const and Composition

const

- Many things can be specified as const in C++
- Examples:
  - Objects
  - Member Functions
  - Data members

const Objects

- Principle of least privilege
- What happens when we declare any object to be a const?
- Example:
  - const int SIZE = 50;
- What do you think it means if I have
  - const Time dinnerTime(18, 30, 0);
- What member functions of class Time do you think dinnerTime can call?

const Member Functions

- A const object can only call const data members
- How do we declare member functions to be const?
  - Use the const keyword in both the function prototype and the function definition
  - Appears after the parameter list
- const member functions CANNOT modify data members

const Member Functions

```
class Rational
{
public:
   Rational( int = 0, int = 1 );
   Rational addition( const Rational & );
   Rational subtraction( const Rational & );
   Rational multiplication( const Rational & );
   Rational division( const Rational & );
   void printRational ();
private:
   int numerator;
   int denominator;
   void reduction();
};
```

- Which functions should be const functions?
- How would we make them const functions?

const Data Members

- Are the following statements correct?
  - const int x;
  - x = 50;

const Data Members

- const variables need to be initialized as soon as they are declared
- It is illegal to initialize the data members of a class

```
class Simple
{
private:
  const int SIZE = 50;    // ILLEGAL
public:
  Simple( );
};
```

const Data Members

- To initialize data members we must use a *member initializer list* (also called a constructor initializer list)
- Constants are initialized every time the constructor is called (i.e whenever an object is created)

Member Initializer List

```
class simple
{
private:
  const int SIZE;
public:
  simple( );
};

simple::simple( ) : SIZE( 50 )
{
}
```

Member Initializer List

- Can member initializer lists be used for non-constant data members?
- Yes!

```
class simple
{
private:
  const int SIZE;
  int num;
public:
  simple( );
};

simple::simple( ) : num( 4 ), SIZE( 50 )
{
}
```

Example

- Write a complete class that will contain an integer counter that will increment by a constant amount using an increment member function
- Write a driver for this program
  - A driver is the main part of the program

Initializing Constants

- It is possible to initialize constants when creating the object rather than inside of the constructor
- Makes it possible to have two objects of the same class with different constant values
- How would we modify the Increment class so that the increment value is different for each object created?

Composition

- All the data members we have seen so far have been simple variables (int, double, etc)
- It is possible to have objects of classes as data members of other classes
- This is called composition

Example

- Create a class Employee that will contain the employee name and the time the employee starts work and the time the employee finishes work
- The time should be represented as objects of class Time

Summary

- Today we covered
  - const data members, objects, and member functions
  - Composition
- Completed pages 469 - 485