Hochiminh City University of Technology
Computer Science and Engineering
[CO1027] - Fundamentals of C++ Programming

Class

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Credits: 3

Outcomes

- Understand the concept of Class.
- Understand advantages of Object Oriented Programming (OOP).
- Be able to program using OOP technique.

Outline

- Class:
  - Concept and definition
  - Encapsulation
- Constructor/Destructor

Structure versus Object-Oriented Programming

- **Structure programming** focuses on the process/actions that occur in a program. The program starts at the beginning, does something, and ends.

- **Object-Oriented programming** is based on the data and the functions that operate on it. Objects are instances of abstract data types that represent the data and its functions

Limitations of Structure Programming

- If the data structures change, many functions must also be changed
- Programs that are based on complex function hierarchies are:
  - difficult to understand and maintain
  - difficult to modify and extend
  - easy to break

Class

Class

- Class: a user defined datatype which groups together related pieces of information
  - Data
  - Functions (Methods)
- **Classes** are similar to **Structure** but contain functions, as well.

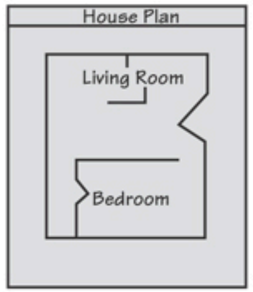
Terminologies

- Object is an instant of a particular class
- Data are known as fields, members, attributes, or properties
- Functions are known as methods

Classes and Objects

- A Class is like a blueprint and objects are like houses built from the blueprint

Blueprint that describes a house.



Instances of the house described by the blueprint.

Features

- Encapsulation (hiding data): allows the programmer to group data and the subroutines that operate on them together in one place, and to hide irrelevant details from the user.
- Inheritance: allows code to be reused between related types.
- Polymorphism: allows a value to be one of several types, and determining at runtime which functions to call on based on its type.

Encapsulation

- Packaging related stuff together
- User need to know only public methods/data of the object: interface
- Interfaces abstract away the details of how all the operations are performed
  - "Data hiding", "black box".

Class Declaration

```
class <Class_Name>
{
<access_specifier>:
    member declaration;
    ...
<access_specifier>:
    member declaration;
    ...
};
```

Class Example

```
class Rectangle
{
private:
   double width;
   double height;
public:
   void setWidth(double);
   void setHeight(double);
   double getWidth();
   double getHeight();
   double getArea();
};
```

Class Access specifier

- Used to control access to members of the class:
  - private (**default**) : the members declared as private are only accessible from within the class. No outside Access is allowed.
  - public: the members declared as public are accessible from outside the Class through an object of the class.
- Can be listed in any order in a class
- Can appear multiple times in a class

Member Function Definition

- When defining a member function:
  - Put prototype in class declaration
  - Define function using class name and scope resolution operator (::)

```
void Rectangle::setWidth(double w)
{
   width = w;
}
```

Declaration vs Definition

- Separate the declaration (specification) part from the definition (implementation) part.
- Place class declaration in a header file. E.g. Rectangle.h
- Place member function definitions in *.cpp file. E.g. Rectangle.cpp. This file must #include the class specification file.
- Programs that use the class must #include the class specification file.

Set and Get

- Set (mutator): a member function that stores a value in a private member variable, or changes its value in some way.

```
void setWidth(double);
void setHeight(double);
```

- Get (accessor): a member function that retrieves a value from a private member variable.

```
double getWidth();
double getHeight();
```

Using `const` With Member Functions

- `const` appearing after the parentheses in a member function declaration specifies that the function will not change any data in the calling object.
- Example

```
double getWidth() const;

double getHeight() const;

double getArea() const;
```

Scope operator

- Scope operator `::`
  - Is used in the definition of member function outside the class
  - Inline function vs. normal function
    - Member functions defined in the class definition is considered as inline function.

Static Class Members

- Static data members: are considered as “class” variables since they are common variables for all objects of the same class.
  - Need to be initialized somewhere outside the class
  - Can be accessed through object or class
  - Example: object counter
- Static function members: can only access static members of the class.

Constructor vs Destructor

Constructor

- Constructors: a special function that is automatically called whenever a new object is created .
  - allow the class to initialize member variables or allocate storage.
  - do not return a value, including void.
  - can not be called explicitly as member functions.

Default Constructor

- A default constructor is a constructor that takes no arguments.
- If you write a class with no constructor at all, C++ will write a default constructor for you, one that does nothing.
- A simple instantiation of a class (with no arguments) calls the default constructor:

```
Rectangle r;
```

Constructor Syntax

```
class <Class_Name>
{
      ...
public:
      <Class_Name>();
      ...
};
```

Constructors with Parameters

- To create a constructor that takes arguments:
  - Indicate parameters in prototype:

```
Rectangle(double , double );
```

  - Use parameters in the definition:

```
Rectangle::Rectangle(double w, double h)
{
   width = w;
   height = h;
}
```

- You can pass arguments to the constructor when you create an object:

```
Rectangle r2(6, 4);
```

More About Default Constructors

- If all of a constructor's parameters have default arguments, then it is a default constructor. For example:

```
Rectangle(double = 0, double = 0);
```

- Creating an object and passing no arguments will cause this constructor to execute:

```
Rectangle r;
```

Overloading Constructors

- A class can have more than one constructor. They can be overloaded.
- The compiler automatically call the one whose parameters match the arguments.

```
Rectangle();

Rectangle(double);

Rectangle(double, double);
```

Destructor

- Destructor: responsible for the necessary cleanup of a class when lifetime of an object ends.
- Destructors cannot:
  - return a value
  - accept parameters
- Destructors must have the same name as the class.
- Only one destructor per class, i.e., it cannot be overloaded
- If constructor allocates dynamic memory, destructor should release it

Destructor Syntax

```
class <Class_Name>
{
      ...
public:
      ~<Class_Name>();
      ...
};
```

Using Private Member Functions

- A `private` member function can only be called by another member function
- It is used for internal processing by the class, not for use outside of the class
- If you wrote a class that had a public sort function and needed a function to swap two elements, you'd make that private

Arrays of Objects

- Objects can be the elements of an array:

```
Rectangle rooms[8];
```

- Default constructor for object is used when array is defined

Arrays of Objects

- Must use initializer list to invoke constructor that takes arguments:

```
Rectangle rectArray[3]={Rectangle(2.1,3.2),
                        Rectangle(4.1, 9.9),
                        Rectangle(11.2, 31.4)};
```

Accessing Objects in an Array

- Objects in an array are referenced using subscripts

- Member functions are referenced using dot notation:

```
rectArray[1].setWidth(11.3);
cout << rectrArray[1].getArea();
```

Pointer to Class

- Objects can also be pointed by pointers. Class is a valid type.
- Class pointers is similar to struct pointers.
- E.g.:

```
Rectangle r2(6, 4);
Rectangle* r3 = &r2;
cout << r3->getArea() << endl;
cout << (*r3).getArea() << endl;
```

Using the this Pointer

- Every object has access to its own address through a pointer called `this` (a C++ keyword)

```
void Rectangle::setWidth(double width)
{
   this->width = width;
}
```

Summarise

- Understand Class: concept and definition, encapsulation
- Member functions, static and const members
- Constructor/Destructor and overloaded operators