Assignment 2 Solutions

CMPT 215

Due: July 27^{th}, 2017

Total: 65 marks

Problem 1.

(8 marks) Add the following, indicate if there is a type of overflow or carry over for a 8 bit binary.

i $12 + 10$

ii $01001100 + 00111110$

iii $10010000 + 11111111$

iv $4 + -13$

Solution:

1 mark for the correct solution,

1 mark for the correct identification of overflow.

i 0001 0110

ii 1000 1010 signed overflow

iii 1 0000 1111 signed and unsigned overflow

iv 1111 0111 not possible for unsigned (unsigned overflow)

Problem 2.
(8 marks) Subtract the following, indicate if there is a type of overflow or carry over for a 8 bit binary.

i $00111010 - 00011111$

ii $9 - 10$

iii $00001010 - 11111111$

iv $4 - 13$

Solution:
1 mark for the correct answer,
1 mark for the correct identification of overflow.

i 0001 1011

ii 1111 1111 Not possible for unsigned (or unsigned overflow)

iii 0000 1011 Not possible of unsigned (or unsigned overflow)

iv 1111 0111 Not possible of for unsigned (unsigned overflow)

Problem 3.
(12 marks) Multiply the following, indicate if there is a type of overflow or carry over for a 8 bit binary.

i 00111010×00011111

ii 9×10

iii 01100111×00001111

iv 11010100×11110101

Solution:
Technically all have overflow, this is mistake in the question.
1 mark for showing work and 1 mark for the correct answer.

i 0111 0000 0110

ii 0101 1010

iii 0000 0110 0000 1001

iv 1100 1010 1110 0100 or 0001 1110 0100 (1 bonus if they show work for both unsigned and signed)

Problem 4.
(6 marks) Divide the following, indicate if there is a type of overflow or carry over for a 8 bit binary.

i 01001100/00000100

ii 10101111/00001111

iii 11010100/11110101

Solution:
1 mark for showing work and 1 mark for the correct answer.

i 0001 0011 r 0

ii 0000 1011 r 1010 or 1111 1011 r 1010 (See work below)
(bonus 1 mark if they show both answers)

iii 0 r 1101 0100 or 0000 0100(bonus 1 mark if they show both answers) (see work below)

ii)

$$
\begin{array}{r l}
 & \text{convert } 10101111 \text{ to positive } 01010001 \\
 & \;00000101 \\
00001111 & \overline{)01010001} \\
 & \underline{00111100} \\
 & 00010101 \\
 & \underline{00001111} \\
 & 00000110\text{remainder} \\
 & \text{convert answer back to negative } 11111011
\end{array}
$$

iii)

convert 11010100and11110101to positive00101100 $\div$ 00001011

$$\begin{array}{r|l} & 00000100 \\ 00001011 & \overline{00101100} \\ & \underline{001011} \\ & 000000 \\ & 0000000 \\ & 00000000 \text{bring 2 zeros down} \end{array}$$

Do not need to convert negative because $- \times - = +$

Problem 5.
(8 marks) Convert the following to IEEE 754 single precision binary floating point representation for each of the following numbers.

i -3.96875

ii -1.5

iii 1.1×10^{-126}

iv 2.8×10^{6}

Solution:
1 mark for showing the fields,
1 mark for the correct answer.

i

sign	exponent	fraction
1	1000 0000	111 1110 0000 0000 0000 0000

ii

sign	exponent	fraction
1	0111 1111	100 0000 0000 0000 0000 0000

iii

sign	exponent	fraction
0	0000 0000	000 0000 0000 0000 0000 0000

iv

sign	exponent	fraction
0	1001 0100	010 1010 1110 0110 0000 0000

Problem 6.
(8 marks) Convert the following IEEE 754 single precision binary floating point values to $base_{10}$ number.

i 0100 0000 0100 0000 0000 0000 0000 0000

ii 0100 0001 1010 0000 0000 0000 0000 0000

iii 1111 1111 1000 0000 0000 0000 0000 0000

iv 1100 0001 0101 1010 0000 0000 0000 0000

Solution:
1 mark for explaining their work,
1 mark for the correct answer.

i 3.0

ii 20

iii -Infinity

iv -13.625

Problem 7.
(10 marks) Fill out the following table for the following MIPS instructions, assume that it starting at address 4000.

```
loop:       bne   $s0,$s1,out
            sw    $s2,4($s1)
            addu  $s1,$s1,$t0
            j  loop
out:        ori  $t2,$s7,3
```

In Decimal:

Instruction	Format	Fields					
		6 bits	5 bits	5 bits	5 bits	5 bits	6 bits
loop: bne $\$s0$,$\$s1$,out	I	5	16	17	3		
sw $\$s2$,4($\$s1$),out	I	43	17	18	4		
addu $\$s1$,$\$s1$,$\$t0$	R	0	17	8	17	0	33
j loop	J	2	1000				
ori $\$t2$,$\$s7$,3	I	13	23	10	3		

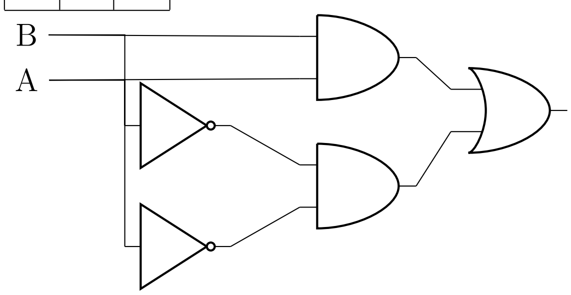
or in Binary:

Instruction	Format	Fields					
		6 bits	5 bits	5 bits	5 bits	5 bits	6 bits
loop: bne $\$s0$,$\$s1$,out	I	000101	10000	10001	00000 00000 000011		
sw $\$s2$,4($\$s1$),out	I	101011	10001	10010	00000 00000 000100		
addu $\$s1$,$\$s1$,$\$t0$	R	000000	10001	01000	10001	00000	100001
j loop	J	000010	00000000000000001111101000				
ori $\$t2$,$\$s7$,3	I	001101	10111	01010	00000 00000 000011		

Problem 8.
(5 marks) Design and show the truth table for Ex-Nor Gate using only NOT, AND and OR gates. EX-Nor gate is a digital logic gate that is the reverse or complementary form of the Exclusive-OR function.

Solution:
2 marks for the table,
3 marks for the circuit.

A	B	Q
0	0	1
0	1	0
1	0	0
1	1	1



Bonus:

Problem 9.
(3 marks) Name two universal Quantum circuits and one error correction gate used in Quantum computers.

Solution:
Universal gates:

- Toffoli (controlled not)
- Hadamard

Error correction gates:

- Fredkin (swap gate)
- Controlled-Not
- Pauli-X or Y or Z