C Programming II
2020 Spring
Homework 02

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Due: 2020.04.14 PM 11:59

Policies:

- Zero tolerance for late submission.
- You need to prepare a README file about how to make and run your program. Moreover, you need to provide your name and your student ID in the README file.
- For the writing assignment, I only accept pdf. MS. doc/docx format is not acceptable. Moreover, please use Chinese instead of English.
- Do not forget your Makefile. For your convenience, each assignment needs only one Makefile.
- The executable programs should be hw0201, hw0202 ....
- You should pack your homework in one zip file. The file name should be StudentId_hw01.zip.

1 Substitution Cipher (20 pts)

In cryptography, a substitution cipher is a method of encrypting by which units of plaintext are replaced with ciphertext, according to a fixed system. Simple substitution can be demonstrated by writing out the alphabet in some order to represent the substitution. For example, given the following mapping table:

Plaintext	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Ciphertext	Z	E	B	R	A	S	C	D	F	G	H	I	J	K	L	M	N	O	P	Q	T	U	V	W	X	Y

A message of

FLEE AT ONCE. WE ARE DISCOVERED!

enciphers to

SIAA ZQ LKBA. VA ZOA RFPBLUAOAR!

Please implement the substitution cipher encryption and decryption function. The user will provide two files, one is the text file and the other is the **key file**. The key file format is as follows:

```
A: Z
B: E
C: B
...
Z: Y
```

Undoubtedly, you need to check the key file format. You also need to take care the case issue. Uppercase remains uppercase and vice versa. The usage of the program is as follows:

```
$ ./hw0201
Please enter the input file: a.txt
Please enter the output file: b.txt
Please enter the key file: key.txt
Encryption (1) or Decryption (2): 1
Done!
```

2 Subtitle Shifter (20 pts)

When you watch a English movie, will you read Chinese subtitles. I hope no because it implies your English is good enough. Unfortunately, My English not good enough. So when I download a Movie from Internet, I need to download its subtitle too. However, sometimes the subtitle's timeline is not compatible with the movie. So please develop a program for a user to modify the subtitle timeline.

The SubRip file format is described on the Matroska multimedia container format website as "perhaps the most basic of all subtitle formats." SubRip (SubRip Text) files are named with the extension .srt, and contain formatted lines of plain text in groups separated by a blank line. Subtitles are numbered sequentially, starting at 1. The timecode format used is hours:minutes:seconds,milliseconds with time units fixed to two zero-padded digits and fractions fixed to three zero-padded digits (00:00:00,000). The fractional separator used is the comma, since the program was written in France.

First, you need to let a user to input a subtitle file name. Backup the file to a file named **[filename].org**. Then ask the user how many seconds he/she wants to shift forward or behind. The subtitle format is srt. I will not introduce what srt is. Please use a text to read it yourself. Of course, the modified subtitle should work successfully with video. If you do not know which video player can support the subtitle feature, you can try VLC player.

```
$ ./hw0202
Please enter the subtitle file: a.srt
Forward Shift (1) or Backward Shift (2): 1
Shift time (sec): 10
Done!
```

For your reference, I put a video and its subtitle on my website. The timeline of the subtitle is not compatible. You need to shift back 4.2 second. Note that you should not allow the user to shift cross zero, right?

3 Simple Syntax Highlighter (20 pts)

When you coding, you always uses a text editor that supports the syntax highlight feature, right? Try to implement this function ... just kidding. I just want you to highlight all keywords of a C source code. For your convenience, I list the keywords you need to highlight:

break	case	char	const
continue	default	do	double
else	enum	extern	float
for	goto	if	include
int	int8_t	int16_t	int32_t
int64_t	long	return	short
signed	sizeof	static	struct
switch	typedef	uint8_t	uint16_t
uint32_t	uint64_t	union	unsigned
void	while		

So the user inputs a C file, you need to print the source code on the screen with highlighting the keywords. You also need to highlight **parentheses, square brackets, curly brackets** with different colors.

How to print colorful words? Please google "**ansi color**". You also need to answer one additional question: **Why don't I list define and include here?**

4 C Unit Test (20 pts)

In computer programming, unit testing is a software testing method by which individual units of source code, sets of one or more computer program modules together with associated control data, usage procedures, and operating procedures, are tested to determine whether they are fit for use. Now I want you to develop a simple unit test tool for C.

First, a programmer writes the following code:

```
#include "test.h"

int fibonacci(int n)
{
    if (n <= 1)
        return n;
    return fibonacci(n - 1) + fibonacci(n - 2);
}

int factorial(int n) {
  int result = 1;
  for (int i = 1; i <= n; i++) {
    result *= i;
  }
```

```
15
16   return result;
17 }
```

To test this code, the programmer can write down the test script as follows:

```
1  INCLUDE( test.h )
2  REQUIRE( test.c )
3
4  EXPECT_EQ(-5, fibonacci(-5));
5  EXPECT_EQ(-1, fibonacci(-1));
6  EXPECT_EQ(0, fibonacci(0));
7  EXPECT_EQ(1, fibonacci(1));
8  EXPECT_EQ(1, fibonacci(2));
9  EXPECT_EQ(2, fibonacci(3));
10 EXPECT_EQ(55, fibonacci(10));
11
12 EXPECT_EQ(1, factorial(-5));
13 EXPECT_EQ(1, factorial(-1));
14 EXPECT_EQ(1, factorial(0));
15 EXPECT_EQ(1, factorial(1));
16 EXPECT_EQ(2, factorial(2));
17 EXPECT_EQ(6, factorial(3));
18 EXPECT_EQ(40320, factorial(8));
```

Based on this script, your program needs to **generate a C test source code and a Makefile to make your test code.** The test source code can be named as you wish.

```
1  $ ./hw0204
2  Please enter the test script: script.txt
3  a.c and Makefile are generated.
4  $ make
5  $ ./a.out
6  Running 14 test cases:
7  1) fibonacci(-5): PASS
8  2) fibonacci(-1): PASS
9  3) fibonacci(0): PASS
10 4) fibonacci(1): PASS
11 5) fibonacci(2): PASS
12 6) fibonacci(3): PASS
13 7) fibonacci(10): PASS
14 8) factorial(-5): PASS
15 9) factorial(-1): PASS
16 10) factorial(0): PASS
17 11) factorial(1): PASS
18 12) factorial(2): PASS
19 13) factorial(3): PASS
20 14) factorial(8): PASS
```

If there is any test fails, print the return value and the wanted value.

5 Dosbox Configuration (20 pts)

DOSBox is an emulator program which emulates an IBM PC compatible computer running a DOS operating system. I will give you a dosbox configuration file. Please develope a

program to configure the dosbox configuration file.

```
$ ./hw0205
Please enter the configuration file: dosbox.conf
Option: fullscreen
Value: true
Done!
```

The **fullscreen** option in dosbox.conf will be set to true.

6 Bit Operation (5 pts)

In this class, I have written a code to display all bits of a 32-bit integers as follows:

```
int32_t number = 0;

scanf( "%d", & number );

int32_t bit = 1;
bit = bit << 31;

for( int i = 0 ; i < 32 ; i++ )
{
    if( bit & number )
        printf( "1" );
    else
        printf( "0" );
    bit = bit >> 1;
}
```

Please explain the problem of this code and show how to fix it.