Lab 01

~~2022/10~~ 2022/10/02

tutorial 01

(01)

① Programming AVR microcontrollers

example → microchip pic, Atmel AVR

freescale semiconductors, intel 8051

① Introduction to AVR microcontroller

* microcontroller → Can perform some specific task

CPU	RAM	ROM
I/O ADC	Timer	Serial Com port

all these units are connected peripherally

Atmel

product family

amount of flash memory in KB (power of 2)

Atmega 328p → include in arduino uno

- 8 bit processor
- 131 instructions
- 32 general purpose registers

③ Status register (SReg)

flag register

8 bit register

corresponding flags are set by the execution of arithmetic or logical instructions

Bit	D_7	D_6	D_5	------	D_1	D_0
SReg	I	T	H	S	V	N	Z	C

C → Carry
Z → zero
N → Negative
V → overflow

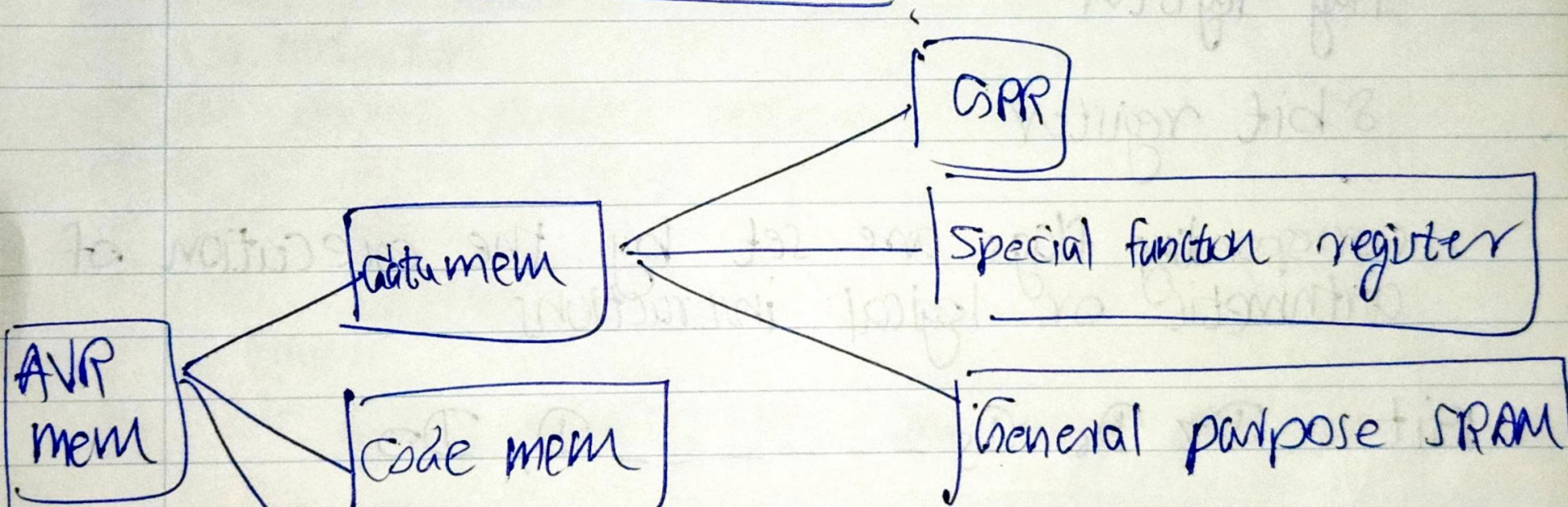
S → Sign
H → Half
T → Bit Copy storage
I → Global interrupt enable

reduced instruction set computer

most of instructions take single clock cycle

2 stage pipeline → fetch
→ execute

(5) AVR memory architecture



SRAM

use for storing data and parameters
called the scratch pad
each location 8 bit

EEPROM

storing data which are changed rarely or should not lost when power is off

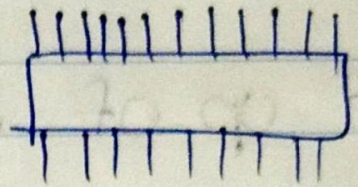
Program memory

- stores the program code
- made up of flash memory
- mem location → 2 byte

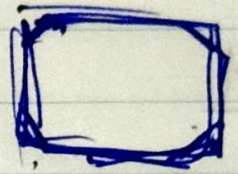
1 byte → 8 bits

✱ different package types

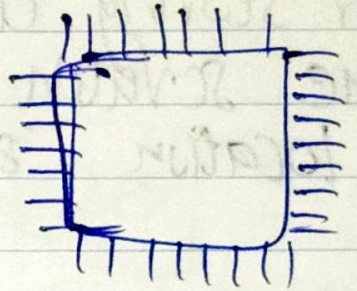
DIP (dual in line) →



MLF (Micro lead frame) →



QFP (Quad flat) →



✱ Pin description

VCC → power supply pin., 5V

port B → 8 bit bidirectional I/O

port C → (PC6:0) 7 bit bidirectional I/O

port D → 8 bit bidirectional I/O → (PD7:0)

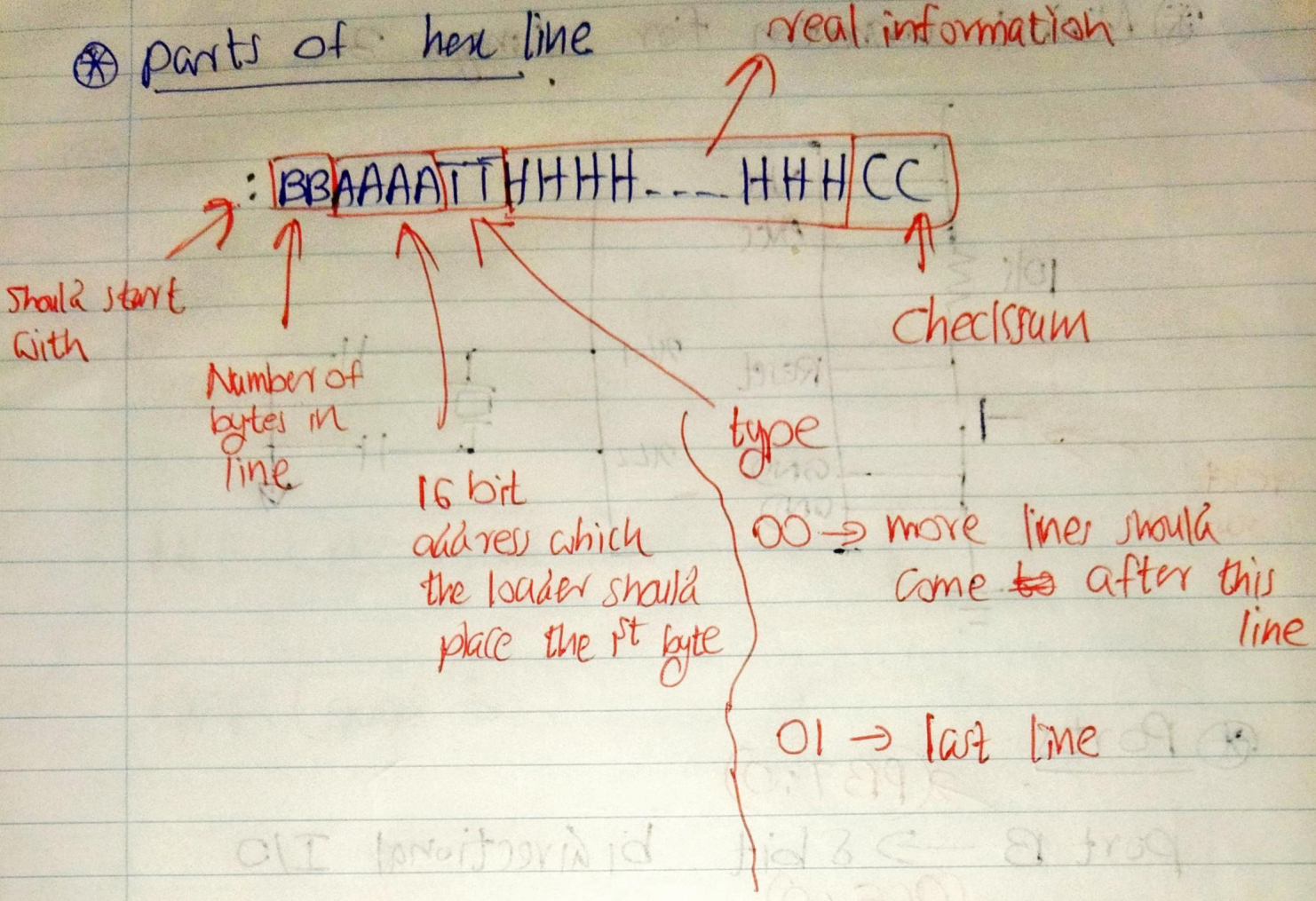
Hex files for AVR

intel hex is a widely used file format for loading of executable machine code into a chip

nations which are included in hex file

Number of bytes of informations to be loaded
Information to be loaded
Starting address where information must be placed.

⊛ Parts of hex line



(6) AVR programming

3 ways to load a program to the Flash memory

⊛ Parallel programming

1. chip is programmed before inserted
2. or the chip is removed and reprogrammed
3. ZIF sockets are used

requires communication port and program space on the microcontroller

④ Advantage → convenience

A

Data types in AVR/C

Type	Size in bits	Data range
unsigned char	8	0 - 255
char	8	-128 - +127
unsigned int	16	0 - 65535
int	16	

Avrgcc install

✳ Examples

① Code for send values 00-FF to port B

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

int main(void){

    unsigned char z;
    DDRB=0xFF;
    for(z=0; z<=255; z++){
        PORTB=z;
    }

    return 0;

}
```

✳ Example 02

Blinking led with binary values upto 15

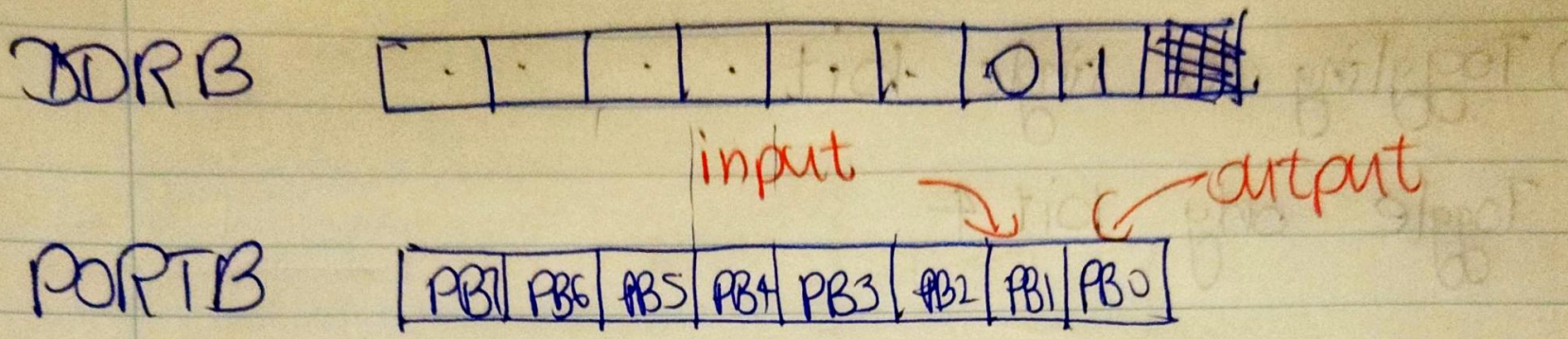
```
0000
0001
0010
0011
0100
0101
0110
0111
1000
1001
1010
1011
1100
1101
1110
1111
```

```
DDRB=0x0F;
for(z=0;z<15;z++){
    PORTB=z;
    _delay_ms(BLINK_
        DELAY_MS);
}
return 0;
```

at 1 → ball on
0 → ball off

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

#define BLINK_DELAY_
        MS 2000
int main(void){
    unsigned char z;
```



to make PB0 as output DDRB0 = 1
PB0 as input DDRB0 = 0

✱ PINB

Use when the port ! should be input

✱ Setting a single bit

way to accessing only one bit

✱ set only bit 4

No: Date: / /

✱ Clearing a single bit

clearing bit 4

```
PORTB = PORTB & ~(1<<4)
```

✱ Toggling a single bit

Toggle only bit 4

```
PORTB = PORTB ^ (1<<4)
```

✱ Checking a single bit

Checking if bit 4 set to 1

① `if ((PORTB >> 4) & 1) { }`

② `if (PORTB & (1<<4)) { }`

✱ Changing multiple bits

```
PORTB = PORTB | ((1<<2) | (1<<4))
```