C语言位运算

GCC 编译命令

```
gcc -o bit_opts.exe bit_opts.c
gcc -g -o bit_opts.exe bit_opts.c   # GDB Debugging
```

任务一：将输入的一个无符号整数的第 i 位置 0 或置 1

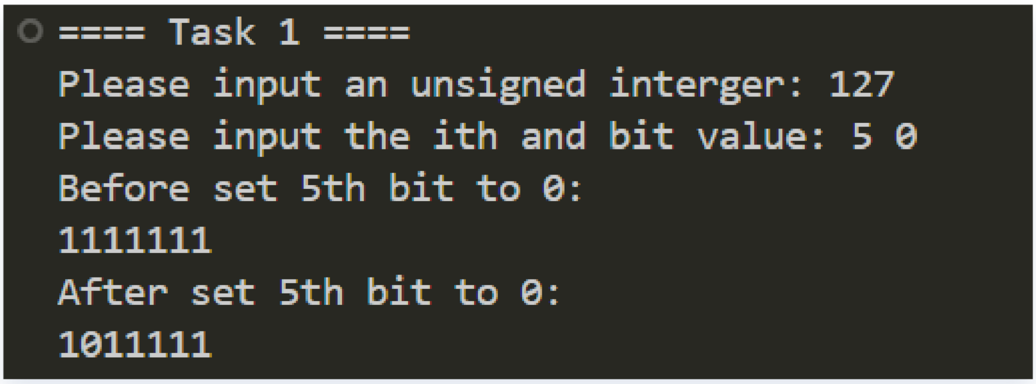
函数设计

```c
void Task1()
{
    printf("==== Task 1 ====\n");
    unsigned int m = 0, i, num;

    printf("Please input an unsigned interger: ");
        scanf("%u", &m);
    printf("Please input the ith and bit value: ");
    scanf("%u%u", &i, &num);

    printf("Before set %dth bit to %d:\n", i, num);
    PrintBits(m);

    printf("After set %dth bit to %d:\n", i, num);

    if(num == 0) m &= ~(1 << i);
    else m |= (1 << i);

    PrintBits(m);
    printf("\n");

    return ;
}
```

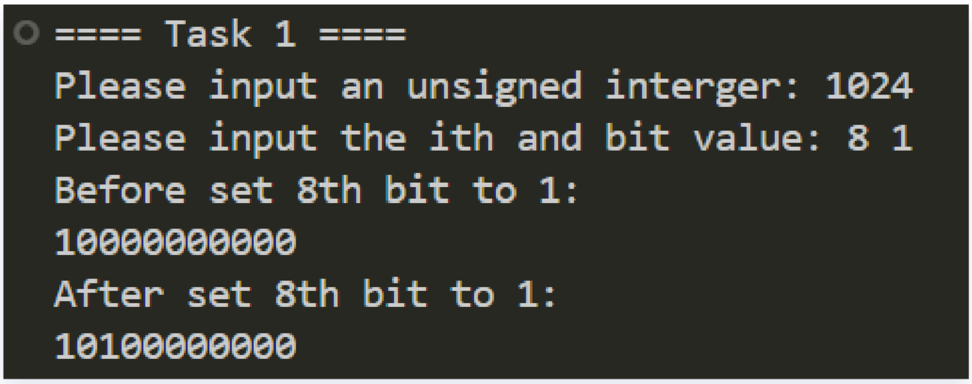
测试数据

- 无符号整数：127，1024
- 比特位：5，8
- 置/复位：0，1

运行结果



```
==== Task 1 ====
Please input an unsigned interger: 127
Please input the ith and bit value: 5 0
Before set 5th bit to 0:
1111111
After set 5th bit to 0:
1011111
```



```
==== Task 1 ====
Please input an unsigned interger: 1024
Please input the ith and bit value: 8 1
Before set 8th bit to 1:
10000000000
After set 8th bit to 1:
10100000000
```

任务二：检测一个无符号整数的第 i 位置是 0 还是 1

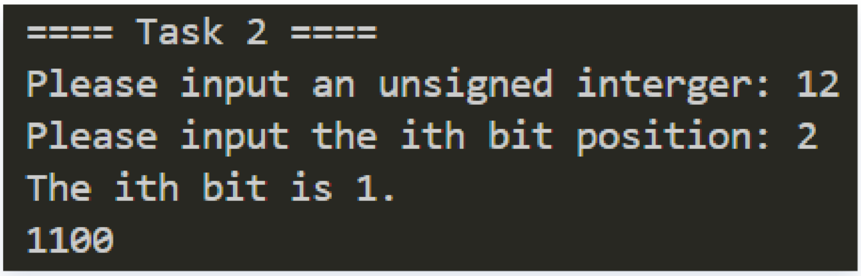
函数设计

```
void Task2()
{
    printf("==== Task 2 ====\n");
    unsigned int m = 0, pos = 0;
    printf("Please input an unsigned interger: ");
    scanf("%u", &m);
    printf("Please input the ith bit position: ");
    scanf("%u", &pos);

    if(m & (1 << pos)) printf("The ith bit is 1.\n");
    else printf("The ith bit is 0.\n");
    PrintBits(m);
    printf("\n");

    return ;
}
```

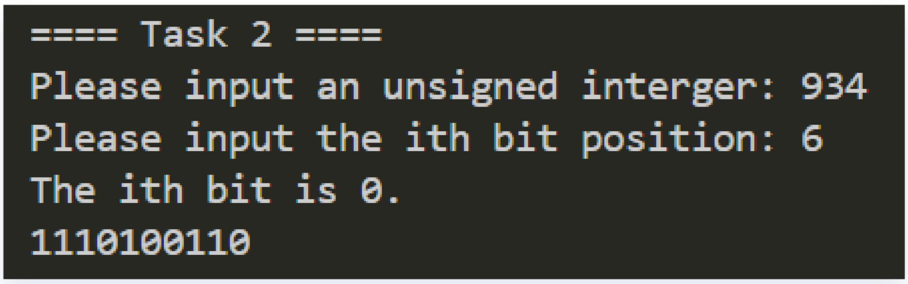
测试数据

- 无符号整数：12，934
- 比特位：2，6

运行结果



```
==== Task 2 ====
Please input an unsigned interger: 12
Please input the ith bit position: 2
The ith bit is 1.
1100
```



```
==== Task 2 ====
Please input an unsigned interger: 934
Please input the ith bit position: 6
The ith bit is 0.
1110100110
```

任务三：在屏幕上输出一个整数的二进制表示

函数设计

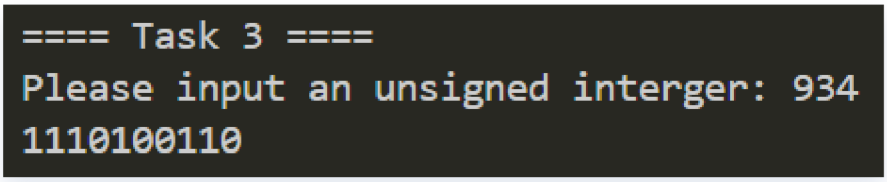
```
void PrintBits(unsigned int m)
{
    bool first = false;
    for(int j=31;j>=0;j--){
        if(m & (1 << j)){
            printf("1");
            first = true;
        }else if(first) printf("0");
    }
```

```c
    printf("\n");
    return ;
}
void Task3()
{
    printf("==== Task 3 ====\n");
    unsigned int m = 0;

    printf("Please input an unsigned interger: ");
    scanf("%u", &m);
    PrintBits(m);
    printf("\n");
    return ;
}
```

测试数据

- 无符号整数：934

测试结果



```
==== Task 3 ====
Please input an unsigned interger: 934
1110100110
```

任务四：将一个16bit 整数转化为 BCD 码表示

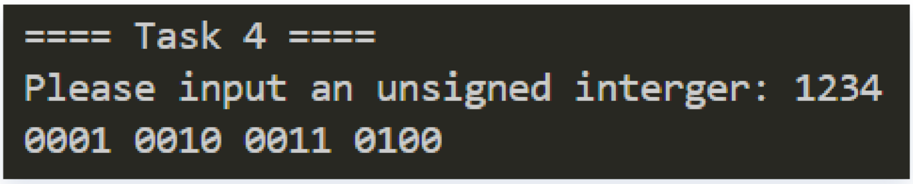
函数设计

```c
void Task4()
{

    printf("==== Task 4 ====\n");
    unsigned int m = 0, n = 0;

    printf("Please input an unsigned interger: ");
    scanf("%u", &m);

    for(int i=0; m > 0; i++){
        n |= ((m % 10) << (4 *  i));
        m /= 10;
    }

    for(int j=15;j>=0;j--){
        if(n & (1 << j)) printf("1");
        else printf("0");
        if(j % 4 == 0 ) printf(" ");
    }

    printf("\n\n");
    return ;
}
```

测试数据

- 16bit 整数：1234

运行结果



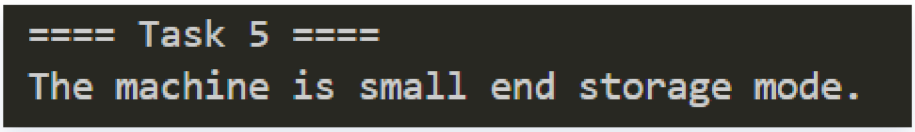
```
==== Task 4 ====
Please input an unsigned interger: 1234
0001 0010 0011 0100
```

任务五：检测当前计算机是大端机还是小端机

函数设计

```
void Task5()
{
    printf("==== Task 5 ====\n");
    union {
        char c;
        int i;
    }un;

    un.i = 1;
    if(un.c == 1) printf("The machine is small end storage mode.\n");
    else printf("The machine is large end storage mode.\n");
    printf("\n");
    return ;

}
```

运行结果



```
==== Task 5 ====
The machine is small end storage mode.
```

任务六：编写一个 C 语言的宏函数，将 4 个 unsigned char 型变量合成一个 unsigned int 型变量

函数设计

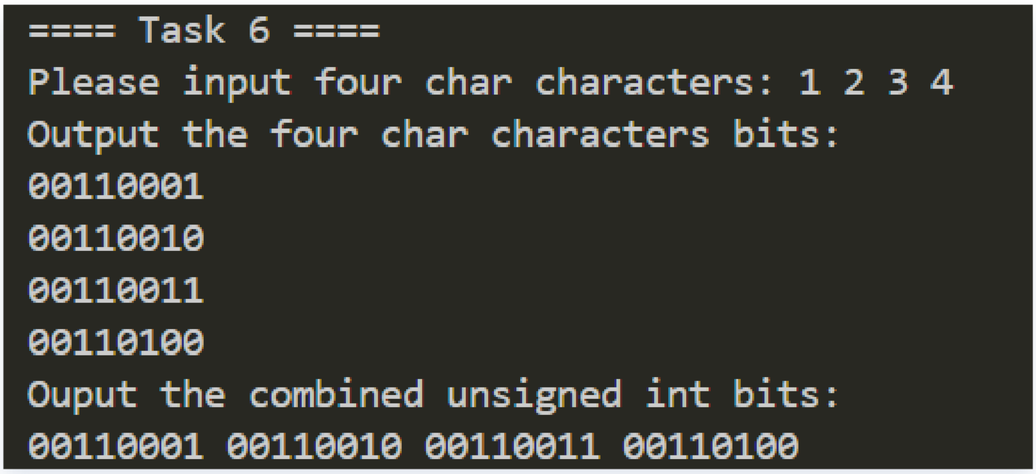
```c
#define COMBINE_BYTES(a, b, c, d) ((unsigned int)((a << 24) | (b << 16) | (c << 8) | d))
void Task6()
{
    printf("==== Task 6 ====\n");
    unsigned char a, b, c, d;
    printf("Please input four char characters: ");
    scanf(" %c %c %c %c", &a, &b, &c, &d);
    printf("Output the four char characters bits:\n");

    void print(unsigned char n){
        for(int j=7;j>=0;j--){
            if(n & (1 << j)) printf("1");
            else printf("0");
        }
        printf("\n");
        return ;
    }
    print(a);
    print(b);
    print(c);
    print(d);

    unsigned int m;
    m = COMBINE_BYTES(a, b, c, d);
    printf("Ouput the combined unsigned int bits:\n");
    for(int j=31;j>=0;j--){
        if(m & (1 << j)) printf("1");
        else printf("0");
        if(j % 8 == 0 ) printf(" ");
    }
    printf("\n");
```

```
        return ;

    }
```

测试数据

- 数字字符：'1', '2', '3', '4'

运行结果



```
==== Task 6 ====
Please input four char characters: 1 2 3 4
Output the four char characters bits:
00110001
00110010
00110011
00110100
Ouput the combined unsigned int bits:
00110001 00110010 00110011 00110100
```

完整源代码

```
#include<stdio.h>
#include<stdbool.h>
#define COMBINE_BYTES(a, b, c, d) ((unsigned int)((a << 24) | (b << 16) | (c << 8) | d))

void PrintBits(unsigned int m)
{
    bool first = false;
    for(int j=31;j>=0;j--){
        if(m & (1 << j)){
            printf("1");
            first = true;
        }else if(first) printf("0");
    }
    printf("\n");
    return ;
}

void Task1()
```

```
{
    printf("==== Task 1 ====\n");
    unsigned int m = 0, i, num;

    printf("Please input an unsigned interger: ");
        scanf("%u", &m);
    printf("Please input the ith and bit value: ");
    scanf("%u%u", &i, &num);

    printf("Before set %dth bit to %d:\n", i, num);
    PrintBits(m);

    printf("After set %dth bit to %d:\n", i, num);

    if(num == 0) m &= ~(1 << i);
    else m |= (1 << i);

    PrintBits(m);
    printf("\n");

    return ;
}
void Task2()
{
    printf("==== Task 2 ====\n");
    unsigned int m = 0, pos = 0;
    printf("Please input an unsigned interger: ");
    scanf("%u", &m);
    printf("Please input the ith bit position: ");
    scanf("%u", &pos);

    if(m & (1 << pos)) printf("The ith bit is 1.\n");
    else printf("The ith bit is 0.\n");
    PrintBits(m);
    printf("\n");

    return ;
}

void Task3()
{
    printf("==== Task 3 ====\n");
    unsigned int m = 0;

    printf("Please input an unsigned interger: ");
    scanf("%u", &m);
```

```c
    PrintBits(m);
    printf("\n");
    return ;
}

void Task4()
{

    printf("==== Task 4 ====\n");
    unsigned int m = 0, n = 0;

    printf("Please input an unsigned interger: ");
    scanf("%u", &m);

    for(int i=0; m > 0; i++){
        n |= ((m % 10) << (4 *  i));
        m /= 10;
    }

    for(int j=15;j>=0;j--){
        if(n & (1 << j)) printf("1");
        else printf("0");
        if(j % 4 == 0 ) printf(" ");
    }

    printf("\n\n");
    return ;
}
void Task5()
{
    printf("==== Task 5 ====\n");
    union {
        char c;
        int i;
    }un;

    un.i = 1;
    if(un.c == 1) printf("The machine is small end storage mode.\n");
    else printf("The machine is large end storage mode.\n");
    printf("\n");
    return ;

}
void Task6()
{
    printf("==== Task 6 ====\n");
    unsigned char a, b, c, d;
    printf("Please input four char characters: ");
    scanf(" %c %c %c %c", &a, &b, &c, &d);
    printf("Output the four char characters bits:\n");

    void print(unsigned char n){
        for(int j=7;j>=0;j--){
            if(n & (1 << j)) printf("1");
            else printf("0");
        }
        printf("\n");
        return ;
    }
    print(a);
    print(b);
    print(c);
    print(d);

    unsigned int m;
    m = COMBINE_BYTES(a, b, c, d);
    printf("Ouput the combined unsigned int bits:\n");
    for(int j=31;j>=0;j--){
        if(m & (1 << j)) printf("1");
        else printf("0");
        if(j % 8 == 0 ) printf(" ");
    }
    printf("\n");
    return ;

}
int main()
{
    // running tasks in turn
    Task1();
    Task2();
    Task3();
    Task4();
    Task5();
    Task6();
    return 0;
}
```