Floating Point Numbers (5A)

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Please send corrections (or suggestions) to youngwlim@hotmail.com.

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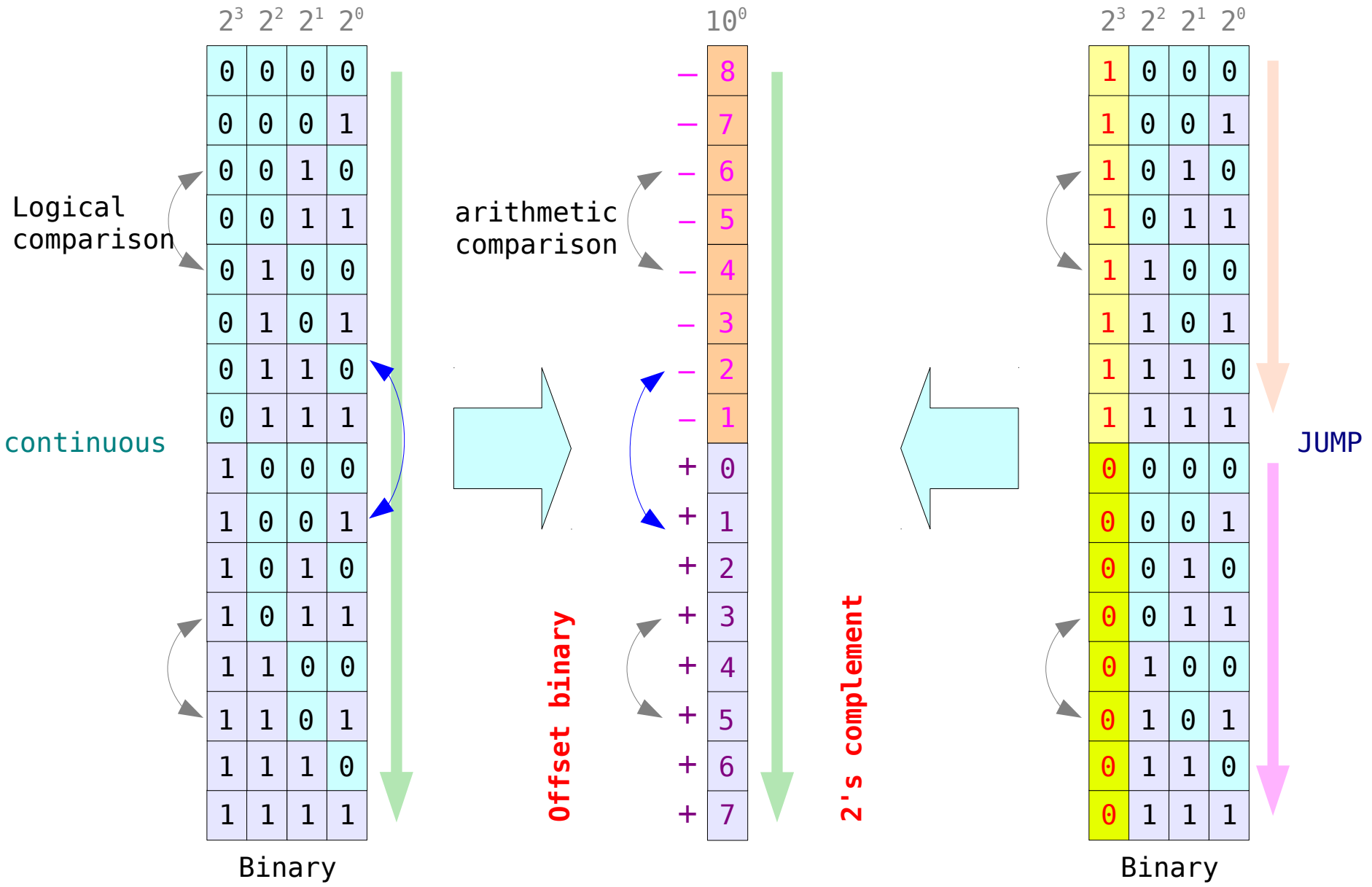
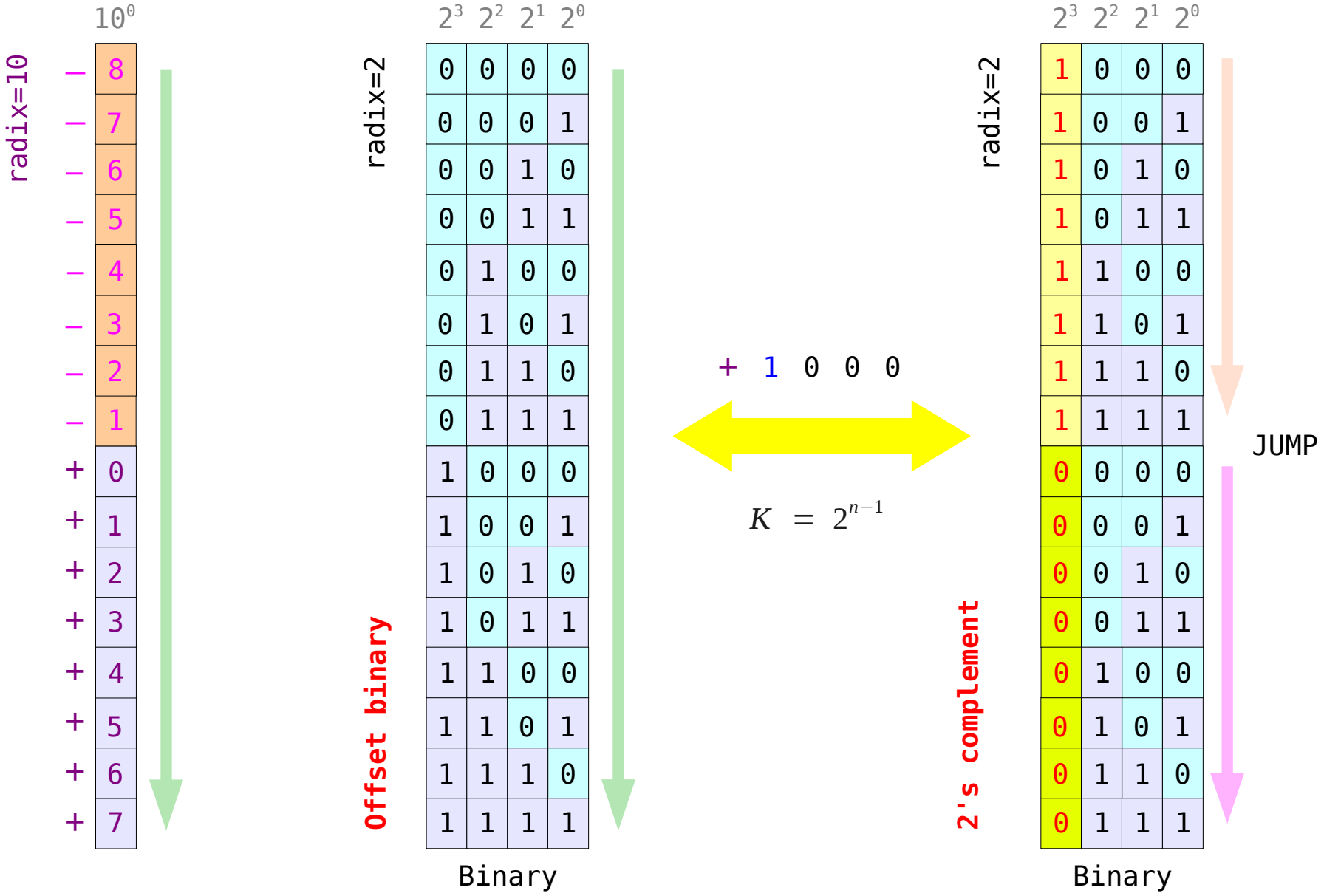
Offset Binary and 2's Complement

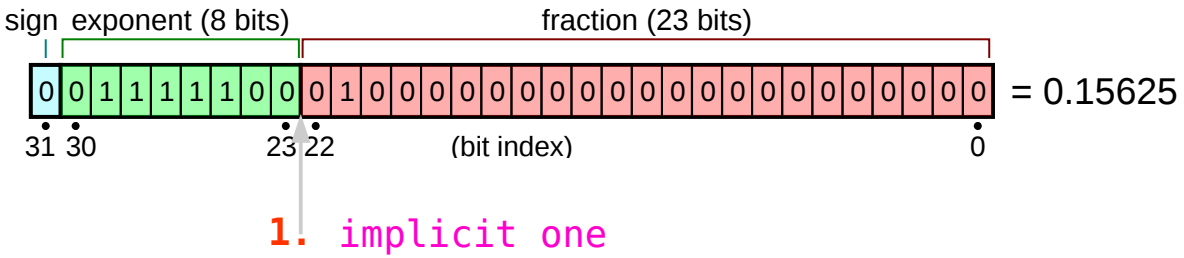


Offset Binary (Excess K Code)

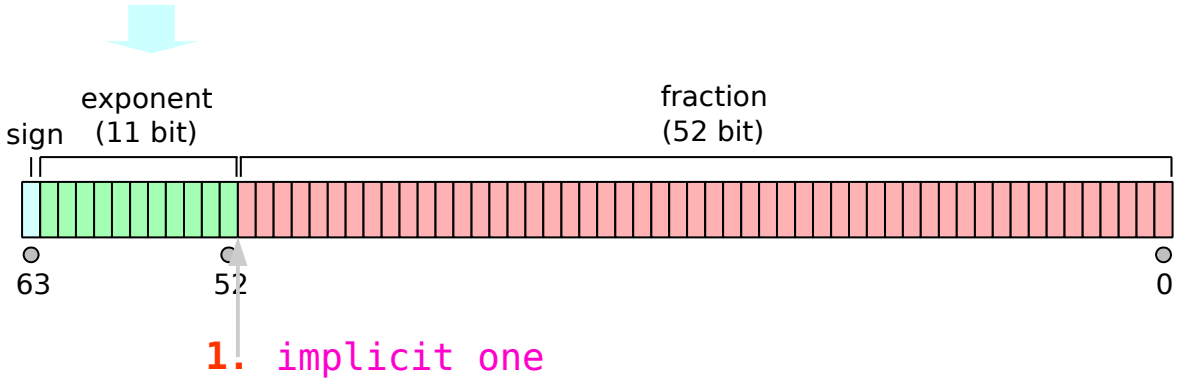


Floating Pointer Numbers

Excess-127 Code $K = 2^7 - 1$

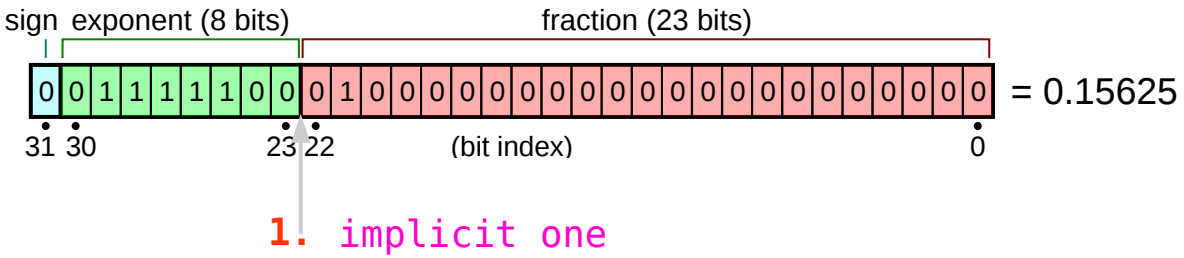


Excess-1023 Code $K = 2^{10} - 1$



Single Precision Mantissa

Excess-127 Code $K = 2^7 - 1$

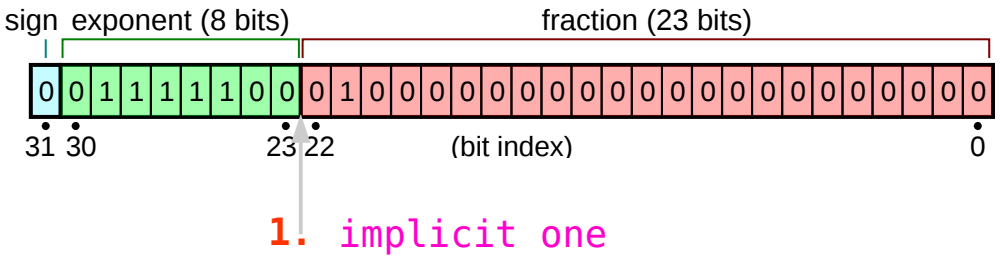


$0/2^{23} + 1$	1.00000000000000000000000	1.0
$(2^{22}-1)/2^{23} + 1$	1.01111111111111111111111	$1.5-2^{-23}$
$2^{22}/2^{23} + 1$	1.10000000000000000000000	1.5
$(2^{23}-1)/2^{23} + 1$	1.11111111111111111111111	$2-2^{-23}$

$[1.0, \quad 2.0-2^{-23}]$

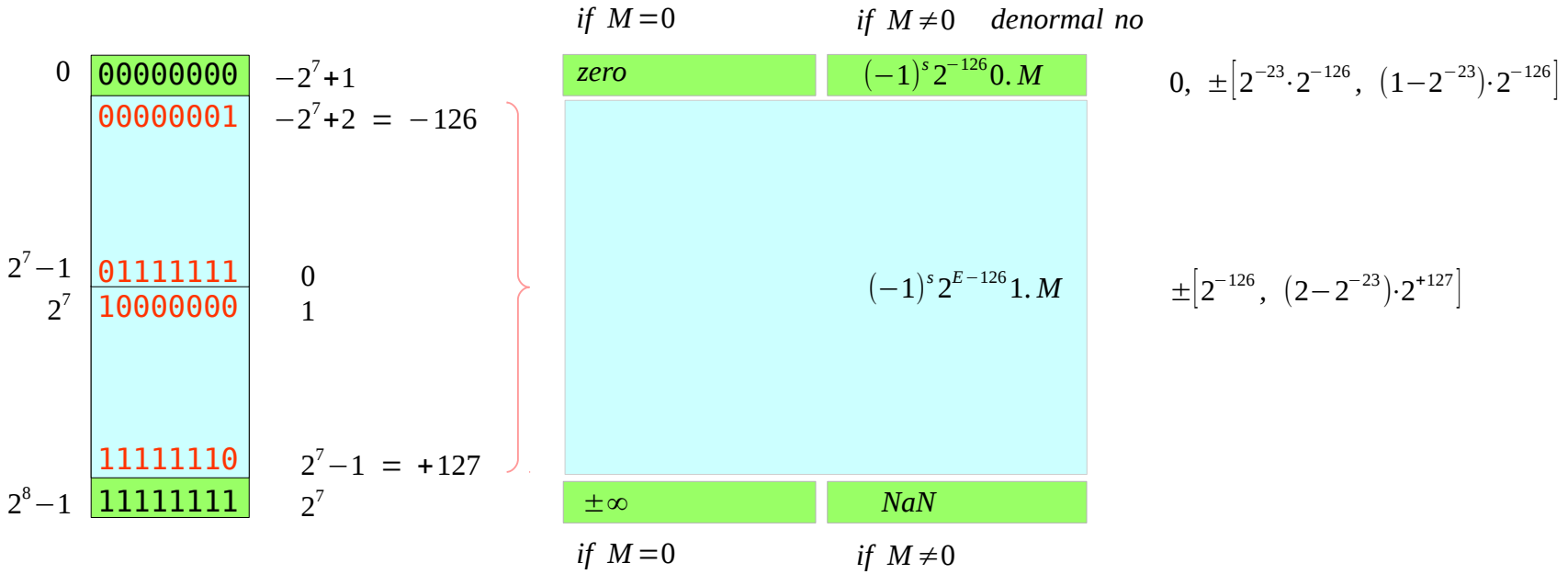
Single Precision Exponent

Excess-127 Code $K = 2^7 - 1$



$= 0.15625$

$\pm\left[10^{-44.85},\ 10^{38.53}\right]$

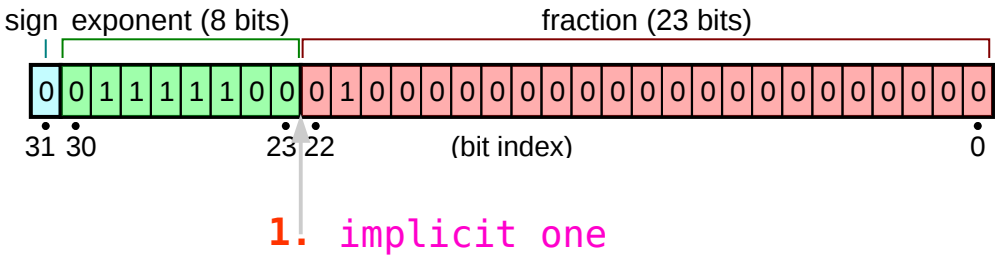


$0,\ \pm\left[2^{-23}\cdot 2^{-126},\ (1-2^{-23})\cdot 2^{-126}\right]$

$\pm\left[2^{-126},\ (2-2^{-23})\cdot 2^{+127}\right]$

Single Precision Ranges

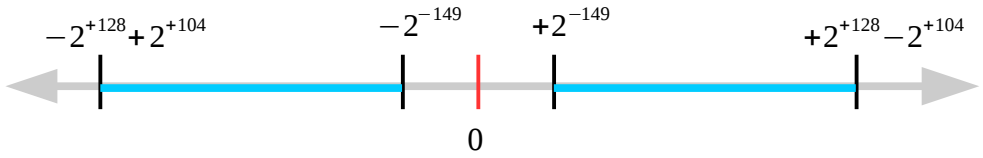
Excess-127 Code $K = 2^7 - 1$



$= 0.15625$

$\pm\left[10^{-44.85},\ 10^{38.53}\right]$

$0,\ \pm\left[2^{-23}\cdot 2^{-126},\ (1-2^{-23})\cdot 2^{-126}\right]$



$\pm\left[2^{-126},\ (2-2^{-23})\cdot 2^{+127}\right]$

Single Precision Floating Point Number (1)

```
// 23-bit mantissa  : m
// 8-bit exponent   : e
// 1-bit sign       : s

int m, e, s;
float M, E, S;

typedef union {
  float x;
  unsigned int n;
} single_precision;


single_precision num;
```

```
num.x = 14.0;


printf("num.x: %f \n", num.x);
printf("num.n: %#x \n", num.n);

m = (num.n) & 0x7fffff;

e = (num.n >> 23) & 0xff;

s = (num.n >> 31) & 0x1;

printf("23-bit mantissa: %#20x %10d\n", m, m);
printf(" 8-bit exponent: %#20x %10d\n", e, e);
printf(" 1-bit sign    : %#20x %10d\n", s, s);
```

```
num.x: 14.000000
num.n: 0x41600000
23-bit mantissa:             0x600000    6291456
 8-bit exponent:                 0x82        130
 1-bit sign    :                    0          0
```

Single Precision Floating Point Number (2)

```
M = 1.0 + (float) m / (1 << 23) ;

E = e - 127.;

S = s ? -1. : +1.;

printf("----------------------------\n");
printf("mantissa M: %10f \t 1.+m/(1<<23)\n", M);
printf("exponent E: %10f \t e-127\n", E);
printf("sign     S: %10f \t s?-1:+1\n", S);
printf("----------------------------\n");
printf("S*M*2^E = %g * %g * 2^%g = %+g\n", S, M, E, S*M*(1<<(int)E) );
```

```
num.x: 14.000000
num.n: 0x41600000
23-bit mantissa:              0x600000    6291456
 8-bit exponent:                  0x82        130
 1-bit sign    :                     0          0
----------------------------
mantissa M:   1.750000    1.+m/(1<<23)
exponent E:   3.000000    e-127
sign     S:   1.000000    s?-1:+1
----------------------------
S*M*2^E = 1 * 1.75 * 2^3 = +14
```

References

[1] http://en.wikipedia.org/