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HW5: Truncation, Sign Extension, and Arithmetic (CS220-02)

1) What is the resulting bit pattern when the unsigned 10 bit binary value 1101001101 is stored in an 8 bit container?

1101001101 -> chop off first 2 bits: 01001101

2) What is the resulting bit pattern when the signed 10 bit binary value 1100101110 is stored in an 8 bit container?

1100101110 -> chop off first 2 bits: 00101110
truncation doesn't matter signed or unsigned

3) What is the resulting bit pattern when the unsigned 8 bit binary value 11001101 is stored in a 10 bit container?

11001101 -> add 2 0s : 0011001101
extension if unsigned add 0's

4) What is the resulting bit pattern when the signed 8 bit binary value 01001101 is stored in a 10 bit container?

01001101 -> add 2 0s : 0001001101
extension if signed add whatever 1st digit is before

5) What is the resulting bit pattern when the signed 8 bit binary value 10110010 is stored in a 10 bit container?

10110010 -> add 2 1s : 1110110010

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For problems 6 through 22, assume a 6 bit machine and that
A = 000111, B = 111100, C = 011010, D = 110101 and E = 111101

6) (a) Show work to find unsigned A + C. (b) What is the decimal equivalent of the answer?

A = 7, C = 26
000111
+ 011010
= 100001
= 2^5 + 1 = 33

7) (a) Show work to find unsigned D + E. (b) What is the decimal equivalent of the answer?

110101
+ 111101
= 1110010 -> extra bit added chop off = 110010
= 114 before chop off, 50 after
D = 53 , E = 61 total should be 114 total

8) (a) Show work to find signed 2s complement A + D. (b) What is the decimal equivalent of the answer?

Signed addition: binary add then find 2's complement to find real value

000111 : 7
+ 110101 + 53
= 111100 : 60
2's complement: 111100 -> 000011 + 1 = 000100

so the answer 60 was originally a -4

9) (a) Show work to find signed 2s complement -B + C. (b) What is the decimal equivalent of the answer?

-111100 : 60 convert to pos-> = 000011 + 1 = 000100
+011010 : 26
=
000100 : -60
+011010 : 26
=011110 : 30. -> 2's complement = 100001 + 1 = 100010 = 34

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10) (a) Show work to find signed 2s complement A + -B. (b) What is the decimal equivalent of the answer?

A= 000111: 7, B= 111100: 60, convert -B to pos: = 000100

000111
+ 000100
= 001011 : 11 -> 2's complement = 110100 + 1 = 110101 = 53

11) (a) Show work to find signed 2s complement C + E. (b) What is the decimal equivalent of the answer?

c=011010 , e = 111101

011010 : 26
+ 111 101 + 61
1010111 truncate -> 010111 = 23
2's complement: 010111 -> 101000 + 1 = 101001 = 41

*not sure if to truncate excess 7th bit before or after 2's complement...

12) (a) Show work to find signed 2s complement B + D. (b) What is the decimal equivalent of the answer?

b = 111100 D = 110101
111100 : 60
+ 110101 : 53
1110001 :113 (truncate) = 110001 = 49
2's complement: 110001 -> 001110 + 1 = 001111 = 15

13) (a) Show work to find signed 2s complement C - A. (b) What is the decimal equivalent of the answer?

c=011010 , a = 000111

- A -> 2's complement = 111000+ 1 = 111001

C+A:
011010 : 26
+ 111001 : 7
= 1010011 : (truncate) = 010011 = 19
2's complement 010011 = 101100+ 1 = 101101 = 45

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14) (a) Show work to find signed 2s complement A - D. (b) What is the decimal equivalent of the answer?

a = 000111, d = 110101

-D -> 2's complement = 001010 + 1 = 001011
A+D
000111 : 7
+001011 : 53
=010010 = 18 -> 2's complement = 101101 + 1 = 101110 = 46

15) (a) Show work to find signed 2s complement E - C. (b) What is the decimal equivalent of the answer?

c=011010 , e = 111101

-C -> 2's complement = 100101 + 1 = 100110

E+C
111101 : 61
+100110 : 26
1100011 (truncate) = 100011 -> 2's complement = 011100 + 1 = 100011 = 35

16) (a) Show work to find signed 2s complement -B - C. (b) What is the decimal equivalent of the answer?

c=011010 , b = 111100

-C -> 2's complement = 100101 + 1 = 100110
-B -> 2's complement = 000011 + 1 = 000100

B + C
000100 : 60
+100110 : 26
101010 -> 2's complement = 010101 + 1 = 010110 = 22

17) (a) Show work to find signed 2s complement C - D. (b) What is the decimal equivalent of the answer?

c=011010 , d = 110101

-D -> 2's complement = 001010 + 1 = 001011

C + D
100110 : 26
+001011 : 53
110001 -> 2's complement = 001110 + 1 = 001111 = 15

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18) (a) Show work to find unsigned E * C. For this, restrict the result to 6 bits. (b) What is the decimal equivalent of the answer?

c=011010 , e = 111101

```
              | 1 1 1 1 0 1
              |*0 1 1 0 1 0
    ----------------------------------
    =           1 1 1 1 0 1
          1 1 1 1 0 1
        1 1 1 1 0 1
              | 1 1 0 0 1 0      = 50
```

19) (a) Show work to find signed 2s complement B * E. For this, restrict the result to 6 bits. (b) What is the decimal equivalent of the answer?

b = 111100 , e = 111101

```
              |  1 1 1 1 0 0
              |* 1 1 1 1 0 1
    ----------------------------------
    =             1 1 1 1 0 0
            1 1 1 1 0 0
          1 1 1 1 0 0
        1 1 1 1 0 0
      1 1 1 1 0 0
    1 1 1 1 0 0
              | 1 1 0 1 0 0      = 52
```

20) (a) Show work to find signed 2s complement A * -B. For this, restrict the result to 6 bits. (b) What is the decimal equivalent of the answer?

b = 111100, a = 000111

-B -> 2's complement = 000011 + 1 = 000100

```
              |  0 0 0 1 1 1
              |* 0 0 0 1 0 0
    ----------------------------------
    =           0 0 0 1 1 1

              | 0 0 0 1 1 1      = 7
```

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21) (a) Show work to find signed 2s complement -E * A. For this, restrict the result to 6 bits.
(b) What is the decimal equivalent of the answer?

e = 111101, a = 000111

-E -> 2's complement = 111101 + 1 = 111110

```
              l 1 1 1 1 1 0
              l*0 0 0 1 1 1
    ------------------------------------
    =           1 1 1 1 1 0
              1 1 1 1 1 0
            1 1 1 1 1 0

              l 1 1 1 0 1 0      = 58
```

22) (a) Show work to find signed 2s complement B * -D. For this, restrict the result to 6 bits.
(b) What is the decimal equivalent of the answer?

b = 111100 , d = 110101

-D -> 2's complement = 001010 + 1 = 001011

```
               l  1 1 1 1 0 0
               l* 1 1 0 1 0 1
    ------------------------------------
    =            1 1 1 1 0 0
               1 1 1 1 0 0
           1 1 1 1 0 0
         1 1 1 1 0 0
                l 1 0 1 1 0 0      = 44
```