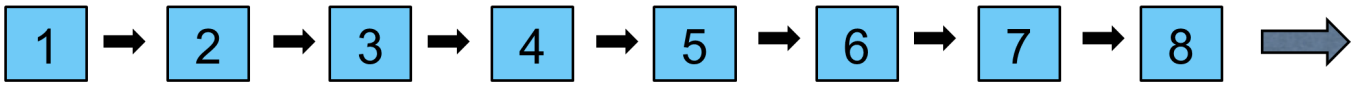
# Forward Lists

A forward list is the primitive form of the list structure we studied in the previous lesson. Nevertheless, forward lists are still useful.




std::forward_list is a singly linked list, which needs the header `<forward_list>`. `std::forward_list` has a drastically reduced interface and is optimized for minimal memory requirements.

`std::forward_list` has a lot in common with `std::list`:

- It supports no random access.
- The access of an arbitrary element is slow because in the worst case you have to iterate forward through the whole list.
- To add or remove an element is fast, if the iterator points to the right place.
- If you add or remove an element, the iterator stays valid.
- Operations always refer to the beginning of the `std::forward_list` or the position past the current element.

The characteristic that you can iterate a `std::forward_list` forward has a great impact. So the iterators cannot be decremented and therefore, operations like `It--` on iterators are not supported. For the same reason, `std::forward_list` has no backward iterator. `std::forward_list` is the only sequential container which doesn't know it size.

> 🗝 **std::forward_list has a very special domain**
> `std::forward_list` is the replacement for single linked lists. It's optimized for minimal memory management and performance if the insertion, extraction or movement of elements only affect adjacent elements. This is typical for sort algorithm.

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The special methods of `std::forward_list`.

| Method | Description |
| --- | --- |
| `forw.before_begin()` | Returns an iterator before the first element. |
| `forw.emplace_after(pos, args...)` | Creates an element after `pos` with the arguments `args...`. |
| `forw.emplace_front(args...)` | Creates an element at the beginning of `forw` with the arguments `args...`. |
| `forw.erase_after(pos, ...)` | Removes from `forw` the element `pos` or a range of elements, starting with `pos`. |
| `forw.insert_after(pos, ...)` | Inserts after `pos` new elements. These elements can be single elements, ranges or initialiser lists. |
| `forw.merge(c)` | Merges the sorted forward list c into the sorted forward list `forw`, so that `forw` keeps sorted. |
| `forw.merge(c, op)` | Merges the forward sorted list c into the forward sorted list `forw`, so that `forw` keeps sorted. Uses `op` as sorting criteria. |
| `forw.splice_after(pos, ...)` | Splits the elements in `forw` before `pos`. The elements can be single elements, ranges or lists. |

| | |
|---|---|
| `forw.unique()` | Removes adjacent element with the same value. |
| `forw.unique(pre)` | Removes adjacent elements, fulfilling the predicate `pre`. |

### Special methods of `std::forward_list`

Let's have a look at how the unique methods of `std::forward_list` work.

```
// forwardList.cpp
#include <iostream>
#include <algorithm>
#include <forward_list>

using std::cout;

int main(){
  std::forward_list<int> forw;
  std::cout << forw.empty() << std::endl; // 1 (1 denoted true)

  forw.push_front(7);
  forw.push_front(6);
  forw.push_front(5);
  forw.push_front(4);
  forw.push_front(3);
  forw.push_front(2);
  forw.push_front(1);
  for (auto i: forw) cout << i << " "; // 1 2 3 4 5 6 7
  cout<<"\n";

  forw.erase_after(forw.before_begin());
  cout<< forw.front(); // 2
  cout<<"\n";

  std::forward_list<int> forw2;
  forw2.insert_after(forw2.before_begin(), 1);
  forw2.insert_after(++forw2.before_begin(), 2);
  forw2.insert_after(++(++(forw2.before_begin())), 3);
  forw2.push_front(1000);
  for (auto i= forw2.cbegin();i != forw2.cend(); ++i) cout << *i << " ";  // 1000 1 2 3
  cout<<"\n";

  auto IteratorTo5= std::find(forw.begin(), forw.end(), 5);
  forw.splice_after(IteratorTo5, std::move(forw2));
  for (auto i= forw.cbegin(); i != forw.cend(); ++i) cout << *i << " ";  // 2 3 4 5 1000 1 2
  cout<<"\n";

  forw.sort();
  for (auto i= forw.cbegin(); i != forw.cend(); ++i) cout << *i << " ";
    // 1 2 2 3 3 4 5 6 7 1000
  cout<<"\n";
```

```
  forw.reverse();
  for (auto i= forw.cbegin(); i != forw.cend(); ++i) cout << *i << " ";
    // 1000 7 6 5 4 3 3 2 2 1
  cout<<"\n";

  forw.unique();
  for (auto i= forw.cbegin(); i != forw.cend(); ++i) cout << *i << " ";
    // 1000 7 6 5 4 3 2 2 1
  cout<<"\n";

  return 0;
}
```