# **STDLIB**

# The standard library

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#### A FEW WORDS ON TEMPLATES

- Classes and functions depending on compile-time defined types or values
- · template-arguments given in <>, other arguments as usual

```
std::array<int, 50> test;
```

- · arguments can sometimes be deducted from context
- · since C++17 class arguments can sometimes be deducted:

```
std::sort(test.begin(), test.end());
std::array test{1, 2, 3};
std::array test{1, 2, 3.0}; // error
```

```
struct ListElem {
    int content;
    ListElem* next:
// Why reinvent the wheel?
#include <forward list>
std::forward list<char> letters {'H', 'i'};
std::forward_list x {'H', 'i'}; // since C++17
x.insert after(x.begin() + 1, 's');
std::cout << letters.front() << "\n";</pre>
```

```
#include <list>
std::list<char> letters {'H', 'i'};
std::list x {'e', 'l', 'l', 'o'};

x.insert(x.begin(), 'H');
if (!letters.empty()) {
    std::cout << x.front() << "\n";
}</pre>
```

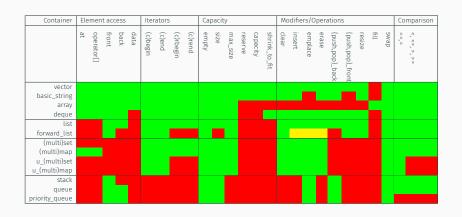
#### **CONTAINERS - VECTOR**

```
#include <vector>
std::vector<char> l
std::vector x {'H', 'i'}; // since C++17
letters[1] = 'e';
letters.push back('l');
letters.push back('l');
letters.push_back('o');
std::cout << letters[4] << "\n";</pre>
```

### OTHER CONTAINERS

- · array, vector
- · queue, deque, stack
- · list, forward\_list
- · set, multiset
- · map, multimap
- · unordered\_set, unordered\_multiset
- · unordered\_map, unordered\_multimap
- · string, basic\_string

## **COMPARISON: FUNCTIONALITY**



## **COMPARISON: COMPLEXITY**

· always O(1): begin(), end(), empty(), size(), push\_back()

Container	Insertion/Erase				Access	Find
vector	n	n	n	1	1	n
string			n	1	1	n
list	1	1	n	1	$\leftarrow$	n
forward_list	1	1			$\leftarrow$	n
set/map	log(n)	log(n)	log(n)	log(n)	1	log(n)
unordered set/map	1 (n)	1 (n)	1 (n)	1 (n)	1 (n)	n
(de)que(ue)	log(n)	log(n)	log(n)	log(n)	1	n
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#### **ITERATORS**

- · what happens internally in a range-based for-loop?
- · what if we want to traverse backwards?

```
std::vector fib {1, 1, 2, 3, 5, 8};
for (auto i : fib) { std::cout << i; }

for (auto i = fib.begin(); i != fib.end(); ++i) {
    std::cout << *i;
}</pre>
```

#### **ITERATORS**

- · what happens internally in a range-based for-loop?
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for (auto i : fib) { std::cout << i; }

for (auto i = fib.begin(); i != fib.end(); ++i) {
    std::cout << *i;
}</pre>
```

```
for (auto i = fib.rbegin(); i != fib.rend(); ++i) {
    std::cout << *i;
}</pre>
```

#### ALGORITHMS: INTRODUCTION

· a lot of commonly used algorithms and functionality is already given:

```
std::vector fib {1, 8, 1, 2, 34, 5, 21, 13, 3};

std::is_sorted(fib.begin(), fib.end()); // false
std::is_sorted_until(fib.begin(), fib.end());
// returns fib.begin() + 2

std::sort(fib.begin(), fib.end());
std::replace(fib.begin(), fib.end(), 1, 0);
```

```
std::vector fib {1, 8, 1, 2, 34, 5, 21, 13, 3};
bool f(int i) { return i % 2 == 0; }
bool g(int i) { return i > 5; }
int h(int i) { return i * 2; }
bool k(int i, int j) { return i > j; }
std::partition(fib.begin(), fib.end(), f);
// fib: 34 8 2 1 1 5 21 13 3
std::replace if(fib.begin(), fib.end(), g, 0);
// fib: 0 0 2 1 1 5 0 0 3
std::for each(fib.begin(), fib.end(), h);
// fib: 0 0 4 2 2 10 0 0 6
std::sort(fib.begin(), fib.end(), k);
```

#### ALGORITHMS: LAMBDA FUNCTION

```
std::vector fib {1, 8, 1, 2, 34, 5, 21, 13, 3};
std::for_each(fib.begin(), fib.end(),
      [](int i){ return i * 2; }
);
```

#### ALGORITHMS: LAMBDA FUNCTION

```
std::vector fib {1, 8, 1, 2, 34, 5, 21, 13, 3};
std::for_each(fib.begin(), fib.end(),
      [](int i){ return i * 2; }
);
```

```
int a = 0, b = 1;
std::vector<int> fib = {0, 1};
fib.resize(20);
std::generate(fib.begin() + 2, fib.end(),
       [&](){int c = a + b; a = b; b = c; return c; }
);
```

## ALGORITHMS: ALL/ANY/NONE

```
std::vector fib {1, 8, 1, 2, 34, 5, 21, 13, 3};

std::all_of(fib.begin(), fib.end(),
    [](int i) {return i < 10;});

std::any_of(fib.begin(), fib.end(),
    [](int i) {return i < 10;});

std::none_of(fib.begin(), fib.end(),
    [](int i) {return i < 10;});</pre>
```