SEE2030: Introduction to Computer Systems (Fall 2017)

Programming Assignment #1:

Tiny FP (8-bit floating point) representation

Due: September 27th (Wednesday), 11:59PM

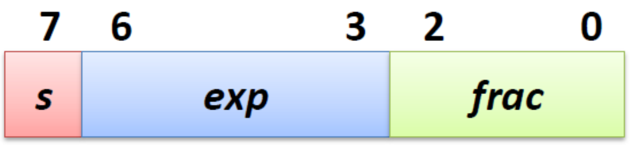
1. Introduction

The purpose of this assignment is to get familiar with the floating-point representation by implementing a simplified 8-bit floating-point representation.

2. Problem specification

2.1. Overview

`tinyfp` is a simplified 8-bit floating point representation which follows the IEEE 754 standard for floating-point arithmetic. The overall structure of the **`tinyfp`** representation is shown below. The MSB (Most Significant Bit) is used as a sign bit (***s***). The next four bits are used for exponents (***exp***) with a bias value of 7. The last three bits are used for the fractional part (***frac***).



In C, the new type **`tinyfp`** can be defined as follows.

```
typedef unsigned char tinyfp;
```

Your task is to implement the following four C functions that convert **`int`** or **`float`** type values to the **`tinyfp`** format and vice versa.

```
tinyfp int2tinyfp(int x);
int tinyfp2int(tinyfp x);
tinyfp float2tinyfp(float x);
float tinyfp2float(tinyfp x);
```

2.2. Implementation details

2.2.1. `int2tinyfp()`

- Integer zero (0) should be converted to plus zero (+0.0) in **`tinyfp`**.
- An integer value that exceeds the range of the **`tinyfp`** representation should be converted to the infinity in **`tinyfp`** (+∞ or -∞ depending on the sign).
- If necessary, use the **round-toward-zero** mode.

2.2.2. `tinyfp2int()`

- Drop the fractional part when you convert the value in the **`tinyfp`** format to integer. (e.g. the value 1.5 in **`tinyfp`** is converted to 1)
- Convert +∞ and -∞ in `tinyfp` to TMax and TMin in integer, respectively.
- +NaN and -NaN in `tinyfp` is converted to TMin in integer.

2.2.3. `float2tinyfp()`

- A floating-point value that exceeds the range of the **`tinyfp`** representation should be converted to the infinity in **`tinyfp`** (+∞ or -∞ depending on the sign).
- If necessary, use the **round-toward-zero** mode.

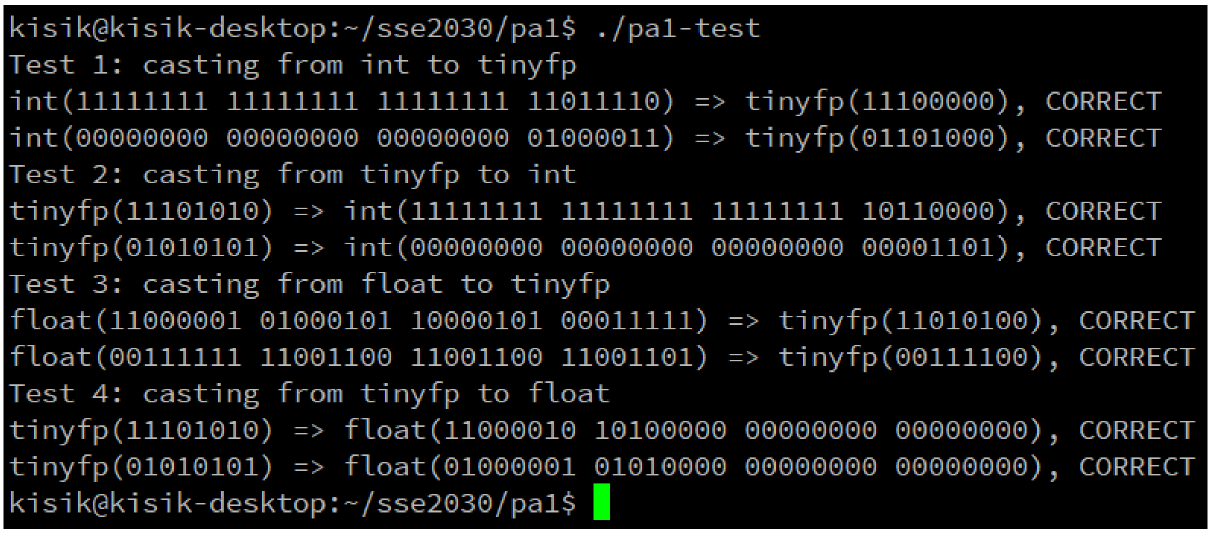
2.2.4. `tinyfp2float()`

- The **`tinyfp`** type is a subset of the **`float`** type. Hence, all the values in **`tinyfp`** should be represented in the **`float`** format without any error.

3. Example

The skeleton code is available in the course homepage (http://csl.skku.edu/SSE2030F17/Assignment)

The results of some sample runs are as follows.



```
kisik@kisik-desktop:~/sse2030/pa1$ ./pa1-test
Test 1: casting from int to tinyfp
int(11111111 11111111 11111111 11011110) => tinyfp(11100000), CORRECT
int(00000000 00000000 00000000 01000011) => tinyfp(01101000), CORRECT
Test 2: casting from tinyfp to int
tinyfp(11101010) => int(11111111 11111111 11111111 10110000), CORRECT
tinyfp(01010101) => int(00000000 00000000 00000000 00001101), CORRECT
Test 3: casting from float to tinyfp
float(11000001 01000101 10000101 00011111) => tinyfp(11010100), CORRECT
float(00111111 11001100 11001100 11001101) => tinyfp(00111100), CORRECT
Test 4: casting from tinyfp to float
tinyfp(11101010) => float(11000010 10100000 00000000 00000000), CORRECT
tinyfp(01010101) => float(01000001 01010000 00000000 00000000), CORRECT
kisik@kisik-desktop:~/sse2030/pa1$
```

4. Hand in instructions

- Register an account to the submission site (http://sys.skku.edu).
  - You must type your real name & student ID
  - Wait for an enrollment.
- Submit only the **pa1.c** file to the submission site.

5. Logistics

- You will work on this assignment alone.
- Only the assignments submitted before the deadline will receive the full credit. 25% of the credit will be deducted for every single day delay.
  - You can use up to 5 ***slip days***
- Any attempt to copy others' work will result in heavy penalty (for both the copier and the originator). Don't take a risk.

Good luck!

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