CO450 Computer Architectures Week 8 Exercise Handout

Recap on Signed Magnitude Notation

1. Represent the following decimal number in binary using Signed Magnitude Notation:

-83_{10}

128	64	32	16	8	4	2	1
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	1	•	1	•	•	1	1

The correct answer is:

1	1	•	1	•	•	1	1

Recap on Binary Excess Notation to Decimal

1. What is the decimal number that is represented by 10101101_2 in Excess Notation?

	128	64	32	16	8	4	2	1
	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
	1	•	1	•	1	1	•	1
Unsigned binary to decimal conversion using positional notation								
Unsigned decimal value minus Excess ($2^{(n-1)}$) Note: n = number of bits								

The correct answer is:

45

Recap on Decimal to Binary Excess Notation

1. What is the binary Excess Notation representation of the following decimal number:

-35_{10}

Decimal plus Excess ($2^{(n-1)}$) Note: *n* = number of bits	93							
	128	64	32	16	8	4	2	1
	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Convert Decimal with Excess to binary using positional notation	0	1	0	1	1	1	0	1

The correct answer is:

0	1	0	1	1	1	0	1

Recap on Two's Complement

1. Convert 23_{10} to binary then use Two's Complement to convert the unsigned binary representation of 23_{10} in to the Two's Complemented binary representation for -23_{10}, what is the correct answer:

	128	64	32	16	8	4	2	1
	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Positional notation used to convert decimal to binary	0	0	0	1	0	1	1	1
Flipped bits	1	1	1	0	1	0	0	0
One to add to the flipped bits above								1
Result of addition of flipped bits and one	1	1	1	0	1	0	0	1
Carry Bits								

The correct answer is:

1	1	1	0	1	0	0	1

Recap on Two's Complement Binary Additions

1. Add the following numbers together using two's complement binary representation and then answer the questions below:

$-15_{10} + 25_{10} =$

			128	64	32	16	8	4	2	1
			2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
			1	1	1	1	·	·	·	1
+			·	·	·	1	1	·	·	1
			·	·	·	·	1	·	1	·
		1	1	1	1				1	

Did the calculation produce an overflow? YES / NO

Did the calculation produce a carryout? YES / NO

Would the calculation produce a correct result in an 8 bit system? YES / NO

How many bits were carried to the left during the calculation? 5

Recap on Decimal to Excess 50 Notation

1. Represent -6_{10} in excess 50 notation:

-6	+	50_{10}	=	44

The correct answer is:

4 4

Recap on Conversion of Decimal Numbers to SEEZMMMM Format

1. Convert -0.000001113251_{10} into the SEEZMMMM format:

S = signed magnitude notation	=	1
EE = Exponent Excess 50 notation	=	45
ZMMMM = Mantissa	=	11133
Normalise Mantissa	=	

The correct answer is:

1 45 11133

Recap on Conversion of SEEZMMMM Format to Decimal Number

1. Convert 15413283 in the SEEZMMMM Format to a decimal number:

S = signed magnitude notation	=	1	=	−
EE = Exponent Excess 50 notation	=	54	=	4
ZMMMM = Mantissa	=		=	

13283

The correct answer is:

-1328.3

Recap on Conversion of Decimal Exponent to Excess 127 Binary

1. Represent an Exponent of -8_{10} in the Excess 127 format:

Excess	127	=								
Two's Complement Exponent	-8	=								
Result of addition of excess and exponent										
Carry's										

The correct answer is:

	=	

119

Recap on Conversion of IEEE 754 Single Precision Binary Float to Decimal

1. Convert the following IEEE 754 single precision binary float to decimal:

$11000010011110010000000000000000_2$

Sign		=	−
Excess		=	1 . . . . 1 . .
Convert excess binary unsigned to decimal and subtract excess 127 to get exponent		=	5

Mantissa	1.1111001
Shift decimal point with exponent	
Convert shifted binary mantissa to decimal	
Add sign to converted decimal	

The correct answer is:

-62.25 111110.01

Recap on the Little Man Computer

1. Look at the Little Man Computer code below. What number will be in the Accumulator after the CPU executes the instruction held in memory location 6?

```
        LDA   first
        STA   second
        ADD   first
        STA   second
        LDA   first
        SUB   second
        OUT
stop          HLT
first         DAT    010
second        DAT
```

−10

Recap on the Register Transfer Language (RTL)

1. What does the following RTL notation indicate?

We have done this first one for you.

$[7_{(1:8)}] \leftarrow 0$

The RTL notation indicates that bits 1 to 8 of memory address 7 are to be set to zero.

2. What does the following RTL notation indicate?

[2] = [6]

reg 2 set same as reg 6

3. What does the following RTL notation indicate?

$[9] \leftarrow [3]-1$

reg 9 set same as reg 3 but -1

4. What does the following RTL notation indicate?

$[PC] \leftarrow [8]+1$

prog count = reg 8 + 1

Recap on MIPS

1. What does the following MIPS assembly code do?

We have done this first one for you.

addi $t0, $t0, 10

This line of MIPS assembly code places immediate number 10 into register location t0

2. What does the following MIPS assembly code do?

li $v0, 4

la $a0, data

syscall

load 4 into v0 (counts as print a string)
puts a string set as data into a0
runs it printing data

3. What does the following MIPS assembly code do?

sub $t3, $t0, $t1

t0 - t1 = t3

4. What does the following MIPS assembly code do?

mult $t0, $t0

t0 x t0

5. What does the following MIPS assembly code do?

blez $t0, out

branch if t0 less or equal to zero to out

6. What does the following MIPS assembly code do?

jal dothisnow

jump always to dothisnow

Huffman Coding

1. What is the Huffman Coding for the following alphabet:

A = {a/20, b/15, c/5, d/15, e/45}

c/5	d/15	b/15	a/20	e/45
0	1	0	1	
A1/20(c,d)		A2/35(b,a)		
0		1		
A3/55(c,d,b,a)				
1				0
A4/100(c,d,b,a,e)				

Letter		Huffman Coding
a	=	111
b	=	110
c	=	100
d	=	101
e	=	0

2. What is the Huffman Coding for the following alphabet:

A = {a/30, b/5, c/15, d/10, e/25}

Letter		Huffman Coding
a	=	
b	=	
c	=	
d	=	
e	=	

The Answers

Signed Magnitude Notation

1. 11010011_2

Binary Excess Notation to Decimal

1. $+45_{10}$

Decimal to Binary Excess Notation

1. 01011101_2

Two's Complement

1. 11101001_2

Two's Complement Binary Additions

1. No, Yes, Yes, 5

Decimal to Excess 50 Notation

1. $+44_{10}$

Conversion of Decimal Numbers to SEEZMMMM Format

1. 14511133

Conversion of SEEZMMMM Format to Decimal Number

1. -1328.3_{10}

Conversion of Decimal Exponent to Excess 127 Binary

1. $01110111_2 = 119_{10}$

Conversion of IEEE 754 Single Precision Binary Float to Decimal

1. -62.25_{10}

Recap on the Little Man Computer

1. -10

The Register Transfer Language

1. The RTL notation indicates that bits 1 to 8 of memory address 7 are to be set to zero.

2. The RTL notation indicates that the contents of memory address 2 are the same as memory address 6

3. The RTL notation indicates that the contents of memory address 3 are decremented by 1 and the result placed in to memory address 9

4. The RTL notation indicates that the contents of memory address 8 will be incremented by 1 and the result placed in to the Program Counter.

Recap on MIPS

1. This line of MIPS assembly code places immediate number 10 into register location t0

2. This line of MIPS assembly code prints a string located in a memory location address labelled as ‘data’

3. This line of MIPS assembly code subtracts the contents of register t1 from register t0 and puts the result in register t3

4. This line of MIPS assembly code multiplies the contents of register t0 by register t0

5. This line of MIPS assembly code jumps the program counter to the line labelled ‘out’ if the contents of register t0 are less than or equal to zero (TRUE)

6. This line of MIPS assembly code jumps the program counter to the line labelled ‘dothisnow’ and places the next address in the return address register

Huffman Coding

2. A = {a/30, b/5, c/15, d/10, e/25}

b/5	d/10	c/15	e/25	a/30
0	1	0	1	
A1/15(b,d)		A2/40(c,e)		
0				1
A3/45(b,d,a)				
1		0		
A4/85(b,d,a,c,e)				

Letter		Huffman Coding
a	=	11
b	=	100
c	=	00
d	=	101
e	=	01