**Homework**

1. Given a (very) tiny computer that has a word size of 5 bits, what are the smallest negative

numbers and the largest positive numbers that this computer can represent in each of the

following representations?

Hint: show your answers in binary and decimal forms.

a. One's complement

The largest: 01111 = 15

The smallest: 10000 = -15

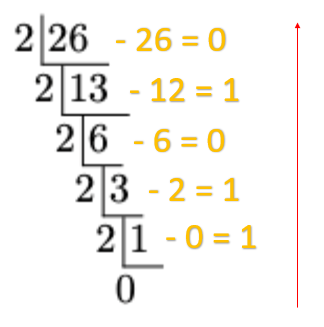
b. Two's complement

The largest: 01111 = 15

The smallest: 10000 = -16

2. Show how the floating point value of 26.625 would be stored using IEEE-754 double

precision with excess-1023 exponent (be sure to indicate the sign bit, the exponent, and the

significand fields):

First step, Convert 26.625 to binary.

(26)10 = (11010)2

(0.625)10 = (0.101)2

(26.625)10 = (11010)2 + (0.101)2

= (11010.101)2 \* 20

= (1.1010101)2 \* 24

Second step, finding the exponent by adding 1023 to the exponent of our binary.

4 + 1023 = 1027

Convert (1027)10 = (10000000011)2

Final step, Because of the IEEE-754 double precision, we need a mantissa of 52 bits.

1010101 add 0 for 45 times = 1010101000000000000000000000000000000000000000000000

We will get answer is:

Sign = 0

Exponent = 10000000011

Mantissa = 1010101000000000000000000000000000000000000000000000

IEEE-754 double precision:

| 0 | 10000000011 | 1010101000000000000000000000000000000000000000000000 |
| --- | --- | --- |
| Sign [1] | Exponent [11] | Mantissa [52] |

3. Suppose a computer uses 4-bit one’s complement representation. Ignoring overflows, what value will be stored in the variable j after the following pseudocode routine terminates?

-2 → j // Store -2 in j.

6 → k // Store 6 in k.

while k ≠ -6

j = j-1

k = k+1

end while

First step, One complement:

6 = 0110 =====> -6 = 1001

Second step, start the loop:

Start from > 0110 + 1

1st run: 0110 + 1 = 0111

2nd run: 0111 + 1 = 1000

3rd run: 1000 + 1 = 1001

Final step, We need to add 3 times. In the while loop, it will run 3 times:

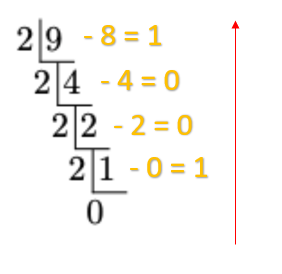
j = j + [(-1) 3 times]

j = -2 + (-3)

j = -5

4. Convert 9.5 and 1.25 to unsigned binary, then compute the multiplication of the two

values. Answer in 14-bit floating point model with bias-16 exponent.



First step, Convert 9.5 to unsigned binary:

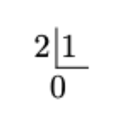
(9)10 = (1001)2

(0.5)10 = (0.1)2

(9 + 0.5)10 = (1001)2 + (0.1)2

= (1001.1)2 \* 20

= (1.0011)2 \* 23

Second step, Convert 1.25 to unsigned binary:

(1)10 = (0001)2

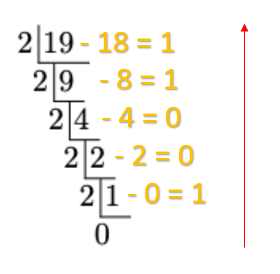
(0.25)10 = (0.01)2

(1 + 0.25)10 = (0001)2 + (0.01)2

= (0001.01)2 \* 20

Third step, Multiply the binary numbers:

(1.0011 \* 23) \* (0001.01 \* 20) = (1.0011 \* 1.01 \* 2(3+0))

= (1.011111 \* 23)

Fourth step, Biassed exponent for 3:

16 + 3 = 19

(19)10 = (10011)2

We will get answer is:

Sign = 0

Exponent = 10011

Mantissa = 01111100

IEEE-754 double precision:

| 0 | 10011 | 01111100 |
| --- | --- | --- |
| Sign [1] | Exponent [5] | Mantissa [8] |

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