Adaptors

Iterators can do more than just search through data, they can now insert values!

WE'LL COVER THE FOLLOWING

Iterator adaptors enable the use of iterators in insert mode or with streams. They need the header `<iterator>`.

Insert iterators

With the three insert iterators `std::front_inserter`, `std::back_inserter`, and `std::inserter`, we can insert an element into a container at the beginning, at the end or an arbitrary position respectively. The memory for the elements will be automatically provided. All of these insert iterators map their functionality on the underlying methods of the container `cont`.

The table below gives us two pieces of information: Which methods of the containers are internally used and which iterators can be used depending on the container's type.

Name	Internally-used Method	Container
`std::front_inserter(val)`	`cont.push_front(val)`	`std::deque` `std::list`
`std::back_inserter(v`		

`al)`	`cont.push_back(val)`	`std::vector`
		`std::deque`
		`std::list`
		`std::string`

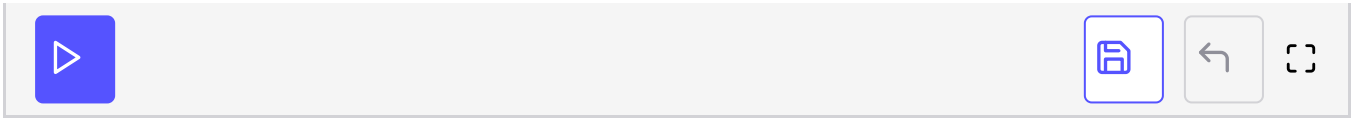
`std::inserter(val, pos)`	`cont.insert(pos, val)`	`std::vector`
		`std::deque`
		`std::list`
		`std::string`
		`std::map`
		`std::set`

The three insert iterators

We can combine the algorithms in the STL with the three insert iterators.

```
#include <iostream>
#include <iterator>
#include <queue>
#include <vector>
#include <unordered_map>
#include <algorithm>

int main(){

  std::deque<int> deq{5, 6, 7, 10, 11, 12};
  std::vector<int> vec{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15};

  std::copy(std::find(vec.begin(), vec.end(), 13), vec.end(), std::back_inserter(deq));

  for (auto d: deq) std::cout << d << " "; // 5 6 7 10 11 12 13 14 15
  std::cout<<std::endl;

  std::copy(std::find(vec.begin(), vec.end(), 8),
  std::find(vec.begin(), vec.end(), 10),
```

```
  std::inserter(deq, std::find(deq.begin(), deq.end(), 10)));
  for (auto d: deq) std::cout << d << " "; // 5 6 7 8 9 10 11 12 13 14 15
  std::cout<<std::endl;


  std::copy(vec.rbegin()+11, vec.rend(),
  std::front_inserter(deq));
  for (auto d: deq) std::cout << d << " "; // 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
  std::cout<<std::endl;

  return 0;
}
```



Stream iterators

Stream iterator adaptors can use streams as a data source or data sink. C++ offers two functions to create `istream` iterators and two to create `ostream` iterators. The created `istream` iterators behave like input iterators and the `ostream` iterators behave like insert iterators.

Function	Description
`std::istream_iterator<T>`	Creates an end-of-stream iterator.
`std::istream_iterator<T>(istream)`	Creates an istream iterator for `istream`.
`std::ostream_iterator<T>(ostream)`	Creates an ostream iterator for `ostream`
`std::ostream_iterator<T>(ostream, delim)`	Creates an ostream iterator for `ostream` with the delimiter `delim`.

The four stream iterators

Thanks to the stream iterator adapter we can directly read from or write to a stream.

The following interactive program fragment reads natural numbers in an endless loop from `std::cin` and pushes them into the vector `myIntVec`. If the

endless loop from `std::cin` and pushes them into the vector `myIntVec`. If the input is not a natural number, an error in the input stream will occur. All

numbers in `myIntVec` are copied to `std::cout`, separated by `:`. Now we can see the result on the console.

```
#include <iostream>
#include <iterator>
#include <queue>
#include <vector>
#include <unordered_map>
#include <algorithm>
#include <iterator>

int main(){
  std::vector<int> myIntVec;
  std::istream_iterator<int> myIntStreamReader(std::cin);
  std::istream_iterator<int> myEndIterator;

  // Possible input
  // 1
  // 2
  // 3
  // 4
  // z
  while(myIntStreamReader != myEndIterator){
    myIntVec.push_back(*myIntStreamReader);
    ++myIntStreamReader;
  }

  std::copy(myIntVec.begin(), myIntVec.end(), std::ostream_iterator<int>(std::cout, ":"));
          // 1:2:3:4:

  return 0;
}
```

This concludes our discussion on iterators. In the next chapter, we'll discuss the most prominent class, i.e., string.