

# Autumn 2022, Homework 1 (20 points in total)

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

1. (2 pts) Convert the hexadecimal number D412316 to the decimal number of the same value.

$$\begin{aligned} & D \times 16^4 + 4 \times 16^3 + 1 \times 16^2 + 2 \times 16^1 + 3 \times 16^0 \\ &= 13 \times 65536 + 4 \times 4096 + 1 \times 256 + 2 \times 16 + 3 \\ &= 868643 \end{aligned}$$

Grading guide: wrong result -1, wrong result without progress -2.

2. (2 pts) Convert to the decimal number 678912345 to hexadecimal number of the same value.

$$\begin{array}{l} 16 \mid 678912345 \\ 16 \mid 42432021 \dots 9 \\ 16 \mid 2652001 \dots 5 \\ 16 \mid 165750 \dots 1 \\ 16 \mid 10359 \dots 6 \\ 16 \mid 647 \dots 7 \\ 16 \mid 40 \dots 2 \\ 16 \mid 2 \dots 8 \\ 16 \mid 0 \dots 2 \end{array}$$

$$\text{Answer} = 28776159_{16}$$

Grading guide: wrong result -1, wrong result without progress -2.

3. (2 pts) Convert the hexadecimal number DEA5<sub>16</sub> to the number of the same value in base 12.

$$\begin{aligned} & \text{DEA5}_{16} = 56997 \\ & 12 \mid 56997 \\ & 12 \mid 4749 \dots 9 \\ & 12 \mid 395 \dots 9 \\ & 12 \mid 32 \dots 11 \text{ (B)} \\ & 16 \mid 2 \dots 8 \\ & 16 \mid 0 \dots 2 \end{aligned}$$

$$\text{Answer} = 28B99_{12}$$

Grading guide: wrong result -1, wrong result without progress -2.

## Q2. (6 pts) Two's complement

Assume that we are using an 8-bit system. Represent a negative integer with two's complement format.

1. (2 pts) Convert the decimal numbers -99 and -76 into hexadecimal number

$$\begin{aligned} 99 &= 0110\ 0011_2 \\ -99 &= 1001\ 1100 + 0000\ 0001 = 1001\ 1101 = 9D_{16} \end{aligned}$$

$$\begin{aligned} 76 &= 0100\ 1100_2 \\ -76 &= 1011\ 0011 + 0000\ 0001 = 1011\ 0100 = B4_{16} \end{aligned}$$

Grading guide: wrong result for either -99 or -76, 1 point off; wrong result without progress -2.

2. Add two numbers of the previous question as hexadecimal, and answer,

- a. (2 pts) What is the sum in 8-bits system?

$$\begin{aligned} & 9D_{16} + B4_{16} = 1001\ 1101_2 + 1011\ 0100_2 \\ & \begin{array}{r} 1001\ 1101 \\ +\ 1011\ 0100 \\ \hline 1\ 0101\ 0001 \end{array} \\ &= 51_{16} \text{ or } 81_{10} \end{aligned}$$

Grading guide: wrong result -1; wrong result without progress -2.

b. (2 pts) Is it a correct answer? If it is not, explain why.

No. The sum caused an overflow.

Grading guide: If the answer is “Yes”, 1 point off; if the answer is “No” but the reason is wrong, -1.

### Q3. (8 pts) Floating point numbers

You have to show the steps (works), otherwise you get zero.

1. Convert the following decimal numbers in IEEE single-precision format. Give the result as eight hexadecimal digits.

a) (2 pts)  $-66/32$  (Get an integer and a fraction to calculate  $-66$  divided by  $32$  first.)

$$-66/32 = -2.0625_{10}$$

$$.0625$$

$$\times 2$$

$$0.125$$

$$.125$$

$$\times 2$$

$$0.25$$

$$.25$$

$$\times 2$$

$$0.50$$

$$.5$$

$$\times 2$$

$$1.00$$

$$-2.0625_{10} = -10.00001_2 = -1.00001 \times 2^1$$

$$\text{Sign bit} = 1, \text{Exponent} = 1 + 127 = 128 = \underline{1000\ 0000}_2, \text{Mantissa} = 00001$$

$$\underline{1100\ 0000\ 0000\ 0100\ 0000\ 0000\ 0000\ 0000}_2 = \text{C0040000}_{16}$$

Grading guide: any wrong value of Sign Bit, Exponent, and Mantissa, 1 point off. If the final result is wrong, 1 point off.

b) (2 pts)  $-2.375$

$$.375$$

$$\times 2$$

$$0.75$$

$$.75$$

$$\times 2$$

$$1.50$$

$$.5$$

$$\times 2$$

$$1.0$$

$$2.375_{10} = 10.011_2 = 1.0011 \times 2^2$$

$$\text{Sign bit} = 1, \text{Exponent} = 1 + 127 = 128 = \underline{1000\ 0000}_2, \text{Mantissa} = 0011$$

$$\underline{1100\ 0000\ 0001\ 1000\ 0000\ 0000\ 0000\ 0000}_2 = \text{C0180000}_{16}$$

Grading guide: any wrong value of Sign Bit, Exponent, and Mantissa, 1 point off. If the final result is wrong, 1 point off.

2. Convert the following floating IEEE single-precision floating-point numbers from hex to decimal:

a) **(2 pts)** 35F40800

0011 0101 1111 0100 0000 1000 0000 0000

Sign = 0, Exponent =  $01101011_2 = 107 = -20 + 127$ , so the actual exponent value is -20.

Mantissa = 111 0100 0000 1

The actual value is  $= 1.111010000001_2 * 2^{-20} = 2^{-20} * (1 + 2^{-1} + 2^{-2} + 2^{-3} + 2^{-5} + 2^{-12}) = 0.0000018218$

Grading guide: any wrong value of Sign, Exponent, and Mantissa, 1 point off. If the final result is wrong, 1 point off.

b) **(2 pts)** A6E00400

1010 0110 1110 0000 0000 0100 0000 0000

Sign = 1, Exponent =  $01001101 = 77 = -50 + 127$ , so the actual exponent value is -50.

Mantissa = 110 0000 0000 01

The actual value is  $= -1.11000000000000000001_2 * 2^{-50} = -2^{-50} * (1 + 2^{-1} + 2^{-2} + 2^{-13}) = -0.000000000000000000015544$

Grading guide: any wrong value of Sign, Exponent, and Mantissa, 1 point off. If the final result is wrong, 1 point off.