Course C++

Exercise Number 8

Date: 25.04.2013

This exercise is about inheritance. The most important thing that you must understand about inheritance is that it is overused. Meaningful examples of inheritance are hierarchies of graphical objects, and file hierarchies. Inheritance should only be used when the following conditions are met:

1. some group of types have something (important) in common,
2. you want to able to mix these types at run time. This means that you are unable to predict, when writing the program, which of the concrete types your object will have.
3. you don't know in advance how many types there will be. (You want to be able to add more types later.) Put differently: If your algorithms depend on a fixed set of possible types of objects, then you should be careful using inheritance, and consider using `union`.

It is probably a good idea to have a look at http://www.ii.uni.wroc.pl/~nivelle/teaching/object2011/inheritance.pdf first.

1. Consider the following hierarchy:

```cpp
class surf
{
    virtual double area( ) const = 0;
    virtual double circumference( ) const = 0;
    virtual surf* clone( ) const = 0;
    virtual print( std::ostream& ) const = 0;
    ~surf( );
};

class rectangle : public surf
{
    double x1, y1;
    double x2, y2;
};
```
Write suitable constructors for each of the subclasses, and implement the \texttt{area( ) const}, \texttt{circumference( ) const}, \texttt{clone( ) const}, and \texttt{print( std::ostream& ) const} methods.

2. We want to be able to put a mixture of rectangles, triangles, and circles in an \texttt{std::vector} in a robust way, without memory leakage.
   In order to do this, we must define a class

   
   \begin{verbatim}
   struct surface
   {
   surf* ref;
   
surface( const surface& s )
   : ref( s. ref -> clone( ) )
   {
   }
   \end{verbatim}

2
surface( const surf& s )
    : ref( s. clone() )
{
}

void operator = ( const surface& s )
{
    if( ref != s. ref )
    {
        delete ref;
        ref = s. ref -> clone();
    }
    // I am not in favour of making assignment
    // return something.
}

~surface( )
{
    delete ref;
}

const surf& getsurf( ) const { return *ref; }
    // There is no non-const method, because
    // changing would be dangerous.
};

Define a print function

std::ostream& operator << ( std::ostream& stream, const surface& s );

according to the pattern on the slides.

3. Fill an std::vector< surface > with a couple of surfaces, and make sure that the following functions work correctly

std::ostream& operator << ( std::ostream& stream,
    const std::vector< surface >& table )
{
    for( unsigned int i = 0; i < table.size(); ++ i )
    {
        stream << i << "-th element = " << table[i] << "\n";
    }
    return stream;
}
void print_statistics( const std::vector< surface > & table )
{
    double total_area = 0.0;
    double total_circumference = 0.0;
    for( std::vector< surface > :: const_iterator
        p = table. begin( );
        p != table. end( );
        ++ p )
    {
        total_area += p -> getsurf( ). area( );
        total_circumference += p -> getsurf( ). circumference( );
        std::cout << "adding info about " << *p << "\n";
    }

    std::cout << "total area is " << total_area << "\n";
    std::cout << "total circumference is " << total_circumference << "\n";

4. Convince yourself, by writing a for loop, that there are no memory leaks.