map vs unordered_map | When to choose one over another ?

Varun March 26, 2017 std::map, unordered_map 1 Comment

In this article we will compare std::map and std::unordered_map and will also discuss when to choose one over another.

Both std::map & std::unordered_map store elements in key value pair & provide member functions to efficiently insert, search & delete key value pairs.

But they are different in following areas,

- Internal Implementation
- Memory Usage
- Time Complexity
- Using user defined objects as keys

Internal Implementation :

std::map Internally store elements in a balanced BST. Therefore, elements will be stored in sorted order of keys.

std::unordered_map store elements using hash table. Therefore, elements will not be stored in any sorted order. They will be stored in arbitrary order . To know more about hashing check following article, What is Hashing and Hash Table?

Check following example,

C++

```cpp
#include <map>
#include <unordered_map>
#include <string>
#include <iterator>
#include <algorithm>

int main()
{

    // Map of string & int i.e. words as key & there
    // occurrence count as values
    std::map<std::string, int> wordMap = {
                        { "is", 6 },
                        { "the", 5 },
                        { "hat", 9 },
                        { "at", 6 }
                    };

    std::cout<<"std::map Contents : Elements are in sorted order of Keys"<<std::e

    // Print map contents
    std::for_each(wordMap.begin(), wordMap.end(), [](std::pair<std::string, int>
        std::cout<<elem.first<< " :: "<< elem.second<<std::endl;
    });



    // Unordered_map of string & int i.e. words as key & there
    // occurrence count as values
    std::unordered_map<std::string, int> wordUOMap = {
                        { "is", 6 },
                        { "the", 5 },
                        { "hat", 9 },
                        { "at", 6 }
                    };

    std::cout<<"std::unordered_map Contents : Elements are in Random order of Key

    // Print Unordered_map
    std::for_each(wordUOMap.begin(), wordUOMap.end(), [](std::pair<std::string, i
                                std::cout<<elem.first<< " :: "<< elem.second<<std
                            });
    return 0;
}
```

Output:

```
std::map Contents : Elements are in sorted order of Keys
at :: 6
hat :: 9
is :: 6
the :: 5
std::unordered_map Contents : Elements are in Random order of Keys
hat :: 9
the :: 5
at :: 6
is :: 6
```

Memory Usage :

Memory usage is more in unordered_map as compared to map because unordered_map need space for storing hash table too.

Time Complexity for Searching element :

Time complexity for searching elements in **std::map** is O(log n). Even in worst case it will be O(log n) because elements are stored internally as Balanced Binary Search tree (BST).

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Whereas, in **std::unordered_map** best case time complexity for searching is O(1). Where as, if hash code function is not good then, worst case complexity can be O(n) (In case all keys are in same bucket).

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Using user define objects as Keys :

For std::map to use user defined object as keys, we need to override either < operator or pass external comparator i.e. a functor or function pointer that can be used by map for comparing keys.

Where as, For **std::unordered_map** we need to provide definition of function std::hash<K> for our key type K. Also we need to override == operator.

Check following article for detailed explanation :

Using User defined class objects as keys in std::map

Unordered container and Custom Hasher

When to choose map instead of unordered_map

When you need Low Memory:

Unordered_map consumes extra memory for internal hashing, so if you are keeping millions and billions of data inside the map and want to consume less memory then choose std::map instead of std::unordered_map.

When you are interested in Ordering too

As std::map internally use balanced BST, so all the elements inside it will be in sorted order based on the key. So, if you want all keys to be ordered then go for std::map.

When you need guaranted Performance

For searching an element, std::unordered_map gives the complexity O(1) in best case but O(n) in worst case (if hash implementation is not perfect).

So, if your hash implementation is not good and you have millions and billions of data then go for std::map because it will give you guaranteed O(log N).

When to choose unordered_map instead of map

When you have good hasher and no memory limitation

Unordered_map consumes extra memory for internal hashing. But to due to this searching complexity is O(1), if hasher function is good.

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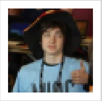

Leonard Inkret - August 7th, 2019 at 12:35 pm

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