Non- Linear Data Structures-MAP

Module 4.1

MAP

- A map is any data structure that groups a dynamic number of *key-value pairs* together,

- Map allows us to
  - retrieve values by key,
  - to insert new key-value pairs, and
  - to update the values associated with keys.

Courtesy: https://noncombatant.org/2014/03/02/maps-and-their-applications/

MAP

- A *Map* is a type of fast key lookup data structure that offers a flexible means of indexing into its individual elements.
- Unlike most **array data structures** that
  - **only allow access to the elements by means of integer** indices,
  - **the indices for a Map can be nearly any scalar numeric value or a character vector.**

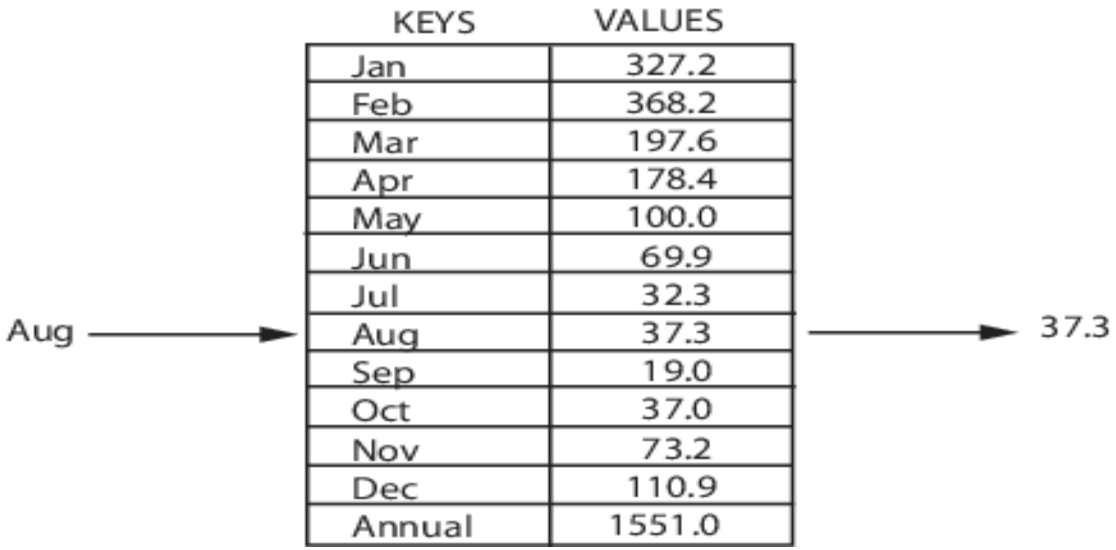
Courtesy: https://in.mathworks.com/help/matlab/matlab_prog/overview-of-the-map-data-structure.html

MAP

- Indices into the elements of a Map are called *keys*.
- These keys, along with the data *values* associated with them, are stored within the Map.
- Each entry of a Map contains exactly one unique key and its corresponding value.
- No two mapped values can have same key values.

MAP-Example

- **Indexing into the Map of rainfall statistics shown below with a character vector representing the month of August yields the value internally associated with that month, 37.3.**
- **Mean monthly rainfall statistics (mm)**



MAP

- **Keys are not restricted to integers as they are with other arrays.**
- Specifically, a key may be any of the following types:
  - 1-by-N character array
  - **Scalar real double** or single
  - **Signed or unsigned scalar integer**

MAP

- The values stored in a Map can be of any type.
- This includes
  - **arrays of numeric values,**
  - **structures,**
  - **cells,**
  - **character arrays,**
  - objects, or
  - **other Maps.**

MAP ADT Functions

Some basic functions associated with Map:

- begin() – Returns an iterator to the first element in the map
- end() – Returns an iterator to the theoretical element that follows last element in the map
- size() – Returns the number of elements in the map
- max_size() – Returns the maximum number of elements that the map can hold
- empty() – Returns whether the map is empty
- pair insert(keyvalue, mapvalue) – Adds a new element to the map
- erase(iterator position) – Removes the element at the position pointed by the iterator
- erase(const g)– Removes the key value ‘g’ from the map
- clear() – Removes all the elements from the map

Courtesy:https://www.geeksforgeeks.org/map-associative-containers-the-c-standard-template-library-stl/

begin() function

- Used to return an iterator pointing to the first element of the map container.
- begin() function returns a bidirectional iterator to the first element of the container.

Syntax :

***mapname*.begin()**

- **Parameters :** No parameters are passed.
- **Returns :** This function returns a bidirectional iterator pointing to the first element.

Demonstrates begin() and end()

```
#include <iostream>
#include <map>
using namespace std;

int main()
{
   // declaration of map container
   map<char, int> mymap;
   mymap['a'] = 1;
   mymap['b'] = 2;
   mymap['c'] = 3;

   // using begin() to print map
   for (auto it = mymap.begin();
        it != mymap.end(); ++it)
      cout << it->first << " = "
           << it->second << '\n';
   return 0;
}
```

Output:

a = 1

b = 2

c = 3

end() function

- end() function is used to return an iterator pointing to past the last element of the map container.
- Since it does not refer to a valid element, it cannot de-referenced end() function returns a bidirectional iterator.

Syntax :

***mapname*.end()**

- **Parameters :** No parameters are passed.
- **Returns :** This function returns a bidirectional iterator pointing to the next of last element.

insert()

- A built-in function in C++ STL which is used to insert elements with a particular key in the map container.

Syntax:

- iterator map_name.insert({key, element})

Parameters:

- The function **accepts a pair that consists of a key and element** which is to be inserted into the map container.
- The function does not insert the key and element in the map if the key already exists in the map.

Return Value:

- The function returns an iterator pointing to the new element in the container.

insert()

```
// C++ program to illustrate
// map::insert({key, element})
#include <bits/stdc++.h>
using namespace std;

int main()
{
    // initialize container
    map<int, int> mp;

    // insert elements in random order
    mp.insert({ 2, 30 });
    mp.insert({ 1, 40 });
    mp.insert({ 3, 60 });

// does not inserts key 2 with element 20
    mp.insert({ 2, 20 });
    mp.insert({ 5, 50 });

    // prints the elements
    cout << "KEY\tELEMENT\n";
    for (auto itr = mp.begin(); itr != mp.end();
++itr) {
        cout << itr->first
             << '\t' << itr->second << '\n';
    }
    return 0;
}
```

OUTPUT-

KEY ELEMENT

1 40

2 30

3 60

5 50

size() function

- In C++, **size()** function is used to return the total number of elements present in the map.

Syntax:

- **map_name.size()**

Return Value: It returns the number of elements present in the map.

size() function

```
Input : map1 = {
                {1, "India"},
                {2, "Nepal"},
                {3, "Sri Lanka"},
                {4, "Myanmar"}
               }
        map1.size();
```

Output: 4

```
Input : map2 = {};
        map2.size();
```

Output: 0

clear()

- clear() function is used to remove all the elements from the map container and thus leaving it's size 0.

Syntax:

map1.clear() where map1 is the name of the map.

Parameters:

No parameters are passed.

Return Value:

None

clear()

Input : map1 = {
{1, "India"},
{2, "Nepal"},
{3, "Sri Lanka"},
{4, "Myanmar"}
}

```
map1.clear();
```

Output: map1 = {}

clear()

```
#include <bits/stdc++.h>
using namespace std;

int main()
{
   // Take any two maps
   map<int, string> map1, map2;

   // Inserting values
   map1[1] = "India";
   map1[2] = "Nepal";
   map1[3] = "Sri Lanka";
   map1[4] = "Myanmar";

  // Print the size of map
   cout<< "Map size before running function: \n";
   cout << "map1 size = " << map1.size() << endl;
   cout << "map2 size = " << map2.size() << endl;;

      // Deleting the map elements
   map1.clear();
   map2.clear();

   // Print the size of map
   cout<< "Map size after running function: \n";
   cout << "map1 size = " << map1.size() << endl;
   cout << "map2 size = " << map2.size();
   return 0;
}
```

Output:

```
Map size before running function:
map1 size = 4
map2 size = 0

Map size after running function:
map1 size = 0
map2 size = 0
```

erase()

- A built-in function in C++ STL which is used to erase element from the container.
- It can be used to **erase keys, elements** at any specified position or a given range.

Syntax :

- map_name.erase(key)

Parameters:

- The function accepts **one mandatory parameter *key*** which specifies the key to be erased in the map container.

Return Value:

- The function **returns 1 if the key element is found** in the map else returns 0.

erase()

```
#include <bits/stdc++.h>
using namespace std;

int main()
{

   // initialize container
   map<int, int> mp;

   // insert elements in random order
   mp.insert({ 2, 30 });
   mp.insert({ 1, 40 });
   mp.insert({ 3, 60 });
   mp.insert({ 5, 50 });

// prints the elements
   cout << "The map before using erase() is : \n";
 cout << "KEY\tELEMENT\n";
            for (auto itr = mp.begin(); itr !=
mp.end(); ++itr) {
       cout << itr->first
            << '\t' << itr->second << '\n';
   }
    // function to erase given keys
   mp.erase(1);
   mp.erase(2);

   // prints the elements
   cout << "\nThe map after applying erase() is :
\n";
   cout << "KEY\tELEMENT\n";
   for (auto itr = mp.begin(); itr != mp.end(); ++itr)
{
       cout << itr->first
            << '\t' << itr->second << '\n';
   }
   return 0;
}
```

erase()

The map before using erase() is :

KEY ELEMENT

1 40

2 30

3 60

5 50

The map after applying erase() is :

KEY ELEMENT

3 60

5 50

empty()

- Used to check if the map container is empty or not.

Syntax :

- ***mapname*.empty()**

Parameters :

- No parameters are passed.

Returns :

- True, if map is empty
- False, Otherwise Examples:

empty()

Examples:

Input : map

```
mymap['a']=10;
mymap['b']=20;
mymap.empty();
```

Output : False