Source Code Rejuvenation is not Refactoring

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Texas A&M University

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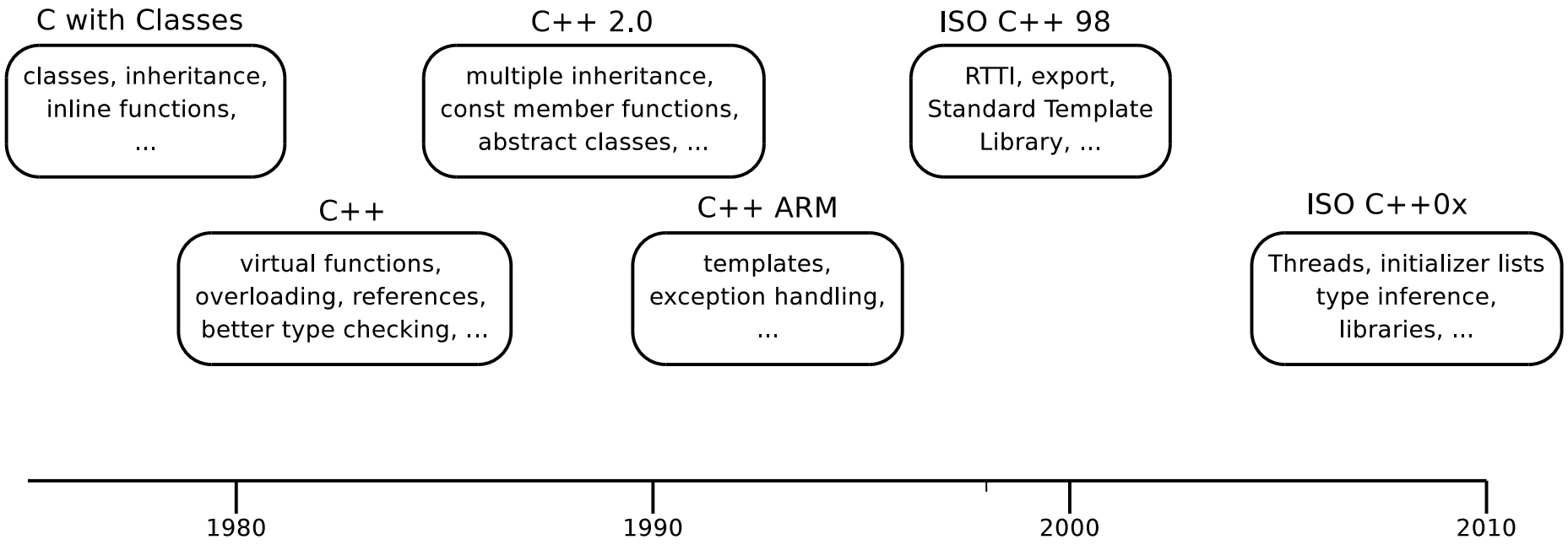
Programming Language Evolution



Evolving a language in and for the real world: C++ 1991-2006. [Str07]

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Overview

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What is Source Code Rejuvenation?

Definition

- Detection of outdated coding styles and idioms
- Automatic replacement of old code with modern language features or libraries.

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Source Code Rejuvenation

Goals

- Preserve or *improve* a program's behavior
- Raise the level of abstraction in source code

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Container Initialization in C++0x

C++0x Initializer List

```
// initializes a vector with 3 elements: 1, 2, 3
vector<int> vec = {1, 2, 3};
```

concise, non-redundant code

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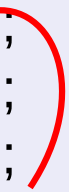
Container Initialization in C++

Consecutive push_backs

```
vector<int> vec;
vec.push_back(1);
vec.push_back(2);
vec.push_back(3);
```



repetitive code

Copying from an array

```
static const int a[] = {1, 2, 3};
vector<int> vec(a, a+sizeof(a)/sizeof(int));
```

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Container Initialization in C++

Consecutive push_backs

```
vector<int> vec;
vec.push_back(1);
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```

potentially inefficient code
(might trigger resize of the vector)

Copying from an array

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redundant type specification

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Copying from an array

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cumbersome range specification

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C++ Concepts - A Quick Introduction

Unconstrained code

```
template <class Iterator>
Iterator random_elem(Iterator first, Iterator last) {
   typename Iterator::difference len = distance(first, last);
   advance(first, rand()%len);
   return first;
}
```

C++ concepts specify syntactic and semantic properties

```
concept RandomElemIter <typename Iterator> {
   Iterator::Iterator(const Iterator&); // copy constructor
   typename Iterator::difference; // associated type
   Iterator::distance distance(Iterator&, Iterator&);
   void advance(Iterator&, Iterator::distance&);
   ...
}

   template<RandomElemIter Iterator>
   Iterator random_elem(Iterator first, Iterator last);
```

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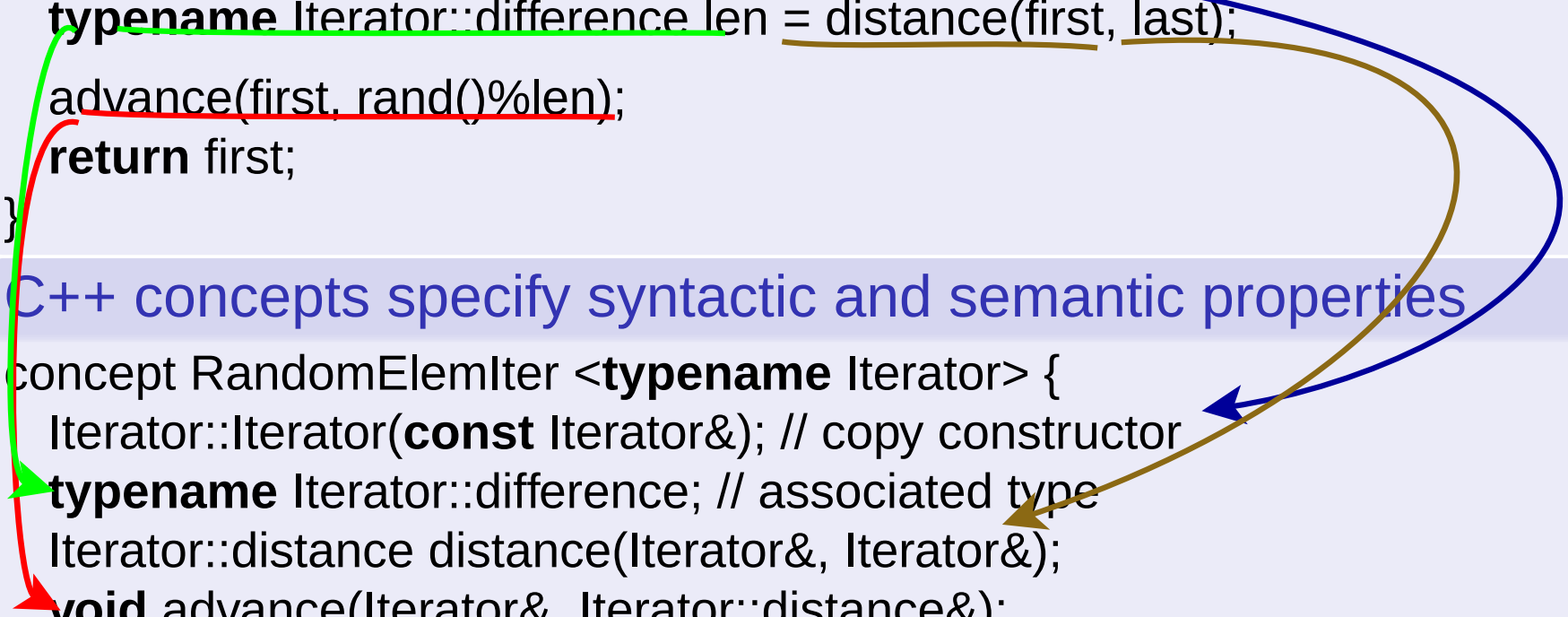

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```

```
template<RandomElemIter Iterator>
Iterator random_elem(Iterator first, Iterator last);
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Concept Recovery

advance — Input iterator

```
template<class Iter, class Dist>
void advance(Iter& iterator, Dist dist, input_iterator_tag) {
  while (dist--) ++iterator;
}
```

advance — Random access iterator

Disjoint sets of constraints

```
template<class Iter, class Dist>
void advance(Iter& iterator, Dist dist, random_access_iterator_tag) {
  iterator += dist;
}
```

Propagating requirements into random_elem

- Which advance exhibits minimal requirements?

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Concept Recovery - w/ workaround analysis

advance — Input iterator

```
template<class Iter, class Dist>
void advance(Iter& iterator, Dist dist, input_iterator_tag) {
  while (dist--) ++iterator;
}
```

Workaround techniques provide semantic information

advance — Random access iterator

```
template<class Iter, class Dist>
void advance(Iter& iterator, Dist dist, random_access_iterator_tag) {
  iterator += dist;
}
```

Propagating requirements into random_elem

- Which advance exhibits minimal requirements?

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Source Code Rejuvenation - Summary

Key Points

- Raises level of abstractions (lowers software entropy)
- Modern code is more concise (easier to read and maintain)

- Code rejuvenation can improve program behavior
- Code rejuvenation is directed

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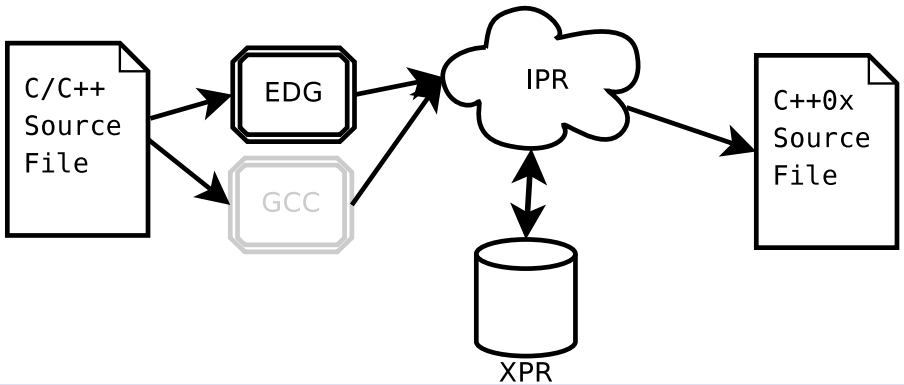
Tool support for Rejuvenation to C++0x - Pivot



The Pivot

- Industrial C++ Frontend
- Intermediate representation (IPR)
  - frontend independent
  - preserves high level details
  - ready for most C++0x features
- eXternal representation (XPR)
  - human read- and writable
  - 1:1 correspondence to IPR

What is refactoring?

Re ◇ factoring

- Factor multiple reoccurring code into a single function

Broader Definition

- An automatic and behavior preserving code transformation that improves source code that was subject to gradual structural deterioration over its life time. [OJ93]

Broader Definition

- Improves the design of existing code [FBB+99]

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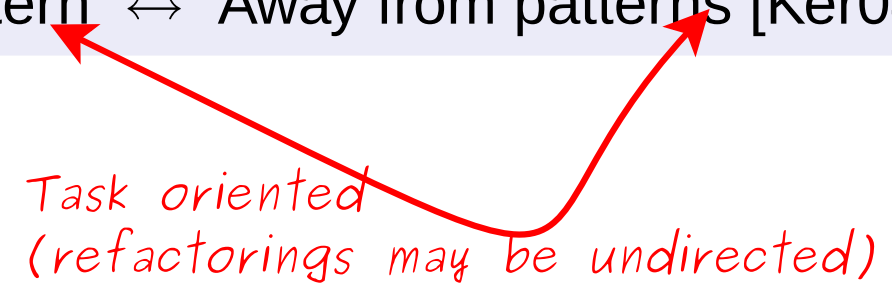
Refactoring Examples

Repeated (user driven) maintenance tasks

- Class specification $\leftrightarrow$ Class generalization [Opd92]
- Towards pattern $\leftrightarrow$ Away from patterns [Ker04]



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Refactoring Examples (cont'd)

Elimination of bad code

- Code smells
- Anti-pattern

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Refactoring versus Rejuvenation

	Source Code Rejuvenation	**Refactoring**
Transformation	Source-to-source	Source-to-source
Behavior preserving	Behavior *improving*	Behavior preserving
Directed	yes Raises the level of abstraction	no
Drivers	Language / library evolution	Feature extensions Design changes
Indicators	Workaround techniques / idioms	Code smells Anti-patterns
Applications	One-time source code migration	Recurring maintenance tasks

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Thank You!

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