CMSI 2210
Homework #2
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Questions about carry and overflow assume signed (modular) arithmetic.

1. **Hex FAC3 in binary is:**
   1111101011000011

2. **Hex FAC3 as an unsigned decimal is:**
   (15 * 16^3) + (10 * 16^2) + (12 * 16^1) + (3 * 16^0)
   = 64195

3. **Hex FAC3 as a signed decimal is:**
   (-1 * 16^3) + (10 * 16^2) + (12 * 16^1) + (3 * 16^0) =
   = -1341

4. **Hex 0064 in binary is:**
   = 0000 0000 0110 0100

5. **Hex 0064 as an unsigned decimal is:**
   (0 * 16^3) + (0 * 16^2) + (6 * 16^1) + (4 * 16^0)
   = 96 + 4
   = 100

6. **Hex 0064 as a signed decimal is:**
   (0 * 16^3) + (0 * 16^2) + (6 * 16^1) + (4 * 16^0)
   = 96 + 4
   = 100

7. **Hex 8000 in binary is:**
   1000000000000000

8. **Hex 8000 as an unsigned decimal is:**
   (8 * 16^3) + (0 * 16^2) + (0 * 16^1) + (0 * 16^0)
   = 32768

9. **Hex 8000 as a signed decimal is:**
   (-8 * 16^3) + (0 * 16^2) + (0 * 16^1) + (0 * 16^0)
   = -32768

10. **Decimal 8000 encoded in 16-bits (unsigned) is in hex:**

16 | 8000   0
16 | 500   4
16 | 31   F
16 | 1   1
0

= 1F40

11. Decimal 8000 encoded in 16-bits (signed) is in hex:

16 | 8000   0
16 | 500   4
16 | 31   F
16 | 1   1
0

= 1F40

12. Decimal -11 encoded in 16-bits (signed) is in hex:

Decimal: -11 —> 11
Binary: 0000 0000 0000 1011
Negated: 1111 1111 1111 0100
\+ 0000 0000 0000 0001
= 1111 1111 1111 0101

Hex = FFF5

13. Decimal -32717 encoded in 16-bits (signed) is in hex:

Decimal: -32717 —> 32717
Binary: 0111 1111 1100 1101
Negated: 1000 0000 0011 0010
\+ 0000 0000 0000 0001
= 1000 0000 0011 0011

Hex = 8033

14. Binary 10111101 in hex is:

BD

15. Binary 1011110100000001 as an unsigned decimal is:

2^15 + 2^13 + 2^12 + 2^11 + 2^10 + 2^8 + 2^0
= 32768 + 8192 + 4096 + 2048 + 1024 + 256 + 1
= 48385

16. Binary 1011110100000001 as a signed decimal is:

(-1 * 2^15) + 2^13 + 2^12 + 2^11 + 2^10 + 2^8 + 2^0

= -32768 + 8192 + 4096 + 2048 + 1024 + 256 + 1

= -17151

17. If we had 20-bit registers, the smallest signed decimal value would be:

1000/0000/0000/0000/0000 = -2^(20-1)

= -524288

18. If we had 20-bit registers, the largest signed decimal value would be:

0111/1111/1111/1111/1111 = 2^(20-1) - 1

= 524287

19. The modular sum of 16-bit hex values 3511 + 4FFC is:

```
    1 1
    3 5 1 1
+   4 F F C
    —---------
    8 5 0 D
```

20. The saturated sum of 16-bit hex values 3511 + 4FFC is:

```
    1 1
    3 5 1 1
+   4 F F C
    —---------
    8 5 0 D
```

21. The 16-bit operation 3511 + 4FFC has a carry (Y or N):

```
    1 1
    3 5 1 1
+   4 F F C
    —---------
    8 5 0 D
```

No, the operation does not have a carry.

22. The 16-bit operation 3511 + 4FFC has a overflows (Y or N):

```
    1 1
    3 5 1 1
+   4 F F C
    —---------
    8 5 0 D
```

Yes, we added two positive values and got a negative.

23. The modular sum of 16-bit hex values 6159 + F702 is:

```
   1
     6 1 5 9
 +   F 7 0 2
    —---------
     5 8 5 B
```

24. The saturated sum of 16-bit hex values 6159 + F702 is:

```
   1
     6 1 5 9
 +   F 7 0 2
   ——---------
   1 5 8 5 B
```

= FFFF (maximum representable value at 16-bits)

25. The 16-bit operation 6159 + F702 has a carry (Y or N):

```
   1
     6 1 5 9
 +   F 7 0 2
    —---------
     5 8 5 B
```

Yes, the operation has a carry of 1.

26. The 16-bit operation 6159 + F702 has a overflows (Y or N):

```
   1
     6 1 5 9
 +   F 7 0 2
   ——---------
     5 8 5 B
```

For signed, modular arithmetic, there is no overflow. For unsigned numbers, there is overflow.

27. The modular sum of 16-bit hex values EEEE + C00C is:

```
   1       1
     E E E E
 +   C 0 0 C
 —-------------
     A E F A
```

28. The saturated sum of 16-bit hex values EEEE + C00C is:

```
 1    1
   E E E E
+  C 0 0 C
—-------------
  1 A E F A
```

= FFFF (maximum representable value at 16-bits)

29. The 16-bit operation 9EEE + AB0C has a carry (Y or N):

```
 1 1    1
   9 E E E
+  A B 0 C
—-------------
   4 9 F A
```

Yes, the operation has a carry of 1.

30. The 16-bit operation 9EEE + AB0C has a overflows (Y or N):

```
 1 1    1
   9 E E E
+  A B 0 C
—-------------
   4 9 F A
```

For signed, modular arithmetic, there is no overflow, because adding 2 negative numbers results in a negative. For unsigned numbers, there is overflow because there is a carry.

31. The negation of 16-bit word B00F is:

Binary: 1011 0000 0000 1111
Negation: 0100 1111 1111 0001
Hex = 4FF1

32. The negation of 16-bit word 2232 is:

Binary: 0010 0010 0011 0010
Negation: 1101 1101 1100 1100
Hex = DDCC

33. The negation of 16-bit word 8000 is:

Binary: 1000 0000 0000 0000
Negation: 0111 1111 1111 1110
Hex = 7FFE

34. The negation of 32-bit word FFF329BA is:

Binary: 1111 1111 1111 0011 0010 1001 1011 1010

Negation: 0000 0000 0000 1100 1101 0110 0100 0100

Hex = 000CD644

40. 96.03125 as a 32-bit float, in hex is:

a. 96 => 0110/0000 => 0060 (hex)
b. .03125 = 1/16^2 * 8 => .0800 (hex)
c. 0060.0800

35. Hex 43700000, when iterpreted as an IEEE-754 pattern, is in decimal:

a. 0/10000110/1110…
b. e = 134 - 127 = 7
c. 1.111 x 2^7 = 11110000
d. 240

36. Hex C0FF0000, when iterpreted as an IEEE-754 pattern, is in decimal:

a. 1/10000001/11111110…
b. e = 129 - 127 = 2
c. 1.1111111 x 2^2 = 111.11111
d. -7.96875