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# Algorithm Library Computer science portal for geeks L Algorithm

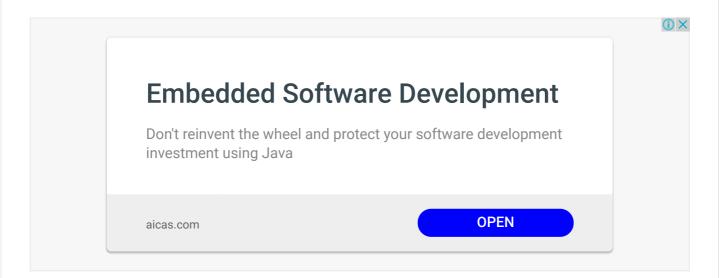
For all those who aspire to even containers of STL is of less use an area of statement to offer.

STL has an ocean of algorithms, for all < algorithm > library functions : Refer here.

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Some of the most used algorithms on vectors and most useful one's in Competitive Programming are mentioned as follows:

# Non-Manipulating Algorithms



- sort(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++)</pre>
```

```
cout << vect[i] << " ";
    // Sorting the Vector in Ascending order
    sort(vect.begin(), vect.end());
    cout << "\nVector after sorting is: ";</pre>
    for (int i=0; i<n; i++)</pre>
       cout << vect[i] << " ";
    // Reversing the Vector
    reverse(vect.begin(), vect.end());
    cout << "\nVector after reversing is: ";</pre>
    for (int i=0; i<6; i++)</pre>
        cout << vect[i] << " ";
    cout << "\nMaximum element of vector is: ";</pre>
    cout << *max_element(vect.begin(), vect.end());</pre>
    cout << "\nMinimum element of vector is: ";</pre>
    cout << *min element(vect.begin(), vect.end());</pre>
    // Starting the summation from 0
    cout << "\nThe summation of vector elements is: ";</pre>
    cout << accumulate(vect.begin(), vect.end(), 0);</pre>
    return 0;
}
```

```
Vector before sorting is: 10 20 5 23 42 15

Vector after sorting is: 5 10 15 20 23 42

Vector before reversing is: 5 10 15 20 23 42

Vector after reversing is: 42 23 20 15 10 5

Maximum element of vector is: 42

Minimum element of vector is: 5

The summation of vector elements is: 115
```

- 6. **count(first\_iterator, last\_iterator,x)** To count the occurrences of x in vector.
- 7. **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 : ";</pre>
```

- 8. binary\_search(first\_iterator, last\_iterator, x) Tests whether x exists in sorted vector or not.
- 9. **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'.
- 10. **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: ";</pre>
    cout << q-vect.begin() << endl;</pre>
    cout << "The upper bound is at position: ";</pre>
    cout << p-vect.begin() << endl;</pre>
    return 0;
}
```

Occurrences of 20 in vector: 2

Element found

```
The lower bound is at position: 3
The upper bound is at position: 5
```

### Some Manipulating Algorithms

- 11. **arr.erase(position to be deleted)** This erases selected element in vector and shifts and resizes the vector elements accordingly.
- 12. 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 :";</pre>
     for (int i=0; i<6; i++)</pre>
         cout << vect[i]<<" ";</pre>
     // Delete second element of vector
    vect.erase(vect.begin()+1);
     cout << "\nVector after erasing the element: ";</pre>
     for (int i=0; i<5; i++)</pre>
         cout << vect[i] << " ";
     // sorting to enable use of unique()
     sort(vect.begin(), vect.end());
     cout << "\nVector before removing duplicate "</pre>
              " occurrences: ";
     for (int i=0; i<5; i++)</pre>
         cout << vect[i] << " ";
     // Deletes the duplicate occurrences
    vect.erase(unique(vect.begin(), vect.end()), vect.end());
     cout << "\nVector after deleting duplicates: ";</pre>
     for (int i=0; i< vect.size(); i++)</pre>
         cout << vect[i] << " ";
    return 0;
}
Output:
 Vector is :5 10 15 20 20 23
 Vector after erasing the element: 5 15 20 20 23
```

```
Vector before removing duplicate occurrences: 5 15 20 20 23
Vector after deleting duplicates: 5 15 20 23 42 45
```

- 13. **next\_permutation(first\_iterator, last\_iterator)** This modified the vector to its next permutation.
- 14. **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";</pre>
    for (int i=0; i<n; i++)</pre>
        cout << vect[i] << " ";</pre>
    // modifies vector to its next permutation order
    next_permutation(vect.begin(), vect.end());
    cout << "\nVector after performing next permutation:\n";</pre>
    for (int i=0; i<n; i++)</pre>
        cout << vect[i] << " ";
    prev permutation(vect.begin(), vect.end());
    cout << "\nVector after performing prev permutation:\n";</pre>
    for (int i=0; i<n; i++)</pre>
        cout << vect[i] << " ";</pre>
    return 0;
}
```

```
Given Vector is:
5 10 15 20 20 23 42 45

Vector after performing next permutation:
5 10 15 20 20 23 45 42

Vector after performing prev permutation:
5 10 15 20 20 23 42 45
```

14. **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: ";</pre>
    cout << distance(vect.begin(),</pre>
                      max_element(vect.begin(), vect.end()));
    return 0;
}
```

```
Distance between first to max element: 7
```

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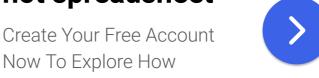
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