C++ Magicians – STL Algorithms

For all those who aspire to excel in competitive programming, only having a knowledge about containers of STL is of less use till one is not aware what all STL has to offer. STL has an ocean of algorithms, some of the most used algorithms on vectors and most useful one’s in Competitive Programming are mentioned as follows:-

**Non-Manipulating Algorithms**

1. [**sort**](http://www.geeksforgeeks.org/sort-c-stl/)**(first\_iterator, last\_iterator)** – To sort the given vector.
2. **reverse(first\_iterator, last\_iterator)** – To reverse a vector.
3. **\*max\_element (first\_iterator, last\_iterator)** – To find the maximum element of a vector.
4. **\*min\_element (first\_iterator, last\_iterator)**– To find the minimum element of a vector.
5. **accumulate(first\_iterator, last\_iterator, initial value of sum)** – Does the summation of vector elements

|  |
| --- |
| // A C++ program to demonstrate working of sort(),  // reverse()  #include <algorithm>  #include <iostream>  #include <vector>  #include <numeric> //For accumulate operation  using namespace std;    int main()  {      // Initializing vector with array values      int arr[] = {10, 20, 5, 23 ,42 , 15};      int n = sizeof(arr)/sizeof(arr[0]);      vector<int> vect(arr, arr+n);        cout << "Vector is: ";      for (int i=0; i<n; i++)          cout << vect[i] << " ";        // Sorting the Vector in Ascending order      sort(vect.begin(), vect.end());        cout << "\nVector after sorting is: ";      for (int i=0; i<n; i++)         cout << vect[i] << " ";        // Reversing the Vector      reverse(vect.begin(), vect.end());        cout << "\nVector after reversing is: ";      for (int i=0; i<6; i++)          cout << vect[i] << " ";        cout << "\nMaximum element of vector is: ";      cout << \*max\_element(vect.begin(), vect.end());        cout << "\nMinimum element of vector is: ";      cout << \*min\_element(vect.begin(), vect.end());        // Starting the summation from 0      cout << "\nThe summation of vector elements is: ";      cout << accumulate(vect.begin(), vect.end(), 0);        return 0;  } |

1. Run on IDE
2. Output:
3. Vector before sorting is: 10 20 5 23 42 15
4. Vector after sorting is: 5 10 15 20 23 42
5. Vector before reversing is: 5 10 15 20 23 42
6. Vector after reversing is: 42 23 20 15 10 5
7. Maximum element of vector is: 42
8. Minimum element of vector is: 5
9. The summation of vector elements is: 115
10. **count(first\_iterator, last\_iterator,x)** – To count the occurrences of x in vector.
11. **find(first\_iterator, last\_iterator, x)** – Points to last address of vector ((name\_of\_vector).end()) if element is not present in vector.

|  |
| --- |
| // C++ program to demonstrate working of count()  // and find()  #include <algorithm>  #include <iostream>  #include <vector>  using namespace std;    int main()  {      // Initializing vector with array values      int arr[] = {10, 20, 5, 23 ,42, 20, 15};      int n = sizeof(arr)/sizeof(arr[0]);      vector<int> vect(arr, arr+n);        cout << "Occurrences of 20 in vector : ";        // Counts the occurrences of 20 from 1st to      // last element      cout << count(vect.begin(), vect.end(), 20);        // find() returns iterator to last address if      // element not present      find(vect.begin(), vect.end(),5) != vect.end()?                           cout << "\nElement found":                       cout << "\nElement not found";        return 0;  } |

1. Run on IDE
2. Output:
3. Occurrences of 20 in vector: 2
4. Element found
5. [**binary\_search**](http://quiz.geeksforgeeks.org/binary-search-algorithms-the-c-standard-template-library-stl/)**(first\_iterator, last\_iterator, x)** – Tests whether x exists in sorted vector or not.
6. **lower\_bound(first\_iterator, last\_iterator, x)** – returns an iterator pointing to the first element in the range [first,last) which has a value not less than ‘x’.
7. **upper\_bound(first\_iterator, last\_iterator, x)** – returns an iterator pointing to the first element in the range [first,last) which has a value greater than ‘x’.

|  |
| --- |
| // C++ program to demonstrate working of lower\_bound()  // and upper\_bound().  #include <algorithm>  #include <iostream>  #include <vector>  using namespace std;    int main()  {      // Initializing vector with array values      int arr[] = {5, 10, 15, 20, 20, 23, 42, 45};      int n = sizeof(arr)/sizeof(arr[0]);      vector<int> vect(arr, arr+n);        // Sort the array to make sure that lower\_bound()      // and upper\_bound() work.      sort(vect.begin(), vect.end());        // Returns the first occurrence of 20      auto q = lower\_bound(vect.begin(), vect.end(), 20);        // Returns the last occurrence of 20      auto p = upper\_bound(vect.begin(), vect.end(), 20);        cout << "The lower bound is at position: ";      cout << q-vect.begin() << endl;        cout << "The upper bound is at position: ";      cout << p-vect.begin() << endl;        return 0;  } |

1. Run on IDE
2. Output:
3. The lower bound is at position: 3
4. The upper bound is at position: 5

**Some Manipulating Algorithms**

1. **arr.erase(position to be deleted)** – This erases selected element in vector and shifts and resizes the vector elements accordingly.
2. **arr.erase(unique(arr.begin(),arr.end()),arr.end())** – This erases the duplicate occurrences in sorted vector in a single line.

|  |
| --- |
| // C++ program to demonstrate working of erase()  #include <algorithm>  #include <iostream>  #include <vector>  using namespace std;    int main()  {      // Initializing vector with array values      int arr[] = {5, 10, 15, 20, 20, 23, 42, 45};      int n = sizeof(arr)/sizeof(arr[0]);      vector<int> vect(arr, arr+n);        cout << "Vector is :";      for (int i=0; i<6; i++)          cout << vect[i]<<" ";        // Delete second element of vector      vect.erase(vect.begin()+1);        cout << "\nVector after erasing the element: ";      for (int i=0; i<5; i++)          cout << vect[i] << " ";        // sorting to enable use of unique()      sort(vect.begin(), vect.end());        cout << "\nVector before removing duplicate "               " occurrences: ";      for (int i=0; i<5; i++)          cout << vect[i] << " ";        // Deletes the duplicate occurrences      vect.erase(unique(vect.begin(),vect.end()),vect.end());        cout << "\nVector after deleting duplicates: ";      for (int i=0; i< vect.size(); i++)          cout << vect[i] << " ";        return 0;  } |

1. Run on IDE
2. Output:
3. Vector before erasing the element:5 20 5 23 20 20
4. Vector after erasing the element: 5 5 23 20 20
5. Vector before removing duplicate occurrences: 5 5 20 20 23
6. Vector after deleting duplicates: 5 20 23
7. **next\_permutation(first\_iterator, last\_iterator)**– This modified the vector to its next permutation.
8. **prev\_permutation(first\_iterator, last\_iterator)**– This modified the vector to its previous permutation.

|  |
| --- |
| // C++ program to demonstrate working of next\_permutation()  // and prev\_permutation()  #include <algorithm>  #include <iostream>  #include <vector>  using namespace std;    int main()  {      // Initializing vector with array values      int arr[] = {5, 10, 15, 20, 20, 23, 42, 45};      int n = sizeof(arr)/sizeof(arr[0]);      vector<int> vect(arr, arr+n);        cout << "Given Vector is:\n";      for (int i=0; i<n; i++)          cout << vect[i] << " ";        // modifies vector to its next permutation order      next\_permutation(vect.begin(), vect.end());      cout << "\nVector after performing next permutation:\n";      for (int i=0; i<n; i++)          cout << vect[i] << " ";        prev\_permutation(vect.begin(), vect.end());      cout << "\nVector after performing prev permutation:\n";      for (int i=0; i<n; i++)          cout << vect[i] << " ";        return 0;  } |

1. Run on IDE
2. Output:
4. Given Vector is:
5. 5 10 15 20 20 23 42 45
6. Vector after performing next permutation:
7. 5 10 15 20 20 23 45 42
8. Vector after performing prev permutation:
9. 5 10 15 20 20 23 42 45
10. **distance(first\_iterator,desired\_position)** – It returns the distance of desired position from the first iterator.This function is very useful while finding the index.

|  |
| --- |
| // C++ program to demonstrate working of distance()  #include <algorithm>  #include <iostream>  #include <vector>  using namespace std;    int main()  {      // Initializing vector with array values      int arr[] = {5, 10, 15, 20, 20, 23, 42, 45};      int n = sizeof(arr)/sizeof(arr[0]);      vector<int> vect(arr, arr+n);        // Return distance of first to maximum element      cout << "Distance between first to max element: ";      cout << distance(vect.begin(),                       max\_element(vect.begin(), vect.end()));      return 0;  } |

1. Run on IDE
2. Output:
3. Distance between first to max element: 7

More – [STL Articles](http://www.geeksforgeeks.org/tag/stl/)

This article is contributed by **Manjeet Singh.** If you like GeeksforGeeks and would like to contribute, you can also write an article and mail your article to contribute@geeksforgeeks.org. See your article appearing on the GeeksforGeeks main page and help other Geeks.

Please write comments if you find anything incorrect, or you want to share more information about the topic discussed above