



Chapter 14

Friends of Classes

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- Reading pp.807-812, 819-853
 - Good Problems to work: p. 811 14.1, 14.2, 14.3, 14.4, 14.5, 14.6, 14.7; p. 834 14.14, 14.19; p. 846 14.21

Friends of Classes

- Only the member functions of a class have direct access to the private data members of the class
- **friend** functions are friends of the class that are defined outside of the class but still have access to private data members

Friends of Classes

- A friend function can be
 - a) a regular stand-alone function
 - b) a member of another class
 - c) an entire class

friend Functions

- The function prototype is placed in the class, preceded by the keyword **friend**
- The function definition can be written anywhere without the class name (class::)
- The function is able to directly access the private data members of the class

Operator Overloading

- C++ allows overloading operators to work with class objects
- For example, we can overload the extraction operator `>>` and insertion operator `<<` for Rational objects

Overloading Stream Operators

- Two classes named ostream and istream provide stream I/O.
- Definitions for >> and << are provided for the primitive datatypes such as int, float, char, and so on but not for programmer-defined types. Stream operators can be overloaded for our **Rational** class. As an example, we would like the following to have meaning:

```
Rational cR1(3,1);  
  
cout << "Enter a rational number:";  
cin >> cR1;
```

In particular, we would like to be able to enter a value such as 1/3 for cR1.

Overloading Stream Operators

- The general format for overloading the stream operators is as follows:

```
class ClassDef
{
    public:
        .....
        friend ostream& operator>> (ostream &cOutputStream,
                                     ClassDef &cObject);
        friend ostream& operator<< (ostream &cOutputStream,
                                     const ClassDef &cObject);

    private:
        .....
};
```

Overloading Stream Operators

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- Note: For the stream extraction operator `>>` some istream object is passed to the operator function through **cInputStream** such as `cin`.
 - Similarly, the stream insertion operator `<<` is passed some ostream object through **cOutputStream** such as `cout`.
 - The function returns a modified stream so that the following chain can be executed correctly:
 - `cin >> r1 >> r2; // What is the associativity of >>? Why?`
 - Similar logic is used for the insertion operator `<<` function.

Overload Insertion Operator <<

```
class Rational
{
    public:
        Rational (void);
        Rational (int, int);
        .....
        friend ostream& operator<< (ostream &,
                                     const Rational &);

    private:
        ...
};
```

Overload Insertion Operator <<

```
ostream& operator<< (ostream &cOutput,  
                    const Rational &cRational)  
{  
    cOutput << cRational.mNumerator << '/'  
            << cRational.mDenominator;  
    return cOutput;  
}
```

Overload Problem for Rational

1. Overload the insertion operator
2. Overload the extraction operator
3. Overload the multiplication operator
4. Write a driver to test all methods and overloaded operators