OBJECT-ORIENTED PROGRAMMING PRINCIPLES

1ST WEEK LECTURE

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Outline

- Object Oriented Programming (OOP)
  - Basic Terms
  - Class in OOP
  - C++ Examples
  - C++ Constructor and Destructor
  - Other Stuff (Part of Overview)
  - Summary
  - Some Differences between C & C++
- Q&A

Basic Terms

- Object
  - Collection of Data and Operations on This Data
- Type
  - Characteristics Associated with Objects or Data Elements
- OOP
  - Programming with Objects User-defined types

Class in OOP

- Means to Define Data Types
  - Collection of Members: Data Elements and Operations
    - E.g., Music CD Class
    - Possibly with Access Control
  - Used for Instantiation of Objects

- Means to Realize OOP Concepts
  - Abstraction
  - Encapsulation
  - Inheritance
  - Polymorphism

C++ Example: Abstraction

- Online Retailer Such as Amazon.Com
  - Item: Type, Title, Maker, Price, Availability, etc.

```
class Item { // Class definition
        public:
                String title; // String is a class defined earlier
                double price; // double is a predefined data type
                double SalePrice() { return (price*0.9);}
};
Item A; // Class object definition
// OKAY: A.title, A.price, and A.SalePrice()
```

C++ Example: Encapsulation

- Online Retailer Example Cont'd

```
class Item { // Class definition
        public:
                String title;
                double price;
                double SalePrice() { return (price*0.9);}
                bool isAvailable() { return (inStockQuantity > 0); }
        private:
                int inStockQuantity;
};
Item A; // Class object definition
// NOT OKAY: A.inStockQuantity
// OKAY: A.isAvailable()
```

C++ Example: Inheritance

- Online Retailer Example Cont'd

```
class MusicCDItem : public Item {
public:
String singer_name;
};
MusicCDItem B; // Class object definition
// OKAY: B.singer_name, B.title, B.price, B.SalePrice(),
// and B.isAvailable()
// NOT OKAY: B.inStockQuantity
```

Derivation
-private: public & protected
-> private
-protected: public & protected
-> protected

- Friendship

```
class Item {
friend class MusicCDItem;
...
```

C++ Example: Polymorphism

- Online Retailer Example Cont'd

```
class Item { // Class definition
        public:
                String title; // String is a class defined earlier
                double price; // double is a predefined data type
                double SalePrice() { return (price*0.9);}
                int isAvailable() { return (inStockQuantity > 0 ? 1 : 0); }
                virtual void specificInfo() {
                        cout << "no Info: a base-class object" << endl; }
        private:
        int inStockQuantity;
};
```

```
virtual void specificInfo() = 0;
// pure virtual function:
// making this class be used
// only as a base class
```

C++ Example: Polymorphism Cont'd

- Online Retailer Example Cont'd

```
class MusicCDItem : public Item {
        public:
            String singer_name;
              void specificInfo() { cout << "singer name = "
              << singer_name
              << " : a derived-class object" << endl; }
};
void printSpecificInfo(Item *P) { P->specificInfo(); }
Item A; // Class object definition
MusicCDItem B; // Class object definition
printSpecificInfo(&A); // Call Item::specificInfo()
printSpecificInfo(&B); // Call MusicCDItem::specificInfo()
// -Another derived class (e.g., MovieDVDItem) with specificInfo()
```

C++ Constructor and Destructor

- Example

```
#include <assert.h>
class String {
public:
        String(const char *s) {
        len = strlen(s);
        str = new char[len + 1];
        assert(str != 0);
        strcpy(str,s);
        }
        ~String() { delete [] str; }
private:
        int len;
        char *str;
};
```

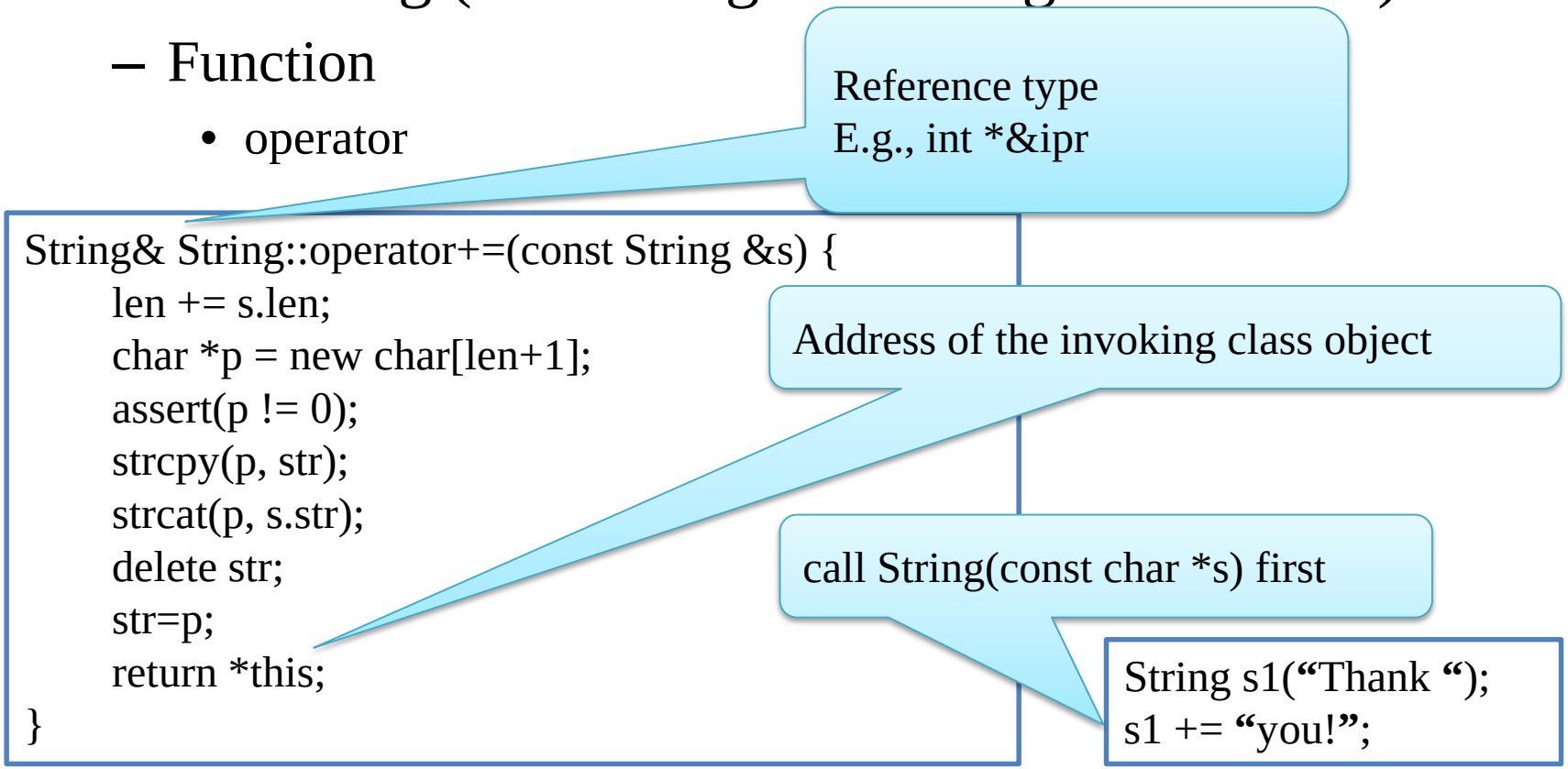
```
String(int ln) { …}
// Function overloading
// String buf = 1024;
```

```
String() { …}
// Default constructor
// String st(); -> Error
```

```
String name0 = String("Andrew");
// Definition
String name1("Karl");
String *name_ptr = new String("Thomas");
delete name_ptr;
// Explicit destruction
```

Other Stuff

- Overloading (w/ Distinguished Argument Lists)
  - Function
    - operator



Other Stuff Cont'd

- Reference Type
  - Reference Object to Be Initialized
    - Unable to alias another object once initialized

```
int &refVal = val; // int &const refVal = val;
const int &cir = 1024;
```

```
OK: uc, d1+d2
// unsigned char uc;
// double d1, d2;
```

- Class Template
  - Automatic Generation of Class Instances Bound to a Particular Type

```
template <class SDT>
class Stack { …
```

```
Stack<int> s; // typedef int SDT
```

Other Stuff Cont'd

- Multiple Inheritance
  - Child Class as a Composite of Its Multiple Base Classes

```
Class C : public A, public B { …}
```

e.g., A::a or B::a in C::func()

  - Qualification to resolve ambiguity
- Dominance in the Inheritance Chain
  - Most Derived Instance Dominating

e.g., C::func() dominates over A::func()

Summary

- Class
  - To Define New Types in OOP
  - To Realize OOP
    - Concepts: Abstraction
    - Encapsulation
    - Inheritance
    - Polymorphism

Some Differences between C & C++

- Type Checking (Regarding Function Declarations)
  - Meaning of No Argument
    - ANSI C: zero or more arguments of any data type
    - C++: no argument
  - Effect of No Declaration
    - ANSI C: permitted
    - C++: error
- C++ Support for Default Arguments

```
void new_line(int n=1) {
        while(n-- > 0)putchar('\n');
}
```

```
new_line(2);
new_line();
```

- Dynamic Memory Allocation