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

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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	$-M = (4)^n_{10} - M$
Q1.b	(i) 1000111101_2 (ii) 11001100_2
Q1.c	(i) 101331_4 (ii) 12130_4
Q1.d	$-1149_{10} = (4)^6_{10} - (1149)_{10}$ $= 4096_{10} - 1149_{10}$ $= 2947_{10}$ $= 232003_{4S}$ (4's complement representation) $-412_{10} = (4)^6_{10} - 412_{10}$ $= 4096_{10} - 412_{10}$ $= 3684_{10}$ $= 321210_{4S}$ (4's complement representation)
Q1.e	$1149_{10} - 412_{10} = 1149_{10} + (-412)_{10}$ $= (101331)_{4S} + (321210)_{4S}$ $= (023201)_{4S}$ $1149_{10} - 412_{10} = 737_{10}$ $(002321)_4 = 737_{10}$ $\therefore 1149_{10} - 412_{10} = (023201)_{4S}$

QUESTION 2. REAL NUMBERS (11 MARKS)

Q2.a

(i)

integer part fraction part

0111..1. 0...0 2s

m-1 bits 16-m bits

$2^{m-1}-1$

(ii)

integer part fraction part

1000..00 . 000..00 2s

m-1 bits 16-m bits

-2^{m-1}

(iii)

integer part fraction part

000..00 . 000..01 2s

m bits 15-m bits

2^{m-16}

Q2.b

m	Most positive integer	Most negative integer	Smallest positive value
4	7	−8	0.000244140625 (2^{-12})

Q2.c

Most positive value	Most negative value	Smallest positive value
1.996×2^{64}	-1.996×2^{64}	1.000×2^{-63}

more precise representation of float values as compared

Q2.d

Advantage: to floating point representation. Floating point representation has a wider representable range

Disadvantage:

- various implementation of floating point representation which may not be compatible to each other and is bound to error
- operations are more time consuming as compared to fixed-point representation

QUESTION 3. C and Assembly Programming (8 MARKS)

Q3.a

```
XOR $s0,$s0,$t1
```

Q3.b

31 iterations

$2+6(31)+1+1=190$

Q3.c

```
#include <stdio.h>
int main(void){
    int to=data;
    unsigned int t1=0x80000000;
    int t2;
    while (to!=0){
      t2= to%2;   # copy LSB
      if(t2!=0){
        data= data^t1;
      }
      to >>=1;
    }
    data=data^t1;
    return 0;
}
```

QUESTION 4. INSTRUCTION ENCODING (8 MARKS)

Q4.a

base address: $3
numelement: 10
add 1 to all the elements in the array

Q4.b

2 + 6(10) = 62

Q4.c (Provide encodings only for the four instructions in **bold and underline**.)

Label	Instruction	Hexadecimal Encoding
	addi $4, $3, 40	0x20640028
	addi $5, $3, 0	[redacted]
loop:	lw $6, 0($5)	
	addi $6, $6, 1	
	sw $6, 0($5)	0xACA60000
	addi $5, $5, 4	[redacted]
	slt $6, $5, $4	0x00A4302A
	bne $6, $zero, loop	0x14C0FFFA