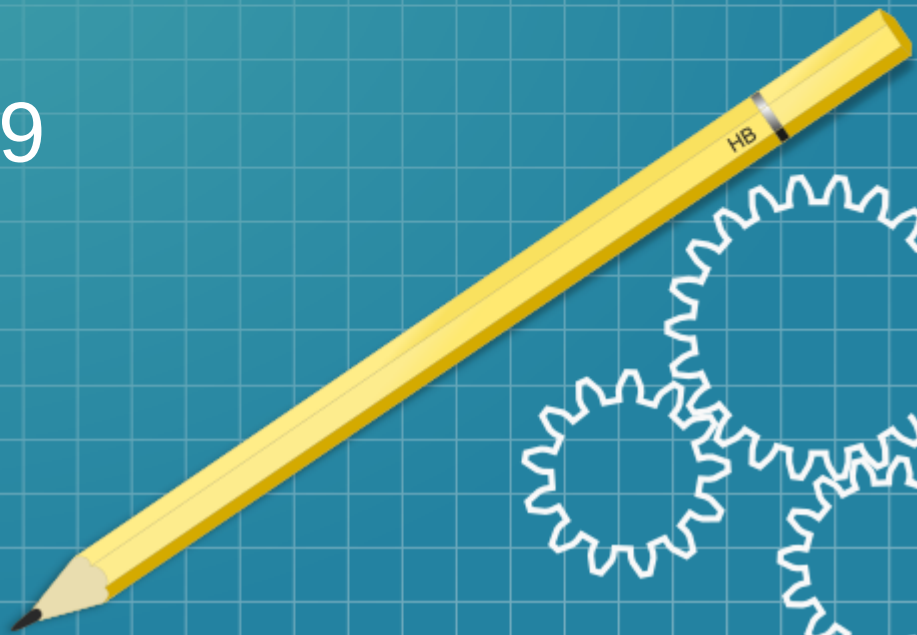
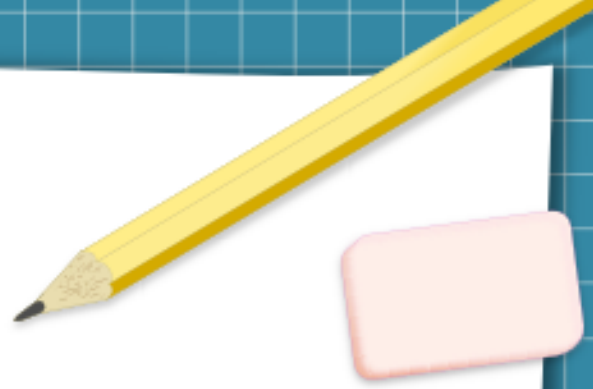
Classes: A Deeper Look (part 2)

Chapter 9



Today we will



Discuss

- return values of member functions
- copy assignment
- `const` objects and `const` Member Functions
- `friend` functions and `friend` classes
- `this` pointer

Complex numbers: returning a value

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// returns reference to the real part
double& Complex::getRealPart2() {
   return realPart;
}

// returns reference to the real part
double* Complex::getRealPart3() {
   return &realPart;
}
```

See complex.h, complex.cpp, usingComplexClass.cpp

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Encapsulation is when we keep the implementation details of our classes private to protect them from direct use that could complicate maintenance.
(from *Programming Principles and Practice Using C++*, by Bjarne Stroustrup) – one of many definitions

Complex numbers: returning a value

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Encapsulation is a process of packaging some data along with the set of operations that can be performed on the data. (from *Data Structures and Algorithms Using Python and C++*, by David M. Reed and John Zelle) – one of many definitions

Default Memberwise Assignment (Copy Assignment)

Consider the following code fragment:

```
Complex d(-3, -4), a(1);

a = d;

cout << a.toString() << endl;
cout << d.toString() << endl;

cout << "modifying a ...\n";

a.setRealPart(-8);
a.setImPart(-9);

cout << a.toString() << endl;
cout << d.toString() << endl;
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```

each data member of d is assigned individually to the same data member in the object a

See complex.h, complex.cpp, dma.cpp

Default Memberwise Assignment (Copy Assignment)

We can pass an object to a function as an argument or return an object from a function.

In such case, by default, *pass-by-value* is used, i.e. a copy of the object is passed/returned.

See complex.h, complex.cpp, dma.cpp

`const` Objects and `const` Member Functions

The statement

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const Complex a(2,5);
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A constructor must be a non-constant member function.

See complex2.h, complex2.cpp, constOandMF.cpp

Objects as Members of Classes

Consider a set of complex numbers …
We can find intersection, union, difference … of sets.

If we decide to define a class Set, we might consider objects of type Complex to be its members.

In this case we observe *has-a relationship*:
a class can have objects of other class as members

`friend` Functions and `friend` Classes

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In the next chapters we will be using it to overload certain operators, like displaying on the screen.

Recall our complex number class: wouldn't it be easier to just cout an object? `cout << a;`

See a silly example of `friend` function declaration in friendFunction.cpp

Using `this` Pointer

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How do member functions know which object to manipulate?
- every object has access to its own address through the pointer called `this`.

`this` is not a part of the object itself, so the `sizeof` operation will not reflect it in the result.

`this` pointer is passed by the compiler as an *implicit* parameter/argument to each of the object's *non-static member functions*.

Using `this` Pointer

We can use `this` pointer to avoid naming conflicts, for example:

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void Complex::setImPart(double imaginaryPart) {

   this->imaginaryPart = imaginaryPart;
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The type of the `this` pointer depends on the type of the object and whether the member function in which this is used is declared `const`:

- in a `non-const` member function, the this pointer has the type `Complex* const` - a constant pointer to a non-constant object
- in a `const` member function, this has the type `const Complex* const` – a constant pointer to a constant object

HW assignment

1) Exercise 9.23 – from previous class meeting

Suggested exercises
(*not for grade, but the questions related to these will appear on a quiz or a test*):
1) Chapter 9, Summary and all Self-Review Exercises
2) Chapter 9, Exercise: 9.16