Lab 11/15

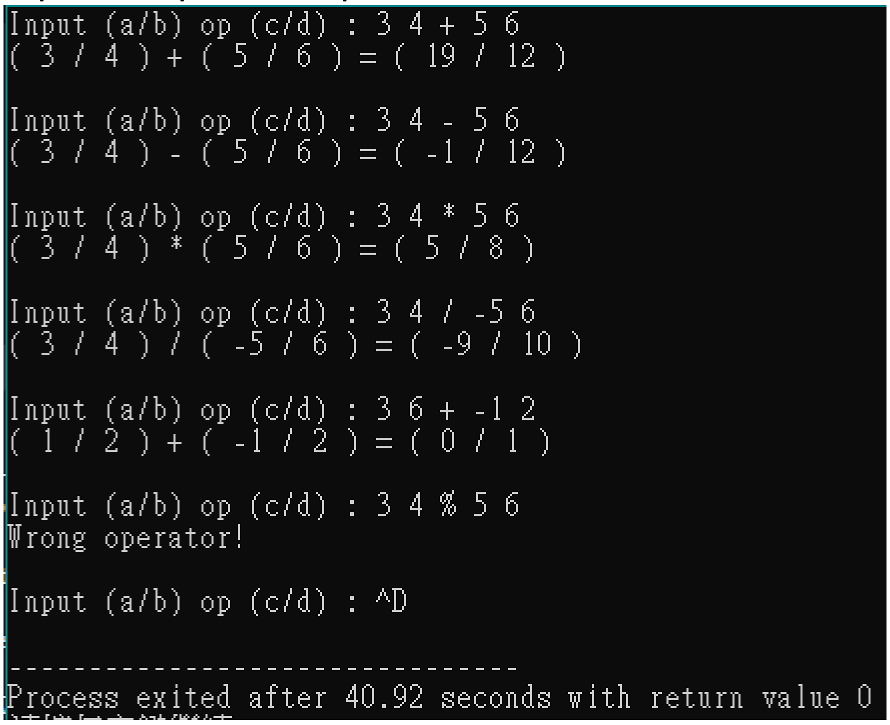
Please don't use global variable and array in this lab. Please use call by value in function writing in this lab. No call by address, no recursive function.

■ Lab Part

1. Please write these functions:
   (a) Function gcd:
   Take two integers and return the gcd.
   (b) Function print_irreducible:
   Take two integers as nominator and denominator, and print the fraction in irreducible form as the example. Use function (a) in the calculation.
   (c) Function calculate:
   Take four integers a, b, c, d, and an operator character (+ - * /), and calculate the answer of each operation respectively. Show an error message when the operator is invalid. Use function (b) to print each fraction.

   Write the main function to prompt and let the user input continuously until Ctrl + D. Follow the format as the example below.

   Input/Output Example:



```
Input (a/b) op (c/d) : 3 4 + 5 6
( 3 / 4 ) + ( 5 / 6 ) = ( 19 / 12 )

Input (a/b) op (c/d) : 3 4 - 5 6
( 3 / 4 ) - ( 5 / 6 ) = ( -1 / 12 )

Input (a/b) op (c/d) : 3 4 * 5 6
( 3 / 4 ) * ( 5 / 6 ) = ( 5 / 8 )

Input (a/b) op (c/d) : 3 4 / -5 6
( 3 / 4 ) / ( -5 / 6 ) = ( -9 / 10 )

Input (a/b) op (c/d) : 3 6 + -1 2
( 1 / 2 ) + ( -1 / 2 ) = ( 0 / 1 )

Input (a/b) op (c/d) : 3 4 % 5 6
Wrong operator!

Input (a/b) op (c/d) : ^D

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Process exited after 40.92 seconds with return value 0
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2. Unix Time

   Unix time is a date and time representation widely used in computing. It measures time by the number of seconds that have elapsed since 00:00:00 UTC on 1 January 1970, the beginning of the Unix epoch.
   The timestamp is saved in unsigned int datatype.

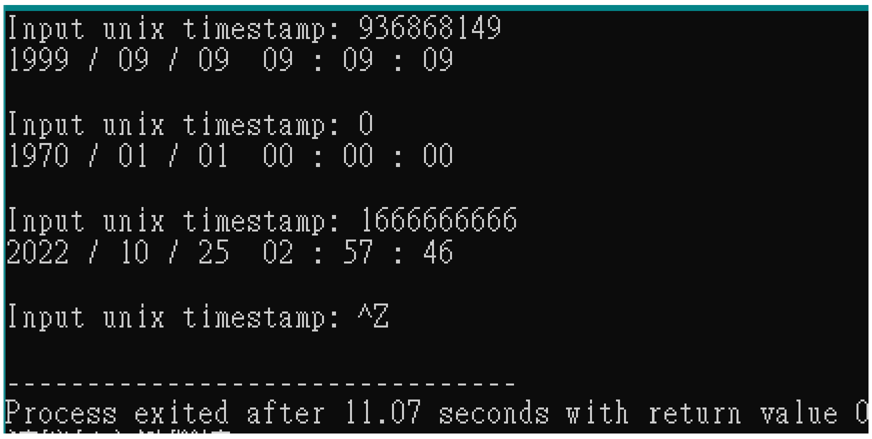
   No need to be concerned about leap seconds and time zones.
   You need to check leap year for days in February. (See Problem 5)

   Finish the following functions:

   (a) unsigned int sec_in_month(year, month):
       Return the total seconds of the specific month.
   (b) void print_unix(stamp):
       Print the corresponding year, month, date, hour, minute, seconds.
       Subtract the timestamp with the result of sec_in_month to find out the year and month.

   Write the main function to prompt and let user input timestamp continuously until Ctrl + Z.
   Follow the format as the example below.

   Input/Output Example:



```
Input unix timestamp: 936868149
1999 / 09 / 09  09 : 09 : 09

Input unix timestamp: 0
1970 / 01 / 01  00 : 00 : 00

Input unix timestamp: 1666666666
2022 / 10 / 25  02 : 57 : 46

Input unix timestamp: ^Z

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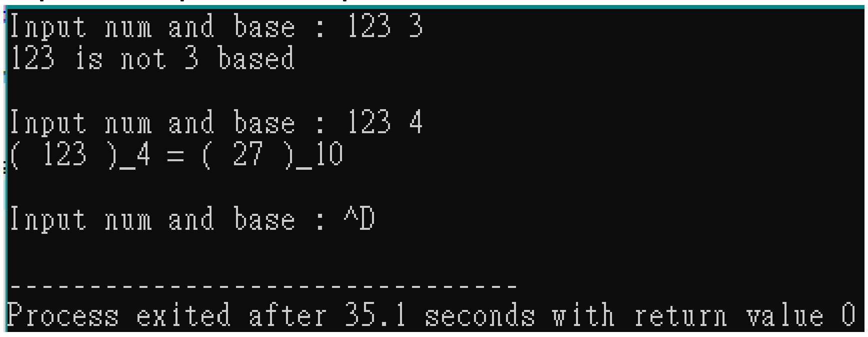
Process exited after 11.07 seconds with return value 0
```

3. Please write these functions:
   (a) Function isBaseB:
       Take a long long int as input num and an int as base B.
       Return true if the input num is B based, false otherwise.
   (b) Function B2dec:
       Take a long long int as input num and an int as base B.
       Return the input num in decimal base.

   Write the main function to prompt and let the user input num and base continuously until Ctrl+D.

   In the main function:
   Check the input by isBaseB. If the input is B based, print the number in decimal base with B2dec. Otherwise, print "xxx is not x based".

   Input/Output Example:



```
Input num and base : 123 3
123 is not 3 based

Input num and base : 123 4
( 123 )_4 = ( 27 )_10

Input num and base : ^D

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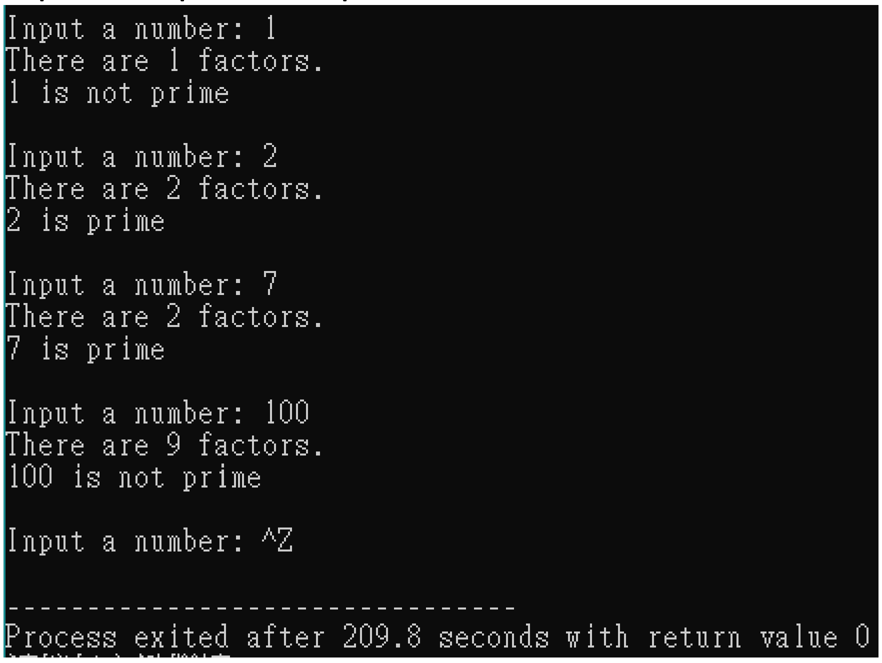
Process exited after 35.1 seconds with return value 0
```

Homework Part

4. 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.
   Please write a main program that inputs one integer and pass this integer to the IsPrime(…) to test this function.
   Stop the program when inputting CTRL+Z.

   Modification:
   Return the number of factors of the number.
   Then, print the number of factors and whether it is prime or not in the main function.

   Input/Output Example:



```
Input a number: 1
There are 1 factors.
1 is not prime

Input a number: 2
There are 2 factors.
2 is prime

Input a number: 7
There are 2 factors.
7 is prime

Input a number: 100
There are 9 factors.
100 is not prime

Input a number: ^Z

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Process exited after 209.8 seconds with return value 0
```

5. Write a function printCal(…) that prints a calendar for a year. Prompt the user for the year and print the year and the calendar.
   Stop the program when inputting CTRL+Z

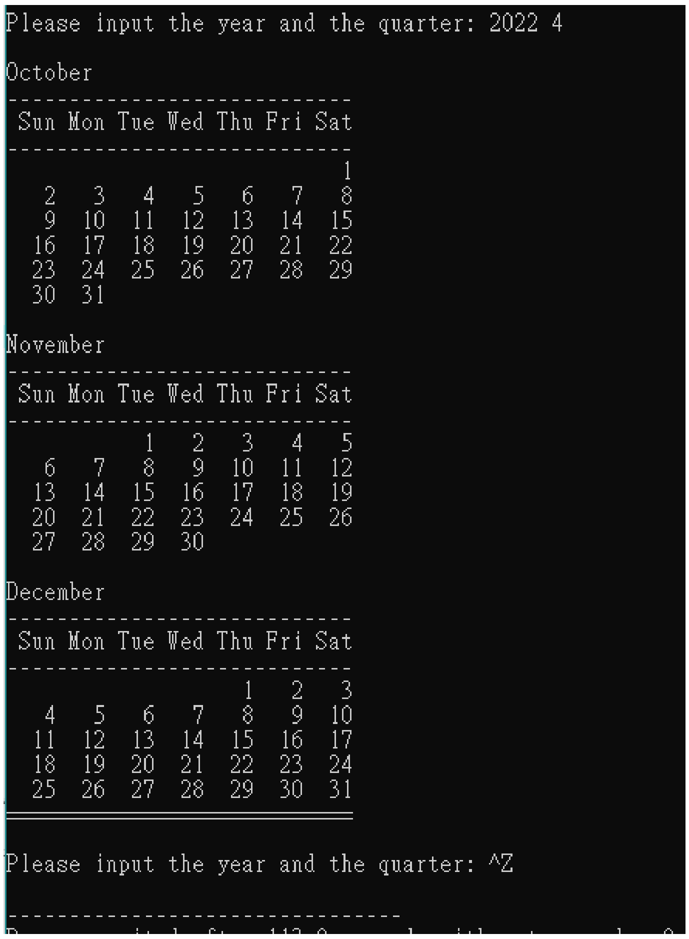
   Hint1:
   January 1 in year x begins on day:

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

   Hint2: Year x is a leap year if
   x is divisible by 4 and not by 100 or
   x is divisible by 400

   Modification:
   Let user input year and quarter and prints a calendar for the specific year and quarter in printCal(…).

   Input/Output Example:



```
Please input the year and the quarter: 2022 4

October
----------------------------
 Sun Mon Tue Wed Thu Fri Sat
----------------------------
                           1
   2   3   4   5   6   7   8
   9  10  11  12  13  14  15
  16  17  18  19  20  21  22
  23  24  25  26  27  28  29
  30  31

November
----------------------------
 Sun Mon Tue Wed Thu Fri Sat
----------------------------
           1   2   3   4   5
   6   7   8   9  10  11  12
  13  14  15  16  17  18  19
  20  21  22  23  24  25  26
  27  28  29  30

December
----------------------------
 Sun Mon Tue Wed Thu Fri Sat
----------------------------
                   1   2   3
   4   5   6   7   8   9  10
  11  12  13  14  15  16  17
  18  19  20  21  22  23  24
  25  26  27  28  29  30  31
============================

Please input the year and the quarter: ^Z

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6. 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.

   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 :
   -10.0 v, -8.0 v, -0.21 v, -0.20 v, -0.05 v, 1.5 v, 0.00 v, 4.5 v, 10.0 v

   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.

   Please show the answer to the 4th decimal place.

   Please follow the example to let user continuously input the initial position and signal stream and stop when inputting CTRL-D and CTRL-Z, respectively.

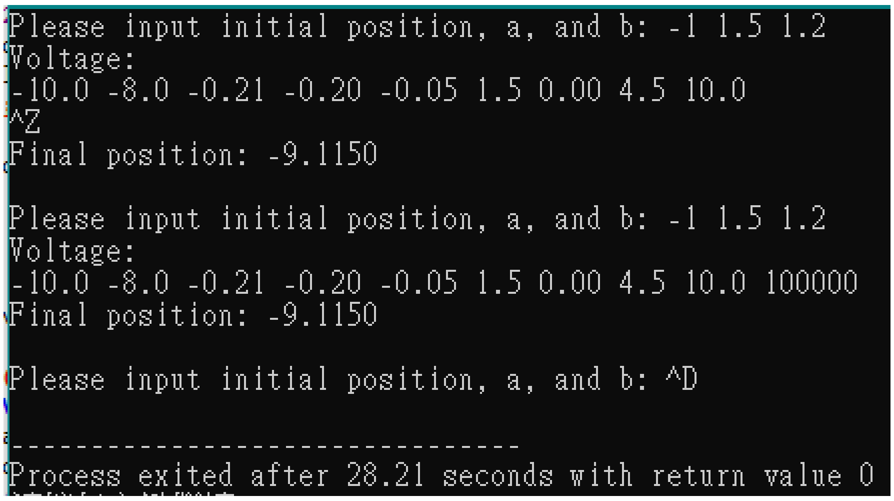
Modification:

Let user input the a, b for the transfer function of the actuator below.

- Voltage less than -0.2 volt:
  Actuator moves a 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 b cm/volt in the positive direction.

(b) stop when inputting CTRL-D and CTRL-Z, respectively. => stop when inputting CTRL-D and (CTRL-Z or $|voltage| > 99999$), respectively.

Input/Output Example:



```
Please input initial position, a, and b: -1 1.5 1.2
Voltage:
-10.0 -8.0 -0.21 -0.20 -0.05 1.5 0.00 4.5 10.0
^Z
Final position: -9.1150

Please input initial position, a, and b: -1 1.5 1.2
Voltage:
-10.0 -8.0 -0.21 -0.20 -0.05 1.5 0.00 4.5 10.0 100000
Final position: -9.1150

Please input initial position, a, and b: ^D

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Process exited after 28.21 seconds with return value 0
```