OBJECT ORIENTED PROGRAMMING LAB

Lab Manual # 07

Operator overloading, Enumeration

Instructor: Iqra Rehman

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Fast National University of Computer and Emerging Sciences Peshawar

Department of Computer Science

OBJECT ORIENTED PROGRAMMING LANGUAGE

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Operator Overloading

In C++, we can change the way operators work for user-defined types like objects and structures. This is known as **operator overloading**. For example, Suppose we have created three objects c1, c2 and result from a class named Complex that represents complex numbers.
Since operator overloading allows us to change how operators work, we can redefine how the + operator works and use it to add the complex numbers of c1 and c2 by writing the following code:

```
result = c1 + c2;
```

instead of something like

```
result = c1.addNumbers(c2);
```

This makes our code intuitive and easy to understand.
Note: We cannot use operator overloading for fundamental data types like int, float, char and so on.

Syntax for C++ Operator Overloading

To overload an operator, we use a special operator function. We define the function inside the class or structure whose objects/variables we want the overloaded operator to work with.

```
class className {
    ... .. ...
    public
       returnType operator symbol (arguments) {
           ... .. ...
       }
    ... .. ...
};
```

Here,

- `returnType` is the return type of the function.
- `operator` is a keyword.
- `symbol` is the operator we want to overload. Like: +, <, -, ++, etc.
- `arguments` is the arguments passed to the function.

Operator Overloading in Unary Operators

Unary operators operate on only one operand. The increment operator ++ and decrement operator -- are examples of unary operators.

Example:

```
// Overload ++ when used as prefix

#include <iostream>
```

```
using namespace std;

class Count {
   private:
    int value;

   public:
    // Constructor to initialize count to 5
    Count() : value(5) {}

    // Overload ++ when used as prefix
    void operator ++ () {
        ++value;
    }
    void display() {
        cout << "Count: " << value << endl;
    }
};
int main() {
    Count count1;
    // Call the "void operator ++ ()" function
    ++count1;
    count1.display();
    return 0;
}
```

Output:

```
Count: 6
```

Here, when we use ++count1;, the void operator ++ () is called. This increases the value attribute for the object count1 by 1.

Note: When we overload operators, we can use it to work in any way we like. For example, we could have used ++ to increase value by 100.
The above example works only when ++ is used as a prefix. To make ++ work as a postfix we use this syntax.

```
void operator ++ (int) {
    // code
}
```

Notice the int inside the parentheses. It's the syntax used for using unary operators as postfix; it's not a function parameter.

Example:

```
// Overload ++ when used as prefix and postfix

#include <iostream>
using namespace std;

class Count {
   private:
    int value;

   public:

    // Constructor to initialize count to 5
    Count() : value(5) {}


    // Overload ++ when used as prefix
    void operator ++ () {
        ++value;
    }


    // Overload ++ when used as postfix
    void operator ++ (int) {
        value++;
    }

    void display() {
        cout << "Count: " << value << endl;
    }
};


int main() {
    Count count1;

    // Call the "void operator ++ (int)" function
    count1++;
    count1.display();
```

```
    // Call the "void operator ++ ()" function
    ++count1;

    count1.display();
    return 0;
}
```

Output:

```
Count: 6
Count: 7
```

The **Example** works when ++ is used as both prefix and postfix. However, it doesn't work if we try to do something like this:

```
Count count1, result;

// Error
result = ++count1;
```

This is because the return type of our operator function is void. We can solve this problem by making Count as the return type of the operator function.

Return Value from Operator Function (++ Operator)

```
#include <iostream>
using namespace std;

class Count {
   private:
    int value;

   public
       :
    // Constructor to initialize count to 5
    Count() : value(5) {}

    // Overload ++ when used as prefix
    Count operator ++ () {
        Count temp;

        // Here, value is the value attribute of the calling object
```

```
        temp.value = ++value;

        return temp;
    }

    // Overload ++ when used as postfix
    Count operator ++ (int) {
        Count temp;

        // Here, value is the value attribute of the calling object
        temp.value = value++;

        return temp;
    }

    void display() {
        cout << "Count: " << value << endl;
    }
};

int main() {
    Count count1, result;

    // Call the "Count operator ++ ()" function
    result = ++count1;
    result.display();

    // Call the "Count operator ++ (int)" function
    result = count1++;
    result.display();

    return 0;
}
```

Output

```
Count: 6
Count: 6
```

Operator Overloading in Binary Operators

Binary operators work on two operands. For example, result = num + 9;

Here, + is a binary operator that works on the operands num and 9. When we overload the binary operator for user-defined types by using the code:
obj3 = obj1 + obj2;

The operator function is called using the obj1 object and obj2 is passed as an argument to the function.

Eaxmaple:

```
// C++ program to overload the binary operator +
// This program adds two complex numbers
#include <iostream>
using namespace std;

class Complex {
   private:
    float real;
    float imag;

   public:
    // Constructor to initialize real and imag to 0
    Complex() : real(0), imag(0) {}

    void input() {
        cout << "Enter real and imaginary parts respectively: ";
        cin >> real;
        cin >> imag;
    }

    // Overload the + operator
    Complex operator + (const Complex& obj) {
        Complex temp;
        temp.real = real + obj.real;
        temp.imag = imag + obj.imag;
        return temp;
    }
    void output() {
        if (imag < 0)
            cout << "Output Complex number: " << real << imag << "i";
        else
            cout << "Output Complex number: " << real << "+" << imag << "i";
    }
};

int main() {
```

```
    Complex complex1, complex2, result;

    cout << "Enter first complex number:\n";
    complex1.input();

    cout << "Enter second complex number:\n";
    complex2.input();

   // complex1 calls the operator function
   // complex2 is passed as an argument to the function
    result = complex1 + complex2;
    result.output();

    return 0;
}
```

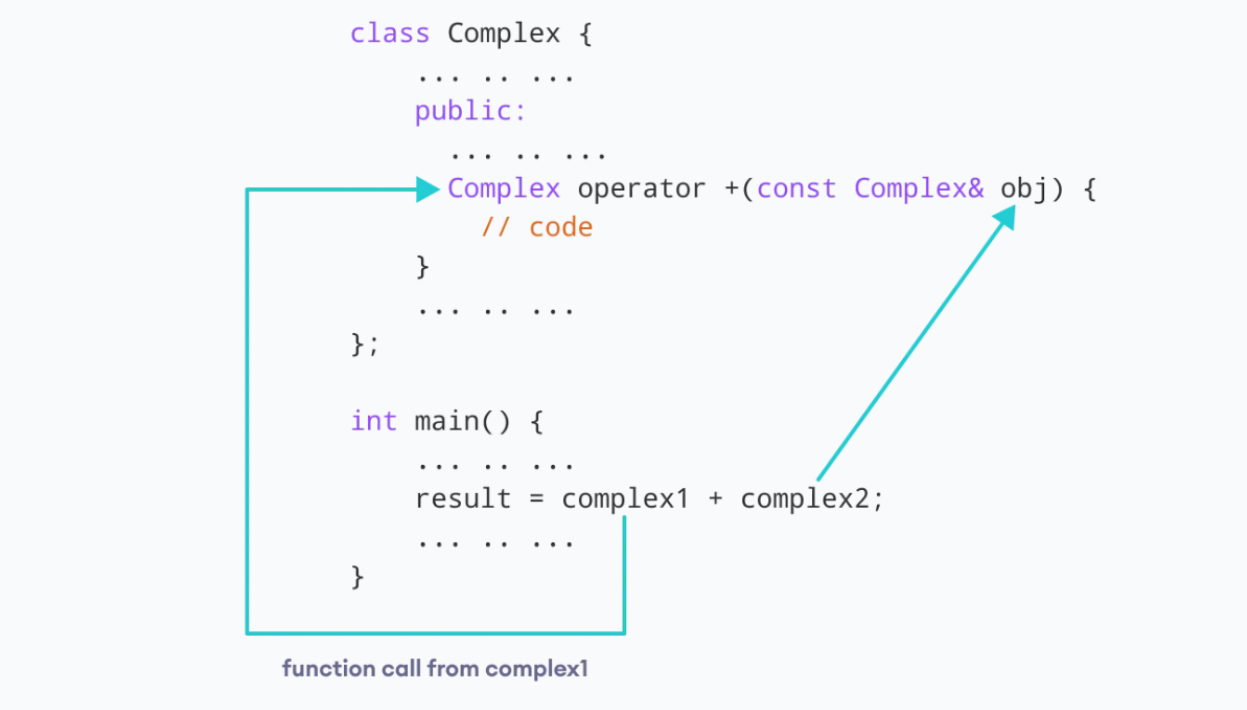
Output:

```
Enter first complex number:
Enter real and imaginary parts respectively: 9 5
Enter second complex number:
Enter real and imaginary parts respectively: 7 6
Output Complex number: 16+11i
```

In this program, the operator function is:

```
Complex operator + (const Complex& obj) {
    // code
}
```

- using & makes our code efficient by referencing the complex2 object instead of making a duplicate object inside the operator function.
- using const is considered a good practice because it prevents the operator function from modifying complex2.



Things to Remember in C++ Operator Overloading

1. Two operators = and & are already overloaded by default in C++. For example, to copy objects of the same class, we can directly use the = operator. We do not need to create an operator function.
2. Operator overloading cannot change the precedence and associativity of operators. However, if we want to change the order of evaluation, parentheses should be used.
3. There are 4 operators that cannot be overloaded in C++. They are:
    a. :: (scope resolution)
    b. . (member selection)
    c. .* (member selection through pointer to function)
    d. ?: (ternary operator)

Enumeration:

- A user defined data type
- Have a set of specified values for variable but variable can have one value from a set of these values.
- It can be used for days of the week (SUNDAY, MONDAY, TUESDAY, WEDNESDAY, THURSDAY, FRIDAY and SATURDAY) , directions (NORTH, SOUTH, EAST and WEST) etc. The C++ enum constants are static and final implicitly.

- C++ Enums can be thought of as classes that have fixed set of constants.
- You can assign value to enum constants but if not assign, then compiler will assign value to them, starting from zero.

Syntax: enum enum_type_name{value1,value2,…..,value n};

Points to remember for C++ Enum:

- enum improves type safety
- enum can be easily used in switch
- enum can be traversed
- enum can have fields, constructors and methods
- enum may implement many interfaces but cannot extend any class because it internally extends Enum class

Eaxmaple:

```
#include <iostream>
using namespace std;

enum week { Monday, Tuesday, Wednesday, Thursday, Friday, Saturday,
Sunday };

int main()
{
   week day;
   day = Friday;
   cout << "Day: " << day+1<<endl;
   return 0;
}
```

References

https://www.programiz.com/cpp-programming/operator-overloading
https://www.javatpoint.com/const-keyword-in-cpp