CS 315-02 Lab Bits

Project03 overview

Bit Manipulation

In C → bitwise operators

binary bits

0	1
unset	set
low	high
off	on
false	true

byte 8 bits

least significant bit
lsb

Most significant bit
msb

7							0
1	1	0	1	1	0	0	1
128	64	32	16	8	4	2	1

128 + 64 + 16 + 8 + 1 = 217

Word 32 bits

31 24	23 16	15 8	7 0
FF	AA	11	22
byte 3	byte 2	byte 1	byte 0

0xFFAA11 22

Bitwise operators

AND &   OR | NOT ~   XOR ^

a	b	a&b
0	0	0
0	1	0
1	0	0
1	1	1

a	b	a|b
0	0	0
0	1	1
1	0	1
1	1	1

a	~a
0	1
1	0

a	b	a^b
0	0	0
0	1	1
1	0	1
1	1	0

```
uint8_t a, b;

a = 0b1100 1010
b = 0b10011001
```

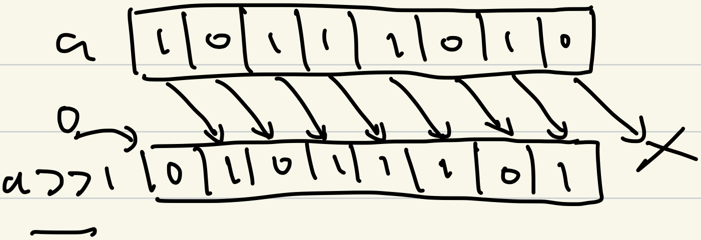
Shifts

$<<$ Left shift

$>>$ Right shift

$a << n$
↑ number of bits

$a >> n$
↑ num of bits



```
t0  1111
a0  0110
--------
    1001
```

Assembly

and / andi

or / ori

xor / xori

sll / slli

srl / srli

not

```
not  li   t0, -1
     xor  a0, a0, t0
```

```
      1 11
  11110111
+ 00000001
----------
  11111000
```

ProjectOS

calling strlen

```
.global strlen

foo:
                ← preserve
        # a0 ← addr
        call strlen
               ↖ a0, a1, .., t0, t1,
                ← restore
```