

# Iterators

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## Begin/end iterator

# 1. Begin and end iterator

Use independent of looping:

Code:

```
vector<int> v{1,3,5,7};
auto pointer = v.begin();
cout << "we start at "
      << *pointer << "\n";
pointer++;
cout << "after increment: "
      << *pointer << "\n";

pointer = v.end();
cout << "end is not a valid
element: "
      << *pointer << "\n";
pointer--;
cout << "last element: "
      << *pointer << "\n";
```

Output

[stl] iter:

```
we start at 1
after increment: 3
end is not a valid
           element: 0
last element: 7
```

(Note: the auto actually stands for `vector::iterator`)

## 2. About that star

This is not a C-style pointer dereference,  
but rather an overloaded operator.

### 3. Copy range

Copy a range at an iterator:

Code:

```
vector<int> counts{1,2,3,4};  
vector<int> copied(5);  
copy( counts.begin(),counts.end(),  
      copied.begin()+1 );  
cout << copied[1] << ".." <<  
      copied[4] << "\n";  
cout << copied[0] << ".." <<  
      copied[3] << "\n";
```

Output

[iter] copy:

1..4

0..3

(No bound checking, so be careful!)

## 4. Erase at/between iterators

Erase from start to before-end:

Code:

```
vector<int> counts{1,2,3,4,5,6};  
vector<int>::iterator second =  
    counts.begin()+1;  
auto fourth = second+2; // easier  
    than 'iterator'  
counts.erase(second,fourth);  
cout << counts[0] << "," << counts[1]  
    << "\n";
```

Output

[iter] erase2:

1,4

(Also single element without end iterator.)

## 5. Insert at iterator

Insert at iterator: value, single iterator, or range:

Code:

```
vector<int>
    counts{1,2,3,4,5,6},zeros{0,0};
auto after_one = zeros.begin()+1;
zeros.insert(
    after_one,counts.begin()+1,counts.begin()+3
);
//vector<int>::insert(
    after_one,counts.begin()+1,counts.begin()+3
);
cout << zeros[0] << "," << zeros[1]
<< ","
<< zeros[2] << "," << zeros[3]
<< "\n";
```

Output

[iter] insert2:

0,2,3,0

## 6. Reconstruct index

Code:

```
vector<int> numbers{1,3,5,7,9};
auto it=numbers.begin();
while ( it!=numbers.end() ) {
    auto d =
        distance(numbers.begin(),it);
    cout << "At distance " << d << " we
        find " << *it << "\n";
    it++;
}
```

Output

[loop] distance:

```
At distance 0 we
    find 1
At distance 1 we
    find 3
At distance 2 we
    find 5
At distance 3 we
    find 7
At distance 4 we
    find 9
```



# Algorithms

## 7. Reduction operation

Default is sum reduction:

Code:

```
vector<int> v{1,3,5,7};  
auto first = v.begin();  
auto last  = v.end();  
auto sum = accumulate(first,last,0);  
cout << "sum: " << sum << "\n";
```

Output

[stl] accumulate:

sum: 16

## 8. Reduction with supplied operator

Supply multiply operator:

Code:

```
vector<int> v{1,3,5,7};  
auto first = v.begin();  
auto last = v.end();  
first++; last--;  
auto product =  
    accumulate  
        (first,last,2,multiplies<>());  
cout << "product: " << product <<  
    "\n";
```

Output

[stl] product:

*product: 30*

## 9. Use lambda to find any of

Here is an example using `any_of` to find whether there is any even element in a vector:

Code:

```
vector<int> integers{1,2,3,5,7,10};
auto any_even = any_of
    ( integers.begin(),integers.end(),
      [=] (int i) -> bool {
          return i%2==0; }
    );
if (any_even)
    cout << "there was an even" << "\n";
else
    cout << "none were even" << "\n";
```

Output

[range] anyof:

*there was an even*

# Exercise 1

Use `for_each` to sum the elements of a vector.

Hint: the problem is how to treat the sum variable. Do not use a global variable!