

Binary Numbers in C (6A)

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Format String

2^7 2^6 2^5 2^4 2^3 2^2 2^1 2^0

0	1	0	0	0	0	0	1
---	---	---	---	---	---	---	---



```
#include <stdio.h>
```

```
void main() {  
    unsigned char x;
```

```
    x = 65;
```

```
    printf("x in decimal      = %d \n", x);
```

```
    printf("x in hexadecimal = %x \n", x);
```

```
    printf("x in octal       = %o \n", x);
```

```
    printf("x in ASCII char  = %c \n", x);
```

```
}
```

2^7 2^6 2^5 2^4 2^3 2^2 2^1 2^0

0	1	0	0	0	0	0	1
---	---	---	---	---	---	---	---

x in decimal = 65

x in hexadecimal = 41

x in octal = 101

x in ASCII char = A

Singed & Unsigned Numbers

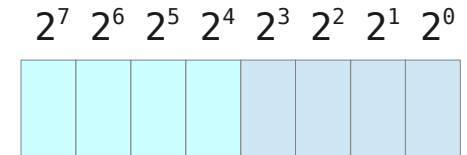
unsigned char x;
(signed) **char** y;

```
-----  
x = 127 0x7f    y = +127 0x0000007f  
x = 128 0x80    y = -128 0xffffffff80  
x = 129 0x81    y = -127 0xffffffff81  
-----  
x = 255 0xff    y = -1 0xffffffffff  
-----  
x = 128 0x80    y = -128 0xffffffff80  
x = 129 0x81    y = -127 0xffffffff81  
x = 130 0x82    y = -126 0xffffffff82  
-----  
x = 255 0xff    y = -1 0xffffffffff
```

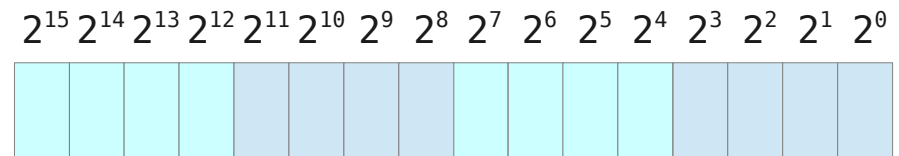
```
printf("-----\n");  
x = y = 127;  
printf("x = %d %#0x  y = %+5d %#010x\n", x, x, y, y);  
x = y = 128;  
printf("x = %d %#0x  y = %+5d %#010x\n", x, x, y, y);  
x = y = 129;  
printf("x = %d %#0x  y = %+5d %#010x\n", x, x, y, y);  
printf("-----\n");  
x = y = 255;  
printf("x = %d %#0x  y = %+5d %#010x\n", x, x, y, y);  
printf("-----\n");  
y = x = -128;  
printf("x = %d %#0x  y = %+5d %#010x\n", x, x, y, y);  
y = x = -127;  
printf("x = %d %#0x  y = %+5d %#010x\n", x, x, y, y);  
y = x = -126;  
printf("x = %d %#0x  y = %+5d %#010x\n", x, x, y, y);  
printf("-----\n");  
y = x = -1;  
printf("x = %d %#0x  y = %+5d %#010x\n", x, x, y, y);
```

Unsigned Integer Numbers in 1, 2, 4 Bytes

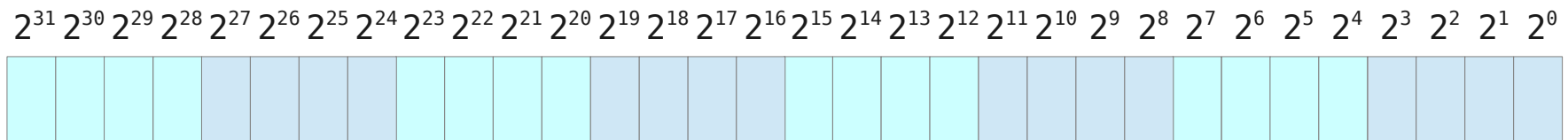
1 Byte : unsigned char



2 Bytes: unsigned short



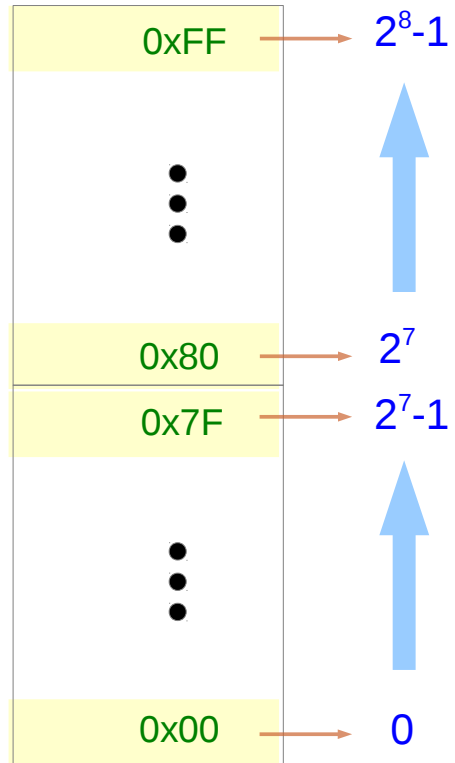
4 Bytes: unsigned int
unsigned long



Unsigned Integer Ranges

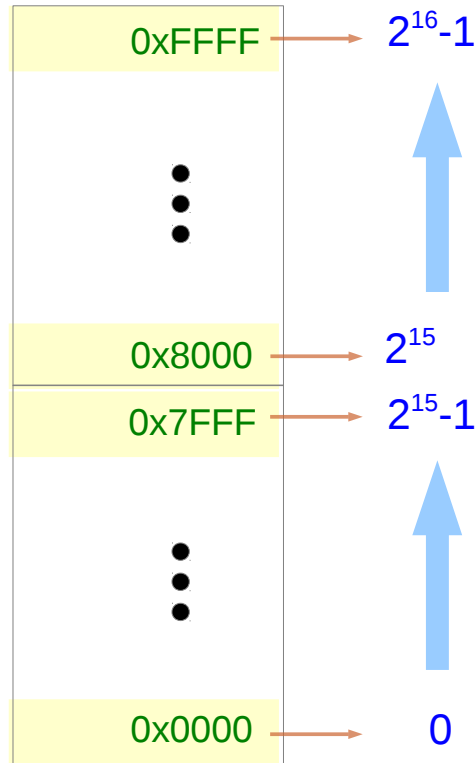
1 Byte

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
-------	-------	-------	-------	-------	-------	-------	-------



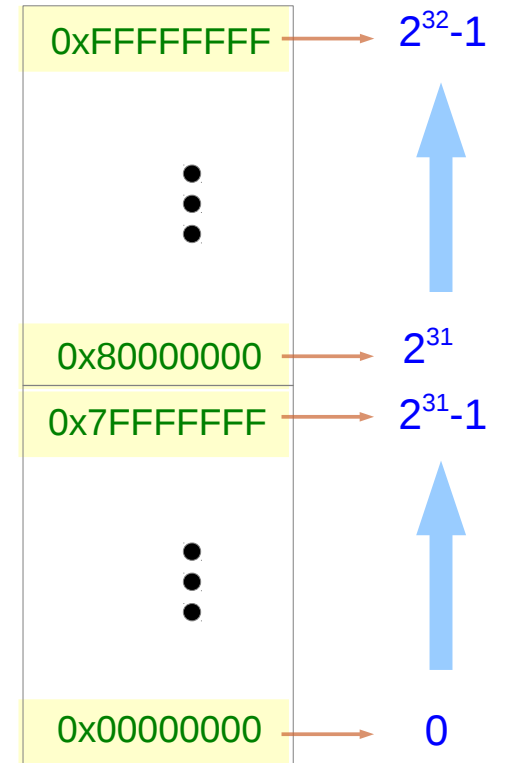
2 Bytes

2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0



4 Bytes

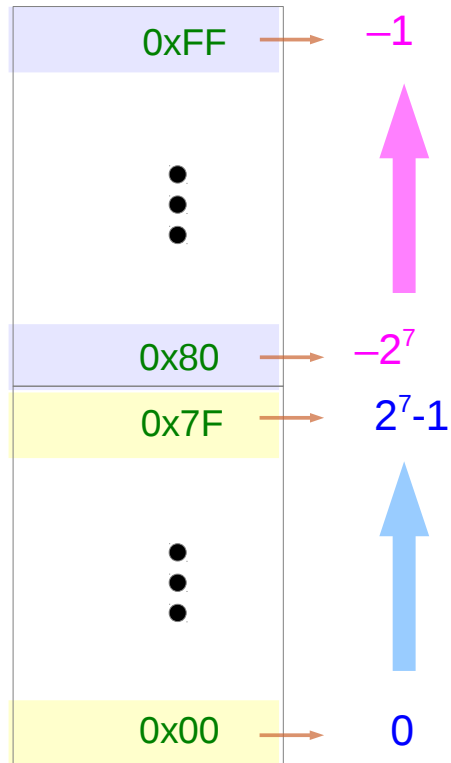
2^{31}	2^{30}	2^{29}	2^{28}	2^{27}	2^{26}	2^{25}	2^{24}
2^{23}	2^{22}	2^{21}	2^{20}	2^{19}	2^{18}	2^{17}	2^{16}
2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0



Signed Integer Ranges

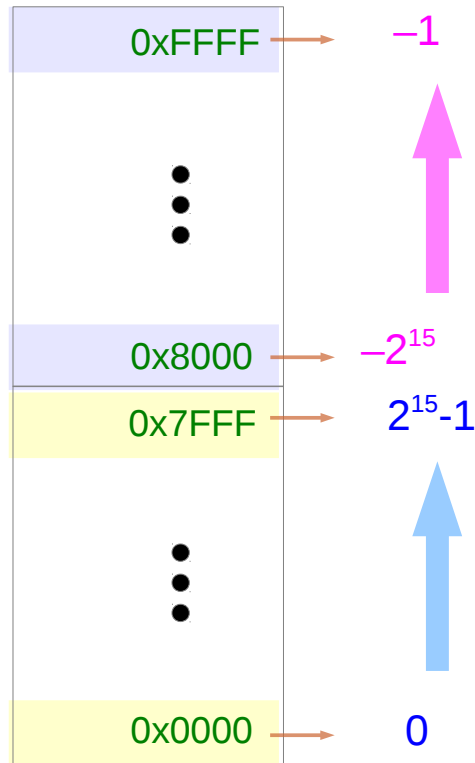
1 Byte

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
-------	-------	-------	-------	-------	-------	-------	-------



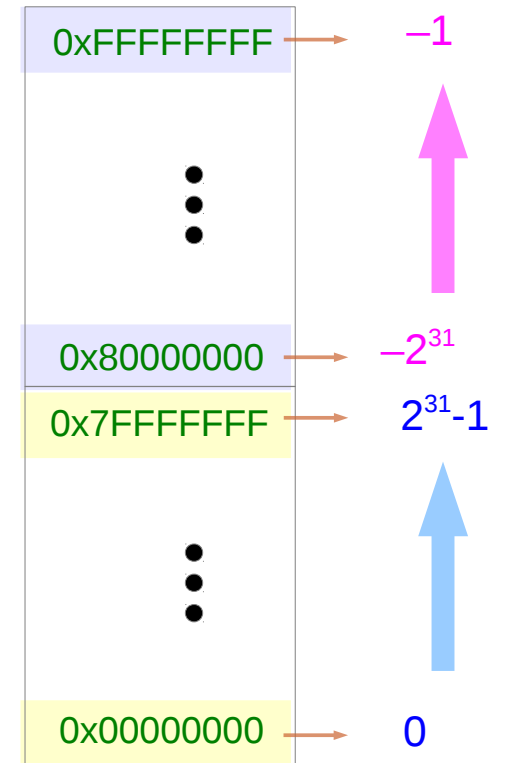
2 Bytes

2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0



4 Bytes

2^{31}	2^{30}	2^{29}	2^{28}	2^{27}	2^{26}	2^{25}	2^{24}
2^{23}	2^{22}	2^{21}	2^{20}	2^{19}	2^{18}	2^{17}	2^{16}
2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0



Signed & Unsigned Interpretation of Hex Numbers

```

unsigned char x1;
signed char y1;
unsigned short x2;
signed short y2;
unsigned int x4;
signed int y4;
    
```

```

x1 = y1 = 0x7F;   x2 = y2 = 0x7FFF;   x4 = y4 = 0x7FFFFFFF;
x1 = y1 = 0x80;   x2 = y2 = 0x7FFF;   x4 = y4 = 0x80000000;
x1 = y1 = 0x81;   x2 = y2 = 0xFFFF;   x4 = y4 = 0xFFFFFFFF;
    
```



```
printf("x = %+12d %+12x  y = %+12d %+12x\n", x, x, y, y);
```



```

-----
x1 =      +127      7f   y1 =      +127      7f
x1 =      +128      80   y1 =     -128     ffffffff80
x1 =     +255      ff   y1 =      -1     ffffffff

-----
x2 =     +32767     7fff  y2 =     +32767     7fff
x2 =     +32768     8000  y2 =    -32768     ffff8000
x2 =    +65535     ffff  y2 =      -1     ffffffff

-----
x4 = +2147483647  7fffffff  y4 = +2147483647  7fffffff
x4 = -2147483648  80000000  y4 = -2147483648  80000000
x4 =           -1  ffffffff  y4 =           -1  ffffffff
-----
    
```

```

X1, x1, y1, y1
X2, x2, y2, y2
X4, x4, y4, y4
    
```


Laplace Equation

Laplace Equation

References

- [1] <http://en.wikipedia.org/>
- [2] <http://planetmath.org/>
- [3] M.L. Boas, "Mathematical Methods in the Physical Sciences"