Lab05

Please do not use any math function (EX: pow()), array, and if/else in this lab.

1. Homework Problem I

(A) Write a program to approximate the value of e using the formula:

$$e = 1 + \frac{1}{1!} + \frac{1}{2!} + \frac{1}{3!} + \ldots$$

(a). Stop when the added term is less than 10^{-6}.

(b). Stop when the difference between the two successive terms is less than 0.001.

Use one while loop to complete this problem.

Please show the answer to the 12^{th} decimal place.

(B) In cryptarithmetic puzzles, mathematical equations are written using letters. Each letter can be a digit from 0 to 9, but no two letters can be the same. Here is a sample problem:

SEND + MORE = MONEY (9567+ 1085 = =10652)

A solution to the puzzle is

S = 9, R = 8, O = 0, M = 1, Y = 2, E = 5, N = 6, D = 7

Question:

Write a program that finds solutions to the cryptarithmetic puzzle of:

TOO + TOO + TOO + TOO = GOOD

The simplest technique is to use a nested loop for each unique letter (in this case T, O, G, D). The loops would systematically assign the digits from 0-9 to each letter.

For example,

it might first try T = 0, O = 0, G = 0, D = 0, then

T = 0, O = 0, G =0, D = 1, then

T = 0, O = 0, G = 0, D = 2, etc. up to

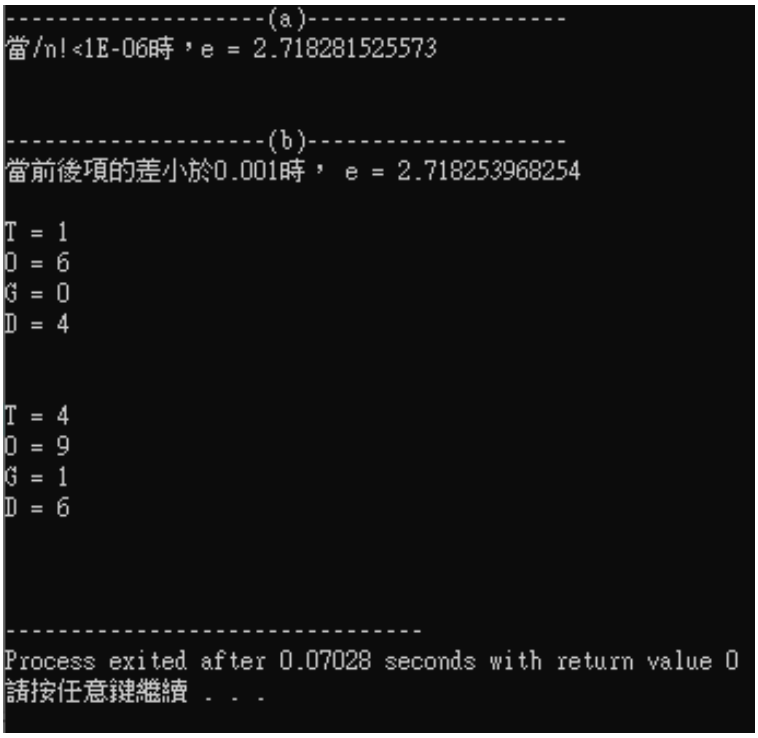
T = 9, O = 9, G = 9, D = 9.

In the loop body test that each variable is unique and that the equation is satisfied.

Output the values for the letters that satisfy the equation.

Leading letter can be zero.

Example:



2. Homework Problem II

(A)Write a program to approximate the value of sin(x) using the formula:

$$\sin(x) = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \ldots + \frac{(-1)^{n+1} x^{2n-1}}{(2n-1)!}$$

(x 值由 keyboard key in).

The program stop when $\frac{(-1)^{n+1} x^{2n-1}}{(2n-1)!} < 10^{-8}$

Use one while loop to complete this problem.

Please show the answer to the 10th decimal place.

(B) Write a program that prompts the user to input a positive integer and then outputs the individual digits of the number.

(while loop only)

Do not use nested loop in this problem.

(C) Write a program to convert binary numbers to decimal.

(First you can decompose a binary number into separate digits.)

Use one while loop to complete this problem.

Example:

```
x = 1.47
sin(1.47) = 0.9949243500

314159
3       1       4       1       5       9

101101
(101101)_2 = (45)_10
```

3. (1) Two-digit Palindrome

A two-digit palindrome is said to be a palindrome if reverse with two-digit of the even-digit number is the same as that number. For example, “123412” is a palindrome, but “123421” is not a palindrome. Please write a program to check if the input number is two-digit palindrome or not. Please let user input data and stop when user input CTRL+Z.

(2) Arctan Calculation

Write a program to approximate the value of arctan(x) using the formula:

$$\arctan(\mathrm{x}) = \frac{\mathrm{x}}{1+x^2}\sum_{n=0}^{\infty}\prod_{k=1}^{n}\frac{2kx^2}{(2k+1)(1+x^2)}$$

Stop when the added term is less than 10^{-20} and show the answer to the 12^{th} decimal place. Remind that “an added term” means $\frac{\mathrm{x}}{1+x^2}\prod_{k=1}^{n}\frac{2kx^2}{(2k+1)(1+x^2)}$. Additionally, you have to repeat your program to let user input x and stop when user input **^Z**. Please use do{}while(); or while() to complete it.

Note: To use CTRL+Z (^Z), you have to use

while (scanf(“%d”, &n) != EOF)

Example:

```
------(1)------
Input n = 123412
Two-Digit Palidrome
Input n = 123421
Not Two-Digit Palidrome
Input n = 123456563412
Two-Digit Palidrome
Input n = ^Z

------(2)------
Input x = 1
arctan(1.000000) = 0.785398163397
Input x = 10
arctan(10.000000) = 1.471127674304
Input x = 100
arctan(100.000000) = 1.560796660107
Input x = ^Z

--------------------------------
Process exited after 44.12 seconds with return value 0
Press any key to continue . . .
```

4. Please printout the following pyramid. User should be able to enter the "level" of the pyramid, and "level" is an odd number. You can only use three for loop (nested loop) and ternary operators to complete it. Let user input n, and stop when inputting CTRL+D.

Note: To use CTRL+D (^D), you have to use

while (scanf("%d", &n))

Example:

```
input n: 15
       A
      A A
     A B A
    A B B A
   A B C B A
  A B C C B A
 A B C D C B A
A B C D D C B A
 A B C D C B A
  A B C C B A
   A B C B A
    A B B A
     A B A
      A A
       A

input n: 9
    A
   A A
  A B A
 A B B A
A B C B A
 A B B A
  A B A
   A A
    A

input n: ^D

--------------------------------
Process exited after 7.588 seconds with return value 0
Press any key to continue . . .
```