C Programming part 2

Bitwise operators – defined for char, short, int, long

Very commonly used in embedded system programming!

Shift right	>>	Positions are filled with zeros } Shift
Shift left	<<	
Bitwise AND	&	} Logical.
Bitwise OR	|	
Bitwise exclusiveOR	^	
Bitwise negation	~	

Examples:

```
int a = 11; //Decimal
int b = 0x000B; //Hexa
```

Binary:

0000 0000 0000 1011 — int represented on 16 bits

0 0 0 B

Hexadecimal:

0x000B

```
char c1 = 0xF3;  //Binary: 11110011
char c2 = 0x54;  //Binary: 01010101
char c3 = c1 & c2; //Binary: 01010001  which is 0x51

char c4, c5, c6, c7;
c4 = c2 | c3;  //Binary: 01010101  which is 0x55
c5 = ~c4;      //Binary: 10101010  which is 0xAA
c6 = c4 ^ c5;  //Binary: 11111111  which is 0xFF
c7 = c6 << 3;  //Result is: 11111000  which is 0xF8
c7 = c6 >> 2;  //Result is: 00111111  which is 0x3F
```

```
C7 = 0x10;    // 00010000 in binary and 16 in decimal.
C8 = C7>>1;   // 00001000 binary and 8 decimal
C8 = C7>>2;   // 00000100 binary and 4 decimal
```

Note: Shift to the right by 1 bit means division by 2, by 2 bits means division by 4 ($=2^2$), etc.

```
C8 = C7<<1;   // 00100000 binary and 32 decimal
```

Note: Shift to the left by 1 bit means multiplication by 2, by 2 bits means multiplication by 4, etc.

```
#define MASK_BIT_3 0x08    // 00001000
```

Bit 0 LSB, Bit 1, Bit 2, Bit 3

```
char a = 0x55;             // 01010101
char b = a | MASK_BIT_3;   // 01011101
```

sets this bit to '1'!

what if I want to set a particular bit to '0'?

```
#define MASK_BIT_3_TO_ZERO 0xF7    // 11110111
char a = 0x0F;                     // 00001111
char b = a & MASK_BIT_3_TO_ZERO;   // 00000111
```

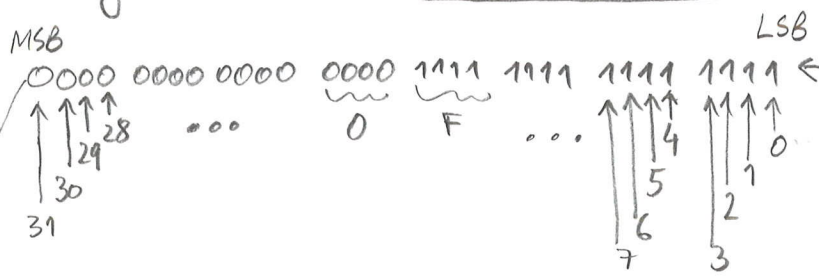
Bit 3

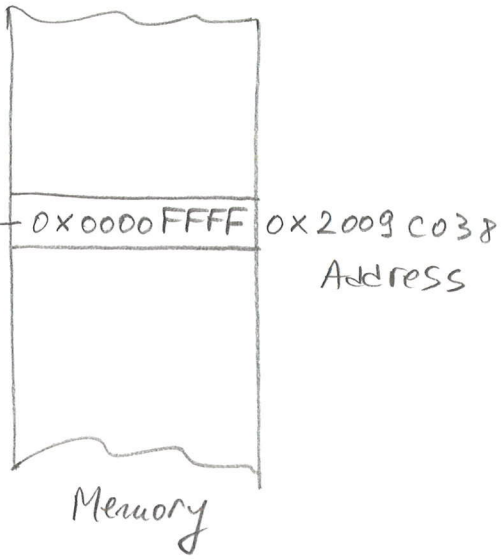
sets this bit to '0'!

Example:

```
FIO1SET   EQU 0x2009C038
LDR  R1, =FIO1SET
LDR  R3, [R1]
ORR  R3, #0x10000000
STR  R3, [R1]
```

Register R3 after `LDR R3,[R1]`





Register R3 after `ORR R3, #0x1000 0000`

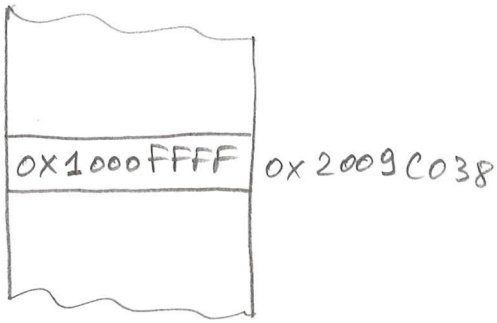
0001 0000 0000

Bitwise OR! with mask

this is basically a mask used to set bit index 28 to '1'.

0001 0000 0000 0000 1111 1111 1111 1111

Memory contents after `STR R3, [R1]`



Functions - a 1st encounter

Function **decleration**: (usually done inside a header file .h)

```
int my_adder(int a, int b);
```

- int: function returns an integer
- my_adder: function name or identifier
- int a, int b: two parameters or arguments

Function description or definition: (usually done inside a source file .c)

```
int my_adder (int a, int b)
{
    int temp c = 0;
    c = a+b;
    return c;
}
```

Function call:

```
...
int one = 3;
int two = 7;
int res = 0;
res = my_adder (one, two);  //result is 10 ☺
```

Pointers - a 1st encounter

- A pointer is a variable which takes addresses as values.
- We declare a pointer like any other variable but with the difference that we use *.

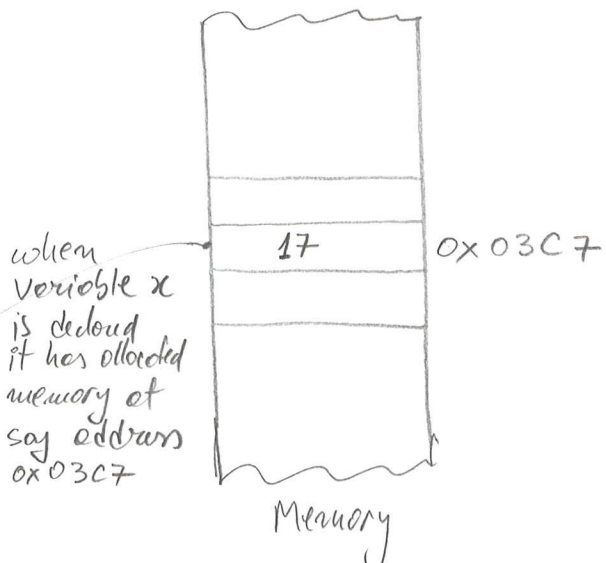
asterisk sign

Example:

```
int *p;
```

name of variable pointer

establishes that p contains addresses of memory locations where we have stored data of type int.




```
int x = 17;
p = &x;  //give p the address of x ! p stores or has value 0x03C7
```

```
int y = 3, z = 4;
y = x + 2 ;  // y gets value 19
y = *p + 2 ;  // y gets value 19
```

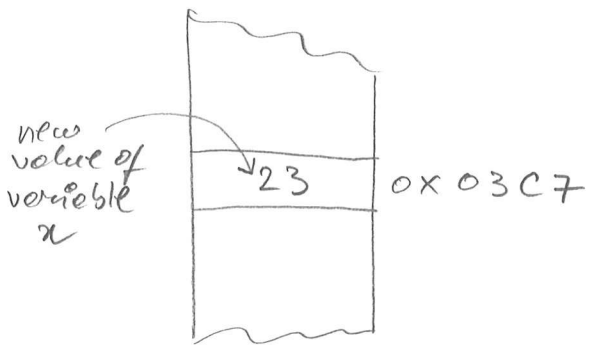
} identical assignments!

Dereferencing operator ≡ provides the value stored in memory location whose address is the value of variable P!

```
p = &x;
```

Referencing or **address operator** ≡ gives/assigns to pointer variable p a value which is the address of memory location where variable x is stored!

```
*p = 23; // changes the contents of variable x, that is
         // the contents of memory location where x is
         // stored!
```




```
z = *p + x ; // z becomes 46
```

Question

what does this do?

```
z = *&x ;  // z gets assigned value 23!
```

***&x ≡ x**

address of variable x

contents of mem. location with this address; that is value of x!