C Programming II
2020 Spring
Midterm

Instructor: Po-Wen Chi

Due: 2020.04.22 PM 15:30

Policies:

- Offline test unless you complete the exam and want to submit your code.
- Do not forget to include your Makefile. TA will only use the command make to build your program. If make fails, you will get zero points and no room for bargaining. So if you do not know how to solve a problem, please, do not include it in your Makefile.
- I do not care your source code file names, but the executive binary names should be **mid01, mid02, mid03, mid04**.
- You can ask TA if you do not understand the problems.

1 Rational Number Arithmetic Part 3 (30 pts)

In your homework, I have asked you to develop a rational number calculator. Now, please enhance your program to support mixed fractions. A mixed fraction is a traditional denotation of the sum of an integer and a proper fraction. There are some examples:

$$1\frac{5}{7}, -3\frac{2}{9}\dots$$

These mixed fractions are denoted as $(1, 5, 7), (-3, 2, 9)$ respectively. Please write a program to calculate the result of a given equation. You need to support **addition +, subtraction -, multiplication *, division /**. Of course, you must follow arithmetic operation precedence. For simplicity, you do not need to consider parentheses. Your answer must follows the following rules. Given $a\frac{b}{c}$,

- $|c| > |b|$.
- $\frac{b}{c}$ must be the reduced form.
- b can be a negative integer only when $a = 0$.

- c must be a positive integer.
- 0 is presented as $(0, 0, 0)$. Except the case of zero, c cannot be 0.

There is an example. If a user wants to get the result of the following equation:

$$\frac{1}{2} + 1\frac{5}{6} \times 2\frac{3}{10} = 4\frac{43}{60}$$

```
$ ./mid01
(0,1,2) + (1,5 , 6) * (2, 3 ,  10 )
(4,43,60)
```

2 BMP: Less Colors (30 pts)

Digital images consist out of pixels. If we want to store or transmit an image, we have to provide information about each individual pixel. A common representation of color information is to use 3 bytes to represent RED, GREEN, BLUE respectively. This is what I have shown you in this class. However, when I was young, we did not use 3 bytes to present a pixel. Instead, we preferred to use **2 bytes** to present one pixel. So there are only 65535 possible colors. How to represent 3 colors in only 2 bytes? We use 5 bits for Red and Blue and 6 bits for Green. The transformation is presented in figure 1. Note that since we have less bits (information) available, we can represent less colors.

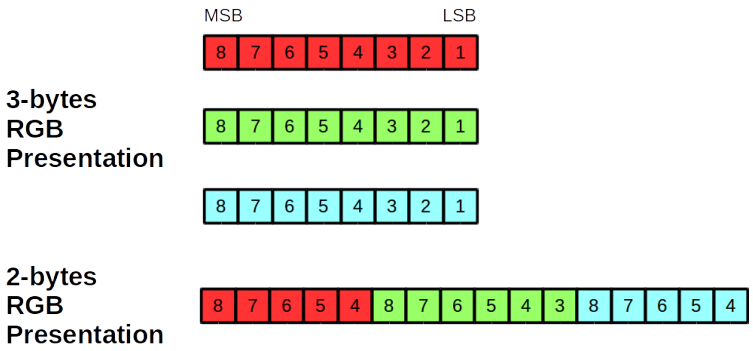

Figure 1: Color Transformation.

For your reference, I provide you BMP wikipedia and two BMP files, one is 3-bytes presentation and the other is 2-bytes presentation. Your program should be

```
$ ./mid02
Please enter the input image name: maldives.bmp
Please enter the output image name: maldives_16.bmp
Done!
```

Note that the user may input a file which is not a BMP file, you need to give a warning. How to check if the input is a BMP file? Read the first two bytes.

3 Version Control Analyzer (40 pts)

In most software version control systems, when a user commits a code, the system will notify all users about this change. Email is a common notification approach. Now I will give you an email record, **mbox-short.txt** , about the subversion notification. Subversion (often abbreviated SVN, after its command name svn) is a software versioning and revision control system distributed as open source under the Apache License. OK, I know most of you use Git but I am an old guy.

Now let's me teach you how to interpret the file. Figure 2 and Figure 3 are descriptions.

Figure 2: How to interpret mbox: SVN record 01.

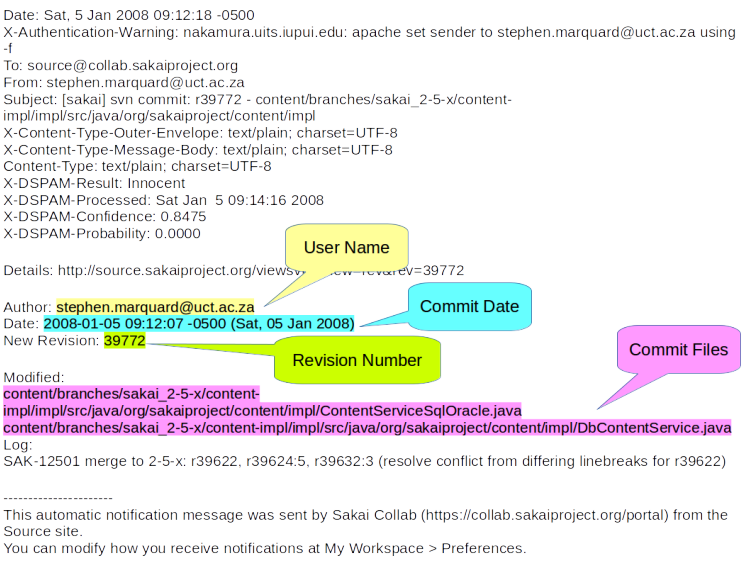

Figure 3: How to interpret mbox: SVN record 02.

Please write a program to read this file and answer the following questions:

```
$ ./mid03
Please enter the mbox file: mbox-short.txt
1) Who commits most?
2) Who commits most in 20:00-24:00 ?
3) What New revision change the most files?
4) New revision --> user
5) Exit.
Your Choice: 4
New Revision Number: 39754
Author: david.horwitz@uct.ac.za
Your Choice: 5
```

Note that file change includes file or directory, addition, modification and remove. Some records are Revision, not New Revision, and they can be ignored.

For your convenience, the user number is less than 64.

4 Bonus: Your Comments (5 pts)

Again, any comments are welcomed. However, you will get nothing if you leave this question blank.