입출력(IO) 포트 실험
LED 컨트롤 실험

마이크로프로세서 종합 설계

"수업자료는 여기"

IO 포트 관련 레지스터

- Port

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)
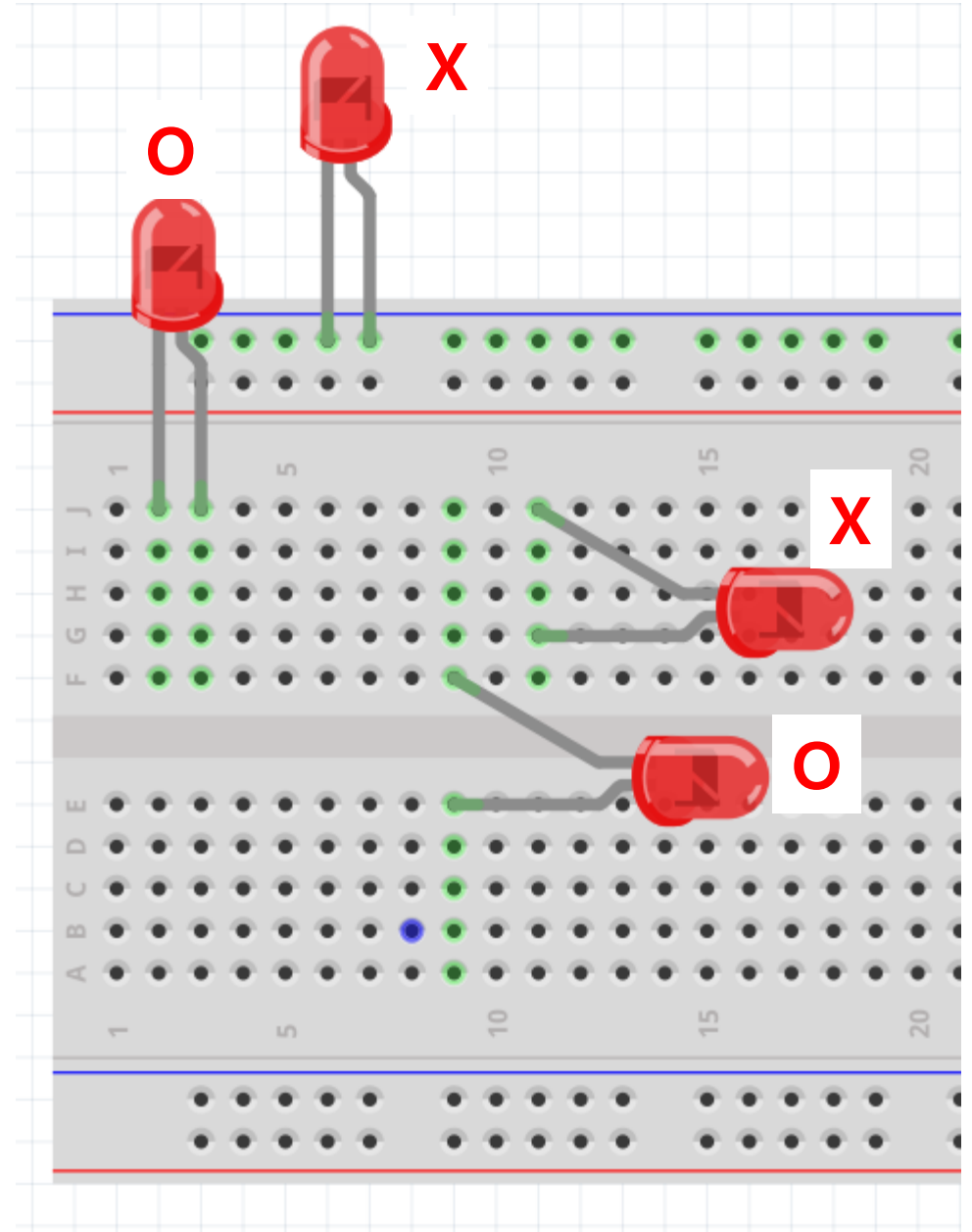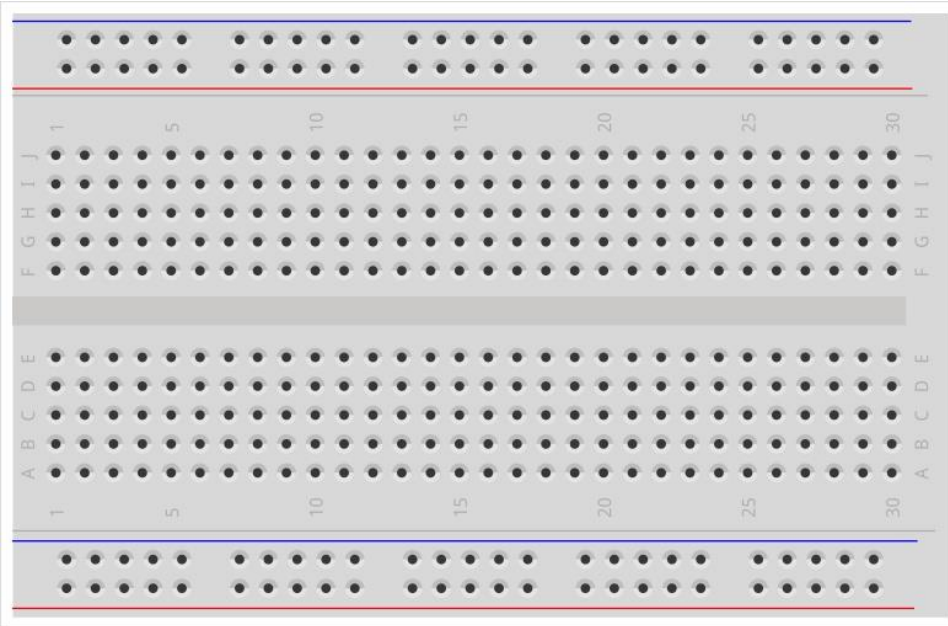
LED를 이용한 포트 제어 실험

- 4개의 LED를 연결해서 포트를 제어 해보자.
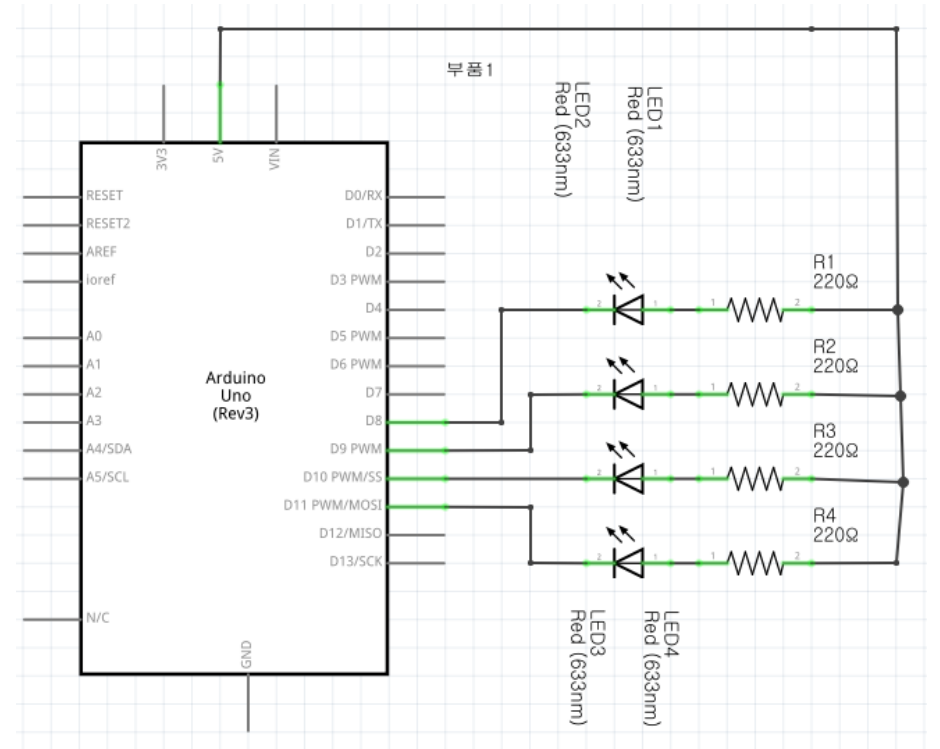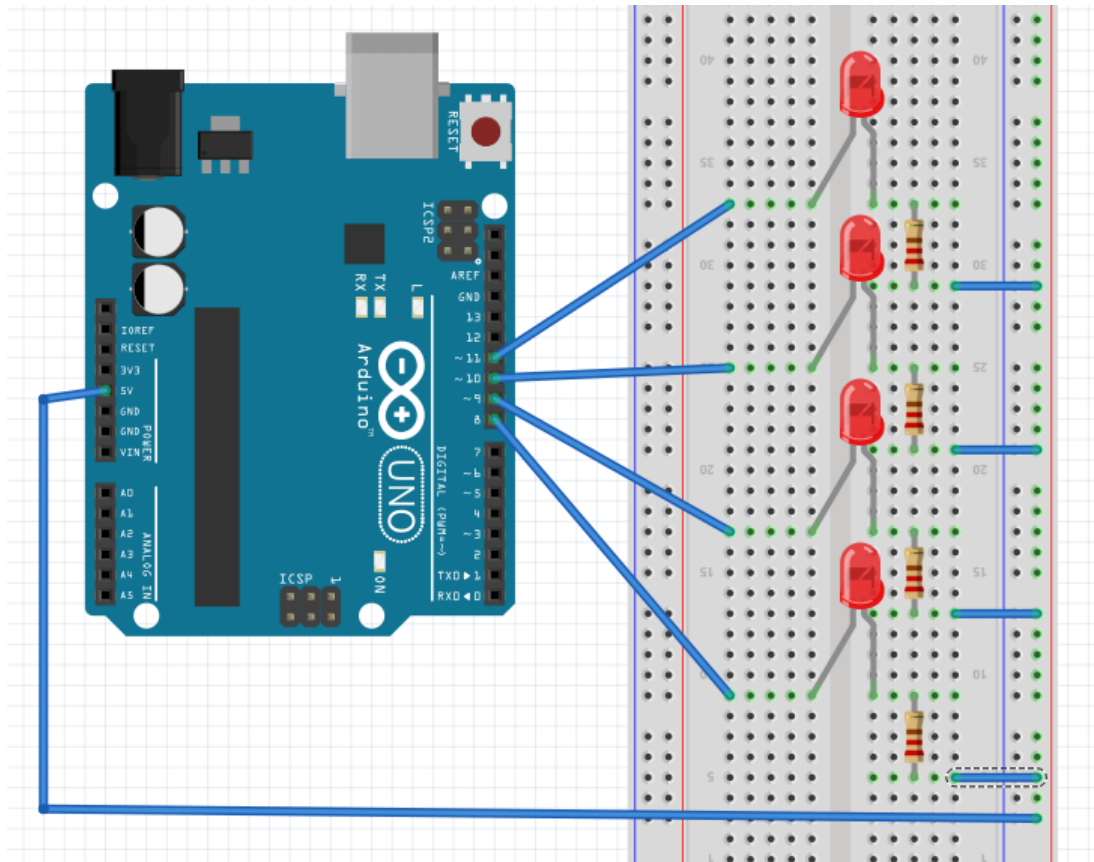
LED를 이용한 포트 제어 실험

- 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) ;
}
```
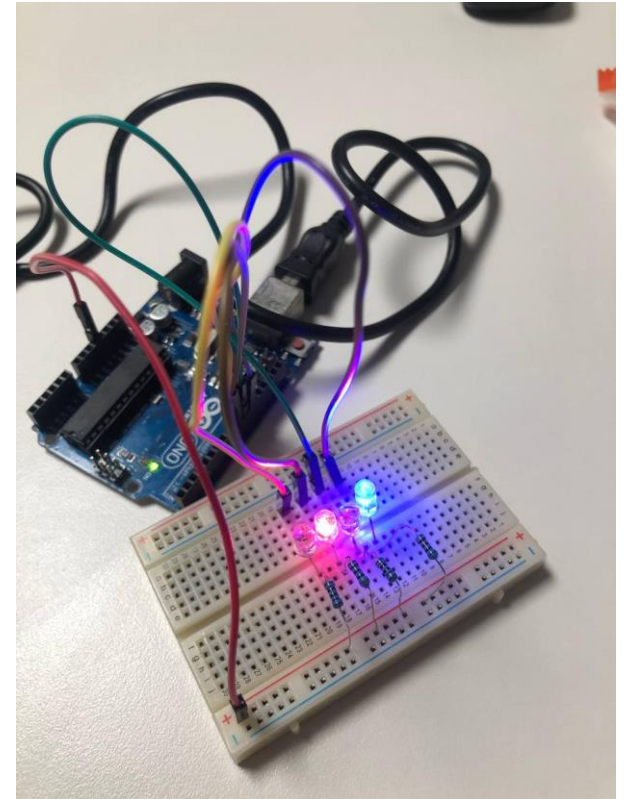
LED를 이용한 포트 제어 실험

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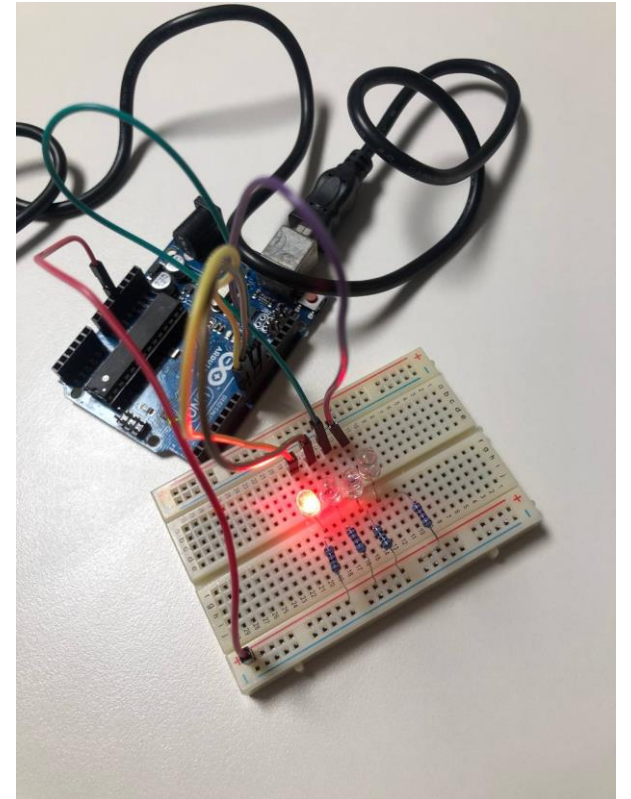
```
void setup() {
  DDRB = B00001111 ;
  PORTB = B00000000 ;


}


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

common-anode type

common-cathode type

LED를 이용한 포트 제어 실험

- 7-segment 실험

g f Vcc a b

a
f b
g
e c
d

e d Vcc c dp

Vcc

a b c d e f g dp

common-anode type

g f Gnd a b

a
f b
g
e c
d

e d Gnd c dp

Gnd

a b c d e f g dp

common-cathode type

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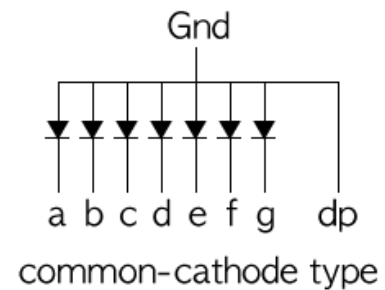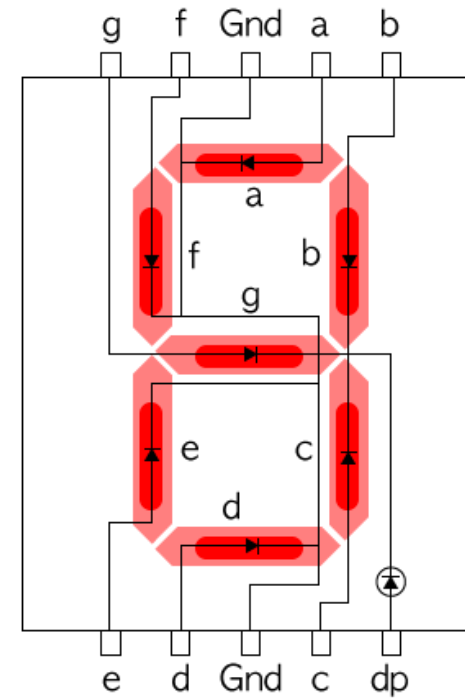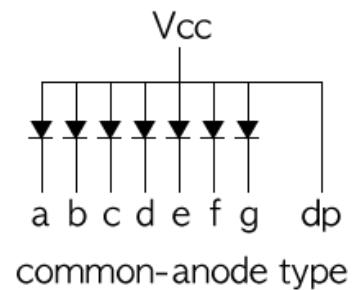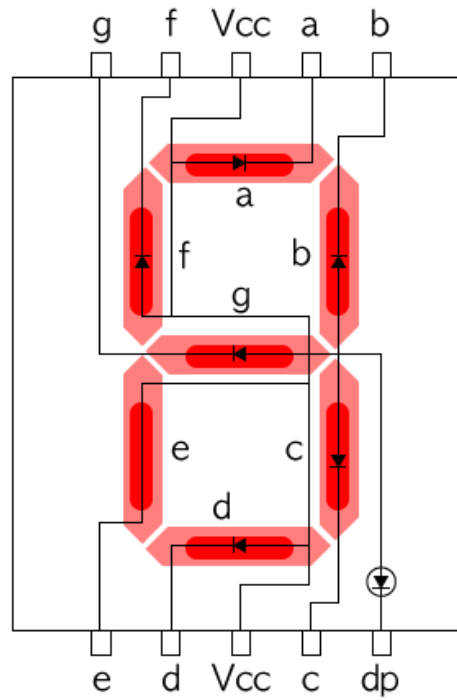
8 = a(0) b(0) c(0) d(0) e(0) f(0) g(0) DP(1)

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

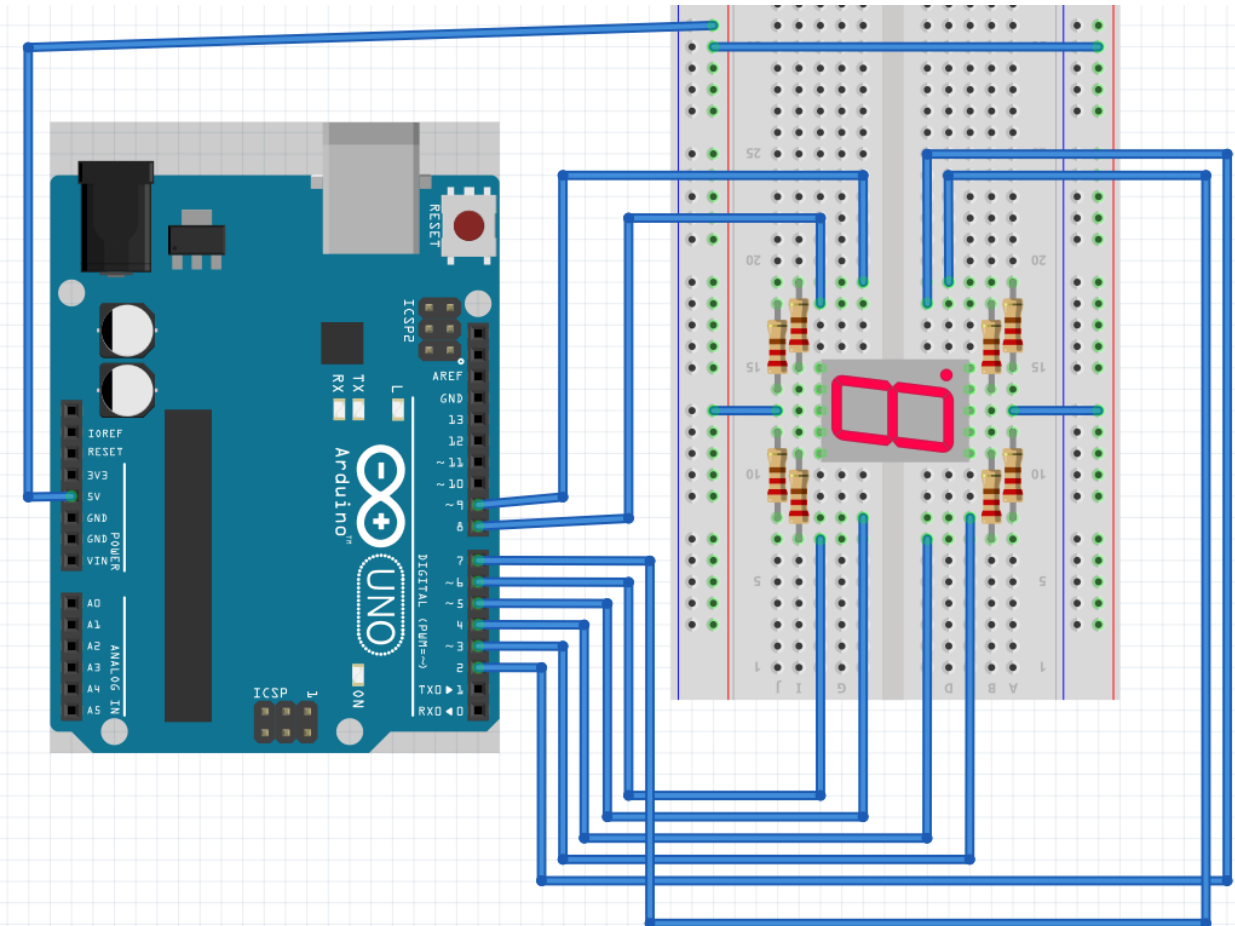| a	→	PB0
b	→	PB1
c	→	PD2
d	→	PD3
e	→	PD4
f	→	PD5
g	→	PD6
DP	→	PD7

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)

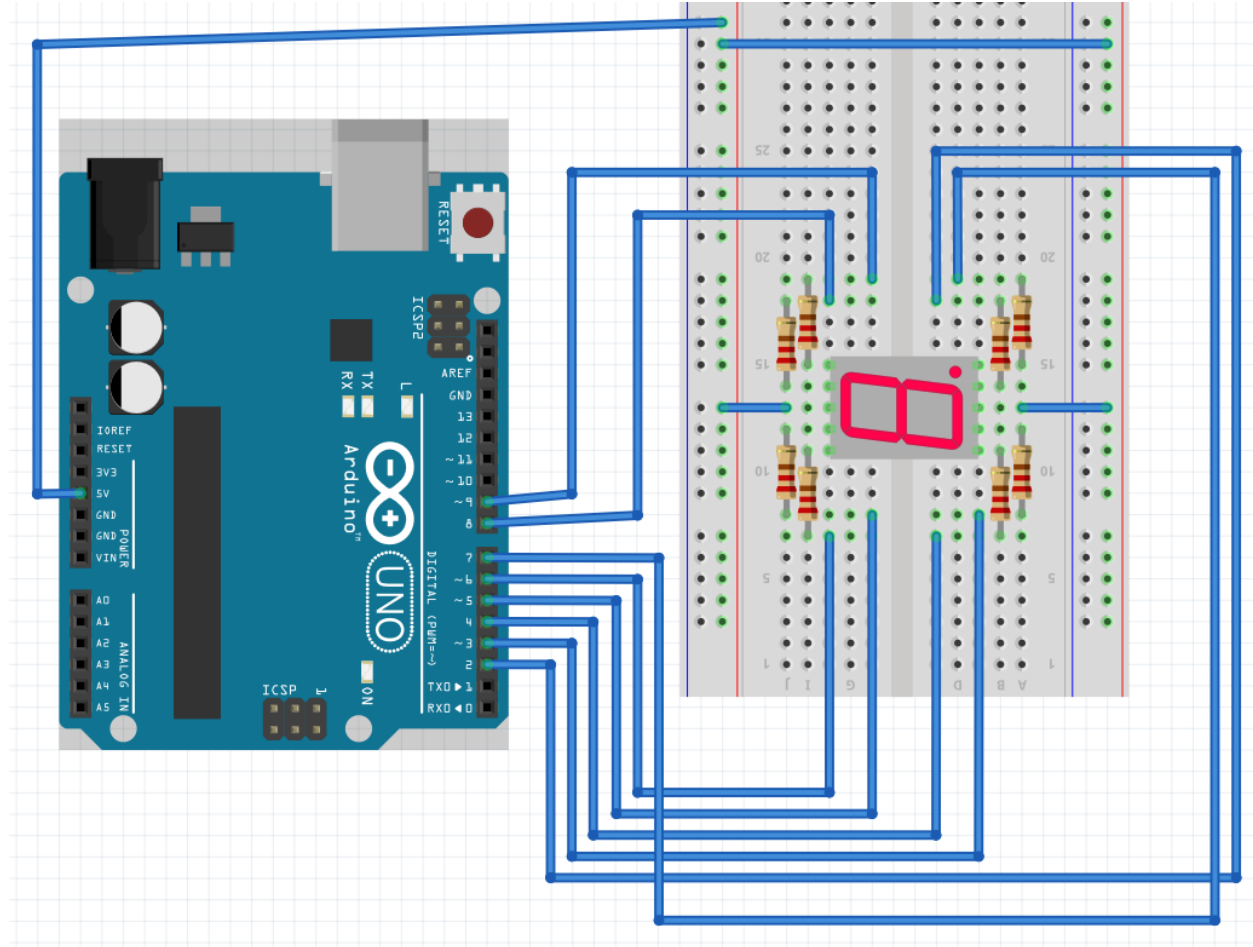8 = a(0) b(0) c(0) d(0) e(0) f(0) g(0) DP(1)

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

. = DP(0)

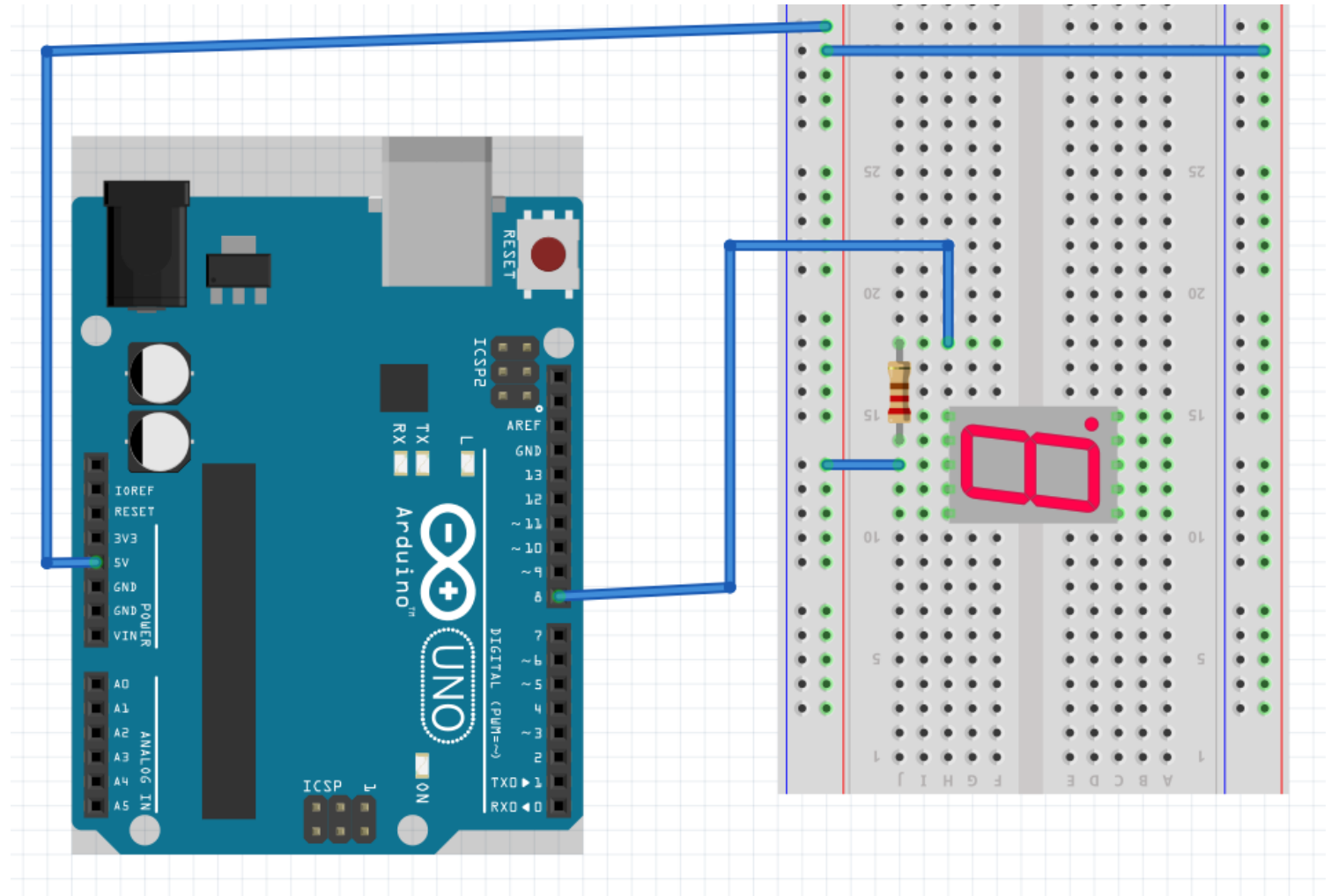|		a	b	c	d	e	f	g	DP
		PB0	PB1	PD2	PD3	PD4	PD5	PD6	PD7
0	→	0	0	0	0	0	0	1	1
1	→	1	0	0	1	1	1	1	1
2	→	0	0	1	0	0	1	0	1
3	→	0	0	0	0	1	1	0	1
4	→	1	0	0	1	1	0	0	1
5	→	0	1	0	0	1	0	0	1
6	→	0	1	0	0	0	0	0	1
7	→	0	0	0	1	1	0	1	1
0	→	0	0	0	0	0	0	0	1
9	→	0	0	0	0	1	0	0	1

LED를 이용한 포트 제어 실험

- 7-segment 실험

LED를 이용한 포트 제어 실험

- 7-segment 실험

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

void loop() {
 PORTB = B00000000 ;
}
```
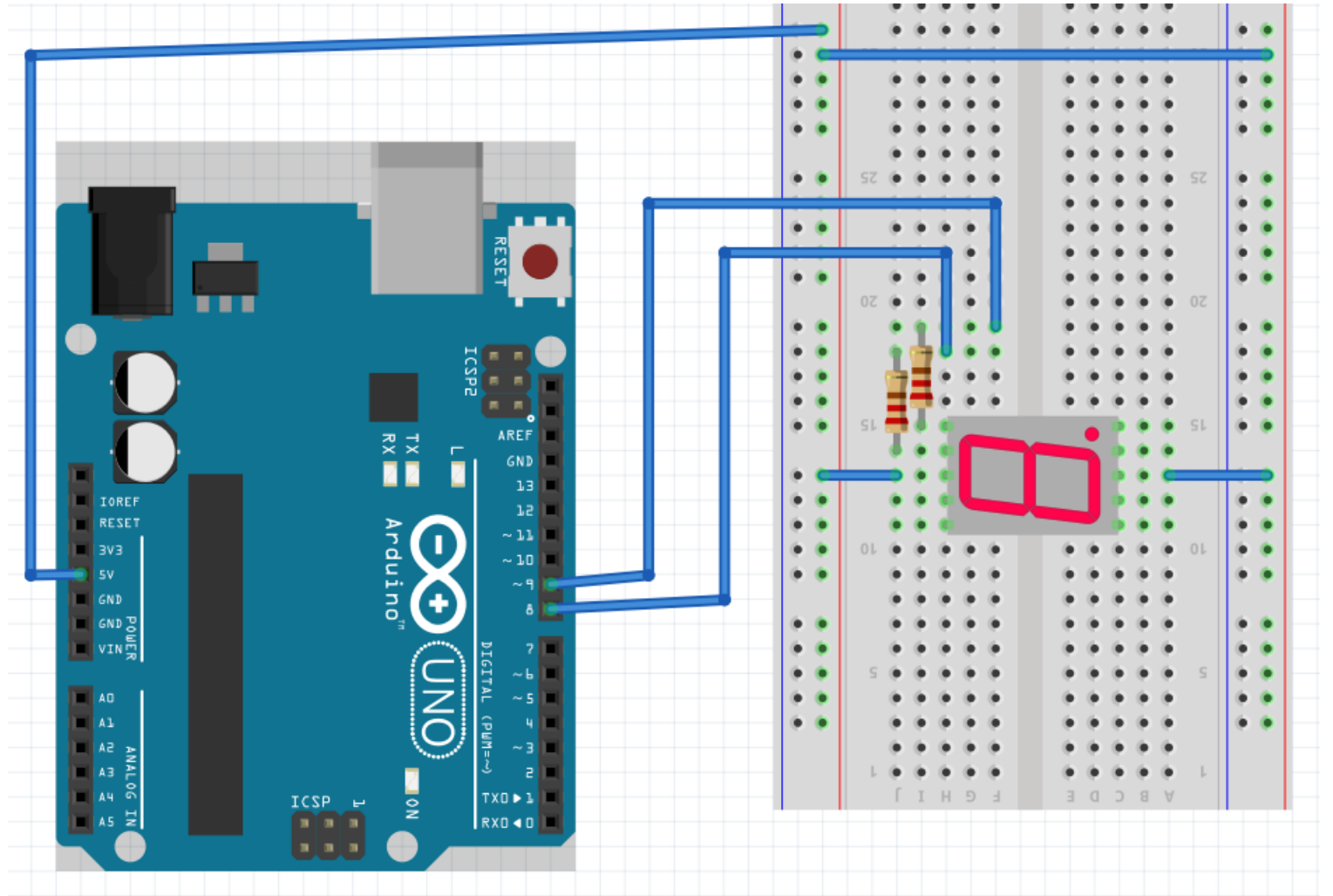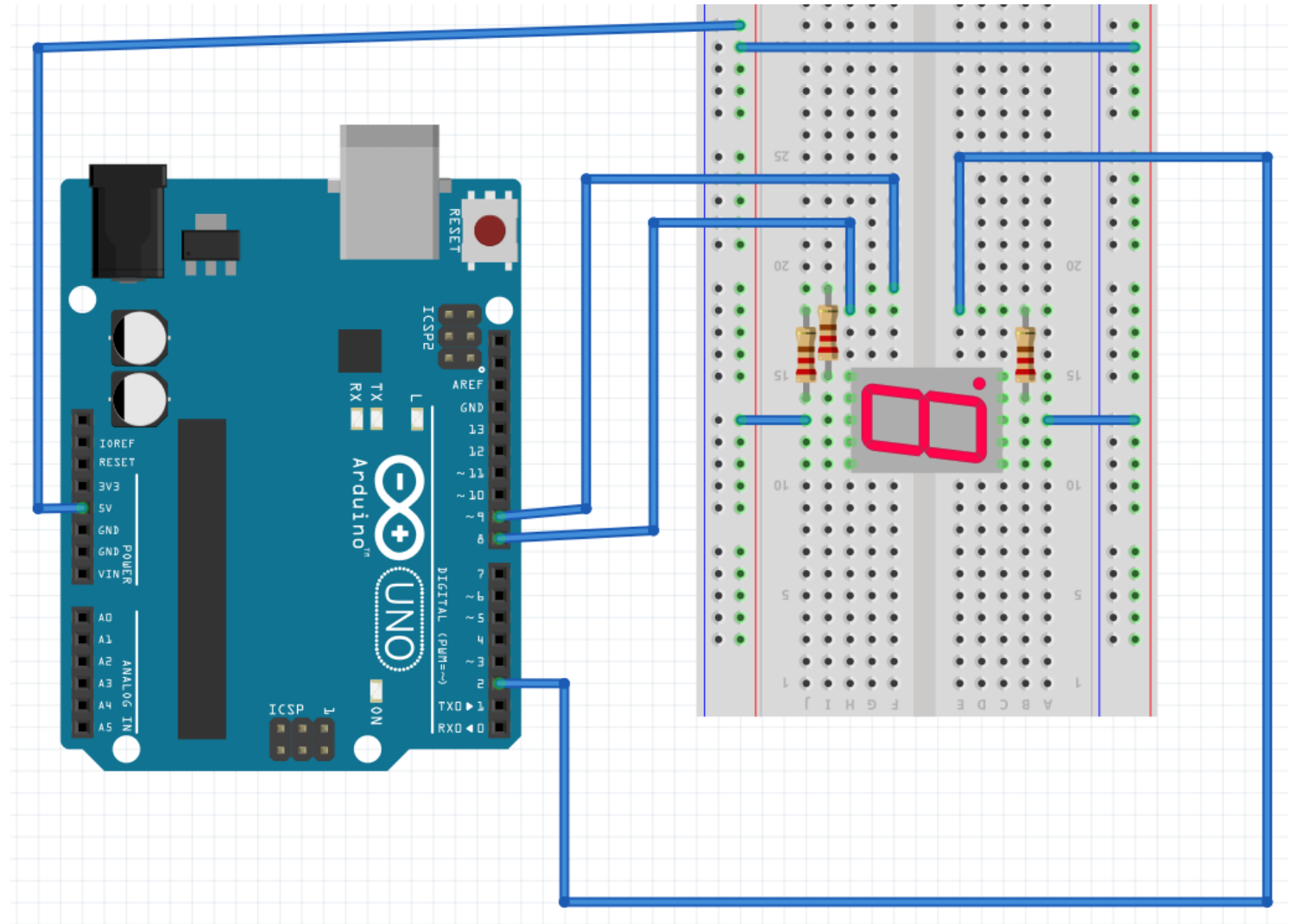
LED를 이용한 포트 제어 실험

• 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 ;
}
```

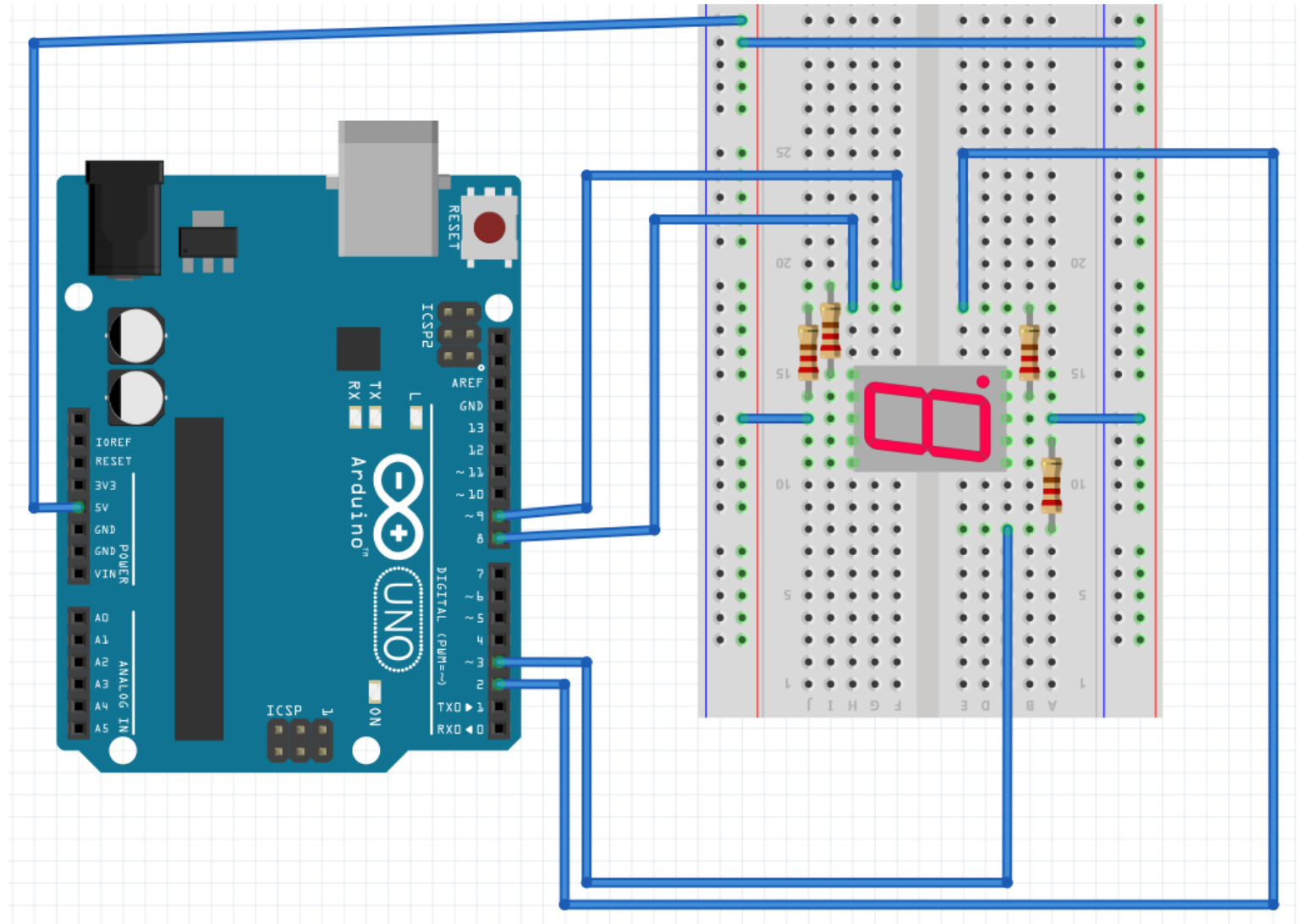# LED를 이용한 포트 제어 실험

- 7-segment 실험

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

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

LED를 이용한 포트 제어 실험

- 7-segment 실험
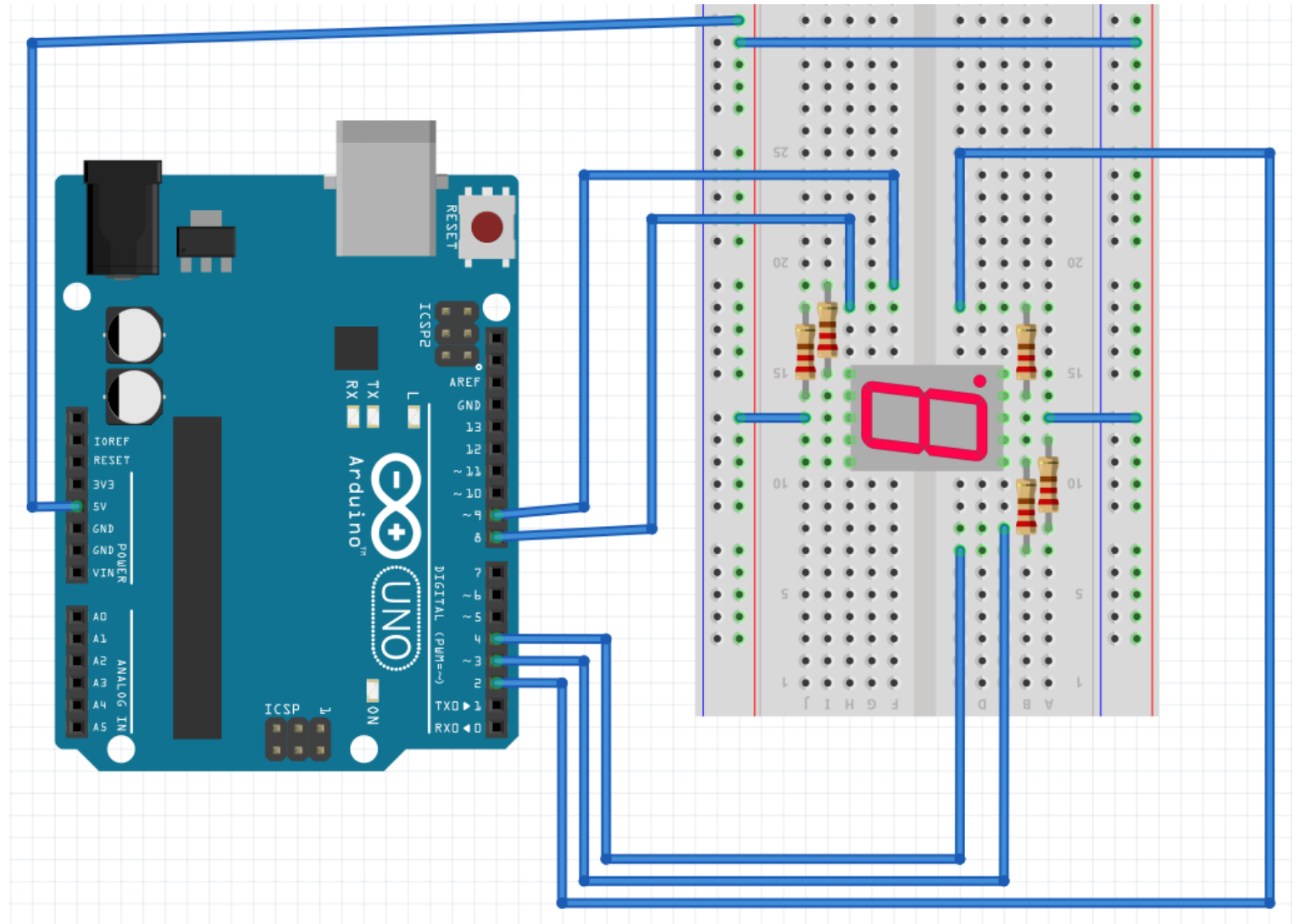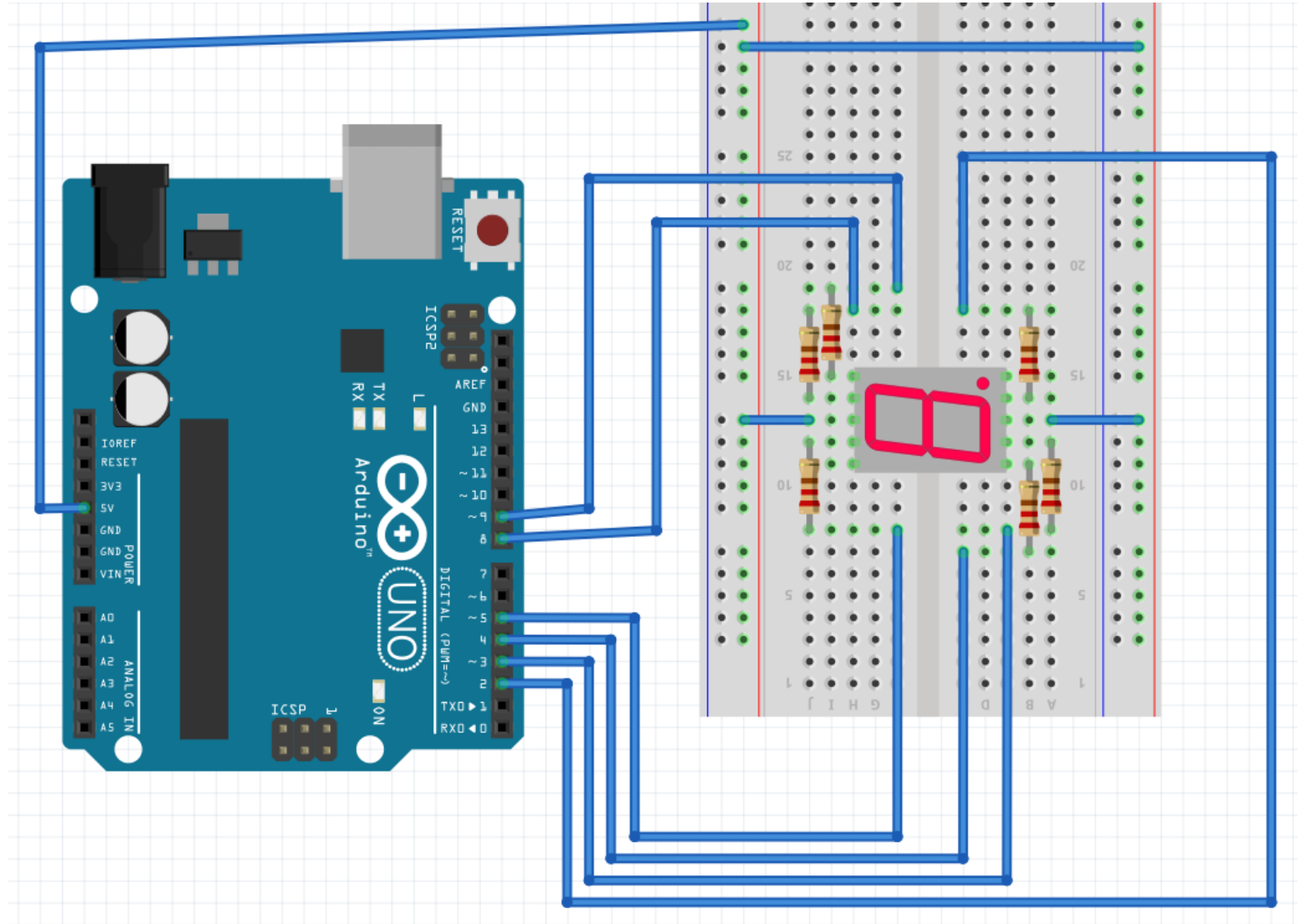
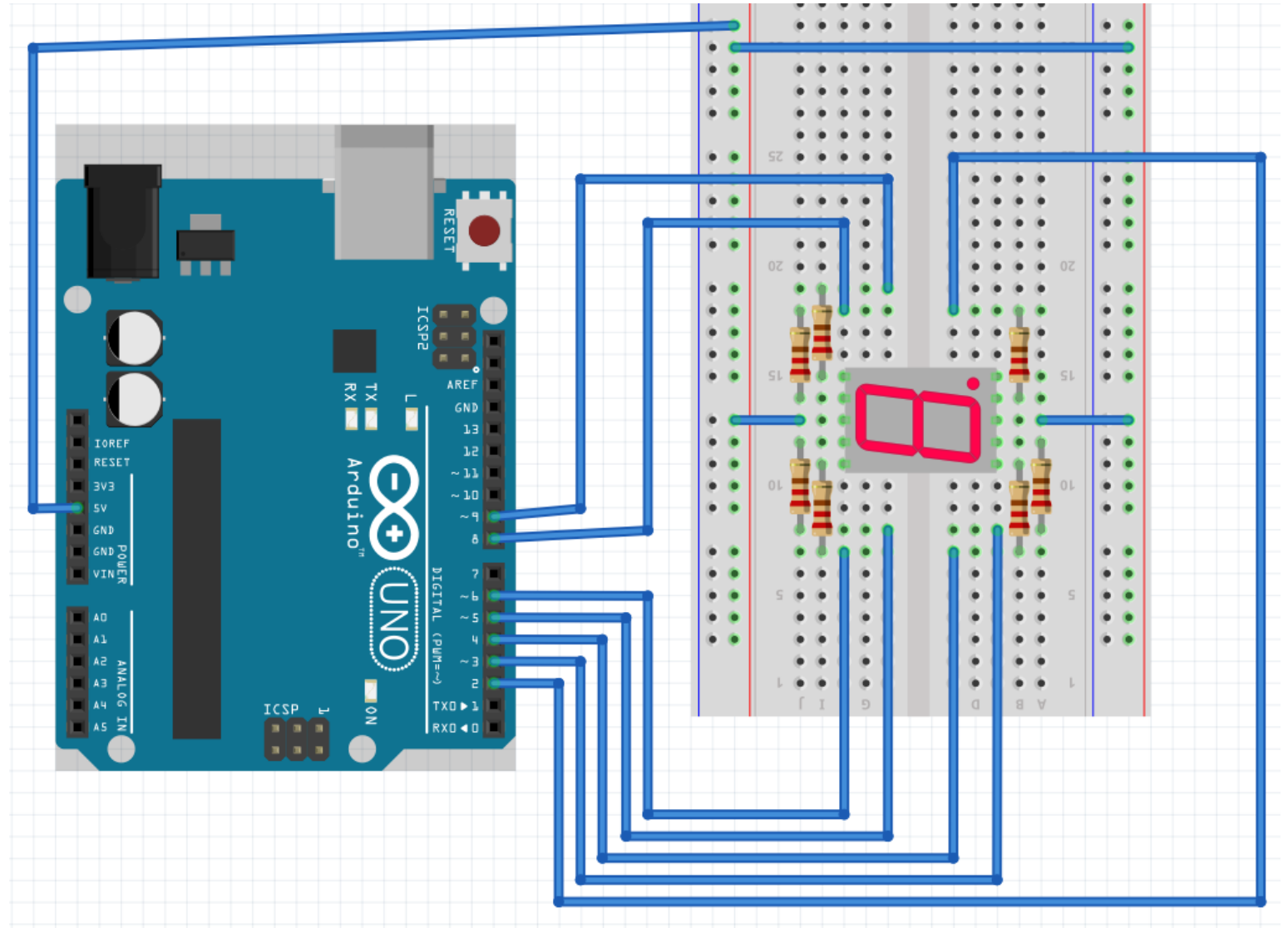```
void setup() {
  DDRB = B00000011 ;
  DDRD = B00111100 ;
}

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

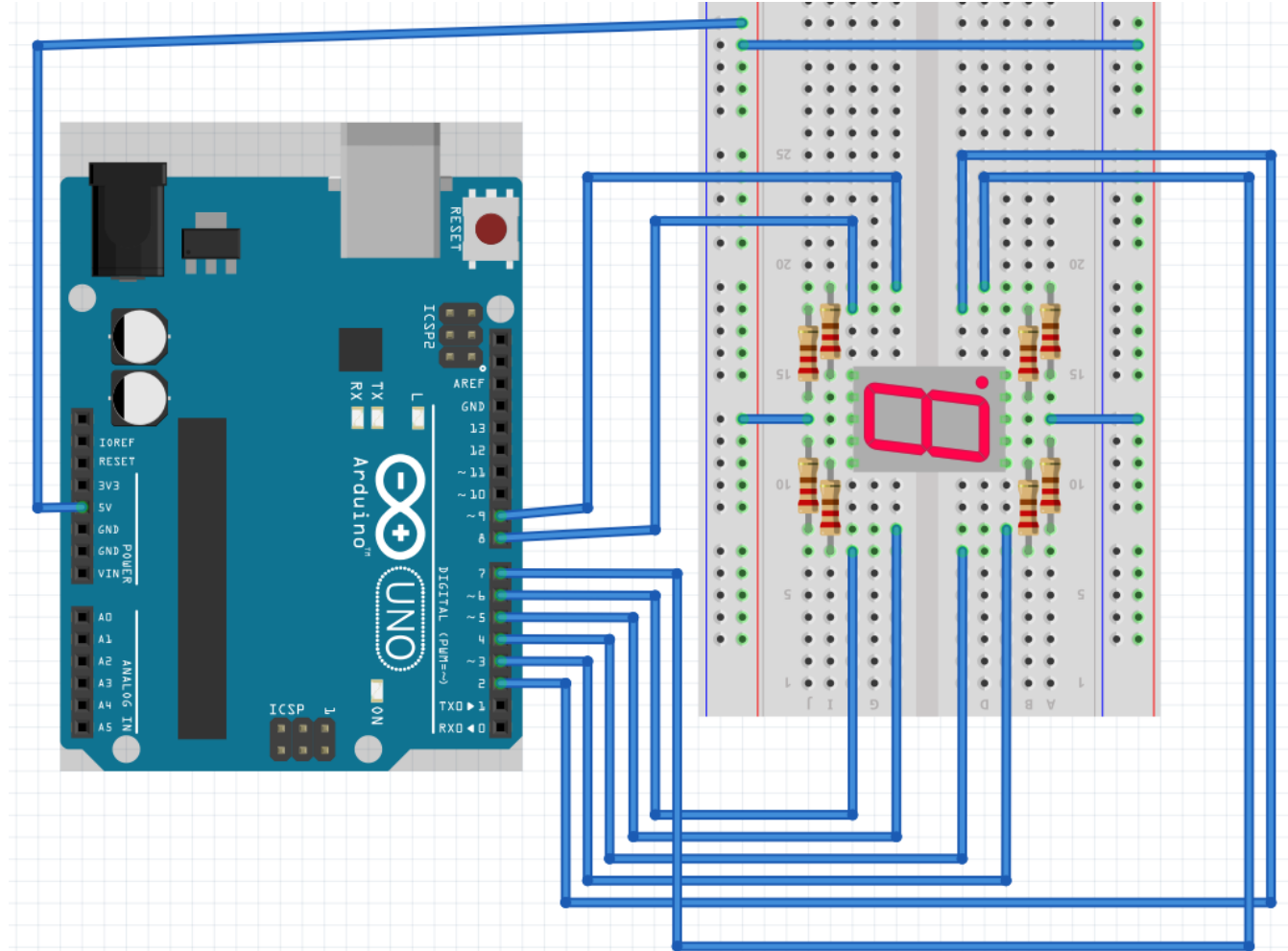- 7-segment 실험

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

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

  PORTB = B00000011 ;
  PORTD = B11111100 ;

  delay(1000);
}
```
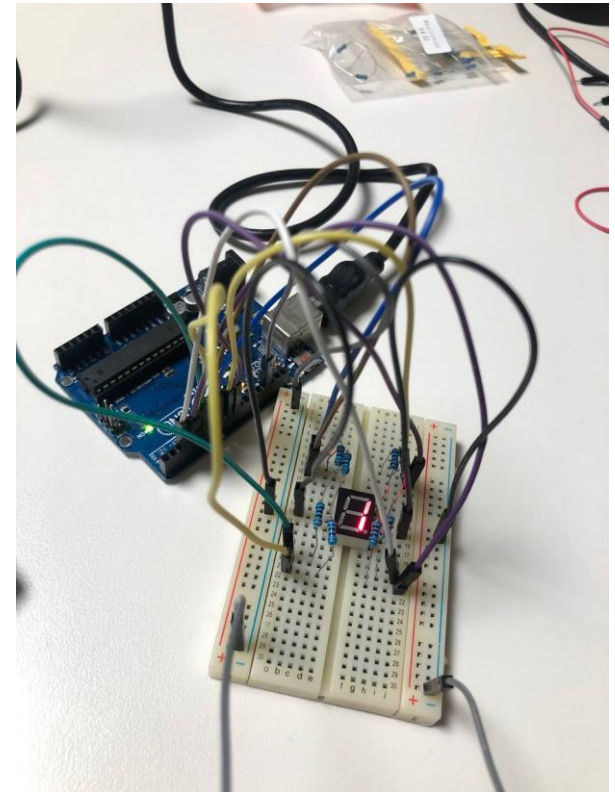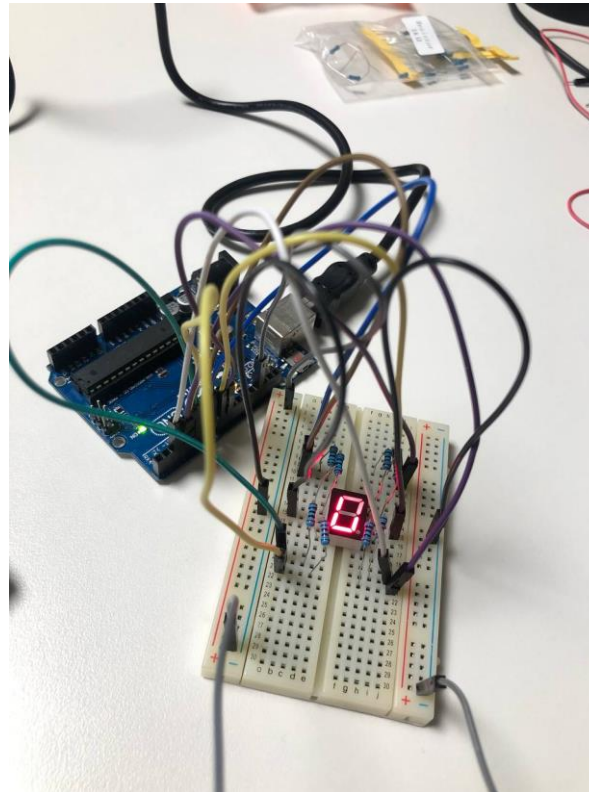
LED를 이용한 포트 제어 실험

- 예제18

```
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 ;
    }
  }
}
```