Metropolitan State University

ICS 232 Computer Organization & Architecture
Homework 1 60 points
Due Date: 02/06/2019

Name: Isse Nur

Note: Please post your homework to ICS232 D2L on or before the due date.
If you do not post your homework on or before the due data, please post your late homework when complete. (Late Homework: -15% Penalty).

1) (3 pts) Consider an unsigned fixed point decimal ($Base_{10}$) representation with 8 digits, 5 to the left of the decimal point and 3 to the right.

   a. What is the range of the expressible numbers?

r = range

$0 \leq r \leq 99999.999$

   b. What is the precision?

0.001

   c. What is the error?

0.0005

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2) (3 pts) Convert this unsigned base 2 number, **1001 1011**$_2$, to each base given below
(Note: the space in the binary string is purely for visual convenience)
Show your work.

a. Using the Polynomial method convert the number above from base 2 to base 10 (decimal)

b. Using the grouping method convert number above from base 2 to base 16… (hex)

(1001)(1011)

9B

c. Using the grouping method convert number above from base 2 to base 8… (octal)

(100)(101)(100)

4 5 4

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3) (3 pts) Convert this unsigned base 2 number, **11011.10011$_2$**, to each base given below
(Note: The placement of the decimal point. Correct padding must be used)
Show your work.

a. Using the grouping method convert number above from base 2 to base 16… (hex)

(0001)(1011).(1001)(1000)
1 B . 9 8

b. Using the grouping method convert number above from base 2 to base 8… (octal)

(111)(011).(100)(110)
7 3 4 6

c. Using the grouping method convert number above from base 2 to base 4… ( )

(01)(10)(11).(10)(01)(10)
1 2 3 . 2 1 2

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4) (3 pts) Convert 597.22$_{10}$ (decimal number) to **unsigned binary** using the remainder and multiplication methods:. Stop at the 6th digit to the right of the decimal place. (Show your work)

Work on backside

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5) (3 pt) Using the overflow concept and its identifying methods introduced in the class, solve the problem: suppose that we have a computing device that has only 8 bits. Using this device, add the following two unsigned 8 bit binary numbers and give the final result. If there is an overflow, point that out (you must clearly indicate whether your final result has overflow).

```
  1 1   1 1 1      carry bits
  0110 1110
+ 1110 1011
============
 10101 1001
```

Answer: 10101 1001

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6) (3 pts) Convert -123_{10} to an 8-bit binary number using the representations given below. Show all 8 bits.

a. signed magnitude number

Answer: 11111011

Answer

$64+32+16+8+2+1 = 123$

$112 + 11$

$2^6+2^5+2^4+2^3+2^1+2^0$

b. one's complement number

Answer: 11111011 → 10000100

Answer

c. two's complement number

Answer: $-(11111011) \rightarrow$ flip all then 1 for "-1"

$000100 + 1 = 10000101$

add 1

000100
$+\ 1$
000101

Answer

d. excess 128 number (bias the two's complement number)

Answer: $-123 + 128 = 5 \rightarrow 00000101$

Answer

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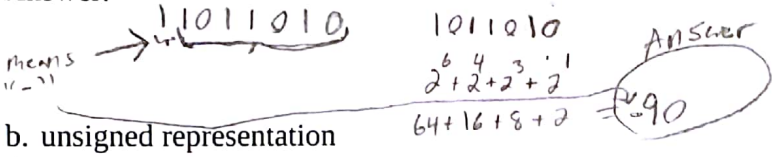
7) (6 pts) Consider the bit pattern 1101 1010_2. **Provide the equivalent value in Base$_{10}$ (decimal)** for this bit pattern based on the following assumptions: (if the bit pattern represents a negative number under the assumed context, then give its negative value). (show your work)

Assume the original number is expressed using:

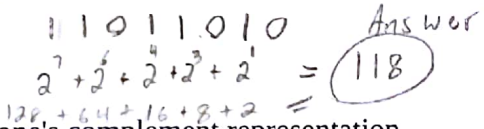
a. signed magnitude representation

Answer:



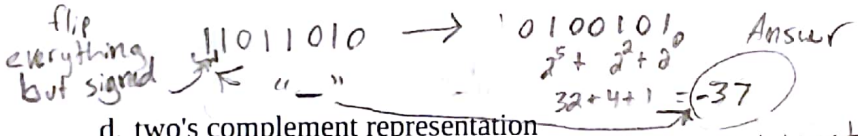
b. unsigned representation

Answer:



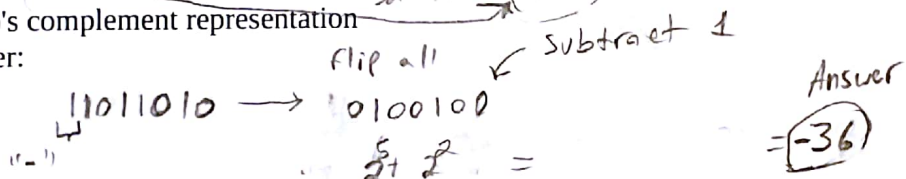
c. one's complement representation

Answer:



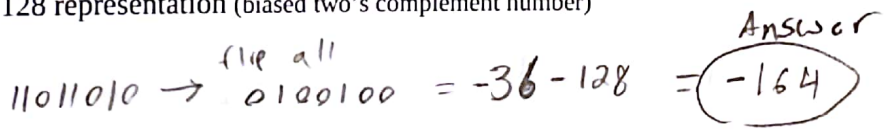
d. two's complement representation

Answer:



e. excess 128 representation (biased two's complement number)

Answer:



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8) (3 pts) This problem tests your knowledge about coding schemes. What is the binary bit pattern for the letter 'h' using?

The answers should give the whole bit string (including leading 0s).

a. ASCII encoding (7-bits)

104_{10} = 1 0 1 0 0 0_2

b. EBCDIC encoding (8-bits)

9068_{10} = 1000100

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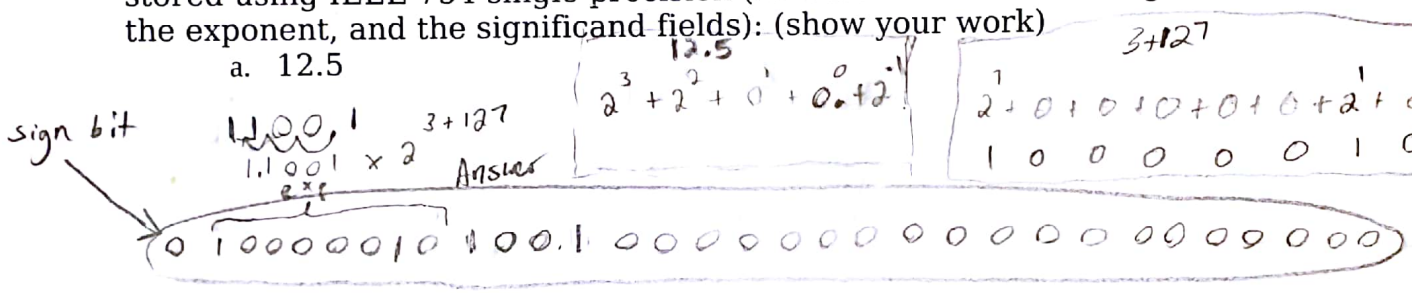
c. UNICODE encoding (16 bits)

0068_{16}

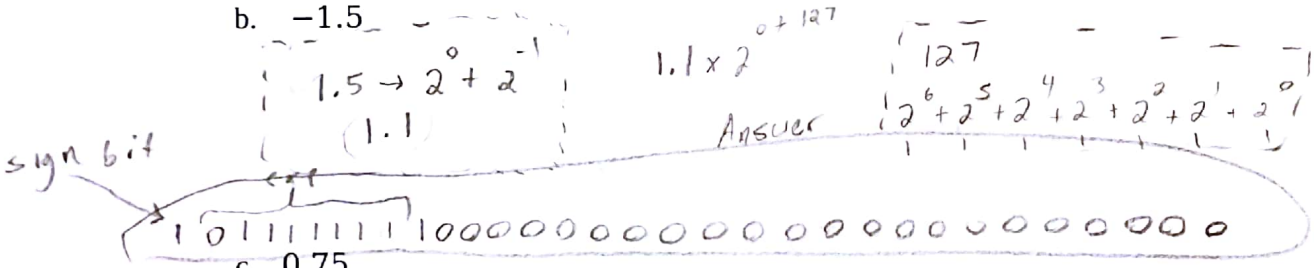
$110\ 1000_2$

9) (3 pts) Show how each of the following floating point values would be stored using IEEE-754 single precision (be sure to indicate the sign bit, the exponent, and the significand fields): (show your work)

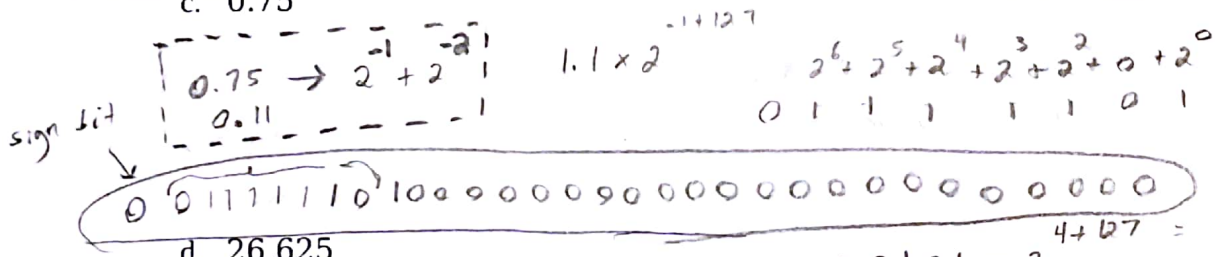
a. 12.5



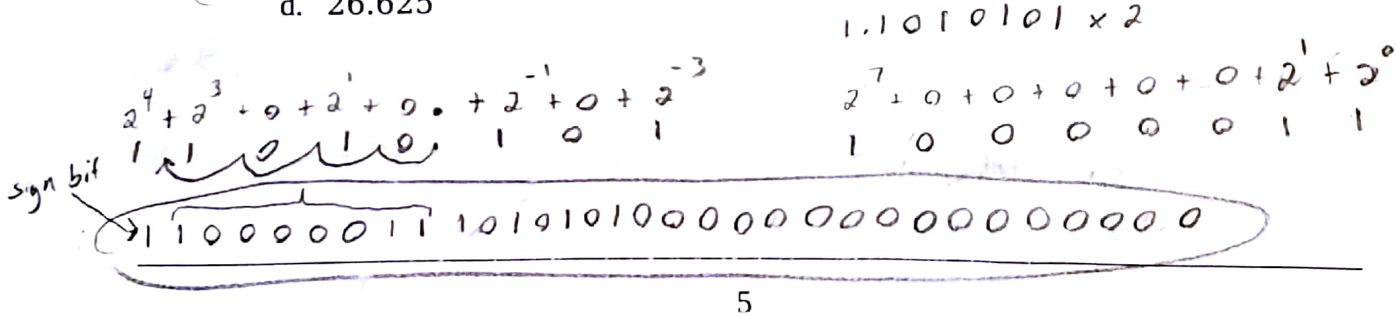
b. −1.5



c. 0.75



d. 26.625



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10) (6 pts) Show how each of the following floating point values would be stored using IEEE-754 double precision (be sure to indicate the sign bit, the exponent, and the significand fields): (show your work)

a. 13.5

b. −102.25

Work on the back side

c. 0.0078125

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11) (6 pts) Perform the following binary multiplications using Booth's algorithm, (assuming signed two's complement integers): (show your work)

a. 1011 × 0101

b. 0011 × 1011

c. 1011 × 1100

Name:

12) (3 pts) Using arithmetic shifting, perform the following on the two's compliment numbers:

a. double the value 00010101_2

b. quadruple the value 01110111_2

c. divide the value 11001010_2 in half

13) (3 pts) Find the quotients and remainders for the following division problems modulo 2 (show your work)

a. $1001111_2 \div 1101_2$

b. $1011110_2 \div 1100_2$

c. $1001101110_2 \div 11001_2$

d. $111101010_2 \div 10011_2$

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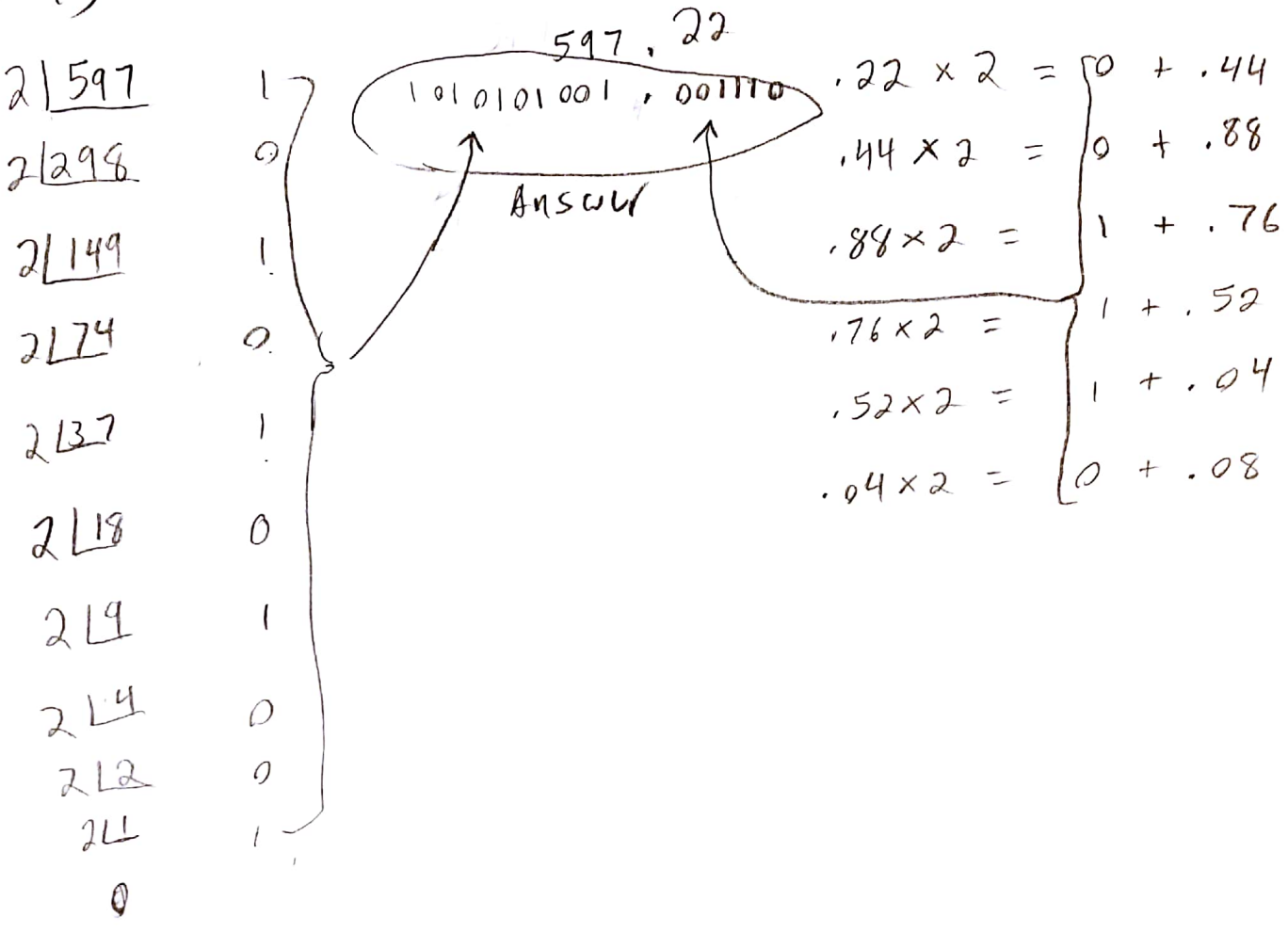
14) (6 pts) Using the CRC polynomial 1101, compute the CRC code word for the information word, 01001101. Check the division performed at the receiver. (Show your work)

15) (6 pts) Using the CRC polynomial 1101, compute the CRC code word for the information word, 01011101. Check the division performed at the receiver. (Show your work)

#4.)


597.22
1001010100 1 . 001110
Answer
2|597 1
2|298 0
2|149 1
2|74 0
2|37 1
2|18 0
2|9 1
2|4 0
2|2 0
2|1 1
0
.22 × 2 = 0 + .44
.44 × 2 = 0 + .88
.88 × 2 = 1 + .76
.76 × 2 = 1 + .52
.52 × 2 = 1 + .04
.04 × 2 = 0 + .08

#10

a.)

$13.5 = 1.1011 \times 2^{3+1023}$

1000000000010

2 | 1026	0
2 | 513	1
2 | 256	0
2 | 128	0
2 | 64	0
2 | 32	0
2 | 16	0
2 | 8	0
2 | 4	0
2 | 2	0
2 | 1	1
0	

Answer

signed bit

exponent

0 1000000010 1011 0000000000000000000000000000000000000000000000000000

#10
b.)

(-) 102.5 →

2 | 102	0
2 | 51	0
2 | 25	1
2 | 12	0
2 | 6	0
2 | 3	1
2 | 2	0
2 | 1	1
0	

→ 1.1001100 1 × 2 (7 + 1023)

1.01001001

2 | 1030	0
2 | 515	1
2 | 257	1
2 | 128	0
2 | 64	0
2 | 32	0
2 | 16	0
2 | 8	0
2 | 4	0
2 | 2	0
2 | 1	1
0	

10000000110

Answer

sign bit

exp

1 10000000110 0100100100000000000000000000000000000000000000000000

#10.)

C.)

(-7+1023)

.0000001 × 2

.007815

× 2

0.01563

.01563

× 2

0.03126

.03126

× 2

0.06252

.06252

× 2

0.12504

.12504

× 2

0.25008

.25008

× 2

0.50016

.50016

× 2

1.00032

.00032

× 2

0.00064

.00064

× 2

0.00128

.00128

× 2

0.00256

.00256

× 2

0.00512

.00512

× 2

0.01024

.01024

2|1016 0

2|508 0

2|254 0

2|127 0

2|63 1

2|31 1

2|15 1

2|7 1

2|3 1

2|1 1

0

sign bit

↓

0 1111110000 1000000000000000000000 00000 0000000000000000000000