Lecture Ten

Virtual Functions

Ref: Herbert Schildt, Teach Yourself C++, Third Edn (Chapter 10)

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Pointers to Derived Classes

- **A pointer declared as a pointer to a base class can also be used to point to any class derived from that base; however, the reverse is not true.**
- **A type casting can be used, but not recommended.**

```
base *p;                  //base class pointer
base base_ob;             // object of base type
derived derived_ob;       // object of type derived
p = &base_ob;              // p points to base object
p = &derived_ob;           // p points to derived object
```

Introduction to Virtual Functions

- A ***virtual function*** is a member function that is declared within a base class and redefined by a derived class. The keyword virtual is used in base class and the keyword is not needed in derived class.
- Virtual function implements one interface, multiple methods.
- A class that contains a virtual function is referred to as a ***polymorphic class***.
- The determination of the type of object being pointed to by the pointer is made at run time.

```
#include <iostream>
using namespace std;

class area {
    double dim1, dim2;
public:
    void setarea( double d1, double d2){
        dim1 = d1;
        dim2 = d2;
    }
    void getdim( double &d1, double &d2){
        d1 = dim1;
        d2 = dim2;
    }
    virtual double getarea(){
        cout << " You must override this
                    function.\n";
        return 0.0;
    }
};
```

Introduction to Virtual Functions

```
class rectangle: public area {
public:
    double getarea(){
        double d1, d2;
        getdim(d1, d2);
        return d1 * d2;
    }
};

class triangle: public area {
public:
    double getarea(){
        double d1, d2;
        getdim(d1, d2);
        return 0.5*d1 * d2;
    }
};
```

```
int main(){
    area *p;
    rectangle r;
    triangle t;

    r.setarea( 3.3, 4.5);
    t.setarea( 4.0, 5.0);

    p = &r;
    cout << "Rectangle has area: " ;
    cout << p->getarea() << '\n';

    p = &t;
    cout << "Rectangle has area: ";
    cout << p->getarea() << '\n';

    return 0;
}
```

More about Virtual Functions

- **A pure *virtual function* has no definition relative to the base class. Only the function's prototype is included. The general form is:**
  virtual type func-name (parameter-list) = 0;

```
#include <iostream>
using namespace std;

class area {
      double dim1, dim2;
public:
     void setarea( double d1, double d2){
           dim1 = d1;
           dim2 = d2;
     }

     void getdim( double &d1, double &d2){
           d1 = dim1;
           d2 = dim2;
     }
    virtual double getarea()=0;
                        // pure virtual function
};
```

Applying Polymorphism

- **There are two terms linked with OOP: early binding and late binding.**
- **Early binding refers to those function calls that can be resolved during compilation. This method is faster but not flexible.**
- **Late binding refers to those function calls that can be resolved during run time. This method is slower but flexible.**

```
#include <iostream>
#include <cstdlib>
#include <ctype>
using namespace std;

class list {
public:
      list *head, *tail, *next;
      int num;

      list () { head = tail = next = NULL;}
      virtual void store(int i) = 0;
      virtual int retrieve() = 0;
};
```

Applying Polymorphism

```
class queue: public list {
public:
    void store(int i);
    int retrieve();
};
```

```
void queue::store(int i){
    list *item;

    item = new queue;
    if (!item){
        cout << "Allocation Error.\n";
        exit(1);
    }
    item->num = i;
    if (tail) tail->next = item;
    tail = item;
    item->next = NULL:
    if (!head) head = tail;
}
```

```
int queue::retrieve(){
    int i;
    list *p;

    if (!head){
        cout << "List empty.\n";
        return 0;
    }
    i = head->num;
    p = head;
    head = head->next;
    delete p;

    return i;
}
```

Applying Polymorphism

```
class stack: public list {
public:
    void store(int i);
    int retrieve();
};
```

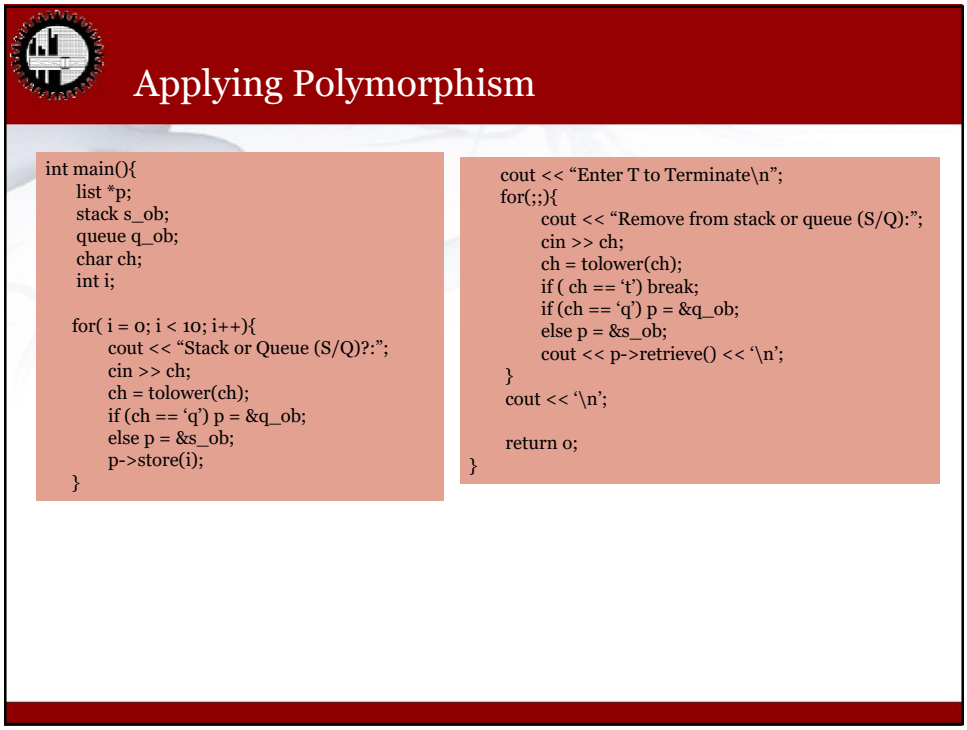
```
void stack::store(int i){
    list *item;

    item = new stack;
    if (!item){
        cout << "Allocation Error.\n";
        exit(1);
    }
    item->num = i;
    if (head) item->next = head;
    head = item;
    if (!tail) tail = head;
}
```

```
int stack::retrieve(){
    int i;
    list *p;

    if (!head){
        cout << "List empty.\n";
        return 0;
    }
    i = head->num;
    p = head;
    head = head->next;
    delete p;

    return i;
}
```



Applying Polymorphism

```
int main(){
      list *p;
      stack s_ob;
      queue q_ob;
      char ch;
      int i;

     for( i = 0; i < 10; i++){
            cout << "Stack or Queue (S/Q)?:";
            cin >> ch;
            ch = tolower(ch);
            if (ch == 'q') p = &q_ob;
            else p = &s_ob;
            p->store(i);
      }
      cout << "Enter T to Terminate\n";
      for(;;){
            cout << "Remove from stack or queue (S/Q):";
            cin >> ch;
            ch = tolower(ch);
            if ( ch == 't') break;
            if (ch == 'q') p = &q_ob;
            else p = &s_ob;
            cout << p->retrieve() << '\n';
      }
      cout << '\n';

      return 0;
}
```