CS 225

#6: Lifecycle of Classes

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Copy Constructor

When a non-primitive variable is passed/returned **by value,** a copy must be made. As with a constructor, an automatic copy constructor is provided for you if you choose not to define one:

All **copy constructors** will:

The **automatic copy constructor**:

1.

2.

To define a **custom copy constructor**:

cs225/Cube.h

```
4  class Cube {
5    public:
6      Cube();                // default ctor
7      Cube(double length);   // 1-param ctor
8
9
10     double getVolume();
11     double getSurfaceArea();
12
13   private:
14     double length_;
15 };
```

Recall the joinCubes function:

joinCubes-{byValue,byReference,byPointer}.cpp

```
15 Cube joinCubes(Cube ___ c1, Cube ___ c2) {
16   double totalVolume = c1.getVolume() + c2.getVolume();
17
18   double newLength = std::pow( totalVolume, 1.0/3.0 );
19
20   Cube result(newLength);
21   return result;
22 }
```

Bringing Concepts Together:

How many times do our different joinCubes files call each constructor?

	By Value	By Pointer	By Reference
`Cube()`			
`Cube(double)`			
`Cube(const Cube &)`			

Cubes Unite!

Consider a Tower made of three Cubes:

Tower.h

```
1  #pragma once
2
3  #include "cs225/Cube.h"
4  using cs225::Cube;
5
6  class Tower {
7    public:
8      Tower(Cube c, Cube *ptr, const Cube &ref);
9      Tower(const Tower & other);
10
11   private:
12     Cube cube_;
13     Cube *ptr_;
14     const Cube &ref;
15 };
```

Automatic Copy Constructor Behavior:

The behavior of the automatic copy constructor is to make a copy of every variable. We can mimic this behavior in our Tower class:

Tower.cpp

```
10 Tower::Tower(const Tower & other) {
11   cube_ = other.cube_;
12   ptr_ = other.ptr_;
13   ref_ = other.ref_;
14 }
```

```
10 Tower::Tower(const Tower & other) : cube_(other.cube_),
11    ptr_(other.ptr_), ref_(other.ref_) { }
```

...we refer to this as a _____ because:

Deep Copy via Custom Copy Constructor:
Alternatively, a custom copy constructor can perform a deep copy:

Tower.cpp

```
11  Tower::Tower(const Tower & other) {
12    // Deep copy cube_:
13
14
15
16    // Deep copy ptr_:
17
18
19
20    // Deep copy ref_:
21
22
23  }
```

Destructor
The last and final member function called in the lifecycle of a class is the destructor.

Purpose of a **destructor**:

The **automatic destructor**:

1.

2.

Custom Destructor:

cs225/Cube.h

```
 5  class Cube {
 6    public:
 7      Cube();                 // default ctor
 8      Cube(double length);  // 1-param ctor
 9      Cube(const Cube & other);   // custom copy ctor
10      ~Cube();           // destructor, or dtor
11      ...
```

Overloading Operators
C++ allows custom behaviors to be defined on over 20 operators:

Arithmetic	`+  -  *  /  %  ++  --`
Bitwise	`&  |  ^  ~  <<  >>`
Assignment	`=`
Comparison	`==  !=  >  <  >=  <=`
Logical	`!  &&  ||`
Other	`[]  ()  ->`

General Syntax:

Adding overloaded operators to Cube:

cs225/Cube.h

```
 1  #pragma once
 2
 3  class Cube {
 4    public:
 …      // ...
16
17
18
19
20
 …      // ...
```

cs225/Cube.cpp

```
 …  /* ... */
10
11
12
13
14
15
16
17
18
 …  /* ... */
```

Assignment Operator
Among all of the operators, one the assignment operator is unique:

1.

2.

CS 225 – Things To Be Doing:

1. Theory Exam #1 starts **this Thursday**, covers through today
2. MP1 due tonight; grace period until Tuesday @ 11:59pm
3. MP2 released on Tuesday *(start early for extra credit!)*
4. Lab Extra Credit → Attendance in your registered lab section!
5. Daily POTDs every M-F for daily extra credit!