Lab05

1. Homework Problem I
   (1) Exponential Calculation

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

(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 10th decimal place.

(2) Sine Function Calculation

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

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.

(3) Write a program that prompts the user to input a positive integer x and then outputs the individual digits of the number. Do not use nested loop in this problem.


```
------ (1) ------
(a) 2.7182815256
(b) 2.7182539683

------ (2) ------
x= -0.1
-0.0998334167

------ (3) ------
x= 1234567890
1 2 3 4 5 6 7 8 9 0
```

2. Homework Problem II

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

  TOO + TOO + TOO + TOO = GOOD

  Output the values for the letters that satisfy the equation.

  Leading letter is no zero.

Solution 1: T=4,O=9,G=1,D=6

3. Pi & Binary Palindrome

(1) Pi Calculation

$$\frac{2}{\pi} = \underbrace{\frac{\sqrt{2}}{2}}_{term1} \cdot \underbrace{\frac{\sqrt{2+\sqrt{2}}}{2}}_{term2} \cdot \underbrace{\frac{\sqrt{2+\sqrt{2+\sqrt{2}}}}{2}}_{term3} \cdot \underbrace{\frac{\sqrt{2+\sqrt{2+\sqrt{2+\sqrt{2}}}}}{2}}_{term4} \cdots\cdots$$

   The program stops when the difference between the current result and the next result is smaller than 1E-15. Please use do{}while(); to complete it and show the answer of π to the 15th decimal place.

Hint: You can use sqrt() function in math.h.

π = 3.141592653589789

(2) Binary Palindrome

   Write a program to convert binary numbers to decimal and check if they are palindromic. The program should run repeatedly until the user inputs ^D or ^Z. Do not use nested loop and no more than 2 loops in this problem.

```
------ (1) ------
pi = 3.141592653589789

------ (2) ------
100001
Binary Number: 100001
Decimal Number: 33
Biniary: palindromic.
Decimal: palindromic.


10101
Binary Number: 10101
Decimal Number: 21
Biniary: palindromic.
Decimal: not palindromic.


10111
Binary Number: 10111
Decimal Number: 23
Biniary: not palindromic.
Decimal: not palindromic.


^D


--------------------------------
Process exited after 58.33 seconds with return value 0
Press any key to continue . . .
```

4. Manhattan Distance Table

Write a program to print out the table of Manhattan distance from (x, y) to (a, b), where (x,y) are read from the keyboard, and (a,b) are 0~10. (One for loop and ternary operators are allowed for the main part of this program; no nested loop and if/else.) Let user input x and y, and stop when inputting CTRL+D or CTRL+Z.

```
0 0
  a b  0  1  2  3  4  5  6  7  8  9 10
  ------------------------------------
  0 |  0  1  2  3  4  5  6  7  8  9 10
  1 |  1  2  3  4  5  6  7  8  9 10 11
  2 |  2  3  4  5  6  7  8  9 10 11 12
  3 |  3  4  5  6  7  8  9 10 11 12 13
  4 |  4  5  6  7  8  9 10 11 12 13 14
  5 |  5  6  7  8  9 10 11 12 13 14 15
  6 |  6  7  8  9 10 11 12 13 14 15 16
  7 |  7  8  9 10 11 12 13 14 15 16 17
  8 |  8  9 10 11 12 13 14 15 16 17 18
  9 |  9 10 11 12 13 14 15 16 17 18 19
 10 | 10 11 12 13 14 15 16 17 18 19 20
```

→ Only one for loop

```
3 7
  a b  0  1  2  3  4  5  6  7  8  9 10
  ------------------------------------
  0 | 10  9  8  7  6  5  4  3  4  5  6
  1 |  9  8  7  6  5  4  3  2  3  4  5
  2 |  8  7  6  5  4  3  2  1  2  3  4
  3 |  7  6  5  4  3  2  1  0  1  2  3
  4 |  8  7  6  5  4  3  2  1  2  3  4
  5 |  9  8  7  6  5  4  3  2  3  4  5
  6 | 10  9  8  7  6  5  4  3  4  5  6
  7 | 11 10  9  8  7  6  5  4  5  6  7
  8 | 12 11 10  9  8  7  6  5  6  7  8
  9 | 13 12 11 10  9  8  7  6  7  8  9
 10 | 14 13 12 11 10  9  8  7  8  9 10

^D


------------------------------------
Press any key to continue . . .
```