Comp 3350: Computer Organization & Assembly Language
HW # 1: Theme: Binary Number Representations (Review of prerequisites)
All main questions are of equal weight.
(Credit awarded to only those answers that show work)

1. What is the decimal representation of each of the binary integers below: assume (a) and (b) are signed and (c) is unsigned?
   a. 1100 0111
   b. 0010 1000
   c. 1111 0011

Ans:

a. 1100 0111 is signed, the highest bit is a 1
   1. reverse the bits — ¬1100 0111 = 0011 1000
   2. add 1 — 0011 1000 + 1 = 0011 1001
   3. convert the absolute value to decimal — 0011 1001 = 57
   4. the original binary integer is negative — the decimal representation = -57

b. 0010 1000 is signed, the highest bit is a 0, convert it as if it is an unsigned binary integer
   1. convert the absolute value to decimal — 0010 1000 = 40
   2. the original binary integer is positive — the decimal representation = 40

c. 1111 0011 is unsigned
   1. convert the absolute value to decimal
      $1111\ 0011 = (1\times2^7) + (1\times2^6) + (1\times2^5) + (1\times2^4) + (0\times2^3) + (0\times2^2) + (1\times2^1) + (1\times2^0) = (243)_{10}$
   2. the decimal representation = 243

2. What is the minimum number of binary bits needed to represent each of the following decimal numbers?
   a. 65531
   b. 13662
   c. -2658

Ans:

a. 65531 = 1111 1111 1111 1011
   the minimum number of binary bits is 16
b. 13662 = 11 0101 0101 1110
   the minimum number of binary bits is 14
c. -2658 = 1 1010 0110 0010
   the minimum number of binary bits is 13

3. What is the hexadecimal representation of each of the following binary numbers?
   a. 1010 1001 1101 1101
   b. 1111 0010 0100 0011
   c. 1010 1110 0101 1100

Ans:

a. 1010 1001 1101 1101 = 0xA9DD
b. 1111 0010 0100 0011 = 0xF243
c. 1010 1110 0101 1100 = 0xAE5C

4. What is the decimal value of the following representation of each hex integer below—assume they use unsigned notation?
   a. 3039
   b. 1D2
   c. A5E3

Ans:

a. $3039 = (0011\ 0000\ 0011\ 1001)_2 = (12345)_{10}$
b. $1D2 = (0001\ 1101\ 0010)_2 = (466)_{10}$
c. $A5E3 = (1010\ 0101\ 1110\ 0011)_2 = (42467)_{10}$

5. What is the 16-bit hexadecimal representation of each decimal integer?
   a. –481
   b. –198
   c. +2020

Ans:

a. -481
   1. convert the absolute value to binary 481 = 0000 0001 1110 0001
   2. reverse the bits ¬ 0000 0001 1110 0001 = 1111 1110 0001 1110
   3. add 1 1111 1110 0001 1110 + 1 = 1111 1110 0001 1111
   4. the 16-bit hexadecimal representation = FE1F

b. -198
   1. convert the absolute value to binary 198 = 0000 0000 1100 0110
   2. reverse the bits ¬ 0000 0000 1100 0110 = 1111 1111 0011 1001
   3. add 1 1111 1111 0011 1001 + 1 = 1111 1111 0011 1010
   4. the 16-bit hexadecimal representation = FF3A

c. +2020 = 111 1110 0100 =7E4
   1. convert the absolute value to binary 2020 = 0000 0111 1110 0100
   2. the 16-bit hexadecimal representation = 07E4

6. What is the 8-bit binary (2's complement) representation of each of the decimal integers?
   a. –65
   b. +113
   c. –119

Ans:

a. -65 is negative
   1. convert the absolute value to binary 65 = 0100 0001
   2. reverse the bits ¬0100 0001 = 1011 1110
   3. add 1 1011 1110 + 1 = 1011 1111
   4. the 8-bit binary representation = 1011 1111

b. +113 is positive
   1.convert the absolute value to binary 113 = 0111 0001
   2. the 8-bit binary representation = 0111 0001

c. -119 is negative
   1. convert the absolute value to binary 119 = 0111 0111
   2. reverse the bits ¬0111 0111= 1000 1000
   3. add 1 1000 1000 + 1 = 1000 1001
   4. the 8-bit binary representation = 1000 1001

7. Write the ASCII code for the string "Spring". The answer should provide ASCII (in hexadecimal) corresponding to each letter in the string. The ASCII values can be found on the inner cover of the book.

Ans:

Spring = 0x537072696E67

8. What is the range of decimal values that can be represented by:
   a) 5-bit unsigned integer?
   b) 5-bit signed integer?

Ans:

a. mini = 0
   max = $2^5 - 1 = (11111)_2 = (31)_{10}$

b. mini = $-2^4 = (10000)_2 = (-16)_{10}$
   max = $2^4 - 1 = (01111)_2 = (15)_{10}$