Name: **Id#**

COE 200, Term 023
Fundamentals of Computer Engineering

Quiz# 2

Date: Saturday, July 12, 2003

Q1. Consider the following two numbers **A=-98** and **B= 33**:

     a. Express the two numbers in **Sign-Magnitude**, **1`s complement** and **2`s complement** notations, assuming *8-bit representation*.

     b. Perform the operation **A-B** two times, once using **1`s complement notation** and once using **2`s complement notation**.

Q2. Determine, in <u>binary</u> and <u>decimal</u>, the smallest (negative) number and the largest (positive) number that can be stored using **Sign-Magnitude**, **1's Complement** and **2's complement** notations, assuming **12-bit** representation.

Name: Key   Id#

COE 200, Term 023
Fundamentals of Computer Engineering

Quiz# 2

Date: Saturday, July 12, 2003

Q1. Consider the following two numbers **A=-98** and **B= 33**:

    a. Express the two numbers in **Sign-Magnitude, 1's complement** and **2's complement** notations, assuming *8-bit representation*.

Number	Sign-magnitude	1's Comp.	2's Comp.
98	0 1 1 0 0 0 1 0	0 1 1 0 0 0 1 0	0 1 1 0 0 0 1 0
−98	1 1 1 0 0 0 1 0	1 0 0 1 1 1 0 1	1 0 0 1 1 1 1 0
33	0 0 1 0 0 0 0 1	0 0 1 0 0 0 0 1	0 0 1 0 0 0 0 1

    b. Perform the operation **A-B** two times, once using **1's complement notation** and once using **2's complement notation**.

    - **1's Complement :**

      1 0 0 1 1 1 0 1 — 0 0 1 0 0 0 0 1

   = 1 0 0 1 1 1 0 1 + 1 1 0 1 1 1 1 0

        1 1 1

      1 0 0 1 1 1 0 1

 + 1 1 0 1 1 1 1 0

(1)← 0 1 1 1 1 0 1 1

 +   1

    0 1 1 1 1 1 0 0

overflow because the sign-bit has changed

The correct result should be −131 which cannot be represented in 8-bits.

- 2's complement :

100 11110 — 00100001 ≈ 100 11110 + 11011111

    1 1 11
  100 11110
+ 110 1 1111
① ← 0 111 1101
   overflow because the sign-bit has changed.

Q2. Determine, in <u>binary</u> and <u>decimal</u>, the smallest (negative) number and the largest (positive) number that can be stored using **Sign-Magnitude**, **1's Complement** and **2's complement** notations, assuming **12-bit** representation.

- <u>Sign — magnitude</u> :

  - Smallest $-2^{11} - 1 = -2047$ 1 1111 1111 111

  - Largest $2^{11} - 1 = +2047$ 0 1111 1111 111

- <u>1's Complement</u> :

  - Smallest $-2^{11} - 1 = -2047$ 1 0000 0000 000

  - Largest $+2^{11} - 1 = +2047$ 0 1111 1111 111

- <u>2's complement</u> :

  - Smallest $-2^{11} = -2048$ 1 0000 0000 000

  - Largest $+2^{11} - 1 = +2047$ 0 1111 1111 111