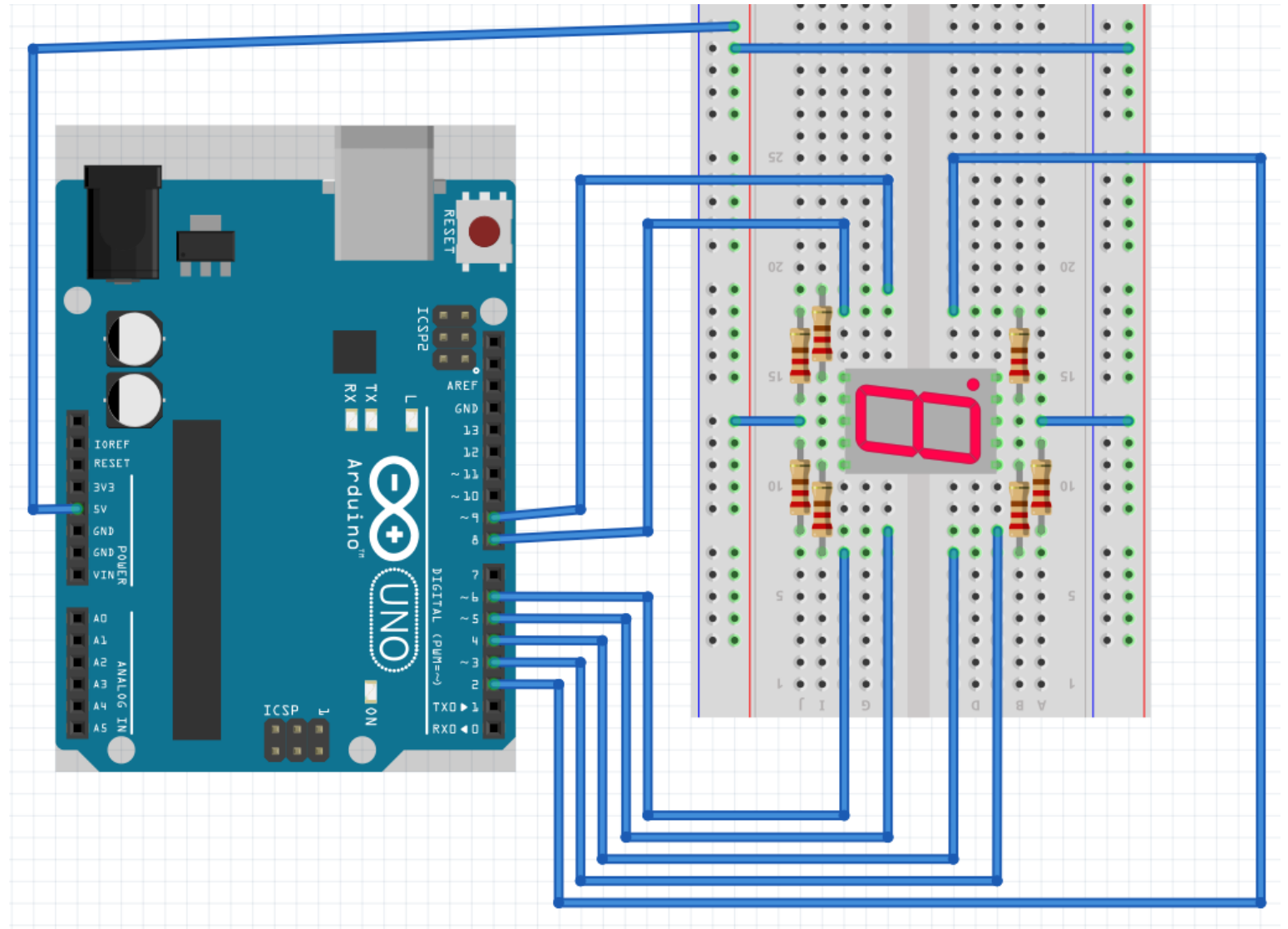


LED를 이용한 포트 제어 실험

• 7-segment 실험

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

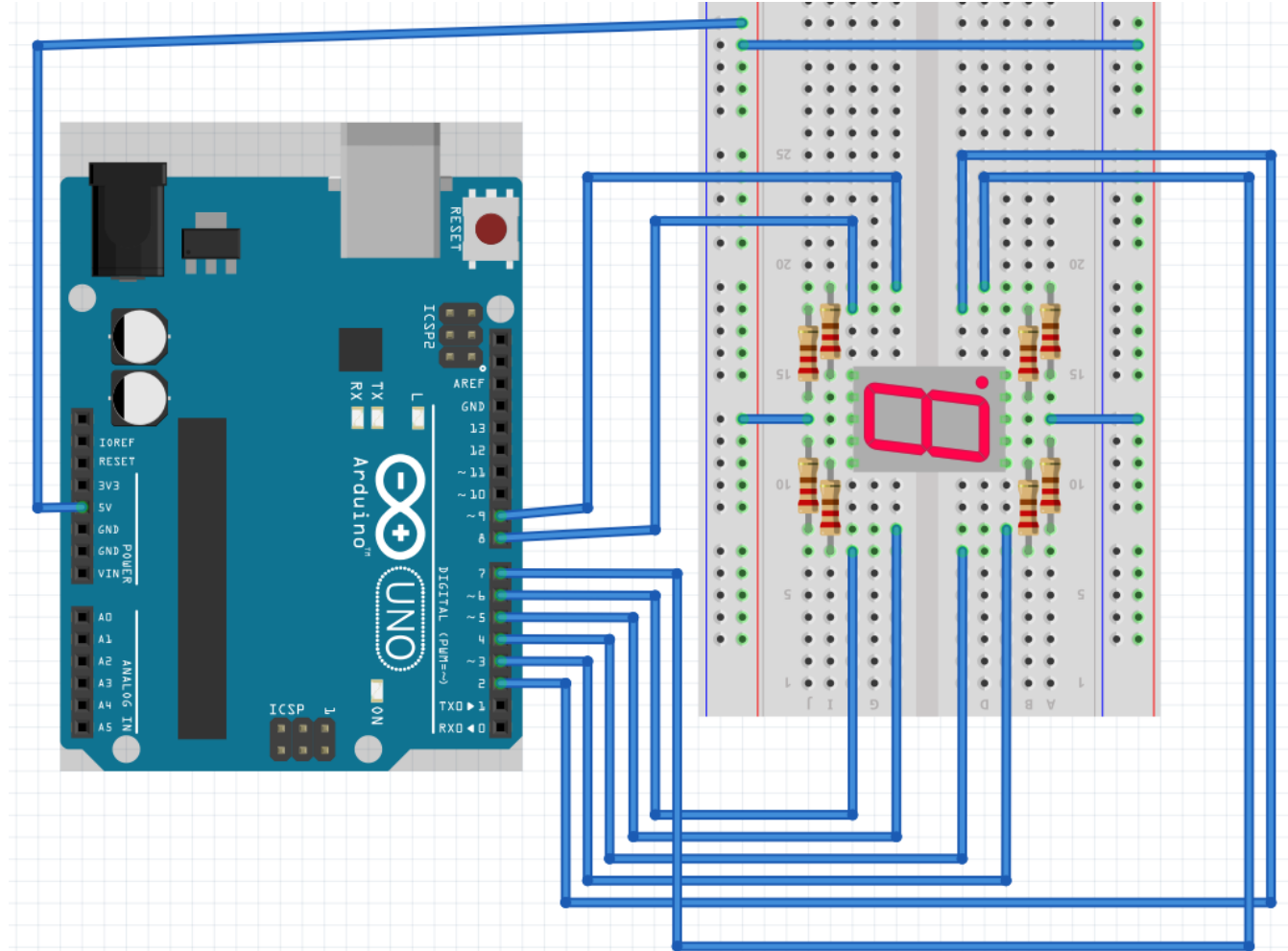
```
void loop() {  
  PORTB = B00000000 ;  
  PORTD = B00000000 ;  
  delay(1000) ;  
  
  PORTB = B00000011 ;  
  PORTD = B01111100 ;  
  
  delay(1000);  
}
```



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

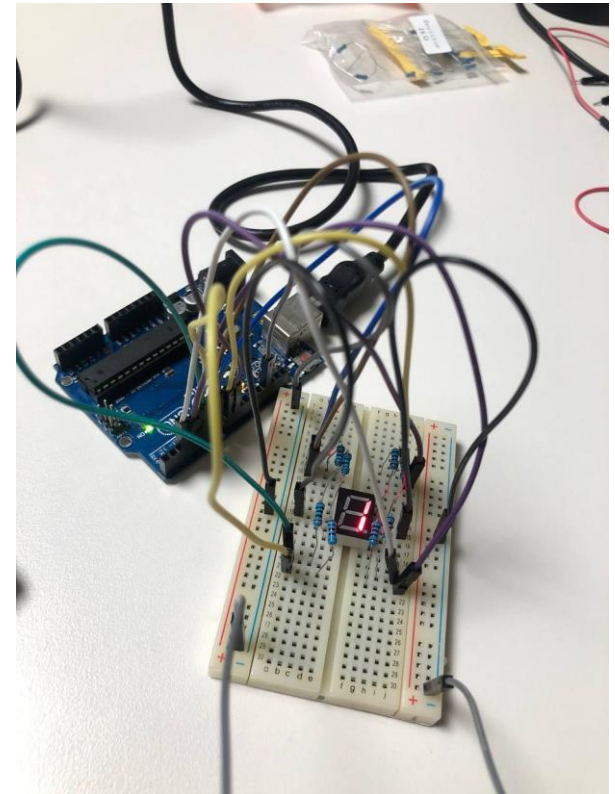
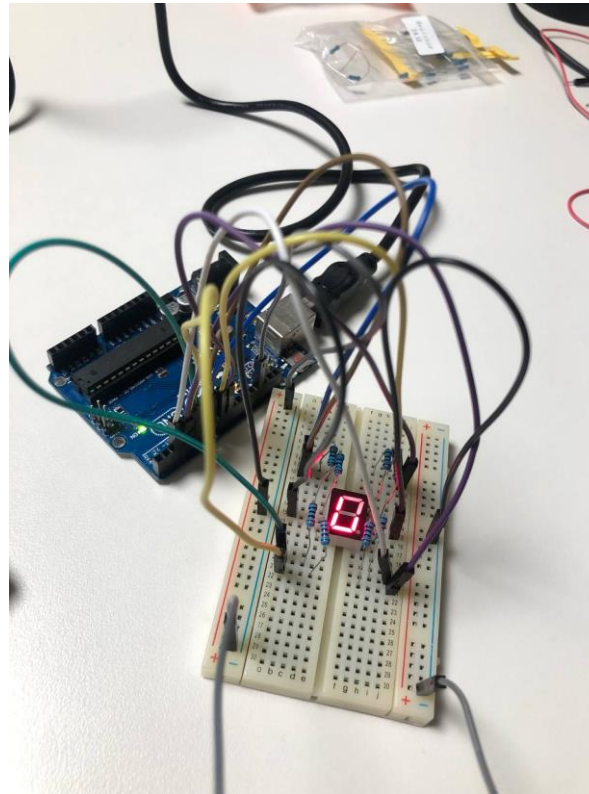
- 예제18 (숫자0 → 숫자1 반복)

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

  PORTD = B00000000 ;
  PORTB = B00000000 ;
}

void loop()
{
  PORTB = B[ ] ;
  PORTD = B[ ] ;
  delay(1000) ;

  PORTB = B[ ] ;
  PORTD = B[ ] ;
  delay(1000) ;
}
```



LED를 이용한 포트 제어 실험

• 예제 19

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

  Serial.begin(9600) ;
}

void loop()
{
  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 ;
    }
  }
}
```

