CSULB
CECS225
Lab3
Show your work
No work, no credit even if the answer is correct
Type your final answers
(Overflow occurs when the result of an addition/subtraction using 2's complement arithmetic is too large or too small to be expressed using the number of bits of the representation used. This results in the overflow flag OF being set to 1.)

1. Add the following unsigned 4-bit binary numbers to get a possible 5-bit result.

Addend 1	Addend 2	5-bit Binary Sum				
1001	0101	0	1	1	1	0
1100	0110	1	0	0	1	0
0011	1100	0	1	1	1	1
0101	0111	0	1	1	0	0
1011	0010	1	0	0	0	0

2. Add the following signed 4-bit binary numbers. Indicate if there is overflow by setting the OF flag.

Addend 1	Addend 2	4-bit Binary Sum				OF
1001	0101	1	1	0	0	0
1100	0110	0	0	1	0	1
0011	1100	1	1	1	1	0
0101	0111	1	1	0	0	0
0001	1111	0	0	0	0	1

3. Add the following decimals by adding their 8-bit 2's complement representations. Indicate if OF.

Addend 1	Addend 2	8-bit Binary Sum								OF
58	-100	1	1	0	1	0	1	1	0	0
-35	-69	1	0	0	1	1	0	0	0	1
89	75	1	0	1	0	0	1	0	0	1
-126	-13	0	1	1	1	1	0	0	1	1
-105	80	1	1	1	0	0	1	1	1	0

4. Convert each decimal to 8-bit binary then find the negative 2's complement by going from the rightmost bit and inverting every digit beyond the first 1 found as you continue to the left.

Decimal	8-bit Binary Representation									2's Complement Value							
44	0	0	1	0	1	1	0	0		1	1	0	1	0	1	0	0
81	0	1	0	1	0	0	0	1		1	0	1	0	1	1	1	1
113	0	1	1	1	0	0	0	1		1	0	0	0	1	1	1	1
62	0	0	1	1	1	1	1	0		1	1	0	0	0	0	1	0
125	0	1	1	1	1	1	0	1		1	0	0	0	0	0	1	1

5. Perform the sum of pair of hexadecimal numbers (unsigned).

Num1	Num2	Sum
$6B4_{16}$	$3FE_{16}$	$AB2_{16}$
$A49_{16}$	$6BD_{16}$	1106_{16}
$7C4_{16}$	$3BE_{16}$	$B82_{16}$

$B69_{16}$	$7AD_{16}$	1316_{16}

6. What is the sum of each pair of **12-bits binary signed numbers** represented in hexadecimal? Convert the result to its equivalent singed integer?

Num1	Num2	Sum	Decimal
$6B4_{16}$	$3FE_{16}$	$AB2_{16}$	2738
$A49_{16}$	$6BD_{16}$	1106_{16}	262
$7C4_{16}$	$3BE_{16}$	$B82_{16}$	2946
$B69_{16}$	$7AD_{16}$	1316_{16}	790

7. Repeat 5 but perform the subtraction of each pair of **the 12-bits binary signed numbers** represented in hexadecimal.

Num1	Num2	Difference	Decimal
$6B4_{16}$	$3FE_{16}$	2B6	694
$A49_{16}$	$6BD_{16}$	38C	908
$7C4_{16}$	$3BE_{16}$	406	1030
$B69_{16}$	$7AD_{16}$	3BC	956

8. Write your initials in ASCII code decimal, hex, oct, binary and in Unicode Initials Dec hex Binary Oct Unicode

Initials	Dec	Hex	Binary	Oct	Unicode
M	77	4D	0100 1101	115	U + 4D
Z	90	5A	0101 1010	132	U + 5A

A floating-point decimal contains three components: a sign, a significand -**mantissa-** and an exponent. Single precision uses 32 bits.

9. Convert the following number to IEEE single-precision real

Num																																
+10.75	+	1	0	0	0	0	0	1	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-76.0625	-	1	0	0	0	0	1	0	1	0	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0

10. Convert the following IEEE single-precision real numbers -given in Hex- to its Decimal equivalent
    a. 41 86 00 00 = 16.75_{10}
    b. CD 32 A2 00 = -187310080_{10}

1.
    a. 1001 + 0101 =
        i. 1001
        ii. + 0101
        iii. = 01110
    b. 1100 + 0110 =
        i. 11 1100
        ii. + 0110
        iii. = 10010
    c. 0011 + 1100 =
        i. 0011
        ii. + 1100
        iii. = 1111
    d. 0101 + 0111 =
        i. 111 0101
        ii. + 0111
        iii. = 1100
    e. 0001 + 1111 =
        i. 1111 0001
        ii. + 1111
        iii. = 10000
2.
    a. 1001 + 0101 =
        i. 1 1001
        ii. + 0101
        iii. = 1110
    b. 1100 + 0110
        i. 11 1100
        ii. + 0110
        iii. = 10010
    c. 0011 + 1100 =
        i. 0011
        ii. + 1100
        iii. = 1111
    d. 0101 + 0111 =
        i. 111 0101
        ii. + 0111
        iii. = 1100
    e. 0001 + 1111 =
        i. 1111 0001
        ii. + 1111
        iii. = 10000
3. First binary, then addition
    a. 58 – 100

i. 58
    1. 58 / 2 = 29, R = 0
    2. 29 / 2 = 14, R = 1
    3. 14 / 2 = 7, R = 0
    4. 7 / 2 = 3, R = 1
    5. 3 / 2 = 1, R = 1
    6. 1 / 2 = 0, R = 1
    7. 0011 1010
ii. -100
    1. 100 / 2 = 50, R = 0
    2. 50 / 2 = 25, R = 0
    3. 25 / 2 = 12, R = 1
    4. 12 / 2 = 6, R = 0
    5. 6 / 2 = 3, R = 0
    6. 3 / 2 = 1, R = 1
    7. 1 / 2 = 0, R = 1
    8. 0110 0100
    9. 1001 1011 + 1 = 1001 1100

1 1 1

iii. 00111010
iv. + 10011100
v. = 1101 0110

b. -35 – 69 =
i. -35
    1. 35 / 2 = 17, R = 1
    2. 17 / 2 = 8, R = 1
    3. 8 / 2 = 4, R = 0
    4. 4 / 2 = 2, R =0
    5. 2 / 2 = 1, R = 0
    6. 1 / 2 = 0, R = 1
    7. 0010 0011
    8. 1101 1100 + 1 = 1101 1101
ii. -69
    1. 69 / 2 = 34, R = 1
    2. 34 / 2 = 17, R = 0
    3. 17 / 2 = 8, R = 1
    4. 8 / 2 = 4, R = 0
    5. 4 / 2 = 2, R = 0
    6. 2 / 2 = 1, R = 0
    7. 1 / 2 = 0, R = 1
    8. 0100 0101
    9. 1011 1010 + 1 = 1011 1011

1 1 1 1 1 1 1

iii. 1101 1101
iv. + 1011 1011
v. = 1 1001 1000

c. 89 + 75 =
   i. 89
      1. 89 / 2 = 44, R = 1
      2. 44 / 2 = 22, R = 0
      3. 22 / 2 = 11, R = 0
      4. 11 / 2 = 5, R = 1
      5. 5 / 2 = 2, R = 1
      6. 2 / 2 = 1, R = 0
      7. 1 / 2 = 0, R = 1
      8. 0101 1001
   ii. 75
      1. 75 / 2 = 37, R = 1
      2. 37 / 2 = 18, R = 1
      3. 18 / 2 = 9, R = 0
      4. 9 / 2 = 4, R = 1
      5. 4 / 2 = 2, R = 0
      6. 2 / 2 = 1, R = 0
      7. 1 / 2 = 0, R = 1
      8. 0100 1011
   iii. 0101 1001
   iv. + 0100 1011
   v. = 1010 0100
d. -126 – 13 =
   i. -126
      1. 126 / 2 = 63, R = 0
      2. 63 / 2 = 31, R = 1
      3. 31 / 2 = 15, R = 0
      4. 15 / 2 = 7, R = 1
      5. 7 / 2 = 3, R = 1
      6. 3 / 2 = 1, R = 1
      7. 1 / 2 = 0, R = 1
      8. 0111 1010
      9. 1000 0101 + 1 = 1000 0110
   ii. -13
      1. 13 / 2 = 6, R = 1
      2. 6 / 2 = 3, R = 0
      3. 3 / 2 = 1, R = 1
      4. 1 / 2 = 0, R = 1
      5. 0000 1101
      6. 1111 0010 + 1 = 1111 0011
   iii. 1000 0110
   iv. + 1111 0011
   v. = 1 0111 1001
e. -105 + 80

i. -105
    1. 105 / 2 = 52, R = 1
    2. 52 / 2 = 26, R = 0
    3. 26 / 2 = 13, R = 0
    4. 13 / 2 = 6, R = 1
    5. 6 / 2 = 3, R = 0
    6. 3 / 2 = 1, R = 1
    7. 1 / 2 = 0, R = 1
    8. 0110 1001
    9. 1001 0110 + 1 = 1001 0111
ii. 80
    1. 80 / 2 = 40, R = 0
    2. 40 / 2 = 20, R = 0
    3. 20 / 2 = 10, R = 0
    4. 10 / 2 = 5, R = 0
    5. 5 / 2 = 2, R = 1
    6. 2 / 2 = 1, R = 0
    7. 1 / 2 = 0, R = 1
    8. 0101 0000
iii. 1001 0111
iv. + 0101 0000
v. = 1110 0111

4.

a. a. 44
    i. 44 / 2 = 22, R = 0
    ii. 22 / 2 = 11, R = 0
    iii. 11 / 2 = 5, R = 1
    iv. 5 / 2 = 2, R = 1
    v. 2 / 2 = 1, R = 0
    vi. 1 / 2 = 0, R = 1
    vii. 0010 1100
    viii. 1101 0011 + 1 = 1101 0100
b. b. 81
    i. i. 81 / 2 = 40. 5 = 40 R = 1
    ii. ii. 40 / 2 = 20 = 20 R = 0
    iii. iii. 20 / 2 = 10 = 10 R = 0
    iv. iv. 10 / 2 = 5 = 5 R = 0
    v. v. 5 / 2 = 2.5 = 2 R = 1
    vi. vi. 2 / 2 = 1 = 1 R = 0
    vii. vii. 1 / 2 = 0.5 = 0 R = 1
    viii. viii. 0101 0001
    ix. ix. 1010 1110 + 1 = 1010 1111
c. c. 113
    i. i. 113 / 2 = 56.5 = 56 R = 1

ii. ii. 56 / 2 = 28 = 28 R = 0
iii. iii. 28 / 2 = 14 = 14 R = 0
iv. iv. 14 / 2 = 7 = 7 R = 0
v. v. 7 / 2 = 3.5 = 3 R = 1
vi. vi. 3 / 2 = 1.5 = 1 R = 1
vii. vii. 1 / 2 = 0.5 = 0 R = 1
viii. viii. 0111 0001
ix. ix. 1000 1110 + 1 = 1000 1111

d. d. 62
i. i. 62 / 2 = 31 = 31 R = 0
ii. ii. 31 / 2 = 15.5 = 15 R = 1
iii. iii. 15 / 2 = 7.5 = 7 R = 1
iv. iv. 7 / 2 = 3.5 = 3 R = 1
v. v. 3 / 2 = 1.5 = 1 R = 1
vi. vi. 1 / 2 = 0.5 = 0 R = 1
vii. vii. 0011 1110
viii. viii. 1100 0001 + 1 = 1100 0010

e. e. 125
i. i. 125 / 2 = 62.5 = 62 R = 1
ii. ii. 62 / 2 = 31 = 31 R = 0
iii. iii. 31 / 2 = 15.5 = 15 R = 1
iv. iv. 15 / 2 = 7.5 = 7 R = 1
v. v. 7 / 2 = 3.5 = 3 R = 1
vi. vi. 3 / 2 = 1.5 = 1 R = 1
vii. vii. 1 / 2 = 0.5 = 0 R = 1
viii. viii. 0111 1101
ix. ix. 1000 0010 + 1 = 1000 0011

5.

a. a. 6B4 + 3FE =
i. 6 = 0110
ii. B = 1011
iii. 4 = 0100
iv. 3 = 0011
v. F = 1111
vi. E = 1110
vii. 0110 1011 0100 + 0011 1111 1110 =
viii. 1010 1011 0010
ix. AB2

b. b. A49 + 6BD =
i. A = 1010
ii. 4 = 0100
iii. 9 = 1001
iv. 6 = 0110
v. B = 1011

vi. D = 1101
vii. 1010 0100 1001 + 0110 1011 1101 =
viii. 0001 0001 0000 0110
ix. 1106

c. c. 7C4 + 3BE =
i. 7 = 0111
ii. C = 1100
iii. 4 = 0100
iv. 3 = 0011
v. B = 1011
vi. E = 1110
vii. 0111 1100 0100 + 0011 1011 1110 =
viii. 1011 1000 0010
ix. B82

d. d. B69 + 7AD =
i. B = 1011
ii. 6 = 0110
iii. 9 = 1001
iv. 7 = 0111
v. A = 1010
vi. D = 1101
vii. 1011 0110 1001 + 0111 1010 1101 =
viii. 0001 0011 0001 0110
ix. 1316

6.

a. AB2 16 = $10*16^2 + 11*16^1 + 2*16^0$)
i. 2738

b. 106 16 => (1 * 16 2) + (0 * 16) + (6 * 16 0)
i. 256 + 0 + 6
ii. 262 10

c. B82 16 => (11 * 16 2) + (8 * 16) + (2 * 16 0)
i. 2816 + 128 + 2
ii. 2946 10

d. 16 16 => (3 * 16 2) + (1 * 16) + (6 * 16 0)
i. 768 + 16 + 6
ii. 790 10

7.

a. 6B4 - 3FE =
i. 0110 1011 0100 - 0011 1111 1110 = 0010 1011 0110 = 2B6
ii. $2*16^2 + 11*16^1 + 6*16^0$
iii. 694

b. b. A49 - 6BD =
i. 1010 0100 1001 - 0110 1011 1101 = 0011 1000 1100 = 38C

ii. $3*16^2 + 8*16^1 + 12*16^0$
iii. 908

c. 7C4 - 3BE =
i. 0111 1100 0100 - 0011 1011 1110 = 0100 0000 0110 = 406
ii. $4*16^2 + 0*16^1 + 6*16^1$
iii. v. 1030

d. B69 - 7AD
i. 1011 0110 1001 - 0111 1010 1101 = 0011 1011 1100 = 3BC
ii. $3*16^2 + 11*16^1 + 12*16^0$
iii. v. 956

8.

a. M
i. Decimal
1. M = 77
ii. Hexadecimal
1. 77 / 16 = 4, R = 13 = D
2. 4 / 16 = 0, R = 4
3. $4D_{16}$
iii. Binary
1. Using hex, 4D
2. 4 / 2 = 2, R = 0
3. 2 / 2 = 1, R = 0
4. 1 / 2 = 0, R = 1
5. 0100
6. D = 13 / 2 = 6, R = 1
7. 6 / 2 = 3, R = 0
8. 3 / 2 = 1, R = 1
9. 1 / 2 = 0, R = 1
10. 1101
11. $0100\ 1101_2$
iv. Octal
1. Using decimal, 77
2. 77 / 8 = 9, R = 5
3. 9 / 8 = 1, R = 1
4. 1 / 8 = 0, R = 1
5. 115_8
v. Unicode
1. Sd

b. Z
i. Decimal
1. Z = 90
ii. Hexadecimal
1. 90 / 16 = 5, R = 10 =
2. 5 / 16 = 0, R = 5

3. $5A_{16}$

iii. Binary
1. Using hex, 5A
2. 5 / 2 = 2, R = 1
3. 2 / 2 = 1, R = 0
4. 1 / 2 = 0, R = 1
5. 0101
6. A = 10 / 2 = 5, R =0
7. 5 / 2 = 2, R = 1
8. 2 / 2 = 1, R = 0
9. 1 / 2 = 0, R = 1
10. 1010
11. $0101\ 1010_2$

iv. Octal
1. Using decimal 90
2. 90 / 8 = 11, R = 2
3. 11 / 8 = 1, R = 3
4. 1 / 8 = 0, R = 1
5. 132_8

v. Unicode

9.

a. a. +10.75
i. Sign = 0 (positive)
ii. 10 / 2 = 5, R = 0
iii. 5 / 2 = 2, R = 1
iv. 2 / 2 = 1, R = 0
v. 1 / 2 = 0, R = 1
vi. 1010
vii. 0.75 * 2 = 1.5 = 1
viii. 0.5 * 2 = 1.0 = 1
ix. 0 * 2 = 0 = 0
x. 0 * 2 = 0 = 0
xi. 1100
1. $1010 * 1100 = 10101100 * 2^3$; exp = 3
2. Mantissa = 0101100000
a. Bias = 127 + 3 = 130
b. 130 / 2 = 65, R = 0
c. 65 / 2 = 32, R = 1
d. 32 / 2 = 16, R = 0
e. 16 /2 = 8, R = 0
f. 8 / 2 = 4, R = 0
g. 4 / 2 = 2, R = 0
h. 2 / 2 = 1, R = 0
i. 1 / 2 = 0, R = 1

j. Exponent = 1000 0010

b. -76.0625
   i. Sign = 1 (negative)
   ii. 76 /2 = 38, R = 0
   iii. 38 / 2 = 19, R = 0
   iv. 19 / 2 = 9, R = 1
   v. 9 / 2 = 4, R = 1
   vi. 4 / 2 = 2, R = 0
   vii. 2 / 2 = 1, R = 0
   viii. 1 / 2 = 0, R = 1
   ix. 1001100
   x. 0.0625 * 2 = 0.125 = 0
   xi. 125 * 2 = 0.25 = 0
   xii. 0.25 * 2 = 0.5 = 0
   xiii. 0.5 * 2 = 1 = 1
   xiv. 0 * 2 = 0 = 0
   xv. 0 * 2 = 0 = 0
   xvi. 000100
      1. 1001100 * 000100
      2. 1001100000100 * 2^6; exp = 6
      3. Mantissa = 00110000010000000000000
         a. Bias =127 + 6 = 133
         b. 133 / 2 = 66.5 = 66 R = 1
         c. 66 / 2 = 33 = 33 R = 0
         d. 33 / 2 = 16.5 = 16 R = 1
         e. 16 / 2 = 8 = 8 R = 0
         f. 8 / 2 = 4 = 4 R = 0
         g. 4 / 2 = 2 = 2 R = 0
         h. 2 / 2 = 1 = 1 R = 0
         i. 1 / 2 = 0.5 = 0 R = 1
         j. Exponent = 10000101

10.

a. 41 86 00 00
   i. 4 = 0100
   ii. 1 = 0001
   iii. 8 = 1000
   iv. 6 = 0110
   v. 0 = 0000
   vi. 0 = 0000
   vii. 0100 0001 1000 0110 0000 0000
   viii. Exponent = 10000011
   ix. 10000011 = $1*2^7 + 1*2^1 + 1*2^0$
   x. 128 + 2 + 1 = 131 – 127 (Bias)= 4; exp = 4
      1. 000011000000000 = $1*2^{-5} + 1*2^{-6}$ = 0.03125 + 0.015625

2. Mantissa = 0.046875

xi. $(-1)^s * (1+ \text{mantissa}) + 2^e$

1. $(-1)^0 * (1 + 0.046875) * 2^4$
2. +16.75

b. CD 32 A2 00

i. C = 1100
ii. D = 1101
iii. 3 = 0011
iv. 2 = 0010
v. A = 1010
vi. 2 = 0010
vii. 0 = 0000
viii. 0 = 0000
ix. 1100 1101 0011 0010 1010 0010 0000 0000
x. Exponent = 10011010
xi. $10011010 = 1*2^7 + 1*2^4 + 1*2^3 + 1*^{21} = 128+16+8+2 = 154 - 127$ (Bias); exp = 27

a. $01100101010001000000000 = 1*2^{-2} + 1*2^{-3} + 1*2^{-6} + 1*2^{-8} + 1*2^{-10} + 1*2^{-14} = 0.25 + 0.125 + 0.015625 + 0.00390625 + 0.000976563 + 0.000061035$
b. Mantissa = 0.395568848

2. $(-1)^s * (1+ \text{Mantissa}) + 2\ e$

a. $0 + 1.395568848 * 2^{27} =$
b. -187310080