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CS 219.1001 – Assignment #2

Purpose: Become familiar with the MIPS architecture floating point data

representation and instructions

Due: Monday (2/01)

Points: 75

Reading/References:

Chapters 2, section 2.4, 2.9, Chapter 3, section 3.5 (initial part)

Assignment:

Answer the following questions:

1. Answer the following questions:
2. Convert 1910 to 32-bit two's compliment number. Show result in binary and hex. [1 pts]

Example answer:

*decimal: 1910*

*binary: 0000 0000 0000 0000 0000 0000 0001 00112*

*hex: 1316*

1. Convert -2510 to 32-bit two's compliment number. Show result in binary and hex. [3 pts]

*decimal: -2510*

*binary: 1111 1111 1111 1111 1111 1111 1110 01112*

*Hex: FFFFFFE716*

1. Convert 2210 to 32-bit two's compliment number. Show result in binary and hex. [3 pts]

*decimal: 2210*

*binary: 0000 0000 0000 0000 0000 0000 0001 01102*

*Hex: 0000001616*

1. Convert 204810 to 32-bit two's compliment number. Show result in binary and hex. [3 pts]

*decimal: 204810*

*binary: 0000 0000 0000 0000 0000 1000 0000 00002*

*Hex: 0000080016*

1. Convert -204810 to 32-bit two's compliment number. Show result in binary and hex. [3 pts]

*decimal: -204810*

*binary: 1111 1111 1111 1111 1111 1000 0000 0000 2*

*Hex: FFFFF80016*

1. Convert 0000 0000 0000 0000 0000 0000 0000 00002 to a decimal number. [3 pts]

*Decimal : 010*

1. Convert 1111 1111 1111 1111 1111 1111 0000 01102 to a decimal number. [3 pts]

*Sub 1: 1111 1111 1111 1111 1111 1111 0000 01012*

*1’s Compliment: 0000 0000 0000 0000 0000 0000 1111 10102*

*Decimal: -(128+64+32+16+8+2) = -25010*

1. Convert 1111 1111 1111 1111 1111 1111 1110 11112 to a decimal number. [3 pts]

*Sub 1: 1111 1111 1111 1111 1111 1111 1110 11102*

*1’s Compliment: 0000 0000 0000 0000 0000 0000 0001 00012*

*Decimal: -(16+1) = -1710*

2) Show the format for the IEEE 754 32-bit floating point representation. [2 pts]

1 bit for sign

8 bits for biased exponent

23 bits for fraction

[sign][biased exponent][fraction]

sign (1bit), biased exponent (8 bits), significant (23-bits)

(-1)s × (1.fraction) × 2(exp-127)

3) What is the range of the IEEE 754 32-bit floating point representation. [3 pts]

±1.000000000000000000000002 x2126 to ±1.111111111111111111111112 x 2127

or from special values: ±infinity

4) Show the format for the IEEE 754 64-bit floating point representation. [2 pts]

1 bit for sign

11 bits for biased exponent

52 bits for fraction

[sign][biased exponent][fraction]

sign (1bit), biased exponent (11 bits), significant (52-bits)

(-1)s × (1.fraction) × 2(exp-1023)

5) What is the range of the IEEE 754 64-bit floating point representation. [3 pts]

small as 2.0ten x 10308 and almost as large as 2.0 x 10308

or from special values: ±infinity

6) The bias for the IEEE 754 32-bit representation is 127. What is the ***bias*** for IEEE 754 64-bit representation? [3 pts]

1023

7) What is the decimal representation of the following hex values? Assume IEEE 754 32-bit

floating point representation. Must show work for full credit. [5 pts each]

a)C020000016

1100 0000 0010 0 …

1 10000000 0100...

sign = 1 = negative

bias = 128 -127 = 1

fraction: 1.0100 x 21 = 10.100 = 2.5

decimal = -2.5

b)C112000016

1100 0001 0001 0010 0…

1 10000010 0010 0100 ..

sign = 1= negative

bias = 130 - 127 = 3

fraction = 1.001001 x 23 = 1001.001 = 9.125

decimal = -9.125

c)C144000016

1100 0001 0100 0100 0…

1 10000010 10001000 …

sign = 1 = negative

bias = 130 -127 = 3

fraction = 1.10001000 x 23 = 1100.01 = 12.25

decimal = -12.25

d)C1AA000016

1100 0001 1010 1010 0000 …

1 10000011 01010100000 …

sign = -1

bias: 1000 0011 = 131 - 127 = 4

fraction: 1.010101 x 24 = 10101.01

-10101.01 = -21.25

8) What the is IEEE 754 32-bit floating point representation of the following decimal numbers.

Must show work for full credit. [5 pts each]

a)2.0

sign = 0

fraction: 2.0 = 0010 = 1.0 x 21

biased exponent = 1+127 = 128 = 1000 0000

0 10000000 000…

0100 0000 0000…

0x400....

b)7.25

sign = 0

fraction: 7.25 = 0111.01 = 1.1101 x 22

biased exponent = 2 +127 = 129 = 1000 0001

0 10000001 1101000 …

0100 0000 1110 1000 …

0x40E80...

c)-23.125

sign = 1

fraction: 23.125 = 10111.001 = 1.0111001 x 24

biased exponent : 4 +127 = 131 = 1000 0011

1 1000 0011 0111001 …

1100 0001 1011 1001 …

0xC1B90….

d)-17.625

sign = 1

fraction: 17.625 = 10001.101 = 1.0001101 x 24

biased exponent : 4 +127 = 131 = 1000 0011

1 10000011 000110100…

1100 0001 1000 1101 …

0xC18D0….