The Class Construct

Defining objects with attributes and behavior

Class Types

- Class construct
  - Allows programmers to define new data types for representing information
  - Class type objects can have both attribute components and behavior components
  - Provides the object-oriented programming in C++

- Example we shall consider is
  - RectangleShape
Terminology

- **Client**
  - Program using a class

- **Object behaviors**
  - Realized in C++ via member functions (methods)
    - RectangleShapes can be drawn or resized

- **Object attributes**
  - Are known as data members in C++
    - RectangleShapes have width, height, position, color

Member Functions

- Provide a controlled interface to data members and object access and manipulation
  - Create objects of the class
  - Inspect, mutate, and manipulate object of the class
  - Can be used to keep data members in a correct *state*

  - SetSize()
  - SetColor()
  - Draw()
Member Functions

◆ Constructors
  - Member functions that initialize an object during its definition
    \[ \text{RectangleShape} \, R(W, \, x, \, y, \, c, \, w, \, h); \]
  - Factoid
    ✤ Constructors do not have a type
    ■ Considered superfluous

Member Functions

◆ Inspectors
  - Member functions that act as a messenger that returns the value of an attribute

  - Example
    ✤ RectangleShapes have an inspector \( \text{GetColor()} \)

  \[
  \text{color} \, \text{CurrColor} = \text{R.GetColor();}
  \]
Member Functions

◆ Mutators
  - Changes the value of an attribute

  - Example
    - RectangleShapes have a mutator SetColor()

      \[
      R.\text{SetColor}(\text{Black});
      \]

Member Functions

◆ Facilitators
  - Causes an object to perform some action or service

  - Example
    - RectangleShapes have a facilitator Draw()

      \[
      R.\text{Draw}();
      \]
A Simple RectangleShape Class

- Consider a simpler version of the RectangleShape than what is defined in rect.h
- Giving the class definition *not* the implementation
- The definition in rect.h uses inheritance and member functions with default parameters
  - If you are wondering what is missing
    - Default constructor parameters
    - Member function
      - Erase()
    - Inherited member functions
      - HasBorder(), SetBorder(), and ClearBorder()

Simple RectangleShape Header File

```cpp
#ifndef RECT_SHAPE_H
#define RECT_SHAPE_H
#include "ezwin.h"

class RectangleShape {
public:
  // constructor
  RectangleShape(SimpleWindow &Window, float XCoord, float YCoord, const color &c, float Width, float Height);
  // facilitator
  void Draw();

  /* Other member functions */

  // Preprocessor directives
  ifndef RECT_SHAPE_H
  define RECT_SHAPE_H
  #endif

  /* ezwin.h get us definitions of SimpleWindow and color */
};
```

Passed by reference, do not want a copy of the window

Access right indicates no limitations on who can use these members
Simple RectangleShape

// inspectors
color GetColor() const;
float GetWidth() const;
float GetHeight() const;
void GetSize(float &Width, float &Height) const;
void GetPosition(float &XCoord, float &YCoord) const;
SimpleWindow& GetWindow() const;

Indicates the member functions won't change the object
Reference return, brings actual window (not a copy)

Simple RectangleShape

// mutators
void SetColor(const color &c);
void SetPosition(float XCoord, float YCoord);
void SetSize(float Width, float Height);

Lack of const indicate the member function might change the object
Simple RectangleShape

private:
// data members
SimpleWindow &Window;
float thisXCenter;
float thisYCenter;
color thisColor;
float thisWidth;
float thisHeight;


A client cannot directly access either private or protected data members

Access Tests

◆ Consider
SimpleWindow W("Testing", 20, 10);
RectangleShape R(W, 2, 2, Blue, 4, 3);
const RectangleShape S(W, 15, 10, Red, 5, 6);

◆ Can we do the following?
- color c = R.GetColor();
- color d = S.GetColor();
- color d = R.thisColor;
- R.DetColor(Yellow);
- S.SetColor(Black);
The RectangleShape Class

- **Public access**
  - All clients and class members have access to the public members
- **Private access**
  - Only class members have access to the private members

### Access from outside of class
- Access denied

### Instantiations
- **C**: RectangleShape
  - DM: Window, Color, XCenter, YCenter, Width, Height
  - MF: Draw(), GetColor(), GetSize(), GetWidth(), GetHeight(), GetPosition(), GetWindow(), SetColor(), SetPosition(), SetSize()

- **O**: R1
  - DM: Window: &W, Color: Cyan, XCenter: 1, YCenter: 4
  - Width: 3, Height: 3

- **O**: R2
  - DM: Window: &W, Color: Red, XCenter: 6, YCenter: 4
  - Width: 1, Height: 2
#include "rect.h"
SimpleWindow ColorWindow("Color Palette", 8.0, 8.0);
int ApiMain() {
    const int SideSize = 1;
    float XPosition = 1.5;
    const float YPosition = 4;
    ColorWindow.Open();
    RectangleShape ColorPatch(ColorWindow,
        XPosition, YPosition, White, SideSize, SideSize);
    for (int c = Red; c <= Magenta; c = color(c + 1)) {
        ColorPatch.SetColor(color(c));
        ColorPatch.SetPosition(XPosition, YPosition);
        ColorPatch.Draw();
        XPosition += SideSize;
    }
    return 0;
}