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1  #include "Integer.h"
2  /// Lecture 54-55: Move Semantics – Implementation
3  • (C++11)
4  ///////////////////////////////////
5  // main.cpp (NO MOVE SEMANTICS)
6  #include <iostream>
7  // A function which adds two integer objects and
8  • returns the result by value.
9  // So we create a temporary object
10 Integer Add(const Integer &a, const Integer &b){
11     Integer temp ; // create temporary object
12     temp.SetValue(a.GetValue() + b.GetValue()) ; //
13     • compute the sum of a and b objects
14     return temp; // Return temp by value.
15 }
16 int main() {
17     Integer a(1), b(3) ;
18     // Obtain the number from the temporary object
19     • returned by the function.
20     // We store the sum in the variable a
21     a.SetValue(Add(a,b).GetValue()); // Without the
22     • move semantics, A COPY of this temp object gets
23     • created, so that it can be accessed here. in
24     • some cases, this COPY of the temp object may
25     • not get created, and this is due to the
26     • compiler performing copy or move elision
27     • (Lecture 57).
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29     return 0;
30 }
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33     //Default constructor
34     Integer();
35     //Parameterized constructor
36     Integer(int value);
37     //Copy constructor
38     Integer(const Integer &obj);
39     //MOVE CONSTRUCTOR!
40     Integer(Integer &&obj);
41     int GetValue()const;
42     void SetValue(int value);
43     ~Integer();
44
45 };
46 ///////////////////////////////////////////////////
47
48 // Integer.cpp
49 Integer::Integer() {
50     std::cout << "Integer()" << std::endl;
51     m_pInt = new int(0);
52 }
53
54 Integer::Integer(int value) {
55     std::cout << "Integer(int)" << std::endl;
56     m_pInt = new int(value);
57 }
58
59 Integer::Integer(const Integer & obj) {
60     std::cout << "Integer(const Integer&" <<
    •         std::endl;
61     m_pInt = new int(*obj.m_pInt);
62 }
63
64 // MOVE CONSTRUCTOR
65 Integer::Integer(Integer && obj) {
66     std::cout << "Integer(int&&)" << std::endl; //
    •         move constructor invoked!
67     m_pInt = obj.m_pInt; // shallow copy.
68     obj.m_pInt = nullptr; // to let the other object
    •         know that we have stolen the resources, we will
    •         assign null to the pointer. So this way when
    •         the other object is destroyed, our own
    •         destructor will not crash. The call to delete

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    •         in the destructor will be ignored, because that
    •         would be delete on a null pointer.
69     }
70
71     int Integer::GetValue() const {
72         return *m_pInt;
73     }
74
75     void Integer::SetValue(int value) {
76         *m_pInt = value;
77     }
78
79     Integer::~~Integer() {
80         std::cout << "~Integer()" << std::endl;
81         delete m_pInt;
82     }
83     ///////////////////////////////////
84     // UPDATED main.cpp (with move semantics)
85     #include <iostream>
86     // A function which adds two integer objects and
    •         returns the result by value.
87     // So we create a temporary object
88     Integer Add(const Integer &a, const Integer &b){
89         Integer temp ; // create temporary object
90         temp.SetValue(a.GetValue() + b.GetValue()) ; //
    •         compute the sum of a and b objects
91         return temp; // Return temp by value.
92     }
93     int main() {
94         Integer a(1), b(3) ;
95         // Obtain the number from the temporary object
    •         returned by the function.
96         // We store the sum in the variable a
97         a.SetValue(Add(a,b).GetValue());
98         // When we do this now, the move constructor is
    •         invoked. This means that the state of the temp
    •         object WAS NOT copied into the temporary that
    •         was accessed at the end of the function call.
    •         Instead, the STATE of temp was MOVED into that
    •         temporary.
99
100        // Again, in some cases, you may not see the call

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• to this move constructor, and that is because
• of move elision (lecture 57).
101 // So, this is going to be a MUCH FASTER
• OPERATION than copying (deep copying), so in
• copy semantics we have to allocate new memory
• and then copy the data. Here, we don't have to
• allocate new resources – we just copy the data
• from the source object INTO the target object.
• We'll also have to implement the MOVE
• ASSIGNMENT OPERATOR, but we'll explore more of
• that in the section on Operator Overloading.
102
103 // Hence, the rule of 3 that we talked about
• earlier now becomes a rule of 5.
104 return 0;
105 }
106
```