Computer Programming 1 Lab

2020-12-17

Outline

- bitwise operations
- Examples
- Exercise11

bitwise operations

bitwise operations

0x (zero X) prefix

- A prefix to indicate the number is in hexadecimal
- Often used to show memory address.

example:

```c
int a = 7414;
if(a == 0x1CF6){    // 7414 in hex
    printf("True\n");
}
else{
    printf("False\n");
}
return 0;
```

results:

```
darkknive@1091cp1:~$ gcc ./main.c
darkknive@1091cp1:~$ ./a.out
True
darkknive@1091cp1:~$
```

bitwise operations

operators

- AND(`&`)
- OR(`|`)
- NOT(`~`)
- XOR(`^`)
- shift operators(`<<` , `>>`)

bitwise operations

operator AND(`&`)

- Only when both bits are 1 will result in 1.

<div class="center">

	0	**1**
0	0	0
1	0	1

</div>

example:

```
int a = 0x0000000F;
a &= 0x0000000A;    //  a = a & 0x0000000A
printf("%d\n", a);
```

results:

```
darkknive@1091cp1:~$ gcc ./main.c
darkknive@1091cp1:~$ ./a.out
10
darkknive@1091cp1:~$
```

<div class="center">

F	1	1	1	1
A	1	0	1	0
results	1	0	1	0

</div>

bitwise operations

operator OR(`|`)

- Either one of two bits is 1 will result in 1.

<div class="center">

	0	**1**
0	0	1
1	1	1

</div>

example:

```c
int a = 0x00000006;
a |= 0x0000000A;    //  a = a | 0x0000000A;
printf("%d\n", a);
```

results:

```
darkknive@1091cp1:~$ gcc ./main.c
darkknive@1091cp1:~$ ./a.out
14
darkknive@1091cp1:~$
```

<div class="center">

6	0	1	1	0
A	1	0	1	0
results	1	1	1	0

</div>

bitwise operations

operator NOT(`~`)

- Not operation will negate the bit

<div class="center">

	0	1
~	1	0

</div>

example:

```c
int a = 0xFFFFFFFA;
a = ~a;
printf("%d\n", a);
```

results:

```
darkknive@1091cp1:~$ gcc ./main.c
darkknive@1091cp1:~$ ./a.out
5
darkknive@1091cp1:~$
```

<div class="center">

F	1	1	1	1
results	0	0	0	0

A	1	0	1	0
results	0	1	0	1

</div>

bitwise operations

operator XOR(`^`)

- Only when one of the bits is 1 will result in 1.

<div class="center">

	0	**1**
0	0	1
1	1	0

</div>

example:

```c
int a = 0x00000006;
a ^= 0x0000000A;    //  a = a ^ 0x0000000A;
printf("%d\n", a);
```

results:

```
darkknive@1091cp1:~$ gcc ./main.c
darkknive@1091cp1:~$ ./a.out
12
darkknive@1091cp1:~$
```

<div class="center">

6	0	1	1	0
A	1	0	1	0
results	1	1	0	0

</div>

bitwise operations

operator shift(`<<` , `>>`)

- the least-significant bit is lost
- 0 is inserted on the other end

example:

```c
int a = 0x000000F1;
a >>= 2;    //  a = a >> 2;
printf("%d\n", a);
a <<= 2;    //  a = a << 2;
printf("%d\n", a);
```

results:

```
darkknive@1091cp1:~$ gcc ./main.c
darkknive@1091cp1:~$ ./a.out
60
240
darkknive@1091cp1:~$
```

<div class="center">

0xF1	1	1	1	1	0	0	0	1
>>=2	0	0	1	1	1	1	0	0

0x3C	0	0	1	1	1	1	0	0
<<=2	1	1	1	1	0	0	0	0

</div>

bitwise operations

example:

A list of numbers is given, and every number appears twice except one. Please find out which one is it.

bitwise operations

example:

method 1

Put every number into a list, sort and find which number only appears once.

Time complexity: O(NlogN)

bitwise operations

example:

method 2

Start with 0, and do XOR operation with each number read.

Time complexity: O(N)

bitwise operations

example:

method 2

```
int a = 0;
int tmp;
while(scanf("%d", &tmp) != EOF){
    a ^= tmp;
}
printf("%d\n", a);
```

Exercise11

Any Question?

Course? Assignment? Exercise? TA?