# ECE/CS 252 Fall 2011 Homework 2
# Due in Discussion Wednesday, September 21, 2011

Instructions: You should do this homework in the groups assigned to you in discussion. You should hand in ONE copy of the homework that lists your discussion section number and names and UW ID numbers of all students. You must *staple* all pages of your homework together to receive full credit.

Warning: Most homework will use questions from your textbook, Patt and Patel's *Introduction to Computing Systems*, which we abbreviate (*ItCS*) . This homework explicitly includes all questions to aid those who are late in obtaining the textbook.

First contact for questions is TA Sean Franey: sfraney@wisc.edu

## Problem 1 (1 point – right or wrong)

How many distinct values can be represented by 16 bits?

### *Answer:*

$2^{16} = 65{,}536$

## Problem 2 (3 points – 0.5 points per cell)

Complete the following table for conversion between hexadecimal and binary:

| **Binary** | **Hexadecimal** |
|---|---|
| 11 _ _ 0101 | C __ |
| 0100 1 _ _ 1 | __ D |
| _ _ 11 0110 | 3 __ |

### *Answer:*

| **Binary** | **Hexadecimal** |
|---|---|
| 1100 0101 | C5 |
| 0100 1101 | 4D |
| 0011 0110 | 36 |

# Problem 3 (2.5 points – 0.5 points per code)

Using ASCII 8-bit, null-terminated string patterns, represent each of the characters in the string "Fall 2011" using the hexadecimal value. (Only represent the characters between the quotation marks.)

### *Answer:*

| **Character** | **Hex (from ASCII Table)** |
|---|---|
| F | 46 |
| a | 61 |
| l | 6C |
| l | 6C |
| Space | 20 |
| 2 | 32 |
| 0 | 30 |
| 1 | 31 |
| 1 | 31 |
| Null | 00 |

# Problem 4 (1.5 points – 0.5 points each)

Convert the following 8-bit signed 2's complement binary numbers to decimal.

a. 0011 1001
b. 1110 1111
c. 1011 0101

### *Answer:*

a. $1*2^5 + 1*2^4 + 1*2^3 + 1*2^0 = 57$
b. 2's complement the number: 0001 0001 = $1*2^4 + 1*2^0 = 17$ => -17
c. 2's complement the number: 0100 1011 = $1*2^6 + 1*2^3 + 1*2^1 + 1*2^0 = 75$ => -75

# Problem 5 (2 points – 1 point each)

What conditions indicate overflow has occurred when two 2's complement numbers are added.

### *Answer:*

1. When 2 positive values are added and the sum's MSB is 1

2. When 2 negative values are added and the sum's MSB is 0

## Problem 6 (3 points – 1 point each)

Find the 2's complement of the following binary numbers:

a. 0011 0101
b. 0110 1100
c. 1011 1010

### *Answer:*

a. 1100 1011
b. 1001 0100
c. 0100 0110

## Problem 7 (3 points – 0.5 points per cell)

Using 6 bits to represent each number, write the binary representations of 26 and -26 in unsigned, sign-magnitude, 1's complement, and 2's complement.

### *Answer*

| | **26** | **-26** |
|---|---|---|
| **Unsigned** | 011010 | N/A |
| **1's complement** | 011010 | 100101 |
| **2's complement** | 011010 | 100110 |

## Problem 8 (2 points – 1 point each)

Compute the following:

1. NOT(0110) AND NOT(1011)
2. NOT(1101 OR (0101 AND 1100))

### *Answer:*

1. 1001 AND 0100 = <u>0000</u>
2. NOT(1101 OR (0100)) = NOT(1101) = <u>0010</u>

## Problem 9 (4 points – 2 points each)

Write the decimal equivalents for these IEEE floating point numbers.

a. 0 01111111 11000000000000000000000

b. 1 01111110 10000000000000000000000

***Answer:***

a. $(-1)^0 * 1.75 * 2^{127-127} = 1 * 1.75 * 2^0 = 1.75$

b. $(-1)^1 * 1.5 * 2^{126-127} = -1 * 1.5 * 2^{-1} = -1 * 1.5 * 0.5 = -0.75$

# Problem 10 (3 points)

A programmer attempts to write a program to add two numbers. When the numbers 3 and 7 are added, the result given is the letter ‘j’. Explain why this is the result instead of 10.
Hint: consider how the computer might interpret the values as something other than numbers.

***Answer:***

The *numbers* 3 and 7 are being interpreted as ASCII *characters*. Therefore, ‘3’ takes the hex value 0x33 and ‘7’ takes the hex value 0x37. The sum of these is 0x6A, which is equivalent to the ASCII code for the letter ‘j’.