Microprocessor

5th Week: Port Input Part 1

Computer architecture and system sw Lab
HANYANG UNIVERSITY

Review : registers.DDR

- ◆ DDRx (Data Direction Register) configures **data direction** of port pins.
- ◆ x = A, B, C, D, E, F, G
- ◆ Setting determines whether port pins will be used for input or output.
- ◆ Writing **0** to a bit in DDRx makes corresponding port pin as **input**.
- ◆ Writing **1** to a bit in DDRx makes corresponding port pin as **output**.
- ◆ Pin number: 7 to 0

- ➢ Ex1) To make all pins of A as input pins: DDRA = 0b00000000;
- ➢ Ex2) To make all pins of B as output pins : DDRB = 0b11111111;

- ✓ 0b00000000(binary) = 0x00(hexadecimal) = 0(decimal)
- ✓ 0b11111111(binary) = 0xFF(hexadecimal) = 255(decimal)

Review : registers.PORT

- ◆ Write data into respective bits in PORTx register.
- ◆ x = A, B, C, D, E, F, G
- ◆ Immediately change state of output pins according to data.

➢ Ex)

```
DDRB = 0b11111111; //set all pins of B as outputs
PORTB = 0xFF; //write “11111111” on port B
PORTB = 0x00; //write “00000000” on port B
```

registers.PIN

- Read data respective bits in PINx register.
- x = A, B, C, D, E, F, G
- Automatically stores information values such as switches connected to the outside

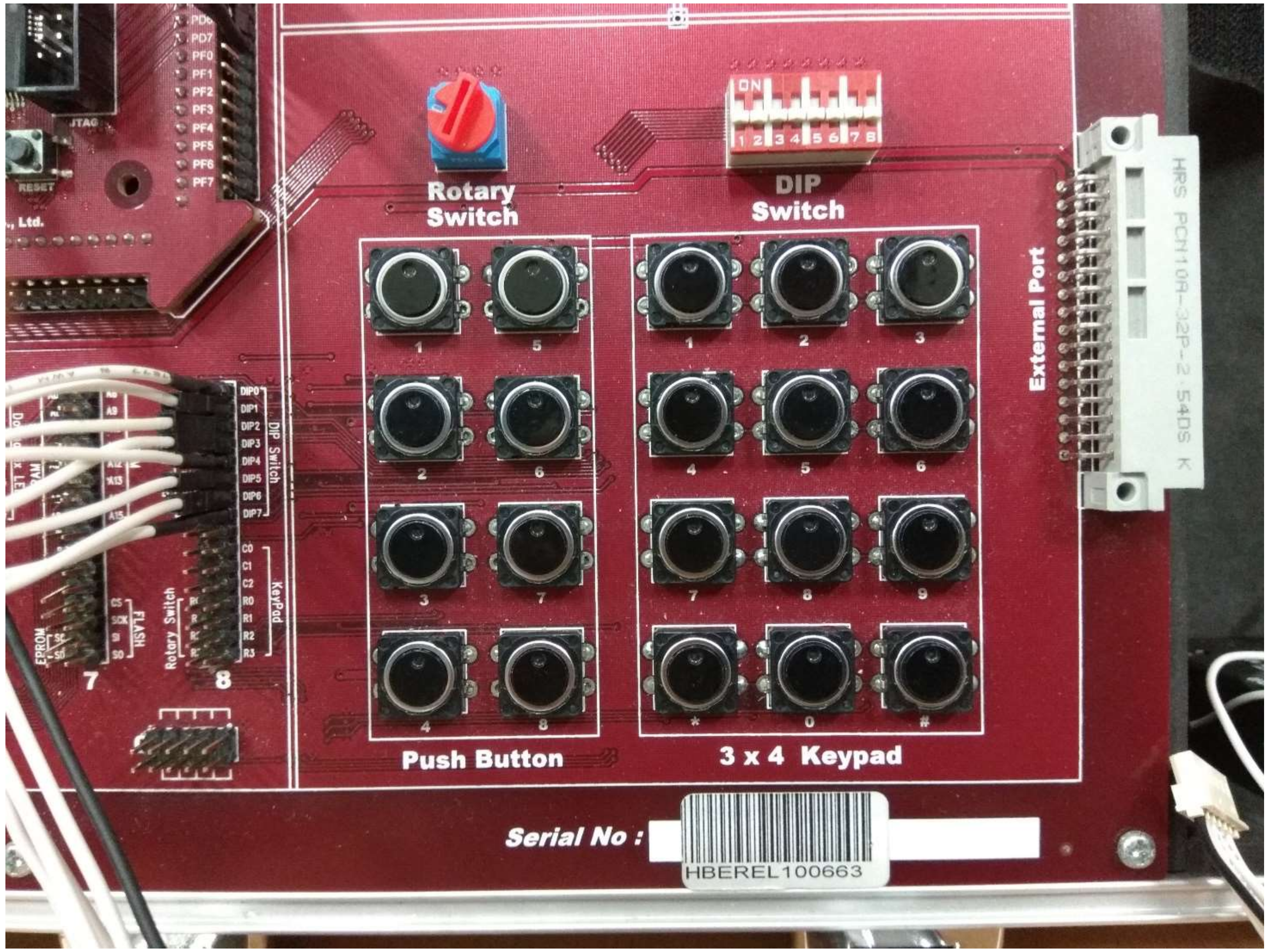
- Ex)

```
DDRB = 0b00000000; //set all pins of B as inputs
input_data = PINB; //write PINB's state to variable input_data
```

switches

- ◆ Switches are electronic components that connect or disconnect the path of electrons.
- ◆ There are 4 kinds of switches in our kit.
  - Push Button
  - DIP Switch
  - Rotary Switch
  - 3 x 4 Keypad -> Next Week

switches

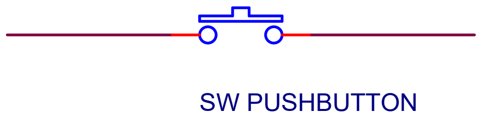


Rotary Switch
DIP Switch
External Port
Push Button
3 x 4 Keypad
Serial No :
HBEREL100663

pushButton

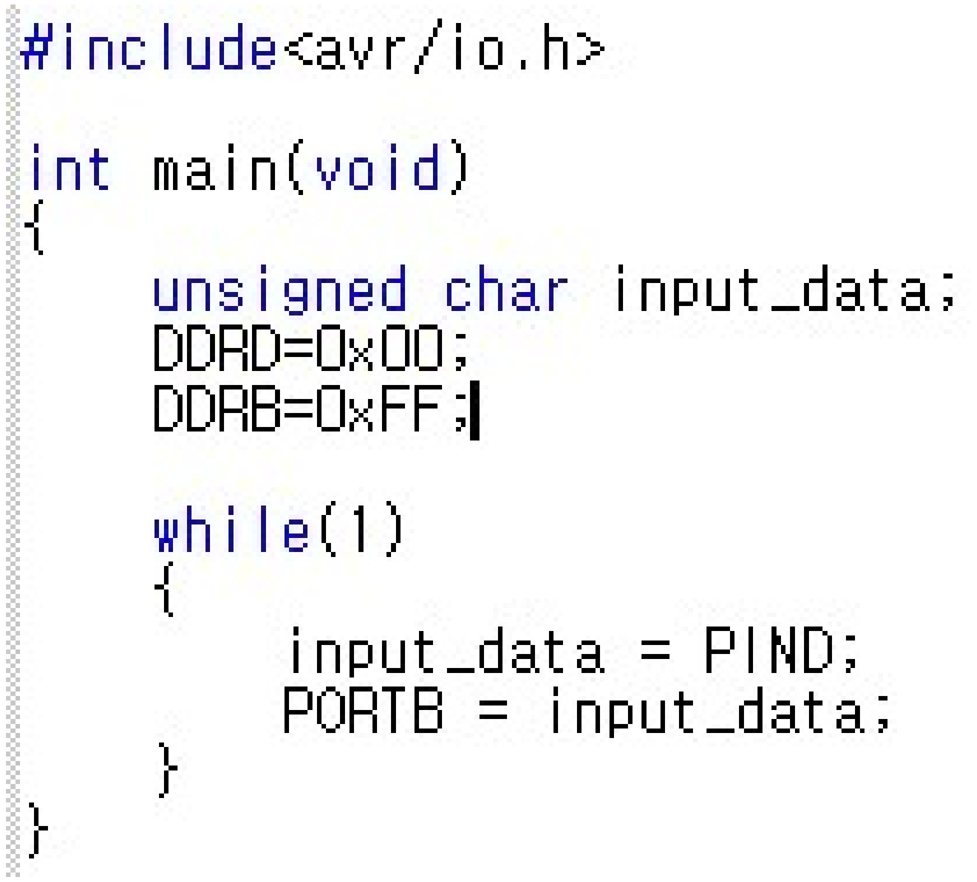
- ◆ Normally it is always open(0), but it only closes while it is pressed(1).
- ◆ [Push Button 1:Push Button 8] -> [BT0:BT7]

* 8



* 8

pushButton.1



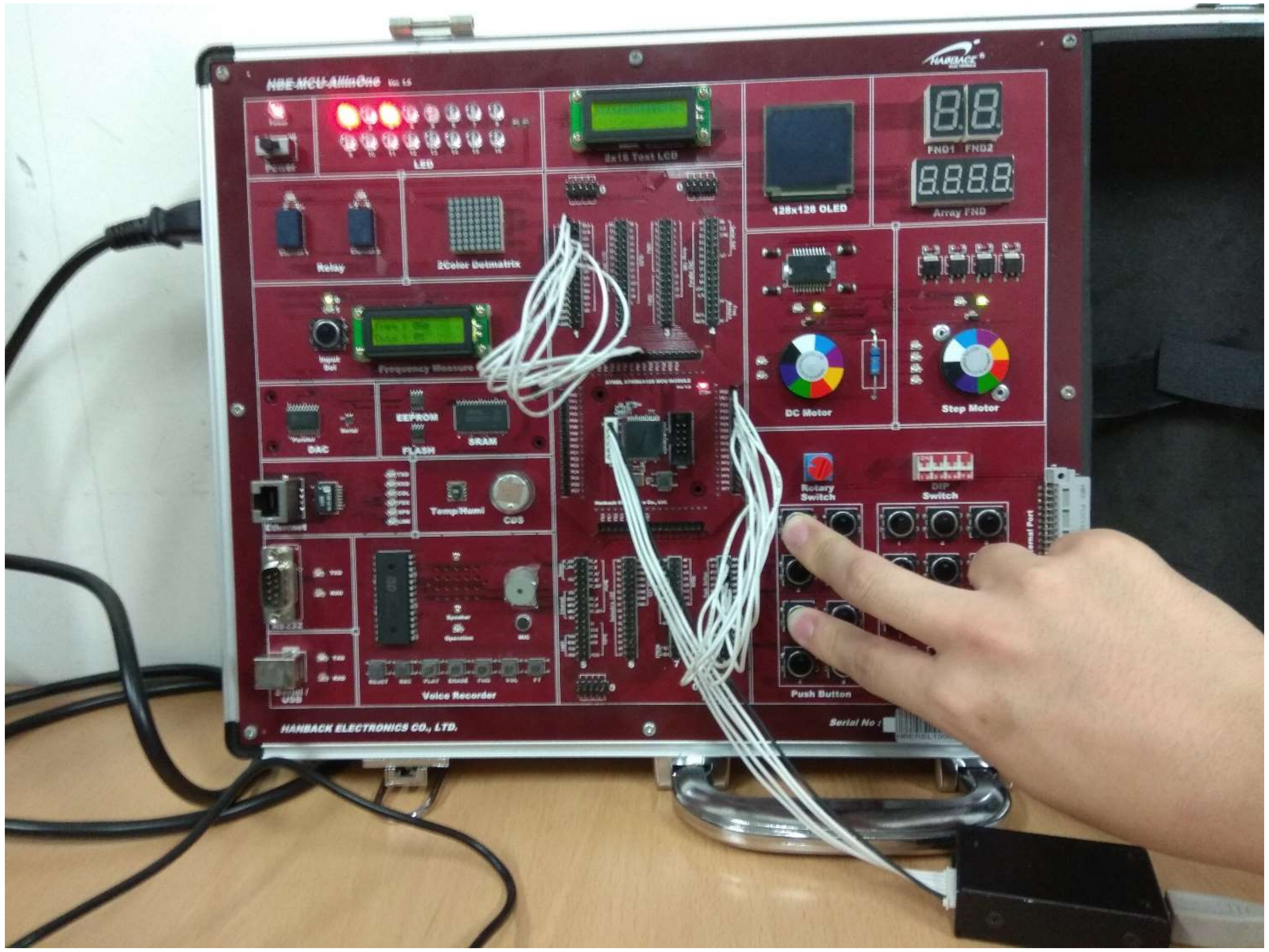
```
#include<avr/io.h>

int main(void)
{
	unsigned char input_data;
	DDRD=0x00;
	DDRB=0xFF;

	while(1)
	{
		input_data = PIND;
		PORTB = input_data;
	}
}
```

pushButton.2

PORTB -> LED								
MCU	PB7	PB6	PB5	PB4	PB3	PB2	PB1	PB0
LED	LED7	LED6	LED5	LED4	LED3	LED2	LED1	LED0

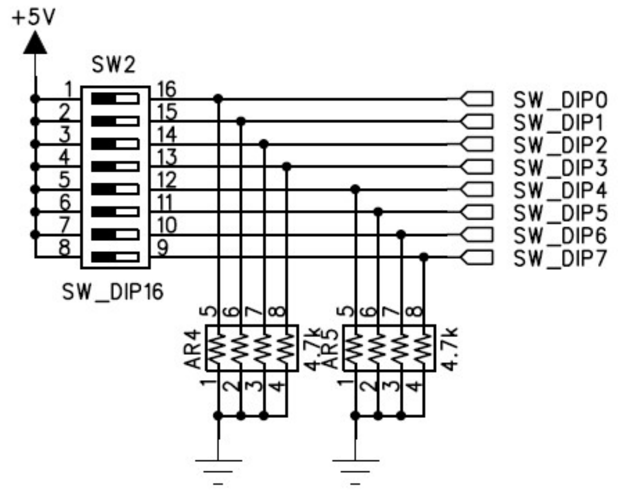
PORTD -> Push Button								
MCU	PD7	PD6	PD5	PD4	PD3	PD2	PD1	PD0
switch	BT7	BT6	BT5	BT4	BT3	BT2	BT1	BT0

pushButton.3

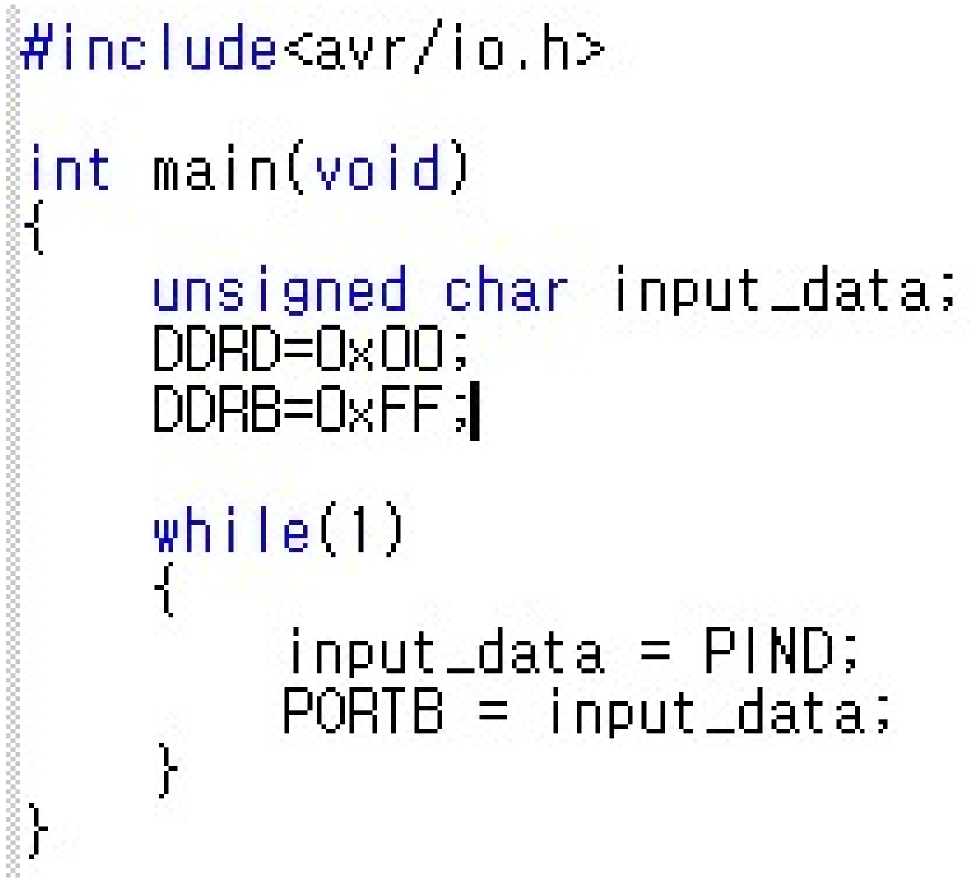


dipSwitch

- ◆ Exactly the same as the push button.
- ◆ Below means 0, above means 1.
- ◆ [DIP Switch 1:DIP Switch 8] -> [DIP0:DIP7]



dipSwitch.1



```
#include<avr/io.h>

int main(void)
{
	unsigned char input_data;
	DDRD=0x00;
	DDRB=0xFF;

	while(1)
	{
		input_data = PIND;
		PORTB = input_data;
	}
}
```

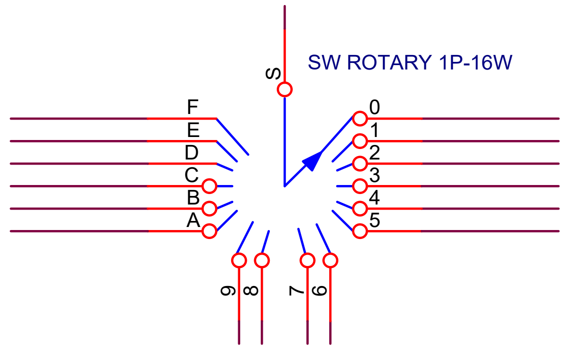
dipSwitch.2

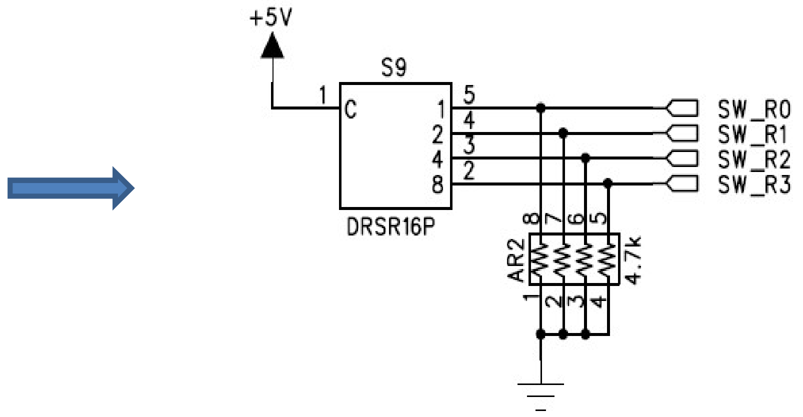
PORTB -> LED								
MCU	PB7	PB6	PB5	PB4	PB3	PB2	PB1	PB0
LED	LED7	LED6	LED5	LED4	LED3	LED2	LED1	LED0

PORTD -> DIP Switch								
MCU	PD7	PD6	PD5	PD4	PD3	PD2	PD1	PD0
switch	DIP7	DIP6	DIP5	DIP4	DIP3	DIP2	DIP1	DIP0

rotarySwitch

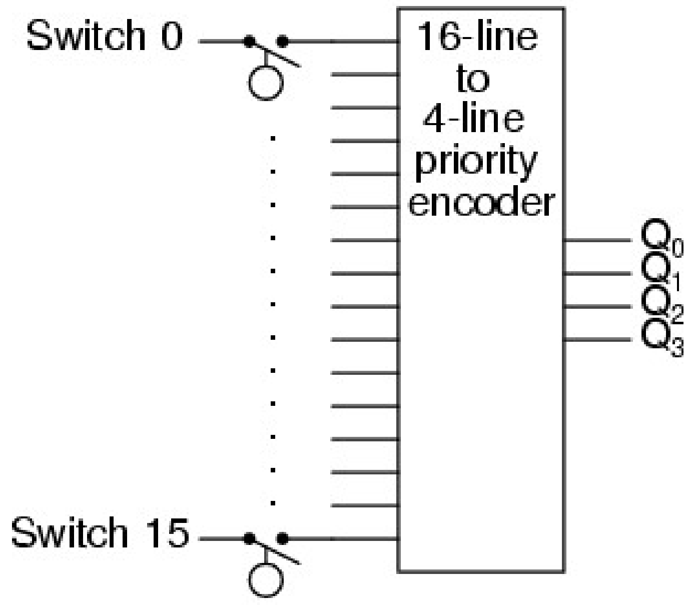
- ◆ 16 inputs -> Waste of pins
- ◆ 16 types can be expressed in 4 bits
- ◆ [0:F(16)] -> 16-to-4 bit encoder -> [R0:R3]





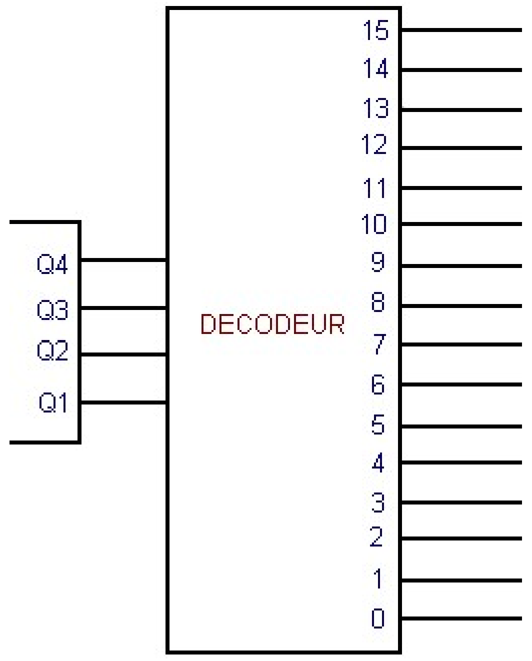
4bit Encoder

encoder.16-to-4

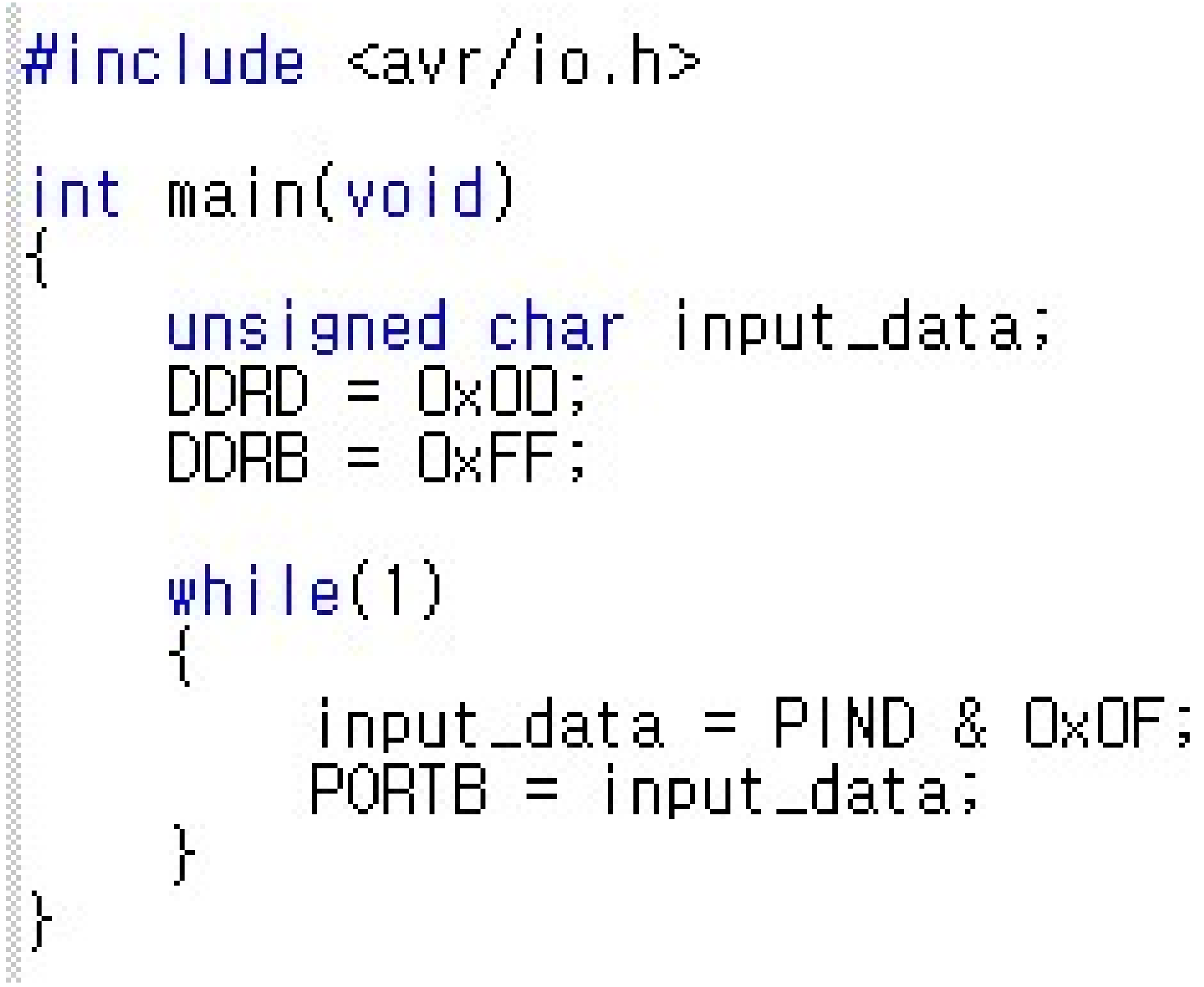


Q_3	Q_2	Q_1	Q_0
0	0	0	0
0	0	0	1
0	0	1	0
0	0	1	1
0	1	0	0
0	1	0	1
0	1	1	0
0	1	1	1
1	0	0	0
1	0	0	1
1	0	1	0
1	0	1	1
1	1	0	0
1	1	0	1
1	1	1	0
1	1	1	1

Decoder.4-to-16



rotarySwitch.1



```
#include <avr/io.h>

int main(void)
{
	unsigned char input_data;
	DDRD = 0x00;
	DDRB = 0xFF;

	while(1)
	{
		input_data = PIND & 0x0F;
		PORTB = input_data;
	}
}
```

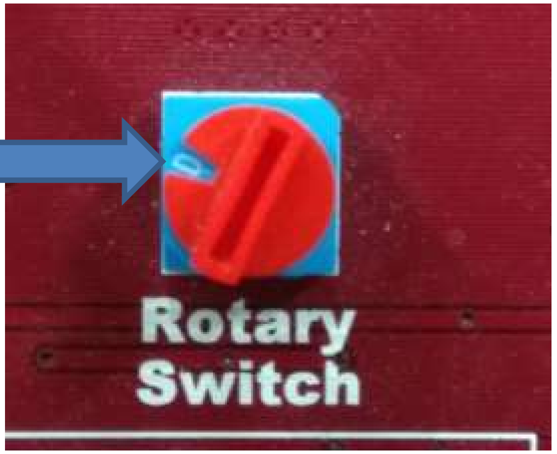
rotarySwitch.2

PORTB -> LED								
MCU	PB7	PB6	PB5	PB4	PB3	PB2	PB1	PB0
LED	LED7	LED6	LED5	LED4	LED3	LED2	LED1	LED0

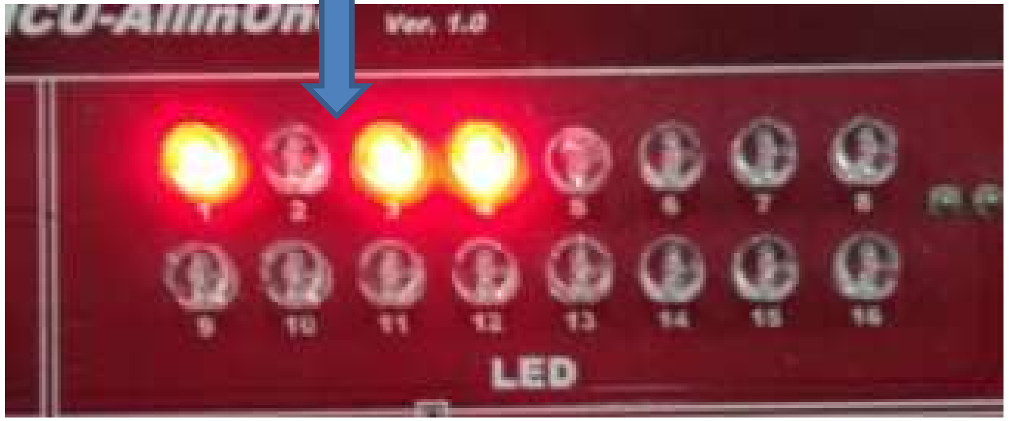
PORTD -> Rotary Switch								
MCU	PD7	PD6	PD5	PD4	PD3	PD2	PD1	PD0
switch	x	x	x	x	R3	R2	R1	R0

rotarySwitch.3

D = 13 = 1101(2)



1 0 1 1



Homework4

◆ Write a program that decodes Rotary Switch

- Rotary Switch 0 -> LED 1 0 0 0 0 0 0 0
- Rotary Switch 1 -> LED 0 1 0 0 0 0 0 0
- Rotary Switch 2 -> LED 0 0 1 0 0 0 0 0
- Rotary Switch 3 -> LED 0 0 0 1 0 0 0 0
- Rotary Switch 4 -> LED 0 0 0 0 1 0 0 0
- Rotary Switch 5 -> LED 0 0 0 0 0 1 0 0
- Rotary Switch 6 -> LED 0 0 0 0 0 0 1 0
- Rotary Switch 7 -> LED 0 0 0 0 0 0 0 1
- default -> LED 0 0 0 0 0 0 0 0

◆ Due date : 2020.10.10 23:59

◆ Upload on your GitLab project, only the C file (only the code)

◆ File name : mp_week5_studentNumber.c