COMP2611 Spring 2022 Homework #2

Note:

- **The deadline of this homework is at 11:55pm on Friday, 25 March 2022 (Hong Kong Time, UTC+8). NO late submissions will be accepted!**
- **Work out the answers of the questions either directly on the hardcopy of this document or on your own paper sheets. Then scan all the answer pages into a single pdf file "homework2_<studID>.pdf". Or take photos and zip them into a single zip file "homework2_<stdID>.zip". Make sure every detail of the answers is clearly visible in your submission (verify this on the scanned pages before submitting), otherwise marks may be deducted.**
- **We only accept e-submissions at the Canvas. To submit, first find the Canvas page of COMP2611, homework 2, and then upload the file. You can upload for multiple times, only the last one before the deadline will be marked.**
- **Make sure you keep the original copy of your homework until the homework score is finalized.**

Name :

Student ID :

Email :

Question	Marks
1. Data Representation – Signed Integers	**/16**
2. Floating Point Representation (IEEE754)	**/18**
3. A Floating Point System for Lengths	**/16**
Total	**/50**

Question 1: Data Representation – Signed Integers (16 points)

a) Given the following 16-bit 2's complement representation, write their **hexadecimal representations** and **decimal values**. (8 points)

1) 1111 0110 1101 0101: (4 points)

Hexadecimal representation =

Decimal =

2) 0101 0010 1011 1111: (4 points)

Hexadecimal representation =

Decimal =

b) Given the following 32-bit 2's complement representation, write their **hexadecimal representations** and **decimal values**. (8 points)

1) 0111 1111 1111 1111 0100 1101 0010 1011: (4 points)

Hexadecimal representation =

Decimal =

2) 1111 1111 1111 1110 1100 0101 0110 1010: (4 points)

Hexadecimal representation =

Decimal =

Question 2: Floating Point Representation (18 points)

a) Write the IEEE754 single-precision representation of the following decimal numbers. Can the decimal numbers be represented exactly? **If not, please find the nearest approximation** of the number (either **rounding** or **truncation**). Show your steps briefly, otherwise no mark will be given. (10 points)

1) -116.625 (4 points)

2) 0.085 (6 points)

b) What decimal values are represented by the following IEEE754 single-precision floating-point representations? Show your steps briefly. You don't need to work out the exact value, it's good enough to show your answers in powers of 2. (8 points)

1) 0 10000110 10010101110100000000000 (4 points)

2) 1 00000000 00110100000000000000000 (4 points)

Question 3: A Floating-Point System for Lengths (16 points)

You are asked to design a 16-bit floating point number system to store the lengths of various man-made objects. This system should work in a similar way as the IEEE754 standard. Assume a value stored in the system denotes the length of an object in centimeters, assume also that the maximum length to be stored is 45845.0 centimeters (i.e. length of the biggest man-made oil-tanker, the "Seawise Giant").

Note:
This representation has normalized, de-normalized and special cases as you have seen in IEEE754 standard.

Answer the questions below:

a) Is sign bit needed in this system? Why yes or why not. (2 points)

b) What is the minimum number of bits needed for the exponent? What is the value of the corresponding bias? Show your steps clearly. If you write the values directly without showing the steps, you will not get any point. (6 points)

c) What is the maximum length the system can represent? Please show your steps clearly, otherwise no point will be given. (2 points)

d) If a length exceeds the maximum length the system can represent, it will be represented as infinity. Show the representation of the infinity with this number system. (2 points)

e) Show the representation of $\mathbf{3245_{(10)}}$ with this system. Please show your steps clearly, otherwise no point will be given. (2 points)

f) Can the number **$953.375_{(10)}$** be represented precisely by the system? The answer "Yes" or "No" alone will get you no mark. Please justify your answer with clear calculation steps. (2 points)