Computer Programming Language

【Fall, 2020】

Homework 4

Program A: Perfect number (25%)

A positive integer is a perfect number if it is equal to the sum of all of its factors, including one but excluding itself. For example, 6 is a perfect number, since 6 = 1 + 2 + 3, and 1, 2, and 3 are factors of 6. Design a PerfectNumber(long int Num) function that determines whether the supplied number Num is a perfect number. Write a program to find all perfect numbers between 1 and 10000 by calling the function PerfectNumber(long int Num). What is the greatest perfect number you can find?

■ *AUTOLAB Submission Check:*

int answer1; // Store the largest perfect number less than 10000 in this global variable

Program B: Matrix multiplication function (25%)

Design a function **matrixMultiplication** for matrix multiplication. The two input matrices are **A** (M×L) and **B** (L×N), and the result is matrix **C** (M×N, **C** = **A**×**B**, where M, L, N are all less than 20). Also design a function **displayResult** to display the matrix multiplication result. You need to write a main program to test your functions with the following sample matrix multiplication. You may set the value of matrix elements of **A** and **B** directly in your main program.

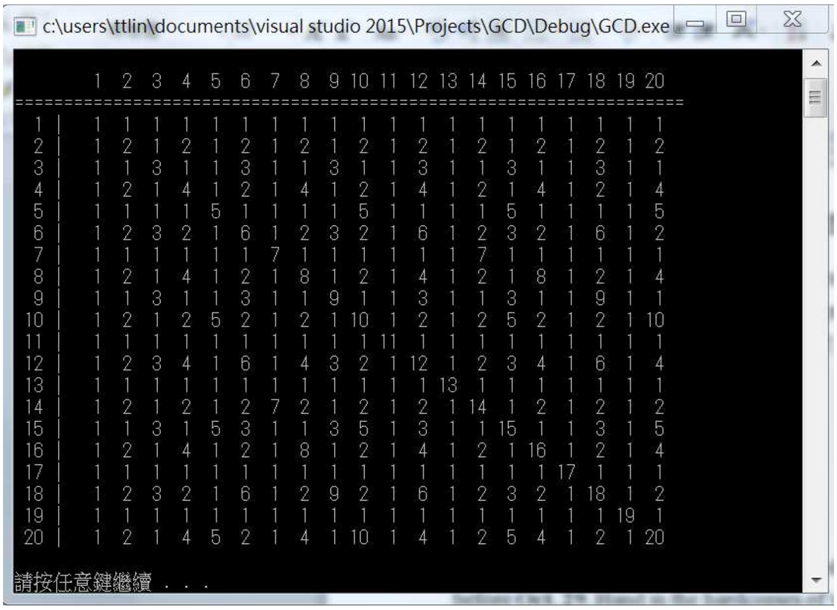
$$\mathbf{C} = \mathbf{A} \times \mathbf{B} = \begin{bmatrix} 2.1 & 3.1 & 6.7 & 7.1 \\ 5.0 & 3.0 & 4.2 & 2.2 \\ 3.3 & 4.4 & 5.5 & 0.5 \end{bmatrix} \begin{bmatrix} 1.0 & 1.1 & 7.7 & 2.1 & 4{,}4 \\ 2.2 & 2.3 & 2.3 & 8.6 & 3.3 \\ 7.5 & 8.1 & 2.4 & 9.2 & 0.7 \\ 9.1 & 2.3 & 9.9 & 0.5 & 0.9 \end{bmatrix}$$

■ *AUTOLAB Submission Check:*

double answer1; // Store the sum of all elements in matrix **C**

Program C：Use of function and nested loops (25%)

The greatest common divisor of integers **x** and **y** is the largest integer that evenly divides both **x** and **y**. Write a function **gcd** that returns the greatest common divisor of **x** and **y**. Also write a C++ program that calls the **gcd** function repetitively to create a table of greatest common divisor of paired integers from 1 to 20, as the following figure shows.



c:\users\ttlin\documents\visual studio 2015\Projects\GCD\Debug\GCD.exe

```
         1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20
==================================================================
  1 |    1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1
  2 |    1  2  1  2  1  2  1  2  1  2  1  2  1  2  1  2  1  2  1  2
  3 |    1  1  3  1  1  3  1  1  3  1  1  3  1  1  3  1  1  3  1  1
  4 |    1  2  1  4  1  2  1  4  1  2  1  4  1  2  1  4  1  2  1  4
  5 |    1  1  1  1  5  1  1  1  1  5  1  1  1  1  5  1  1  1  1  5
  6 |    1  2  3  2  1  6  1  2  3  2  1  6  1  2  3  2  1  6  1  2
  7 |    1  1  1  1  1  1  7  1  1  1  1  1  1  7  1  1  1  1  1  1
  8 |    1  2  1  4  1  2  1  8  1  2  1  4  1  2  1  8  1  2  1  4
  9 |    1  1  3  1  1  3  1  1  9  1  1  3  1  1  3  1  1  9  1  1
 10 |    1  2  1  2  5  2  1  2  1 10  1  2  1  2  5  2  1  2  1 10
 11 |    1  1  1  1  1  1  1  1  1  1 11  1  1  1  1  1  1  1  1  1
 12 |    1  2  3  4  1  6  1  4  3  2  1 12  1  2  3  4  1  6  1  4
 13 |    1  1  1  1  1  1  1  1  1  1  1  1 13  1  1  1  1  1  1  1
 14 |    1  2  1  2  1  2  7  2  1  2  1  2  1 14  1  2  1  2  1  2
 15 |    1  1  3  1  5  3  1  1  3  5  1  3  1  1 15  1  1  3  1  5
 16 |    1  2  1  4  1  2  1  8  1  2  1  4  1  2  1 16  1  2  1  4
 17 |    1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1 17  1  1  1
 18 |    1  2  3  2  1  6  1  2  9  2  1  6  1  2  3  2  1 18  1  2
 19 |    1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1 19  1
 20 |    1  2  1  4  5  2  1  4  1 10  1  4  1  2  5  4  1  2  1 20

請按任意鍵繼續 . . .
```

■ *AUTOLAB Submission Check:*

```
int answer1;    // Store the greatest common divisor of 5 and 15 in this global variable
int answer2;    // Store the greatest common divisor of 2 and 13 in this global variable
int answer3;    // Store the greatest common divisor of 6 and 12 in this global variable
```

Program D: Game of Craps simulation (25%)

Write a C++ program that simulates the casino game of Craps. These are the rules of the game:

- If a player throws a 7 or 11 (sum of two dice) on the first roll, the player wins the game.
- If a player throws a 2, 3 or 12 (sum of two dice) on the first roll, the player loses the game.
- If a player throws a 4, 5, 6, 8, 9 or 10 (sum of two dice) on the first roll, the player neither wins nor loses but creates a "point." If this is the case, the player keeps rolling the dice until the point (4, 5, 6, 8, 9 or 10) is thrown again, and the player wins the game. However, if the player throws a 7 (sum of two dice) before the "point" is thrown, the player loses the game.

Check this video for more explanation of the rule: https://www.youtube.com/watch?v=7Vom4YWEOI0.

You will create a function called rollDice that will, when called, roll two dice and return a random number between 2 and 12. The program will play 10000 games of craps and keep track of the statistics to answer the following questions:

(a). What is the probability of winning at game of Craps?

(b). What is the average length of a game of Craps?

■ *AUTOLAB Submission Check:*

```
double answer1;    // Store the probability of winning at game of Craps in this global variable
double answer2;    // Store the average length of a game of Craps in this global variable
```

Notes:

1. Please submit your programs (source codes) to the AUTOLAB grading system website (http://140.112.183.225) before **Nov. 19** (3:30PM)

2. Late submission will have a penalty of 10% discount per day of your homework total score toward a maximum of 50% discount. No late submission over five days will be accepted.

3. Criteria of grading include: (1) Program functionality; (2) User interface; (3) Structure of the program; (4) Suitable comments; (5) Programming style; (6) Creativity.