6. This integer is written in big endian: 0x2945 10FA 639B 3E7D. Compute the negative of this

number and write that negative in little endian. [4]

Answer: First replace each digit with its complement. Then we have

0xD6BA EF05 9C64 C182

Next add 1, and the answer is 0xD6BA EF05 9C64 C183

The last step is to invert the bytes: 0x83C1 649C 05EF BAD6

7. Suppose you are working with 4 byte registers. Convert this decimal integer 2187 to twos

complement hex in big endian. [7]

Answer: Let’s use repeated division.

2187/2 = 1093 R 1

1093/2 = 546 R 1

546/2 = 273 R 0

273/2 = 136 R 1

136/2 = 68 R 0

68/2 = 34 R 0

34/2 = 17 R 0

17/2 = 8 R 1

8/2 = 4 R 0

4/2 = 2 R 0

2/2 = 1 R 0

1/2 = 0 R 1

0/2 = 0 R 0

Time to stop

100010001011, but we need 32 bits. So far we have only 12 bits. So add 20 leading zeros.

0000 0000 0000 0000 0000 1000 1000 1011. For better readability we write this number in hex.

0X0000 088B

11. Convert the number 737.1875 to binary scientific notation. [7]

Answer: 737 1(512)+0(256)+1(128)+1(64)+1(32)+0(16+0(8)+0(4)+0(2)+1(1)

737 = 1011100001

737

-512

225

-128

97

-64

33

-32

1

Now work on the fractional part:

0.1875 x 2 = 0.375

0.375 x 2 = 0.75

0.75 x 2 = 1.5

0.5 x 2 = 1.0

0.0 x 2 = 0/0

Time to stop. The fraction part is 0.1875 = 0.0011

Now combine the whole number and the fraction number:

737.1875 = 1011100001.0011 x 2^0 = 1.0111000010011 x 2^9. That is good enough.

12. Convert the number 1.11001 x 2^-3 to base 10 number. [7]

Answer: 1.11001 = 1 + (1⁄2) + (1⁄4) + (1/32)

= 57/32 [Add all the fraction over a common denominator]

That is a partial answer. We want the following:

1.11001 x 2^-3 = 57/32 x 2^-3 = (57/32) x (1/8) = 57/256 That’s not a pretty fraction, but

that is what the answer is.

Use a calculator and the answer becomes: 0.22265625

1. What is the largest signed integer in a 64-bit register. Show the answer first in hex and and

then in decimal. If you add 1 to this number what is the sum. Show the sum in hex and then in

decimal. [This question requires 4 numbers.][4]

Answers

Largest = 0x7FFF FFFF FFFF FFFF = 2

63

-1

Now add 1 to both numbers.

The hex number becomes 0x8000 0000 0000 0000, which equals - 263

Obviously, if you add 1 to 2

63

-1 the result is 2

63

, which is outside the range of 64-bit integers.

10. Convert to IEEE format. [8]

Show sufficient work to convince the grader that you know how to do it.

Answer: First work on the whole number part: 113 = 1110001

Second, work on the fractional part:

The sequence has started to repeat.

Now we can write the number in binary scientific format:

N = 1110001 . 0100 0100 0100 0100 0100 0100 0100 …. etc … x 20

= 1 . 1100 0101 0001 0001 0001 0001 0001 0001 0001 … etc … x 26

Next focus on the stored exp = 0x3FF + 6 = 0x405

Now the final answer can be recorded:

N = 0x405C 5111 1111 1111

The answer is in yellow highlighting. End of solution.

11. Convert 277.1 to IEEE format. [8]

Show sufficient work to get partial credit.

Answer:

Conversion of 277 to binary is elementary math. Here we leave those minor details to you the reader: 277 = 100010101

Now work on converting the fractional part to binary:

, ,, , , , … etc …. The sequence now shows the beginning of a pattern.

So, we can now write the fractional part: 0.00011001100110011001100110011 … etc.

Now combine the integral part and the fractional part to express our number:

N = 100010101 . 00011001100110011001100110011 … etc … x 20

= 1 . 0001010100011001100110011001100110011 … etc … x 28

The stored exp = 0x3FF + 8 = 0x407.

For better visibility we segregate the mantissa in groups of 4 bits per group

N = 1 . 0001 0101 0001 1001 1001 1001 1001 1001 1001 1 … etc … x 28

= 0x4071 5199 9999 999A

Done. The IEEE number is shown in yellow.

12. Convert 0x3FAF 0000 0000 0000 from IEEE to decimal float. [8]

Show sufficient work to convince me you really know what you’re doing.

Answer:

First compute the true exponent = ox3FA – 0x3FF = -(0x3FF – 0x3FA) = -5

The number we want is 1 . 1111 x 2-5

= 11111 x 2-9

= 31 x 2-9 <== That is a full base 10 number. You can leave it as your answer.

Alternatively, use a calculator to get this answer 31/512 = 0.060546875

1. Convert this signed integer 0xB538 7124 0FA6 2310 to its negative. Show sufficient work to

convince the grader that you really know what you’re doing. [4]

Answer: First establish the complements in base 16.

0<=>F

1<=>E

2<=>D

3<=>C

4<=>B

5<=>A

6<=>9

7<=>8

Next, exchange each digit for its complement: 0x4AC7 8EDB F059 DCEF

Then add 1 to get the final answer: 0x4AC7 8EDB F059 DCF0

12. Convert 203.2 to IEEE 64-bit format. [8]

Show sufficient work to convince me.

Answer: First convert 203 to binary integer: 203 = 11001011

Next convert the fractional part to binary:

0.2 x 2 = 0.4

0.4 x 2 = 0.8

0.8 x 2 = 1.6

0.6 x 2 = 1.2

0.2 x 2 = 0.4 <=== The sequence has begun to repeat

Therefore, 0.2 = .0011 0011 0011 0011 0011 ........

Combine the whole number part with the fractional part.

N = 11001011 . 0011 0011 0011 0011 0011 ....... x 20

= 1 . 1001 0110 0110 0110 0110 0110 0110 ...... x 27

Compute the stored exponent = 0x3FF + 7 = 0x406

Now write the final answer N = 0x4069 6666 6666 6666

13. Convert 0x40B1 1111 1111 1111 from IEEE to decimal. [8]

Show sufficient work to convince me.

Answer: Let N be the number want to find.

Compute the true exponent: 0x40B – 0x3FF = 0xC = 12 (decimal).

Then N = 1.0001 0001 0001 0001 0001 …… 0001 x 212

13 groups of 0001

N =

=

= <== Apply the geometric summation rule

=

=

=

= <== That is all we can do without a calculator

Using a calculator the expression above reduces to 4369.066666666666497

12. Convert 203.2 to IEEE 64-bit format. [8]

Show sufficient work to convince me.

Answer: First convert 203 to binary integer: 203 = 11001011

Next convert the fractional part to binary:

0.2 x 2 = 0.4

0.4 x 2 = 0.8

0.8 x 2 = 1.6

0.6 x 2 = 1.2

0.2 x 2 = 0.4 <=== The sequence has begun to repeat

Therefore, 0.2 = .0011 0011 0011 0011 0011 ........

Combine the whole number part with the fractional part.

N = 11001011 . 0011 0011 0011 0011 0011 ....... x 20

= 1 . 1001 0110 0110 0110 0110 0110 0110 ...... x 27

Compute the stored exponent = 0x3FF + 7 = 0x406

Now write the final answer N = 0x4069 6666 6666 6666

13. Convert 0x3FA7 8000 0000 0000 from IEEE to decimal. [8]

Show sufficient work to convince me.

Answer: Compute the stored exponent = 0x3FA – 0x3FF = -(0x3FF – 0x3FA) = - 5 (decimal)

Next express the number in scientific binary form:

N = 1.0111 1000 0 .... 0 x 2-5

= 1.01111 x 2

-5

To simplify shift the point 5 places to the right. Then we have

N = 101111. x 2

-10

= 47 /1024 <== This could be a final answer

= 0.0458984375 <== Obtained by using a calculator