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C++11 / C++14 : 'delete' keyword and deleted functions with Use Cases | Examples

Varun August 25, 2018 C++ 11, delete 1 Comment

In this article we will discuss how to use delete keyword with functions and its use cases.

Deleting Functions using 'delete' keyword

In C++11 a new feature of keyword **delete** is introduced. Now we can apply the delete keyword to functions to make them uncallable.

```
1 | void someFunction() = delete ;
```

Its practical use cases are,

- Deleting compiler generated functions like copy constructor, assignment operators, move constructor , move assignment operator and default constructor.
- Deleting member functions to prevent data loss conversions

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Let's discuss them one by one i.e.

Deleting Copy Constructor and Assignment Operator

```

1  class User
2  {
3
4      int id;
5      std::string name;
6  public:
7      User(int userId, std::string userName) : id(userId), name
8      {}
9
10     // Copy Constructor is deleted
11     User(const User & obj) = delete;
12     // Assignment operator is deleted
13     User & operator = (const User & obj) = delete;
14
15     void display()
16     {
17         std::cout<<id << " ::: "<<name<<std::endl;
18     }
19
20 };

```

In the above class User, Copy Constructor and Assignment Operator are deleted. If anybody tries to call the deleted function then it will generate compile time error.

For example,

```

1 User userObj(3, "John");
2
3 User obj = userObj;

```

As copy constructor is deleted, therefore above lines will throw following compile time error i.e.

```

1 delete_example.cpp: In function 'int main()':
2 delete_example.cpp:136:13: error: use of deleted function 'Us
3     User obj = userObj;
4             ^
5 delete_example.cpp:111:2: note: declared here
6     User(const User & obj) = delete;

```

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A part from applying delete keywords to compiler generated functions, we can apply delete keyword to other functions too.

Deleting member functions to prevent data loss conversions

Some times due to automatic type conversion we can call the functions with wrong parameters too. For example, for User class we have this parameterized constructor i.e.

```
1 User(int userId, std::string userName) : id(userId), name(use  
2 {}
```

Even if this constructor accepts id as int, still we can call this by double 7 char too i.e.

```
1 User obj4(5.5, "Riti");  
2  
3 User obj5('a', "Riti");
```

It will work but these are invalid conversions, with delete keyword we can prevent them too by declaring them deleted i.e.

```
1 // Deleting a constructor that accepts a double as ID to prevent  
2 User(double userId, std::string userName) = delete ;  
3  
4 // Deleting a constructor that accepts a double as ID to prevent  
5 User(char userId, std::string userName) = delete ;
```

Now on creating User object with double and char will throw compile time error i.e.

```
1 error: use of deleted function 'User::User(double, std::__cxx11::string)'  
2 User obj4(5.5, "Riti");  
3 ^  
4 note: declared here  
5 User(double userId, std::string userName) = delete ;  
6  
7 error: use of deleted function 'User::User(char, std::__cxx11::string)'  
8 User obj5('a', "Riti");  
9 ^  
10 note: declared here  
11 User(char userId, std::string userName) = delete ;
```

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deleting new operator for class

We can delete the new operator of class User i.e.

```
1 | class User
2 | {
3 |     int id;
4 |     std::string name;
5 | public:
6 |     User(int userId, std::string userName) : id(userId), name
7 |     {}
8 |
9 |     // Delete the new function to prevent object creation on heap
10|     void * operator new (size_t) = delete;
11|
12| };
```

Now if we try to create User Object on heap using new, it will give compile time error i.e.

```
1 | User * ptr = new User(1, "Riti");
```

Compile Error:

```
1 | error: use of deleted function 'static void* User::operator new (size_t)'
2 | User * ptr = new User(1, "Riti");
3 | ^
4 | note: declared here
5 |     void * operator new (size_t) = delete;
```

Complete example is as follows,

```
1 | #include <iostream>
2 | #include <string>
3 |
4 | class User
5 | {
6 |
7 |     int id;
8 |     std::string name;
9 | public:
10|     User(int userId, std::string userName) : id(userId), name
11|     {}
12|
13|     // Copy Constructor is deleted
14|     User(const User & obj) = delete;
15|     // Assignment operator is deleted
16|     User & operator = (const User & obj) = delete;
17| }
```

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```

18
19
20
21
22
23 // Deleting a constructor that accepts a double as ID to prevent heap allocation
24 User(double userId, std::string userName) = delete ;
25
26 // Deleting a constructor that accepts a double as ID to prevent heap allocation
27 User(char userId, std::string userName) = delete ;
28
29 // Delete the new function to prevent object creation on heap
30 void * operator new (size_t) = delete;
31
32 }
33
34
35 int main()
36 {
37     User userObj(3, "John");
38
39 // Can not copy User object as copy constructor is deleted
40 //User obj = userObj;
41
42 /*
43 * Creating User objects with double or char as ID will cause undefined behavior
44 */
45 User obj4(5.5, "Riti");
46
47 obj4.display();
48
49 User obj5('a', "Riti");
50
51 obj5.display();
52 */
53
54
55 // Can not create object on heap as new operator is deleted
56 //User * ptr = new User(1, "Riti");
57
58 return 0;
59 }
60

```

Delete specific template specialisation

With delete keyword we can restrict certain template specialisations of template classes or functions. Let's see how to do that,

Suppose we have a template class of Complex Number

```

1 template <typename T>
2 class ComplexNumber
3 {
4     T x;
5     T y;
6 public:
7     ComplexNumber(T a, T b) : x(a), y(b)
8     {}
9     void display()

```

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```

10 {
11     std::cout<<x << " + i" <<y<<std::endl;
12 }
13 };

```

We can use ComplexNumber with different types like int, double & char etc. i.e.

```

1 ComplexNumber<int> obj1(1,2);
2
3 ComplexNumber<double> obj2(1.0,2.0);
4
5 ComplexNumber<char> obj3('1' , '2');

```

Now we want to restrict that no one can use ComplexNumber class with double or char as template parameter. For that we need to delete certain specialized functions i.e.

```

1 ComplexNumber(char a, char b) = delete;
2
3 ComplexNumber(double a, double b) = delete;

```

Now on trying to use ComplexNumber<> class with double or char as template parameter will generate compile time error.

Complete ComplexNumber class with deleted specialisations is as follows,

```

1 template <typename T>
2 class ComplexNumber
3 {
4     T x;
5     T y;
6 public:
7     ComplexNumber(T a, T b) : x(a) , y(b)
8     {}
9     void display()
10    {
11        std::cout<<x << " + i" <<y<<std::endl;
12    }
13    // Deleted template specialisation
14    ComplexNumber(char a, char b) = delete;
15    // Deleted template specialisation
16    ComplexNumber(double a, double b) = delete;
17 };

```

Different between deleted function and private functions

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By making functions private we can also restrict its calling but still marking function deleted with delete keyword has its own advantages like,

- Private member functions can be called from other member functions, whereas, deleted functions can not be called even from other member functions.
- Deleted functions exists in name lookup , if compiler finds a function is deleted then it will not lookup for other matching functions based on type lookups, hence prevents unnecessary data loss and bugs.

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lvalue vs rvalue

Is rvalue immutable in C++?

What is rvalue reference in C++11

Move Constructor

Callbacks in C++

Function Pointers

Function Objects & Functors

Design Patterns

Behavioral Design Patterns

- ... Observer Design Pattern
- ... State Design Pattern
- ... Strategy Design Pattern

Structural Design Patterns

- ... Composite Design Pattern
- ... Flyweight Design Pattern

Creational Design Patterns

as keys

4.) Set vs Map

5.) How to Iterate over a map in C++

6.) Map Insert Example

7.) Iterate a map in reverse order

8.) Check if a key exists in a Map

9.) Search by value in a Map

10.) Erase by Key | Iterators

11.) C++ Map : Operator []

12.) Erase by Value or callback

13.) copy all Values from a Map to vector

STL Multimap

MultiMap Example and Tutorial

multimap::equals_range - Tutorial

STL Algorithms

std::sort Tutorial & Example

std::unique Tutorial & Example

1.) Using std::find & std::find_if with User Defined Classes

2.) Iterating over a range of User Defined objects and calling member function using std::for_each

Pointers

Pointer vs Reference

Allocating 2D Array Dynamically

C++ Strings

Find and Replace all occurrences of a string

Find all occurrences of a sub string

C++ Memory Management

Memory Leaks
new and delete operator

Python : map() function explained with examples	How to append elements to a Numpy Array	Case Insensitive string::find	delete vs []delete
Delete elements from a Numpy Array by value or conditions in Python	Find max value & it's index in Numpy Array numpy.amax()	Convert First Letter of each word to Upper Case	Out Of Memory Errors
Python : filter() function Tutorial & Examples	Find unique values in a numpy array with frequency & indices	Converting a String to Upper & Lower Case	Overload new & delete
Python : max() function explained with examples	numpy.where() : Tutorial & Examples Python	Trim strings in C++	Restrict Dynamic Deletion
Python : min() function Tutorial with examples	numpy.zeros() & numpy.ones() Create a numpy array of zeros or ones	C++ : How to split a string using String and character as Delimiter?	Placement new operator
Java - Hashmap	Create Numpy Array of different shapes & initialize with identical values using numpy.full()	startsWith() Implementation	Delete 'this' pointer
What is Hashing and Hash Table?	numpy.amin() Find minimum value in Numpy Array and it's index	endsWith() Implementation	
Associating Multiple values with same Key	numpy.linspace() Create same sized samples over an interval in Python	Remove Sub Strings from String	
Remove elements while Iterating	Delete elements, rows or columns from a Numpy Array by index positions using numpy.delete() in Python	Polymorphism	
Update the value of an existing key	How to get Numpy Array Dimensions using numpy.ndarray.shape & numpy.ndarray.size() in Python	Virtual Functions	
Get all keys by a value in HashMap	Sorting 2D Numpy Array by column or row in Python	vTable and vPointer	
Java - HashSet	How to Reverse a 1D & 2D numpy array using np.flip() and [] operator in Python		
What is Hashing and Hash Table?	How to save Numpy Array to a CSV File using numpy.savetxt() in Python		
Create and add elements in a HashSet	What is a Structured Numpy Array and how to create and sort it in Python?		
Iterate over a HashSet			
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Merge two HashSet			
Initializing HashSet from an Array			
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Questions

Method Overriding

Tutorial

Overriding with
Different Return Type

Calling Base class's
overridden method

Preventing Method
Overriding

Need of preventing
Method Overriding

How to sort a Numpy
Array in Python ?

Python: Date Time Tutorials

Convert a timestamp
string to a datetime
object

Get Current date and
timestamp

Get Last Modification
date & time of a file