

# Partition

In this lesson, we will study different algorithms that partition a range or help in the partitioning of a range.

## i What is a partition?

A partition of a set is a decomposition of a set into subsets such that each element of the set is precisely in one subset. The subsets are defined in C++ by a unary predicate so that the members of the first subset fulfill the predicate. The remaining elements are in the second subset.

C++ offers a few functions for dealing with partitions. All of them need a unary predicate `pre`. `std::partition` and `std::stable_partition` take as input a predicate and a range and partition it according to the predicate and return the partition point. With `std::partition_point` we can get the partition point of a partition. Afterwards we can check the partition with `std::is_partitioned` or copy it with `std::partition_copy`.

`std::is_partitioned`: Checks if the range is partitioned.

```
bool is_partitioned(InpIt first, InpIt last, UnPre pre)
bool is_partitioned(ExePol pol, FwdIt first, FwdIt last, UnPre pre)
```



`std::partition`: Partitions the range.

```
FwdIt partition(FwdIt first, FwdIt last, UnPre pre)
FwdIt partition(ExePol pol, FwdIt first, FwdIt last, UnPre pre)
```



`std::stable_partition`: Partitions the range in a way that the relative order of elements is maintained.

```
BiIt stable_partition(FwdIt first, FwdIt last, UnPre pre)
BiIt stable_partition(ExePol pol, FwdIt first, FwdIt last, UnPre pre)
```



`std::partition_copy`: Copies a partition in two ranges.

```
pair<OutIt1, OutIt2> partition_copy(InIt first, InIt last, OutIt1 result_true, OutIt2 result_false)
pair<FwdIt1, FwdIt2> partition_copy(ExePol pol, FwdIt1 first, FwdIt1 last, FwdIt2 result_true, FwdIt2 result_false)
```

`std::partition_point`: Returns the partition point.

```
FwdIt partition_point(FwdIt first, FwdIt last, UnPre pre)
```

An `std::stable_partition` guarantees, in contrast to an `std::partition`, that the elements preserve their relative order. The returned iterators `FwdIt` and `BiIt` point to the initial position in the second subset of the partition. The pair `std::pair<OutIt, OutIt>` of the algorithm `std::partition_copy` contains the end iterator of the subsets `result_true` and `result_false`. The behavior of `std::partition_point` is undefined if the range is not partitioned.

```
#include <algorithm>
#include <cctype>
#include <deque>
#include <iostream>
#include <list>
#include <string>
#include <vector>

bool isOdd(int i){ return (i%2); }

int main(){

    std::cout << std::boolalpha << std::endl;

    std::vector<int> vec{1, 4, 3, 4, 5, 6, 7, 3, 4, 5, 6, 0, 4, 8, 4, 6, 6, 5, 8, 8, 3, 9, 3, 7};

    for ( auto v: vec ) std::cout << v << " ";

    std::cout << "\n\n";

    auto parPoint= std::partition(vec.begin(), vec.end(), isOdd);

    for (auto v: vec) std::cout << v << " ";
    std::cout << std::endl;
    for (auto v= vec.begin(); v != parPoint; ++v) std::cout << *v << " ";
    std::cout << std::endl;
    for (auto v= parPoint; v != vec.end(); ++v) std::cout << *v << " ";
    std::cout << std::endl;

    std::cout << std::endl;

    std::cout << "std::is_partitioned: " << std::is_partitioned(vec.begin(), vec.end(), isOdd) << "\n";

    std::cout << "std::partition_point: " << (std::partition_point(vec.begin(), vec.end(), isOdd) - vec.begin()) << "\n";
}
```

```
std::cout << std::endl;

std::list<int> li;
std::list<int> de;
std::partition_copy(vec.begin(), vec.end(), std::back_inserter(li), std::back_inserter(de),

for (auto v: li) std::cout << v << " ";
std::cout << std::endl;
for (auto v: de) std::cout << v << " ";

std::cout << "\n\n";

}
```



Partition algorithms

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In the next lesson, we'll learn how sorting can easily be done in C++.