EE3704 Embedded System

Chapter 2

Presented by
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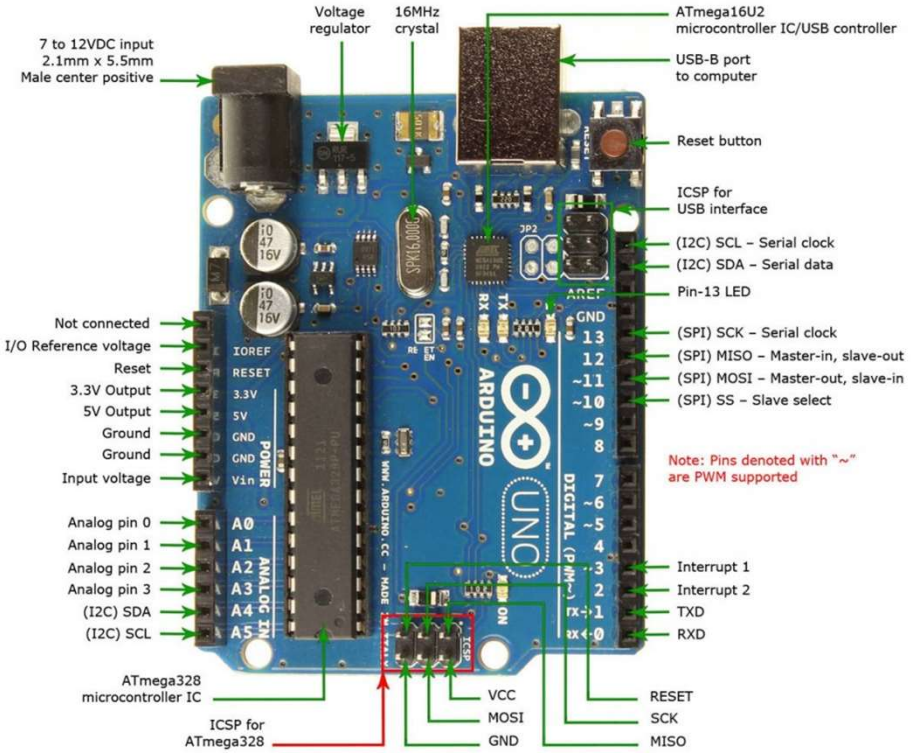
Chapter 2: Digital Output



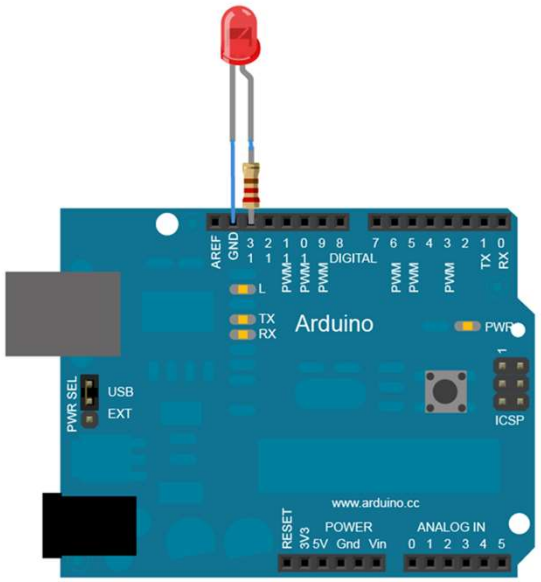
Function:

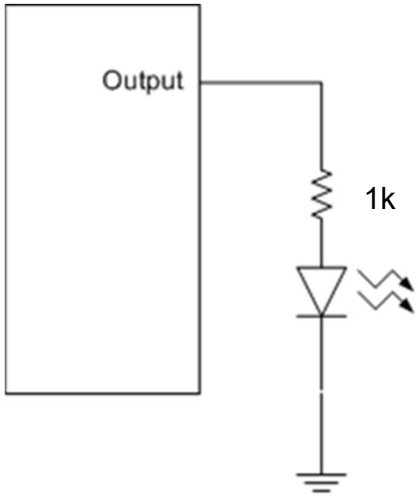
pinMode(PORTnumber, OUTPUT);

digitalWrite();

Chapter 2: Digital Output

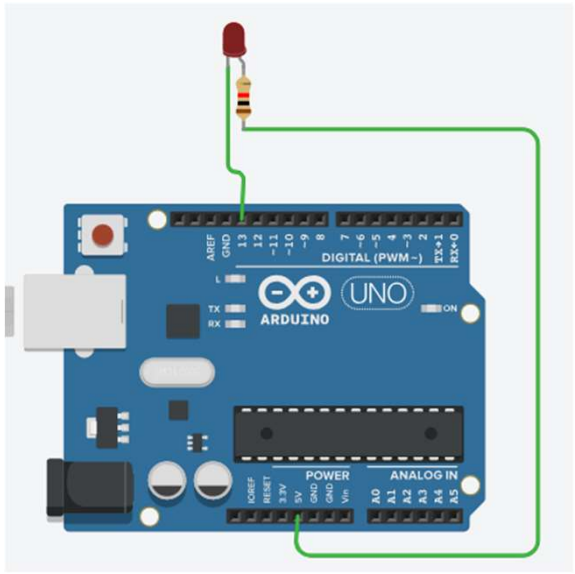
- Active High

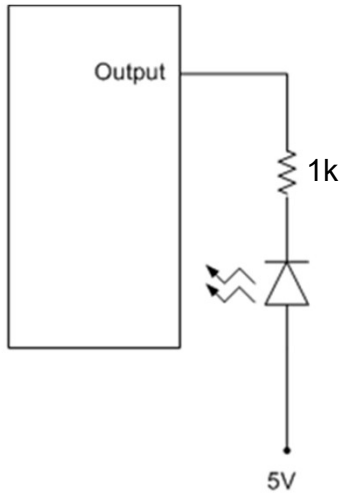




Output	led
0	Off
1	On

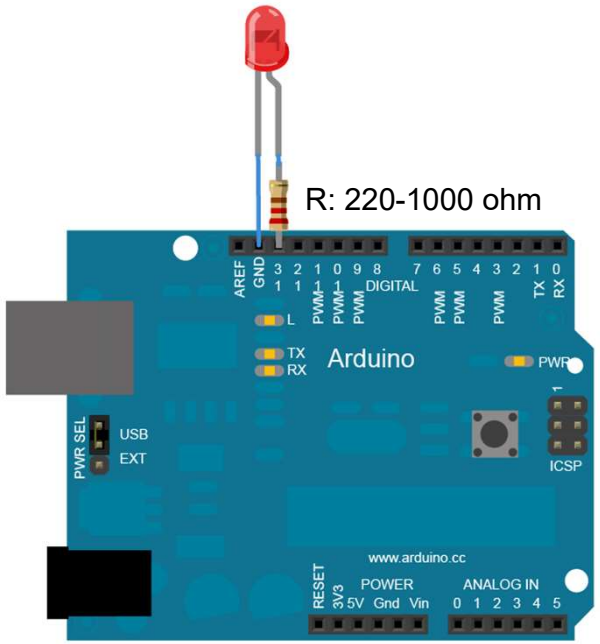
- Active Low





Output	led
0	On
1	Off

Chapter 2: Digital Output

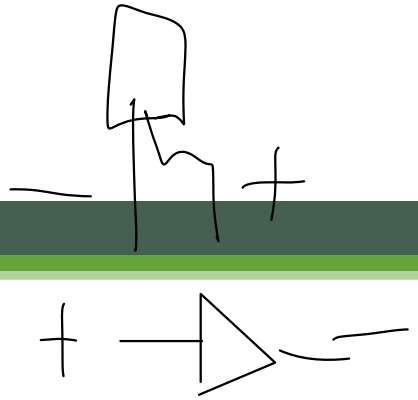


- Active High

Lecture §

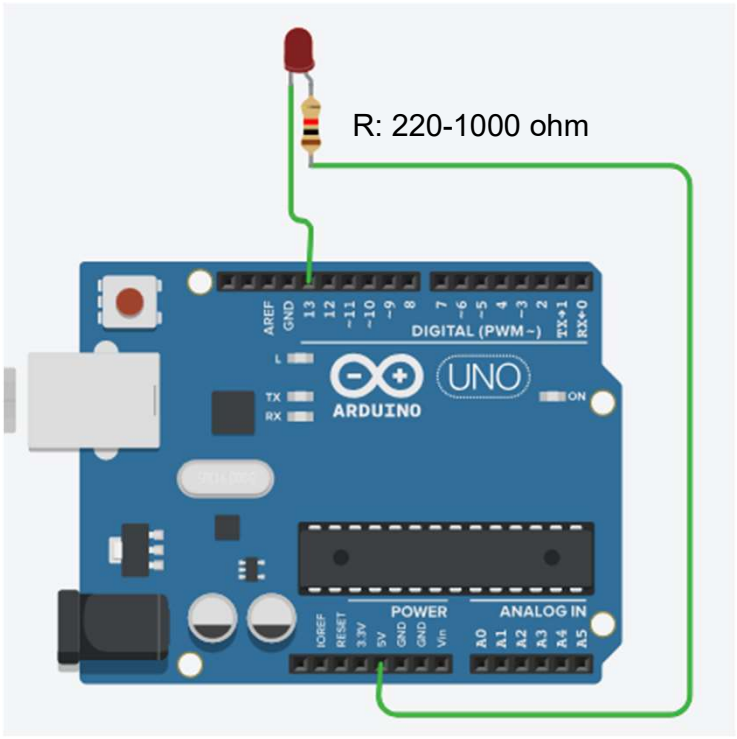
```
void setup()
{
  pinMode(13, OUTPUT);
}

void loop()
{
  digitalWrite(13, HIGH);
}
```



Chapter 2: Digital Output

- Active Low



Lecture §

```
void setup()
{
  pinMode(13, OUTPUT);
}

void loop()
{
  digitalWrite(13, LOW);
}
```

Chapter 2: Digital Output

Example 2.1: Active High load

- Turn On / Off LED (Pin 13) for 5 times
- Check the LED output
  - Tinkercad
  - Real Arduino board

Chapter 2: Digital Output

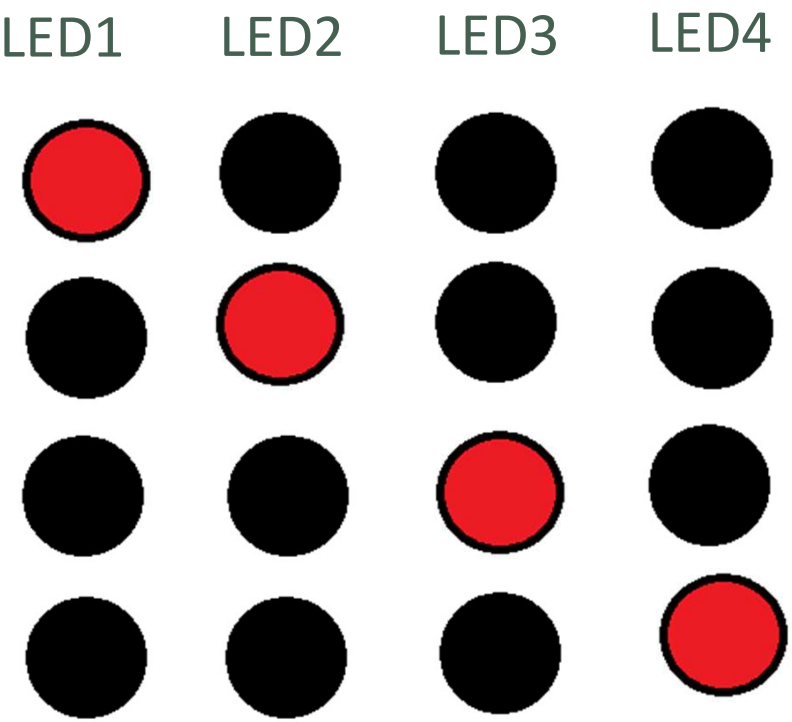
Example 2.2: Active High and Active Low loads

- Turn On / Off LED (Pin 13 and Pin 12) for 5 times
- Check the LED output
  - Tinkercad
  - Real Arduino board

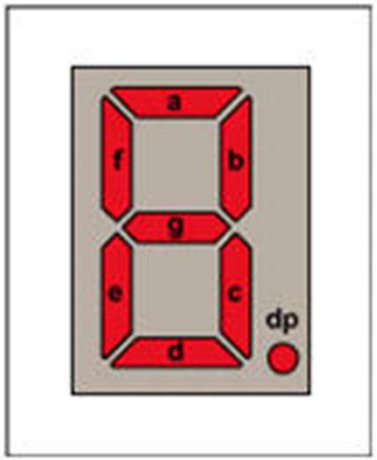
Chapter 2: Digital Output

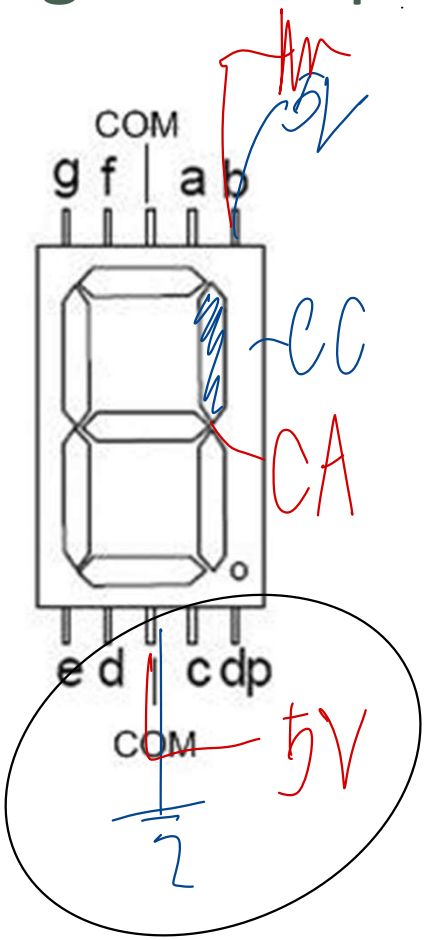
Example 2.3 (all Active Low)

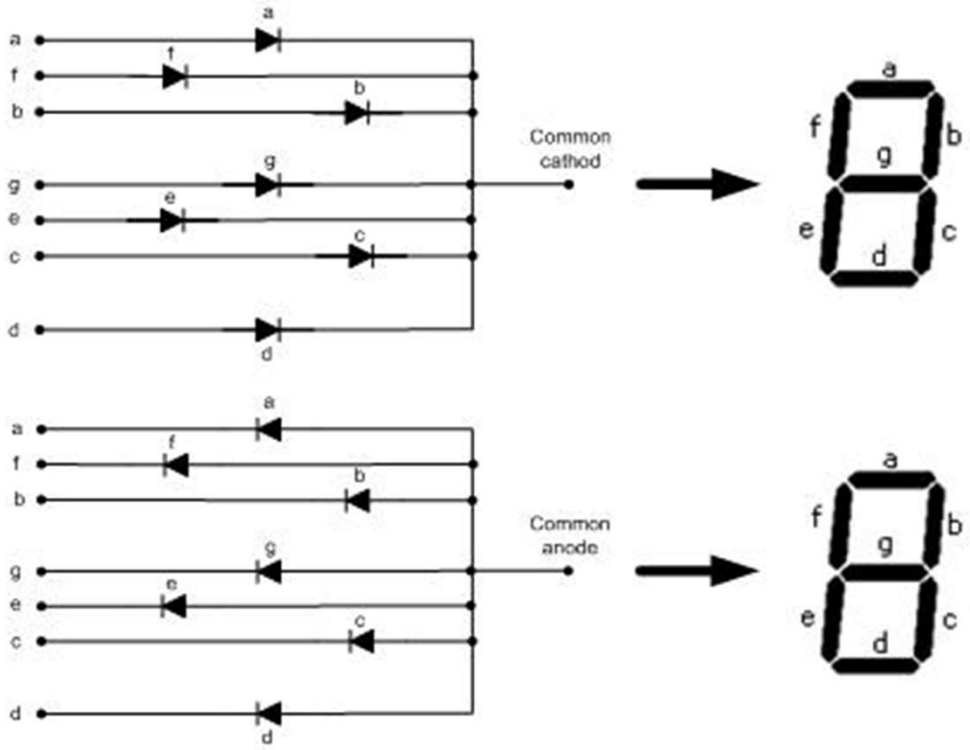
- Connect LED to Pin 0 to 3
- Turn On / Off LED Pin 0 to 3 with delay of 1 second
  - Use function delay(ms);
- Show Circuit diagram / and Coding
  - Tinkercad
  - Real Arduino board



Chapter 2: Digital Output (7 Segment display)

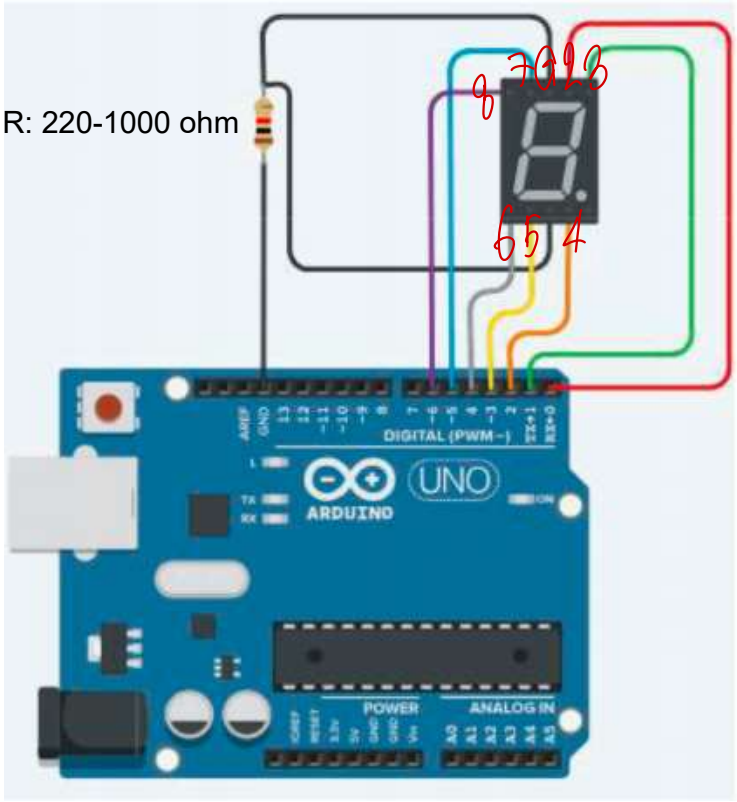






Chapter 2: Digital Output

- 7 Segment Common Cathode

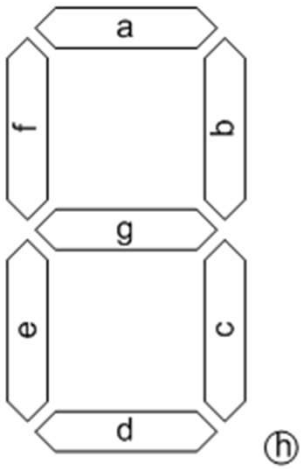


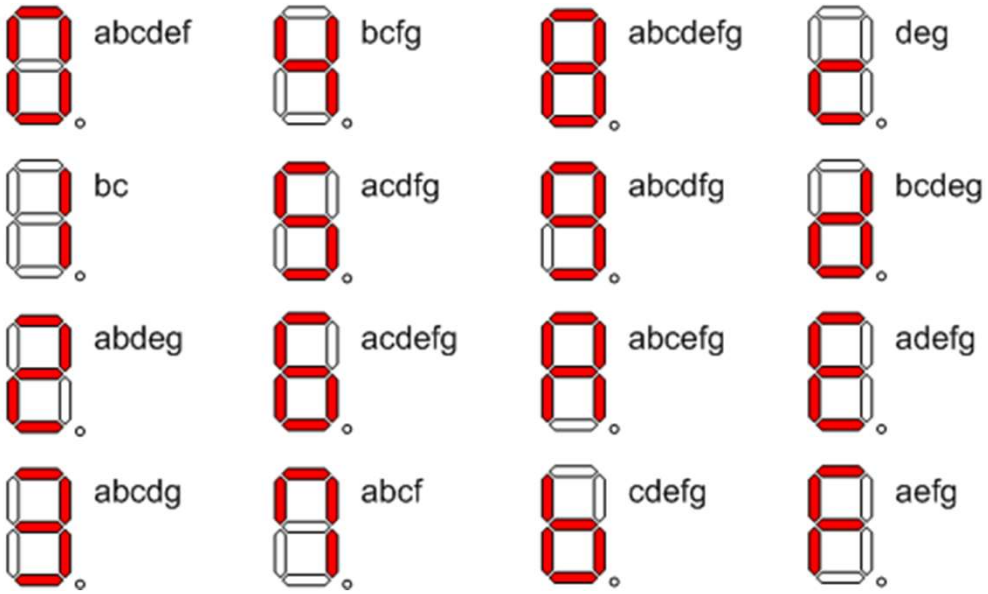
- RED – A Pin 0
- GREEN – B Pin 1
- Orange – C Pin 2
- Yellow – D Pin 3
- Grey – E Pin 4
- Blue – F Pin 5
- Purple – G Pin 6

- Black – Common GND

Chapter 2: Digital Output

- 7 Segment Common Cathode

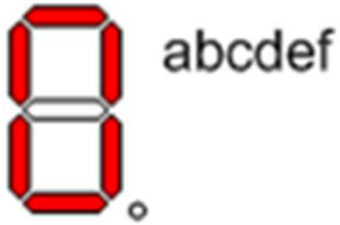




Chapter 2: Digital Output

- 7 Segment Common Cathode

W3	W2	W1	W0	g	f	e	D	c	b	a	HEX	7SEG
0	0	0	0	0	1	1	1	1	1	1	3F	0
0	0	0	1	0	0	0	0	1	1	0	06	1
0	0	1	0	1	0	1	1	0	1	1	5B	2
0	0	1	1	1	0	0	1	1	1	1	4F	3
0	1	0	0	1	1	0	0	1	1	0	66	4
0	1	0	1	1	1	0	1	1	0	1	6D	5
0	1	1	0	1	1	1	1	1	0	1	7D	6
0	1	1	1	0	0	0	0	1	1	1	07	7
1	0	0	0	1	1	1	1	1	1	1	7F	8
1	0	0	1	1	1	0	1	1	1	1	6F	9

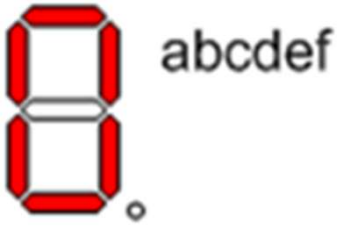


0 1 1 0 0 1 1

Chapter 2: Digital Output

- 7 Segment Common Anode

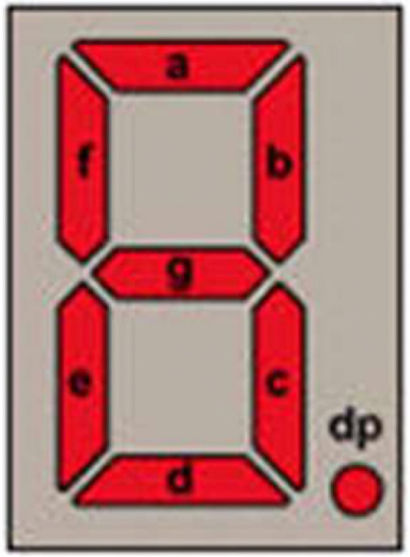
g	f	e	d	c	b	a	Hex	Dec
1	0	0	0	0	0	0	40	0
1	1	1	1	0	0	1	79	1
0	1	0	0	1	0	0	24	2
0	1	1	0	0	0	0	30	3
0	0	1	1	0	0	1	19	4
0	0	1	0	0	1	0	12	5
0	0	0	0	0	1	1	02	6
1	1	1	1	0	0	0	78	7
0	0	0	0	0	0	0	00	8
0	0	1	0	0	0	0	10	9

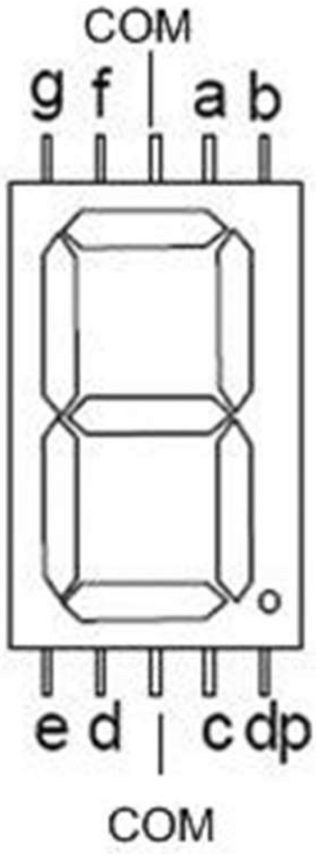


Chapter 2: Digital Output

Example 2.4: 7 Segment (CC or CA)

- Make 7 segment display number 5
- Pins starting from Pin2 to Pin 8
- Check the 7 segment display
  - Tinkercad
  - Real Arduino board



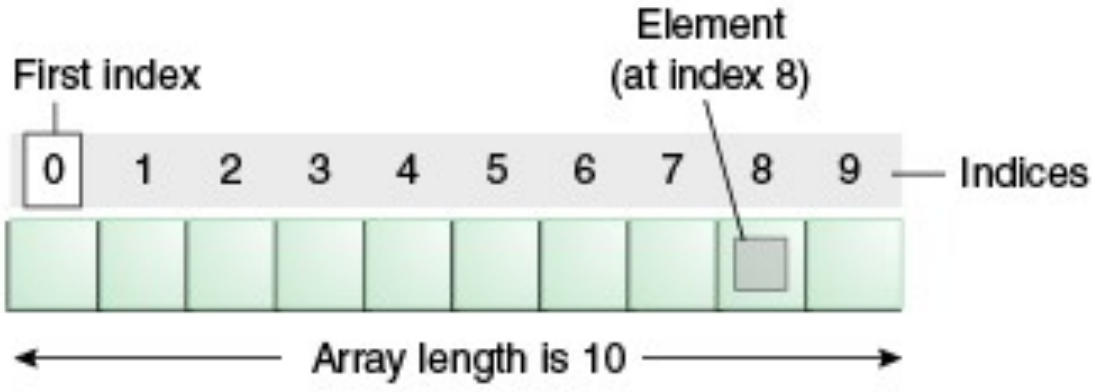


Array

-Array is a container of object that hold fixed number of values of single type.

-Item in an array is called element.

-First index is 0. So the 9th element is at index 8th.



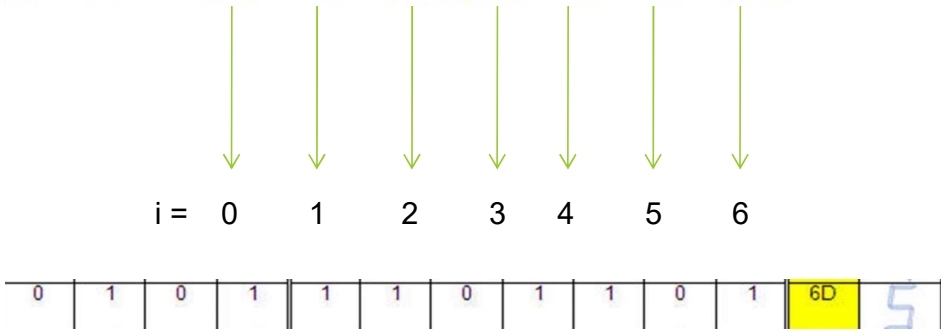
Array

-Declaration
- row, column

1 row 7column

```
int number_5[7] = {1, 0, 1, 1, 0, 1, 1};
```

```
int number_5[i] = {1, 0, 1, 1, 0, 1, 1};
```



7 6 5 4 3 2 1
g f e d c b a

Chapter 2: Digital Output

Example 2.5: 7 Segment (CC or CA)

- Make 7 segment display number 5 using array
- Pins starting from Pin2 to Pin 8

2D-Array

-Declaration
- row, column

1 row 7column

```
int number_5[7] = {1, 0, 1, 1, 0, 1, 1};
```

2 row 7column

```
int number[2][7] = { {0, 1, 1, 0, 0, 1, 1},
                     {1, 0, 1, 1, 0, 1, 1} };
```

Chapter 2: Digital Output

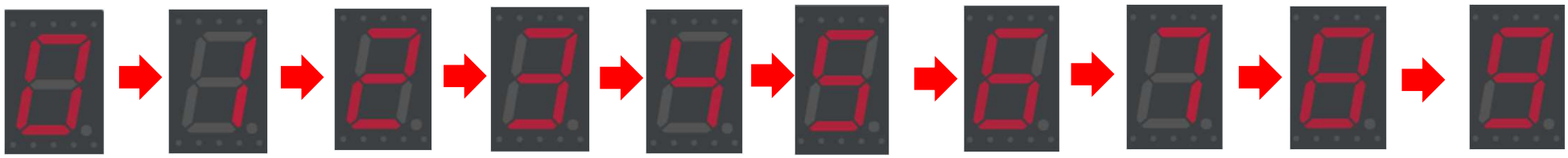
Example 2.6: 7 Segment (CC or CA)

- Make 7 segment display number 4 and 5 with 1s interval using array
- Pins starting from Pin2 to Pin 8
- Check the 7 segment display
  - Tinkercad
  - Real Arduino board

Chapter 2: Digital Output

Example 2.7 : 7 Segment (CC or CA)

- 7 Segment running 0 – 9 and repeat with delay of 1 second
- Show Circuit diagram / and Coding
  - Tinkercad
  - Real Arduino board

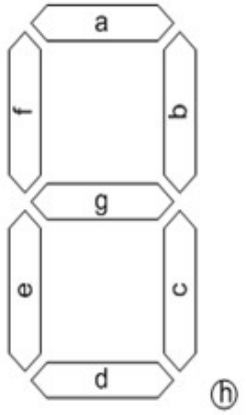


Chapter 2: Digital Output

Example 2.8 : 7 Segment (CC or CA)

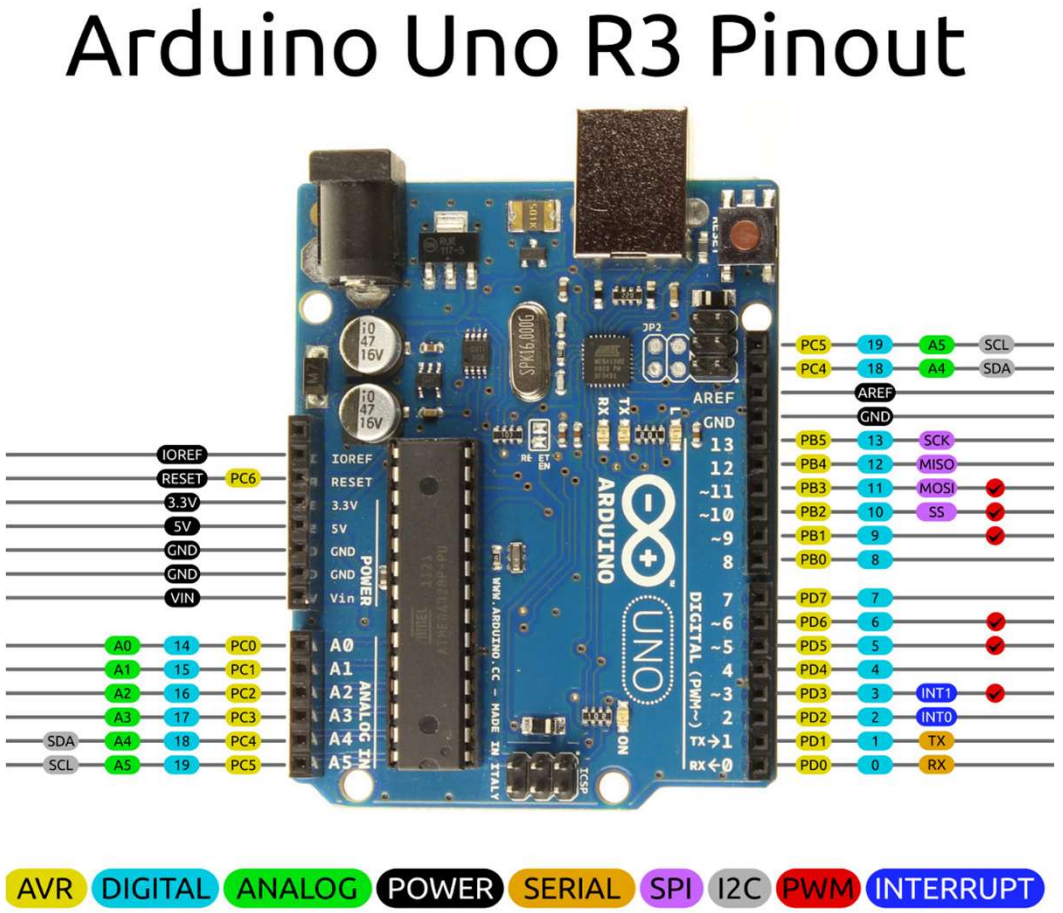
- Make Led on 7 segment start at ‘a’ and follow by ‘b’, and so on…… until ‘g’ with 1 s delay.
- When it reached ‘g’ and go reveres as follow ‘f’ so on…… until back to ‘a’ with 1 s delay.
- Then repeat the process
- Show Circuit diagram / and Coding
  - Tinkercad
  - Real Arduino board

Make LED Off



Chapter 2: Digital Output

- Port Register
  - B (Digital pin 8 to 13)
  - C (Analog input pins)
  - D (Digital pin 0 to 7)



Chapter 2: Digital Output

- DDRx and PORTx map to Arduino digital pins (example x=D)
  - DDRD – The Port D Data Direction Register – read/write
    - Input : 0, Output : 1
  - PORTD – The Port D Data Register – read/write
    - Low : 0, High : 1

Chapter 2: Digital Output

- Example set Digital Output Pin(2 – 8)

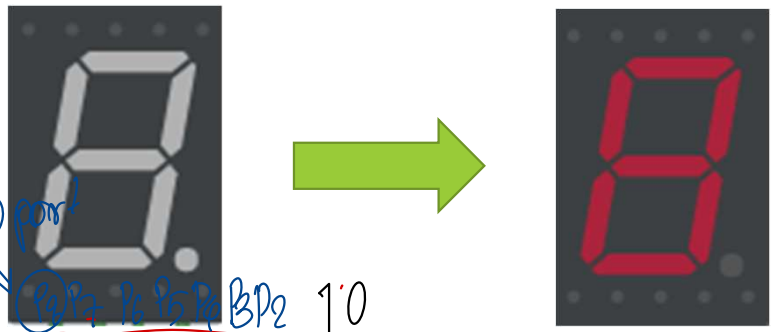
```
void setup()
{
 DDRD =      ;  //Set pin 2-8    to be Output
 PORTD =     ; // Set Digital output pin 2-8
}
void loop()
{

}
```

hex

DDRD= 0XFC;

DDRB= 0X01;



Show 4; 1100110XX

PORTD=0X26;<<2

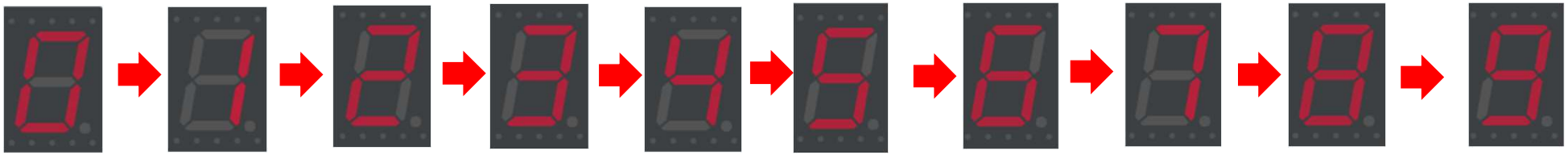
PORTB=0X01;

g	f	e	D	c	b	a	HEX	7SEG
0	1	1	1	1	1	1	3F	0
0	0	0	0	1	1	0	06	1
1	0	1	1	0	1	1	5B	2
1	0	0	1	1	1	1	4F	3
1	1	0	0	1	1	0	66	4
1	1	0	1	1	0	1	6D	5
1	1	1	1	1	0	1	7D	6
0	0	0	0	1	1	1	07	7
1	1	1	1	1	1	1	7F	8
1	1	0	1	1	1	1	6F	9

Chapter 2: Digital Output

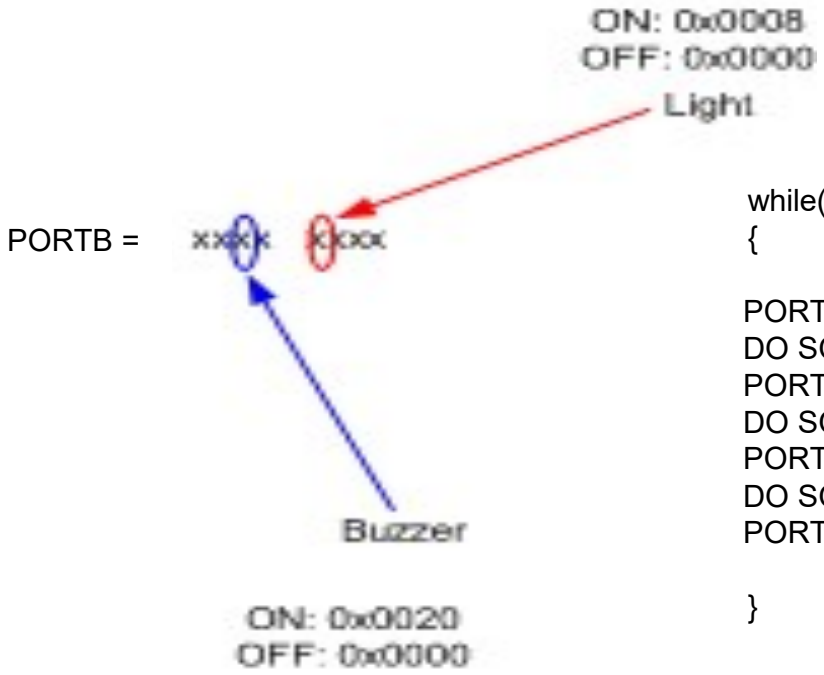
Example 2.9: Use DDRx, PORTx registers

- 7 Segment running 0 – 9 and repeat with delay of 1 second
- Pins starting from Pin2 to Pin 8
- Show Circuit diagram / and Coding
  - Tinkercad
  - Real Arduino board



Why need |= and &=

***Consider 2 different outputs are in the same port



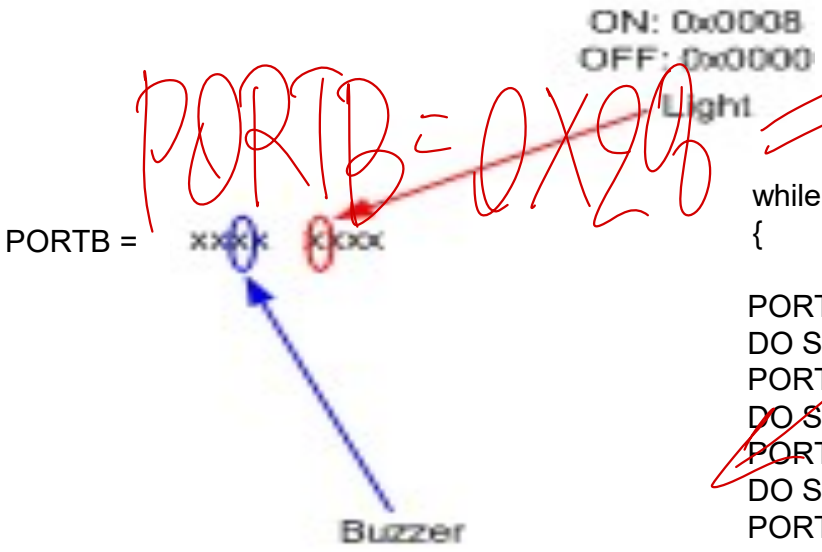

```
while(1)
{

PORTB = 0x0008;  //ON THE LIGHT;
DO SOMETHING;
PORTB = 0x0020; //ON THE ON BUZZER;
DO SOMETHING;
PORTB = 0x0000; //OFF THE BUZZER;
DO SOMETHING;
PORTB = 0x0000; //OFF THE LIGHT;

}
```

ANYTHING WRONG???

Why need |= and &=



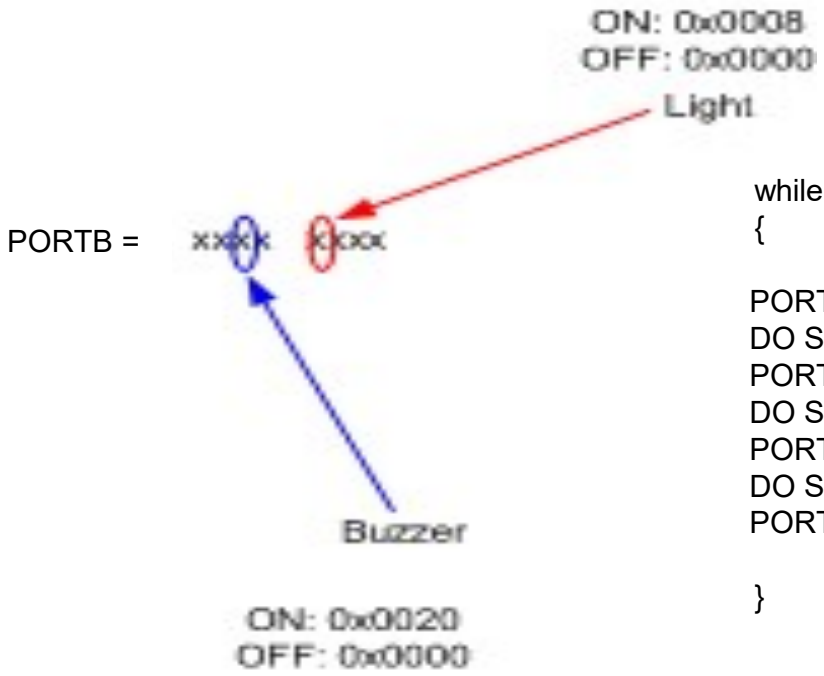

```
while(1)
{

PORTB |= 0x0008;  //ON THE LIGHT;
DO SOMETHING;
PORTB |= 0x0020; //ON THE ON BUZZER;
DO SOMETHING;
PORTB &= ~(0x0020); //OFF THE BUZZER;
DO SOMETHING;
PORTB &= ~(0x0008); //OFF THE LIGHT;

}
```

ISN"T OK???

Why need |= and &=




```
while(1)
{

PORTB |= 0x0008;  //ON THE LIGHT;
DO SOMETHING;
PORTB |= 0x0020; //ON THE ON BUZZER;
DO SOMETHING;
PORTB &= ~(0x0020); //OFF THE BUZZER;
DO SOMETHING;
PORTB &= ~(0x0008); //OFF THE LIGHT;

}
```

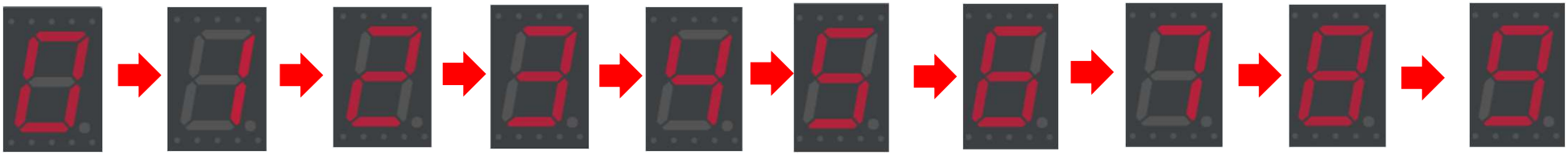
Basically : Force 0 use &=
Force 1 use |=

g	f	e	d	c	b	a	Hex	Dec
1	0	0	0	0	0	0	40	0
1	1	1	1	0	0	1	79	1
0	1	0	0	1	0	0	24	2
0	1	1	0	0	0	0	30	3
0	0	1	1	0	0	1	19	4
0	0	1	0	0	1	0	12	5
0	0	0	0	0	1	1	02	6
1	1	1	1	0	0	0	78	7
0	0	0	0	0	0	0	00	8
0	0	1	1	0	0	0	10	9

Chapter 2: Digital Output

Example 2.10: Any method (DDRx or pinMode, Portx or digitalWrite)

- **CA** 7 Segment running 0 – 9 and repeat with delay of 1 second
- Pins starting from Pin2 to Pin 8
- Show Circuit diagram / and Coding
  - Real Arduino board

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