S&T2024 Advanced C Tutorial 2

21 May 2025 Wednesday 2pm, PGPR

1. What are the results of the following expressions ?
   (Assume all numbers are in bases 16.)

   (i) b4 & 08
   (ii) b4 | 08
   (iii) c4 ^ 08
   (iv) f0 >> 4
   (v) 14 << 2

2. What are the results of the following expressions ?
   (Assume all numbers are in bases 16.)

   (i) bc & 08
   (ii) 07 | d0
   (iii) bc ^ 08
   (iv) 80 >> 1
   (v) 8f << 3

3. An integer n is a multiple of 128 provided it can be expressed as

   $$n = i * 128 \quad \text{where i is an integer.}$$

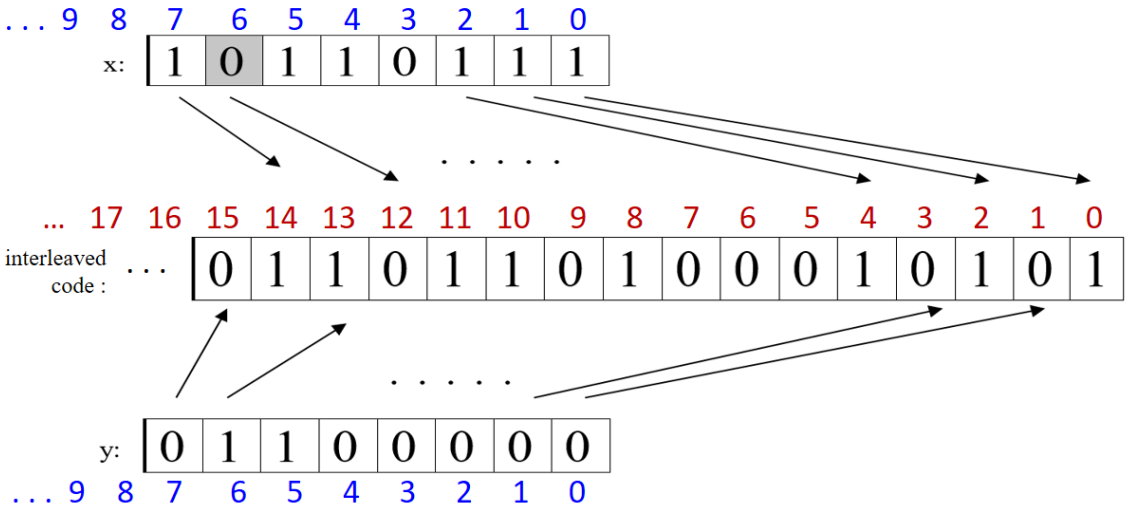
   Write a program to accept an integer from the keyboard and use bit operators to determine if the integer entered is a multiple of 128.

4. Bit-wise interleaving is often used in spatial database to map a multi-dimensional coordinate to a 1-dimensional coordinate. For example, the 2-dimensional coordinate (183, 96) is mapped to 27925 as illustrated below.

   (In the following illustrations all base-2 notations are 32-bit unsigned integer.)

   $x = 183 = 10110111_{(2)}$
   $y = 96 = 01100000_{(2)}$

   interleaved code = $\ldots.0000011011010001010 1_{(2)} = 27925$



Write a program named as **merge.c** to read two unsigned integers in the demarcated range {0,1,2,3, .., 65535} from the keyboard and display the decimal and the binary contents of their interleaved contents. The program will repeat the execution until the user selects not to continue.

Assume that the x, y values are not greater than 65535. Consequently, your program will have to repeat the data entry if x or y is greater than 65535. The interleaved contents composed from the two numbers should be stored in an unsigned integer.

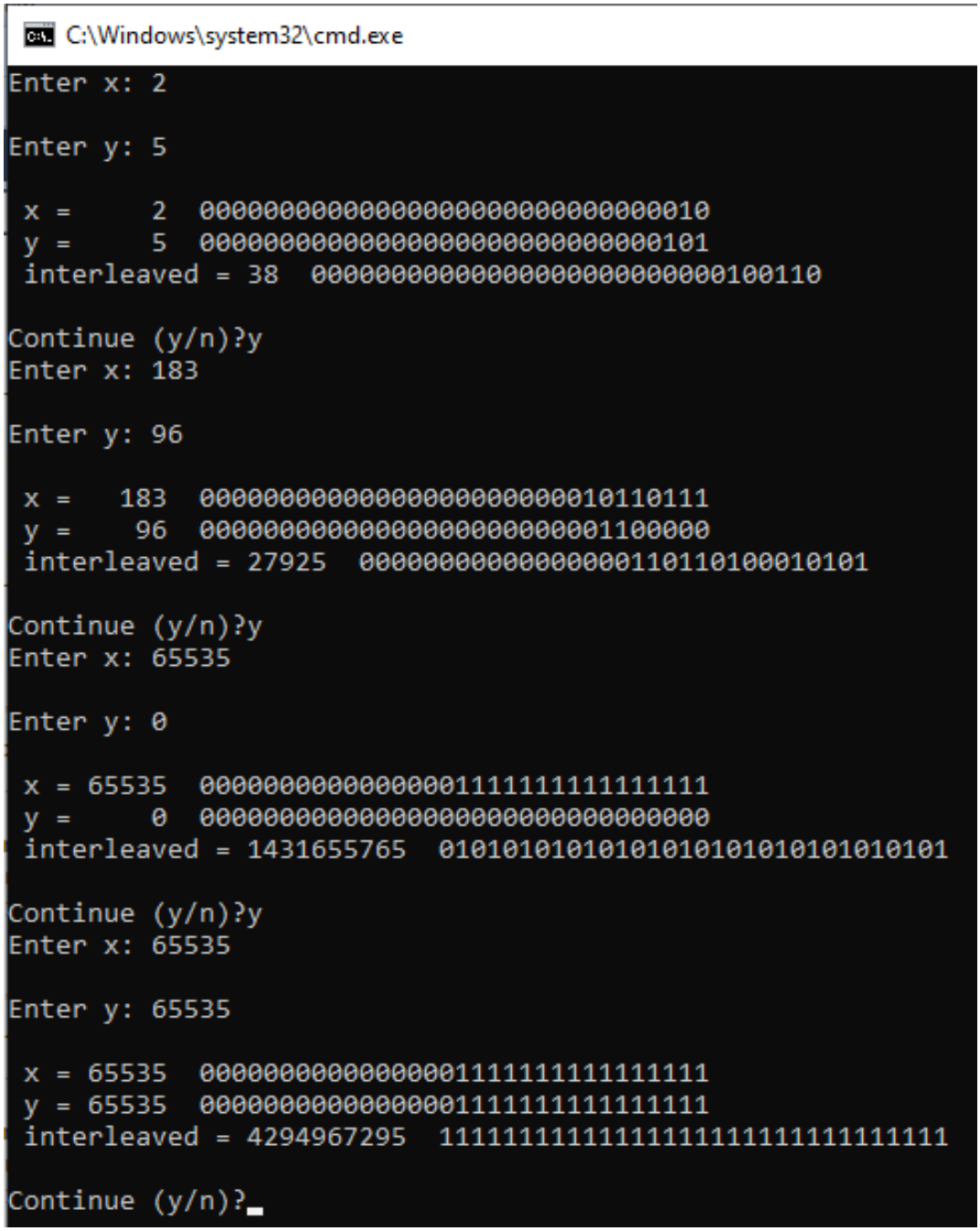
The program execution is shown as follows:

```
C:\Windows\system32\cmd.exe
Enter x: 65536
Enter x: -887
Enter x: 798865
Enter x: 65535

Enter y: 0

 x = 65535  00000000000000001111111111111111
 y =     0  00000000000000000000000000000000
 interleaved = 1431655765  01010101010101010101010101010101

Continue (y/n)?
```


C:\Windows\system32\cmd.exe
Enter x: 2
Enter y: 5
x = 2 00000000000000000000000000000010
y = 5 00000000000000000000000000000101
interleaved = 38 00000000000000000000000000100110
Continue (y/n)?y
Enter x: 183
Enter y: 96
x = 183 00000000000000000000000010110111
y = 96 00000000000000000000000001100000
interleaved = 27925 00000000000000000110110100010101
Continue (y/n)?y
Enter x: 65535
Enter y: 0
x = 65535 00000000000000001111111111111111
y = 0 00000000000000000000000000000000
interleaved = 1431655765 01010101010101010101010101010101
Continue (y/n)?y
Enter x: 65535
Enter y: 65535
x = 65535 00000000000000001111111111111111
y = 65535 00000000000000001111111111111111
interleaved = 4294967295 11111111111111111111111111111111
Continue (y/n)?