COMP3350 Homework 01

Important Notes:

- Solutions turned in must be your own. Please, mention references (if any) at the end of each question. The use of GenAI tools is not allowed unless explicitly specified.
- 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.

1. What is the 5-bit binary representation of the decimal number 21? Show your steps. **(3 points)**

2. What is the 6-bit two's complement representation of the decimal number -23? Show your steps. **(3 points)**

3. What MIPS Instruction does this represent? Show your steps. **(4 points)**

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

4. Annotate the following MIPS instructions to indicate source registers and destination registers. A source register is read during the instruction's execution, while a destination register is written during the instruction's execution. **(6 points)**

    - add $t3, $t2, $zero
    - sub $t3, $t1, $t4
    - addi $t1, $t2, 100
    - lw $s1, 4($gp)
    - sw $s1, 12($gp)
    - bne $t1, $s2, loop1

5. Consider a program that declares global integer variables x, y, z, w[15]. Assume that an integer occupies 4 bytes. These variables are allocated starting at a base address of decimal 4000. All these variables have been initialized to decimal 25. The base address 4000 has been placed in $gp. The program executes the following assembly instructions:

```
lw $s1, 0($gp)
lw $s2, 4($gp)
add $s1, $s2, $s1
sub $s2, $s1, $s2
add $s2, $s1, $s2
sw $s1, 8($gp)
sw $s2, 12($gp)
subi $s2, $s2, 55
sw $s2, 16($gp)
add $s2, $s1, $s2
add $s1, $s2, $s1
sw $s1, 20($gp)
sw $s2, 24($gp)
```

What are the memory addresses of variables x, y, z, w[0], w[1], w[2], w[3], and w[4]? (**4 points**)
What are the values of variables x, y, z, w[0], w[1], w[2], w[3], and w[4] at the end of the program? Explain this by adding comments to the code to show the effect of each instruction. (**4 points**)