



CS250 Intro to CS II

Spring 2014

Chapter 13

Introduction to Classes

- Reading: pp. 705-723, 728-734
- Good Problems to Work: p. 727 13.1, 13.2, 13.3, 13.4, 13.5,

Introduction to Classes

- Procedural programming is a programming methodology centered on procedures (or actions) taking place in a program
- Object-oriented programming is a programming methodology centered on objects created from user-defined data types that encapsulate data and functions together

OOP

The class is a C++ construct used to create objects which are fundamental to object-oriented programming (OOP).

- OOP hides the details of objects from objects of other types
- When an object needs information from another object or needs another object to perform a task, a message is sent as a form of communication between objects
- As a result, object-oriented programs can be written more generically than structured programs
- Usually, making changes to the object-oriented programs is easier than changing structured programs

Class Declaration

A class:

1. is a programmer-defined datatype
2. consists of variables and functions:

General Format

```
class ClassName
```

```
{  
  Declarations for member variables and member  
  functions  
};
```

Person Class

```
const int CURRENT_YEAR = 2014;
class Person
{
    public:
        int getAge ();
        int getBirthYear ();

        int mAge;
};
int main ()
{
    Person cPerson;

    cPerson.mAge = 28;
    cout << "Person is: " << cPerson.getAge () << endl;
    cout << "Person Born in: " << cPerson.getBirthYear () << endl;

    return EXIT_SUCCESS;
}
```

Person Class Definitions

```
int Person::getAge ()
{
    return mAge;
}
```

```
int Person::getBirthYear ()
{
    return CURRENT_YEAR - mAge;
}
```

public: versus private:

- Class data members and member functions can be either `private:` or `public:`
- Private data members and member functions can only be accessed within the class in which they are defined
- Public data members and member functions can be accessed from inside or outside of the class in which they are defined

Revised Person Class

```
class Person
{
    public:
        void setAge (int age);    // member function prototypes
        int  getAge ();
        int  getBirthYear ();

    private:
        int  mAge;                // private member variable
};
int main ()
{
    Person cPerson;              // creates (instantiates) a Person object

    cPerson.mAge = 28;           // error
    cPerson.setAge (28);        // correct setting of age
}
```

Mutator

- A mutator is any function that can change the value of a member variable

```
void Person::setAge (int age)
{
    mAge = age;
}
```

Accessor

- An accessor is a function that uses a class member but cannot change the member value
- Using the reserved word `const` after a function prototype prohibits the function from changing any data directly in the class

```
int Person::getAge () const
{
    return mAge;
}
```

Revised Person Class

```
class Person
{
    public:
        void setAge (int age);           // mutator
        int getAge () const;            // accessor
        int getBirthYear () const;     // accessor

    private:
        int mAge;                       // private member variable
};
```

Rectangle ADT?

- A rectangle has a width and length
- Operations we might want to perform on a rectangle include
 - setting the length or width to a value
 - getting the length or width
 - calculating the area
 - calculating the perimeter

Representation in a Procedural Language

- Basically length and width are set/reset somewhere and getArea and getPerimeter can be called when needed
- length and width are separate from the functions

```
double length;
```

```
double width;
```

```
double getArea (double length, double width);
```

```
double getPerimeter (double length, double width);
```

OO Representation

```
class Rectangle
{
    public:
        void setLength (double length);
        void setWidth (double width);
        double getLength () const;
        double getWidth () const;
        double getArea () const;
        double getPerimeter() const;

    private:
        double mLength;
        double mWidth;
};
```

class Rectangle Questions

Q1: How many members does class Rectangle have? List them.

Q2: How many functions does class Rectangle have? List them.

Q3: How many mutators does class Rectangle have? List them.

Q4: How many accessors does class Rectangle have? List them.

class Rectangle Questions

Q5: Where can we define any member function?

Q6: Show how getArea is defined both ways.

class Rectangle Questions

Q7: How do we create objects of class Rectangle?

- a) A regular object

- b) An array of 50 objects

class Rectangle Questions

Q8: Write the C++ code that shows how to use each of the objects created in Q7 a) & b).

Constructors

- Special member function to initialize data members
- Has the same name as the class
- Does not have a return value
- The constructor is called whenever an object of that class is created (instantiated)

Constructor for Rectangle

What might the constructor for class Rectangle look like?

- 1) Add `Rectangle ()` ; as a public member prototype of Rectangle
- 2) Add implementation code as:

```
Rectangle::Rectangle (double length, double width)
{
    mLength = length;
    mWidth = width;
}
```

OO Features

- Information hiding
 - Separate the implementation (.cpp) from the interface (.h)
 - Objects are concerned with the interface, for example what functions are available to manipulate the data
 - Objects are not concerned with the implementation. They do not care how the functions do what they do

Overloaded Constructors

- Constructors and functions can be overloaded (multiple definitions)
- We could have multiple constructors in the Rectangle class, each of which accepts a different number of arguments
- The appropriate constructor will be chosen based on the number of arguments used when creating the object

Overloaded Rectangle Constructor

```
// default constructor
```

```
Rectangle::Rectangle ()  
{  
    mLength = mWidth = 0;  
}
```

```
// overloaded constructor
```

```
Rectangle::Rectangle (double length, double width)  
{  
    mLength = length;  
    mWidth = width;  
}
```


Default Constructor

- The default constructor is the constructor with no arguments
- If you do not create any constructors in your class, then the default constructor will be created for you
- If you only have a constructor that takes arguments, then there is no default constructor
- It is good programming practice to always create a default constructor, why?

Default Arguments

- You can set default arguments to constructors
- In the class definition, the constructor prototype will be
 - `Rectangle (double = 0.0, double = 0.0);`

- The function definition will be

```
Rectangle::Rectangle (double length,  
                     double width)  
{  
    mLength = length;  
    mWidth = width;  
}
```

Using Default Arguments

- By having default arguments in the constructor, we can now create objects of the Rectangle class as follows:

```
Rectangle cR1 ;
```

```
Rectangle cR2 (10.0) ;
```

```
Rectangle cR3 (5.0, 25.0) ;
```

Rectangle Interface

```
#ifndef RECTANGLE_H
#define RECTANGLE_H

class Rectangle
{
public:
    Rectangle (double = 0.0, double = 0.0);
    void setLength (double);
    void setWidth (double);
    double getLength () const;
    double getWidth () const;
    double getArea () const;
    double getPerimeter() const;

private:
    double mLength;
    double mWidth;
};

#endif
```

Rectangle Implementation

```
#include "Rectangle.h"

// overloaded constructor
Rectangle::Rectangle (double length, double
width)
{
    mLength = length;
    mWidth = width;
}
```

Problem

- Grab the files `Rectangle.h`, `Rectangle.cpp`, and `main.cpp` from the folder `Rectangle` found in the `Public` directory
- Add a project `Rectangle` to your `CS250InClass` solution
- Place the three files appropriately into the project, build, and run