C++ Classes odds and Ends, Operators

Some content adapted from ‘Absolute C++’ by Walter Savitch

Outline

- The ‘this’ pointer
- Review Classes - Stack verses Heap
- Review Shallow verses deep copies
- Review Objects and Dynamic data
- Making constructors/operators functions inaccessible
- Static Members
- Operator overloading

The this Pointer

- Member function definitions might need to refer to calling object. Use the predefined *this* pointer. It automatically points to the calling object:

```
Class Simple
{
public:
    void showStuff() const;
private:
    int stuff;
};


void showStuff(){
    cout << stuff;
    cout << this->stuff;
}
```

Refers to this instance of the Simple class

Review – Classes –stack verses Heap

- If created on heap (with new)

```
MyClass *p;
p = new MyClass;
p->grade = "A";  // Equivalent to:
(*p).grade = "A";
```

- If created on stack

```
MyClass mc;
mc.grade = "A";
```

Review-Shallow and Deep Copies

- Shallow copy
  - Assignment copies only member variable contents over (so only pointer addresses copied, NOT the data pointed to)
  - This is how default (compiler generated) assignment and copy constructors work
  - Fine if No dynamic memory involved. (or stateful objects like database or network connections)
- Deep copy
  - Pointers, dynamic memory involved
  - Must dereference pointer variables to "get to" data for copying.
- See https://github.com/CNUClasses/9_shallow_verses_deep_copies

Review-When your object holds dynamic data

- YOU MUST IMPLEMENT
  - **Class destructor**
    - Special member function
    - Automatically destroys objects
  - **Copy constructor**
    - Single argument member function
    - Called automatically when temp copy needed
    - MUST DO DEEP COPY
  - **Assignment operator**
    - Must be overloaded as member function
    - MUST DO DEEP COPY

See sample templates online

Static Members

```
#pragma once
class staticDemo
{
public:
    staticDemo(void);
    virtual ~staticDemo(void);
    static int getNumberInstances();
private:
    static int numberInstances;
};
```

This object used to track number of active Instances of staticDemo object

Static members
Do not need instance of class
Cannot access non static member variables

Static functions
Can only access static mem vars and other static functions

```
#include "stdafx.h"
#include "staticDemo.h"

staticDemo::staticDemo(void)
{
    staticDemo::numberInstances++;
}



staticDemo::~staticDemo(void)
{
    staticDemo::numberInstances--;
}

int staticDemo::getNumberInstances(){
    //since this object is static only
    //static objects can be referenced
    return staticDemo::numberInstances;
}
//initialize static var
int staticDemo::numberInstances=0;
```

Operator Overloading Introduction

- Operators <,+, -, %, ==, etc.
  - Really are just functions!
- Simply "called" with different syntax:
  x < 7
  - “<" is binary operator with x & 7 as operands
  - We "like" this notation as humans
- Think of it as:
  <(x, 7)
  - “<" is the function name
  - x, 7 are the arguments
  - Function “<" returns bool of it’s arguments
- Can be done 2 ways
  - Overload as an object member function
  - Overload as a non member function

Operator Overloading Why

- Already work for C++ built-in types (int, double, etc.)
- Our types get same built in behavior. But we can (and usually need to) customize it programmatically.

Did this already for objects with dynamic data

```
//assignment operator
HoldsDynamicData & operator= (const HoldsDynamicData & other);
```

Overloadable operators

+	-	*	/	=	<	>	+=	-=	*=	/=	<<	>>
<<=	>>=	==	!=	<=	>=	++	--	%	&	^	!	|
~	&=	^=	|=	&&	||	%=	[]	()	,	->*	->	new
delete		new[]		delete[]								

Implement this one to simplify sorting using std::sort

Sorting – what < overload buys you

- Remember using a get function or a friend function to help with sorting?
- Implement < operator. Then the object knows how to sort itself

```
#pragma once
class sortable
{
public:
    sortable();
    ~sortable(void);
    void setValue(int value);
    bool operator< (const sortable& param);
private:
    int value;
};
```

```
bool sortable::operator< (const sortable& param)
{
  return value<param.value;
}
```

implementation

```
vector<sortable> myVector;
//sort using sortables operator <
//no more custom sort functions needed
//its all encapsulated, the object knows
//how to sort itself
sort(myVector.begin(),myVector.end());
```

Just 2 arguments

Sorting– as opposed to using getters

- Remember using a get function or a friend function to help with sorting?

```
#pragma once
class sortable
{
public:
    sortable();
    ~sortable(void);
    void setValue(int value);
    int getValue();
private:
    int value;
};
```

Exposed data here

```
vector<sortable> myVector;
std::sort(myVector.begin(), myVector.end(), compareVal);

bool compareVal(const sortable &l,const sortable &r){
        return l.getValue() < r.getValue();
}
```

Sorting– as opposed to using friends

- Remember using a friend function to help with sorting?

```
class sortable
{
public:
    sortable();
    ~sortable(void);
    void setValue(int value);
    friend bool compare(const sortable& param1, const sortable& param2);
private:
    int value;
};
```

Break encapsulation here

```
vector<sortable> myVector;
std::sort(myVector.begin(), myVector.end(), compare);

bool compare(const sortable &l,const sortable &r){
        return l.value< r.value
}
```

Summary

- Review
- Static Members
- C++ built-in operators can be overloaded
  - To work with objects of your class
- Operators are really just functions