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FACULTY OF INFORMATION TECHNOLOGY
SOFTWARE ENGINEERING DEPARTMENT
ADVANCED PROGRAM IN COMPUTER SCIENCE
COURSE: **PROGRAMMING SYSTEMS**
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WEEK 06

USER-DEFINED FUNCTION

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1 Requirements

Complete the following exercises, with several requirements:

1. Programming language: C++
2. IDE: Microsoft Visual Studio 2010
3. Solution name: StudentID_WeekXX. XX: 01-10
4. Project name: ExYY. YY:01-99 (hope we don't have 99 exercises/week ☺)
5. At the beginning of each source code file, write down 3 types of info: (1) Student ID; (2) Full name; (3) Exercise XX
6. Remove all folders Debug, ipch, and file .sdf before submitting to Moodle
7. Your file name: StudentID_WeekXX.rar/zip. For example, 0512299_Week01.zip

2 Instruction

In this lab, we learn how to:

1. How to declare, define and call an user-defined function

There are 3 parts of a function:

1. Function name: follow the identifier naming rule. (characters, digits, underscores, no space, no Vietnamese...)
2. Input/Parameters: types of parameters are important, names of them are not important → *because you have to pass correct data type when calling a function.*
3. Output (return type): type of output are very important → *when receiving a return value, focus on data type, not name of variable.*

There are 3 steps to create a user-defined function:

1. Function declaration (once): file *Function.h*.

```
#ifndef _FUNCTION_H_
#define _FUNCTION_H_

// include all lib needed
#include<iostream>
#include<math.h>
using namespace std;

// declare all user-defined function

// Name: CalS1
// Input: integer number -> int
// Output: sum -> integer -> int
int CalS1(int n);

#endif
```

2. Function definition (once): file *Function.cpp*.

```
#include "Function.h"

int CalS1(int n)
{
    int s=0;
    for(int i=1;i<=n;i++)
    {
        s+=i;
    }
    return s;
}
```

3. Invoking a function (many times). Write main function in file *main.cpp*.

```
#include "Function.h"

int main()
{
    int k;
    cout<<"Enter k: ";
    cin>>k;

    int result;
    result=CalS1(k);

    cout<<"Sum of n : "<<result<<endl;

    return 0;
}
```

Except functions like input sth, output sth, list sth, you are not allowed to cout<< or cin>> in functions.

1. Replace cin>> by passing parameter

```
int CalS1()
{
    // Error
    int n;
    cout<<"Enter n: ";
    cin>>n;
    // Error

    int s=0;
    for(int i=1;i<=n;i++)
    {
        s+=i;
    }
    return s;
}
```

```
#include "Function.h"

int CalS1(int n)
{
    int s=0;
    for(int i=1;i<=n;i++)
    {
        s+=i;
    }
    return s;
}
```

2. Replace cout<< by returning value

```
void CalS1(int n)
{
    int s=0;
    for(int i=1;i<=n;i++)
    {
        s+=i;
    }
    // Error
    cout<<s;
    // Error
}
```

```
#include "Function.h"

int CalS1(int n)
{
    int s=0;
    for(int i=1;i<=n;i++)
    {
        s+=i;
    }
    return s;
}
```

3 Exercises

Complete these exercises by define own functions for them. Try to write in English in this lab, use dictionary as needed

1. Calculate $S(n)$ or $S(x,n)$

a) $S = 1 + 2 + 3 + \dots + n$

b) $S = 1^2 + 2^2 + 3^2 + \dots + n^2$

c) $S = 1 + \frac{1}{2} + \frac{1}{3} + \dots + \frac{1}{n}$

d) $P = n! = 1 \times 2 \times 3 \times \dots \times n$

e) $S = 1! + 2! + 3! + \dots + n$

$$f) \quad S = \sqrt{2 * N + \sqrt{2 * (N - 1) + \dots + \sqrt{4 + \sqrt{2}}}}$$

$$g) \quad S = \frac{1}{0!} + \frac{1}{1!} + \frac{1}{2!} + \dots + \frac{1}{n!}$$

$$h) \quad S = x - \frac{x^3}{3!} + \frac{x^5}{5!} + \dots (-1)^n \frac{x^{2n+1}}{(2n+1)!} \text{ với } -\infty < x < \infty$$

$$i) \quad S = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} + \dots (-1)^n \frac{x^{2n}}{(2n)!} \text{ với } -\infty < x < \infty$$

$$j) \quad \frac{1}{1-x} = 1 + x + x^2 + x^3 + \dots = \sum_{n=0}^{\infty} x^n \text{ với } -1 < x < 1$$

$$k) \quad \cos(x) = 1 - \frac{1}{2}x^2 + \frac{1}{24}x^4 - \frac{1}{720}x^6 + \dots = \sum_{n=0}^{\infty} \frac{(-1)^n}{(2n)!} x^{2n} \text{ với } -\infty < x < \infty$$

$$l) \quad \operatorname{arccotan}(x) = \frac{\pi}{2} - x + \frac{1}{3}x^3 - \frac{1}{5}x^5 + \frac{1}{7}x^7 - \frac{1}{9}x^9 + \dots = \frac{\pi}{2} - \sum_{n=0}^{\infty} \frac{(-1)^n}{2n+1} x^{2n+1}$$

$$m) \quad \arctan(x) = x - \frac{1}{3}x^3 + \frac{1}{5}x^5 - \frac{1}{7}x^7 + \dots = \sum_{n=1}^{\infty} \frac{(-1)^{n+1}}{2n-1} x^{2n-1} \text{ với } -1 < x < 1$$

$$n) \quad e^x = 1 + x + \frac{1}{2}x^2 + \frac{1}{6}x^3 + \frac{1}{24}x^4 + \dots = \sum_{n=0}^{\infty} \frac{1}{n!} x^n \text{ với } -\infty < x < \infty$$

$$o) \quad \ln(1+x) = x - \frac{1}{2}x^2 + \frac{1}{3}x^3 - \frac{1}{4}x^4 + \dots = \sum_{n=1}^{\infty} \frac{(-1)^{n+1}}{n} x^n \text{ với } -\infty < x < \infty$$

$$p) \quad \ln\left(\frac{1+x}{1-x}\right) = 2x + \frac{2}{3}x^3 + \frac{2}{5}x^5 + \frac{2}{7}x^7 + \dots = \sum_{n=1}^{\infty} \frac{2}{2n-1} x^{2n-1} \text{ với } -\infty < x < \infty$$

$$q) \quad \sin(x) = x - \frac{1}{6}x^3 + \frac{1}{120}x^5 - \frac{1}{5040}x^7 + \dots = \sum_{n=0}^{\infty} \frac{(-1)^n}{(2n+1)!} x^{2n+1} \text{ với } -\infty < x < \infty$$

2. Write the following functions with an positive integer number

- a. Is n a prime number?
- b. Is n a perfect number?
- c. Is n a square number?
- d. Is n a symmetric number?
- e. Is n an abundant number?
- f. Is n a Kaprekar number?
- g. Is n a Motzkin number?
- h. Are all digits of n odd numbers?
- i. Do all digits of n increase from left to right?
- j. Find the max digit of n
- k. How many max digit of n?
- l. Calculate F(n) in a Fibonacci sequence
- m. List all prime number less than or equal to n
- n. Find a prime number nearest to n
- o. List all amicable numbers less than n
- p. List all Lucas prime numbers less than n
- q. List all Mersenne prime numbers less than n
- r. List all triangular numbers less than n
- s. List all Catalan numbers less than n
- t. Rewrite n by several prime numbers, for example: $24 = 2^3 * 3$

Enjoy it here! <http://www2.stetson.edu/~efriedma/numbers.html>

3. Write the following functions with 2 positive numbers
 - a. List all common divisors of a, b
 - b. Find greatest common divisor of a, b
 - c. Find least common multiple of a, b
 - d. Are a, b amicable numbers?
4. Solve the equation $ax+b=0$ (use pass-by-reference parameters)
5. Solve the equation $ax^2+bx+c=0$
6. Print all ways to exchange N VND to 500 VND, 1000 VND, 2000 VND, 5000 VND, 10.000 VND
7. Functions handle with date:
 - a. Is this a leap year?
 - b. How many days are there in a specific month?
 - c. If Jan 1 is the first day of a year, dd/mm/yyyy is the nth day of a year. Find n
 - d. If Jan 1, 1 is the first day, dd/mm/yyyy is the mth day. Find m

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- e. Find the next day (tomorrow)
- f. Find the prev day (yesterday)

4 In-class Assignment (IA)

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5 Homework (HW)

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