

Computer Memory

①

The bit is smallest unit of information. Each bit can be in one of two possible states: 0 or 1 and representing off or on or true or false. Individual bits grouped together into groups of 8 to create bytes, and the byte is how numbers and characters are actually stored. The value of the byte set by the state of the bits.

Each position in the byte represents a value:

128	64	32	16	8	4	2	1
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

If the bit at a position is 1, then that value is included in calculating the byte value. For example:

128	64	32	16	8	4	2	1
0	0	0	1	1	0	1	0
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

$$\begin{aligned}\text{byte} &= 2 + 8 + 16 = 26 \\ &= 2^1 + 2^3 + 2^4 = 26\end{aligned}$$

Powers of two
for each position

Computer Memory

(2)

The 0101... is binary digit. Conversion of previous page was binary to decimal. But addresses and values generally reported as hexadecimal, which is base 16. Digits 0-F represent values from 0-15.

$$A = 10$$

$$B = 11$$

$$C = 12$$

$$D = 13$$

$$E = 14$$

$$F = 15$$

Look at byte again. What is maximum decimal value of byte? What about max. value of first 4 bits?

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

4 bits

$$\text{Max value} = 255$$

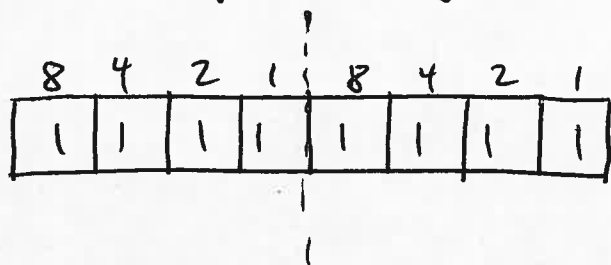
$$\begin{aligned} \text{Max value of} \\ \text{first 4 bits} &= \\ 8 + 4 + 2 + 1 &= 15 \end{aligned}$$

The 15 is also max
hex value of F,
Since $F = 15$

Computer Memory

(3)

In hex representation of byte, we don't use decimal values of position, we split the byte into 2 groups of 4 bits and each group gets a hex value

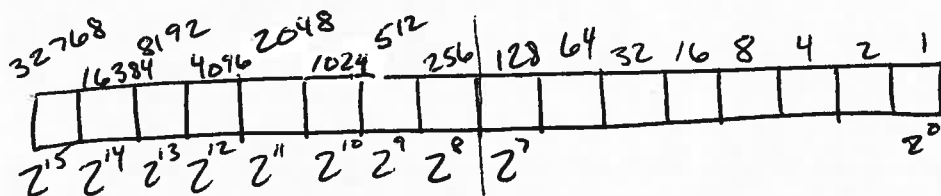


Max value = FF

But, clearly we need to represent numbers larger than 255. How do we represent:

$$x = 1880$$

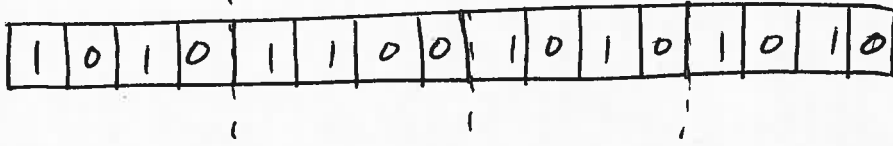
1880 is greater than 255. We need more than one byte. We continue with powers of 2 to represent larger values. For example, if we use 2 bytes, we get 16 bits each with a 0 or 1 value.



Computer Memory

(4)

Two byte memory example:



$$= 32768 + 8192 + 2048 + 1024 + 128 + 32 + 8 + 2$$
$$= 44202$$

Easier to represent in hex: ACAA

Because you only have to add to 15

What is max value of 2 bytes:

Can add up all positions. Or, since 2^{15} is last position we can use $2^{16} - 1$

$$= 65536 - 1 = 65535$$

Look at smaller example to prove to yourself that it's true. The max value of one byte is 255, which is $2^8 - 1$. The leftmost position in one byte represents 2^7 . The first position in the second byte is 2^8 .
(right-most)

Computer Memory

(5)

Common data types and the values they can store:

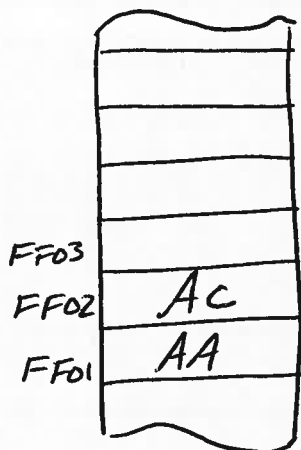
int	4 bytes
char	1 byte
float	4 bytes
long	8 bytes
double	8 bytes

the char will treat the number stored as a letter when its used. For example

char 'A' is stored in memory as 65.

the ascii table defines all char codes.

How a variable looks at a memory address



Each box is one byte

Two byte value stored in two boxes.