CS2100 Computer Organisation
AY2021/22 Semester I
Assignment 1 [ANSWER SHEET]

FULL NAME:	**Toh Jia-Yih Ronald**
STUDENT ID: E.g., <AxxxxxxY>	**A0199937B**
TUTORIAL GROUP:	**2**

QUESTION 0. SUBMISSION INSTRUCTIONS (3 MARKS)

a. Ensure that you name your file <AxxxxxxxY>.pdf, where AxxxxxxxY is your matric number. (1 mark)	**Y / N**
b. Ensure that you submit your assignment as a single PDF file. (1 mark)	**Y / N**
c. Ensure that your assignment submission has your tutorial group number, student ID and name	**Y / N**

QUESTION 1. COMPLEMENT NUMBER SYSTEMS (10 MARKS)

Q1.a	$-m = 4^n - m$
Q1.b	(i) 10001111101_2 (ii) 11001110_2
Q1.c	(i) 101331_4 (ii) 12130_4
Q1.d	(i) $-1149 = 4^6 - 1149 = 2947_{10} = 1232003_4$ (ii) $-412 = 4^5 - 412 = 612_{10} = 121210_4$
Q1.e	$1149 + (-412) = 101331_4 + 121210_4 = 023201_4 = 737_{10}$ (Verified)

QUESTION 2. REAL NUMBERS (11 MARKS)

<table>
<tr><td>Q2.a</td><td>(i) $2^{m-1} - 1$</td></tr>
<tr><td></td><td>(ii) -2^{m-1}</td></tr>
<tr><td></td><td>(iii) $2^{-(16-m)}$</td></tr>
<tr><td>Q2.b</td><td>
<table>
<tr><th>m</th><th>Most positive integer</th><th>Most negative integer</th><th>Smallest positive value</th></tr>
<tr><td>4</td><td>7</td><td>-8</td><td>2^{-12}</td></tr>
</table>
</td></tr>
<tr><td>Q2.c</td><td>
<table>
<tr><th>Most positive value</th><th>Most negative value</th><th>Smallest positive value</th></tr>
<tr><td>1.996×2^{64}</td><td>-1.996×2^{64}</td><td>1.000×2^{-63}</td></tr>
</table>
</td></tr>
<tr><td>Q2.d</td><td>Advantage: Floating-point number representations allow a much larger range of values to be expressed as compared to fixed-point representation.
Disadvantage: Floating-point number loses precision as it will be rounded off in large numbers.</td></tr>
</table>

QUESTION 3. C and Assembly Programming (8 MARKS)

Q3.a	xor $s0, $s0, $t1
Q3.b	2 + 31*5 + 2 = 159

Q3.c	include <math.h>
	
	int t0 = data;
	int t1 = (int) pow(2, 31);
	while (t0 != 0){
	int t2 = t0 & 1;
	if (t2 == 1){
	s0 = s0 ^ t1;
	}
	t0 = t0 >> 1;
	}
	s0 = s0 ^ t1;

QUESTION 4. INSTRUCTION ENCODING (8 MARKS)

<table>
<tr><td>Q4.a</td><td>Add 1 to every element in array. 10 elements, base address of array at $3.</td></tr>
<tr><td>Q4.b</td><td>62</td></tr>
<tr><td>Q4.c</td><td>(Provide encodings only for the four instructions in <u>bold and underline</u>.)

<table>
<tr><th>Label</th><th>Instruction</th><th>Hexadecimal Encoding</th></tr>
<tr><td></td><td><u>addi $4, $3, 40</u></td><td>0x30640028</td></tr>
<tr><td></td><td>addi $5, $3, 0</td><td rowspan="3"></td></tr>
<tr><td>loop:</td><td>lw $6, 0($5)</td></tr>
<tr><td></td><td>addi $6, $6, 1</td></tr>
<tr><td></td><td><u>sw $6, 0($5)</u></td><td>0xACA60000</td></tr>
<tr><td></td><td>addi $5, $5, 4</td><td></td></tr>
<tr><td></td><td><u>slt $6, $5, $4</u></td><td>0x00A4302A</td></tr>
<tr><td></td><td><u>bne $6, $zero, loop</u></td><td>0x14C0FFF9</td></tr>
</table>
</td></tr>
</table>