National Taiwan Normal University
CSIE Computer Programming I

Instructor: Po-Wen Chi
Due Date: 2024.10.08 PM 11:59

Assignment 1

Policies:

- Zero tolerance for late submission.
- Please pack all your submissions in one zip file. **RAR is not allowed!!**
- For convenience, your executable programs must be named following the rule hwXXYY, where the red part is the homework number and the blue part is the problem number. For example, hw0102 is the executable program for homework #1 problem 2.
- I only accept **PDF** or **TEXT**. MS Word is not allowed.
- Do not forget your Makefile. For convenience, each assignment needs only one Makefile.
- Please provide a README file. The README file should have at least the following information:
  - Your student ID and your name.
  - How to build your code.
  - How to execute your built programs.
  - Anything that you want to notify our TAs.
- **DO NOT BE A COPYCAT!!** You will get ZERO if you are caught.

1.1 Print Colorful Words (20 pts)

In this class, I have shown you how to print strings on your screen. However, it is very boring to use the same color all the time. Can I print strings with different colors? Absolutely yes! But how to do this? The keyword is **ANSI escape codes**.

Please write a program to show the following message on the screen, including punctuation marks. Then you should color all Kim's lyrics with red, all Chris's lyrics with blue and all duet's lyrics with green.

```
$ ./hw0101
[KIM]
You are sunlight and I moon
Joined by the gods of fortune
Midnight and high noon sharing the sky
We have been blessed, you and I

[CHRIS]
You are here like a mystery
I'm from a world that's so different from all that you are
How in the light of one night did we come so far?

[KIM]
Outside day starts to dawn

[CHRIS]
Your moon still floats on high

[KIM]
The birds awake

[CHRIS]
The stars shine too

[KIM]
My hands still shake
See upcoming pop shows
Get tickets for your favorite artists

You might also like
My Boy Only Breaks His Favorite Toys
Taylor Swift
Who' s Afraid of Little Old Me?
Taylor Swift
Guilty as Sin?
Taylor Swift

[CHRIS]
I reach for you

[KIM & CHRIS]
And we meet in the sky

[KIM]
You are sunlight and I moon
Joined here
Brightening the sky with the flame of love

[KIM & CHRIS]
Made of
Sunlight
Moonlight
```

1.2 A Simple Math Problem (20 pts)

Have you ever solved the following problem in your elementary school?

$$\begin{array}{rccc} & 1 & \triangle & 3 \\ +) & \square & 5 & \bigcirc \\ \hline & 5 & 7 & 9 \end{array}$$

I believe that you know that $\square = 4, \triangle = 2, \bigcirc = 6$. This time, I want you to develop a program to solve this kind of problem.

```
$ ./hw0102
Please enter the first  operand: 1x3
Please enter the second operand: y5z
Please enter the sum            : 579
Ans: x = 2, y = 4, z = 6
$ ./hw0102
Please enter the first  operand: 1x3
Please enter the second operand: y5z
Please enter the sum            : 1029
Ans: x = 7, y = 8, z = 6
```

If there is any invalid input, print an error message and terminate your program. For example, $12x4$ is not an allowed operand. For your simplicity, I promise

- The three variables are definitely x, y, z.
- The first operand is defined as the format **int**-x-**int**.
- The second operand is defined as the format y-**int**-z.
- y can be zero.

1.3 Flip an Octal Number (20 pts)

Please write a program for a user to input an unsigned 16-bits integer and flip the number's octal form.

```
$ ./hw0103
Please enter an unsigned 16-bits number: 668
Before Flip:
668_10 = 1234_8
After  Flip:
4321_8 = 2257_10
```

Currently, you do not need to consider the case that the input is not an **unsigned 16-bits integer**.

1.4 Poker Hands (20 pts)

In poker, players form sets of five playing cards, called hands, according to the rules of the game. Each hand belongs to a category determined by the patterns formed by its cards. A hand in a higher-ranking category always ranks higher than a hand in a lower-ranking category. A hand is ranked within its category using the ranks of its cards. Individual cards are ranked, from highest to lowest: A, K, Q, J, 10, 9, 8, 7, 6, 5, 4, 3 and 2. There are nine categories of hand and I list them in figure 1.1.

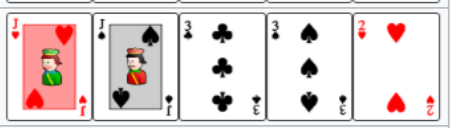
1	Straight flush**	
2	Four of a kind	
3	Full house	
4	Flush**	
5	Straight**	
6	Three of a kind	
7	Two pair	
8	One pair	
9	High card	

FIGURE 1.1: Ranking Category.

Please write a program to determine the rank of the given five cards. The card is encoded as follows:

- 1-13: ♠ Ace to King.

- 14-26: ♡ Ace to King.
- 27-39: ♢ Ace to King.
- 40-52: ♣ Ace to King.

```
$ ./hw0104
Please enter 5 cards: 1 2 3 4 5
Straight Flush
```

1.5 Binary Variable (20 pts)

Panda is a student in CSIE. He is very interested in computer science so he wants to learn how computers store variables. But he is really bad at math, so you need to help him create a program that converts binary numbers into different types of variables.

Please write a program that allows the user to convert a binary number, inputted as hex, to a desired variable type. The input hex will always be a 16-bit number.

If you don' t know how computers store numbers, don' t worry. The following sections will serve as a lesson on binary numbers, and extra resources will be provided.

you may only use syntax that has already been taught in class.

You might not be able to calculate 2^n. So you only need to print float numbers in scientific notation.

Hint:

1. You can find how to input hex in scanf's manual.
2. You can extract bits from a number by multiplying it with 2^n or by using the mod operator.

Example:

```
sample 1:
$ ./hw0105
Please input a hex:DCEF
Please choose the output type(1:integer,2:unsigned integer,3:
   float):3
Binary of DCEF is: 1101 1100 1110 1111
Converted float is: -1.233398*2^8
sample 2:
$ ./hw0105
Please input a hex:DAD1
Please choose the output type(1:integer,2:unsigned integer,3:
   float):2
Binary of DAD1 is: 1101 1010 1101 0001
Converted unsigned integer is: 56017
sample 3:
```

```
$ ./hw0105
Please input a hex:DAD1
Please choose the output type(1:integer,2:unsigned integer,3:
    float):1
Binary of DAD1 is: 1101 1010 1101 0001
Converted unsigned integer is: -9519
sample 4:
$ ./hw0105
Please input a hex:78E7
Please choose the output type(1:integer,2:unsigned integer,3:
    float):1
Binary of DAD1 is: 0111 1000 1110 0111
Converted unsigned integer is: 30951
```

1.5.1 Binary and Hex

Binary:

Similar to decimal, when a digit reaches 2, it is carried over to the next digit.

Example: $1_{(2)} + 1_{(2)}$ will be $10_{(2)}$ because 2 is greater than 1 so it will be carried over to the next digit.

All data in computers are binary. Each digit is called a "bit," and 8 bits make a "byte." Therefore, a byte's max value is $11111111_{(2)}$, which is 127 in decimal.

Hex:

By grouping every 4 digits of a binary number, we can convert it to 1 hex digit represented by $0 \sim 9$ then A$\sim$F (resembles $10 \sim 16$).

Example 1: $1010_{(2)} = 10_{(10)} = A_{(16)}$.

Example 2: $1010101111001101_{(2)} = ABCD_{(16)}$.

1.5.2 Computer-Stored Data

Here's an example of a 16 bit variable:

1.5.2.1 Unsigned Integer

The range of an unsigned 16-bit integer is from 0 to $2^{16} - 1$.

Example 1: Given $0001000101001101_{(2)}$, starting from the right, bits 0, 2, 3, 6, 8, and 12 are 1. Therefore, we can obtain the decimal value by doing the following: $2^0 + 2^2 + 2^3 + 2^6 + 2^8 + 2^{12} = 4429$

Example 2: Given $0000000001001101_{(2)}$, starting from the right, bits 0, 2, 3, and 6 are 1. Therefore, we can obtain the decimal value by doing the following: $2^0 + 2^2 + 2^3 + 2^6 = 77$

1.5.2.2 Signed Integer

The first bit of a signed integer represents its sign, where 1 means negative, and 0 means positive.

Positive:

It works just like an unsigned integer.

Negative:

The scheme for negative numbers is called "two' s complement." In this scheme, to convert a positive number x into -x, we **flip all the bits** and then **add 1**. The reasoning behind this will be taught in later courses.

Note: Flip means reversing 1s and 0s.

Example:

12 in binary is $0000000000001100_{(2)}$.
To turn 12 into -12, first:
flip(12) $\rightarrow 1111111111110011_{(2)}$.
Then add 1, which equals:
$1111111111110100_{(2)}$.
Therefore, -12 in binary is $1111111111110100_{(2)}$.

1.5.2.3 Float

In binary, floats are stored in scientific notation using the following format:
$S(1.F) \times 2^{EXP-15}$
Looking at a float in binary from left to right:
Bit 1: Sign bit (1 for negative, 0 for positive) (S)
Bits 2∼6: Exponent(EXP)
Bits 7∼16: Fraction(F)

Example 1: $F = 101$, $1.F$ is $2^0 + 2^{-1} + 2^{-3} = 1.625$
Example 2: Given $0100011010000000_{(2)}$:

- The first bit is 0, which means it's a positive number.
- $EXP = 10001_{(2)} = 17$
- $F = 1010000000_{(2)}$

Therefore this binary represents:
$1.101_{(2)} \times 2^{(17-15)} = 1.101_{(2)} \times 2^2 = 2.625 \times 2^2 = 6.5$
Binary float $0100011010000000_{(2)}$ is +6.5 in decimal.

number	EXP	F
$\pm$ 0	0	0
$\pm\infty$	11111_2	0
NAN	11111_2	non 0

Note: Some specific EXP and F values have special meanings:
Still confused?
Don't worry, partial points will be given to signed and unsigned types.

1.5.3 Reference

The IEEE-754 standard describes how computers store floats in binary:
https://en.wikipedia.org/wiki/IEEE_754
Use this tool to double-check your answers:
https://www.h-schmidt.net/FloatConverter/IEEE754.html

1.6 Bonus: Makefile for Multiple files (5 pts)

Please read the following two codes.

```
// a.c
#include <stdio.h>

int main()
{
    printf( "Hello Kitty" )
    return 0;
}

// b.c
 #include <stdio.h>

int main()
{
    printf( "Hello World" );
    return 0;
}
```

I believe that you can see that **a.c** has an error. In this case, if you write a Makefile as follows, you will find that building **a.c** fails and **b.c** will not be built. How to modify this Makefile to make **b.c** be built even **a.c** fails. **You cannot switch the compiling order.**

```
$ cat Makefile
all:
  gcc a.c -o a
  gcc b.c -o b
$ make
gcc a.c -o a
a.c: In function ‘main’:
a.c:5:28: error: expected ‘;’ before ‘return’
```

```
    5 |     printf( "Hello Kitty" )
      |                            ^
      |                            ;
    6 |     return 0;
      |     ~~~~~~
make: *** [Makefile:2：all] 錯誤 1
```