Chapter 15
Inheritance, Polymorphism, Virtual Functions

Spring 2018

Key Terminology

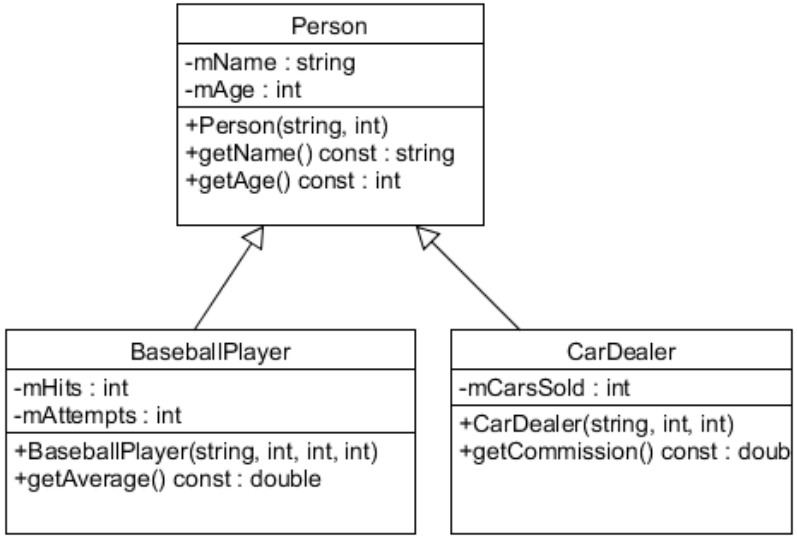
- Inheritance
- Superclass
- Subclass
- Base class
- Derived class
- is-a relationship
- Composition
- has-a relationship

Inheritance

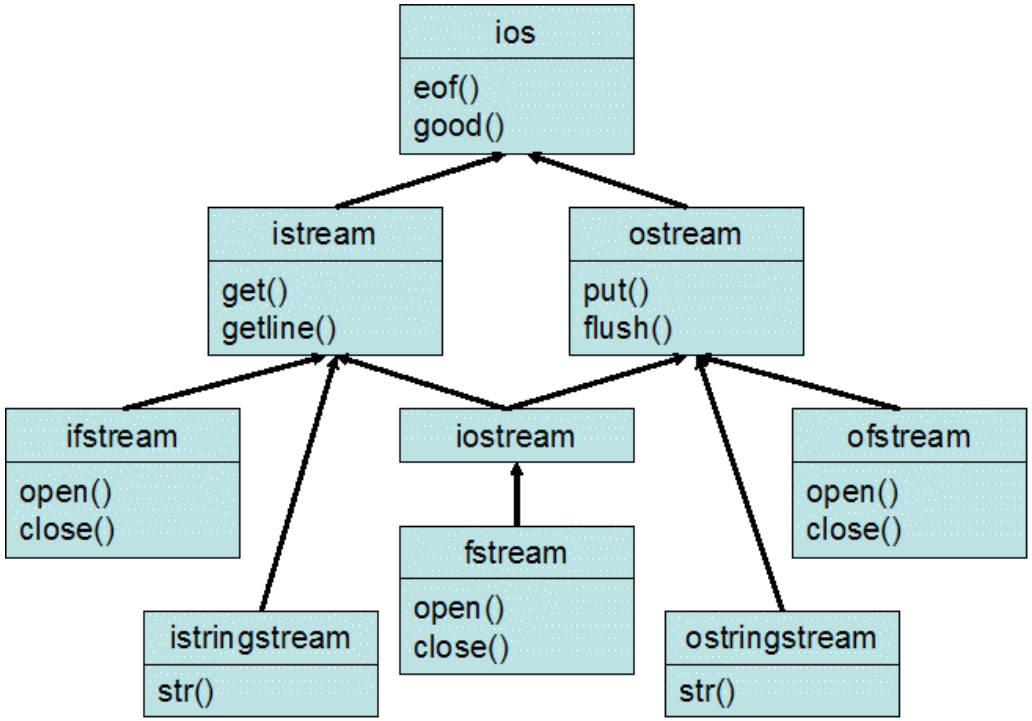
- Allows a new class to be based on an existing class (reusability)
- The new class inherits
  - all member variables
  - all member functions (excluding the constructors and destructor)
- The new class then adds new functionality

Simple Inheritance

- UML Diagram
- UML Software
  http://www.umlet.com/umletino/umletino.html
- Class
  class name
  member variables
  member functions
- – means private
  + means public



More Complex Inheritance



(c) C++ How to program by Deitel

Inheritance and the is-a relationship

- A car is-a vehicle
- A rectangle is-a shape
- An athlete is-a person
- A football player is-a athlete

OOP Terminology

- Inheritance is used to create an is-a relationship
- Inheritance involves a base class (also called a superclass or parent class) and a derived class (also called a subclass or a child class)
- base class is the existing class
- derived class is the new class with inherited members and additional behaviors

Simple Inheritance Example

```
class Employee
{
  public:
    Employee (std::string name = "",
              std::string ssn = "");
    std::string getName () const;
    std::string getSSN () const;
    void print (std::ostream &rcOut) const;

  private:
    std::string mName;
    std::string mSSN;
};
```

HourlyEmployee

- An hourly employee is an employee that
  - earns an hourly wage rate
  - works a certain number of hours

- What additional member variables and behavior is necessary for an hourly employee? Let's draw the UML diagram.

Public Inheritance

- Every derived class object is also an object of the superclass.
- As an example, if the superclass is "Vehicle" then a subclass might be "Cars" and "Trucks." Cars inherit the members and behaviors of a Vehicle and add other behaviors and members
- Members of a subclass cannot directly access the private members of a superclass

Let's Play

1. Grab the solution Inheritance from CS250 Public and let's go though the initial setup
2. Write a print function for HourlyEmployee
3. Create a subclass (derived class) called SalariedEmployee for an employee that works on a yearly salary model. Write the interface and implementation for SalariedEmployee.
4. Make sure this is done before next class

Let's Play

4. Create the following data file employees.txt:

```
S Black 123456789 32000.0
H Ford 234567890 10.0 40.0
H Goodman 345678901 15.0 45.0
S Howell 456789012 44000.0
S Powell 567890123 50000.0
H Smith 678901234 22.5 40
```

5. Overload and test the extraction operator for Employee to print the name and SSN as on the last slide
6. Overload and test the extraction operator for SalariedEmployee
7. Read the first line of data into a SalariedEmployee object. Read the type S or H into a char variable.

Let's Play

4. Create an array of HourlyEmployees and SalariedEmployees.
5. Read the data from the data file into the appropriate array in a single loop without printing any information.
6. Print out each person's monthly gross income in separate loops from 6.

Let's Play

6. Results

```
Name: Black SSN: 123456789 Monthly Earnings $2666.67
Name: Howell SSN: 234567890 Monthly Earnings $3666.67
Name: Powell SSN: 345678901 Monthly Earnings $4166.67
Name: Ford SSN: 456789012 Monthly Earnings $400.00
Name: Goodman SSN: 567890123 Monthly Earnings $675.00
Name: Smith SSN: 678901234 Monthly Earnings $900.00
Press any key to continue . . .
```