The Big Three

C++ Object Oriented Programming

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NTOUCS

Contents

- Destructor
- Copy constructor
- Assignment operator
- Move constructor (C++11)
- Move assignment operator (C++11)
- The managed pointer

Introduction

- When the class has the functionality of **resource management**, it is very likely that the destructor (dtor), the copy constructor (copy ctor), and the assignment operator occur together.

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class Account {
public:



private:
   char *m_name;
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```
class Account {
public:
    Account(const char *name, const char *phone, const char *address);


private:
    char *m_name;
    char *m_phone;
    char *m_address;
};
Account::Account(const char *name, const char *phone, const char *address) {
    m_name = new char[strlen(name)+1]; strcpy(m_name, name);
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    m_address = new char[strlen(address)+1]; strcpy(m_address, address);
}
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remote ownership

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    ~Account();
    ....
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}

Account::~Account() {
    delete[] m_name; delete[] m_phone; delete[] m_address;
}
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dtor

Copy Constructor (copy ctor)

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  Account customer3 = customer1;

  Case 2: void fun1(Account customer) {
  …
  }

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Case 1:
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Account customer3 = customer1;
```

Case 2:
```
void fun1(Account customer) {
    …
}
```

Case 3:
```
Account fun2() {
    Account x;
    …
    return x;
}
```

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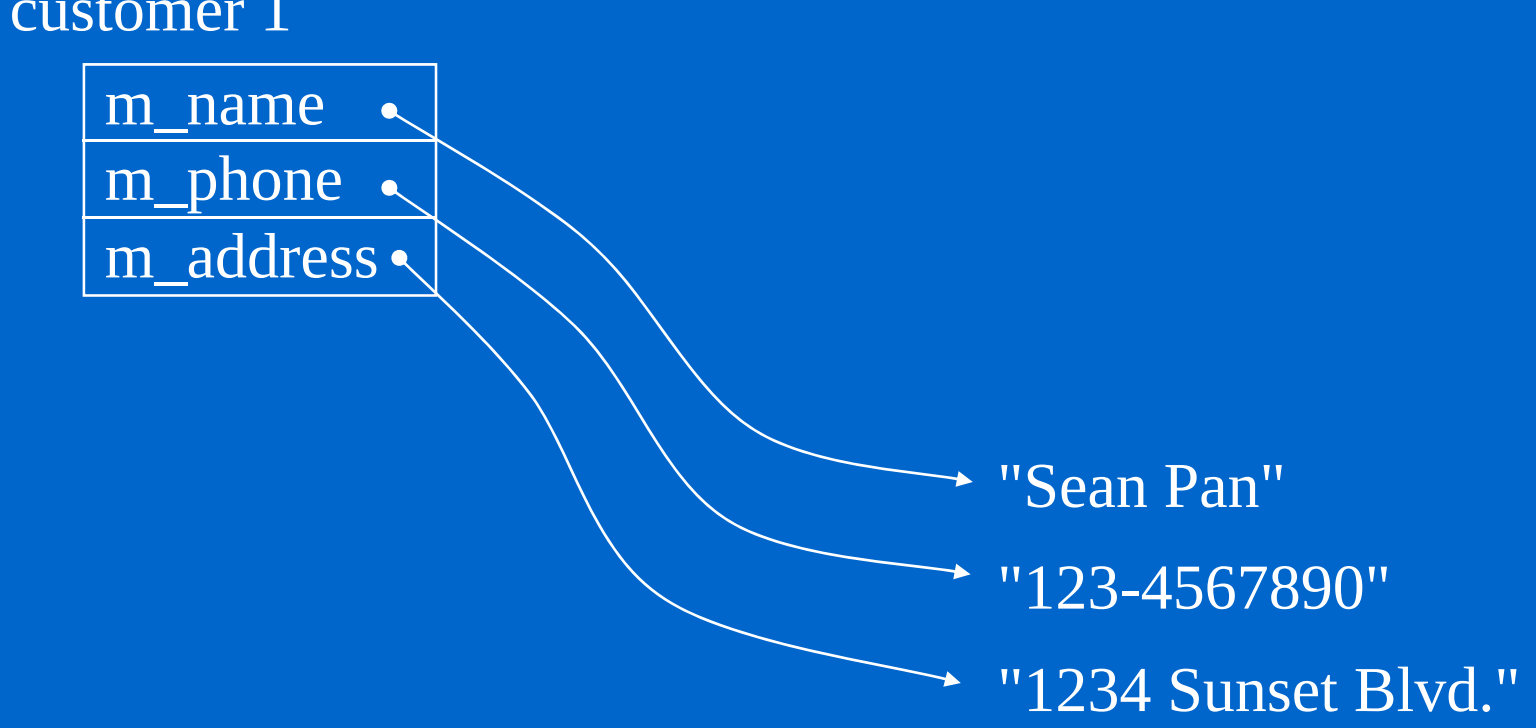

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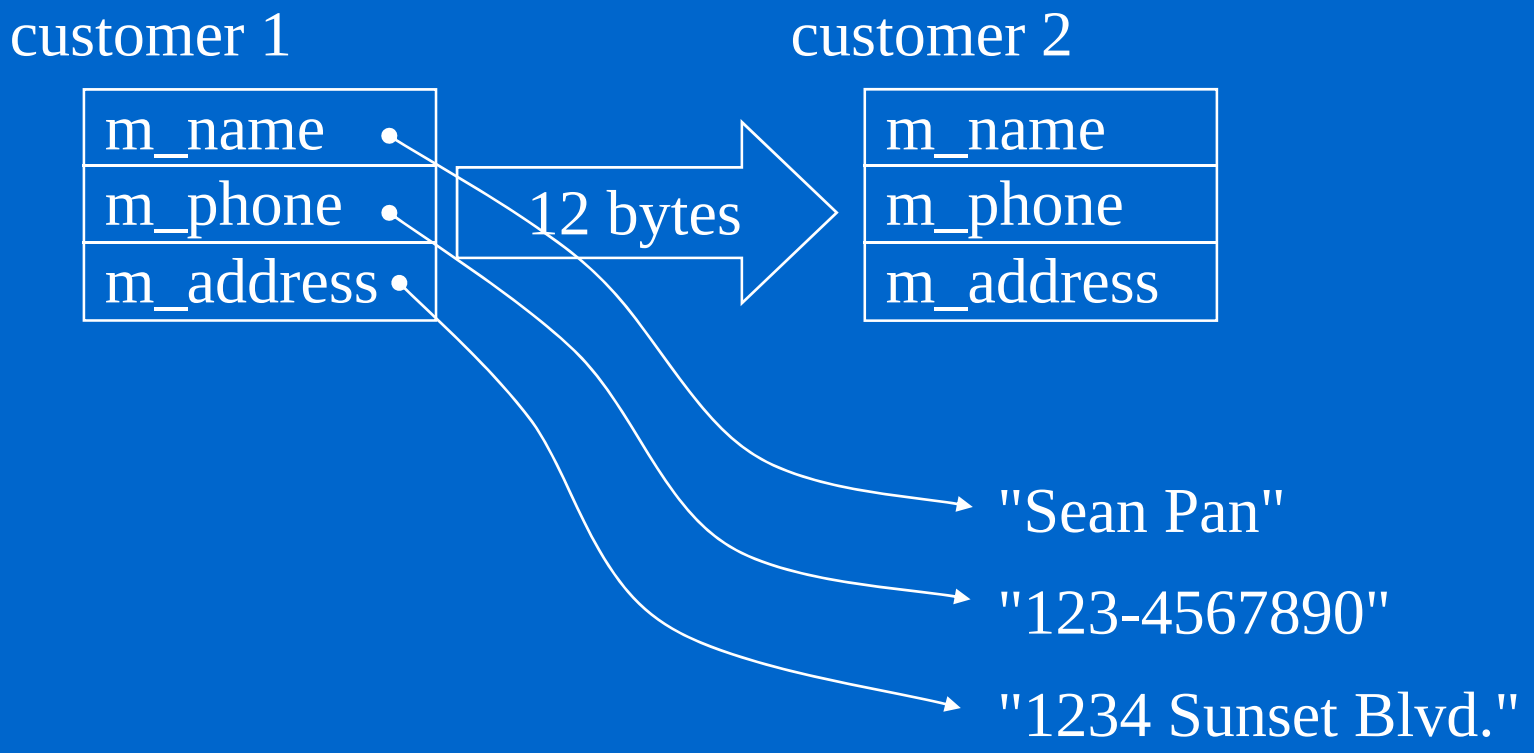

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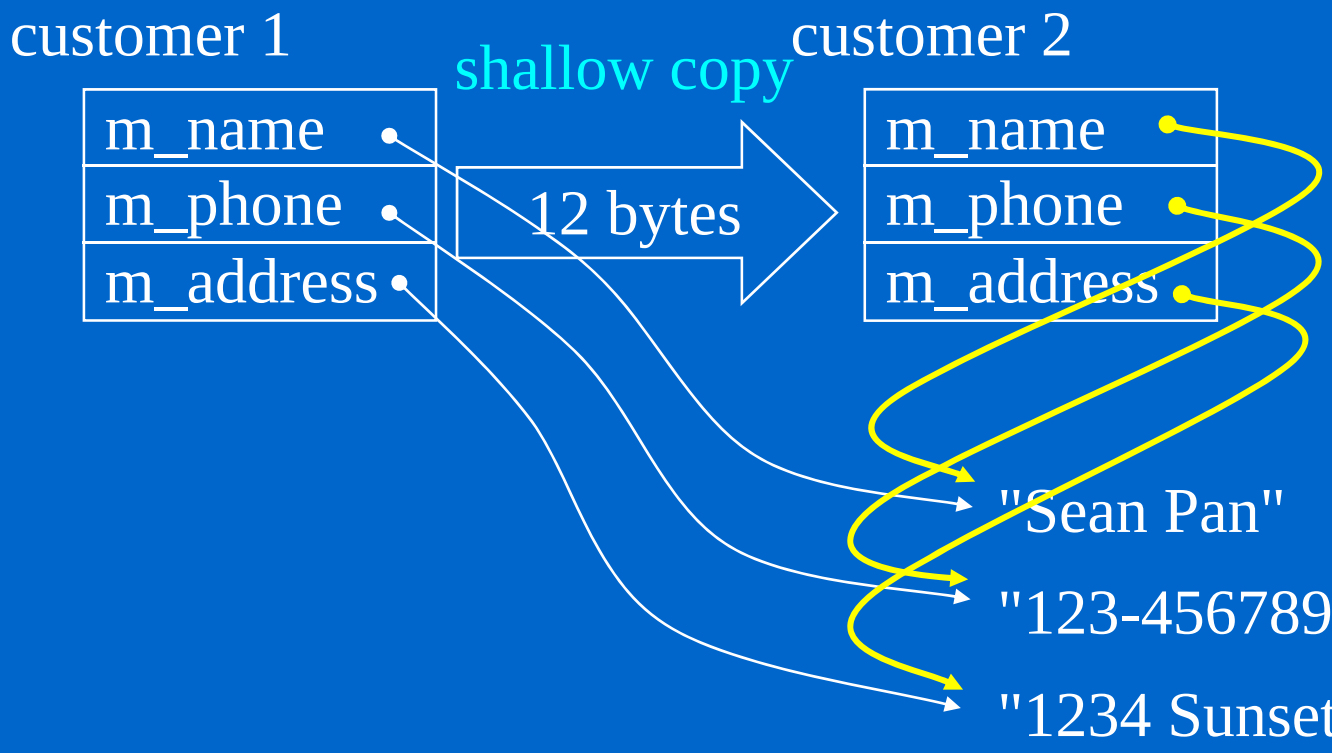

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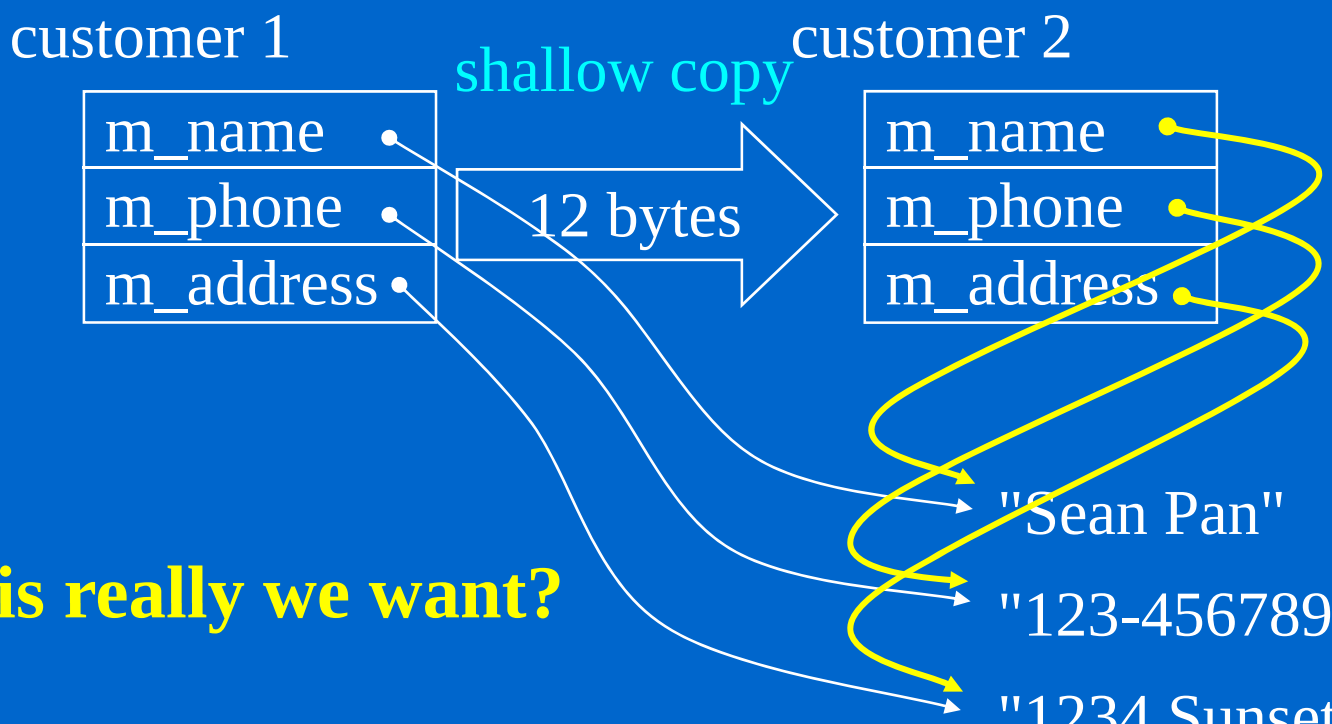

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Dangling Reference

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```
void main() {
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  //  however, these memory blocks are the same as those of customer
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void fun(Account customerLocal) {
         ….
} // the dtor would deallocate the memory belongs to customerLocal
  //  however, these memory blocks are the same as those of customer
```

- The statement **fun(customer)** would cause ***dangling reference*** and the statement **customer.display()** would access memory blocks previously belonged to this customer object and display some strange contents.

Unexpected Release

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- This is a complex problem. The program will have runtime error. Why does the error occurs? You won't be able to correct this by supplying a copy constructor for ifstream because it is a library class. The only thing you can easily do is **not invoking the copy ctor** by passing the parameter with **reference**.

Example Copy Constructor

```
Account::Account(const Account &src) {
    m_name = new char[strlen(src.m_name)+1];
    strcpy(m_name, src.m_name);
    m_phone = new char[strlen(src.m_phone)+1];
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- Copy ctor is a kind of ctor. You should use **initialization list** whenever possible. Especially, you should invoke the **base class copy ctor** if it is a derived class. You should invoke **the component class copy ctor** if it contains a member object.

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- In a copy ctor, you are initiating an object from another object. The memory space for the object is allocated by the system.
- If you want to forbid public usage of **call-by-value** semantics of an object, you can declare a **private copy ctor** for that class.

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Note: this does not contradict the rule that reference does not bind to temporary object

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⑥   // invoke the component object assignment operator

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③   m_name = new char[strlen(rhs.m_name)+1];
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    m_address = new char[strlen(rhs.m_address)+1];
④   strcpy(m_name, rhs.m_name);
    strcpy(m_phone, rhs.m_phone);
    strcpy(m_address, rhs.m_address);
⑤   // invoke the base class assignment operator
⑥   // invoke the component object assignment operator
⑦   return *this;
}
```

Detecting self assignments

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- Three make a team. Do not forget any one of them.

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  5. Retrieve the raw Fred pointer
     Fred *ptrRaw = ptr.get();

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Managed Pointer (cont'd)

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9. If you copy the managed pointer from another managed pointer without ownership to the real object, the new managed pointer does not have ownership to the real object. If you construct a new managed pointer with a raw pointer twice, both objects have ownership. Fortunately, delete in its dtor will only succeed once. But using a pointer without ownership to the real object is likely to be a dangling reference like a raw pointer.

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  The compiler allows you to pass an auto_ptr by value to a function, the original auto_ptr would lose the ownership and ① the managed resource is going to be deleted as the function exits unless another auto_ptr is returned back. ② auto_ptr cannot manage an array and ③ cannot be used in a container.

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  - C++11: **std::shared_ptr**, **std::weak_ptr**, **std::unique_ptr**