Lab08

1. Homework Problem I

a) Write a function IsPrime(…) that has a single parameter x of type integer. If x is a prime number, the function returns 1; otherwise, the function returns 0

a) Write a function EvalPoly(…)that expects four float parameters a, b, c, and x. The function should return the value $ax^2 + bx + c$.

b) Write a program that prints a calendar for a year. Prompt the user for the year and print the year and the calendar.

Hint1:

January 1 in year x begins on day:

$$\left(x + \left\lfloor \frac{x-1}{4} \right\rfloor - \left\lfloor \frac{x-1}{100} \right\rfloor + \left\lfloor \frac{x-1}{400} \right\rfloor \right) \bmod 7$$

(a).Where $\lfloor x \rfloor$ denotes the greatest integer less than or equal to *x*.

(b). M mod n denotes the remainder when m is divided by n.

(c). Sunday corresponds to 0, Monday to 1, and so on.

For example, if *x* = 1998,

$$\left(1998 + \left\lfloor \frac{1998-1}{4} \right\rfloor - \left\lfloor \frac{1998-1}{100} \right\rfloor + \left\lfloor \frac{1998-1}{400} \right\rfloor \right) \bmod 7$$

= (1998 +499- 19 +4) mod 7 = 4

Thus, January 1, 1998 begins on Thursday.

Hint2: Year *x* is a leap year if

x is divisible by 4 and not by 100

or *x* is divisible by 400

For example:

(a).1998 is divisible by neither 4 nor 400. So 1998 is not a leap year.

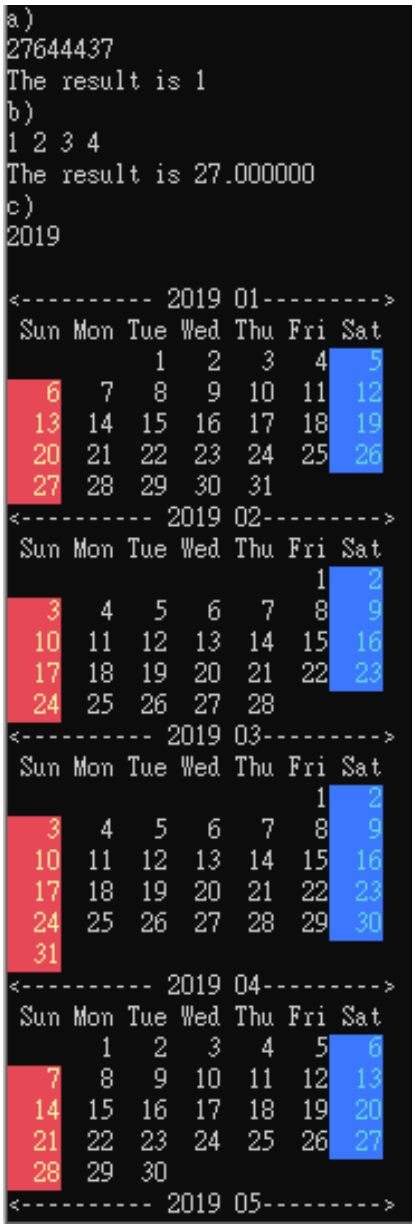
(b).1996 is divisible by 4 and not by 100. So 1996 is a leap year.

(c).2000 is divisible by 400. So 2000 is a leap year.

(d).1990 is divisible by 4 and by 100, and is not divisible by 400.

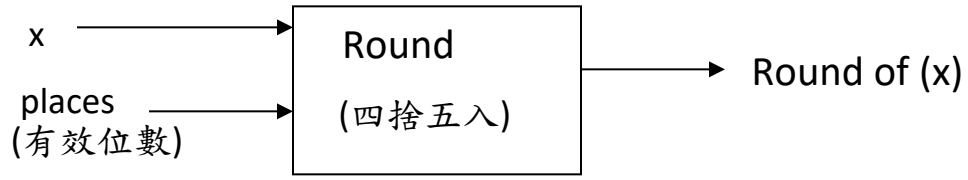
So 1990 is not a leap year.

Please mark the corresponding days as specified text colors and background colors, which is shown as below sample output.



2. Homework Problem II

a) Write a function that rounds a number to a given number of decimal places(有效位數) and returns the rounded value as the function result.



b) A control system applies a force to an actuator proportional to the voltage of a signal coming into the control system.

It is desired not to allow the actuator to quiver back and forth in the presence of small corrections near the zero-force point.

More force is required for the actuator to move to the left (negative direction of motion) than is required for motion to the right (positive direction motion).

Assume that the transfer function (the relationship between the voltage and the movement) of the actuator is

- Voltage less than –0.2 volt: Actuator moves 1 cm/volt in the negative direction.
- Absolute value of voltage less than or equal to 0.2 volt: No motion.
- Voltage great than 0.2 volt: Actuator moves 2 cm/volt in the positive direction.

Write a function **force(…)** to compute the total motion for any signal input.

Write a main program that **repeatedly calls the force (…)** function using an input signal stream such as :

-10 -8 -0.21 -0.2 -0.05 1.5 0 4.5 10

The main program should also take as user input an initial position of the actuator and should output a final position resulting from applying the signals of the given control stream.

The input stream ends when the input is Ctrl+Z or Ctrl+D.

Sample Input/Output:

```
a)
3.1415926 3
The result is 3.142
b)Input initial postion: 1.5
Input signal stream: -10 -8 -0.21 -0.2 -0.05 1.5 0 4.5 10 ^D
The final postion is 15.290000
```

3. Rational root

Please write a function "void parse(int a3,int a2,int a1,int a0)" to find out the rational roots of

$$a_3x^3 + a_2x^2 + a_1x + a_0 = 0$$

If there is no rational root, output "No rational solution". You should prompt the user input continuously until input CTRL+Z or CTRL+D.

- Rational root theorem

(https://en.wikipedia.org/wiki/Rational_root_theorem)

The rational root theorem states a constraint on rational solutions of a polynomial equation with integer coefficients.

$$a_nx^n + a_{n-1}x^{n-1} + \cdots + a_1x + a_0 = 0$$

If a_0 and a_n are nonzero, then each rational solution x, when written as a fraction $x = p/q$ in lowest terms (i.e., the greatest common divisor of p and q is 1), satisfies

- p is an integer factor of the constant term a_0, and
- q is an integer factor of the leading coefficient a_n.

Example :

(2,9,10,3) ➔ -1 -3 -0.5

(3,9,10,3) ➔ No rational solution

4. Base

Please write two functions “bool isBaseB(long long input, int B)” and “long long B2dec(long long num,int B)”. First function should determine if “input” is B based. If “input” is B based, use B2dec to convert “num” from B based to decimal based. If not, print out “input” is not B based. You should prompt the user input continuously until input CTRL+Z or CTRL+D.

Example :

(121212121,3) ➔ 12301

(121212121,2) ➔ 121212121 is not 2 base