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**CS 330**

**Homework Assignment 5**

**3/23/18**

Perform the following additions in four bit binary representation. Write out your work in binary. At the conclusion of each, give the status of the following flags: Zero, Sign, Carry, Overflow.

–7 + 2 → 0111 + 0010 → (1000 + 0001) + 0010 → 1001 + 0010 → 1011

Zero: 0 Carry: 0 Sign: 1 Overflow: 0

–4 + 4 → 0100 + 0100 → (1011 + 0001) + 0100 → 1100 + 0100 → 0000

Zero: 1 Carry: 1 Sign: 0 Overflow: 0

3 + 4  → 0011 + 0100 → 0111

Zero: 0 Carry: 0 Sign: 0 Overflow: 0

5 + 4 → 0101 + 0100 → 1001

Zero: 0 Carry: 0 Sign: 1 Overflow: 1

5 + 3 → 0101 + 0011 → 1000

Zero: 0 Carry: 0 Sign: 1 Overflow: 1

3 + –3 → 0011 + 0011 → 0011 + (1100 + 0001) → 0011 + 1101 → 0000

Zero: 1 Carry: 1 Sign: 0 Overflow: 0

4 + 0 → 0100 + 0000  → 0100

Zero: 0 Carry: 0 Sign: 0 Overflow: 0

7 + 6  → 0111 + 0110  → 1101

Zero: 0 Carry: 0 Sign: 1 Overflow: 1

Perform the following subtractions in four bit binary representation. Do this by complementing the subtrahend and adding that to the minuend. Write out your work in binary. (That is, instead of “5 – 3” perform “5 + (–3)”.) At the conclusion of each, give the status of the following flags: Zero, Sign, Carry, Overflow.

2 – 7 → 2 + (-7) → 0010 + 0111 → 0010 + (1000 + 0001) → 0010 + 1001 → 1011

Zero: 0 Carry: 0 Sign: 1 Overflow: 0

–5 – 2 → -5 + (-2) → 0101 + 0010 → (1010 + 0001) + (1101 + 0001) → 1011 + 1110 →  1001

Zero: 0 Carry: 1 Sign: 1 Overflow: 0

7 – 7 → 7 + (-7) → 0111 + 0111 → 0111 + (1000 + 0001) → 0111 + 1001 → 0000

Zero: 1 Carry: 1 Sign: 0 Overflow: 0

6 – 6 → 6 + (-6) → 0110 + 0110 → 0110 + (1001 + 0001) → 0110 + 1010 → 0000

Zero: 1 Carry: 1 Sign: 0 Overflow: 0

1 – 6 → 1 + (-6) → 0001 + 0110 → 0001 + (1001 + 0001) → 0001 + 1010 → 1011

Zero: 0 Carry: 0 Sign: 1 Overflow: 0

5 – 4 → 5 + (-4) → 0101 + 0100 → 0101 + (1011 + 0001) → 0101 + 1100 → 0001

Zero: 0 Carry: 1 Sign: 0 Overflow: 0

0 – 4 → 0 + ( -4) → 0000 + 0100 → 0000 + (1011 + 0001) → 0000 + 1100 → 1100

Zero: 0 Carry: 0 Sign: 1 Overflow: 0

–7 – 6 → -7 + (-6) → 0111 + 0110 → (1000 + 0001) + (1001 + 0001) → 1001 + 1010 → 0011

Zero: 0 Carry: 1 Sign: 0 Overflow: 1

Perform the following additions in eight bit binary representation. Write out your work in binary.

101 + 33  → 0110 0101 + 0010 0001  → 1000 0110

Zero: 0 Carry: 0 Sign: 0 Overflow: 0

105 + 128  → 0110 1001 + 1000 0000  → 1110 1001

Zero: 0 Carry: 0 Sign: 0 Overflow: 0

43 + 37 → 0010 1011 + 0010 0101 → 0101 0010

Zero: 0 Carry: 0 Sign: 0 Overflow: 0

73 + 128 → 0100 1001 → 1000 0000 → 1100 1001

Zero: 0 Carry: 0 Sign: 0 Overflow: 0

Perform the following subtractions in eight bit binary representation. Do this by complementing the subtrahend and adding that to the minuend. Write out your work in binary. (That is, instead of “5 – 3” perform “5 + (–3)”.) At the conclusion of each, give the status of the following flags: Zero, Sign, Carry, Overflow.

105 – 127 → 105 + (-127) → 0110 1001 + 0111 1111 → 0110 1001 + (1000 0000 + 0000 0001)

→ 0110 1001 + 1000 0001 → 1100 1010

Zero: 0 Carry: 0 Sign: 1 Overflow: 0

94 – 88 → 94 + (-88) → 0101 1110 + 0101 1000→ 0101 1110 + (1010 0111 + 0000 0001)

→ 0101 1110 + 1010 1000 → 0000 0110

Zero: 0 Carry: 1 Sign: 0 Overflow: 0

101 – (–33) → 101 + 33→ 0110 0101 + 0010 0001 → 1000 0110

Zero: 0 Carry: 0 Sign: 1 Overflow: 1

23 – 49 → 23 + (-49) → 0001 0111 + 0011 0001 → 0001 0111 + (1100 1110 + 0000 0001)

→ 0001 0111 + 1100 1111 → 1110 0110

Zero: 0 Carry: 0 Sign: 1 Overflow: 0