# COMP3350 Spring, 2024
# Homework Assignment 1

Important Notes:

- Solutions turned in must be your own. Please, mention references (if any) at the end of each question.
- All solutions must be accompanied by the equations used/logic/intermediate steps. Writing only the final answer will receive **zero** credits.
- Partial score of every question is dedicated to each correct final answer provided by you. Please ensure both your equation/logic and final answer are correct. Moreover, you are expected to provide explanation for your solutions.
- All units must be mentioned wherever required.
- We encourage all solutions to be typed in for which you could use software programs like LaTeX, Microsoft Word etc. If you submit handwritten solutions, they must be readable by the TAs to receive credits.
- All submitted solutions must be in the PDF format unless otherwise mentioned.

**Problem Set A. Encoding Positive Integers**

1. What is the 5-bit binary representation of the decimal number 21? **(6 points)**

2. What is the hexadecimal representation for decimal 219 encoded as an 8-bit binary number? **(6 points)**

3. The hexadecimal representation for an 8-bit unsigned binary number is 0x9E. What is its decimal representation? **(6 points)**

4. Compute the sum of these two 4-bit unsigned binary numbers: 0b1101 + 0b0110. **Express the result in hexadecimal**. You may use 5 bits to represent the solution if needed. **(6 points)**

$$\begin{array}{r} 1101 \\ +\underline{0110} \end{array}$$

**Problem Set B. Two's Complement Representation**

1. What is the 6-bit two's complement representation of the decimal number -21? **(8 points)**

2. What is the hexadecimal representation for decimal -51 encoded as an 8-bit two's complement number? **(8 points)**

3. The hexadecimal representation for an 8-bit two's complement number is 0xD6. What is its decimal representation? **(8 points)**

4. Consider the following subtraction problem where the operands are 5-bit two's complement numbers. Compute the result and give the answer as a decimal (base 10) number. **(8 points)**

$$\begin{array}{r} 10101 \\ -\underline{00011} \end{array}$$

**Problem Set C. Assembly Language**

1. What MIPS Instruction does this represent? **(12 points)**

| op | rs | rt | rd | shamt | funct |
|---|---|---|---|---|---|
| 0 | 9 | 8 | 10 | 0 | 34 |

2. Assume variable h is associated with register $s2 and the base address of the array A is in $s3. What is the MIPS assembly code for the C assignment statement below? **(10 points)**

**A[12] = h + A[9];**

3. Assume variables h,g,h,i,j are associated with registers $s0, $s1, $s2, $s3, $s4. What is the MIPS assembly code for the C assignment statement below? **(10 points)**

**f = (g + h) – (i + j);**

4. If $t1 has the base of the array A and $s3 corresponds to h, the assignment statement A[200] = h + A[200]; is compiled into:

```
lw $t0,800($t1)
add $t0,$s3,$t0
sw $t0,800($t1)
```

What is the MIPS machine language code for these three instructions? **(12 points)**

**Bonus Problem. Overflow (12 points)**

The following addition and subtraction operations are to be carried out with 8-bit 2's complement numbers. For each operation, calculate the result and label as OVERFLOW or CORRECT

Example: 1 + 2 = 0b0000 0001 + 0b0000 0010 = 0b0000 0011 = 3, CORRECT

a. 64 + 64 = ?
b. -127 + 30 = ?
c. -127 - 1 = ?
d. 38 - 40 = ?