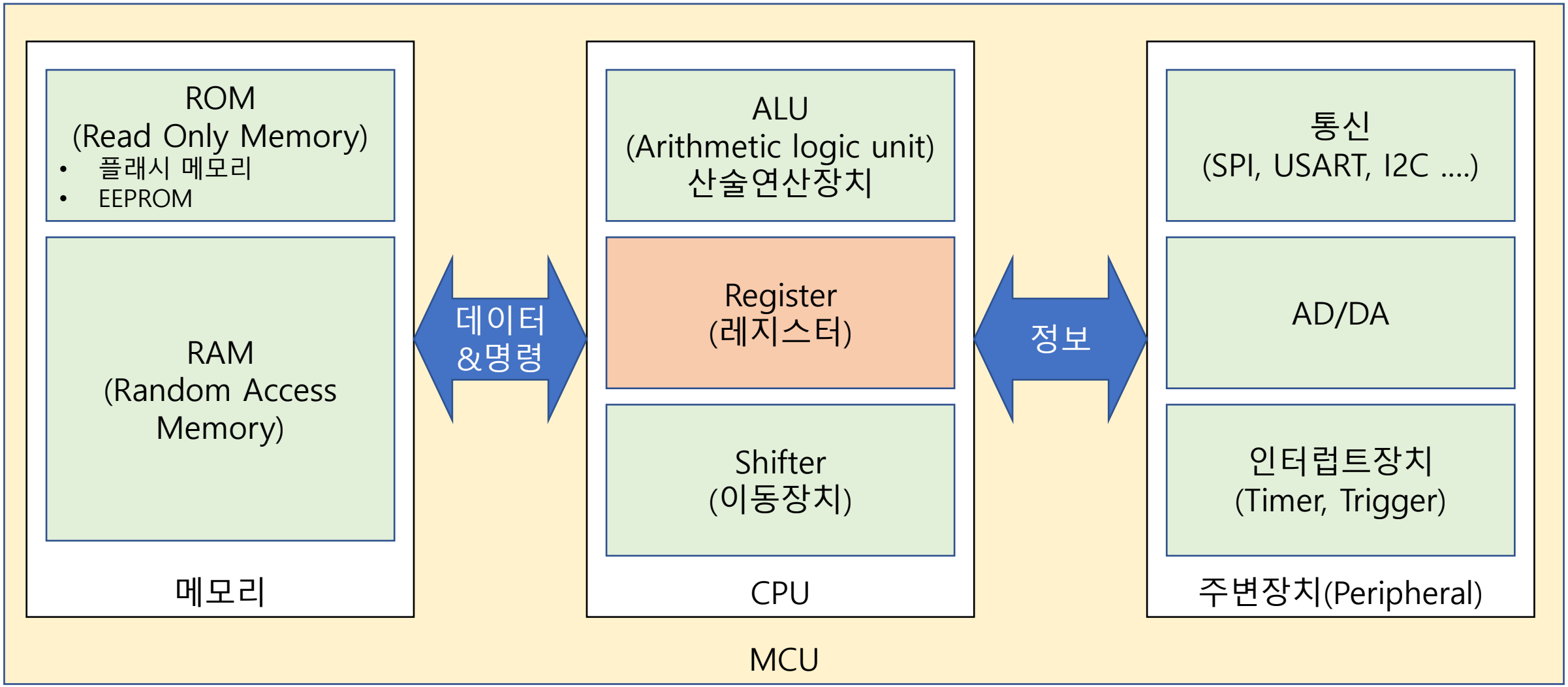
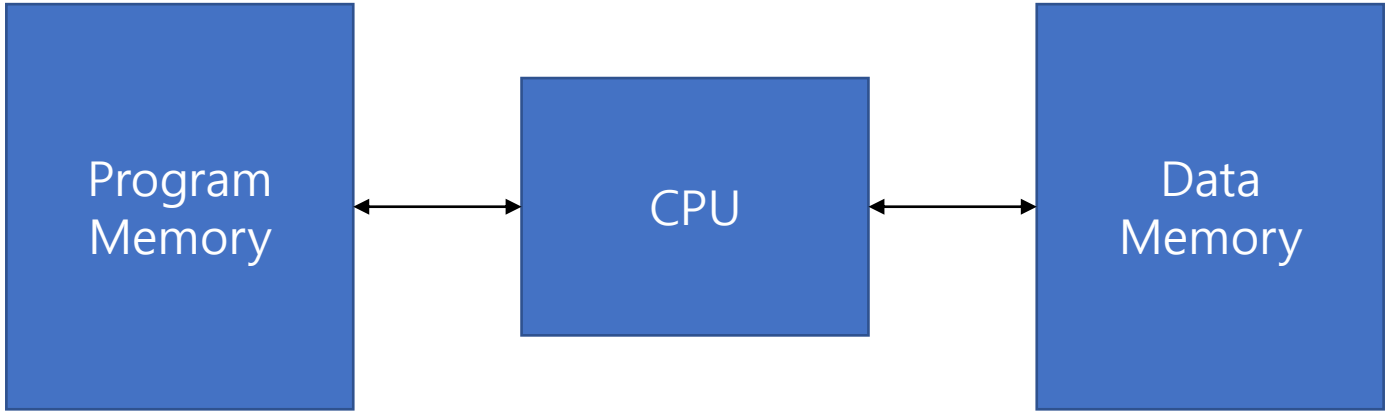
레지스터와 포트의 이해 그리고 C언어

마이크로프로세서 종합 설계. 3주차.

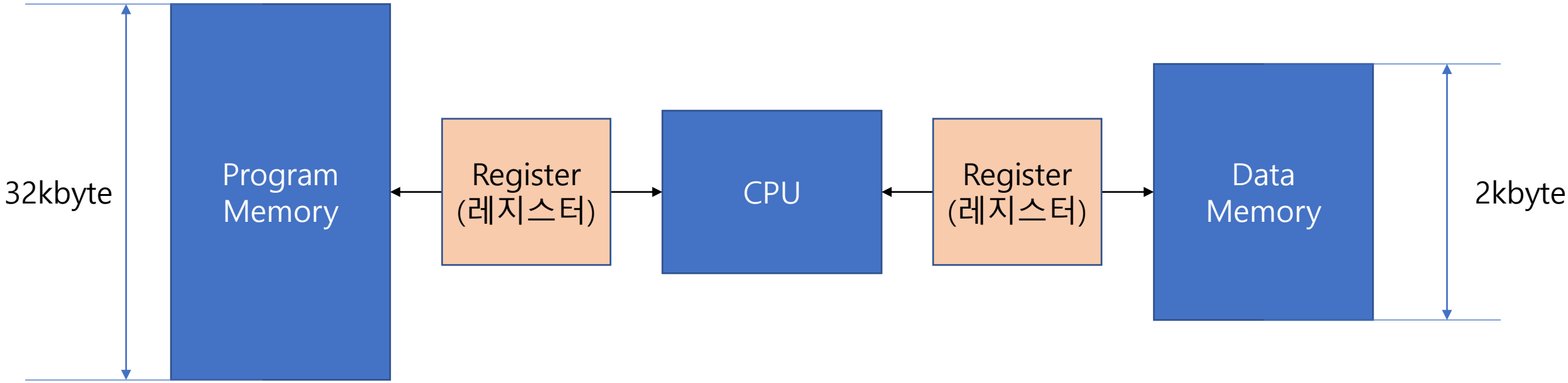
마이크로프로세서의 기본 구성



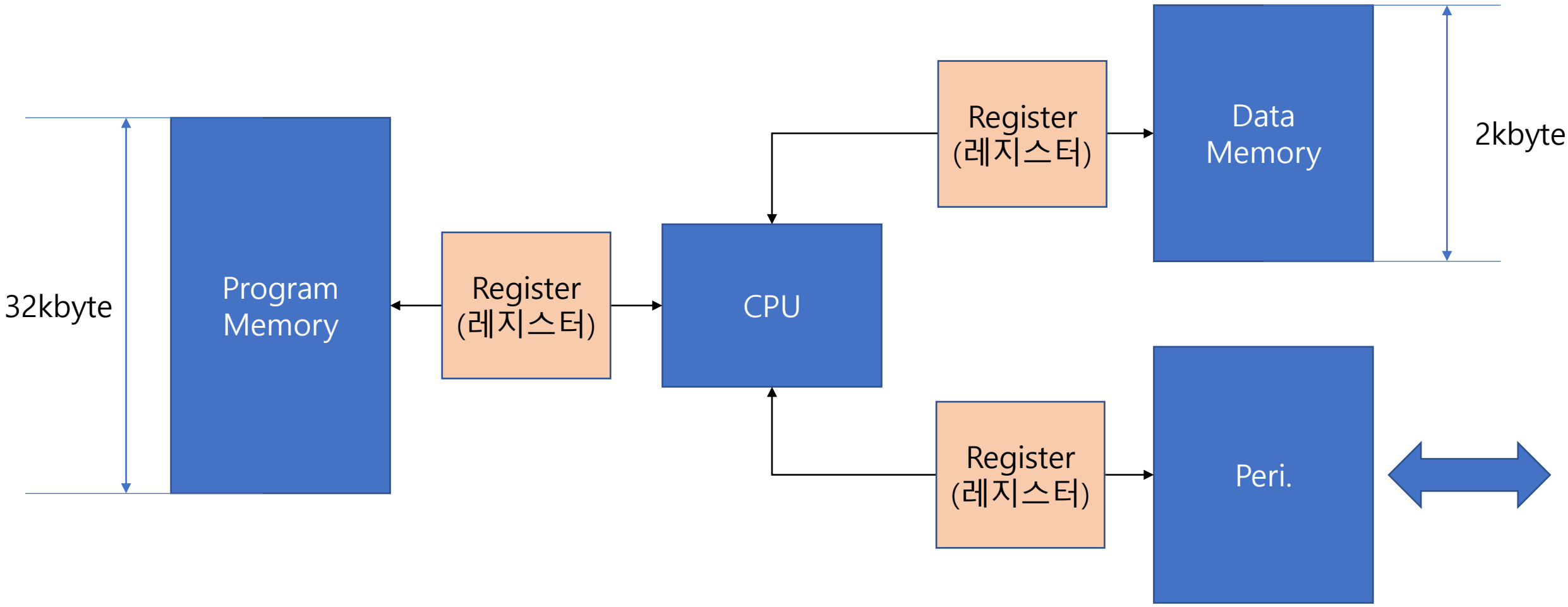
하버드 구조(Harvard architecture)



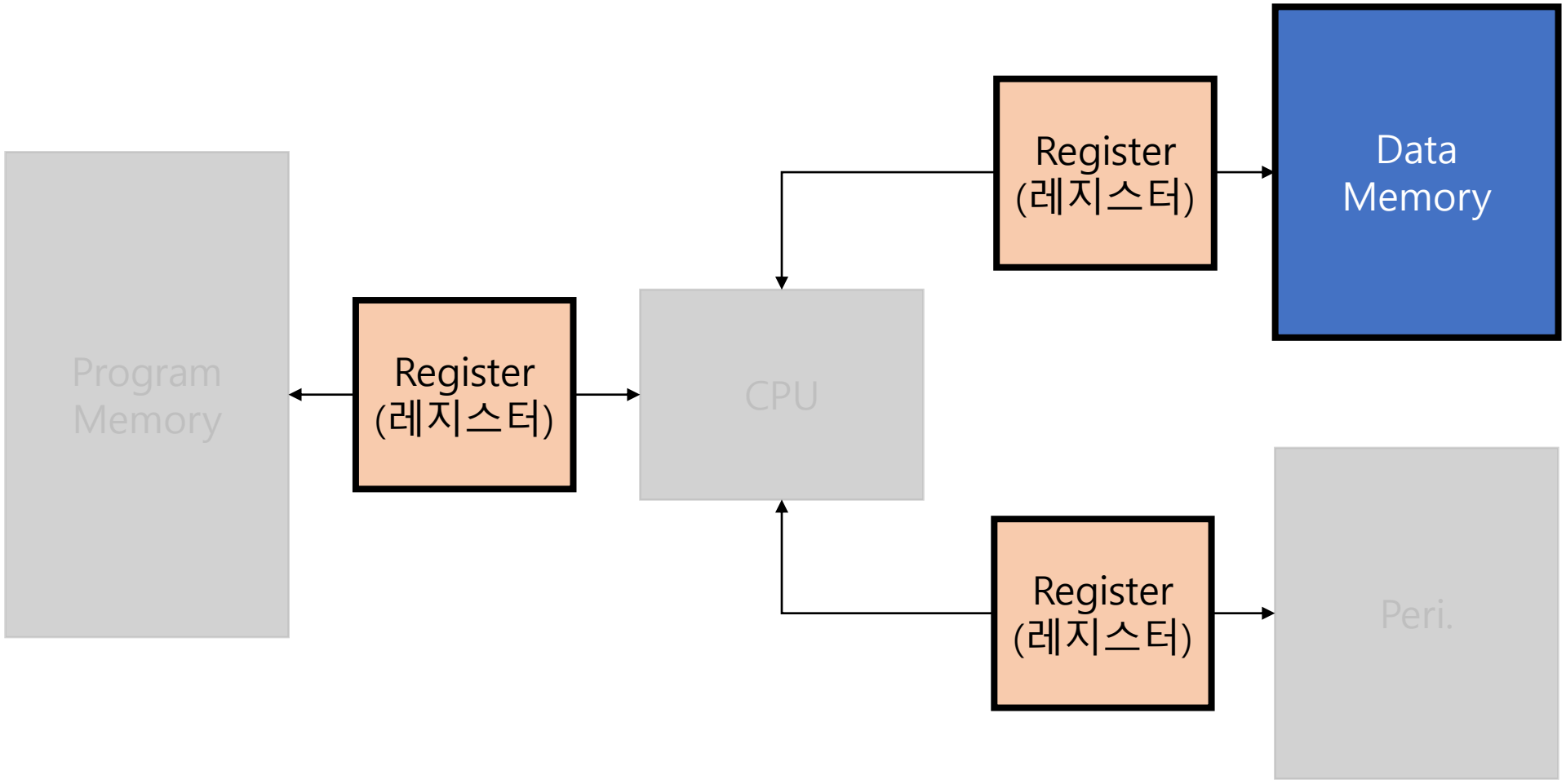
Atmega328p의 메모리



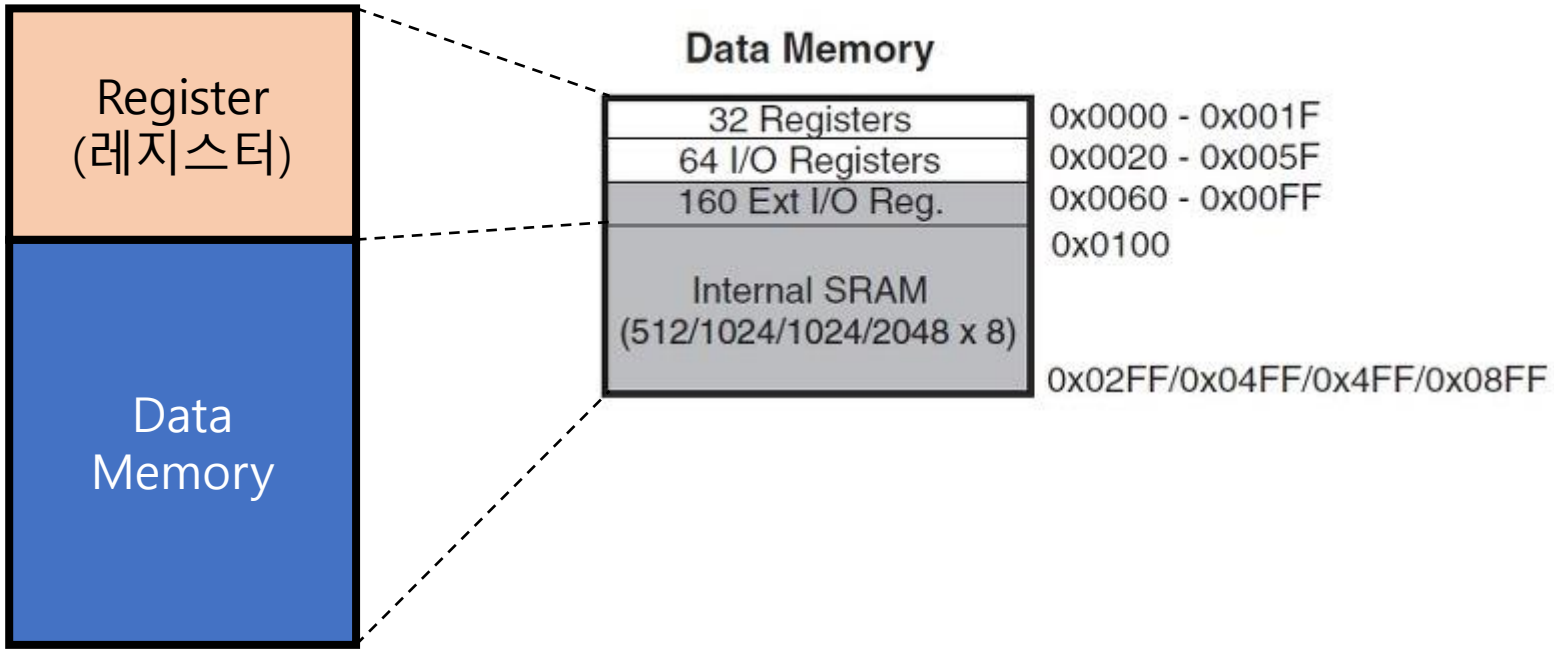
Atmega328p의 메모리 & 외부장치



Atmega328p의 메모리맵

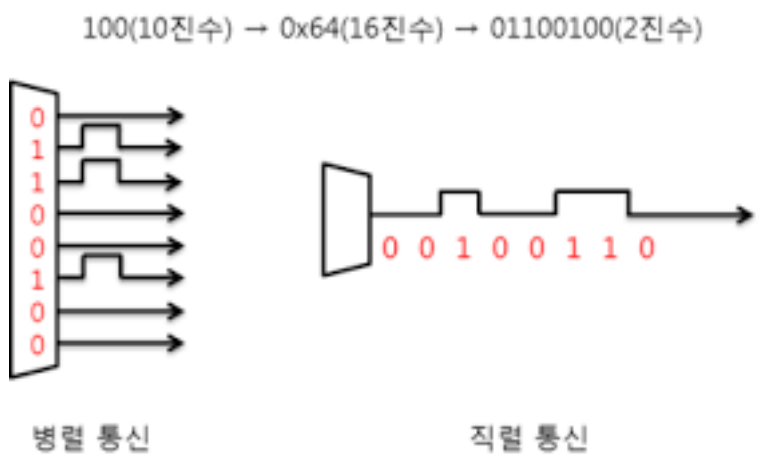


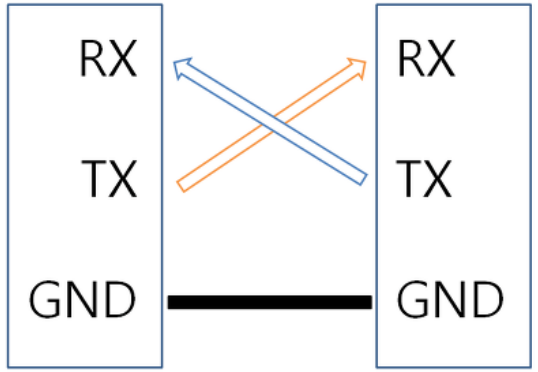
Atmega328p의 메모리맵



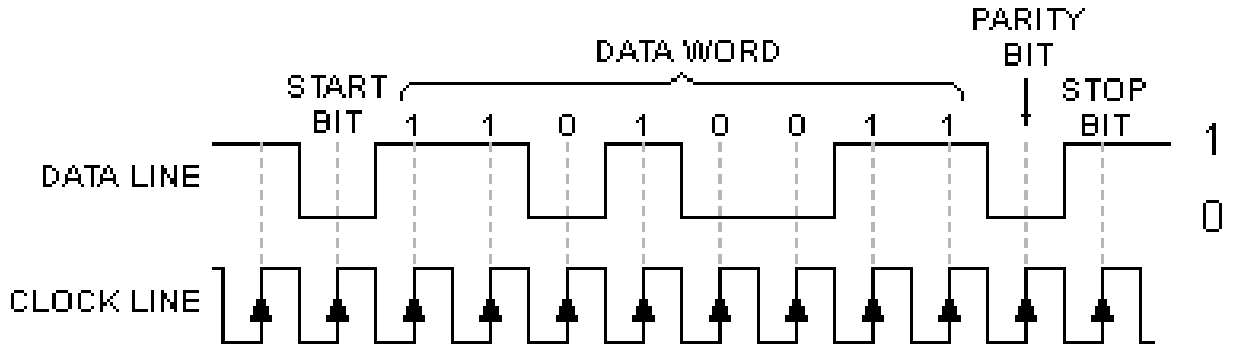
데이타시트 : https://ww1.microchip.com/downloads/en/DeviceDoc/Atmel-7810-Automotive-Microcontrollers-ATmega328P_Datasheet.pdf
30. Register Summary, 275 page 참고

마이크로프로세서와 C언어 - 시리얼통신





직렬통신의 연결



동기/비동기 통신

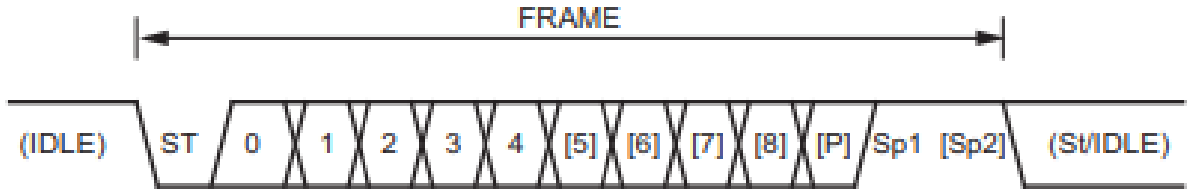
마이크로프로세서와 C언어 - 시리얼통신

- **비동기식 시리얼 통신**
  - UART 통신을 이용하기 위해서는 크게 다음의 두 가지 항목을 사전에 정의해줘야 한다.
    - **통신속도 : Baud rate**
      - Baud rate 의 단위는 bps(bits per second) : 1초당 전송하는 bit 수
      - 표준 bps: 1200, 2400, 4800, **9600**, 19200, 38400, 57600, 115200
    - **프레임사이즈 : Size of each frame field**
      - 일반적으로
        - Data bit는 1
        - Bytes site = 8 bits 사이즈로 설정
        - Stop bit는 1 bit
        - Parity bit는 0 bit로 설정
      - 통신을 사용하는 환경에 따라 미리 약속하여 사용

마이크로프로세서와 C언어 - 시리얼통신

- 시리얼통신 데이터 포멧

Figure 19-4. Frame Formats



St	Start bit, always low.
(n)	Data bits (0 to 8).
P	Parity bit. Can be odd or even.
Sp	Stop bit, always high.
IDLE	No transfers on the communication line (RxDn or TxDn). An IDLE line must be high.

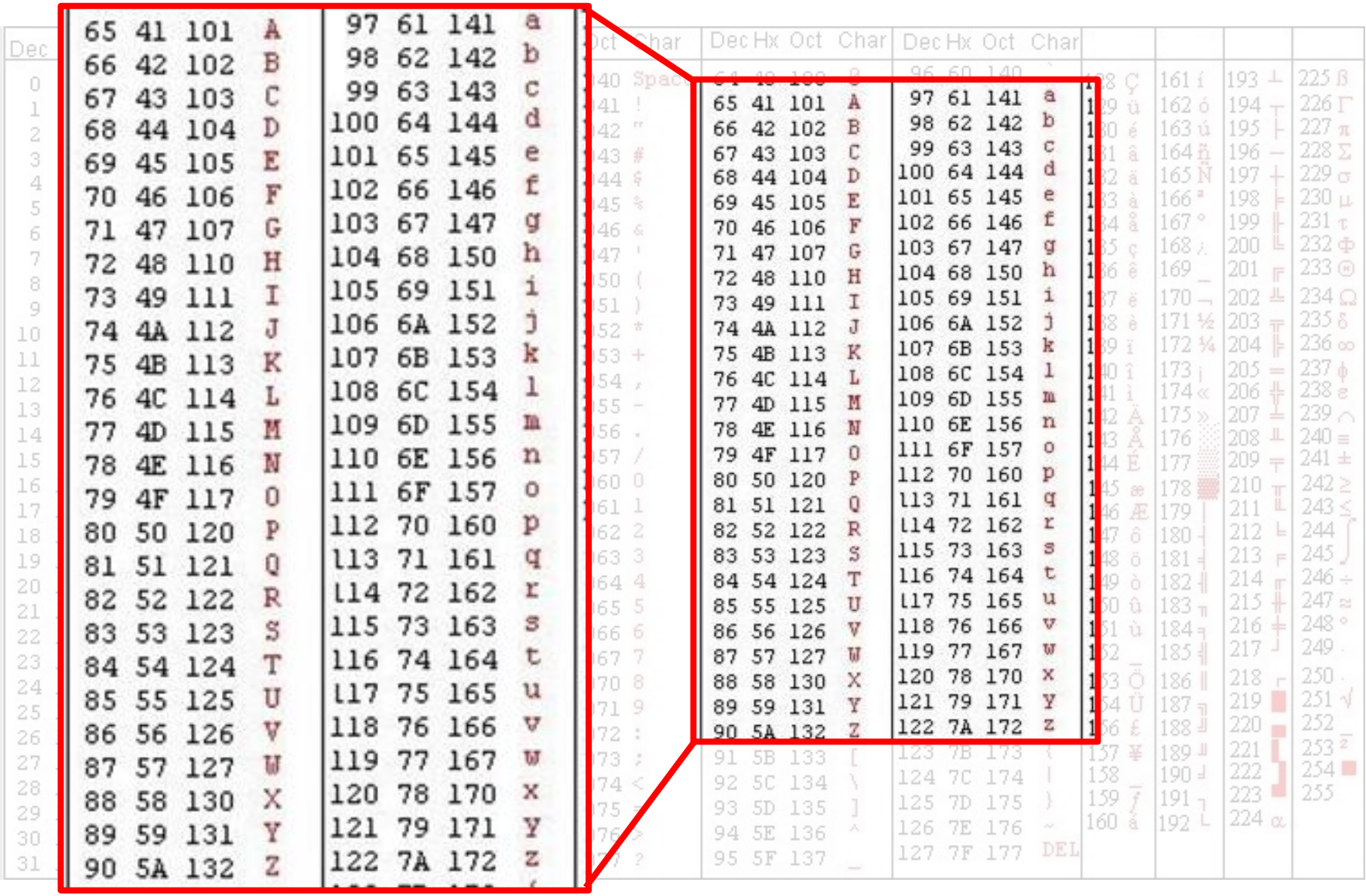
참고 : 데이타시트 https://ww1.microchip.com/downloads/en/DeviceDoc/Atmel-7810-Automotive-Microcontrollers-ATmega328P_Datasheet.pdf 147p

마이크로프로세서와 C언어 - ASCII

Dec	Hx	Oct	Char	Dec	Hx	Oct	Char	Dec	Hx	Oct	Char	Dec	Hx	Oct	Char
0	0	000	NUL (null)	32	20	040	Space	64	40	100	@	96	60	140	`
1	1	001	SOH (start of heading)	33	21	041	!	65	41	101	A	97	61	141	a
2	2	002	STX (start of text)	34	22	042	"	66	42	102	B	98	62	142	b
3	3	003	ETX (end of text)	35	23	043	#	67	43	103	C	99	63	143	c
4	4	004	EOT (end of transmission)	36	24	044	$	68	44	104	D	100	64	144	d
5	5	005	ENQ (enquiry)	37	25	045	%	69	45	105	E	101	65	145	e
6	6	006	ACK (acknowledge)	38	26	046	&	70	46	106	F	102	66	146	f
7	7	007	BEL (bell)	39	27	047	'	71	47	107	G	103	67	147	g
8	8	010	BS (backspace)	40	28	050	(	72	48	110	H	104	68	150	h
9	9	011	TAB (horizontal tab)	41	29	051	)	73	49	111	I	105	69	151	i
10	A	012	LF (NL line feed, new line)	42	2A	052	*	74	4A	112	J	106	6A	152	j
11	B	013	VT (vertical tab)	43	2B	053	+	75	4B	113	K	107	6B	153	k
12	C	014	FF (NP form feed, new page)	44	2C	054	,	76	4C	114	L	108	6C	154	l
13	D	015	CR (carriage return)	45	2D	055	-	77	4D	115	M	109	6D	155	m
14	E	016	SO (shift out)	46	2E	056	.	78	4E	116	N	110	6E	156	n
15	F	017	SI (shift in)	47	2F	057	/	79	4F	117	O	111	6F	157	o
16	10	020	DLE (data link escape)	48	30	060	0	80	50	120	P	112	70	160	p
17	11	021	DC1 (device control 1)	49	31	061	1	81	51	121	Q	113	71	161	q
18	12	022	DC2 (device control 2)	50	32	062	2	82	52	122	R	114	72	162	r
19	13	023	DC3 (device control 3)	51	33	063	3	83	53	123	S	115	73	163	s
20	14	024	DC4 (device control 4)	52	34	064	4	84	54	124	T	116	74	164	t
21	15	025	NAK (negative acknowledge)	53	35	065	5	85	55	125	U	117	75	165	u
22	16	026	SYN (synchronous idle)	54	36	066	6	86	56	126	V	118	76	166	v
23	17	027	ETB (end of trans. block)	55	37	067	7	87	57	127	W	119	77	167	w
24	18	030	CAN (cancel)	56	38	070	8	88	58	130	X	120	78	170	x
25	19	031	EM (end of medium)	57	39	071	9	89	59	131	Y	121	79	171	y
26	1A	032	SUB (substitute)	58	3A	072	:	90	5A	132	Z	122	7A	172	z
27	1B	033	ESC (escape)	59	3B	073	;	91	5B	133	[	123	7B	173	{
28	1C	034	FS (file separator)	60	3C	074	<	92	5C	134	\	124	7C	174	|
29	1D	035	GS (group separator)	61	3D	075	=	93	5D	135	]	125	7D	175	}
30	1E	036	RS (record separator)	62	3E	076	>	94	5E	136	^	126	7E	176	~
31	1F	037	US (unit separator)	63	3F	077	?	95	5F	137	_	127	7F	177	DEL

128 Ç	161 í	193 ┴	225 ß
129 ü	162 ó	194 ┬	226 Γ
130 é	163 ú	195 ├	227 π
131 â	164 ñ	196 ─	228 Σ
132 ä	165 Ñ	197 ┼	229 σ
133 à	166 ª	198 ╞	230 µ
134 å	167 º	199 ╟	231 τ
135 ç	168 ¿	200 ╚	232 Φ
136 ê	169 ⌐	201 ╔	233 Θ
137 ë	170 ¬	202 ╩	234 Ω
138 è	171 ½	203 ╦	235 δ
139 ï	172 ¼	204 ╠	236 ∞
140 î	173 ¡	205 ═	237 φ
141 ì	174 «	206 ╬	238 ε
142 Ä	175 »	207 ╧	239 ∩
143 Å	176 ░	208 ╨	240 ≡
144 É	177 ▒	209 ╤	241 ±
145 æ	178 ▓	210 ╥	242 ≥
146 Æ	179 |	211 ╙	243 ≤
147 ô	180 ┤	212 ╘	244 ⌠
148 ö	181 ╡	213 ╒	245 ⌡
149 ò	182 ╢	214 ╓	246 ÷
150 û	183 ╖	215 ╫	247 ≈
151 ù	184 ╕	216 ╪	248 °
152 ÿ	185 ╣	217 ┘	249 ∙
153 Ö	186 ║	218 ┌	250 ·
154 Ü	187 ╗	219 █	251 √
156 £	188 ╝	220 ▄	252 ⁿ
157 ¥	189 ╜	221 ▌	253 ²
158 ₧	190 ╛	222 ▐	254 ■
159 ƒ	191 ┐	223 ▀	255
160 á	192 └	224 α	

마이크로프로세서와 C언어 - ASCII



Dec	Hex	Oct	Char
65	41	101	A
66	42	102	B
67	43	103	C
68	44	104	D
69	45	105	E
70	46	106	F
71	47	107	G
72	48	110	H
73	49	111	I
74	4A	112	J
75	4B	113	K
76	4C	114	L
77	4D	115	M
78	4E	116	N
79	4F	117	O
80	50	120	P
81	51	121	Q
82	52	122	R
83	53	123	S
84	54	124	T
85	55	125	U
86	56	126	V
87	57	127	W
88	58	130	X
89	59	131	Y
90	5A	132	Z

Dec	Hex	Oct	Char
97	61	141	a
98	62	142	b
99	63	143	c
100	64	144	d
101	65	145	e
102	66	146	f
103	67	147	g
104	68	150	h
105	69	151	i
106	6A	152	j
107	6B	153	k
108	6C	154	l
109	6D	155	m
110	6E	156	n
111	6F	157	o
112	70	160	p
113	71	161	q
114	72	162	r
115	73	163	s
116	74	164	t
117	75	165	u
118	76	166	v
119	77	167	w
120	78	170	x
121	79	171	y
122	7A	172	z

0x48
0x65
0x6C
0x6C
0x6F

아두이노를 이용한 시리얼통신 실험

- 예제2

```
int incomingByte = 0; // for incoming serial data

void setup()
{
  Serial.begin(9600); // opens serial port, sets data rate to 9600 bps
}

void loop()
{
  // send data only when you receive data:
  if (Serial.available()) {
    // read the incoming byte:
    incomingByte = Serial.read();

    // say what you got:
    Serial.print("I received: ");
    Serial.println(incomingByte, DEC);
  }
}
```

아두이노를 이용한 시리얼통신 실험

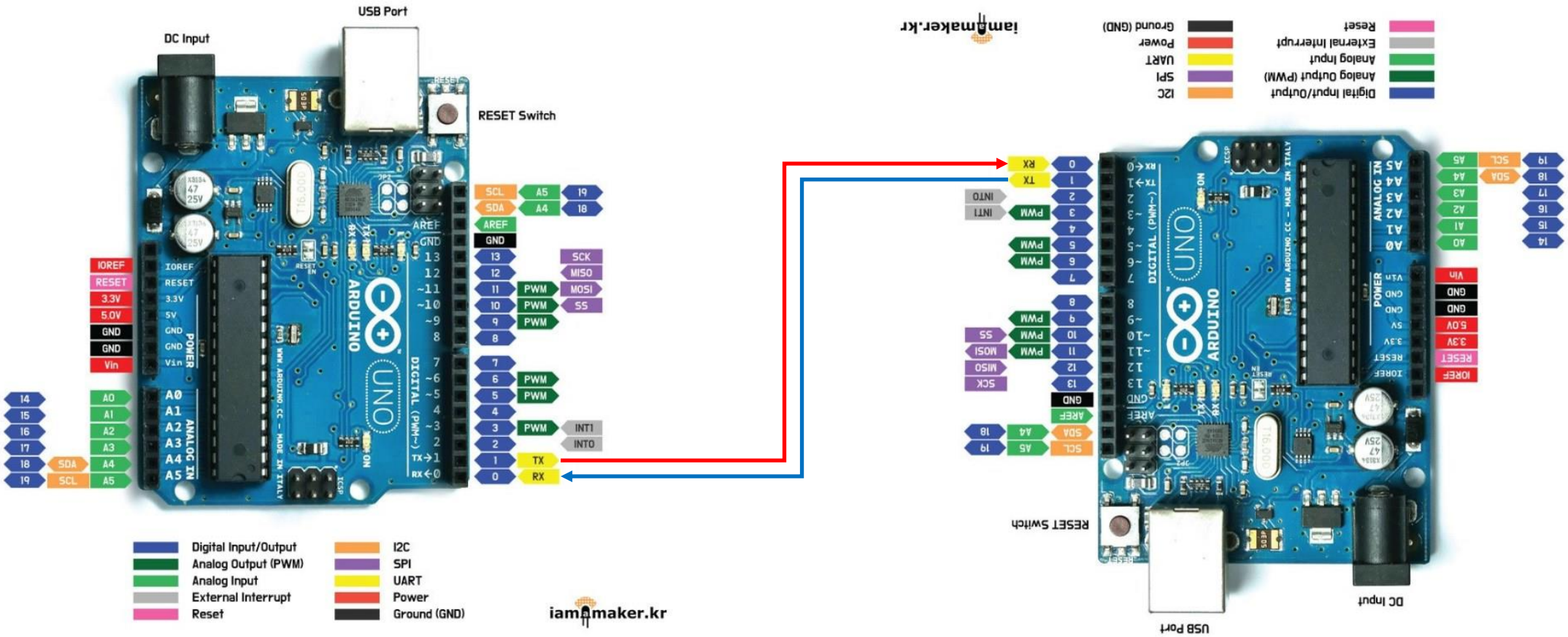
- 예제3

```
void setup()
{
  Serial.begin(9600); // opens serial port, sets data rate to 9600 bps
}

void loop()
{
    Serial.print(char(0x48));
    Serial.print(char(0x65));
    Serial.print(char(0x6c));
    Serial.print(char(0x6c));
    Serial.print(char(0x6f));

    delay(1000) ;
}
```

아두이노를 이용한 시리얼통신 실험



마이크로프로세서와 C언어 - 변수

- 예제4

```
void setup() {
  Serial.begin(9600); // opens serial port, sets data rate to 9600 bps
}

void loop()
{
  char c = 'a' ;
  int i = 10 ;
  unsigned int j = -10 ;
  float f = 1.24 ;
  double d = 1.234 ;

    Serial.print("char mem size= ");
    Serial.print(sizeof(c)) ;
    Serial.println(" byte") ;

delay(1000) ;
}
```

마이크로프로세서와 C언어 – 조건문 if

- 예제5

```
int incomingByte = 0; // for incoming serial data

void setup() {
  Serial.begin(9600); // opens serial port, sets data rate to 9600 bps
}

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

    if( incomingByte == 'a' ) {
        // say what you got:
      Serial.print("I received: ");
      Serial.println(incomingByte, DEC);
    }
  }
}
```

비교연산자
1. ==
2. !=
3. >
4. >=
5. <
6. <=

마이크로프로세서와 C언어 – if~else

- 예제6

```
int incomingByte = 0; // for incoming serial data

void setup() {
  Serial.begin(9600); // opens serial port, sets data rate to 9600 bps
}

void loop() {
  // send data only when you receive data:
  if (Serial.available())
  {
    // read the incoming byte:
    incomingByte = Serial.read();

    if( incomingByte == 'a' )
    {
        // say what you got:
      Serial.print("I received: ");
      Serial.println(incomingByte, DEC);
    }
    else
    {
         // say what you got:
      Serial.print(“Not A");
}
  }
}
```

마이크로프로세서와 C언어 – switch~case

- 예제7

```
int incomingByte = 0; // for incoming serial data

void setup() {
  Serial.begin(9600); // opens serial port, sets data rate to 9600 bps
}

void loop() {
  // send data only when you receive data:
  if (Serial.available())
  {
    // read the incoming byte:
    incomingByte = Serial.read();

    switch(incomingByte)
    {
    case 'a' :
      Serial.println("input a");
      break ;
    case 'b' :
      Serial.println("input b");
      break ;
    case 'c' :
      Serial.println("input c");
      break ;
    case 'd' :
      Serial.println("input d");
      break ;
    default :
      Serial.println(incomingByte, DEC);
      break ;
    }
  }
}
```

마이크로프로세서와 C언어 - 함수

- 예제8

```
void function1(void)
{
  Serial.println("function test");
}

void setup() {
  Serial.begin(9600); // opens serial port, sets data rate to 9600 bps
}

void loop() {
  function1() ;
}
```

마이크로프로세서와 C언어 - 함수

- 예제9

```
void function2(char c)
{
  Serial.print(c);
  Serial.print("Decimal Value = ");
  Serial.println(c, DEC);
}

void setup() {
  Serial.begin(9600); // opens serial port, sets data rate to 9600 bps
}

void loop() {
  function2('k') ;
}
```

마이크로프로세서와 C언어 - 함수

- 예제10

```
int function_add(int a, int b)
{
    int c = a+b ;
    return c ;
}

void setup() {
  Serial.begin(9600); // opens serial port, sets data rate to 9600 bps
}

void loop() {
  int result = function_add(1, 4) ;
  Serial.print("result = ") ;
  Serial.println(result) ;
}
```

마이크로프로세서와 C언어 - 반복문

- while 문
- do~while 문
- for 문

마이크로프로세서와 C언어 - 반복문

- 예제11

```
void setup() {
  Serial.begin(9600); // opens serial port, sets data rate to 9600 bps
}

void loop() {
  int condition = 1 ;
  unsigned int count = 0 ;
  while(condition)
  {
    Serial.print("count = ") ;
    Serial.println(count) ;

    count++ ;

    if( count > 100 ) condition = 0 ;
  }
}
```

마이크로프로세서와 C언어 - 반복문

- 예제12

```
void setup() {
  Serial.begin(9600); // opens serial port, sets data rate to 9600 bps
}

void loop() {
  int condition = 1 ;
  unsigned int count = 0 ;
  do
  {
    Serial.print("count = ") ;
    Serial.println(count) ;

    count++ ;

    if( count > 100 ) condition = 0 ;
  }while(condition);
}
```

마이크로프로세서와 C언어 - 반복문

- 예제13

```
void setup() {
  Serial.begin(9600); // opens serial port, sets data rate to 9600 bps
}

void loop() {
  int i = 0 ;
  for( i = 0 ; i<100 ; i++ )
  {
    Serial.print("i = ") ;
    Serial.println(i) ;
  }
}
```

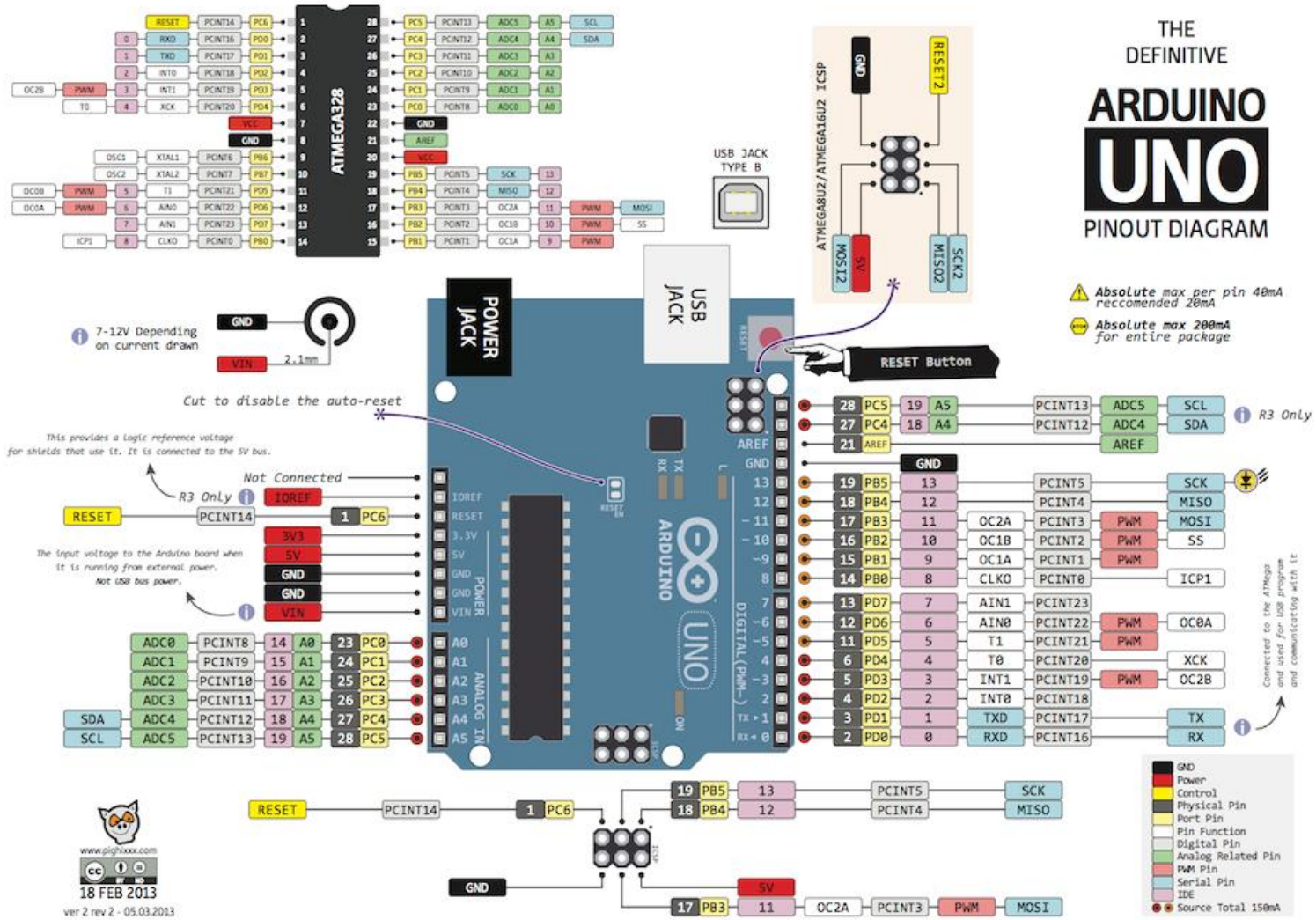
마이크로프로세서와 C언어 - 반복문

- 퀴즈 : for 문을 이용하여 1부터 100까지 더한 결과를 얻는 기능을 프로그래밍 하시오

- Hint : 예제13과 예제10번을 참고

IO 포트

- Port


THE
DEFINITIVE
ARDUINO
UNO
PINOUT DIAGRAM
ATMEGA328
ATMEGA8U2/ATMEGA16U2 ICSP
USB JACK
TYPE B
POWER JACK
USB JACK
RESET Button
Cut to disable the auto-reset
7-12V Depending on current drawn
2.1mm
Not Connected
R3 Only
RESET
3V3
5V
GND
VIN
AREF
SCL
SDA
SCK
MISO
MOSI
SS
ICP1
OC0A
XCK
OC2B
TX
RX
Absolute max per pin 40mA reccomended 20mA
Absolute max 200mA for entire package
18 FEB 2013
ver 2 rev 2 - 05.03.2013
GND
Power
Control
Physical Pin
Port Pin
Pin Function
Digital Pin
Analog Related Pin
PWM Pin
Serial Pin
IDE
Source Total 150mA

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

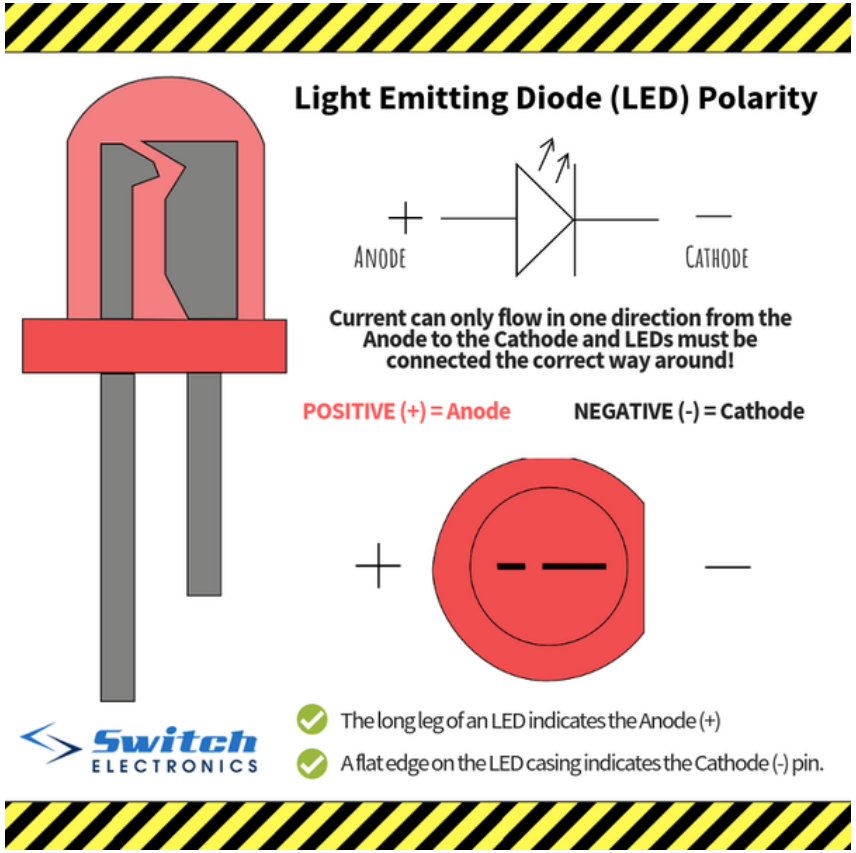
Bit	7	6	5	4	3	2	1	0	
0x04 (0x24)	DDB7	DDB6	DDB5	DDB4	DDB3	DDB2	DDB1	DDB0	DDRB
Read/Write	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	
Initial Value	0	0	0	0	0	0	0	0	

13.4.4 PINB – The Port B Input Pins Address

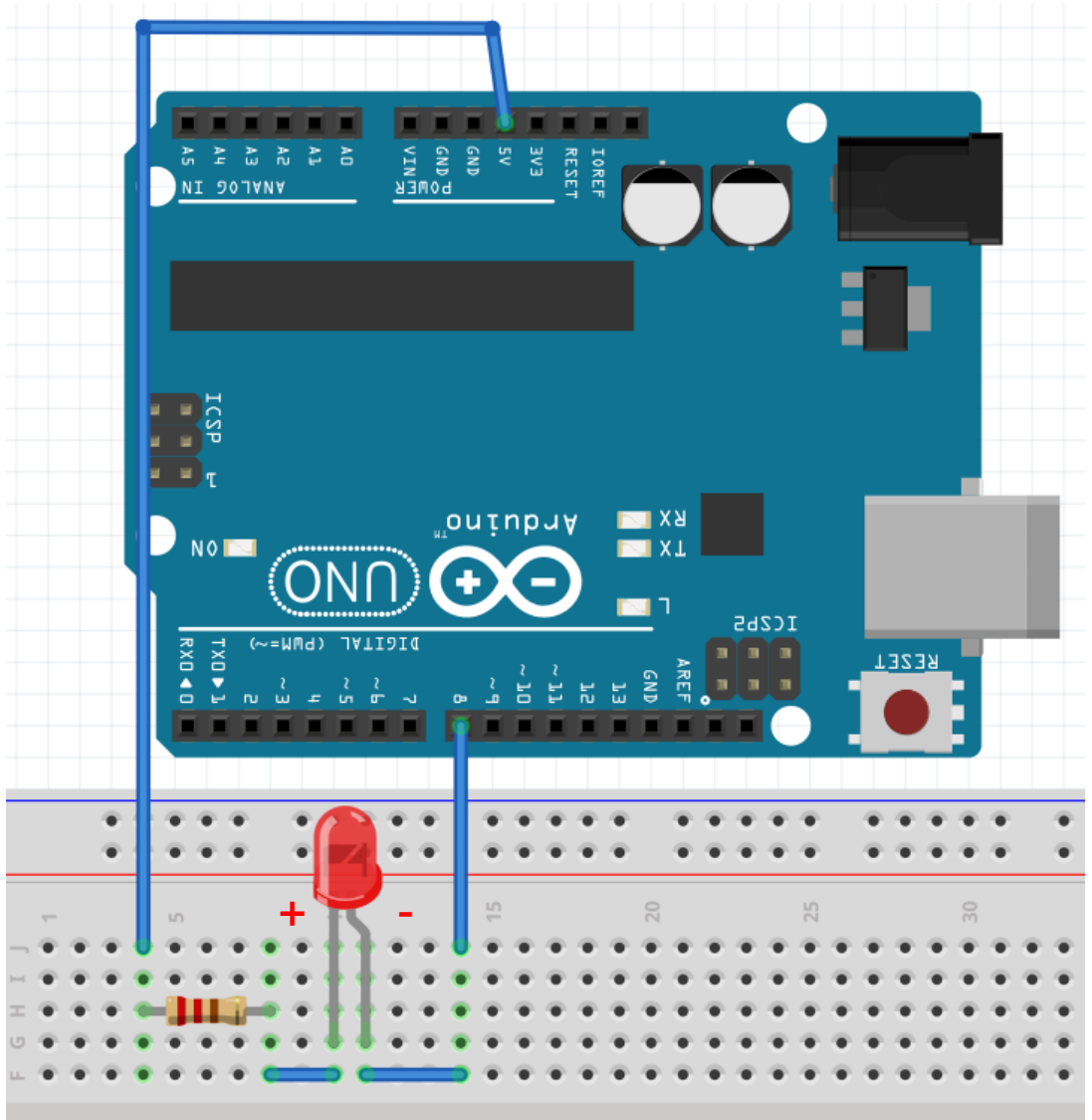
Bit	7	6	5	4	3	2	1	0	
0x03 (0x23)	PINB7	PINB6	PINB5	PINB4	PINB3	PINB2	PINB1	PINB0	PINB
Read/Write	R	R	R	R	R	R	R	R	
Initial Value	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	

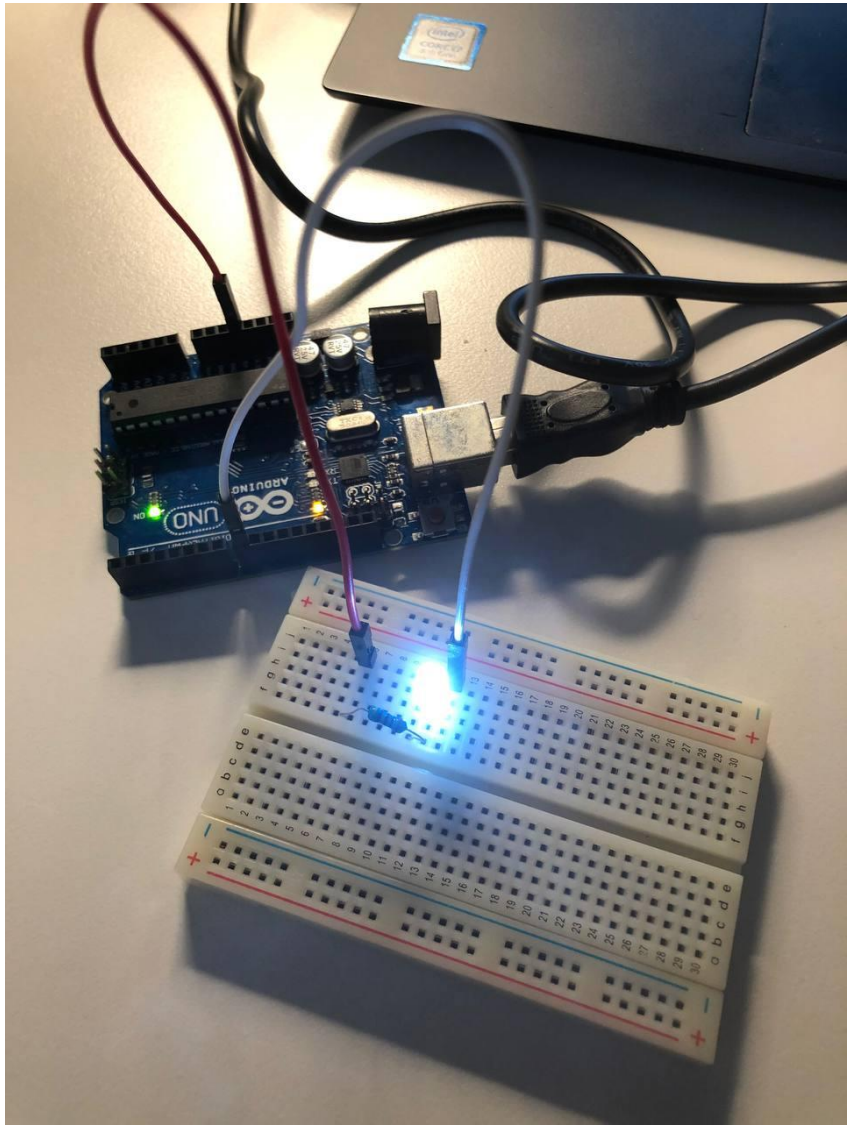
IO 포트 테스트

- LED를 이용한 포트 Output 테스트



IO 포트 테스트





IO 포트 테스트

- 예제14

```
void setup() {
  // put your setup code here, to run once:
  DDRB = B00000001 ;
  PORTB = B00000000 ;

}

void loop() {
  // put your main code here, to run repeatedly:
  PORTB = B00000001 ;
  delay(1000) ;
  PORTB = B00000000 ;
  delay(1000) ;
}
```

수고하셨습니다.

다음주에 만나요.