15-213-S09 Recitation #1

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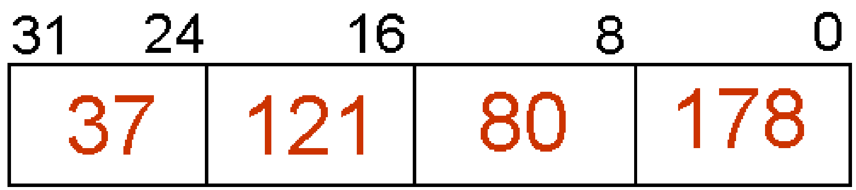
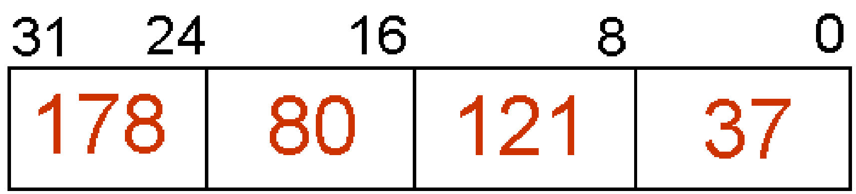
Little Endian to Big Endian

- 32-bit unsigned integer: 0x257950B2
  $n = 37 * 2^{24} + 121 * 2^{16} + 80 * 2^{8} + 178$

- Little Endian:

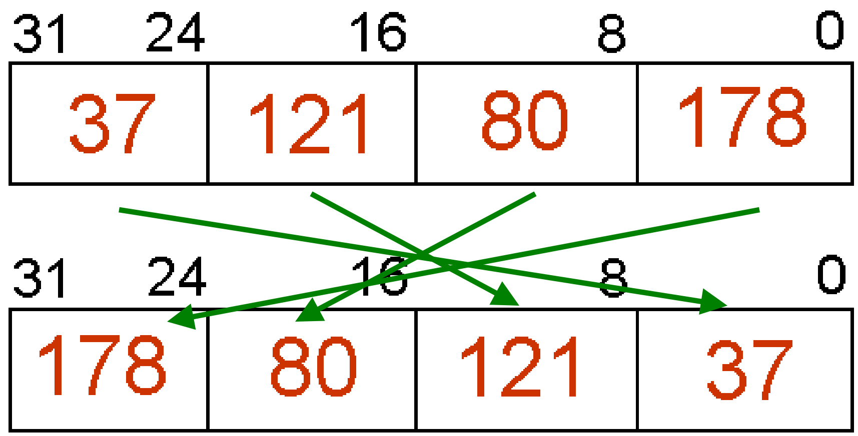


- Big Endian:



Little Endian to Big Endian

- Little Endian:
- Big Endian:




```
unsigned int LE2BE(unsigned int x)
{
  unsigned int result =
          (x << 24) | ((x << 8) & (0xFF << 16)) |
          ((x >> 8) & (0xFF << 8)) | ((x >> 24) & 0xFF);

  return result;
}
```

If-then-else

```
if (condition)
  expression1;
else
  expression2;
```

If-then-else

```
if (condition)
  expression1;
else
  expression2;
```

Rewrite as:

(condition & expression1) |
(~condition & expression2)

Datalab Example - Max

Return the max of 2 ints (x, y)

2 cases:

- Different signs – look at sign of x
- Same sign – look at sign of x-y

```
int max (int x, int y) {
    int sub = x - y;
    int signcomp = x ^ y; // compare the signs
    // if signs are similar, take the sign of x-y, if not, take the sign of x.
    //This will be 1 if y is greater, 0 otherwise
    int mask = ((signcomp) & x) | (~signcomp & sub)) >> 31;
    return (mask & y) | (~mask & x);
}
```

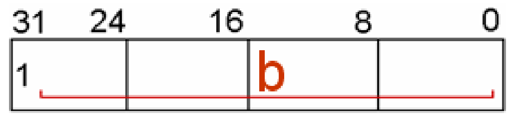
Datalab Example - Least Bit Pos

Return a mask of the least bit position of n

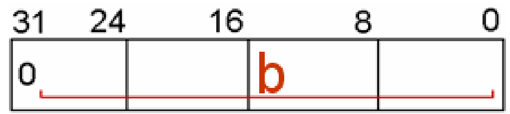
Take a binary number x (1011...010..0)
Flip the bits (0100...101...1)
Add 1 to it (0100...110...0)
Only 1's occupying the same position between each the new number and original are in the lowest bit position

```
int leastBitPos(int x) {




        return x & (~x + 1);
}
```

2’s complement: some examples



$= -2^{31} + b$



$= b$

- 0x0 = 0
- 0x1 = 1
- 0x7FFFFFFF = 2^{31}-1 // largest 32-bit int
- 0xFFFFFFFF = -1
- 0xFFFFFFFE = -2
- 0x800000000 = -2^{31} // smallest 32-bit int
- 0x800000001 = $-2^{31} + 1$

Simple 8-bit Integer Example

Some simple, positive examples:

0b0001 0110
= 128(0) + 64(0) + 32(0) + 16(1) + 8(0) + 4(1) + 2(1) + 1(0)
= 16 + 4 + 2
= 22

53
= 32 + 16 + 4 + 1
= 128(0) + 64(0) + 32(1) + 16(1) + 8(0) + 4(1) + 2(0) + 1(1)
= 0011 0101

Signed 8-bit Integer Examples

Using -x = (~x) + 1

-14
= -(14)
= -(8(1) + 4(1) + 2(1) + 1(0))
= -(0000 1110)
= ~(0000 1110) + 1
= (1111 0001) + 1
= 1111 0010

Using negative sign bit (for numbers close to tMin)

-120
= -128(1) + 8(1)
= 1000 1000

Other Signed 8-bit Integer Examples

12 =

63 =

72 =

-10 =

-100 =

Other Signed 8-bit Integer Examples

12 = 0000 1100

63 = 0011 1111

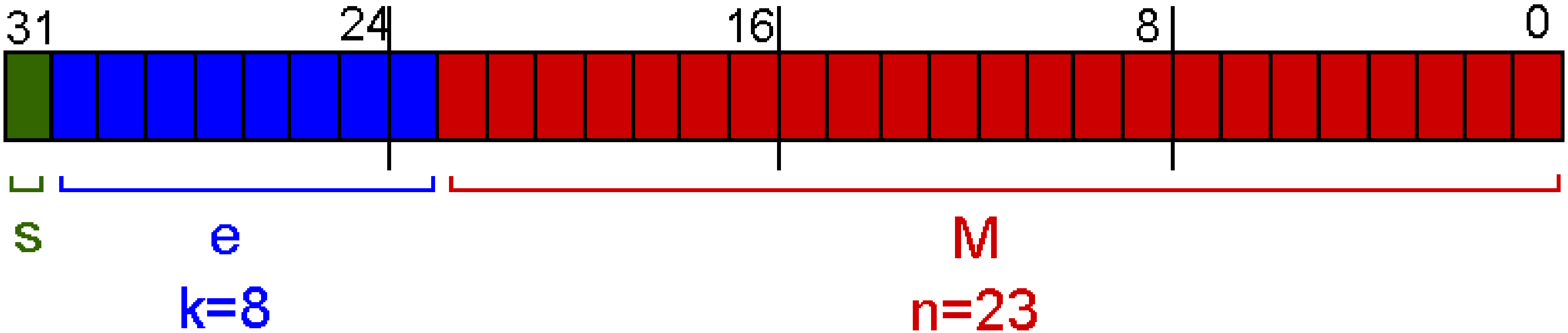
72 = 0100 1000

-10 = ~(0000 1010) + 1 = 1111 0101 + 1 = 1111 0110

-100 = -128 + 28 = 1001 1100

Floating point

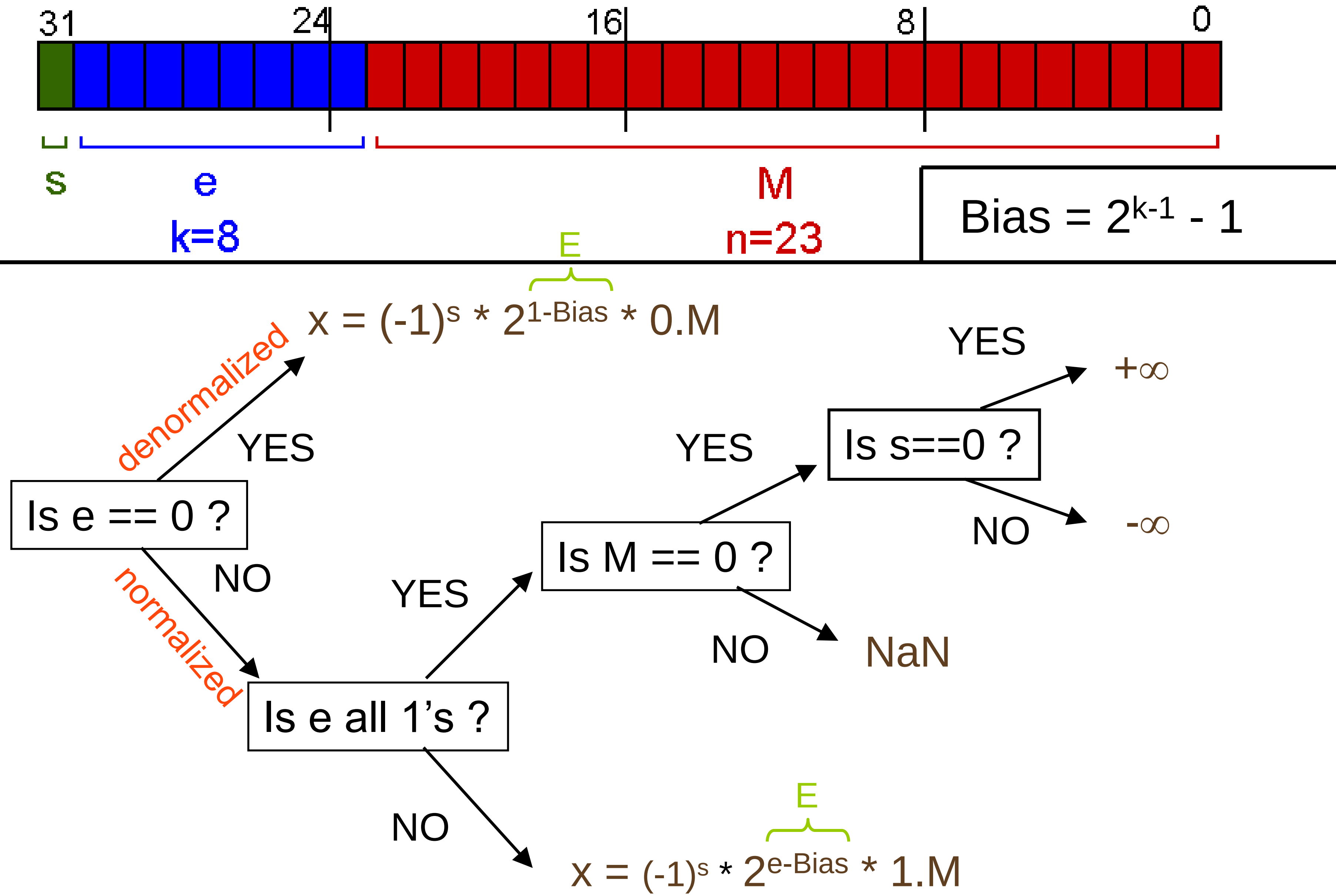
Single precision:



Note: exponent boundary is NOT aligned with byte boundary
e.g. 0xFF7FFFFF has lowest exponent bit zero (is normalized v.)

Double precision:
k = 11, n= 52

Floating point decision diagram

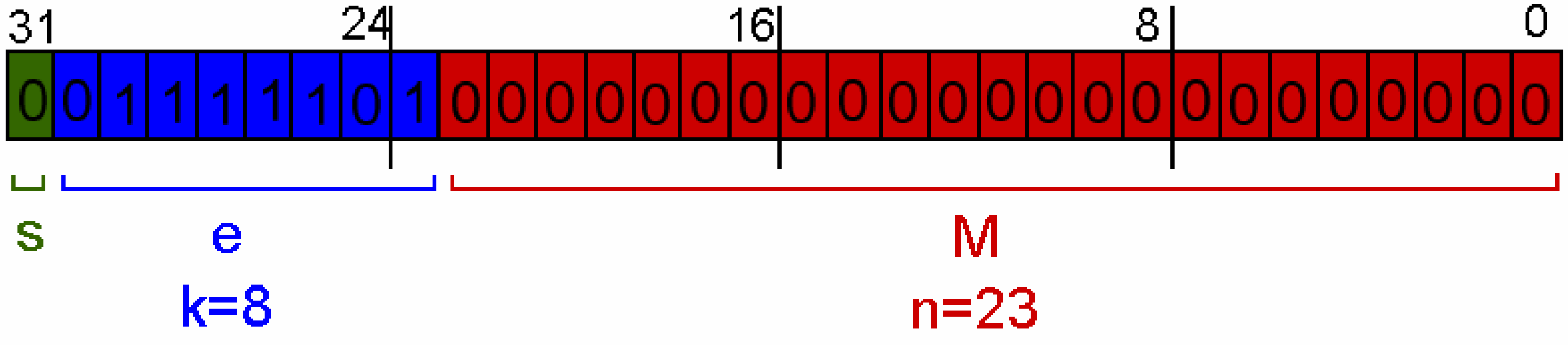


Example

$1/4 = 1.0 * 2^{-2}$

s=0, e = -2 + Bias = 125, M = 0

representation = 3E800000



8-bit Floating Point Example

8-bit floating point (1 sign, 3 exponent, 4 fraction)
    bias = 2^(3 - 1) - 1 = 3

encode 13/16

sign bit = 0 (13/16 >= 0)

13/16 = 13 x 2^(-4)
    = 1101 x 2^(-4)
    = 1.1010 x 2^(-1) (remove the 1 because it's normalized)

exponent = -1 + bias = 2 = 010

result = 0 010 1010

8-bit Floating Point Example

8-bit floating point (1 sign, 3 exponent, 4 fraction)
    bias = 2^(3 - 1) - 1 = 3

encode -3/32

sign bit = 1 (-3/32 < 0)

3/32 = 3 x 2^(-5)
    = 0b11 x 2^(-5)
    = 1.1 x 2^(-4) Note: Lowest possible exponent is -2
                                        Must denormalize
    = .011 x 2^(-2)
exponent = 0 (denormalized)

result = 1 000 0110

Other 8-bit Floating Point Examples

10/4 =

-3 =

-10 =

1/64 =

Other 8-bit Floating Point Examples

10/4 = 0 100 0100

-3 = 1 100 1000

-10 = 1 110 0100

1/64 = 0 000 0001

Good coding style

- Consistent indentation
- Avoid long sequences of commands without a comment
- Each source file should have an appropriate header
- Have a brief comment at the beginning of each function

Version Control - Do It

Version Control allows you to maintain old versions of your source code, potentially saving you if you were to do something like rm -rf *

Good SVN tutorial:

http://artis.imag.fr/~Xavier.Decoret/resources/svn/index.html

Note:

repoDir=`pwd` #of working dir

Path to repo is svn+ssh://unix.andrew.cmu.edu/${repoDir}

Example:

svn+ssh://unix.andrew.cmu.edu/afs/andrew.cmu.edu/usr17/agartrel/svn/15-410