```cpp
/* 3.2 实验： 研究C++的对象模型 */


#include <iostream>
#include <cstring>

class MyClass
{
public:
    static int staticData;
    int integerData;
    double doubleData;
    char *charPtrData;
    std::string stringData;
    int &refData;

public:
    // Constructor with dynamic memory allocation
    MyClass(int intValue, double doubleValue, const char *charValue, const std::string &stringValue, int &ref)
        : integerData(intValue), doubleData(doubleValue), stringData(stringValue), refData(ref)
    {
        charPtrData = new char[strlen(charValue) + 1];
        strcpy(charPtrData, charValue);
        std::cout << "    "
                  << "    "
                  << "++++++ Construct " << charPtrData << " is created ++++++" << std::endl;
    }

    MyClass(const MyClass &obj)
        : integerData(obj.integerData), doubleData(obj.doubleData), stringData(obj.stringData), refData(obj.refData)
    {
        charPtrData = new char[strlen(obj.charPtrData) + 1];
        strcpy(charPtrData, obj.charPtrData);
        std::cout << "    "
                  << "    "
                  << "++++++ Copy Construct " << charPtrData << " is created ++++++" << std::endl;
    }

    // Destructor
    ~MyClass()
    {
        std::cout << "    "
                  << "    "
                  << "++++++ Destruct " << charPtrData << " is deleted ++++++" << std::endl;
        delete[] charPtrData;
    }

    // Static member function
    static void staticFunction()
    {
        std::cout << "Static function called" << std::endl;
    }

    // Non-static member function
    void nonStaticFunction()
    {
        std::cout << "Non-static function called" << std::endl;
    }

    void printData()
```

```
61      {
62
63          std::cout << "  "
64                    << "------ Sec#1:  Data of object ------" << std::endl;
65
66          std::cout << "    "
67                    << "in Object: " << this << std::endl;
68          std::cout << "    "
69                    << "Integer data: " << integerData << std::endl;
70          std::cout << "    "
71                    << "Double data: " << doubleData << std::endl;
72          std::cout << "    "
73                    << "Char pointer data: " << charPtrData << std::endl;
74          std::cout << "    "
75                    << "String data: " << stringData << std::endl;
76      }
77
78      void printDataAddress()
79      {
80          std::cout << "  "
81                    << "------ Sec#2: Address of data ------" << std::endl;
82
83          std::cout << "    "
84                    << "in Object: " << this << std::endl;
85          std::cout << "    "
86                    << "Integer data: " << &integerData << std::endl;
87          std::cout << "    "
88                    << "Double data: " << &doubleData << std::endl;
89          std::cout << "    "
90                    << "Char pointer data: " << reinterpret_cast<void *>(charPtrData) << std::endl;
91          std::cout << "    "
92                    << "String data: " << &stringData << std::endl;
93      }
94  };
95
96  // Initializing static data member
97  int MyClass::staticData = -1010;
98
99  // Global objects
100 MyClass globalObj1(1, 2.3, "Global 1", "Object", MyClass::staticData);
101 MyClass globalObj2(2, 3.7, "Global 2", "Object", MyClass::staticData);
102
103 // External function
104 void func(MyClass obj)
105 {
106     obj.printData();
107     obj.printDataAddress();
108 }
109
110 int main()
111 {
112     std::cout << "\n$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$ MAIN FUNCTION BEGIN:
    $$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$\n"
113               << std::endl;
114
115     std::cout << "\n---------------------- Para#0:  Initialization ----------------------" <<
    std::endl;
116     // Local objects in main()
117     MyClass localObj1(3, 4.9, "Local  1", "Object", MyClass::staticData);
118     MyClass localObj2(4, 5.1, "Local  2", "Object", MyClass::staticData);
119     // Dynamic objects in main()
120     MyClass *dynamicObj1 = new MyClass(5, 6.3, "Dynamic1", "Object", MyClass::staticData);
121     MyClass *dynamicObj2 = new MyClass(6, 7.2, "Dynamic2", "Object", MyClass::staticData);
```

```
122     std::cout << "--------------------------------END---------------------------------\n"
123               << std::endl;
124
125     // Calling external function func()
126     std::cout << "\n------------------ Para#1:  Inside External func() -----------------" <<
    std::endl;
127     std::cout << "    "
128               << "Call external func(): " << &func << "  with object: " << &localObj1 << std::endl;
129     func(localObj1);
130     std::cout << "--------------------------------END---------------------------------\n"
131               << std::endl;
132
133     std::cout << "\n------------------ Para#2:     Inside     main() -------------------" <<
    std::endl;
134     std::cout << "    "
135               << "Global  object 1 address: " << &globalObj1 << std::endl;
136     std::cout << "    "
137               << "Global  object 2 address: " << &globalObj2 << std::endl;
138     std::cout << "    "
139               << "Local   object 1 address: " << &localObj1 << std::endl;
140     std::cout << "    "
141               << "Local   object 2 address: " << &localObj2 << std::endl;
142     std::cout << "    "
143               << "Dynamic object 1 address: " << dynamicObj1 << std::endl;
144     std::cout << "    "
145               << "Dynamic object 2 address: " << dynamicObj2 << std::endl;
146
147     std::cout << "    "
148               << "Size of MyClass: " << sizeof(MyClass) << " bytes" << std::endl;
149     std::cout << "--------------------------------END---------------------------------\n"
150               << std::endl;
151
152     std::cout << "\n------------------ Para#3: Details of  globalObj1 ------------------" <<
    std::endl;
153     globalObj1.printData();
154     globalObj1.printDataAddress();
155     // print function address
156     void (MyClass::*pmf)() = &MyClass::nonStaticFunction;
157     unsigned *p0 = (unsigned *)&pmf;
158     std::cout << "    "
159               << "nonStaticFunction address: " << std::hex << std::noshowbase << *p0 << std::endl;
160     // print static function address
161     void (*pf)() = &MyClass::staticFunction;
162     unsigned *p1 = (unsigned *)&pf;
163     std::cout << "    "
164               << "staticFunction address: " << std::hex << std::noshowbase << *p1 << std::endl;
165     std::cout << "--------------------------------END---------------------------------\n"
166               << std::endl;
167
168     std::cout << "\n------------------ Para#4:  Details of  localObj1 ------------------" <<
    std::endl;
169     localObj1.printData();
170     localObj1.printDataAddress();
171     // print function address
172     void (MyClass::*pmf1)() = &MyClass::nonStaticFunction;
173     unsigned *p2 = (unsigned *)&pmf1;
174     std::cout << "    "
175               << "nonStaticFunction address: " << std::hex << std::noshowbase << *p2 << std::endl;
176     // print static function address
177     void (*pf1)() = &MyClass::staticFunction;
178     unsigned *p3 = (unsigned *)&pf1;
179     std::cout << "    "
180               << "staticFunction address: " << std::hex << std::noshowbase << *p3 << std::endl;
```

```
181     std::cout << "-------------------------------END----------------------------------\n"
182               << std::endl;
183 
184     std::cout << "\n------------------ Para#5: Details of dynamicObj1 ------------------" <<
    std::endl;
185     dynamicObj1->printData();
186     dynamicObj1->printDataAddress();
187     // print function address
188     void (MyClass::*pmf2)() = &MyClass::nonStaticFunction;
189     unsigned *p4 = (unsigned *)&pmf2;
190     std::cout << "    "
191               << "nonStaticFunction address: " << std::hex << std::noshowbase << *p4 << std::endl;
192     // print static function address
193     void (*pf2)() = &MyClass::staticFunction;
194     unsigned *p5 = (unsigned *)&pf2;
195     std::cout << "    "
196               << "staticFunction address: " << std::hex << std::noshowbase << *p5 << std::endl;
197     std::cout << "-------------------------------END----------------------------------\n"
198               << std::endl;
199 
200     // Freeing dynamic objects
201     delete dynamicObj1;
202     delete dynamicObj2;
203 
204     std::cout << "\n$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$ MAIN FUNCTION END
    $$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$\n"
205               << std::endl;
206 
207     return 0;
208 }
```