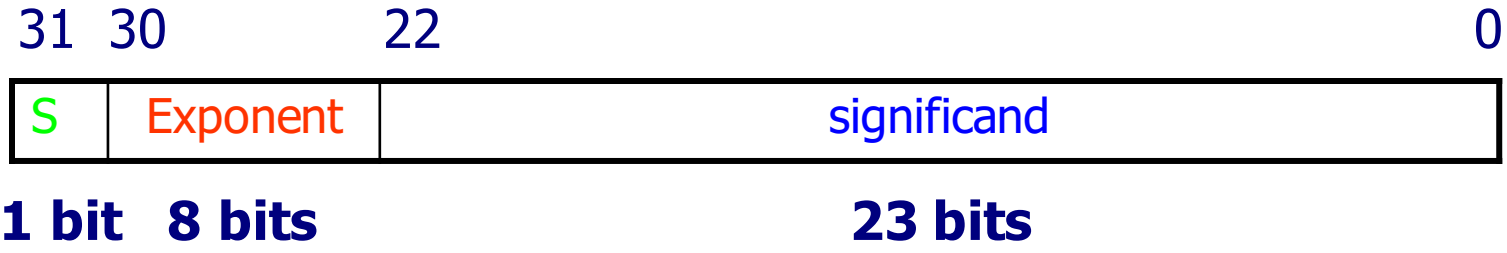
COMP2611: Computer Organization

Data representation (Solution)

The IEEE 754 single precision floating point format

- The IEEE 754 standard uses 32 bits to represent single precision floating point numbers.



- S : sign bit (0 positive, 1 negative),
- Exponent : 8-bit field, bias = 127,
- Significant : 23-bit field.

Exercise: Convert $-5.625_{(10)}$ to the single precision floating point format:

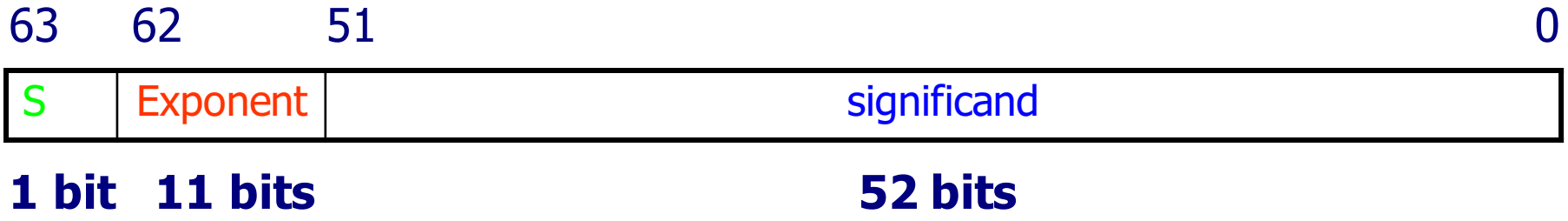
1. $5.625_{(10)} = 101.101_{(2)}$, sign bit =1
2. normalize $101.101 = 1.01101 \times 2^2$
3. exponent value = (bias +2)= $(127+2) = 129_{(10)} = 1000\ 0001_{(2)}$

The resulting single precision representation is

1 1000 0001 01101000000000000000

The IEEE 754 double precision floating point format

- The IEEE 754 standard uses 64 bits to represent double precision floating point numbers.



- S : sign bit (0 positive, 1 negative),
- Exponent : 11-bit field, bias = 1023,
- Significant : 52-bit field.

Exercise: Convert $-5.625_{(10)}$ to the double precision floating point format:

Follow the solution on the previous slide

Exercises

Question 1: Given the bit pattern 1000 0000 0100 0110 0000 0000 0000 0000

- What is the value if this is a 2's complement representation?

  -2,142,896,128

- What if the pattern is an unsigned interger?

  2,152,071,168

- What if it is an IEEE single precision number?

  6.4285×10^{-39}

- What if it represents 4 ASCII characters (assume bits 31-24, 23-16, 15-8, 7-0 store the characters, and ASCII value of 128 is the symbol '€').

  Check the ASCII table

Exercises

Question 2: Assume the bit pattern 1001 1100 follows the IEEE-like floating point representation format

1 bit 3 bits **4 bits**

- What is the bias of the exponent? 2^(3-1) -1 = 3
- What value is the given pattern representing? -0.4375
- What is the range of numbers that this IEEE-like floating point representation system can represent?
- What is the granularity of this representation system?