Build your IT Skill

ណែនាំ Inheritance of C++ Programming

Single Inheritance Multiple Inheritance

រៀបរៀងដោយ៖

គ្រូអោយពីចិត្តល្អ

អនុបណ្ឌិត RUPP, TKU

(Software Engineering)

Assistands: SOUS SEYHA,

LOUN VIRAK , PHEARUM SIVMENG

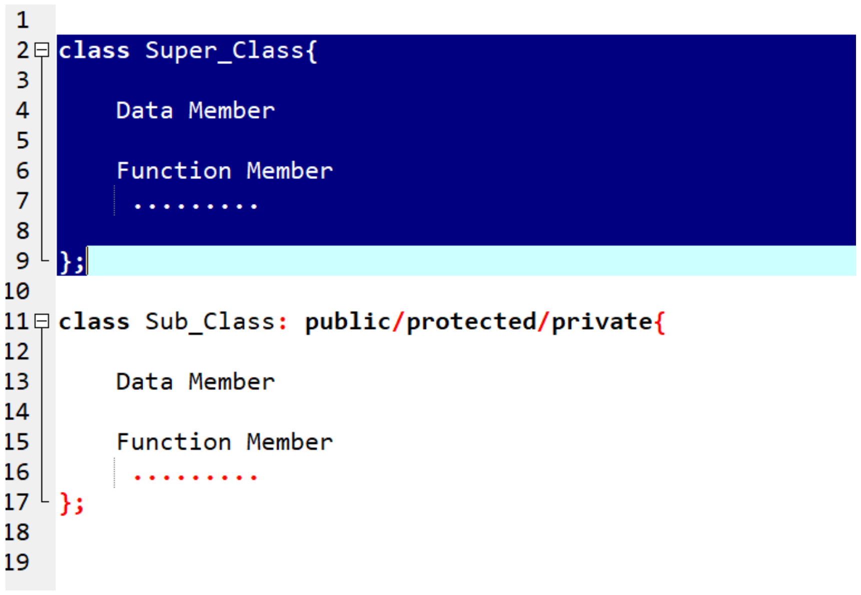
២០២៣

ណែនាំអោយស្គាល់ពី
Inheritance of C++

I. ដូចម្តេចទៅដែលហៅថា Inheritance?

Inheritance គឺជាដំណើរនៃការកកើត Class ថ្មីមួយចេញពី Class ដែលមានស្រាប់ ដែល Class ថ្មី នោះអាចប្រើប្រាស់នូវទិន្នន័យមួយចំនួនរបស់ Class ដើមបាន។ Class ថ្មីនោះ ត្រូវបានគេហៅថា Sub Class ឬ Derived Class ហើយ Class មានស្រាប់ គេហៅថា Base Class ឬ Super Class។

ទំរង់ទូទៅ៖



```
class Super_Class{

    Data Member

    Function Member
     .........

};

class Sub_Class: public/protected/private{

    Data Member

    Function Member
     .........
};
```

នៅក្នុង Inheritance គេបែងចែកជា ៥ប្រភេទគឺ៖

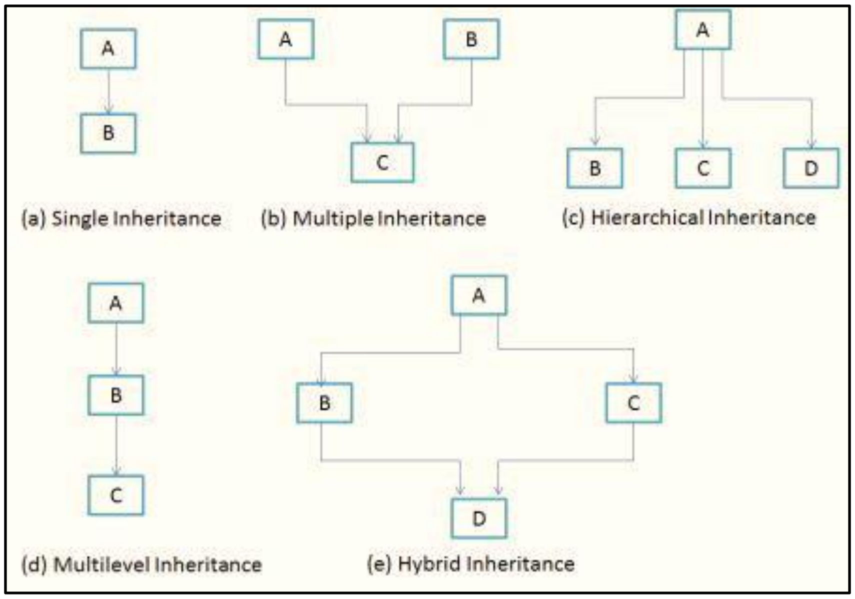
១) Single Inheritance

២) Multiple Inheritance

៣) Hierarchical

៤) Multilevel

៥) Hybrid

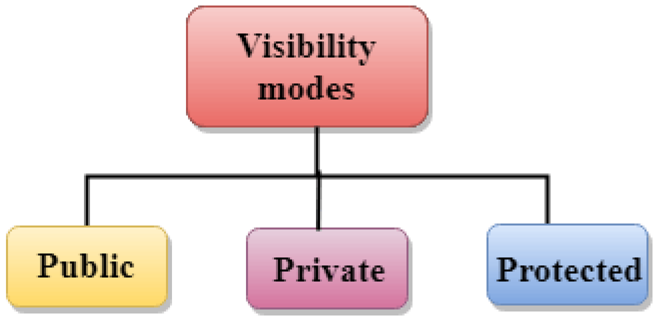


តែការបែងចែកជាចំណែកធំៗនៃ Inheritance គេបែងចែកជាពីរសំខាន់គឺៈ

១) Single Inheritance

២) Multiple Inheritance

ខាងក្រោមគឺជាកំរិតនៃ Level របស់ Inheritance៖

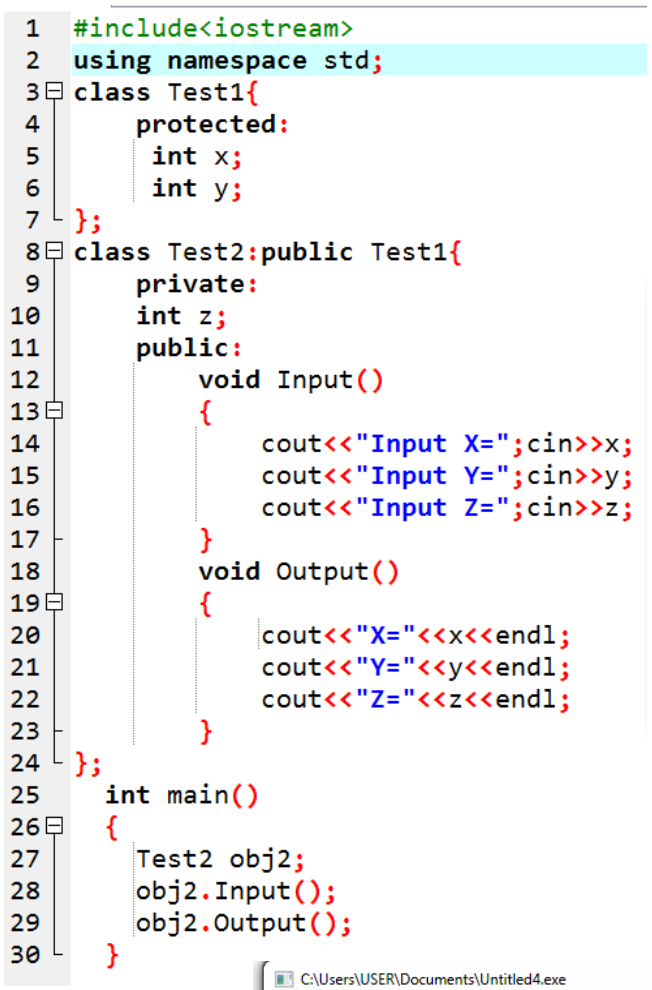


អ្នកត្រូវចាំថាកំរិតនៃការ Accessing Private គឺមិនអាចប្រាស់បានសំរាប់ទំរង់ទាំងអស់ នៃ Inheritance ៖

Base class visibility	Derived class visibility		
	Public	Private	Protected
Private	Not Inherited	Not Inherited	Not Inherited
Protected	Protected	Private	Protected
Public	Public	Private	Protected

1.1. Single Inheritance: គឺជាប្រភេទ Inheritance ដែលមាន Base Class មួយ និង Sub Class អាចមាន១ ឬ ច្រើន។

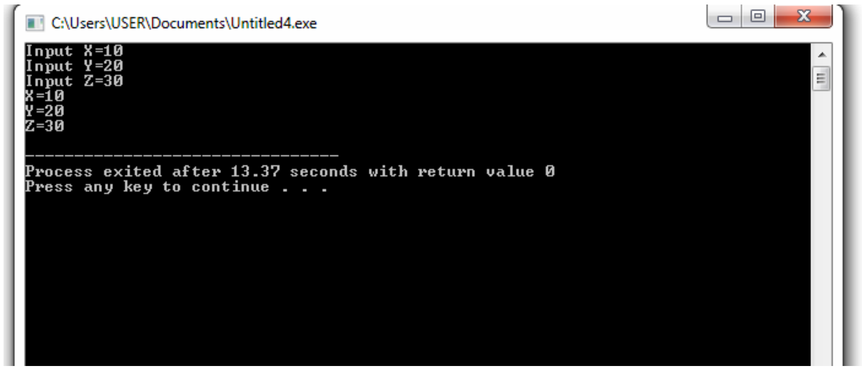
ឧទាហរណ៍ ១



```
#include<iostream>
using namespace std;
class Test1{
    protected:
     int x;
     int y;
};
class Test2:public Test1{
    private:
    int z;
    public:
        void Input()
        {
            cout<<"Input X=";cin>>x;
            cout<<"Input Y=";cin>>y;
            cout<<"Input Z=";cin>>z;
        }
        void Output()
        {
            cout<<"X="<<x<<endl;
            cout<<"Y="<<y<<endl;
            cout<<"Z="<<z<<endl;
        }
};
  int main()
  {
    Test2 obj2;
    obj2.Input();
    obj2.Output();
  }
```

`

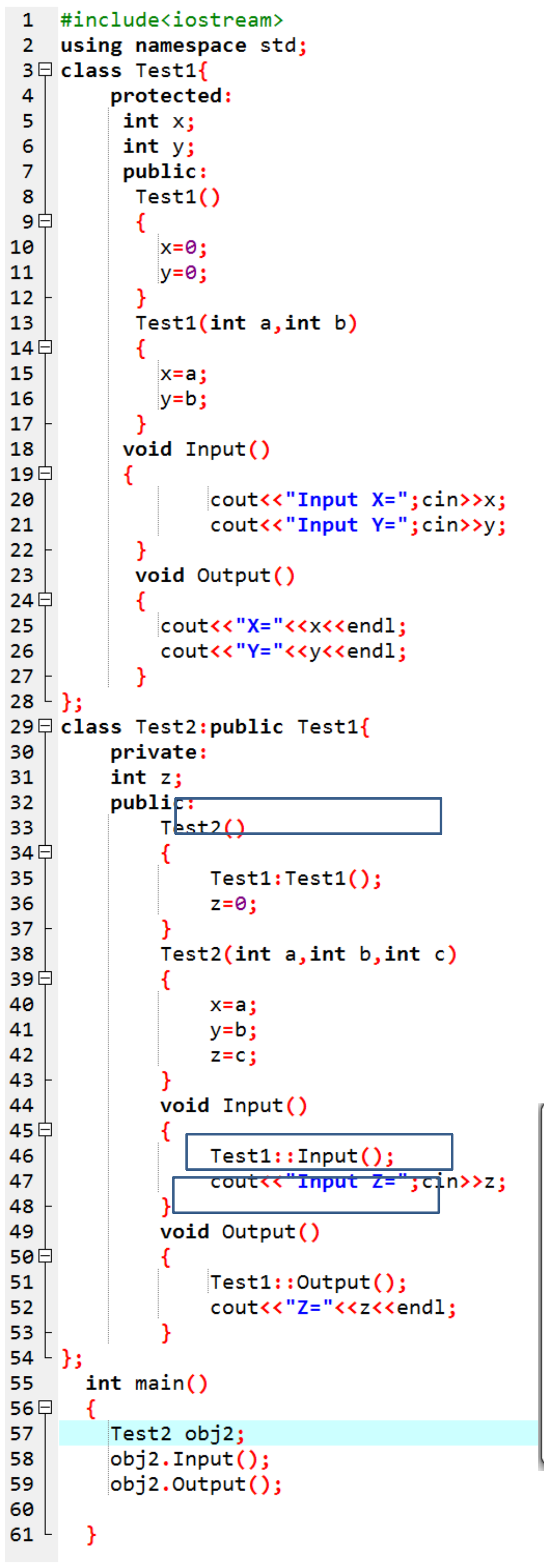
លទ្ធផលទទួលបាន៖



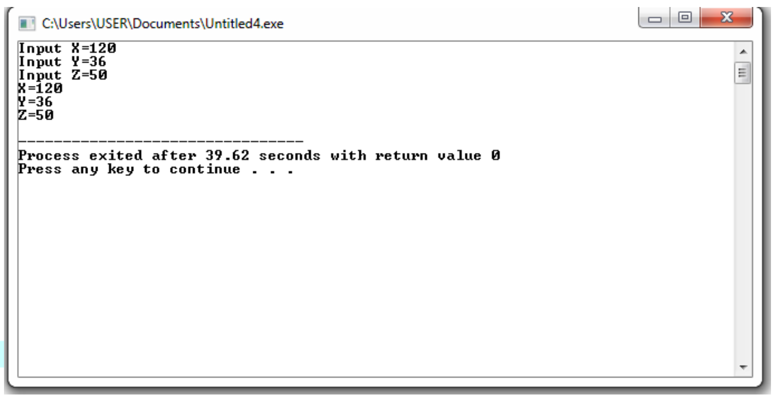
C:\Users\USER\Documents\Untitled4.exe

```
Input X=10
Input Y=20
Input Z=30
X=10
Y=20
Z=30

--------------------------------
Process exited after 13.37 seconds with return value 0
Press any key to continue . . .
```

ឧទាហរណ៍ ២៖



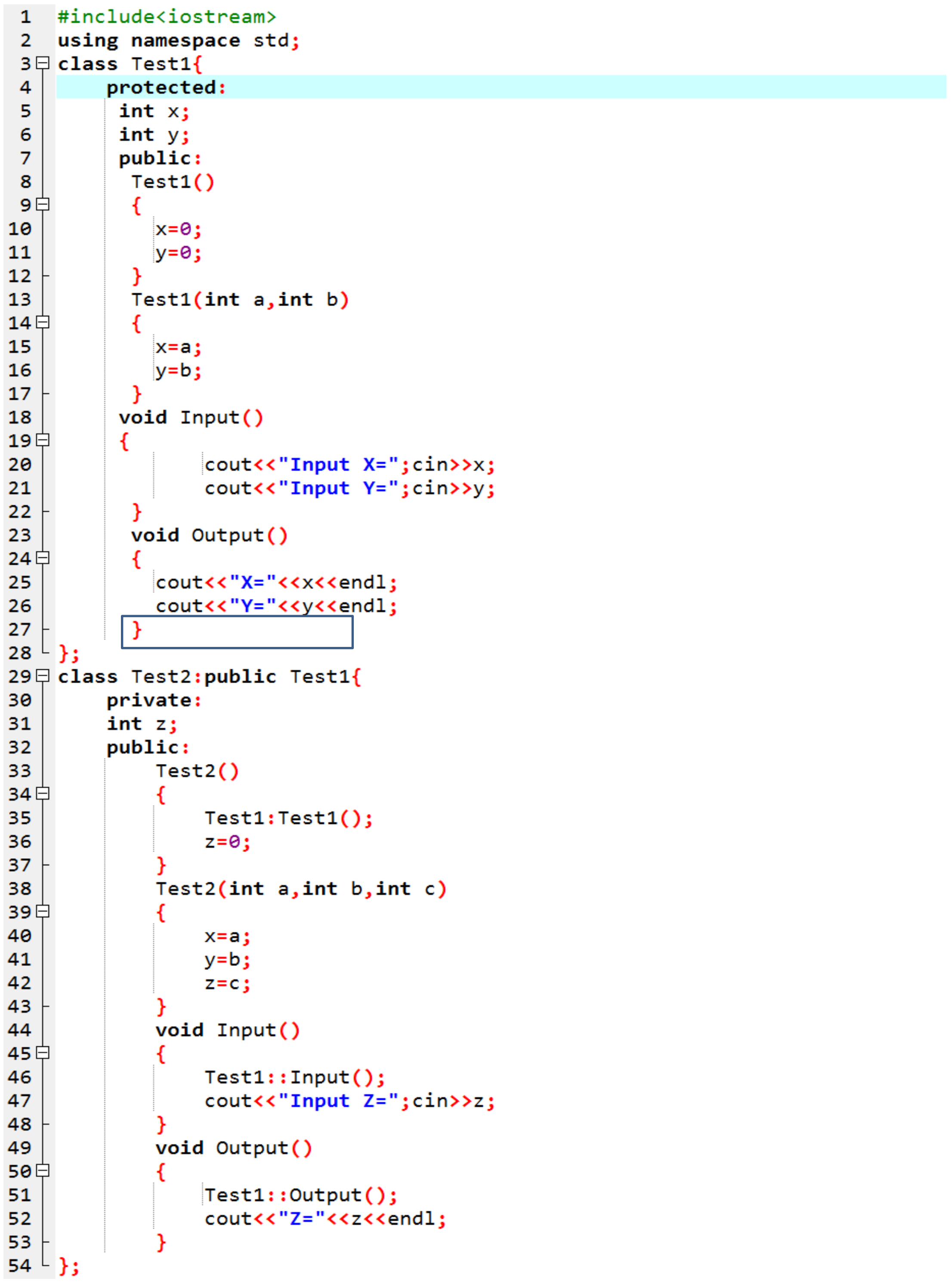
```cpp
#include<iostream>
using namespace std;
class Test1{
    protected:
     int x;
     int y;
     public:
      Test1()
      {
        x=0;
        y=0;
      }
      Test1(int a,int b)
      {
        x=a;
        y=b;
      }
     void Input()
     {
            cout<<"Input X=";cin>>x;
            cout<<"Input Y=";cin>>y;
      }
      void Output()
      {
        cout<<"X="<<x<<endl;
        cout<<"Y="<<y<<endl;
      }
};
class Test2:public Test1{
    private:
    int z;
    public:
        Test2()
        {
            Test1:Test1();
            z=0;
        }
        Test2(int a,int b,int c)
        {
            x=a;
            y=b;
            z=c;
        }
        void Input()
        {
            Test1::Input();
            cout<<"Input Z=";cin>>z;
        }
        void Output()
        {
            Test1::Output();
            cout<<"Z="<<z<<endl;
        }
};
  int main()
  {
    Test2 obj2;
    obj2.Input();
    obj2.Output();

  }
```



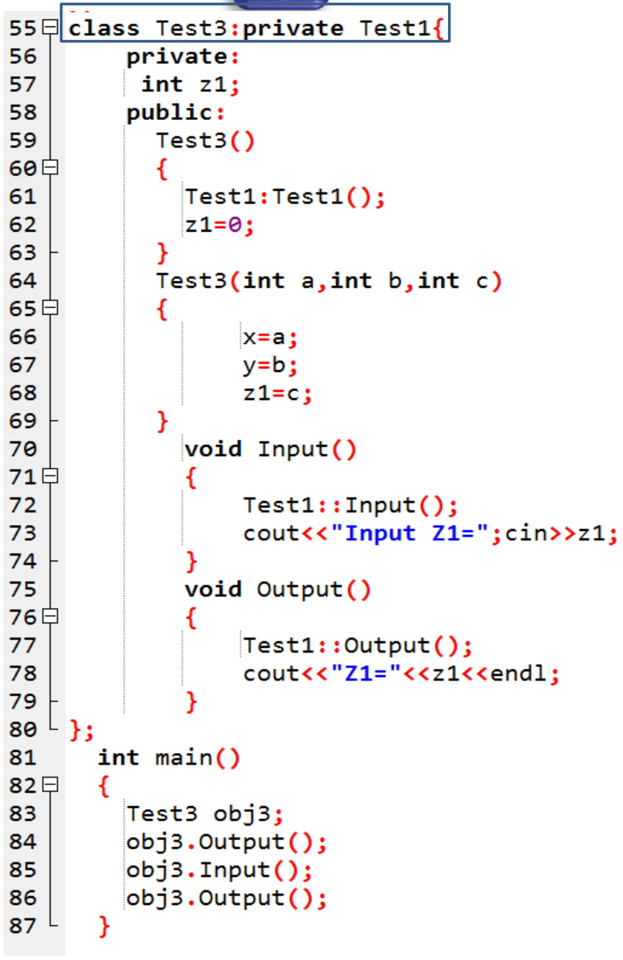
C:\Users\USER\Documents\Untitled4.exe

```
Input X=120
Input Y=36
Input Z=50
X=120
Y=36
Z=50

--------------------------------
Process exited after 39.62 seconds with return value 0
Press any key to continue . . .
```

ឧទាហរណ៍ ៣៖

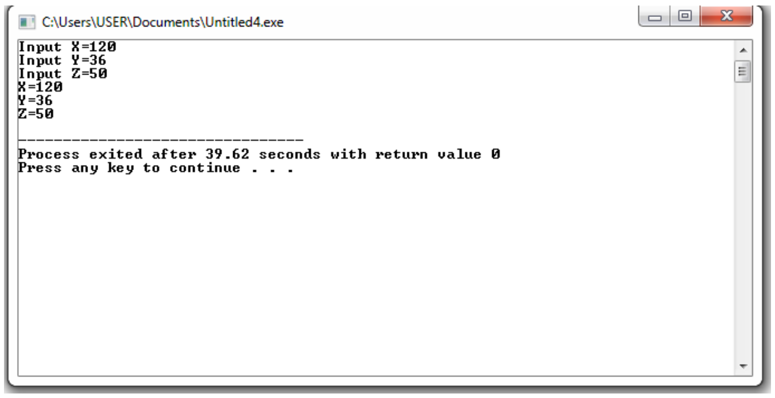


```cpp
#include<iostream>
using namespace std;
class Test1{
    protected:
     int x;
     int y;
     public:
      Test1()
      {
        x=0;
        y=0;
      }
      Test1(int a,int b)
      {
        x=a;
        y=b;
      }
     void Input()
     {
            cout<<"Input X=";cin>>x;
            cout<<"Input Y=";cin>>y;
      }
      void Output()
      {
        cout<<"X="<<x<<endl;
        cout<<"Y="<<y<<endl;
      }
};
class Test2:public Test1{
    private:
    int z;
    public:
        Test2()
        {
            Test1:Test1();
            z=0;
        }
        Test2(int a,int b,int c)
        {
            x=a;
            y=b;
            z=c;
        }
        void Input()
        {
            Test1::Input();
            cout<<"Input Z=";cin>>z;
        }
        void Output()
        {
            Test1::Output();
            cout<<"Z="<<z<<endl;
        }
};
```



```
class Test3:private Test1{
    private:
     int z1;
    public:
      Test3()
      {
        Test1:Test1();
        z1=0;
      }
      Test3(int a,int b,int c)
      {
            x=a;
            y=b;
            z1=c;
      }
        void Input()
        {
            Test1::Input();
            cout<<"Input Z1=";cin>>z1;
        }
        void Output()
        {
            Test1::Output();
            cout<<"Z1="<<z1<<endl;
        }
};
  int main()
  {
    Test3 obj3;
    obj3.Output();
    obj3.Input();
    obj3.Output();
  }
```

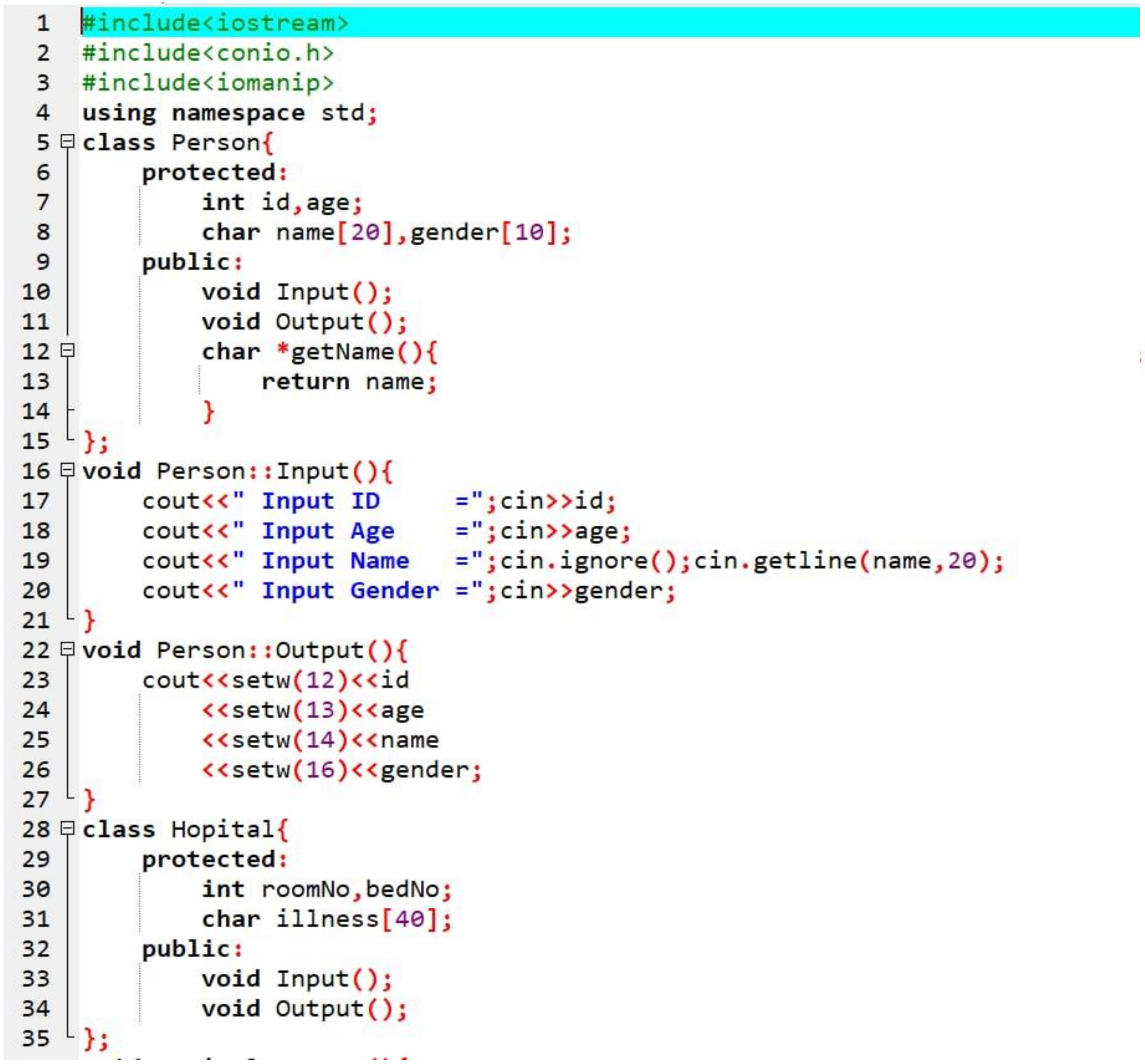
លទ្ធផលទទួលបាន៖



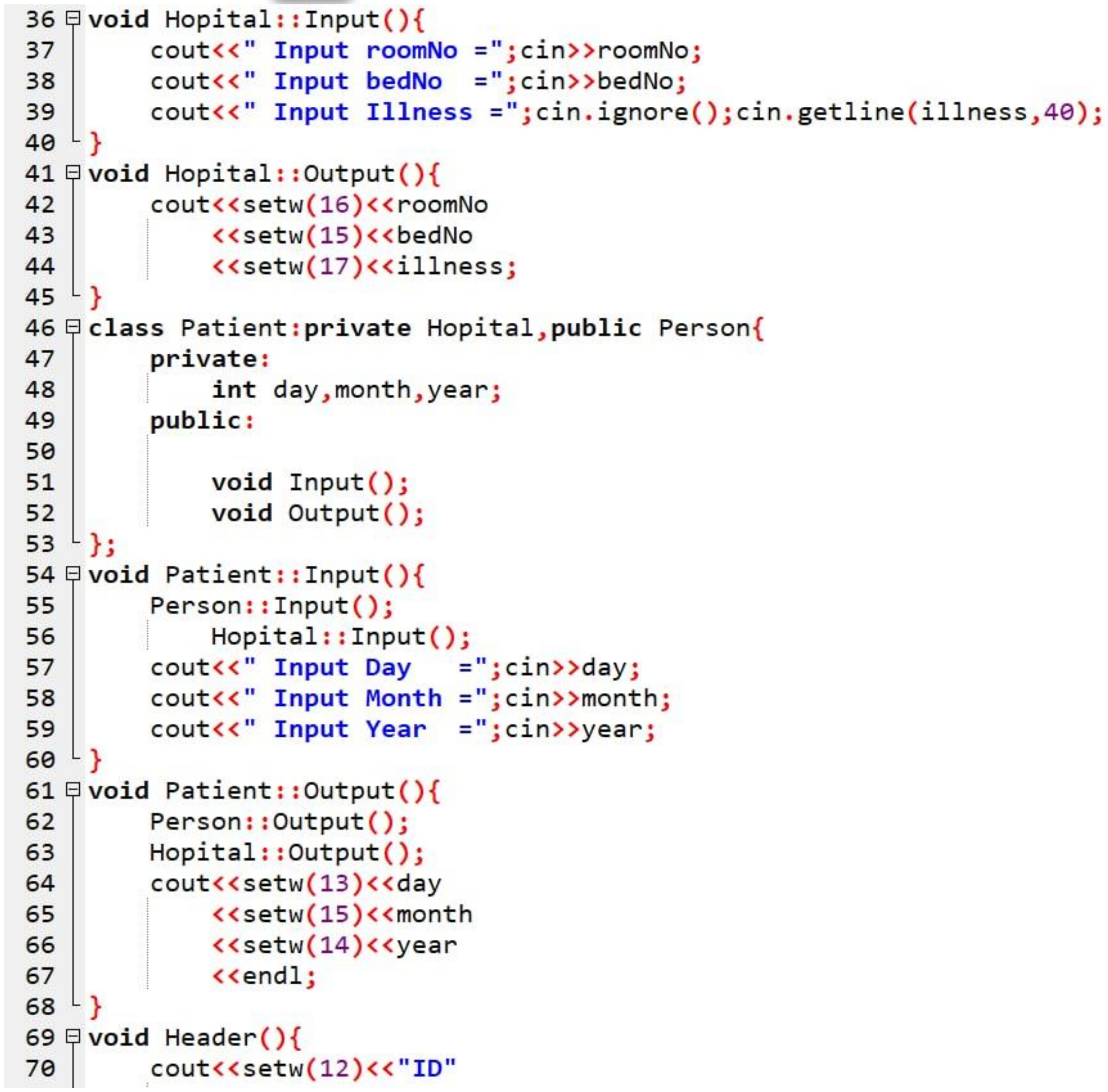
C:\Users\USER\Documents\Untitled4.exe

```
Input X=120
Input Y=36
Input Z=50
X=120
Y=36
Z=50

--------------------------------
Process exited after 39.62 seconds with return value 0
Press any key to continue . . .
```

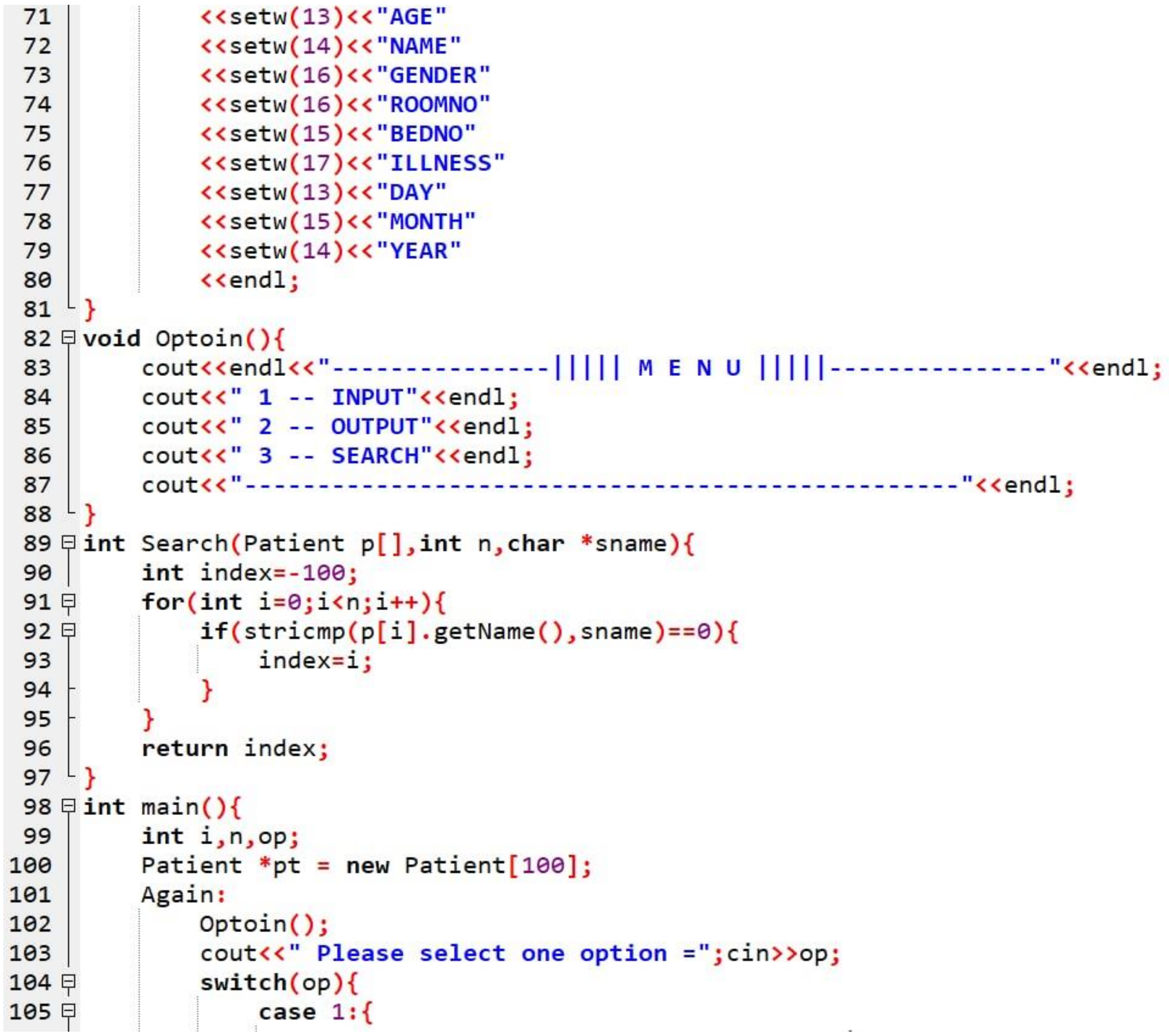
ឧទាហរណ៏ ៤៖



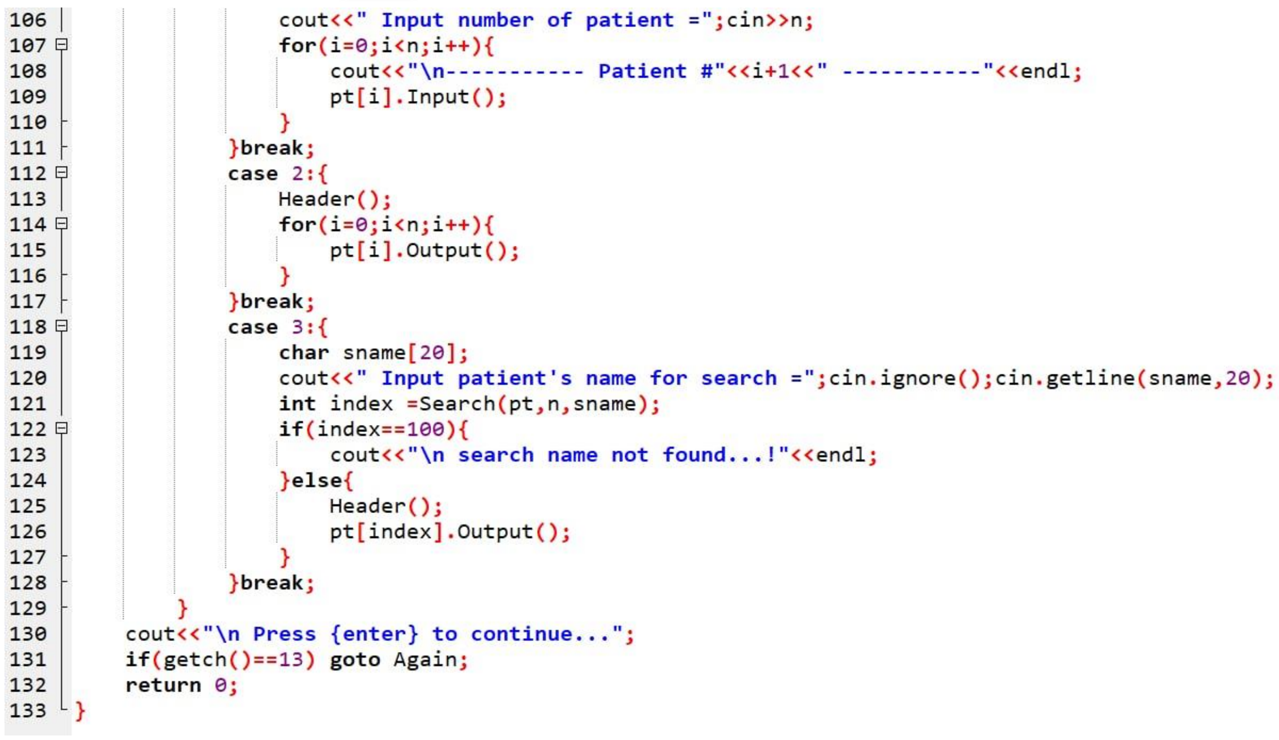
```
#include<iostream>
#include<conio.h>
#include<iomanip>
using namespace std;
class Person{
    protected:
        int id,age;
        char name[20],gender[10];
    public:
        void Input();
        void Output();
        char *getName(){
            return name;
        }
};
void Person::Input(){
    cout<<" Input ID     =";cin>>id;
    cout<<" Input Age    =";cin>>age;
    cout<<" Input Name   =";cin.ignore();cin.getline(name,20);
    cout<<" Input Gender =";cin>>gender;
}
void Person::Output(){
    cout<<setw(12)<<id
        <<setw(13)<<age
        <<setw(14)<<name
        <<setw(16)<<gender;
}
class Hopital{
    protected:
        int roomNo,bedNo;
        char illness[40];
    public:
        void Input();
        void Output();
};
```



```cpp
void Hopital::Input(){
    cout<<" Input roomNo =";cin>>roomNo;
    cout<<" Input bedNo  =";cin>>bedNo;
    cout<<" Input Illness =";cin.ignore();cin.getline(illness,40);
}
void Hopital::Output(){
    cout<<setw(16)<<roomNo
        <<setw(15)<<bedNo
        <<setw(17)<<illness;
}
class Patient:private Hopital,public Person{
    private:
        int day,month,year;
    public:

        void Input();
        void Output();
};
void Patient::Input(){
    Person::Input();
        Hopital::Input();
    cout<<" Input Day    =";cin>>day;
    cout<<" Input Month =";cin>>month;
    cout<<" Input Year   =";cin>>year;
}
void Patient::Output(){
    Person::Output();
    Hopital::Output();
    cout<<setw(13)<<day
        <<setw(15)<<month
        <<setw(14)<<year
        <<endl;
}
void Header(){
    cout<<setw(12)<<"ID"
```



```cpp
        <<setw(13)<<"AGE"
        <<setw(14)<<"NAME"
        <<setw(16)<<"GENDER"
        <<setw(16)<<"ROOMNO"
        <<setw(15)<<"BEDNO"
        <<setw(17)<<"ILLNESS"
        <<setw(13)<<"DAY"
        <<setw(15)<<"MONTH"
        <<setw(14)<<"YEAR"
        <<endl;
}
void Optoin(){
    cout<<endl<<"---------------|||||  M E N U  |||||---------------"<<endl;
    cout<<" 1 -- INPUT"<<endl;
    cout<<" 2 -- OUTPUT"<<endl;
    cout<<" 3 -- SEARCH"<<endl;
    cout<<"-------------------------------------------------"<<endl;
}
int Search(Patient p[],int n,char *sname){
    int index=-100;
    for(int i=0;i<n;i++){
        if(stricmp(p[i].getName(),sname)==0){
            index=i;
        }
    }
    return index;
}
int main(){
    int i,n,op;
    Patient *pt = new Patient[100];
    Again:
        Optoin();
        cout<<" Please select one option =";cin>>op;
        switch(op){
            case 1:{
```



```
            cout<<" Input number of patient =";cin>>n;
            for(i=0;i<n;i++){
                cout<<"\n----------- Patient #"<<i+1<<" -----------"<<endl;
                pt[i].Input();
            }
        }break;
        case 2:{
            Header();
            for(i=0;i<n;i++){
                pt[i].Output();
            }
        }break;
        case 3:{
            char sname[20];
            cout<<" Input patient's name for search =";cin.ignore();cin.getline(sname,20);
            int index =Search(pt,n,sname);
            if(index==100){
                cout<<"\n search name not found...!"<<endl;
            }else{
                Header();
                pt[index].Output();
            }
        }break;
    }
    cout<<"\n Press {enter} to continue...";
    if(getch()==13) goto Again;
    return 0;
}
```

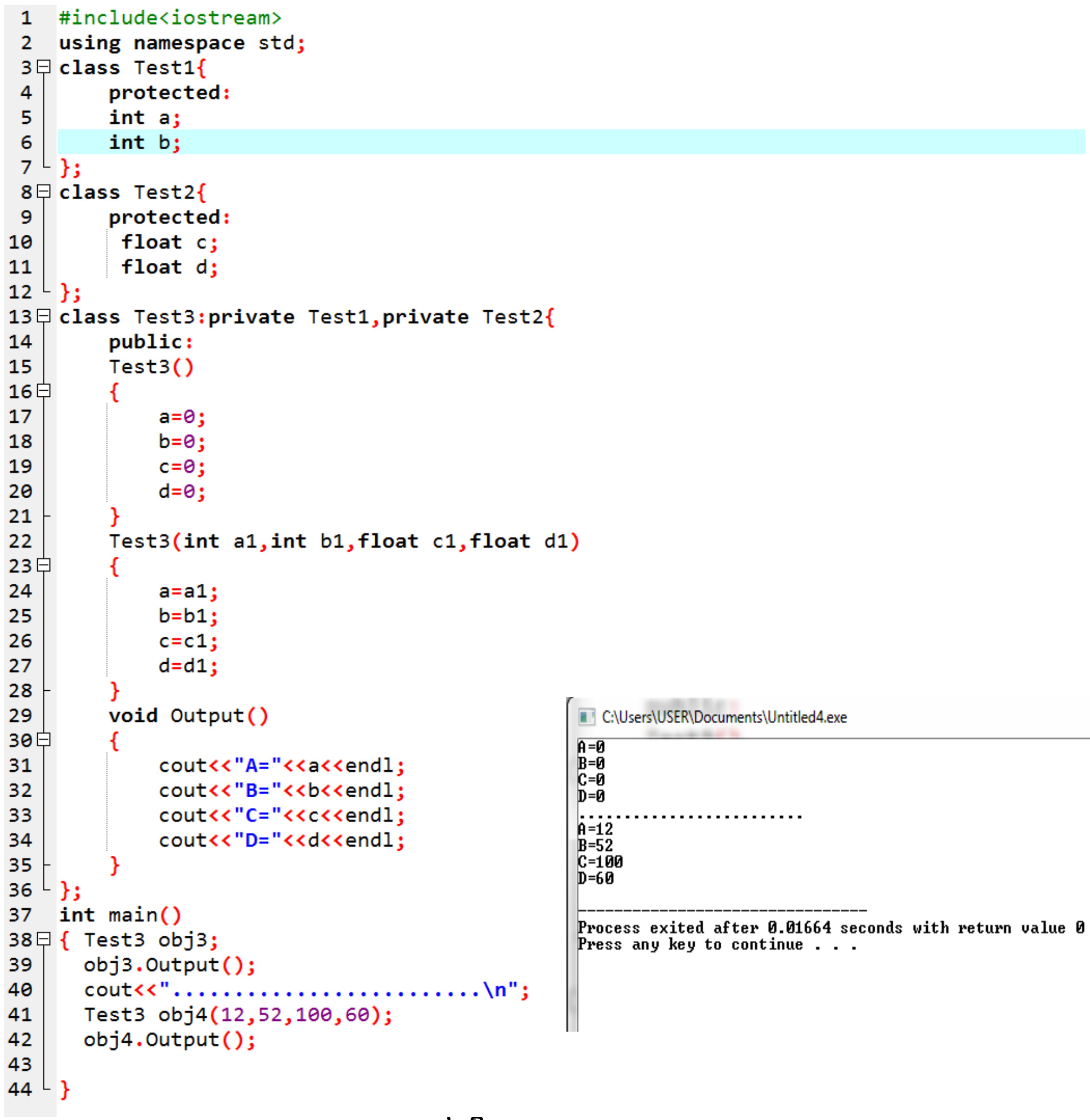
នៅក្នុង Single Inheritance គេបែងចែកជា ពីរប្រភេទទៀត គឺ៖

១) Direct Class(Sub Class to direct Base Class)

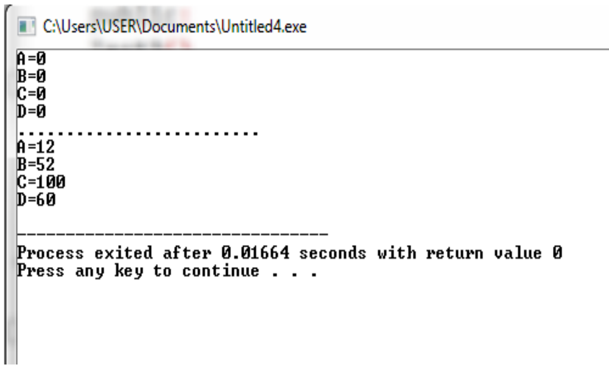
២) InDirect Class(Sub Class to Sub Class to Base Class) មានក្នុង Multi-level

1.2. Multiple Inheritance: គឺជាប្រភេទ Inheritance មួយប្រភេទទៀតដែលគេអាចបង្កើតនូវ Base Class ពីរ ឬច្រើន បន្ទាប់មក Sub Class មួយរឺ ច្រើនអាចទាញយកទិន្នន័យពី Base Class ទាំងនោះបាន។

ឧទាហរណ៏ ១៖ ចូរបង្កើតនូវ Base Class ពីរ និង Sub Class ចំនួន ១ដោយទាញទិន្នន័យពី Base Class ទាំងពីរ ?



```cpp
#include<iostream>
using namespace std;
class Test1{
	protected:
	int a;
	int b;
};
class Test2{
	protected:
	 float c;
	 float d;
};
class Test3:private Test1,private Test2{
	public:
	Test3()
	{
		a=0;
		b=0;
		c=0;
		d=0;
	}
	Test3(int a1,int b1,float c1,float d1)
	{
		a=a1;
		b=b1;
		c=c1;
		d=d1;
	}
	void Output()
	{
		cout<<"A="<<a<<endl;
		cout<<"B="<<b<<endl;
		cout<<"C="<<c<<endl;
		cout<<"D="<<d<<endl;
	}
};
int main()
{ Test3 obj3;
  obj3.Output();
  cout<<"........................\n";
  Test3 obj4(12,52,100,60);
  obj4.Output();

}
```



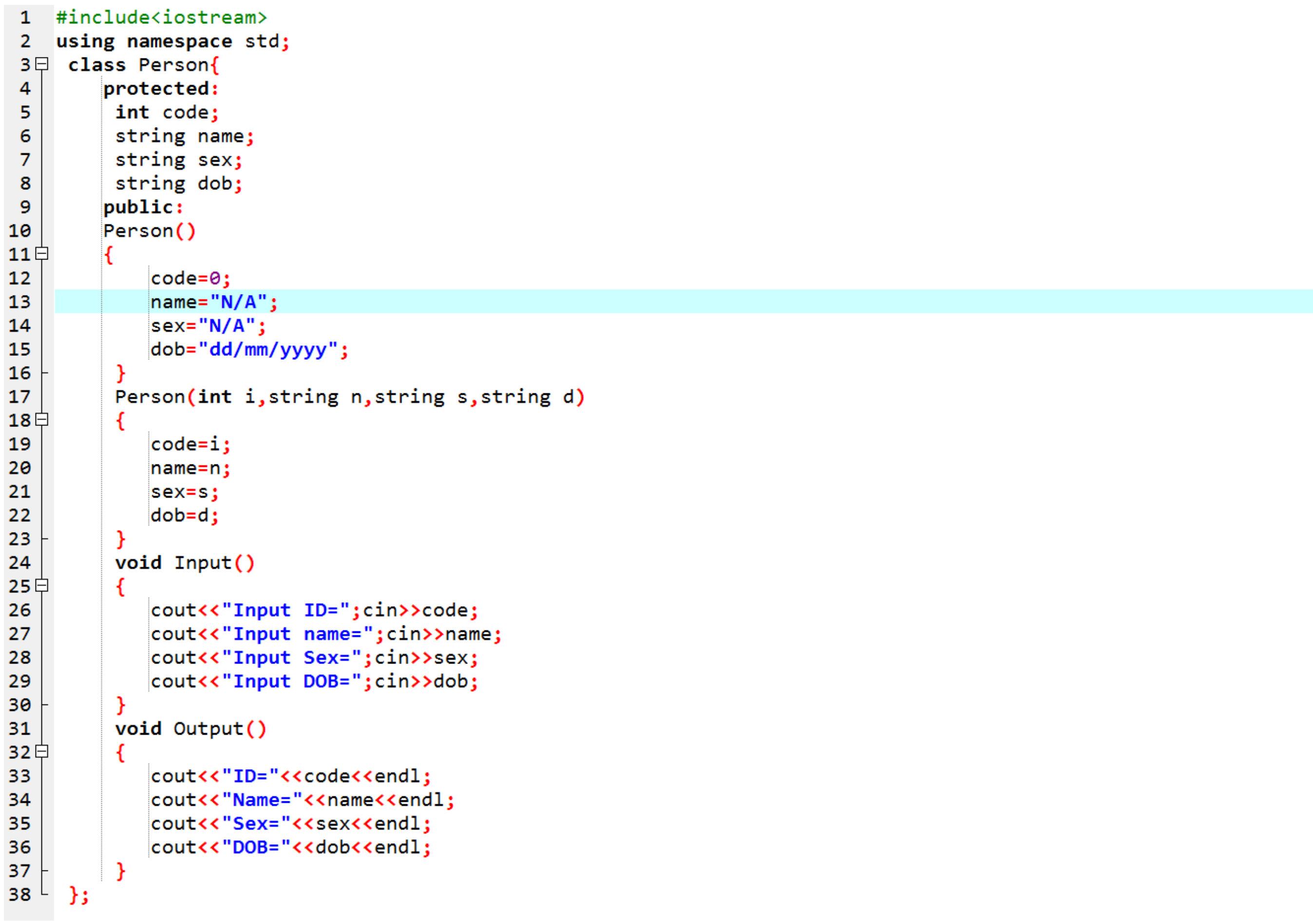
C:\Users\USER\Documents\Untitled4.exe

```
A=0
B=0
C=0
D=0
........................
A=12
B=52
C=100
D=60

--------------------------------
Process exited after 0.01664 seconds with return value 0
Press any key to continue . . .
```

១) ចូរបង្កើត Class មួយឈ្មោះ Person ដែលមាន Data member ដូចជា ID(int), Name(String), Sex(String), DOB(String), Constructor ពីរគឺ Person( ), Person(_,_,_,_) និង Method ចំនួនពីរ ដូចជា void Input( ) និង void Output( ) បន្ទាប់មកបង្កើតobject មួយ ?

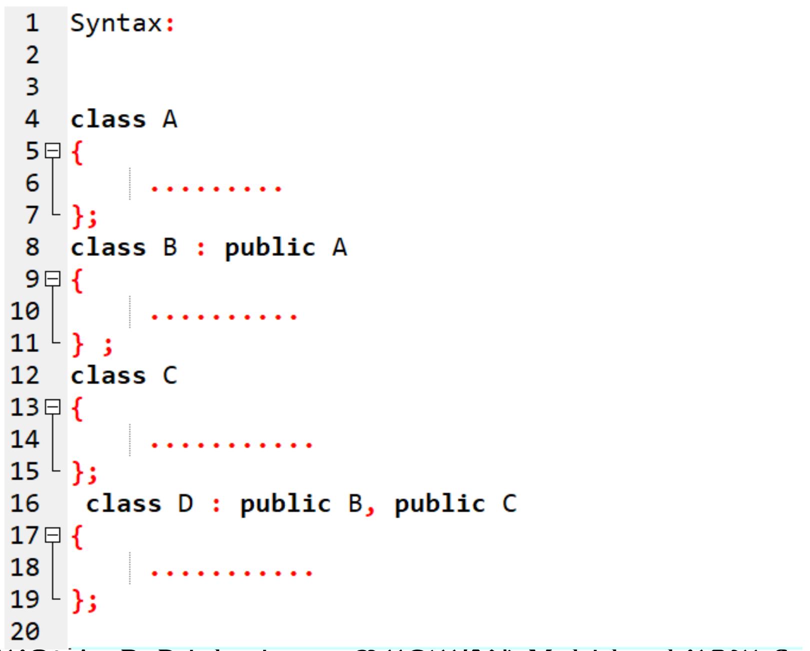
២) តពីលេខ១ ចូរបង្កើត class ចំនួនពីរទៀតគឺ Employee និង Students ហើយហៅទិន្នន័យពី Class Person មកប្រើបន្ទាប់មកបង្កើត Object នៃ Class ទាំងពីរ មកប្រើប្រាស់វា។

គេអោយ Base Class ដូចខាងក្រោម៖



```cpp
#include<iostream>
using namespace std;
 class Person{
    protected:
     int code;
     string name;
     string sex;
     string dob;
    public:
    Person()
    {
        code=0;
        name="N/A";
        sex="N/A";
        dob="dd/mm/yyyy";
     }
     Person(int i,string n,string s,string d)
     {
        code=i;
        name=n;
        sex=s;
        dob=d;
     }
     void Input()
     {
        cout<<"Input ID=";cin>>code;
        cout<<"Input name=";cin>>name;
        cout<<"Input Sex=";cin>>sex;
        cout<<"Input DOB=";cin>>dob;
     }
     void Output()
     {
        cout<<"ID="<<code<<endl;
        cout<<"Name="<<name<<endl;
        cout<<"Sex="<<sex<<endl;
        cout<<"DOB="<<dob<<endl;
     }
 };
```

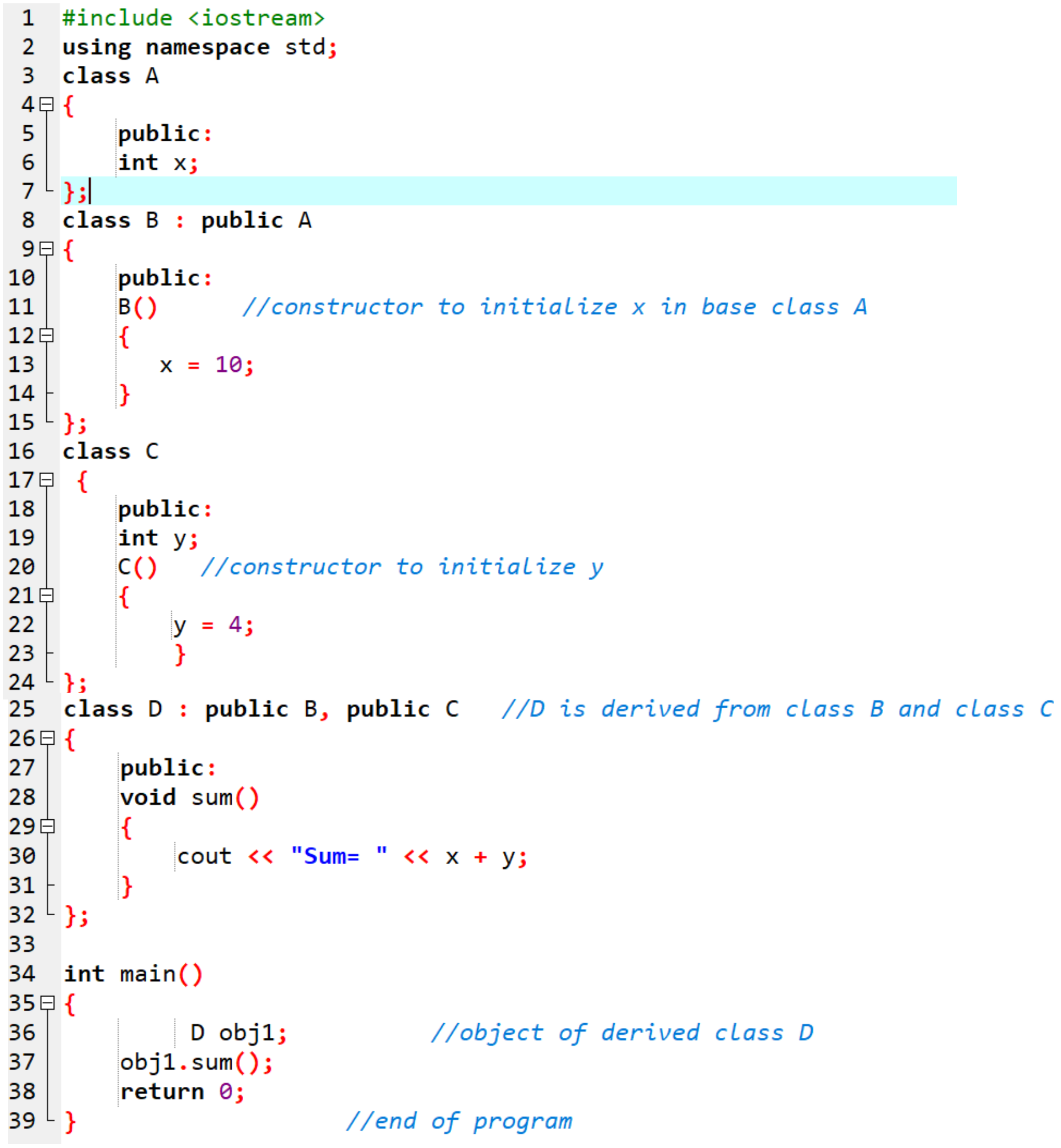
1.3. Hybrid Inheritance: គឺជាប្រភេទ នៃ Inheritance មួយបែបទៀតរបស់ OOP ក្នុង C++ ដែលវាអាចអនុញ្ញាតិអោយមានការទាញយកទិន្នន័យពី Base Class បន្តគ្នាពោលពី Base Class មួយទៅកាន់ Base Class មួយផ្សេងទៀត រហូតដល់ Derived Class។ Hybrid មានន័យថា គន្លងនៃការ Inheritance នោះមានលក្ខណៈ ពីររួមតែមួយ ។



```
Syntax:


class A
{
        .........
};
class B : public A
{
        ..........
} ;
class C
{
        ...........
};
 class D : public B, public C
{
        ...........
};

```

(ក្នុងរូបនេះ A , B ,D inheritance តាមទម្រង់ជា Multi-level ហើយ C , B ,D inheritance តាមទម្រង់ ជា Multiple ហេតុនេះបើសរុបមក A,B,C,D មានលក្ខណៈ Hybrid ព្រោះវាមានពីរលក្ខណៈ Multi-levelនិង Multiple)

ឧទាហរណ៍ ១៖



```
#include <iostream>
using namespace std;
class A
{
    public:
    int x;
};
class B : public A
{
    public:
    B()      //constructor to initialize x in base class A
    {
        x = 10;
    }
};
class C
 {
    public:
    int y;
    C()   //constructor to initialize y
    {
        y = 4;
        }
};
class D : public B, public C   //D is derived from class B and class C
{
    public:
    void sum()
    {
        cout << "Sum= " << x + y;
    }
};

int main()
{
        D obj1;          //object of derived class D
    obj1.sum();
    return 0;
}                    //end of program
```

Build your IT Skill

ណែនាំ Polymorphism of C++ Programming

២០២៣

ណែនាំអោយស្គាល់ពី Polymorphism

I. អ្វីទៅដែលហៅថា Polymorphism ?

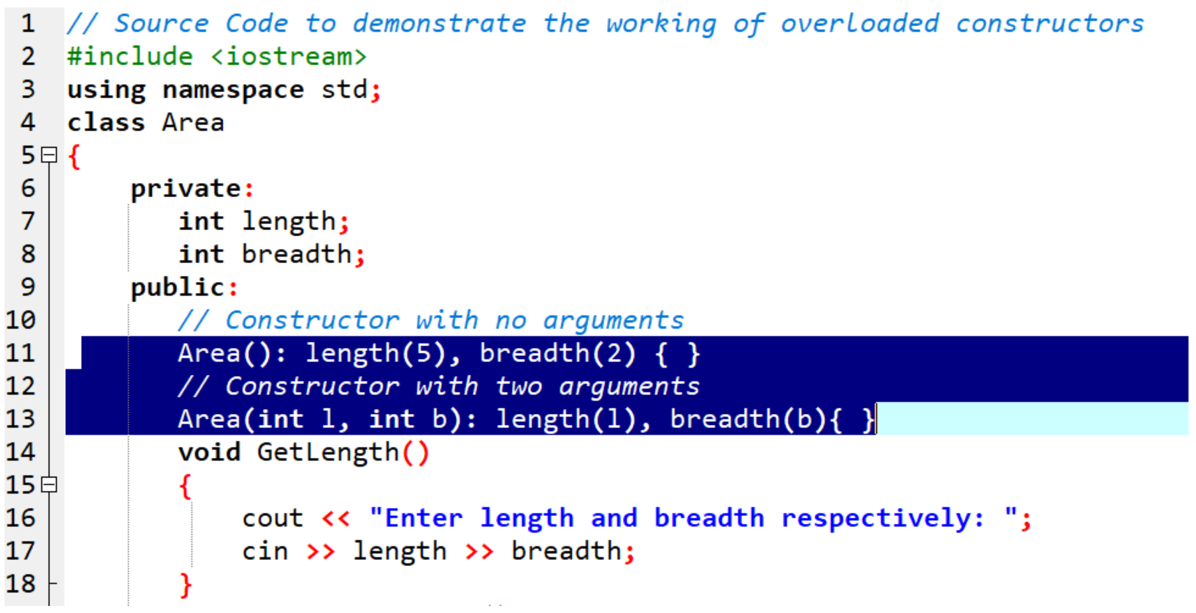
ពាក្យថា Polymorphism គឺមកពីភាសាក្រិចដែលហៅថា (Poly+Mophism: ទំរង់ច្រើន) ចង់សំដៅ លើចំនុច សំខាន់ពី លើ Method និង object របស់ Class។

នៅក្នុងចំនុចនេះអ្នកនិងសិក្សាលើ ៣ចំនុចសំខាន់ដូចជា៖

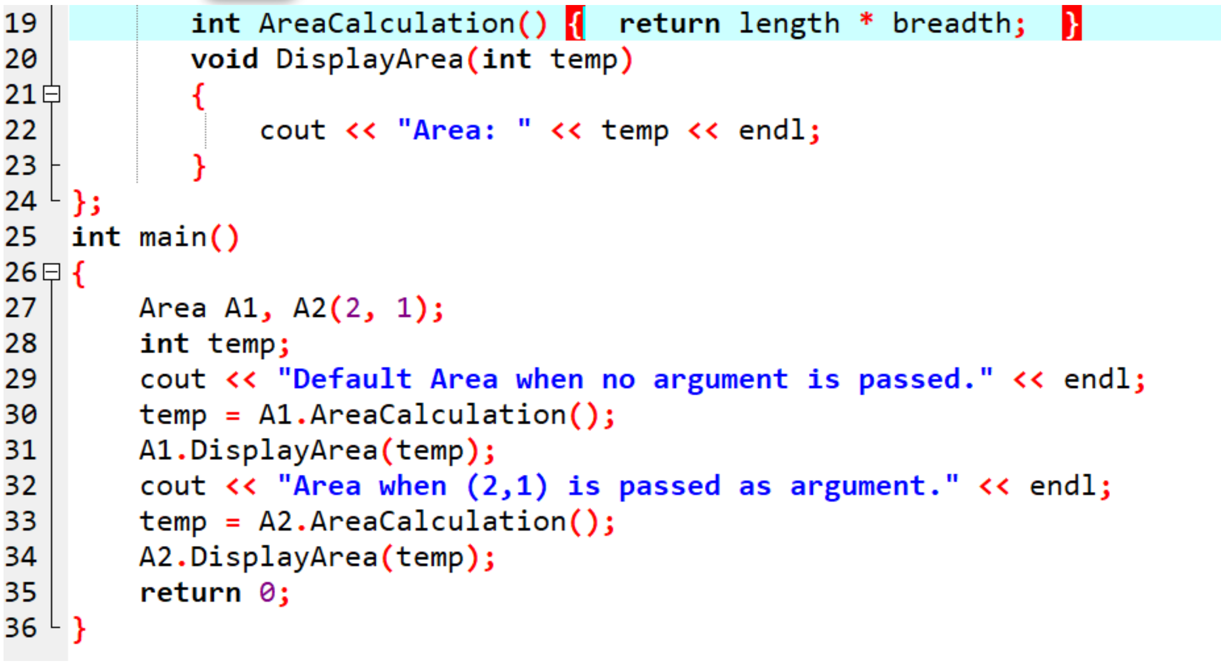
១) Overloading Constructor, Function & Operator
២) Overriding Methods/Abstract Class
៣) Template Function & Template Class
៤) Early Binding/Compile Time Binding និង Late Binding/Run Time Binding

1. Overloading Constructor: គឺជាការបង្កើតនូវ Constructor មានចាប់ពីរឡើងទៅ ដែលខុសគ្នាត្រង់ចំនួន Parameter ដែលមានក្នុង Constructor ទាំងនោះ។

ឧទាហរណ៍ ១៖

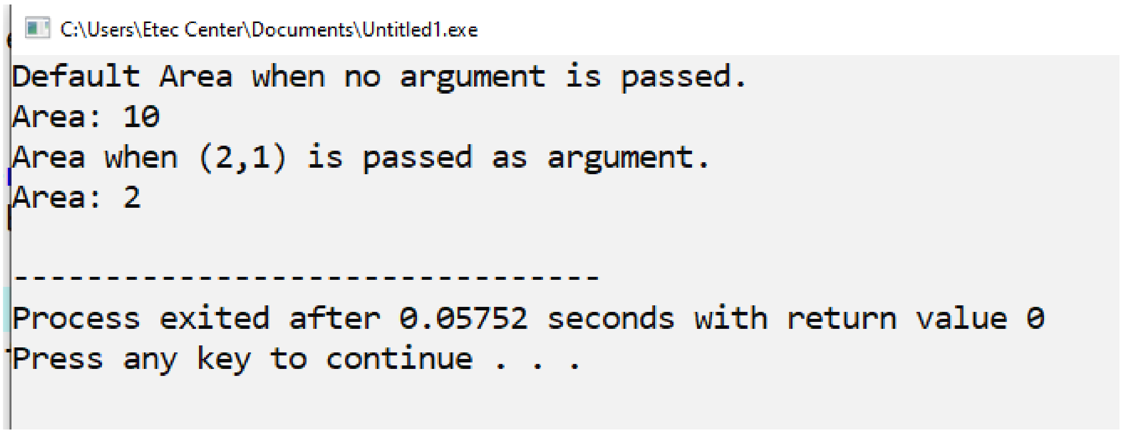


```
// Source Code to demonstrate the working of overloaded constructors
#include <iostream>
using namespace std;
class Area
{
    private:
       int length;
       int breadth;
    public:
       // Constructor with no arguments
       Area(): length(5), breadth(2) { }
       // Constructor with two arguments
       Area(int l, int b): length(l), breadth(b){ }
       void GetLength()
       {
           cout << "Enter length and breadth respectively: ";
           cin >> length >> breadth;
       }
```



```
        int AreaCalculation() {  return length * breadth;  }
        void DisplayArea(int temp)
        {
            cout << "Area: " << temp << endl;
        }
};
int main()
{
    Area A1, A2(2, 1);
    int temp;
    cout << "Default Area when no argument is passed." << endl;
    temp = A1.AreaCalculation();
    A1.DisplayArea(temp);
    cout << "Area when (2,1) is passed as argument." << endl;
    temp = A2.AreaCalculation();
    A2.DisplayArea(temp);
    return 0;
}
```

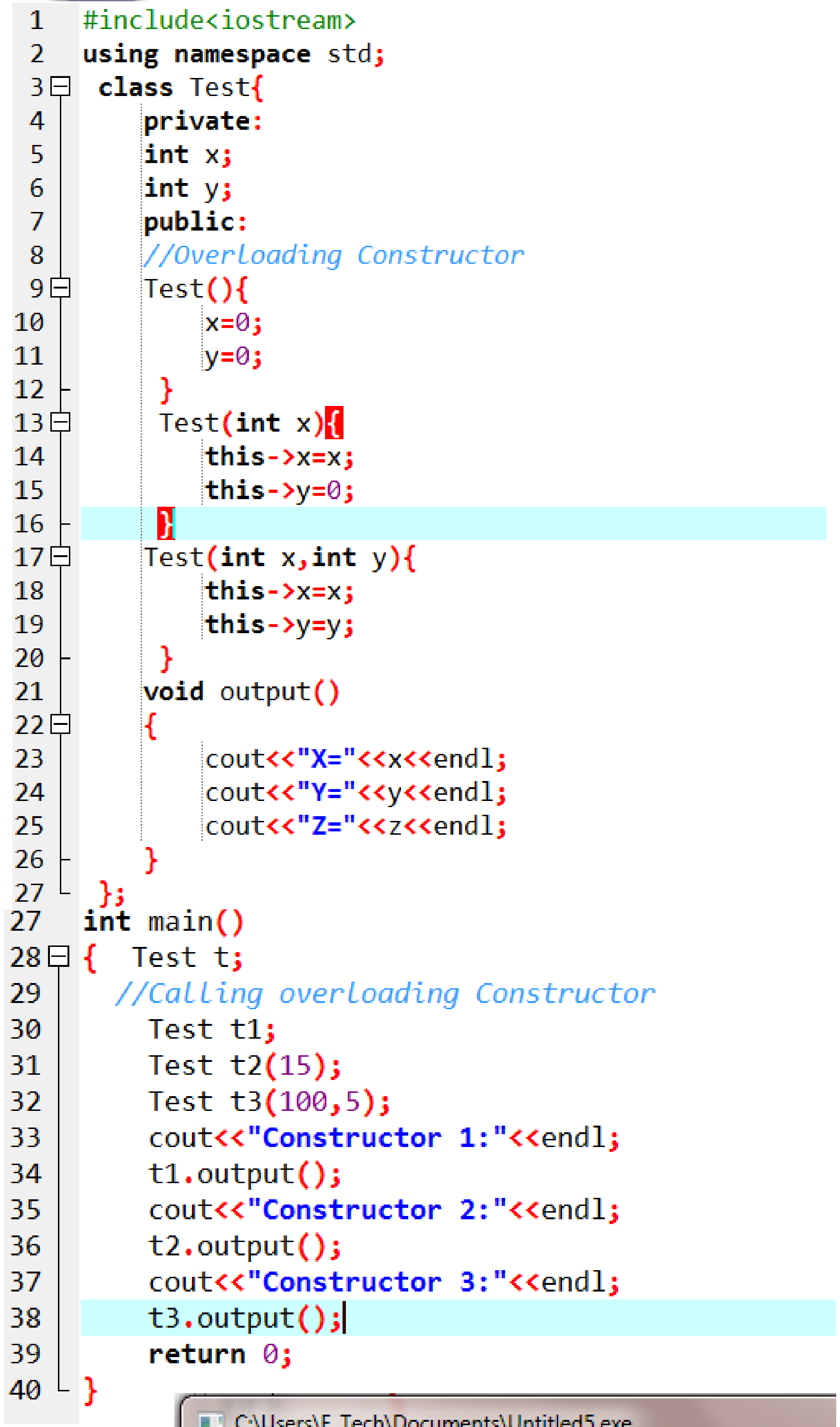
លទ្ធផលទទួលបាន៖



C:\Users\Etec Center\Documents\Untitled1.exe

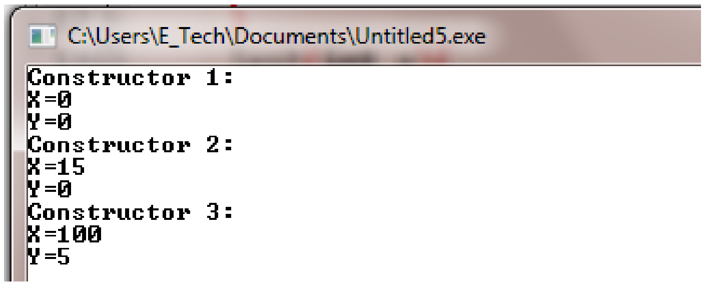
```
Default Area when no argument is passed.
Area: 10
Area when (2,1) is passed as argument.
Area: 2

--------------------------------
Process exited after 0.05752 seconds with return value 0
Press any key to continue . . .
```

ឧទាហរណ៍ ២ ៖



```cpp
#include<iostream>
using namespace std;
 class Test{
    private:
    int x;
    int y;
    public:
    //Overloading Constructor
    Test(){
        x=0;
        y=0;
     }
     Test(int x){
        this->x=x;
        this->y=0;
     }
    Test(int x,int y){
        this->x=x;
        this->y=y;
     }
    void output()
    {
        cout<<"X="<<x<<endl;
        cout<<"Y="<<y<<endl;
        cout<<"Z="<<z<<endl;
    }
 };
int main()
{   Test t;
  //Calling overloading Constructor
    Test t1;
    Test t2(15);
    Test t3(100,5);
    cout<<"Constructor 1:"<<endl;
    t1.output();
    cout<<"Constructor 2:"<<endl;
    t2.output();
    cout<<"Constructor 3:"<<endl;
    t3.output();
    return 0;
}
```

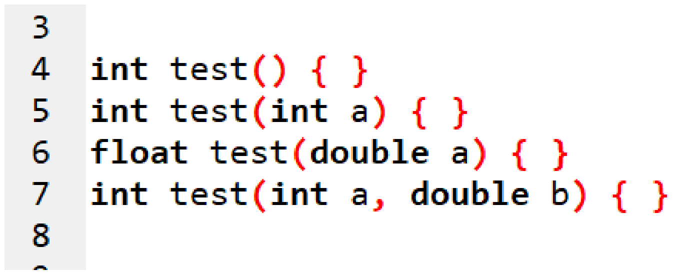
លទ្ធផលទទួលបាន៖



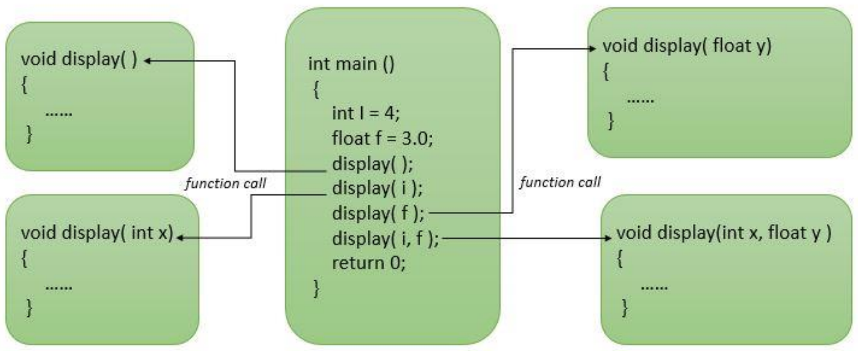
C:\Users\E_Tech\Documents\Untitled5.exe

```
Constructor 1:
X=0
Y=0
Constructor 2:
X=15
Y=0
Constructor 3:
X=100
Y=5
```

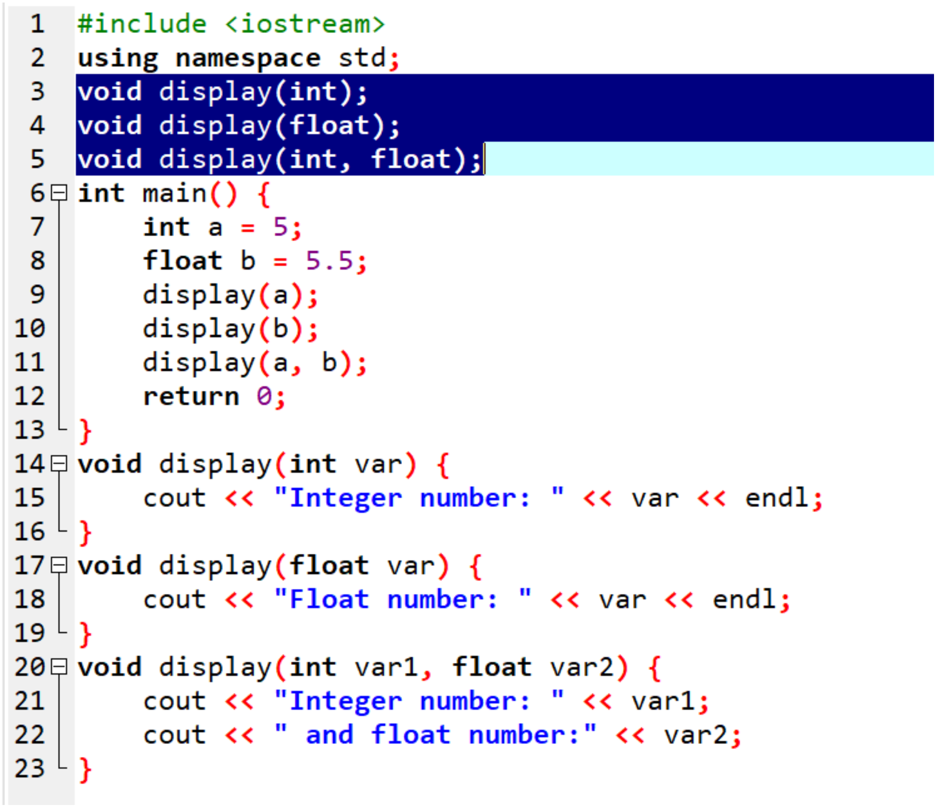
1.2. **Overloading Function** គឺជាប្រភេទ **Function** ដែលបង្កើតឡើង ដោយមានឈ្មោះដូចគ្នាចាប់ពីរឡើងទៅ តែត្រូវតែមានភាពខុសគ្នាត្រង់ចំនួន **Parameter** របស់ **Function** ។



```cpp

int test() { }
int test(int a) { }
float test(double a) { }
int test(int a, double b) { }

```

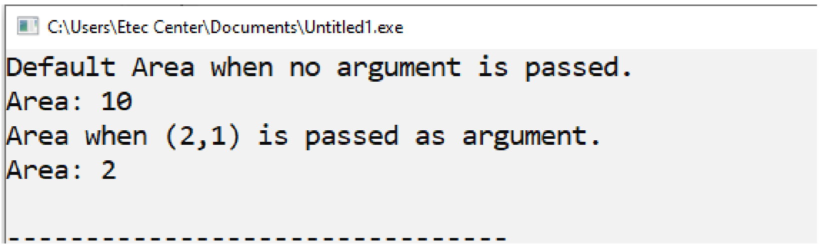


ឧទាហរណ៍ ១៖

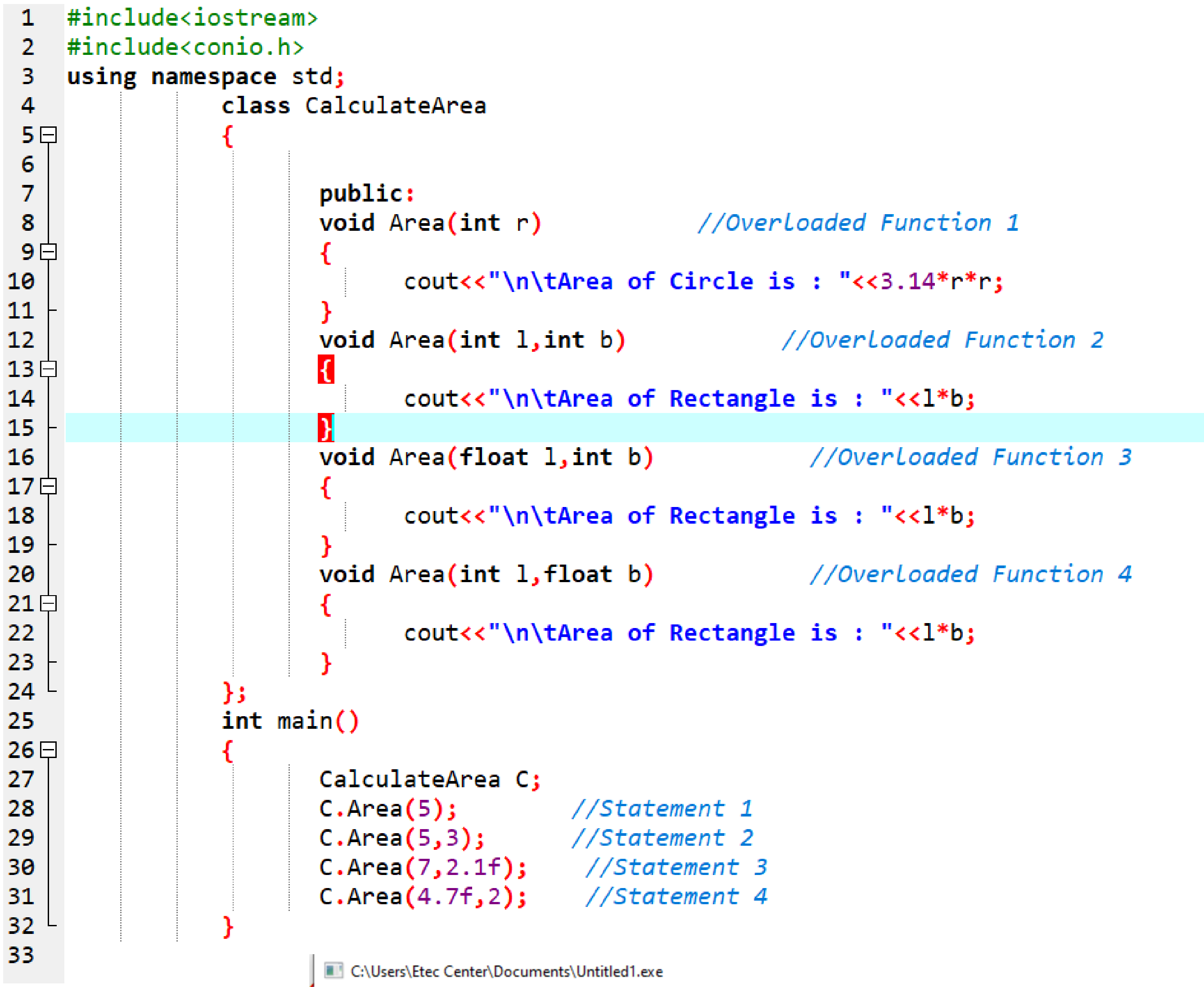


```cpp
#include <iostream>
using namespace std;
void display(int);
void display(float);
void display(int, float);
int main() {
    int a = 5;
    float b = 5.5;
    display(a);
    display(b);
    display(a, b);
    return 0;
}
void display(int var) {
    cout << "Integer number: " << var << endl;
}
void display(float var) {
    cout << "Float number: " << var << endl;
}
void display(int var1, float var2) {
    cout << "Integer number: " << var1;
    cout << " and float number:" << var2;
}
```

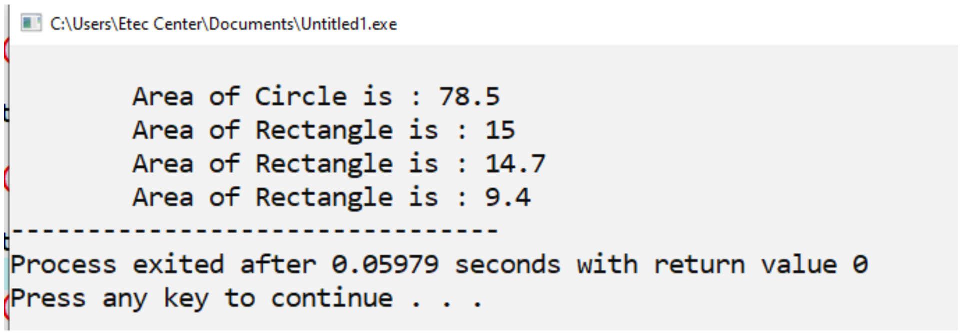
លទ្ធផលទទួលបាន៖


C:\Users\Etec Center\Documents\Untitled1.exe
```
Default Area when no argument is passed.
Area: 10
Area when (2,1) is passed as argument.
Area: 2

-------------------------------
```

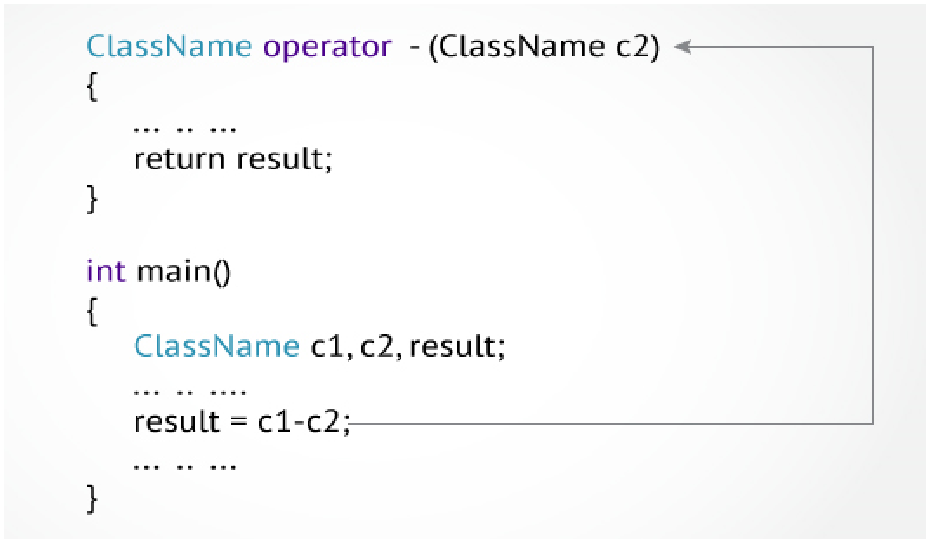
ឧទាហរណ៏ ២៖


```cpp
#include<iostream>
#include<conio.h>
using namespace std;
           class CalculateArea
           {

                  public:
                  void Area(int r)          //Overloaded Function 1
                  {
                        cout<<"\n\tArea of Circle is : "<<3.14*r*r;
                  }
                  void Area(int l,int b)          //Overloaded Function 2
                  {
                        cout<<"\n\tArea of Rectangle is : "<<l*b;
                  }
                  void Area(float l,int b)          //Overloaded Function 3
                  {
                        cout<<"\n\tArea of Rectangle is : "<<l*b;
                  }
                  void Area(int l,float b)          //Overloaded Function 4
                  {
                        cout<<"\n\tArea of Rectangle is : "<<l*b;
                  }
           };
           int main()
           {
                  CalculateArea C;
                  C.Area(5);         //Statement 1
                  C.Area(5,3);       //Statement 2
                  C.Area(7,2.1f);     //Statement 3
                  C.Area(4.7f,2);     //Statement 4
           }
```

លទ្ធផលទទួលបាន៖


C:\Users\Etec Center\Documents\Untitled1.exe
```

        Area of Circle is : 78.5
        Area of Rectangle is : 15
        Area of Rectangle is : 14.7
        Area of Rectangle is : 9.4
--------------------------------
Process exited after 0.05979 seconds with return value 0
Press any key to continue . . .
```

1.3. Overloading Operator: គឺជាការបង្កើតនូវ Function ថ្មី តែប្រើប្រាស់ឈ្មោះ ឬ សញ្ញា Operator ដែលត្រូវបានគេចងកូដស្រាប់ក្នុងភាសា C++ យកមក សរសេរបន្ថែមនៅ មុខងារថ្មីណាមួយក្នុង Class ។ ហេតុនេះ យើងអាចប្រើប្រាស់នូវសញ្ញាណដូចជា +, -, *, /, %, >, <, =, ==, -ល- ដើម្បីធ្វើការគណនានូវ ប្រមាណប្លែកៗ បាន ឧទាហរណ៍ ដូចជា ការគណនា Vector, Matrix, ... តាមរយៈសញ្ញា Operator ខាងលើ ។

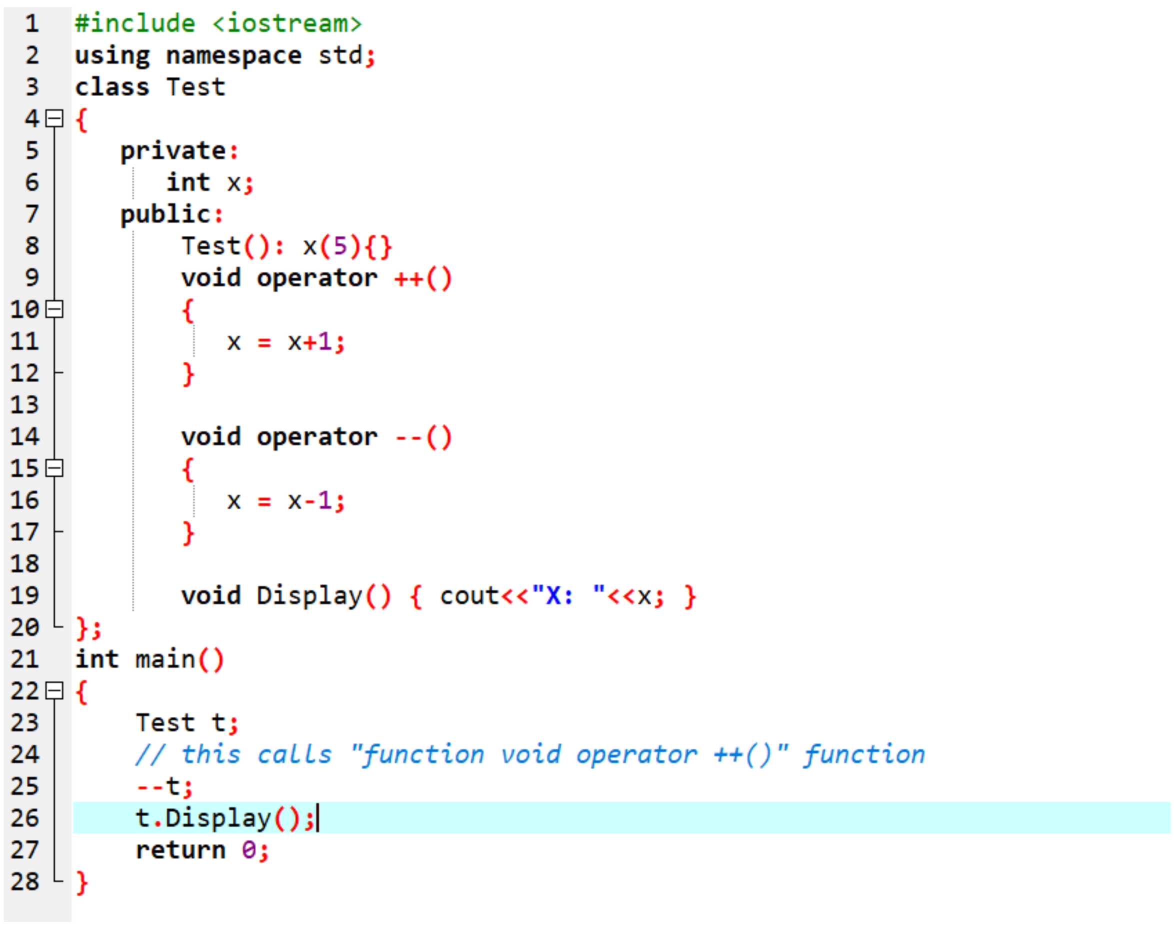


```
ClassName operator - (ClassName c2)
{
    ... .. ...
    return result;
}

int main()
{
    ClassName c1, c2, result;
    ... .. ....
    result = c1-c2;
    ... .. ...
}
```

ទំរង់ទូទៅ៖

```

Syntax:
class className
{
    ... .. ...
    public
       returnType operator symbol (arguments)
       {
           ... .. ...
       }
    ... .. ...
};

```

ឧទាហរណ៍ ១៖

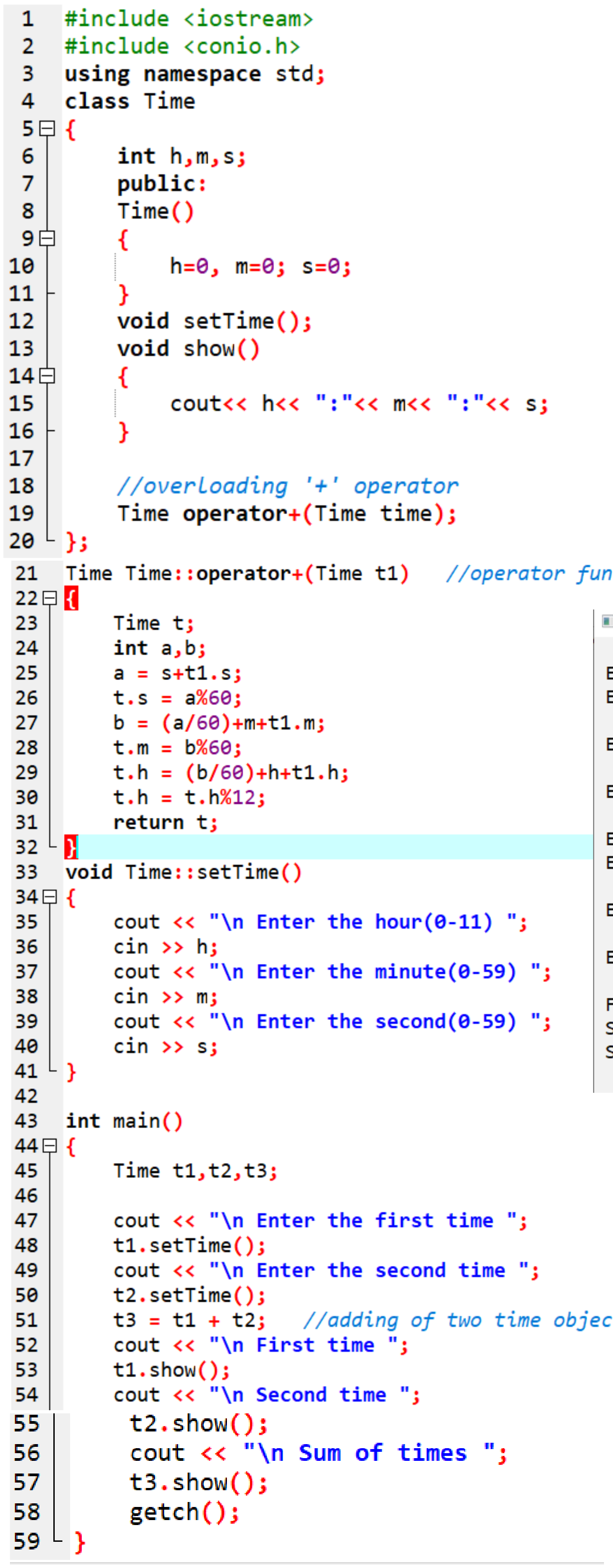


```
#include <iostream>
using namespace std;
class Test
{
    private:
        int x;
    public:
        Test(): x(5){}
        void operator ++()
        {
            x = x+1;
        }

        void operator --()
        {
            x = x-1;
        }

        void Display() { cout<<"X: "<<x; }
};
int main()
{
    Test t;
    // this calls "function void operator ++()" function
    --t;
    t.Display();
    return 0;
}
```

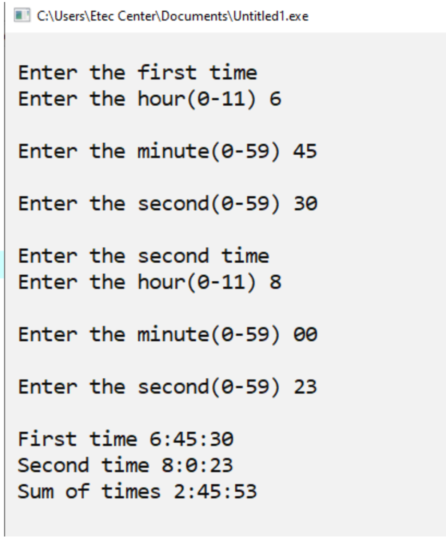
"រៀនអត់ដឹងទៅណា, រៀនអត់ផែនការ, រៀនអត់សកម្មភាព , រៀនអត់ពេលវេលាច្បាស់ទេ និងអត់អនុវត្តន៏អីសោះ កុំសង្ឃឹមចេះអោយសោះ..."

_គ្រូអាយធីចិត្តល្អ

ឧទាហរណ៍ ២៖



```
#include <iostream>
#include <conio.h>
using namespace std;
class Time
{
    int h,m,s;
    public:
    Time()
    {
        h=0, m=0; s=0;
    }
    void setTime();
    void show()
    {
        cout<< h<< ":"<< m<< ":"<< s;
    }

    //overloading '+' operator
    Time operator+(Time time);
};
Time Time::operator+(Time t1)   //operator function
{
    Time t;
    int a,b;
    a = s+t1.s;
    t.s = a%60;
    b = (a/60)+m+t1.m;
    t.m = b%60;
    t.h = (b/60)+h+t1.h;
    t.h = t.h%12;
    return t;
}
void Time::setTime()
{
    cout << "\n Enter the hour(0-11) ";
    cin >> h;
    cout << "\n Enter the minute(0-59) ";
    cin >> m;
    cout << "\n Enter the second(0-59) ";
    cin >> s;
}

int main()
{
    Time t1,t2,t3;

    cout << "\n Enter the first time ";
    t1.setTime();
    cout << "\n Enter the second time ";
    t2.setTime();
    t3 = t1 + t2;    //adding of two time object using '+' operator
    cout << "\n First time ";
    t1.show();
    cout << "\n Second time ";
    t2.show();
    cout << "\n Sum of times ";
    t3.show();
    getch();
}
```

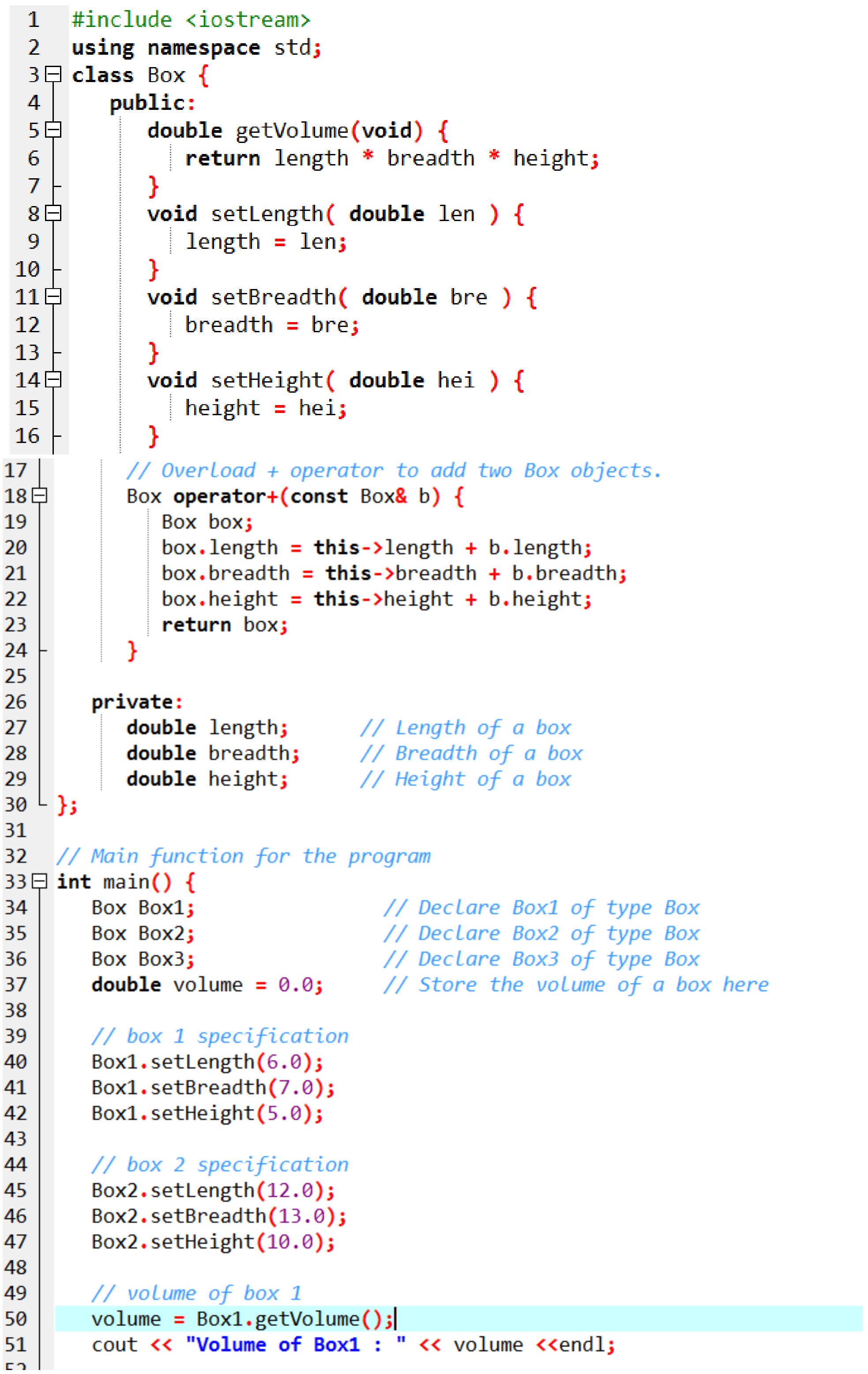


C:\Users\Etec Center\Documents\Untitled1.exe

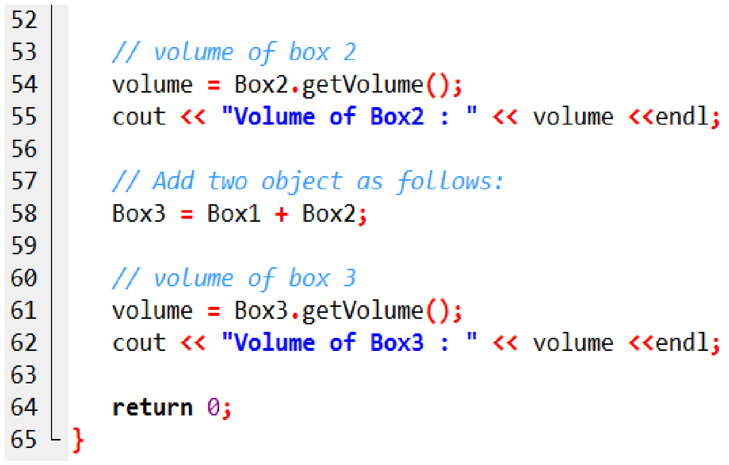
```
Enter the first time
Enter the hour(0-11) 6

Enter the minute(0-59) 45

Enter the second(0-59) 30

Enter the second time
Enter the hour(0-11) 8

Enter the minute(0-59) 00

Enter the second(0-59) 23

First time 6:45:30
Second time 8:0:23
Sum of times 2:45:53
```

ឧទាហរណ៍ ៣៖ ចូរបង្កើតនូវ Overloading Operator + សំរាប់អោយគេអាចយក obj1=obj2+obj3

បន្ទាប់មកបង្ហាញលទ្ធផលមកក្រៅវិញ(លទ្ធផលបោះមកក្រៅជាប្រភេទ object class)

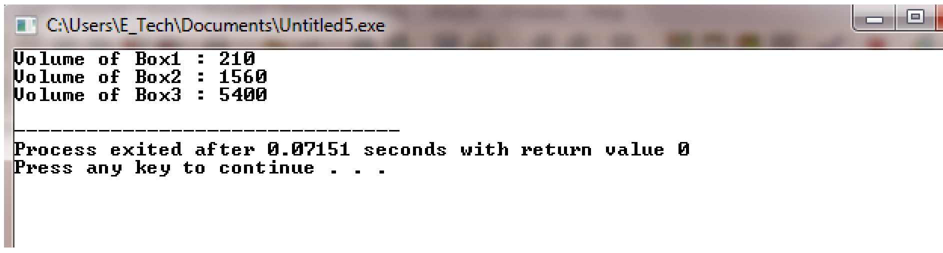


```cpp
#include <iostream>
using namespace std;
class Box {
    public:
        double getVolume(void) {
            return length * breadth * height;
        }
        void setLength( double len ) {
            length = len;
        }
        void setBreadth( double bre ) {
            breadth = bre;
        }
        void setHeight( double hei ) {
            height = hei;
        }
      // Overload + operator to add two Box objects.
      Box operator+(const Box& b) {
         Box box;
         box.length = this->length + b.length;
         box.breadth = this->breadth + b.breadth;
         box.height = this->height + b.height;
         return box;
      }

   private:
      double length;      // Length of a box
      double breadth;     // Breadth of a box
      double height;      // Height of a box
};

// Main function for the program
int main() {
   Box Box1;                // Declare Box1 of type Box
   Box Box2;                // Declare Box2 of type Box
   Box Box3;                // Declare Box3 of type Box
   double volume = 0.0;     // Store the volume of a box here

   // box 1 specification
   Box1.setLength(6.0);
   Box1.setBreadth(7.0);
   Box1.setHeight(5.0);

   // box 2 specification
   Box2.setLength(12.0);
   Box2.setBreadth(13.0);
   Box2.setHeight(10.0);

   // volume of box 1
   volume = Box1.getVolume();
   cout << "Volume of Box1 : " << volume <<endl;
```



```cpp

    // volume of box 2
    volume = Box2.getVolume();
    cout << "Volume of Box2 : " << volume <<endl;

    // Add two object as follows:
    Box3 = Box1 + Box2;

    // volume of box 3
    volume = Box3.getVolume();
    cout << "Volume of Box3 : " << volume <<endl;

    return 0;
}
```

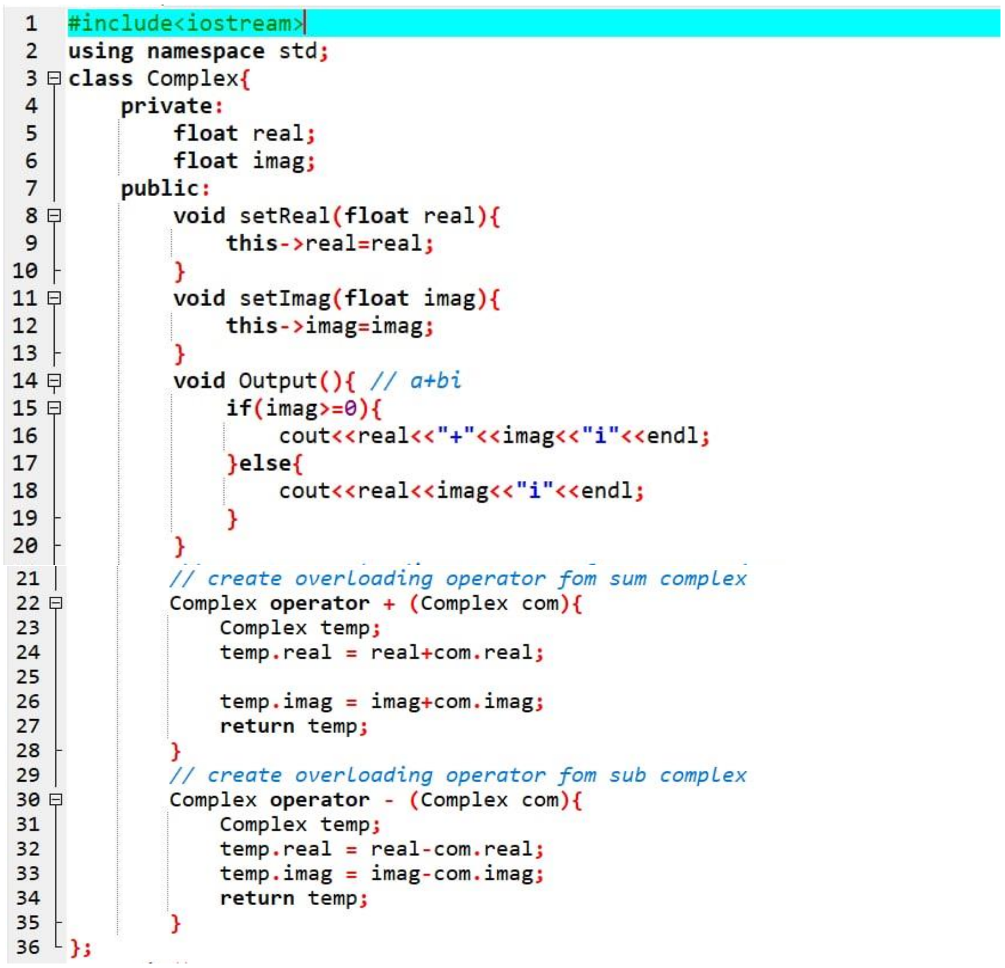
លទ្ធផលទទួលបាន៖



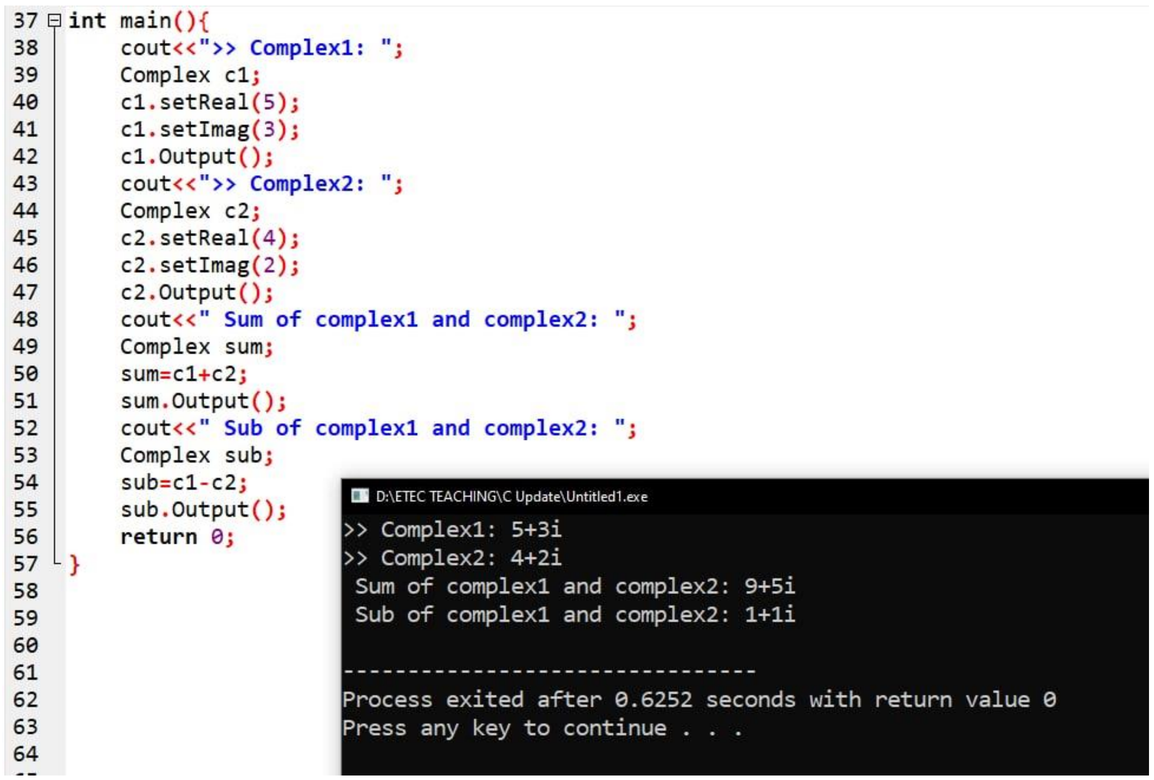
C:\Users\E_Tech\Documents\Untitled5.exe

```
Volume of Box1 : 210
Volume of Box2 : 1560
Volume of Box3 : 5400

--------------------------------
Process exited after 0.07151 seconds with return value 0
Press any key to continue . . .
```

ឧទាហរណ៍ ៨៖ ការគណនា ចំនួនកំផ្លិច



```cpp
#include<iostream>
using namespace std;
class Complex{
    private:
        float real;
        float imag;
    public:
        void setReal(float real){
            this->real=real;
        }
        void setImag(float imag){
            this->imag=imag;
        }
        void Output(){ // a+bi
            if(imag>=0){
                cout<<real<<"+"<<imag<<"i"<<endl;
            }else{
                cout<<real<<imag<<"i"<<endl;
            }
        }
        // create overloading operator fom sum complex
        Complex operator + (Complex com){
            Complex temp;
            temp.real = real+com.real;

            temp.imag = imag+com.imag;
            return temp;
        }
        // create overloading operator fom sub complex
        Complex operator - (Complex com){
            Complex temp;
            temp.real = real-com.real;
            temp.imag = imag-com.imag;
            return temp;
        }
};
```

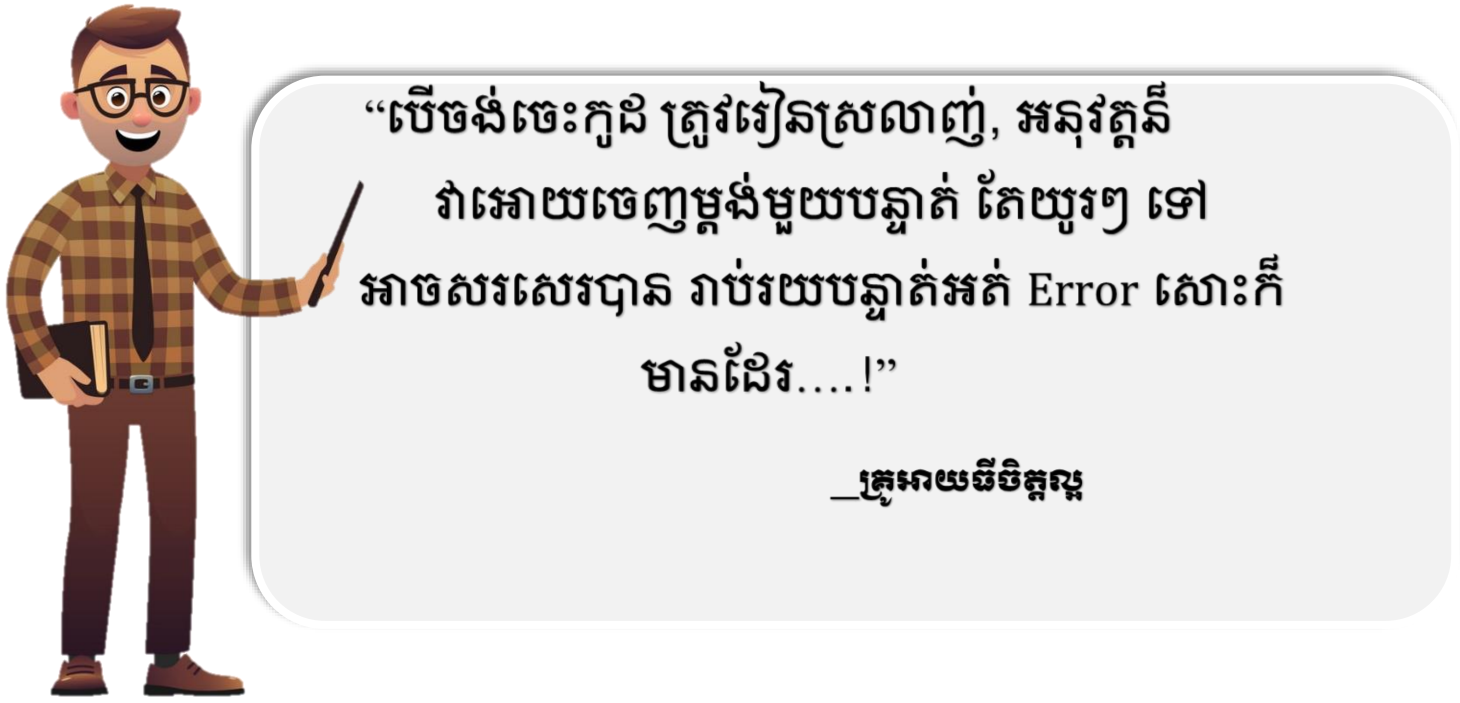


```
int main(){
    cout<<">> Complex1: ";
    Complex c1;
    c1.setReal(5);
    c1.setImag(3);
    c1.Output();
    cout<<">> Complex2: ";
    Complex c2;
    c2.setReal(4);
    c2.setImag(2);
    c2.Output();
    cout<<" Sum of complex1 and complex2: ";
    Complex sum;
    sum=c1+c2;
    sum.Output();
    cout<<" Sub of complex1 and complex2: ";
    Complex sub;
    sub=c1-c2;
    sub.Output();
    return 0;
}
```

D:\ETEC TEACHING\C Update\Untitled1.exe

```
>> Complex1: 5+3i
>> Complex2: 4+2i
 Sum of complex1 and complex2: 9+5i
 Sub of complex1 and complex2: 1+1i

--------------------------------
Process exited after 0.6252 seconds with return value 0
Press any key to continue . . .
```

ជារួម ក្នុង ភាសា C++ , Operator ទាំងនោះមាន មុខងារផ្ទាល់ខ្លួនស្រាប់ហើយ តែយើងអាចបង្កើត Function ទៅ Overloading ជាមួយ Operator ទាំងនោះក្នុងគោលបំណងបង្កើតមុខងារថ្មីសម្រាប់ Operator នោះហើយអាចប្រើប្រាស់ជាមួយ Class នោះ។

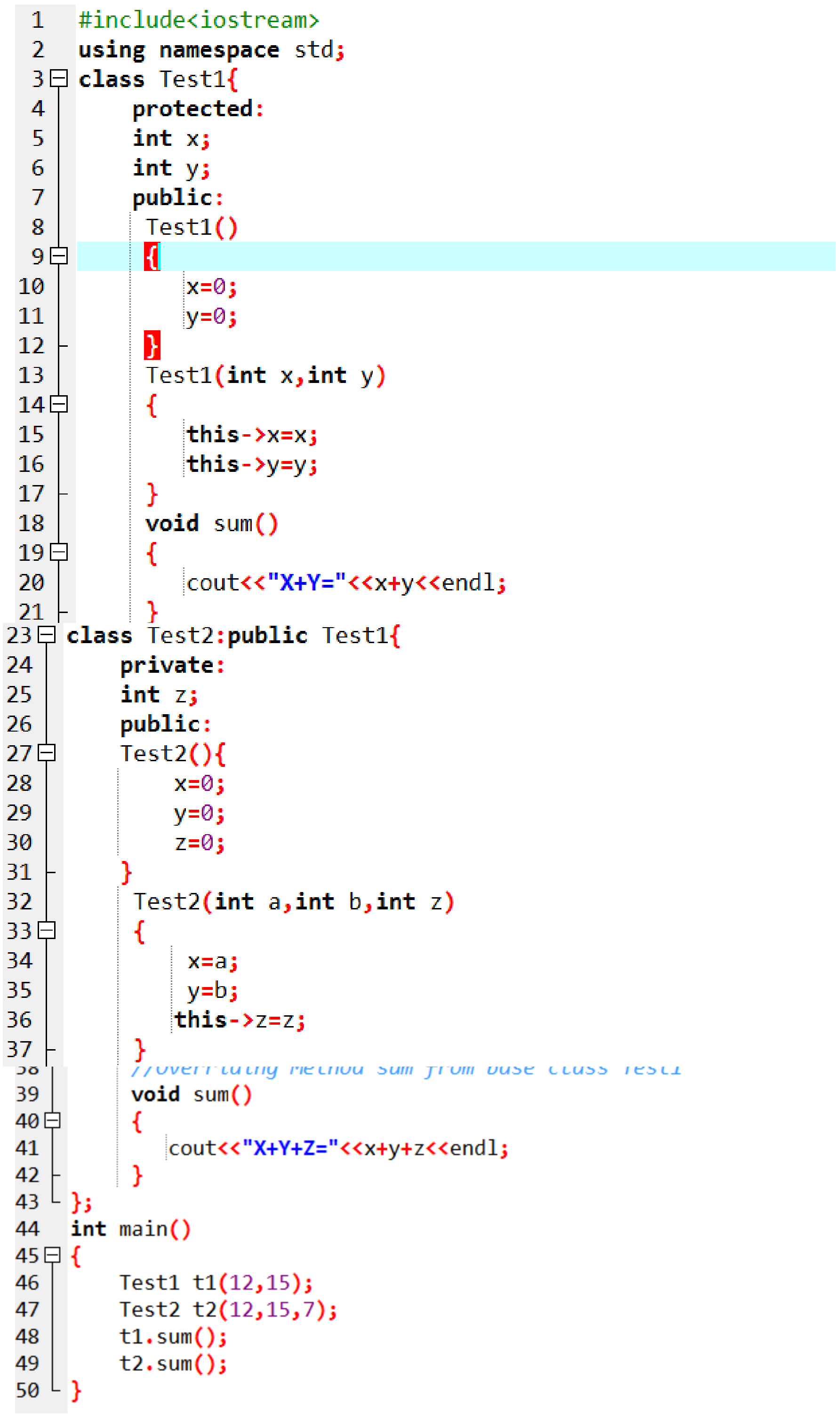


“បើចង់ចេះកូដ ត្រូវរៀនស្រលាញ់, អនុវត្តនឹងវាអោយចេញម្តងមួយបន្ទាត់ តែយូរៗ ទៅអាចសរសេរបាន រាប់រយបន្ទាត់អត់ Error សោះក៏មានដែរ....!”

_គ្រូអាយធីចិត្តល្អ

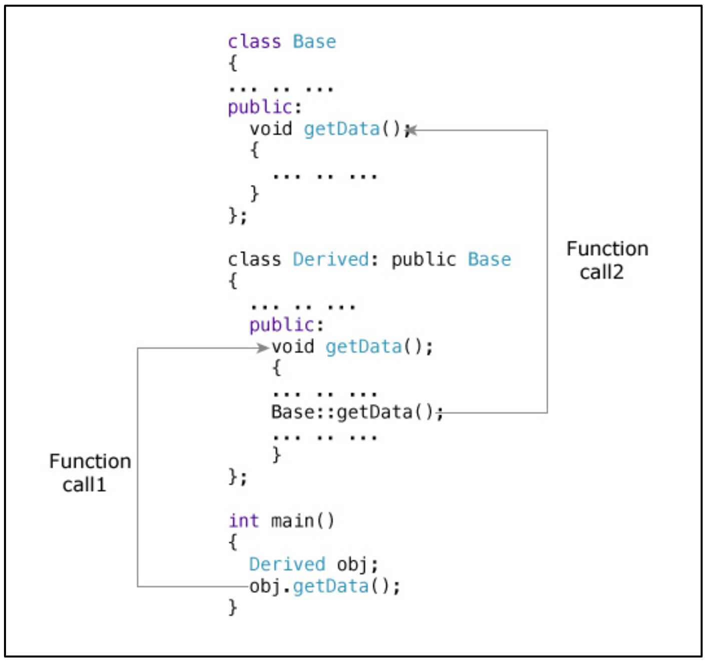
៤) **overriding Method**: គឺជាប្រភេទ Method ដែលមានឈ្មោះដូចគ្នាទាំងក្នុង Base Class និង Sub Class ដែល អាចអោយ Sub Class Overriding នូវ Method ទាំងនោះបាន

ឧទាហរណ៏ ១៖



```cpp
#include<iostream>
using namespace std;
class Test1{
     protected:
     int x;
     int y;
     public:
      Test1()
      {
          x=0;
          y=0;
      }
      Test1(int x,int y)
      {
          this->x=x;
          this->y=y;
      }
      void sum()
      {
          cout<<"X+Y="<<x+y<<endl;
      }
class Test2:public Test1{
     private:
     int z;
     public:
     Test2(){
         x=0;
         y=0;
         z=0;
     }
      Test2(int a,int b,int z)
      {
          x=a;
          y=b;
         this->z=z;
      }
      //overriding Method sum from base class Test1
      void sum()
      {
          cout<<"X+Y+Z="<<x+y+z<<endl;
      }
};
int main()
{
     Test1 t1(12,15);
     Test2 t2(12,15,7);
     t1.sum();
     t2.sum();
}
```

ឧទាហរណ៍ ២៖ ចូរធ្វើការ Design នូវ Class ដូចខាងក្រោម និង Overriding លើ Method ដូចខាងក្រោម៖

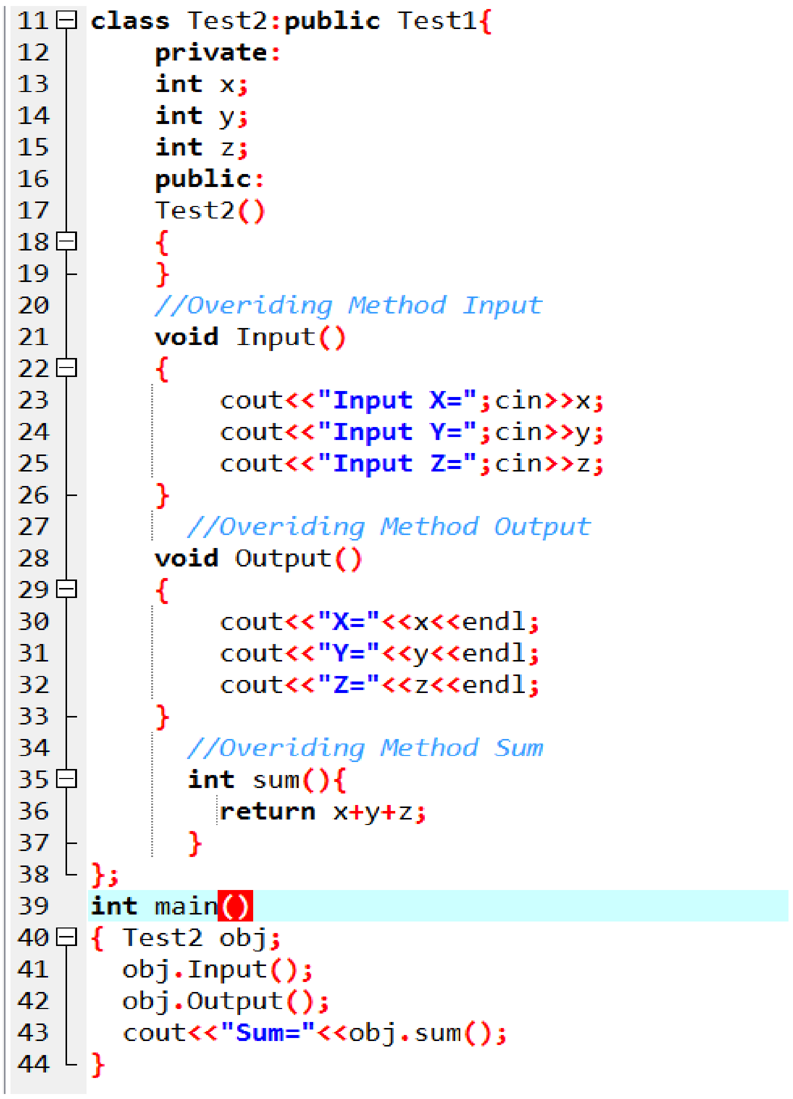


```
class Base
{
... .. ...
public:
  void getData();
  {
    ... .. ...
  }
};

class Derived: public Base
{
  ... .. ...
  public:
    void getData();
    {
    ... .. ...
    Base::getData();
    ... .. ...
    }
};

int main()
{
  Derived obj;
  obj.getData();
}
```

៥) Abstract Class: គឺជាប្រភេទ Class ដែលមាននូវ Method Abstract មួយយ៉ាងតិច។ Method Abstract គឺជាប្រភេទ Method ដែលមានតែប្រកាសតែគ្មានខ្លួន។ ការបង្កើតឡើងនូវ Method Abstract ឡើងគឺ ផ្តល់លទ្ធភាពអោយគេអាច Overriding ទៅលើ Method ដែលមាន ស្រាប់នោះនៅក្នុង Sub Class។

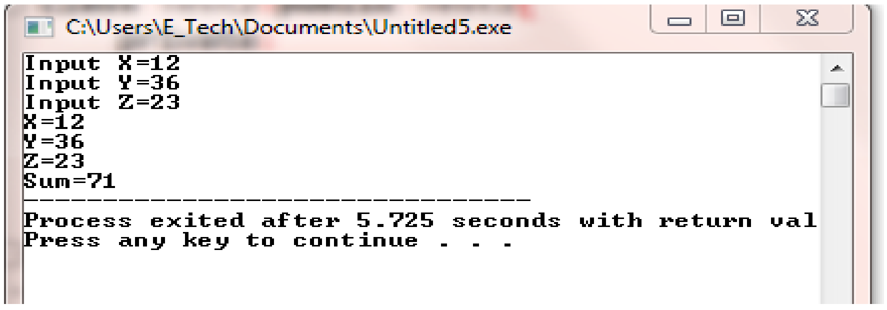
ឧទាហរណ៍៖

```
#include<iostream>
using namespace std;
//Abstract Class
class Test1{
    public:
    //Abstract Method
   virtual void sum1()=0;
   virtual void Input()=0;
   virtual void Output()=0;
};
```



```cpp
class Test2:public Test1{
    private:
    int x;
    int y;
    int z;
    public:
    Test2()
    {
    }
    //Overiding Method Input
    void Input()
    {
        cout<<"Input X=";cin>>x;
        cout<<"Input Y=";cin>>y;
        cout<<"Input Z=";cin>>z;
    }
      //Overiding Method Output
    void Output()
    {
        cout<<"X="<<x<<endl;
        cout<<"Y="<<y<<endl;
        cout<<"Z="<<z<<endl;
    }
      //Overiding Method Sum
      int sum(){
        return x+y+z;
      }
};
int main()
{ Test2 obj;
  obj.Input();
  obj.Output();
  cout<<"Sum="<<obj.sum();
}
```

លទ្ធផលទទួលបាន៖



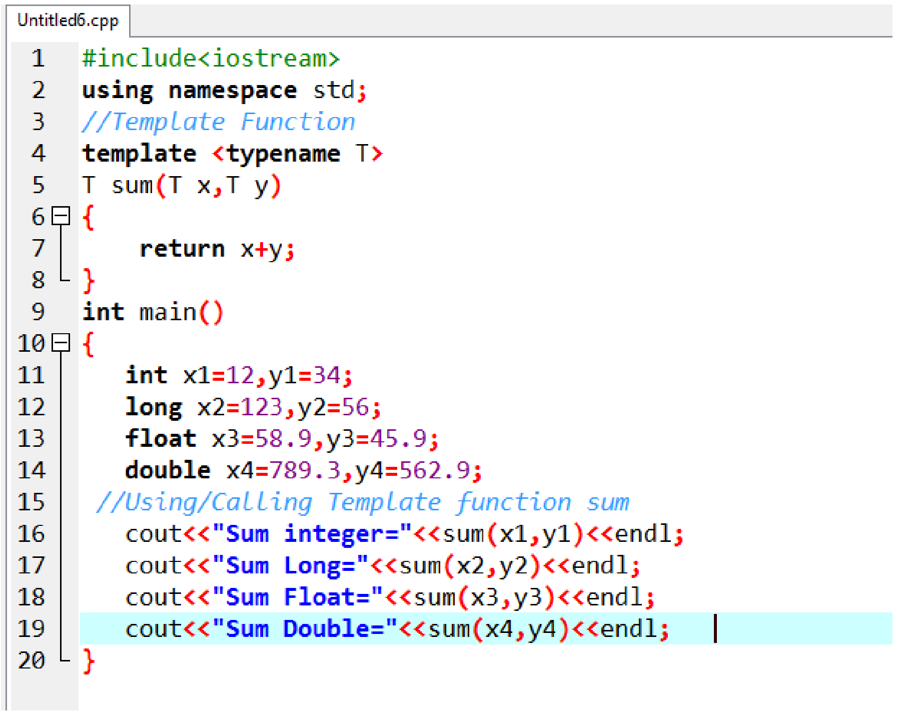
C:\Users\E_Tech\Documents\Untitled5.exe

```
Input X=12
Input Y=36
Input Z=23
X=12
Y=36
Z=23
Sum=71
--------------------------------
Process exited after 5.725 seconds with return val
Press any key to continue . . .
```

៦) Template: គឺជាសំដៅលើការបង្កើតនូវគំរូមួយទៅលើ Class និង Method ដែលគេ ប្រើប្រាស់
សំរាប់កាត់បន្ថយនូវការសរសេរកូដច្រំដែរច្រើនដង ឬ ការបង្កើតនូវ Function ច្រើនក្នុង
ពេលតែមួយ។ នៅក្នុងចំនុចនេះគេបែងចែក Template ជា ពីរប្រភេទគឺ៖

៦.១. Function Template: គឺជាប្រភេទ នៃ Template ដែលគេអាចបង្កើតនូវ Function គំរូ មួយដែលអាចអោយគេប្រើប្រាស់វាជារួមបាន។

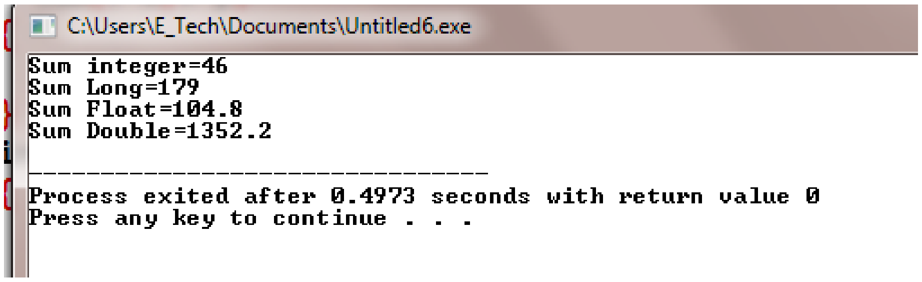
ឧទាហរណ៏ ១៖



Untitled6.cpp

```cpp
#include<iostream>
using namespace std;
//Template Function
template <typename T>
T sum(T x,T y)
{
    return x+y;
}
int main()
{
    int x1=12,y1=34;
    long x2=123,y2=56;
    float x3=58.9,y3=45.9;
    double x4=789.3,y4=562.9;
 //Using/Calling Template function sum
    cout<<"Sum integer="<<sum(x1,y1)<<endl;
    cout<<"Sum Long="<<sum(x2,y2)<<endl;
    cout<<"Sum Float="<<sum(x3,y3)<<endl;
    cout<<"Sum Double="<<sum(x4,y4)<<endl;
}
```

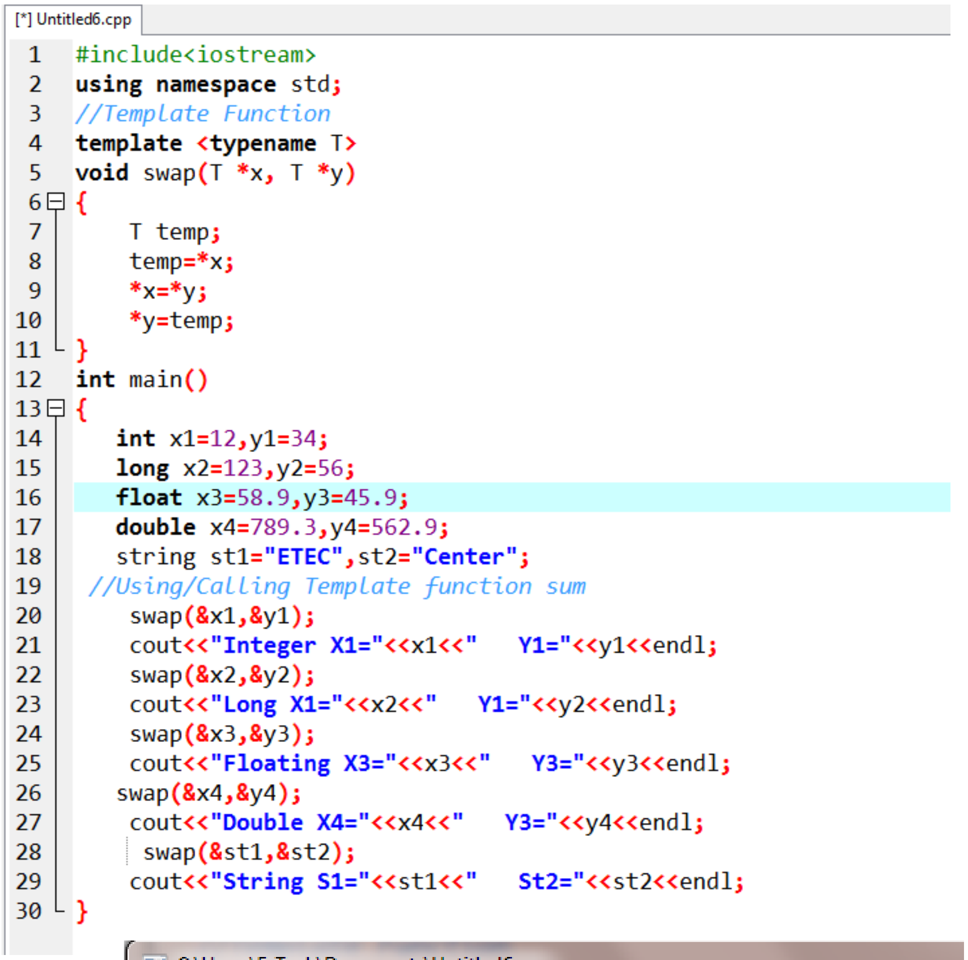
លទ្ធផលទទួលបាន៖



C:\Users\E_Tech\Documents\Untitled6.exe

```
Sum integer=46
Sum Long=179
Sum Float=104.8
Sum Double=1352.2

--------------------------------
Process exited after 0.4973 seconds with return value 0
Press any key to continue . . .
```

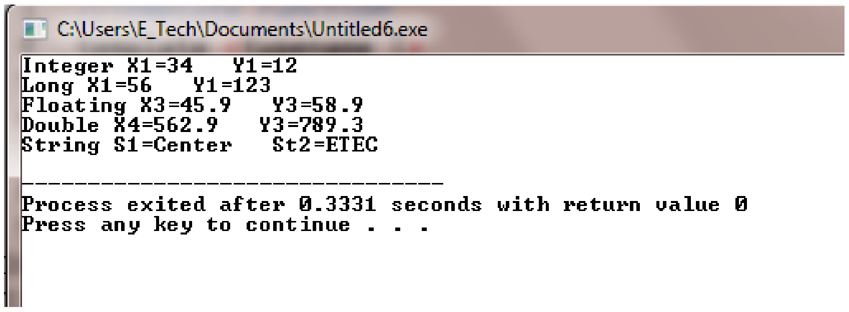
ឧទាហរណ៍ ២៖



[*] Untitled6.cpp

```cpp
#include<iostream>
using namespace std;
//Template Function
template <typename T>
void swap(T *x, T *y)
{
    T temp;
    temp=*x;
    *x=*y;
    *y=temp;
}
int main()
{
   int x1=12,y1=34;
   long x2=123,y2=56;
   float x3=58.9,y3=45.9;
   double x4=789.3,y4=562.9;
   string st1="ETEC",st2="Center";
 //Using/Calling Template function sum
    swap(&x1,&y1);
    cout<<"Integer X1="<<x1<<"   Y1="<<y1<<endl;
    swap(&x2,&y2);
    cout<<"Long X1="<<x2<<"   Y1="<<y2<<endl;
    swap(&x3,&y3);
    cout<<"Floating X3="<<x3<<"   Y3="<<y3<<endl;
   swap(&x4,&y4);
    cout<<"Double X4="<<x4<<"   Y3="<<y4<<endl;
     swap(&st1,&st2);
    cout<<"String S1="<<st1<<"   St2="<<st2<<endl;
}
```

លទ្ធផលទទួលបាន៖

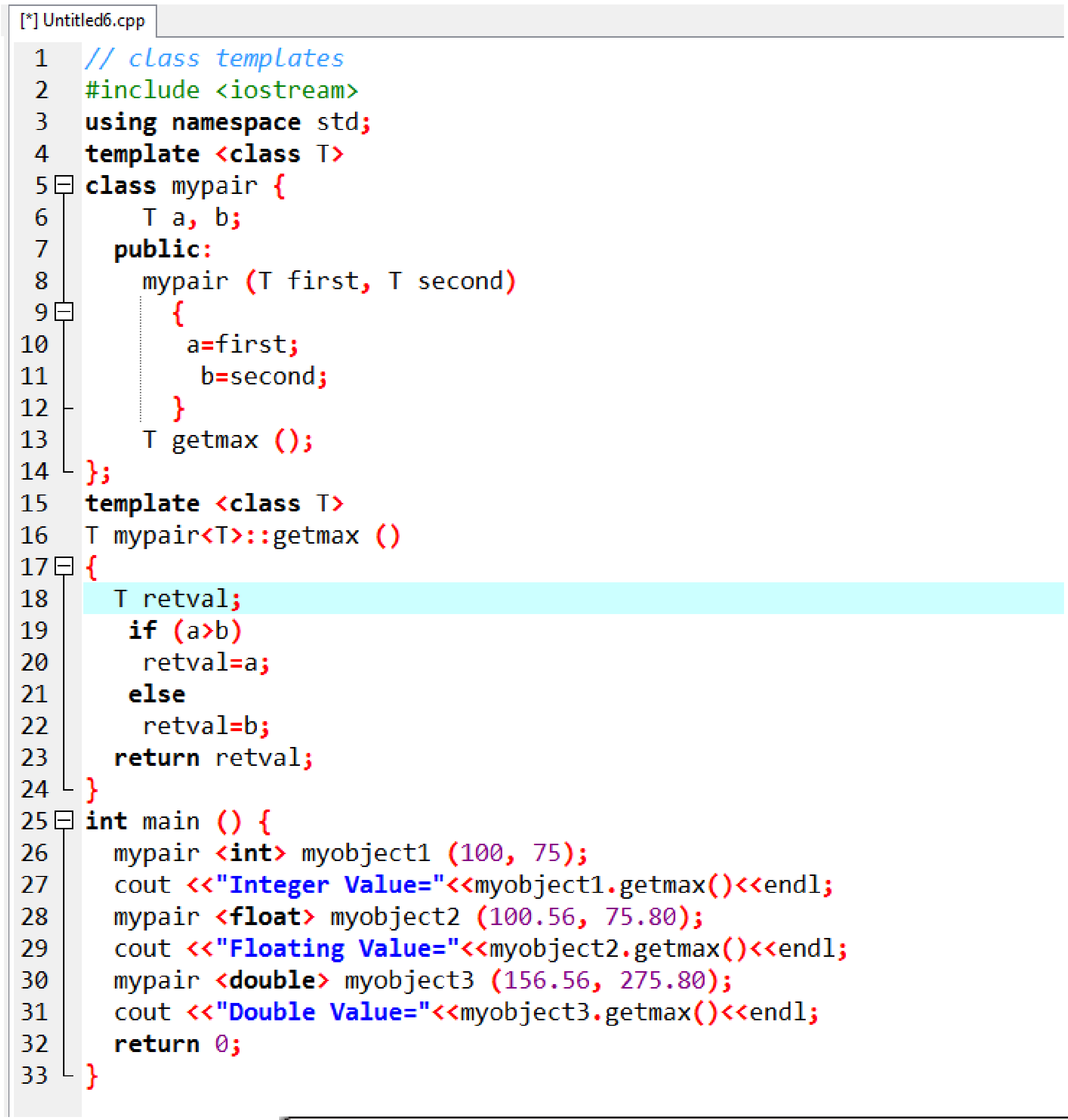


C:\Users\E_Tech\Documents\Untitled6.exe

```
Integer X1=34   Y1=12
Long X1=56   Y1=123
Floating X3=45.9   Y3=58.9
Double X4=562.9   Y3=789.3
String S1=Center   St2=ETEC

--------------------------------
Process exited after 0.3331 seconds with return value 0
Press any key to continue . . .
```

៦.១. Class Template: គឺជាប្រភេទ Class មួយដែលគេអាចបង្កើតវាជាគំរូមួយ សំរាប់អោយគេអាចប្រើប្រាស់នូវ Data Member និង Function Member របស់ វាច្រើនទំរង់។

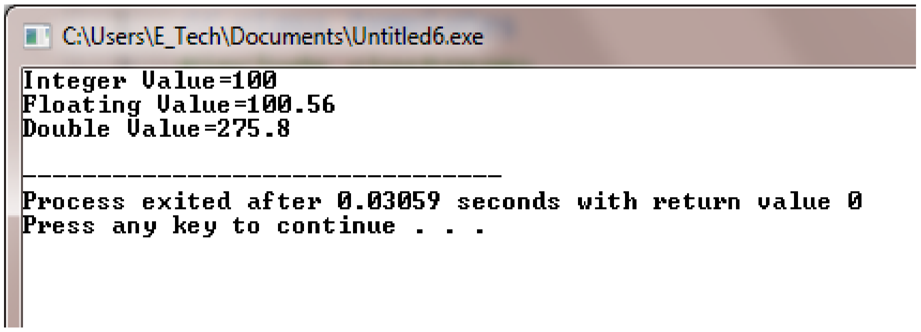
ឧទាហរណ៏១៖



[*] Untitled6.cpp

```cpp
// class templates
#include <iostream>
using namespace std;
template <class T>
class mypair {
      T a, b;
   public:
      mypair (T first, T second)
        {
          a=first;
            b=second;
        }
      T getmax ();
};
template <class T>
T mypair<T>::getmax ()
{
   T retval;
     if (a>b)
      retval=a;
     else
      retval=b;
   return retval;
}
int main () {
   mypair <int> myobject1 (100, 75);
   cout <<"Integer Value="<<myobject1.getmax()<<endl;
   mypair <float> myobject2 (100.56, 75.80);
   cout <<"Floating Value="<<myobject2.getmax()<<endl;
   mypair <double> myobject3 (156.56, 275.80);
   cout <<"Double Value="<<myobject3.getmax()<<endl;
   return 0;
}
```

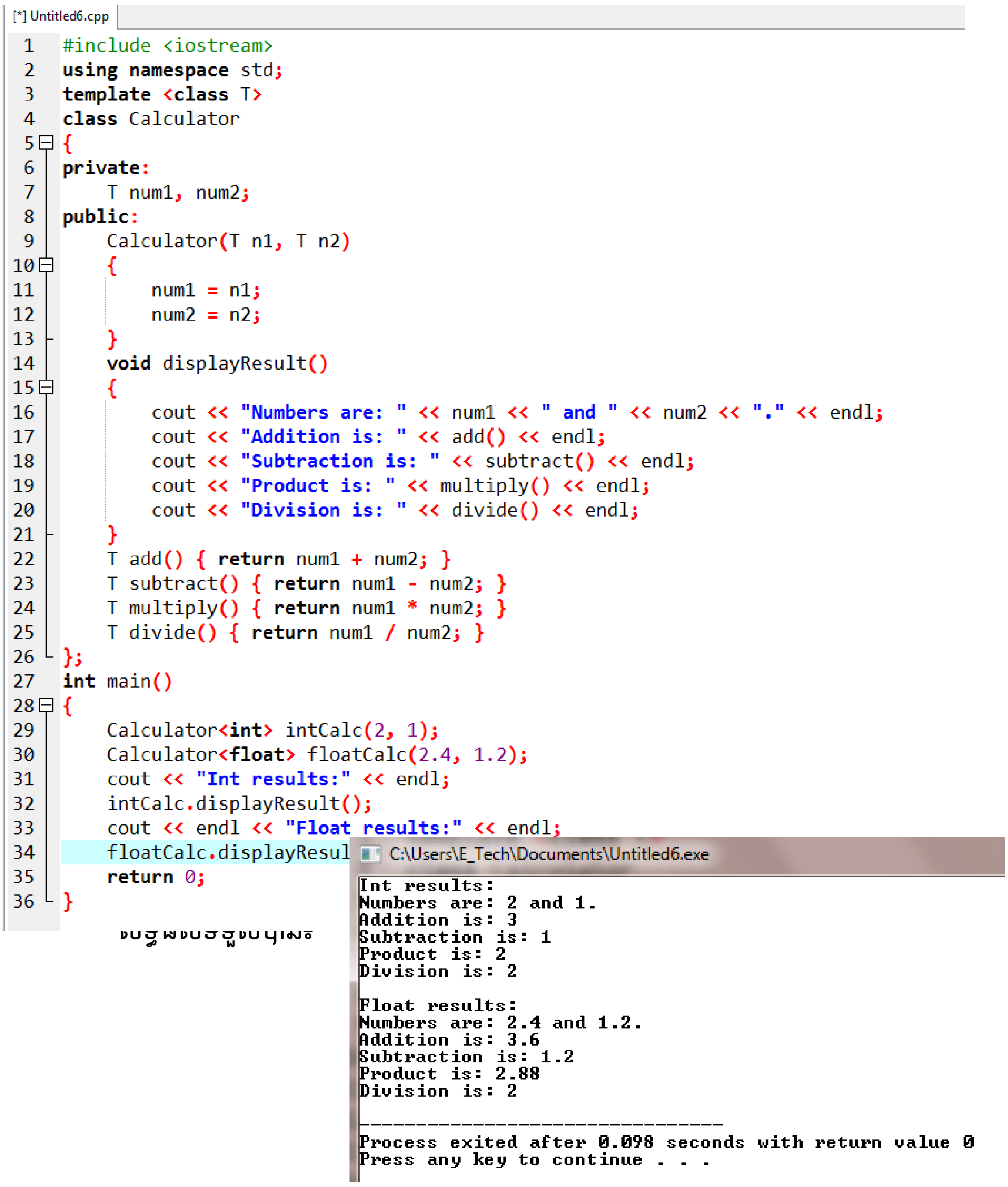
លទ្ធផលទទួលបាន៖



C:\Users\E_Tech\Documents\Untitled6.exe

```
Integer Value=100
Floating Value=100.56
Double Value=275.8

--------------------------------
Process exited after 0.03059 seconds with return value 0
Press any key to continue . . .
```

ឧទាហរណ៍ ២៖



[*] Untitled6.cpp

```cpp
#include <iostream>
using namespace std;
template <class T>
class Calculator
{
private:
    T num1, num2;
public:
    Calculator(T n1, T n2)
    {
        num1 = n1;
        num2 = n2;
    }
    void displayResult()
    {
        cout << "Numbers are: " << num1 << " and " << num2 << "." << endl;
        cout << "Addition is: " << add() << endl;
        cout << "Subtraction is: " << subtract() << endl;
        cout << "Product is: " << multiply() << endl;
        cout << "Division is: " << divide() << endl;
    }
    T add() { return num1 + num2; }
    T subtract() { return num1 - num2; }
    T multiply() { return num1 * num2; }
    T divide() { return num1 / num2; }
};
int main()
{
    Calculator<int> intCalc(2, 1);
    Calculator<float> floatCalc(2.4, 1.2);
    cout << "Int results:" << endl;
    intCalc.displayResult();
    cout << endl << "Float results:" << endl;
    floatCalc.displayResul
    return 0;
}
```

លទ្ធផលបន្ទាប់ពីរាន៖

C:\Users\E_Tech\Documents\Untitled6.exe

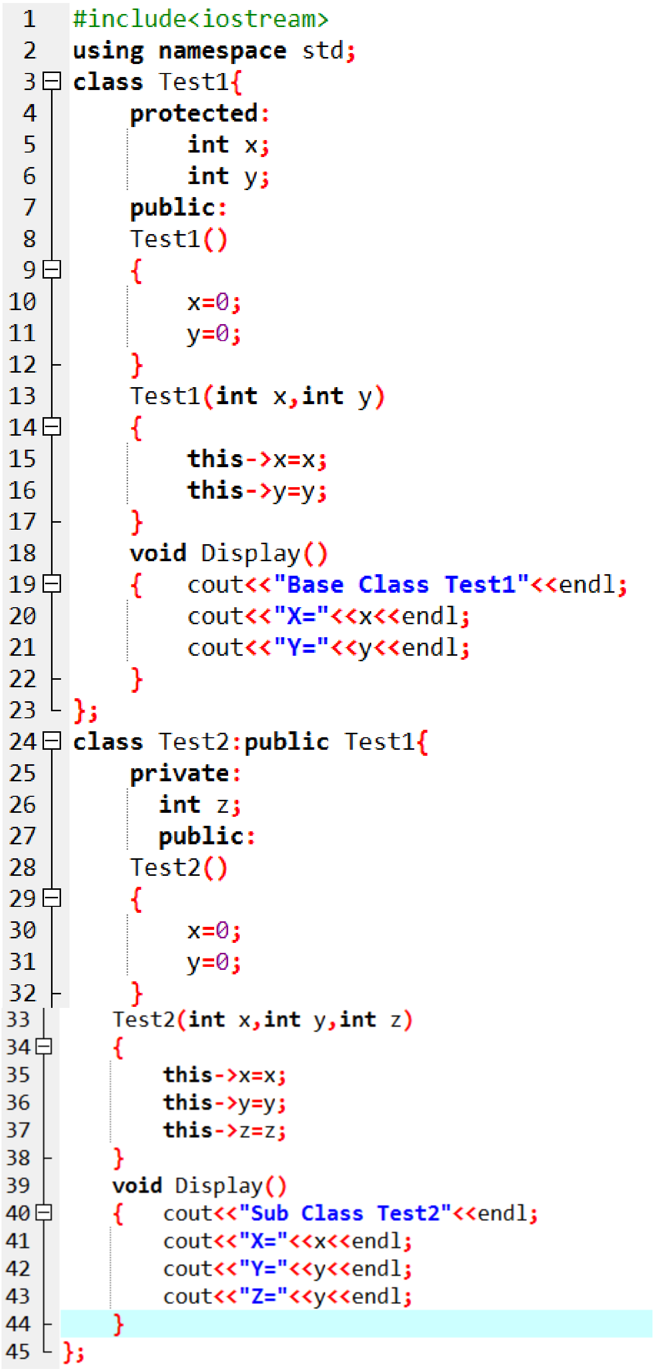
```
Int results:
Numbers are: 2 and 1.
Addition is: 3
Subtraction is: 1
Product is: 2
Division is: 2

Float results:
Numbers are: 2.4 and 1.2.
Addition is: 3.6
Subtraction is: 1.2
Product is: 2.88
Division is: 2

--------------------------------
Process exited after 0.098 seconds with return value 0
Press any key to continue . . .
```

៧). Early Binding/ Late Binding របស់ Polymorphism

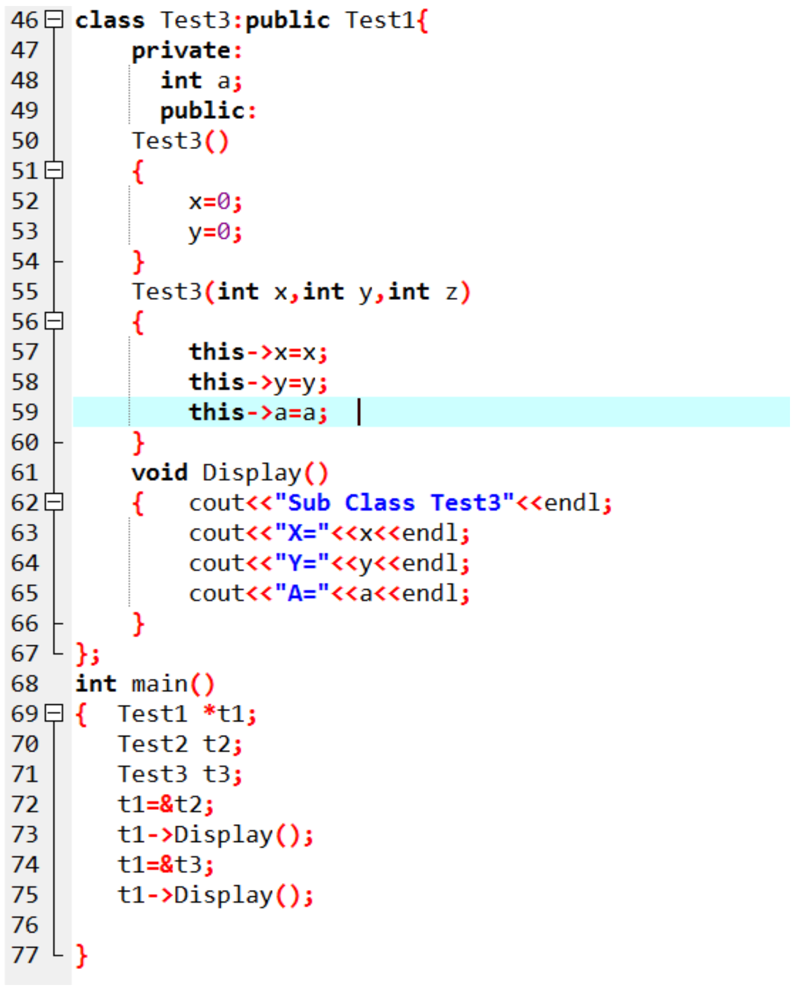
៧.១. Early Binding: គឺជាប្រភេទ Concept របស់ Polymorphism ដែលវាដំណើរជា លើក ដំបូង ក្នុងពេល Compile Code ដែលវាត្រូវជ្រើសរើសនូវ Function ណាមួយដែលត្រូវ ដំណើរ ការនៅពេល Object របស់ Base Class ចង្អុលទៅកាន់ Object របស់ Derived Class។

Compile Time ជា ពេលដែល Compiler ធ្វើការបកប្រែកូដ។ Compile Time Error ភាគច្រើនកើតនៅពេល យើងសរសេរ ខុស syntax ។

ឧទាហរណ៍ ១៖

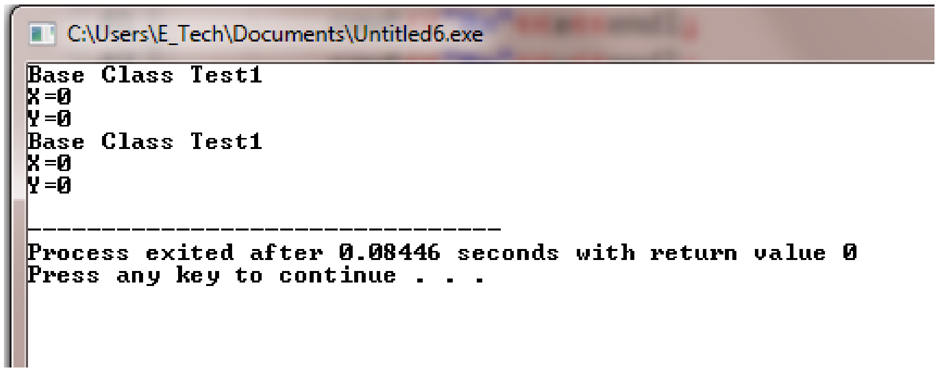


```
#include<iostream>
using namespace std;
class Test1{
    protected:
        int x;
        int y;
    public:
    Test1()
    {
        x=0;
        y=0;
    }
    Test1(int x,int y)
    {
        this->x=x;
        this->y=y;
    }
    void Display()
    {   cout<<"Base Class Test1"<<endl;
        cout<<"X="<<x<<endl;
        cout<<"Y="<<y<<endl;
    }
};
class Test2:public Test1{
    private:
      int z;
      public:
    Test2()
    {
        x=0;
        y=0;
    }
    Test2(int x,int y,int z)
    {
        this->x=x;
        this->y=y;
        this->z=z;
    }
    void Display()
    {   cout<<"Sub Class Test2"<<endl;
        cout<<"X="<<x<<endl;
        cout<<"Y="<<y<<endl;
        cout<<"Z="<<y<<endl;
    }
};
```



```
class Test3:public Test1{
    private:
      int a;
      public:
    Test3()
    {
        x=0;
        y=0;
    }
    Test3(int x,int y,int z)
    {
        this->x=x;
        this->y=y;
        this->a=a;  
    }
    void Display()
    {   cout<<"Sub Class Test3"<<endl;
        cout<<"X="<<x<<endl;
        cout<<"Y="<<y<<endl;
        cout<<"A="<<a<<endl;
    }
};
int main()
{  Test1 *t1;
   Test2 t2;
   Test3 t3;
   t1=&t2;
   t1->Display();
   t1=&t3;
   t1->Display();

}
```

លទ្ធផលទទួលបាន៖



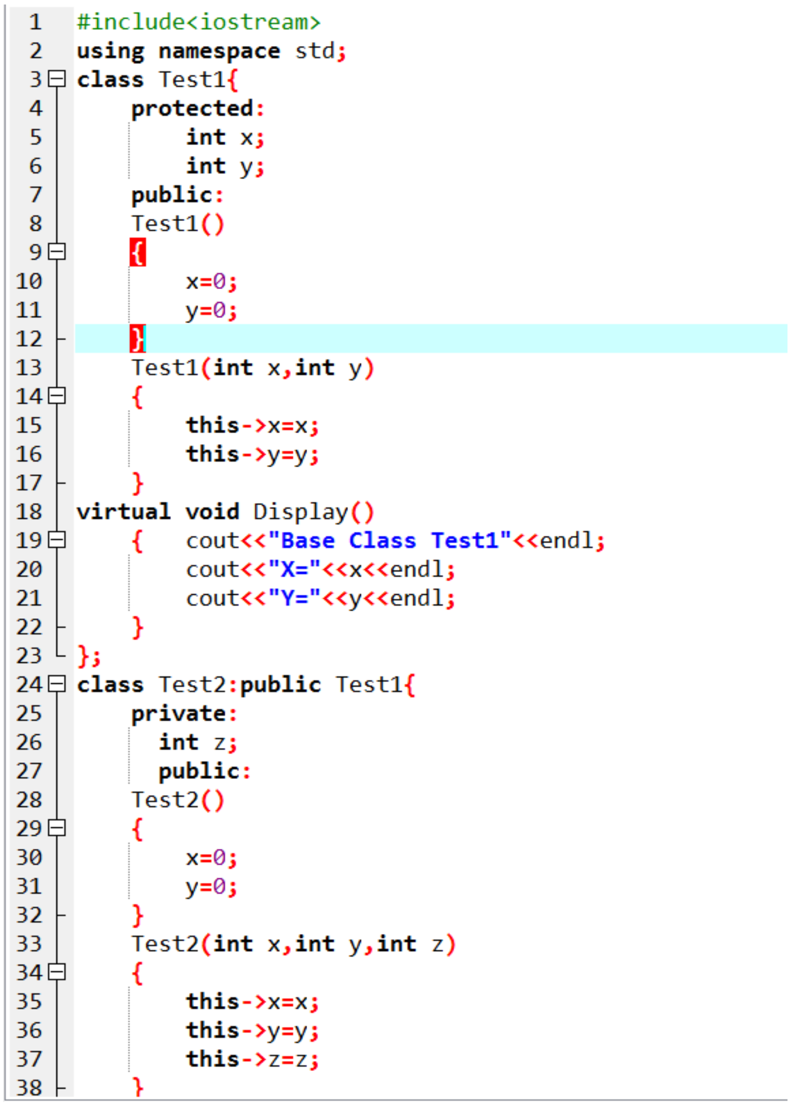
C:\Users\E_Tech\Documents\Untitled6.exe

```
Base Class Test1
X=0
Y=0
Base Class Test1
X=0
Y=0

--------------------------------
Process exited after 0.08446 seconds with return value 0
Press any key to continue . . .
```

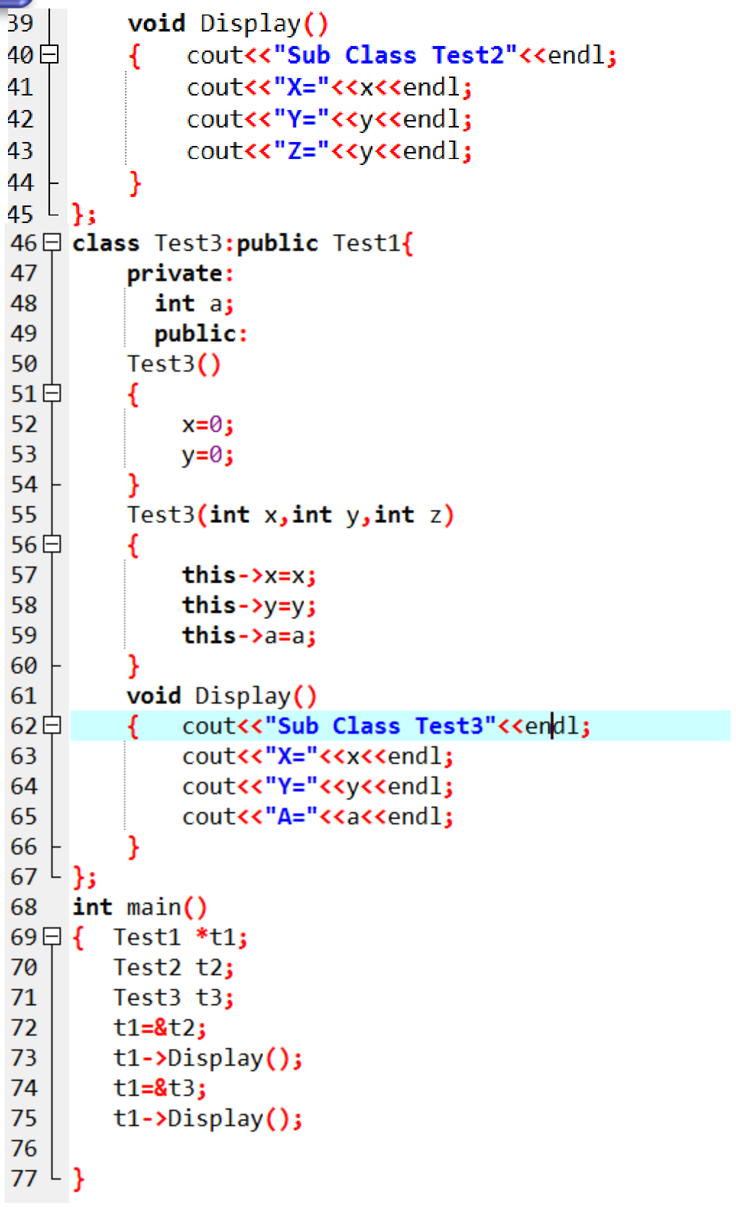
* * * * * * យើងសង្កេតឃើញថា លទ្ធផលដែលទទួលបានគឺសុទ្ធតែបានចេញពី Base Class
ទាំងអស់ ពោលគឺទោះបីយើងព្យាយាមយក Object Pointer របស់ Base Class ទៅចង្អុលទៅកាន់ Object របស់ Derived Class ក៏ដោយនៅតែលទ្ធផលទទួលបានគឺខុសពីការគិតរបស់យើង។ ដូច្នេះចំនុចនេះគឺ ប្រភេទ Early Binding ឬ Compile time binding។

៧.១. Late Binding: គឺជាប្រភេទ Concept របស់ Polymorphism ដែលវាដំណើរការពេល Object កកើតឡើងក្នុងដំណាក់កាល Run Time ឬ Late Binding ហើយចង្អុលទៅកាន់ Object របស់ Sub Class ដោយប្រើប្រាស់នូវ Function virtual ។ Run Time ជា ពេលដែល Machine ធ្វើការដំណើរការកូដ។ Run Time Error កើតនៅពេល យើងសរសេរ ខុស logical ឬ concept ។

ឧទាហរណ៏ ៖

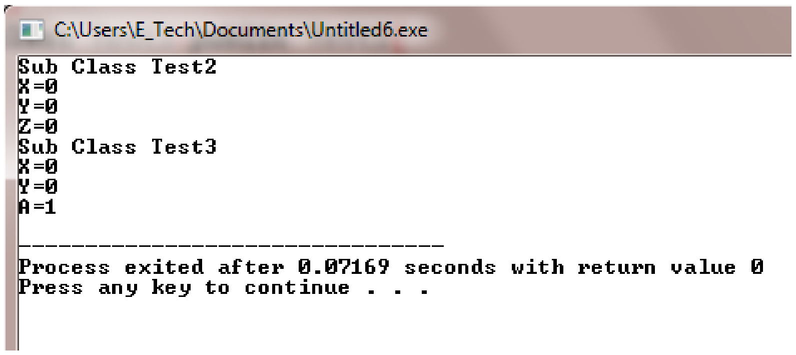


```
#include<iostream>
using namespace std;
class Test1{
    protected:
        int x;
        int y;
    public:
    Test1()
    {
        x=0;
        y=0;
    }
    Test1(int x,int y)
    {
        this->x=x;
        this->y=y;
    }
virtual void Display()
    {   cout<<"Base Class Test1"<<endl;
        cout<<"X="<<x<<endl;
        cout<<"Y="<<y<<endl;
    }
};
class Test2:public Test1{
    private:
      int z;
      public:
    Test2()
    {
        x=0;
        y=0;
    }
    Test2(int x,int y,int z)
    {
        this->x=x;
        this->y=y;
        this->z=z;
    }
```



```
    void Display()
    {   cout<<"Sub Class Test2"<<endl;
        cout<<"X="<<x<<endl;
        cout<<"Y="<<y<<endl;
        cout<<"Z="<<y<<endl;
    }
};
class Test3:public Test1{
    private:
      int a;
      public:
    Test3()
    {
        x=0;
        y=0;
    }
    Test3(int x,int y,int z)
    {
        this->x=x;
        this->y=y;
        this->a=a;
    }
    void Display()
    {   cout<<"Sub Class Test3"<<endl;
        cout<<"X="<<x<<endl;
        cout<<"Y="<<y<<endl;
        cout<<"A="<<a<<endl;
    }
};
int main()
{  Test1 *t1;
   Test2 t2;
   Test3 t3;
   t1=&t2;
   t1->Display();
   t1=&t3;
   t1->Display();

}
```

លទ្ធផលទទួលបាន៖



C:\Users\E_Tech\Documents\Untitled6.exe

```
Sub Class Test2
X=0
Y=0
Z=0
Sub Class Test3
X=0
Y=0
A=1

--------------------------------
Process exited after 0.07169 seconds with return value 0
Press any key to continue . . .
```

យើងសង្កេតឃើញថា ក្រោយពីដាក់នូវ Function virtual នៅពីមុខ Function Display មកហើយអោយ Object របស់ Base Class ចង្អុលទៅ កាន់ Object របស់ Sub Class គឺវាចាប់យក ទិន្នន័យរបស់ Sub Class វិញ។

លំហាត់អនុវត្តន៍

១. ចូលសរសេរប្រូក្រាមមួយដែលប្រើប្រាស់ Class ហើយក្នុង នោះត្រូវរួមបញ្ចូល នូវ getter, setter, overloading constructor, overloading method, override method, និង concept inheritance ។

“រៀនអត់ដឹងទៅណា, រៀនអត់ផែនការ, រៀនអត់សកម្មភាព , រៀនអត់ពេលវេលាច្បាស់ទេ និងអត់អនុវត្តន៏អីសោះ កុំសង្ឃឹមចេះអោយសោះ...”

_គ្រូអាយធីចិត្តល្អ