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 |

1. 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 |

1. 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 |

1. 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 |

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

|  |  |  |
| --- | --- | --- |
| Num1 | Num2 | Sum |
| 6B416 | 3FE16 | AB216 |
| A49­16 | 6BD16 | 110616 |
| 7C416 | 3BE16 | B8216 |
| B69­­16 | 7AD16 | 131616 |

1. 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 |
| 6B416 | 3FE16 | AB216 | 2738 |
| A49­16 | 6BD16 | 110616 | 262 |
| 7C416 | 3BE16 | B8216 | 2946 |
| B69­­16 | 7AD16 | 131616 | 790 |

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

|  |  |  |  |
| --- | --- | --- | --- |
| Num1 | Num2 | Difference | Decimal |
| 6B416 | 3FE16 | 2B6 | 694 |
| A49­16 | 6BD16 | 38C | 908 |
| 7C416 | 3BE16 | 406 | 1030 |
| B69­­16 | 7AD16 | 3BC | 956 |

1. 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.

1. 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 |

1. Convert the following IEEE single-precision real numbers -given in Hex- to its Decimal equivalent
   1. 41 86 00 00 = 16.7510
   2. CD 32 A2 00 = -18731008010
2. 1. 1001 + 0101 =
      1. 1001
      2. + 0101
      3. = 01110
   2. 1100 + 0110 =



* + 1. 1100



* + 1. + 0110
    2. = 10010
  1. 0011 + 1100 =
     1. 0011
     2. + 1100
     3. = 1111
  2. 0101 + 0111 =



* + 1. 0101
    2. + 0111
    3. = 1100
  1. 0001 + 1111 =



* + 1. 0001
    2. + 1111
    3. = 10000

1. 1. 1001 + 0101 =



* + 1. 1001
    2. + 0101
    3. = 1110
  1. 1100 + 0110
     1. 1100



* + 1. + 0110
    2. = 10010
  1. 0011 + 1100 =
     1. 0011
     2. + 1100
     3. = 1111
  2. 0101 + 0111 =



* + 1. 0101



* + 1. + 0111
    2. = 1100
  1. 0001 + 1111 =



* + 1. 0001
    2. + 1111
    3. = 10000

1. First binary, then addition
   1. 58 – 100
      1. 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
      2. -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. 00111010
    2. + 10011100
    3. = 1101 0110
  1. -35 – 69 =
     1. -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
     2. -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. 1101 1101
    2. + 1011 1011
    3. = 1 1001 1000
  1. 89 + 75 =
     1. 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
     2. 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



* + 1. 0101 1001
    2. + 0100 1011
    3. = 1010 0100
  1. -126 – 13 =
     1. -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
     2. -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
     3. 1000 0110
     4. + 1111 0011
     5. = 1 0111 1001
  2. -105 + 80
     1. -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
     2. 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
     3. 1001 0111
     4. + 0101 0000
     5. = 1110 0111
  3. a. 44
     1. 44 / 2 = 22, R = 0
     2. 22 / 2 = 11, R = 0
     3. 11 / 2 = 5, R = 1
     4. 5 / 2 = 2, R = 1
     5. 2 / 2 = 1, R = 0
     6. 1 / 2 = 0, R = 1
     7. 0010 1100
     8. 1101 0011 + 1 = 1101 0100
  4. b. 81
     1. i. 81 / 2 = 40. 5 = 40 R = 1
     2. ii. 40 / 2 = 20 = 20 R = 0
     3. iii. 20 / 2 = 10 = 10 R = 0
     4. iv. 10 / 2 = 5 = 5 R = 0
     5. v. 5 / 2 = 2.5 = 2 R = 1
     6. vi. 2 / 2 = 1 = 1 R = 0
     7. vii. 1 / 2 = 0.5 = 0 R = 1
     8. viii. 0101 0001
     9. ix. 1010 1110 + 1 = 1010 1111
  5. c. 113
     1. i. 113 / 2 = 56.5 = 56 R = 1
     2. ii. 56 / 2 = 28 = 28 R = 0
     3. iii. 28 / 2 = 14 = 14 R = 0
     4. iv. 14 / 2 = 7 = 7 R = 0
     5. v. 7 / 2 = 3.5 = 3 R = 1
     6. vi. 3 / 2 = 1.5 = 1 R = 1
     7. vii. 1 / 2 = 0.5 = 0 R = 1
     8. viii. 0111 0001
     9. ix. 1000 1110 + 1 = 1000 1111
  6. d. 62
     1. i. 62 / 2 = 31 = 31 R = 0
     2. ii. 31 / 2 = 15.5 = 15 R = 1
     3. iii. 15 / 2 = 7.5 = 7 R = 1
     4. iv. 7 / 2 = 3.5 = 3 R = 1
     5. v. 3 / 2 = 1.5 = 1 R = 1
     6. vi. 1 / 2 = 0.5 = 0 R = 1
     7. vii. 0011 1110
     8. viii. 1100 0001 + 1 = 1100 0010
  7. e. 125
     1. i. 125 / 2 = 62.5 = 62 R = 1
     2. ii. 62 / 2 = 31 = 31 R = 0
     3. iii. 31 / 2 = 15.5 = 15 R = 1
     4. iv. 15 / 2 = 7.5 = 7 R = 1
     5. v. 7 / 2 = 3.5 = 3 R = 1
     6. vi. 3 / 2 = 1.5 = 1 R = 1
     7. vii. 1 / 2 = 0.5 = 0 R = 1
     8. viii. 0111 1101
     9. ix. 1000 0010 + 1 = 1000 0011
  8. a. 6B4 + 3FE =
     1. 6 = 0110
     2. B = 1011
     3. 4 = 0100
     4. 3 = 0011
     5. F = 1111
     6. E = 1110
     7. 0110 1011 0100 + 0011 1111 1110 =
     8. 1010 1011 0010
     9. AB2
  9. b. A49 + 6BD =
     1. A = 1010
     2. 4 = 0100
     3. 9 = 1001
     4. 6 = 0110
     5. B = 1011
     6. D = 1101
     7. 1010 0100 1001 + 0110 1011 1101 =
     8. 0001 0001 0000 0110
     9. 1106
  10. c. 7C4 + 3BE =
      1. 7 = 0111
      2. C = 1100
      3. 4 = 0100
      4. 3 = 0011
      5. B = 1011
      6. E = 1110
      7. 0111 1100 0100 + 0011 1011 1110 =
      8. 1011 1000 0010
      9. B82
  11. d. B69 + 7AD =
      1. B = 1011
      2. 6 = 0110
      3. 9 = 1001
      4. 7 = 0111
      5. A = 1010
      6. D = 1101
      7. 1011 0110 1001 + 0111 1010 1101 =
      8. 0001 0011 0001 0110
      9. 1316
  12. AB2 16 = 10\*162 + 11\*161 + 2\*160 )
      1. 2738
  13. 106 16 => (1 \* 16 2 ) + (0 \* 16) + (6 \* 16 0 )
      1. 256 + 0 + 6
      2. 262 10
  14. B82 16 => (11 \* 16 2 ) + (8 \* 16) + (2 \* 16 0 )
      1. 2816 + 128 + 2
      2. 2946 10
  15. 16 16 => (3 \* 16 2 ) + (1 \* 16) + (6 \* 16 0 )
      1. 768 + 16 + 6
      2. 790 10
  16. 6B4 - 3FE =
      1. 0110 1011 0100 - 0011 1111 1110 = 0010 1011 0110 = 2B6
      2. 2\*162 + 11\*161 + 6\*160
      3. 694
  17. b. A49 - 6BD =
      1. 1010 0100 1001 - 0110 1011 1101 = 0011 1000 1100 = 38C
      2. 3\*162 + 8\*161 + 12\*160
      3. 908
  18. 7C4 - 3BE =
      1. 0111 1100 0100 - 0011 1011 1110 = 0100 0000 0110 = 406
      2. 4\*162 + 0\*161 + 6\*161
      3. v. 1030
  19. B69 - 7AD
      1. 1011 0110 1001 - 0111 1010 1101 = 0011 1011 1100 = 3BC
      2. 3\*162 + 11\*161 + 12\*160
      3. v. 956
  20. M
      1. Decimal
         1. M = 77
      2. Hexadecimal
         1. 77 / 16 = 4, R = 13 = D
         2. 4 / 16 = 0, R = 4
         3. 4D16
      3. 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 11012
      4. Octal
         1. Using decimal, 77
         2. 77 / 8 = 9, R = 5
         3. 9 / 8 = 1, R = 1
         4. 1 / 8 = 0, R = 1
         5. 1158
      5. Unicode
         1. Sd
  21. Z
      1. Decimal
         1. Z = 90
      2. Hexadecimal
         1. 90 / 16 = 5, R = 10 =
         2. 5 / 16 = 0, R = 5
         3. 5A16
      3. 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 10102
      4. Octal
         1. Using decimal 90
         2. 90 / 8 = 11, R = 2
         3. 11 / 8 = 1, R = 3
         4. 1 / 8 = 0, R = 1
         5. 1328
      5. Unicode
  22. a. +10.75
      1. Sign = 0 (positive)
      2. 10 / 2 = 5, R = 0
      3. 5 / 2 = 2, R = 1
      4. 2 / 2 = 1, R = 0
      5. 1 / 2 = 0, R = 1
      6. 1010
      7. 0.75 \* 2 = 1.5 = 1
      8. 0.5 \* 2 = 1.0 = 1
      9. 0 \* 2 = 0 = 0
      10. 0 \* 2 = 0 = 0
      11. 1100
          1. 1010 \* 1100 = 10101100 \* 23; exp = 3
          2. Mantissa = 0101100000
             1. Bias = 127 + 3 = 130
             2. 130 / 2 = 65, R = 0
             3. 65 / 2 = 32, R = 1
             4. 32 / 2 = 16, R = 0
             5. 16 /2 = 8, R = 0
             6. 8 / 2 = 4, R = 0
             7. 4 / 2 = 2, R = 0
             8. 2 / 2 = 1, R = 0
             9. 1 / 2 = 0, R = 1
             10. Exponent = 1000 0010
  23. -76.0625
      1. Sign = 1 (negative)
      2. 76 /2 = 38, R = 0
      3. 38 / 2 = 19, R = 0
      4. 19 / 2 = 9, R = 1
      5. 9 / 2 = 4, R = 1
      6. 4 / 2 = 2, R = 0
      7. 2 / 2 = 1, R = 0
      8. 1 / 2 = 0, R = 1
      9. 1001100
      10. 0.0625 \* 2 = 0.125 = 0
      11. 125 \* 2 = 0.25 = 0
      12. 0.25 \* 2 = 0.5 = 0
      13. 0.5 \* 2 = 1 = 1
      14. 0 \* 2 = 0 = 0
      15. 0 \* 2 = 0 = 0
      16. 000100
          1. 1001100 \* 000100
          2. 1001100000100 \* 26; exp = 6
          3. Mantissa = 00110000010000000000000
             1. Bias =127 + 6 = 133
             2. 133 / 2 = 66.5 = 66 R = 1
             3. 66 / 2 = 33 = 33 R = 0
             4. 33 / 2 = 16.5 = 16 R = 1
             5. 16 / 2 = 8 = 8 R = 0
             6. 8 / 2 = 4 = 4 R = 0
             7. 4 / 2 = 2 = 2 R = 0
             8. 2 / 2 = 1 = 1 R = 0
             9. 1 / 2 = 0.5 = 0 R = 1
             10. Exponent = 10000101
  24. 41 86 00 00
      1. 4 = 0100
      2. 1 = 0001
      3. 8 = 1000
      4. 6 = 0110
      5. 0 = 0000
      6. 0 = 0000
      7. 0100 0001 1000 0110 0000 0000
      8. Exponent = 10000011
      9. 10000011 = 1\*27+ 1\*21 + 1\*20
      10. 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
      11. (-1)s \* (1+ mantissa) + 2e
          1. (-1)0 \* (1 + 0.046875) \* 24
          2. +16.75
  25. CD 32 A2 00
      1. C = 1100
      2. D = 1101
      3. 3 = 0011
      4. 2 = 0010
      5. A = 1010
      6. 2 = 0010
      7. 0 = 0000
      8. 0 = 0000
      9. 1100 1101 0011 0010 1010 0010 0000 0000
      10. Exponent = 10011010
      11. 10011010 = 1\*27 + 1\*24 + 1\*23 + 1\*21 = 128+16+8+2 = 154 - 127 (Bias); exp = 27
          + 1. 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
            2. Mantissa = 0.395568848
          1. (-1)s \* (1+ Mantissa) + 2 e
             1. 0 + 1.395568848 \* 227=
             2. -187310080