National Taiwan Normal University
CSIE Computer Programming I

Instructor: Po-Wen Chi
Due Date: 2022.10.25 PM 11:59

Assignment 2

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**. MS Word is not allowed.

- Do not forget your Makefile. For convenience, each assignment needs only one Makefile.

- Please provide a README.

2.1 π (20 pts)

The number π is a mathematical constant that is the ratio of a circle's circumference to its diameter. It is an irrational number, which means that it cannot be expressed exactly as a ratio of two integers. You may have learned that you can use infinite series techniques to derive the value of π. The following are two famous infinite series:

1. Gregory–Leibniz series:

$$\pi = \frac{4}{1} - \frac{4}{3} + \frac{4}{5} - \frac{4}{7} + \dots$$

2. Nilakantha series:

$$\pi = 3 + \frac{4}{2 \times 3 \times 4} - \frac{4}{4 \times 5 \times 6} + \frac{4}{6 \times 7 \times 8} - \frac{4}{8 \times 9 \times 10} + \dots$$

   In mathematics, these two series will finally converge to a constant. Is this true in programming? Please develop a program to calculate the value of π from 1 to a given n. For your simplicity, I promise that n is a 16-bits unsigned integer.

```
1  $ ./hw0201
2  Please enter n (16-bits unsigned): 2
3  n = 1:
4      Gregory – Leibniz series: 4 (ddd1)
5      Nilakantha series: 3 (ddd2)
6  n = 2:
7      Gregory – Leibniz series: xxx (ddd3)
8      Nilakantha series: yyy (ddd4)
```

ddds are absolute values between the calculated value and 3.14159265358979323846. Note that you should use **double** instead of float.

2.2 Palindrome Day (20 pts)

Palindrome Days happen when the day's date can be read the same way backward and forward. In this problem, the date format is **mm-dd-yyyy**. A palindrome day example is 02-02-2020. Please write a program to list all palindrome days with a given range. The start date and the end date are also in the range.

```
1  $ ./hw0202
2  Start Date: 02-01-2020
3  End Date: 02-03-2020
4  02-02-2020
```

2.3 Add Digits (20 pts)

Given a 32-bits unsigned integer, repeatedly add all its digits until the result has only one digit. Please print the process.

```
1  $ ./hw0203
2  Please enter a number: 57
3  5 + 7 = 12
4  1 + 2 = 3
5  Final: 3
```

2.4 Mortgage Calculator (20 pts)

A mortgage is a type of loan used to purchase a house. As you can see, a house in Taiwan is very expensive and we need to borrow money from banks or we cannot afford it. Now, I want you to develop a mortgage calculator. Do not worry! I have prepared a tutorial for you.

https://www.bankrate.com/mortgages/mortgage-calculator/

```
1  $ ./hw0204
2  Loan Date: 2022.10
```

```
3  Loan Price: 340000
4  Loan Term (yrs): 30
5  Interest Rate (%): 5
6  Property Tax (/m): 280
7  Insurance (/m): 66
8  Additional Payment (/m): 0
9  --- Output ---
10 Total monthly payment: 2171
11 2022.11) Principal: $408.33, Interest:$1,416.67, Remaining:
       $339,591.67
12 2022.12) Principal: $410.03, Interest:$1,414.97, Remaining:
       $339,181.64
13 2023.01) Principal: $411.74, Interest:$1,413.26, Remaining:
       $338,769.90
14 ...
```

2.5 Cuboid Super Infinity Exporter

Chao is teaching at NTNU. One day, he walked through the *Mathematics Building* (數學館), and he found that there were four cuboids in front of the BIG NTNU. Each side of the cuboid has a different color(see Figure 2.1).

FIGURE 2.1: "I am hungry" cuboids

Chao's curiosity drives him to generate cuboids in the terminal, which **has a different color on each side**. After that, he would send the screenshot to Neokent. Given length l, width w, height h, and the number of cuboids n, please help him design a **CSIE**, aka **Cuboid Super Infinity Exporter**.

```
1  $ ./hw0205
2  Welcome to Cuboid Super Infinity Exporter!
3  Please enter Length, Width, and Height of the cuboid
4  Length: 4
5  Width: 4
```

```
6  Height: 4
7  How many cuboids do you want to generate?
8  Amount: 10
```

For your simplicity, I guarantee that all the inputs are integers.

The specification of the cuboid is shown in Figure 2.2, and you should follow the instructions below:

1. Print a '#' on the edge.

2. Print a ' '(space) with a color in Color A to C.

3. Print a ' '(space) outside the cuboid.

4. The **CSIE** output length is twice as long as user's input.

5. Because *Chao* doesn't like an ugly cuboid, you should print an error message if user's input length, width or height is less than four.

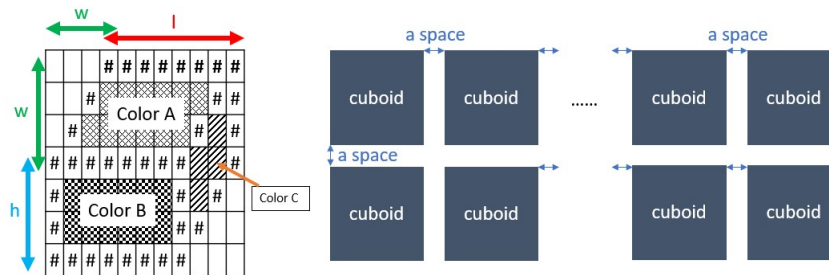6. Print a ' '(space) between cuboids.

FIGURE 2.2: The specification of a cuboid and many cuboids.

Because the terminal may occur a display problem if we print over 80 characters in a single line, you have to wrap these cuboids, i.e., A cuboid can not be cut into separate parts in the terminal. Figure 2.3 is an example of wrapping. BTW, you CAN'T use any array in this problem (Because the cuboid may be very BIG, Chao's computer could be low on memory. You can believe TA will ban the array :)).

Remind that each side of the cuboid has a different color, so you have to draw three different colors. Note that if there is any invalid input, please print an error message and terminate the program.

Hint: It's recommended to generate one cuboid first, then process others.
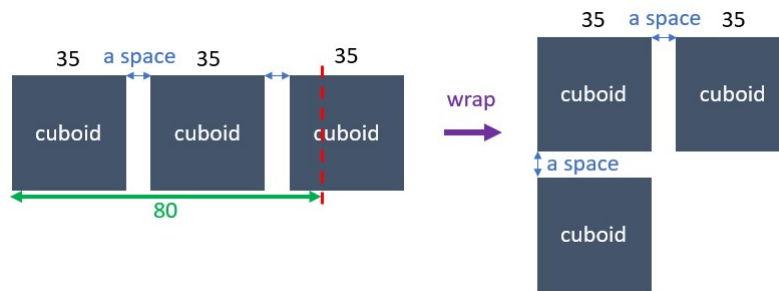
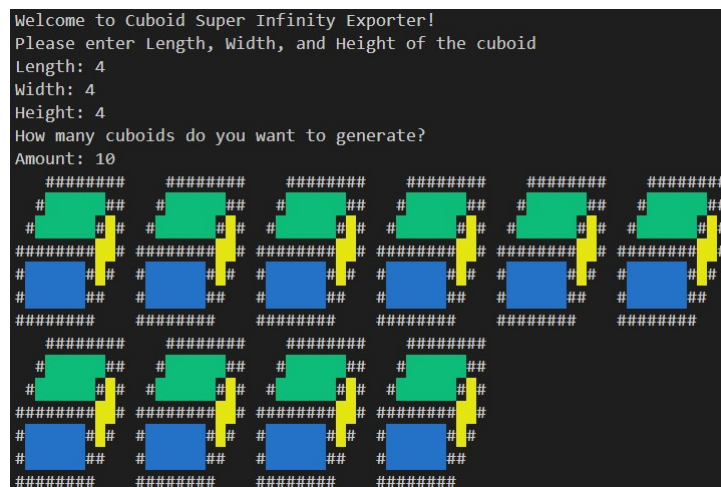Following are two examples:

FIGURE 2.3: Anya example of wrapping

FIGURE 2.4: Cuboid Super Infinity Much Exporter

2.6 Bonus: What Happens?? (5 pts)

Please read the following code and guess the output. Compile this code and run it. Is the output the same with what you guess? Please explain the reason of the output in **Chinese**.

```c
#include <stdint.h>
#include <stdio.h>

uint32_t ui = 0;
uint16_t us = 0;
int32_t si = -1;

int main()
{
    int64_t r1 = ui + si;
    int64_t r2 = us + si;
    printf("%ld %ld\n", r1, r2);
}
```

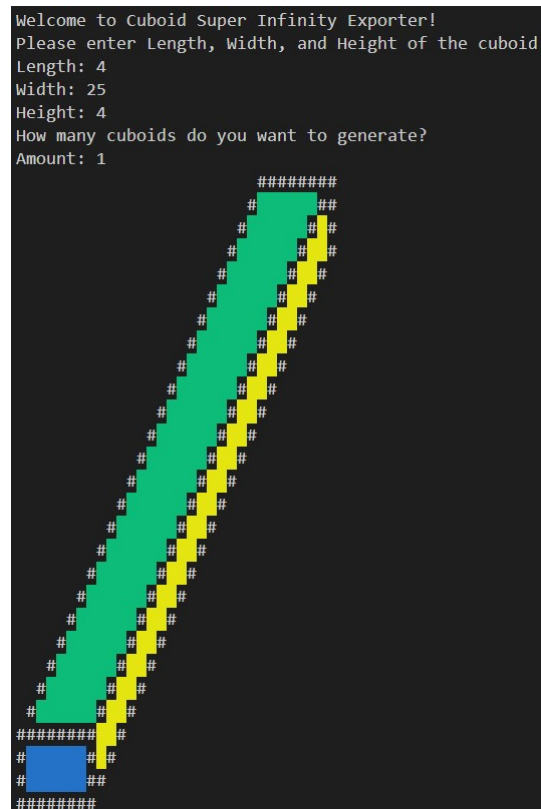Hint: You can look up the reason from C11. I have uploaded C11

FIGURE 2.5: Cuboid Super Infinity Wide Exporter

draft on my website. The keyword: **Integer Conversion** and **Integer Promotion**.