Copy & Assignment

CMSC 202

Copying Objects…

When does C++ make copies of objects?

- Pass by value
- Return by value
- Assignment
- and…
- New object initialized from existing object
  - Haven't seen this yet… but it is very useful

Copy Constructor

Initialize an object based on an existing object

Examples:

```
int a = 7;
int b(a);  // Copy constructor

Shoe shoeOfMJ( "Nike", 16 );
Shoe myShoe( shoeOfMJ );  // Copy
```

Copy Constructor

Use when dynamic memory is allocated

Syntax:

Prototype:

```
ClassName( const ClassName& obj );
```

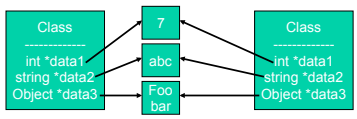
Implementation:

```
ClassName::ClassName( const ClassName& obj )
{
   // code to dynamically allocate data
}
```

Why do we care?

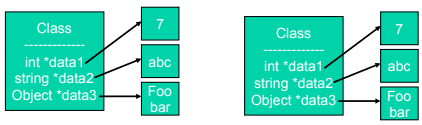
Remember

- Assignment (by default) makes a direct copy of data members…
- With dynamic memory – this would be copying pointers



What do we want?

Each object should have own memory allocated to members…



Example

```
class Shoe
{
   public:
      Shoe( const Shoe& shoe );
   private:
      int *m_size;
      string *m_brand;
};

Shoe::Shoe( const Shoe& shoe )
{
   m_size = new int( *shoe.m_size );
   m_brand = new string( *shoe.m_brand );
}
```

What's going on here?

What else?

Assignment Operator

- Define if using dynamic memory

Syntax:

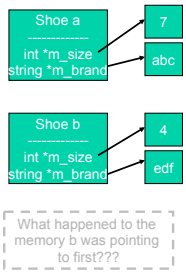
- Prototype:

```
ClassName& operator=( const ClassName& obj );
```

- Definition:

```
ClassName& ClassName::operator=( const ClassName& obj )
{
   // Deallocate existing memory, if necessary
   // Allocate new memory
}
```

What's wrong with this?




```
Shoe& Shoe::operator=(
        const Shoe& shoe )
{
   m_size =
     new int(*shoe.m_size);
   m_brand =
     new string(*shoe.m_brand);
}

// In main()
Shoe a(7, "abc");
Shoe b(4, "edf");

b = a;
```

What's wrong with this?

```
void Shoe::operator=( const Shoe& shoe )
{
  *m_size = *shoe.m_size;
  *m_brand = *shoe.m_brand;
}

Shoe a(7, "abc");
Shoe b(4, "edf");
Shoe c(9, "ghi");

c = b = a;
```

How does the c = b work, when b = a returns nothing??

Fixed

```
Shoe& Shoe::operator=( const Shoe& shoe )
{
  *m_size = *shoe.m_size;
  *m_brand = *shoe.m_brand;

  return *this;
}

Shoe a(7, "abc");
Shoe b(4, "edf");
Shoe c(9, "ghi");

c = b = a;
```

What's this?

this – a pointer to the current object

Self-Assignment

```
class RentalSystem {
   public:
    // Assume constructor, other methods…
    RentalSystem& operator=(
         const RentalSystem & rs )
   private:
    Customer *m_customers;
    int m_nbrOfCustomers;
};

RentalSystem& RentalSystem::operator=(
         const RentalSystem & rs )
{
   delete [] m_customers;

   m_customers = new Customer[rs.m_nbrOfCustomers];
   for (int i = 0; i < rs.m_nbrOfCustomers; ++i)
    m_customers[i] = rs.m_customers[i];

   return *this;
}
```

What happens when you do the following?

```
RentalSystem r;
// Add customers…
r = r;
```

Protect from Self-assignment

```
RentalSystem& RentalSystem::operator=(
       const RentalSystem & rs )
{
   // If this is NOT the same object as rs
   if ( this != &rs )
   {
    delete [] m_customers;

    m_customers = new Customer[rs.m_nbrOfCustomers];
    for (int i = 0; i < rs.m_nbrOfCustomers; ++i)
        m_customers[i] = rs.m_customers[i];
   }

   return *this;
}
```

Practice

Implement copy constructor and = operator

```
class Stapler
{
   public:
      _______________     // copy constructor
      _______________     // operator=
   private:
      int *m_nbrStaples;
};
```