Compose This!

Sean Parent | Senior Principal Scientist, Photoshop

#AdobeRemix
Craig Ward

Function Composition

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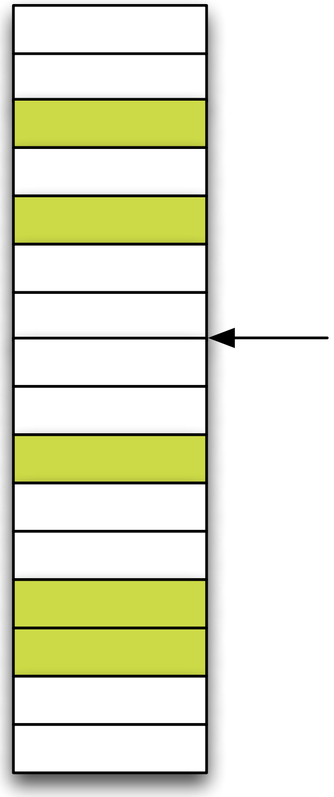
$$f(g(x))$$

Category Theory

- The study of how objects with morphisms (functions) compose

- Category Theory ignores complexity
- There may be multiple ways to compose a function with different efficiency tradeoffs

STL Composition



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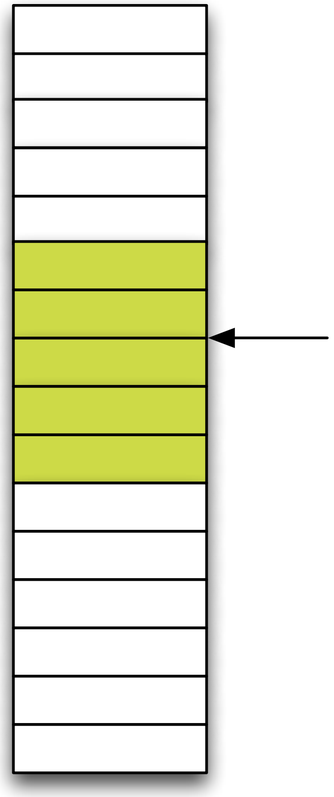

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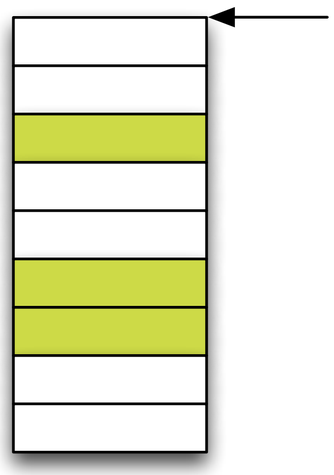

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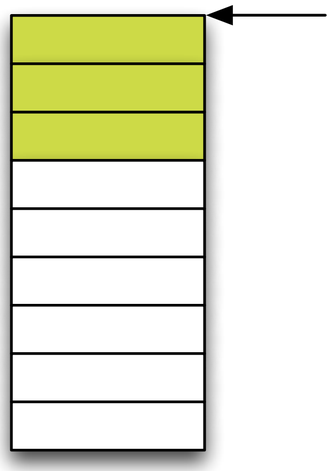

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STL Composition

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stable_partition(p, l, s)
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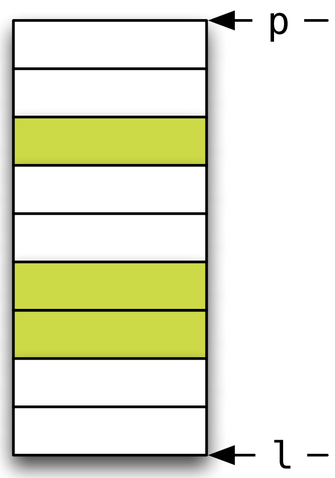

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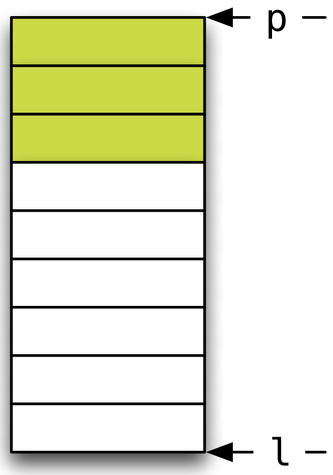

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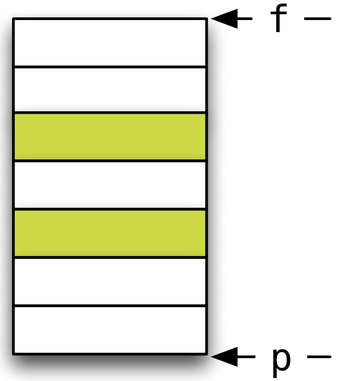


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stable_partition(f, p, not_fn(s))
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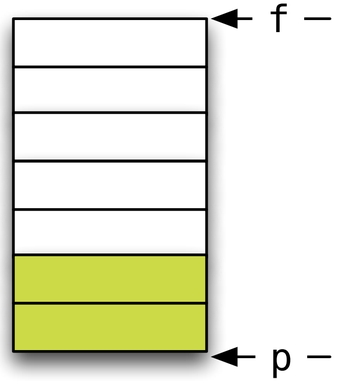
STL Composition

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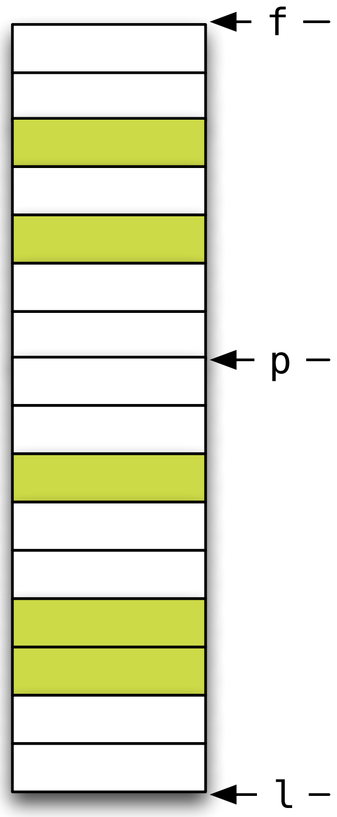


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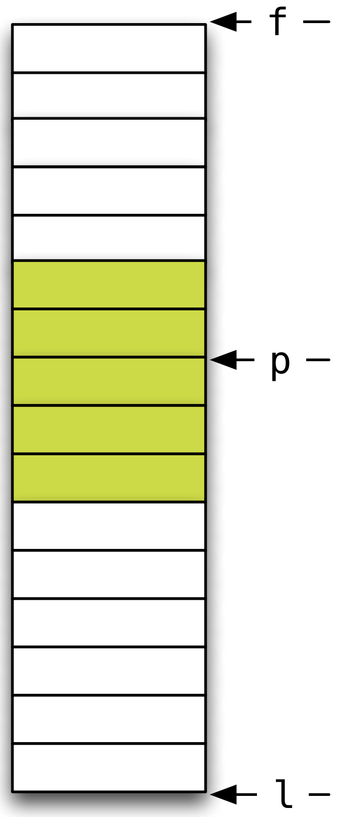


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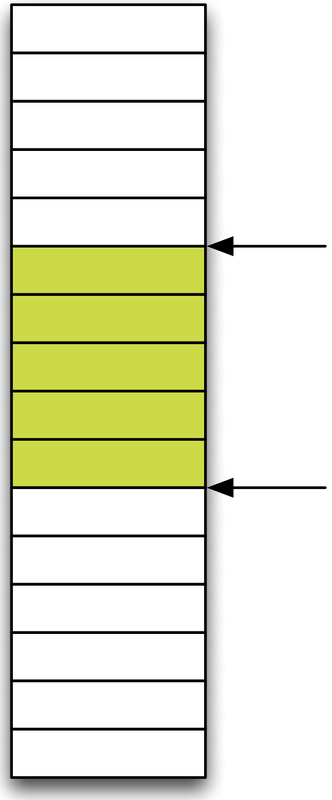

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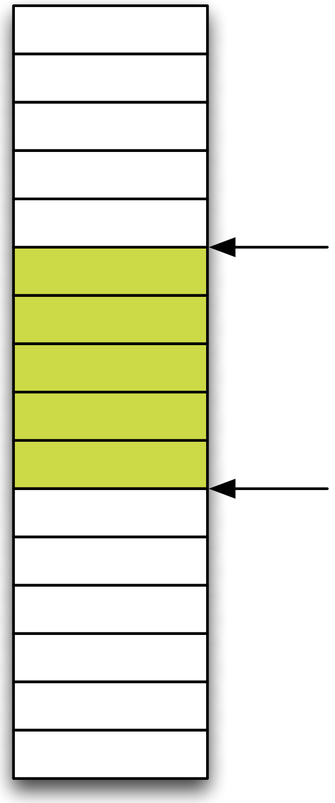

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return { stable_partition(f, p, not_fn(s)),
         stable_partition(p, l, s) };
```


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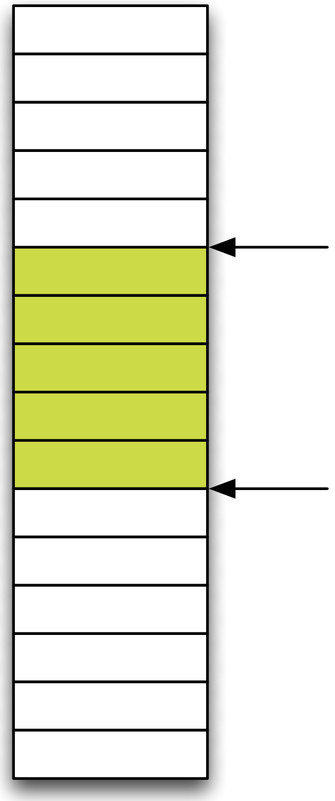

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template <typename I, // I models BidirectionalIterator
          typename S> // S models UnaryPredicate
auto gather(I f, I l, I p, S s) -> pair<I, I>
{
    return { stable_partition(f, p, not_fn(s)),
             stable_partition(p, l, s) };
}
```

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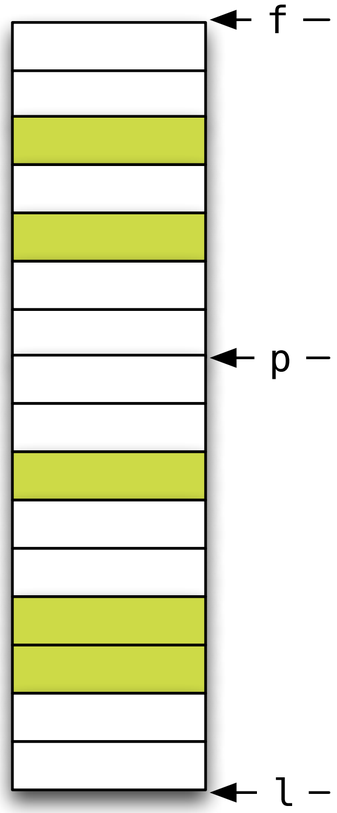


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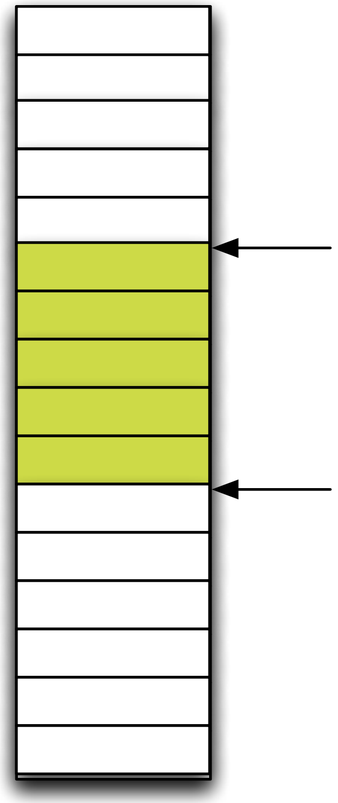

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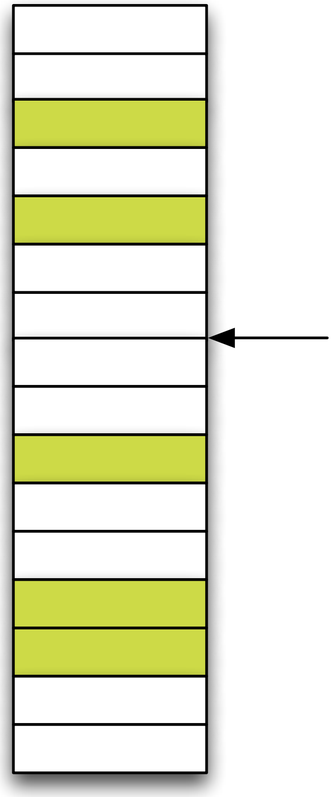
Lazy Gather (with Range v3)



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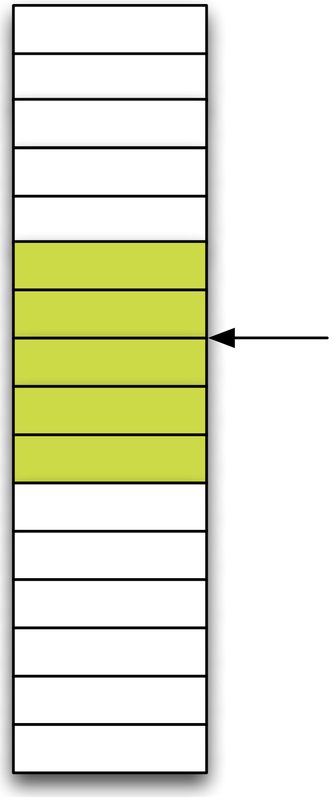

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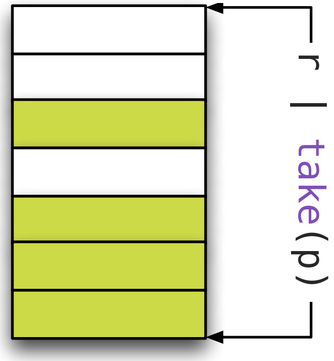


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template <class R, // R models forward_range
          class S> // S models predicate
auto partition(R&& r, S s) {
    return make_tuple(r | filter(s), r | remove_if(s));
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    auto [a, b] = partition(r | take(p), s);
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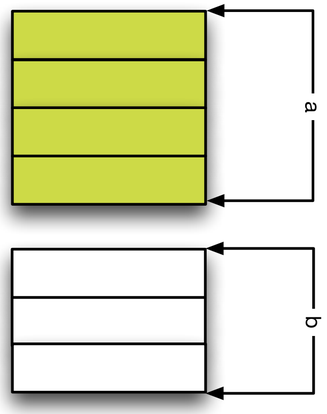


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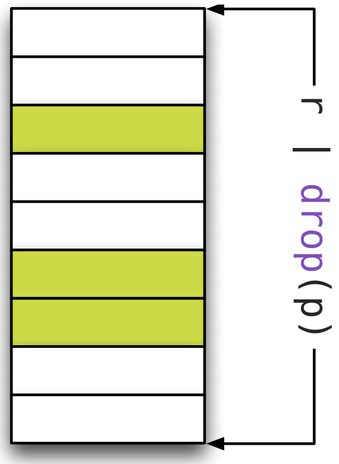


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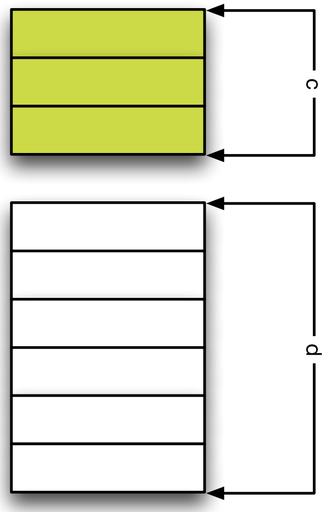


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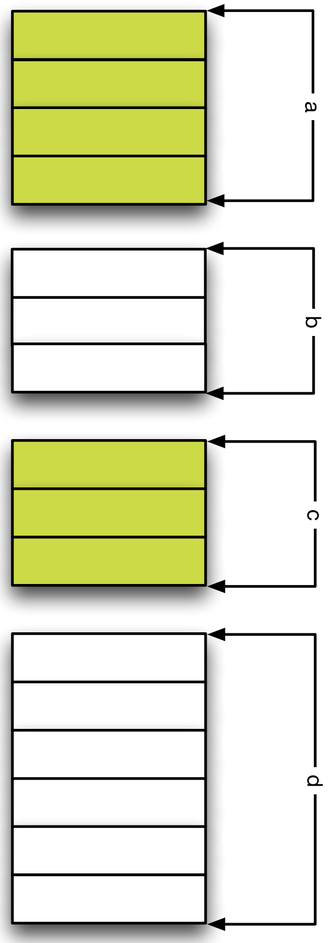


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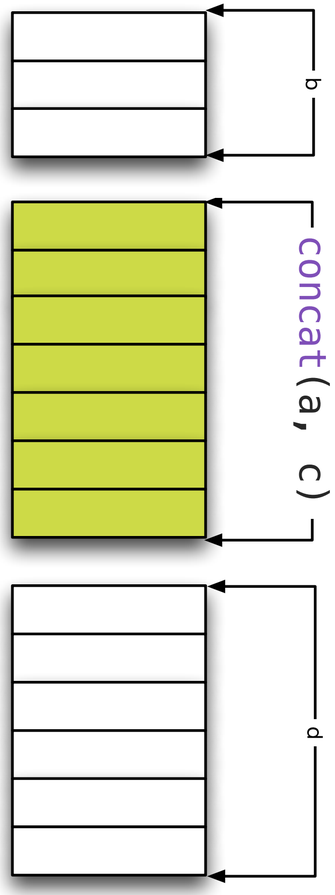


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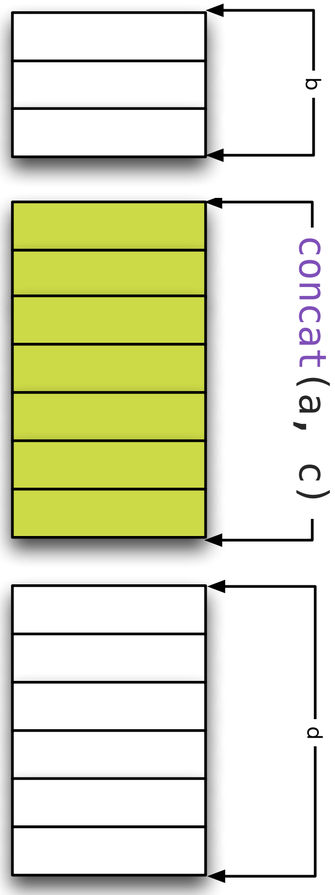


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}

template <class R, // R models forward_range
          class S> // S models predicate
auto gather(R&& r, size_t p, S s) {
    auto [a, b] = partition(r | take(p), s);
    auto [c, d] = partition(r | drop(p), s);
    return make_tuple(b, concat(a, c), d);
}
```

“Surprisingly less bad than I expected!” – Me

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“STL Doesn’t Compose”

- Can’t tie an output iterator to an input iterator

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```
auto odd_even_n(size_t n) {
    vector<int> v;
    generate_n(back_inserter(v), n, [_n = 0]() mutable { return _n++; });
    vector<int> r1, r2;
    partition_copy(begin(v), end(v), back_inserter(r1), back_inserter(r2),
                   [](const auto& e) { return e & 1; });
    return make_tuple(r1, r2);
}
```

Surprisingly less bad than you might expect!

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Compositional Efficiency

- A theory of cost of composition categorized by

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- A theory of cost of composition categorized by
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Compositional Efficiency

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Compositional Efficiency

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  - object attributes
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  - result form (i.e. in-situ, lazy, copy)

Compositional Cost

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- Important for polymorphic values, asynchronous operations
- Cost is time, not number of operations, and considers cache effects and scale
- Goal is to be able to predict the most efficient approach to solve a given problem

MAKE IT AN EXPERIENCE