CS 225

#2: Classes and Reference Variables

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Our First Class – Cube:

Cube.h

```
1  #pragma once
2
3  class Cube {
4    public:
5     double getVolume();
6
7
8
9
10
11   private:
12
13
14
15
16 };
```

Cube.cpp

```
1  #include "Cube.h"
2
3  double Cube::getVolume() {
4
5
6  }
7
8
9
10
11
12
13
14
15
16
```

Public vs. Private:

Situation	Protection Level
`Cube` functionality provided to **client code**	
Variable containing data about the `Cube`	
Helper function used in `Cube`	

Hierarchy in C++:

There `Cube` class we're building might not be the only `Cube` class.
Large libraries in C++ are organized into _____.

Cube.h

```
1  #pragma once
2
3  namespace cs225 {
4    class Cube {
5    public:
6      double getVolume();
7
…
```

Cube.cpp

```
1  #include "Cube.h"
2
3  namespace cs225 {
4    double
       Cube::getVolume() {
5        return length_ *
                length_ * length_;
6    }
…
```

Our First Program:

main.cpp

```
1  #include "Cube.h"
2  #include <iostream>
3
4  int main() {
5    cs225::Cube c;
6    std::cout << "Volume: " << c.getVolume() << std::endl;
7    return 0;
8  }
```

…run this yourself: run `make` and `./main` in the lecture source code.

Several things about C++ are revealed by our first program:

1. _____
   `main.cpp:4`
2. _____
   `main.cpp:5, main.cpp:1`
3. _____
   `main.cpp:6, main:cpp:2`
4. However, our program is unreliable. **Why?**

Default Constructor:

Every class in C++ has a constructor – even if you didn't define one!

- Automatic/Implicit Default Constructor:

- Custom Default Constructor:

Cube.h

```
…
4  class Cube {
5    public:
6     Cube();
…     /* ... */
```

Cube.cpp

```
…
3  Cube::Cube() {
4
5
6  }
…
```

Custom, Non-Default Constructors:
We can provide also create constructors that require parameters when initializing the variable:

Cube.h

```
…
4  class Cube {
5    public:
6     Cube(double length);
…     /* ... */
```

Cube.cpp

```
…
3  Cube::Cube(double length) {
4
5
6  }
…
```

Puzzle #1: How do we fix our first program?

puzzle.cpp w/ above custom constructor

```
…
8    cs225::Cube c;
9    cout << "Volume: " << c.getVolume() << endl;
…
```

…run this yourself: run **`make puzzle`** and **`./puzzle`** in the lecture source code.

Solution #1:

Solution #2:

The beauty of programming is both solutions work! There's no one right answer, both have advantages and disadvantages!

Pointers and References – Introduction
A major component of C++ that will be used throughout all of CS 225 is the use of references and pointers. References and pointers both:

- Are extremely power, but extremely dangerous.
- Pointers are **level of indirection** via memory to our data.

As a level of indirection via memory to the data:

1. _____
2. _____

Often, we will have direct access to our object:

```
Cube c1;      // A variable of type Cube
```

Occasionally, we have a reference or pointer to our data:

```
Cube & s1;  // A reference variable of type Cube
Cube * s1;  // A pointer that points to a Cube
```

Reference Variable
A reference variable is an alias to an existing variable. Modifying the reference variable modifies the variable being aliased. Internally, a reference variable maps to the same memory as the variable being aliased:

main-ref.cpp

```
3  int main() {
4    int i = 7;
5    int & j = i;   // j is an alias of i
6
7    j = 4;                              // j and i are both 4.
8    std::cout << i << " " << j << std::endl;
9
10   i = 2;                              // j and i are both 2.
11   std::cout << i << " " << j << std::endl;
12   return 0;
13 }
```

…run this yourself: run **`make`** and **`./main-ref`** in the lecture source code.

Three things to note about reference variables:

1. _____
2. _____
3. _____

CS 225 – Things To Be Doing:

1. Sign up for "Exam 0" (exam starts Thursday, Sept. 6th)
2. Attend lab and complete lab_intro; due Sunday, Sept. 2nd
3. MP1 released Friday; due Monday, Sept. 10th
4. Visit Piazza and the course website often!