Transform Iterator

Author: David Abrahams, Jeremy Siek, Thomas Witt
Contact: dave@boost-consulting.com, jsiek@osl.iu.edu, witt@ive.uni-hannover.de
Organization: Boost Consulting, Indiana University Open Systems Lab, University of Hanover
Institute for Transport Railway Operation and Construction
Date: 2004-01-13
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abstract: The transform iterator adapts an iterator by modifying the operator* to apply a function object to the result of dereferencing the iterator and returning the result.

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transform_iterator synopsis

template <class UnaryFunction,
class Iterator,
class Reference = use_default,
class Value = use_default>
class transform_iterator
{
public:
typedef /* see below */ value_type;
typedef /* see below */ reference;
typedef /* see below */ pointer;
typedef iterator_traits<Iterator>::difference_type difference_type;
typedef /* see below */ iterator_category;

transform_iterator();
transform_iterator(Iterator const& x, UnaryFunction f);

template<class F2, class I2, class R2, class V2>
transform_iterator(
    transform_iterator<F2, I2, R2, V2> const& t
    , typename enable_if_convertible<I2, Iterator>::type* = 0  // exposition only
    , typename enable_if_convertible<F2, UnaryFunction>::type* = 0  // exposition only
);  
UnaryFunction functor() const;
Iterator const& base() const;
reference operator*() const;
transform_iterator& operator++();
transform_iterator& operator--();

private:
    Iterator m_iterator; // exposition only
    UnaryFunction m_f; // exposition only
};

If Reference is use_default then the reference member of transform_iterator is result_of<UnaryFunction(iterator_traits<Iterator>::reference)>::type. Otherwise, reference is Reference.

If Value is use_default then the value_type member is remove_cv<remove_reference<reference> >::type. Otherwise, value_type is Value.

If Iterator models Readable Lvalue Iterator and if Iterator models Random Access Traversal Iterator, then iterator_category is convertible to random_access_iterator_tag. Otherwise, if Iterator models Bidirectional Traversal Iterator, then iterator_category is convertible to bidirectional_iterator_tag. Otherwise iterator_category is convertible to forward_iterator_tag. If Iterator does not model Readable Lvalue Iterator then iterator_category is convertible to input_iterator_tag.

transform_iterator requirements

The type UnaryFunction must be Assignable, Copy Constructible, and the expression f(*i) must be valid where f is an object of type UnaryFunction, i is an object of type Iterator, and where the type of f(*i) must be result_of<UnaryFunction(iterator_traits<Iterator>::reference)>::type.

The argument Iterator shall model Readable Iterator.

transform_iterator models

The resulting transform_iterator models the most refined of the following that is also modeled by Iterator.

- Writable Lvalue Iterator if transform_iterator::reference is a non-const reference.
- Readable Lvalue Iterator if transform_iterator::reference is a const reference.
- Readable Iterator otherwise.

The transform_iterator models the most refined standard traversal concept that is modeled by the Iterator argument.

If transform_iterator is a model of Readable Lvalue Iterator then it models the following original iterator concepts depending on what the Iterator argument models.

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<td>Random Access Traversal Iterator</td>
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If transform_iterator models Writable Lvalue Iterator then it is a mutable iterator (as defined in the old iterator requirements).

transform_iterator<F1, X, R1, V1> is interoperable with transform_iterator<F2, Y, R2, V2> if and only if X is interoperable with Y.

transform_iterator operations

In addition to the operations required by the concepts modeled by transform_iterator, transform_iterator provides the following operations.

transform_iterator();

Returns: An instance of transform_iterator with m_f and m_iterator default constructed.

transform_iterator(Iterator const& x, UnaryFunction f);

Returns: An instance of transform_iterator with m_f initialized to f and m_iterator initialized to x.

template<class OtherIterator, class R2, class V2>
transform_iterator(
    transform_iterator<UnaryFunction, OtherIterator, R2, V2> const& t
    , typename enable_if_convertible<OtherIterator, Iterator>::type* = 0 // exposition
    );

Returns: An instance of transform_iterator that is a copy of t.
Requires: OtherIterator is implicitly convertible to Iterator.

UnaryFunction functor() const;
Returns: m_f
Iterator const& base() const;
Returns: m_iterator
reference operator*() const;
Returns: m_f(*m_iterator)
transform_iterator& operator++();
Effects: ++m_iterator
Returns: *this
transform_iterator& operator--();
Effects: --m_iterator
Returns: *this

template <class UnaryFunction, class Iterator>
transform_iterator<UnaryFunction, Iterator>
make_transform_iterator(Iterator it, UnaryFunction fun);

Returns: An instance of transform_iterator<UnaryFunction, Iterator> with m_f initialized
to f and m_iterator initialized to x.

template <class UnaryFunction, class Iterator>
transform_iterator<UnaryFunction, Iterator>
make_transform_iterator(Iterator it);

Returns: An instance of transform_iterator<UnaryFunction, Iterator> with m_f default con-
structed and m_iterator initialized to x.

Example
This is a simple example of using the transform_iterators class to generate iterators that multiply (or add to) the value returned by dereferencing the iterator. It would be cooler to use lambda library in this example.

```cpp
int x[] = { 1, 2, 3, 4, 5, 6, 7, 8 };
const int N = sizeof(x)/sizeof(int);

typedef boost::binder1st< std::multiplies<int> > Function;
typed boost::transform_iterator<Function, int*> doubling_iterator;

doubling_iterator i(x, boost::bind1st(std::multiplies<int>(), 2)),
i_end(x + N, boost::bind1st(std::multiplies<int>(), 2));

std::cout << "multiplying the array by 2:" << std::endl;
while (i != i_end)
    std::cout << *i++ << " ";
std::cout << std::endl;

std::cout << "adding 4 to each element in the array:" << std::endl;
std::copy(boost::make_transform_iterator(x, boost::bind1st(std::plus<int>(), 4)),
    boost::make_transform_iterator(x + N, boost::bind1st(std::plus<int>(), 4)),
    std::ostream_iterator<int>(std::cout, " "));
std::cout << std::endl;
```
The output is:

**multiplying the array by 2:**
2 4 6 8 10 12 14 16

adding 4 to each element in the array:
5 6 7 8 9 10 11 12

The source code for this example can be found here.