Homework 1

Hamza Kamal

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Questions

Q1. (6 pts) Number conversion. You must show your work.

Q: Convert the hexadecimal number $973D4_{16}$ to the decimal number. (1.5pts)

A:
$= (4 * 16^0) + (13 * 16^1) + (3 * 16^2) + (7 * 16^3) + (9 * 16^4)$
$= 4 + 208 + 768 + 28672 + 589824$
$= 619476$

Q: Convert to the decimal number 987654321 to hexadecimal number. (1.5pts)

A:
$= 987654321$
$= 987654321/16 = 61728395, r = 1 \rightarrow 1$
$= 61728395/16 = 3858024, r = 11 \rightarrow B$
$= 3858024/16 = 241126, r = 8 \rightarrow 8$
$= 241126/16 = 15070, r = 6 \rightarrow 6$
$= 15070/16 = 941, r = 14 \rightarrow E$
$= 941/16 = 58, r = 13 \rightarrow D$
$= 58/16 = 3, r = 10 \rightarrow A$
$= 3/16 = 0, r = 3 \rightarrow 3$
$= 3ADE68B1_{16}$

Q: Convert the hexadecimal number $C5FE_{16}$ to the octal number. (1.5ps)

A:
$= (14 * 16^0) + (15 * 16^1) + (5 * 16^2) + (12 * 16^3)$
$= 14 + 240 + 1280 + 49152$
$= 50686$
$= 50686/8 = 6335, r = 6 \rightarrow 6$
$= 6335/8 = 791, r = 7 \rightarrow 7$
$= 791/8 = 98, r = 7 \rightarrow 7$
$= 98/8 = 12, r = 2 \rightarrow 2$
$= 12/8 = 1, r = 4 \rightarrow 4$
$= 1/8 = 0, r = 1 \rightarrow 1$
$= 142776_8$

Q: Convert the octal number 125715_8 to the hexadecimal number. (1.5pts)

A:
$= (5 * 8^0) + (1 * 8^1) + (7 * 8^2) + (5 * 8^3) + (2 * 8^4) + (1 * 8^5)$
$= 5 + 8 + 448 + 2560 + 8192 + 32768$
$= 43981$
$= 43981/16 = 2748, r = 13 \rightarrow D$
$= 2748/16 = 171, r = 12 \rightarrow C$
$= 171/16 = 10, r = 11 \rightarrow B$
$= 10/16 = 0, r = 10 \rightarrow A$
$= ABCD_{16}$

Q2. (6 pts) Two's complement

Q: Assume that we are using an 8-bit system. Represent a negative integer with two's complement format.
Convert the decimal numbers -102 and -87 into hexadecimal number (1.5pts)

A:
$2's$ complement of -102:
$= 102$
$= 102/2 = 51, r = 0 \rightarrow 0$
$= 51/2 = 25, r = 1 \rightarrow 1$
$= 25/2 = 12, r = 1 \rightarrow 1$
$= 12/2 = 6, r = 0 \rightarrow 0$
$= 6/2 = 3, r = 0 \rightarrow 0$
$= 3/2 = 1, r = 1 \rightarrow 1$
$= 1/2 = 0, r = 1 \rightarrow 1$
$= 01100110_2$
flipping the bits:
$= 10011001_2$
adding 1:
$= 10011001_2 + 1$
$= 10011010_2$

$2's$ complement of -87:
$= 87$
$= 87/2 = 43, r = 1 \rightarrow 1$
$= 43/2 = 21, r = 1 \rightarrow 1$
$= 21/2 = 10, r = 1 \rightarrow 1$
$= 10/2 = 5, r = 0 \rightarrow 0$
$= 5/2 = 2, r = 1 \rightarrow 1$
$= 2/2 = 1, r = 0 \rightarrow 0$
$= 1/2 = 0, r = 1 \rightarrow 1$
$= 01010111_2$
flipping the bits:
$= 10101000_2$
adding 1:
$= 10101000_2 + 1$
$= 10101001_2$

Convert -102 into hexadecimal:
$= 10011010_2$
$= 1001\ 1010$
$= 9A_{16}$

Convert -87 into hexadecimal:
$= 10101001_2$
$= 1010\ 1001$
$= A9_{16}$

Q: Add two numbers of the previous question as hexadecimal, and answer:
What is the sum in 8-bits system? (1.5pts)

A:
$= 9A_{16} + A9_{16}$
$= 143_{16}$

Q: Is it a correct answer? If it is not, explain why. (1.5pts)

A: Yes

Q3. (8 pts) Floating point numbers

Q: Convert the following decimal numbers in IEEE single-precision format. Give the result as eight hexadecimal digits. 2pts for each of a) and b)
-69/32 (-69 divide by 32)

A:
$= -69/32 = -2.15625$
Sign: 1
$= 2.15625 = 10.00101$
$= 1.000101 * 2^1$
Exponent: $1 + 127 = 128$
$= 128 = 10000000_2$
Mantissa: 00010100000000000000000
= 1 10000000 00010100000000000000000
= 1100 0000 0000 1010 0000 0000 0000 0000
$= C00A0000_{16}$

Q: 13.625

A:
$= 13.625 = 1101.101$
Sign: 0
$= 1.101101 * 23$
Exponent: $3 + 127 = 130$
$= 130 = 10000010_2$
Mantissa: 10110100000000000000000
$= 0\ 10000010\ 10110100000000000000000$
$= 0100\ 0001\ 0101\ 1010\ 0000\ 0000\ 0000\ 0000$
$= 415A0000_{16}$

Q: Convert the following floating IEEE single-precision floating-point numbers from hex to decimal: 2pts for each of a) and b)
$42E48000_{16}$

A:
$= 42E48000_{16}$
$= 0100\ 0010\ 1110\ 0100\ 1000\ 0000\ 0000\ 0000$
Sign: 0
Exponent: $10000101 = 133 - 127 = 6$
Mantissa: $11001001000000000000000 = 1.11001001000000000000000 * 2^6$
$= 1110010.0100000000000000$
$= 114.25$

Q: $C6F00040_{16}$

A:
$= C6F00040_{16}$
$= 1100\ 0110\ 1111\ 0000\ 0000\ 0000\ 0100\ 0000$
Sign: 1
Exponent: 10001101
$= 141 - 127 = 14$
Mantissa: 11100000000000001000000
$= 1.11100000000000001000000 * 2^{14}$
$= 111100000000000.001000000$
$= 30720.125$
Add Sign: -30720.125