Evolution of C++

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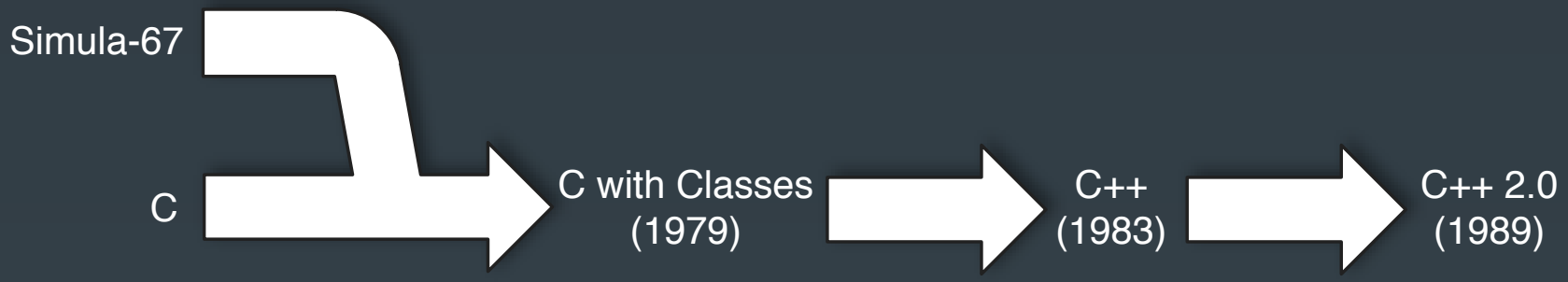
Overview

- C with Classes, C++ and C++89
- C++98
  - Standard Template Library
- Boost Libraries
  - C++ TR1
- C++11
- Future
- Summary



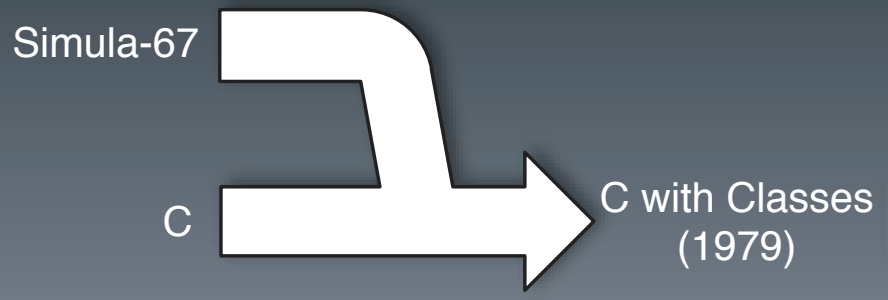
C with Classes, C++ and C++ 2.0

Motivation for C++

- Object oriented languages existed
- Simula
  - Usable in big software projects

- Efficient languages existed
  - Not usable for big projects

- C
  - Fast and portable

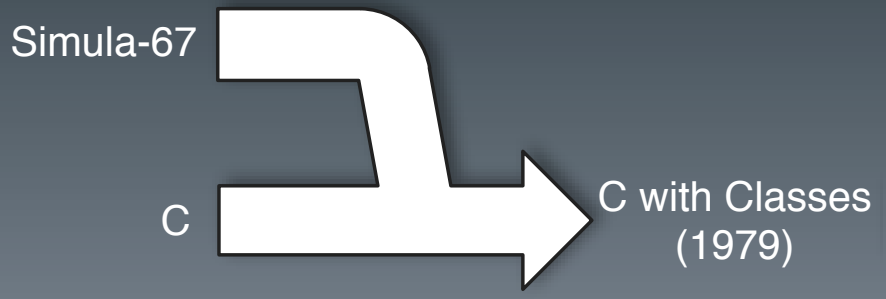


C with Classes (1979)

- Developed by Bjarne Stroustrup

- Extension of C
- Classes like in Simula-67

- Additions:
  - Stronger typesystem
  - Derived classes
  - Inline functions
  - Default arguments

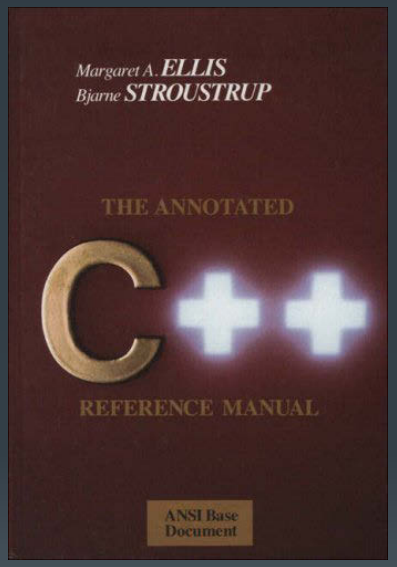


C++ (1983)

- Renaming from C with Classes into C++
  - Increment operator
- Extended with some features
  - Function- and operator-overloading
  - References
  - Comments like in BCPL: // at line end
  - ...
- „The C++ Programming Language“ (1985)

C++ 2.0 (1989)

- Again extensions to the language
  - Multiple inheritance
  - Abstract classes
  - Protected members
  - Static member functions
  - ...



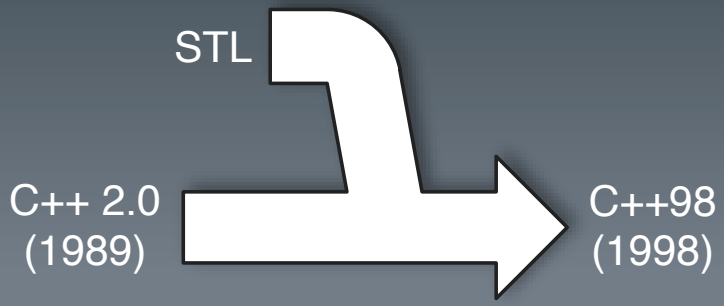
- The Annotated C++ Reference Manual (1990)

C++ (1983) → C++ 2.0 (1989)

C++98

C++98 (1998)

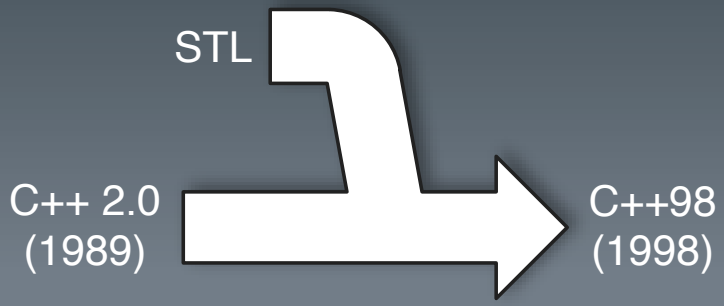
- Many additions from 1989 on
  - Templates
  - Exceptions
  - Namespaces
  - Boolean type
  - ...
- Standard Library
  - Based on C Standard Library
  - Streams (I/O)
  - Numeric
  - STL



Standard Template Library

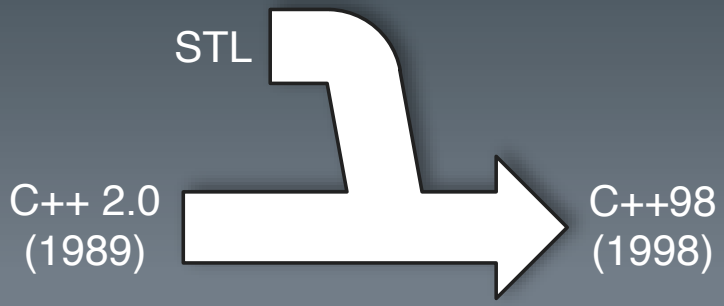
- Origin in the 80s by Hewlett-Packard
- Meeting with C++ standard committee in 1993
  - Big parts included in the standard library
- HP made STL available in 1994 (via Internet)

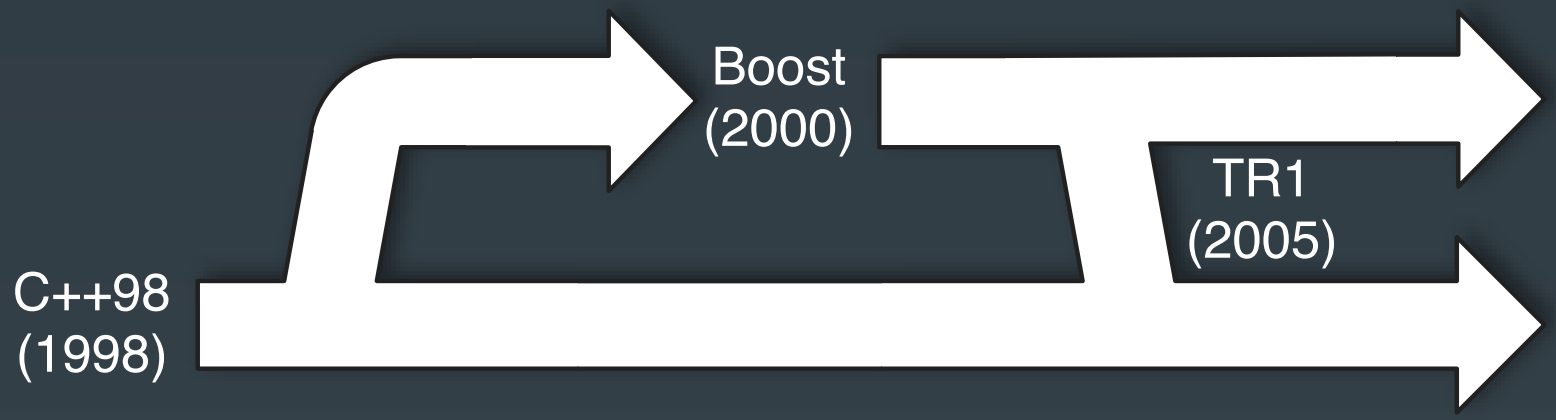
- Focus on generic data structures and algorithms
  - Collections
  - Iterators
  - Algorithms
  - ...



ISO/IEC Standard

- Final version of C++98 released in 1998
- Compilers released years later
  - Implementation is very hard
- New ISO standard in 2003
  - Named C++03
  - Bug-fix for C++98
  - No new features

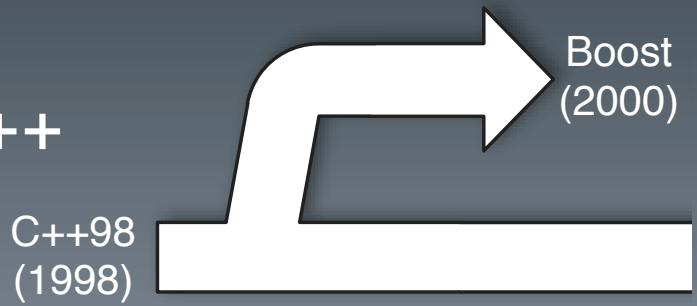




Boost Libraries

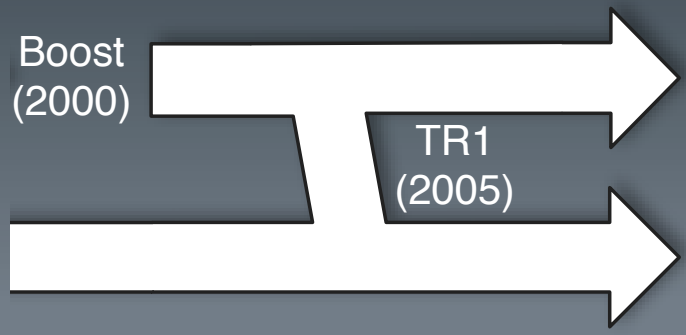
Boost C++ Libraries (2000)

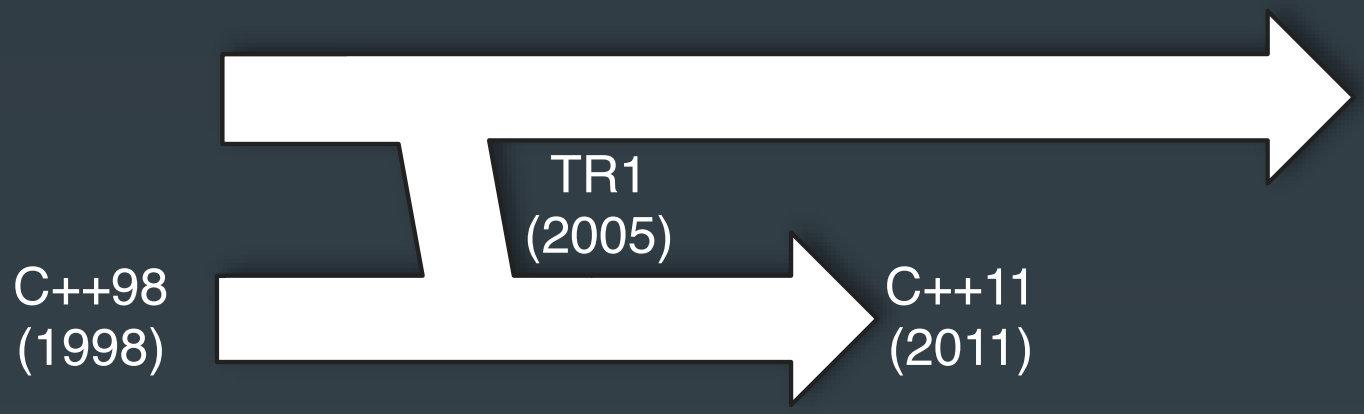
- Boost project founded in 2000
  - By members of the standard committee
- Over eighty different libraries
  - Linear algebra
  - Image processing
  - Networking
  - ...
- Possible extensions for C++



Technical Report 1 (2005)

- Extensions for the future standard
- Writing of the standard takes time
  - TRs are a way to extend the language faster
- „Only“ library extension
  - Smart Pointers
  - Random number generators
  - Regex
  - ...

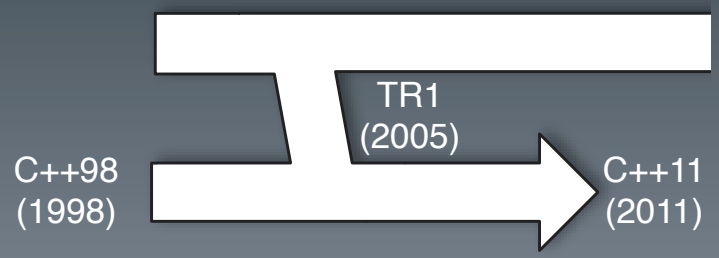




C++11

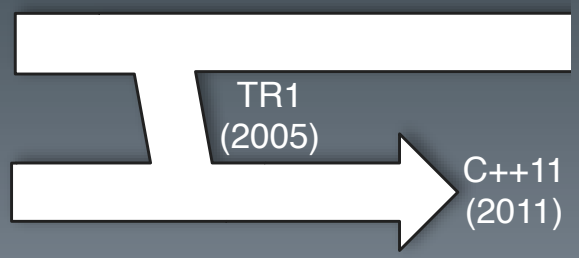
C++11 (2011)

- Includes TR1 partially
- Extends the core language and libraries
  - Core language changes kept to a minimum
- Make C++ easier to teach and learn
- Performance increase
- Maintain compatibility
  - To C++98 and C



Core Language Extensions

- Performance improvements
  - E.g. Rvalue references
- Usability enhancements
  - Type inference
  - Range-based for-loop
  - Lambda functions
- Build time enhancements
- Functionality improvements
  - Multithreading memory model



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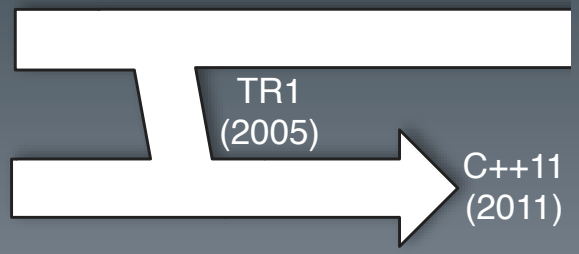
```
A a;
…
{
   std::vector<string> x;…
   a.y = x;
}
```

```
A a;
…
{
   std::vector<string> x;…
   a.y = std::move(x);
}
```



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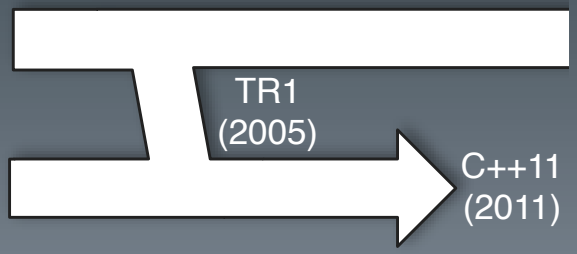
```
std::vector<int> a;

std::vector<int>::const_iterator
    first = a.begin();
```

```
std::vector<int> a;

auto first = a.begin();
```



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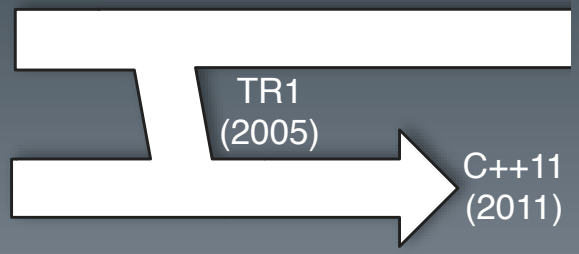
```
std::vector<int> a = {1,2};

for(
std::vector<int>::const_iterator
it = a.begin(); it != a.end();
++it){
    std::cout << *it;
}
```

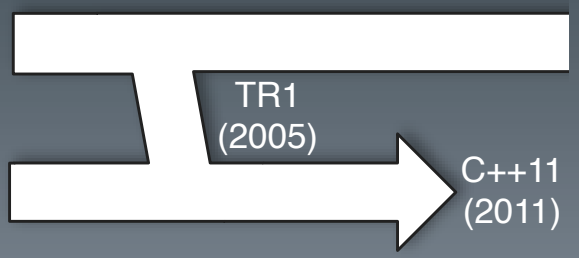
```
std::vector<int> a = {1,2};

for(auto& it: a){
    std::cout << it;
}
```



Standard library changes

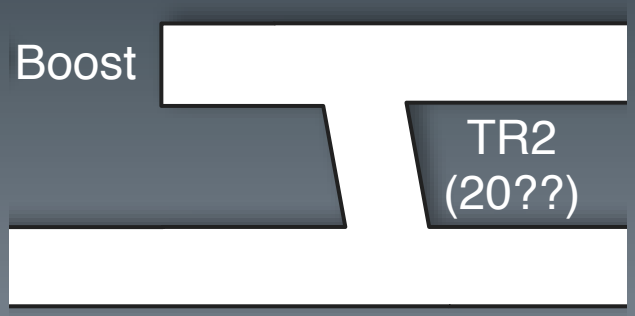
- Changes resulting from new core language
- Mostly changes from TR1
  - Not included were special Math functions and decimal types.
- Most important feature: Smart pointers
  - Automatic reference counting
  - No need for „new“ and „delete“
  - No memory leaks possible



Future

Technical Report 2

- Extensions for the future standards C++14/C++17
- Based partially on Boost
- C++14 minor release (bug fix)
- Library extensions
  - File system library
  - XML/HTML
  - Networking
  - Signals/Slots
  - Any library
  - ...



Summary

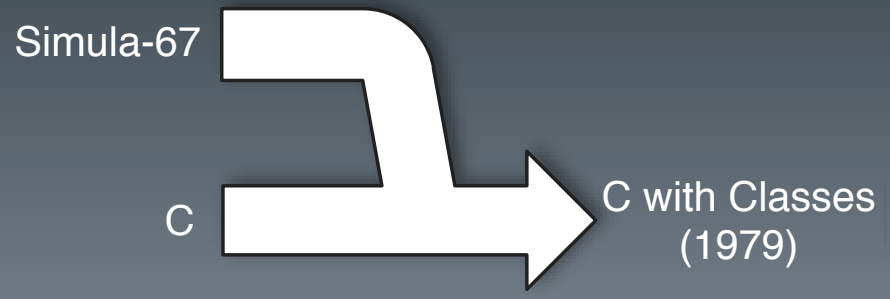
- C++ started as extension to C
- But became much more than C with Classes
- The first ISO standard was released in 1998
- Last year (2011) the third ISO standard was released
  - Almost a new programming language
- Future standards planned for 2014 and 2017

References

- History of C++ until 1994:
  - Stroustrup, Bjarne. The design and evolution of C++, 1994
- Later History:
  - http://www.cplusplus.com/info/history/
- General information about the programming language:
  - http://isocpp.org
  - Stroustrup, Bjarne. The C++ Programming Language, 2000
- C++11 Talks:
  - http://channel9.msdn.com/Events/GoingNative/GoingNative-2012

Cfront

- Converts C with Classes (C++) to C
- Written in C with Classes (C++)
- Problems bootstrapping Cfront
  - C++ compiler needed
  - Solution: Preprocessed code
- Used until 1993



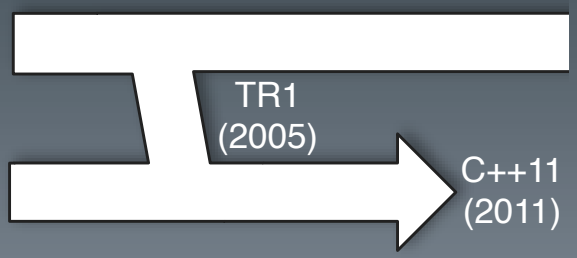
Core Language Extensions
Lambda functions

```
bool myComperator (int x, int y){
    return x > y && myClass::subFunctionResult == 7;
}

class myClass{
      static int subFunctionResult;

      void doStuff(){
            subFunctionResult = subFunction();
            std::vector<int> a = {3,1,5};
            std::sort(a.begin(), a.end(), myComperator);
      }
};
```

```
class myClass{
      void doStuff(){
            int subFunctionResult = subFunction();
            std::vector<int> a = {3,1,5};
            std::sort(a.begin(), a.end(),[=](){
                  return x > y && subFunctionResult == 7;
            });
      }
};
```



Standard library changes
Smart Pointers


```
class A;

A* aFactory(){
      A* result = new A();
      return result;
}

Class B{
      A* a;
      void doStuff(){
            a = aFactory();

            a->method1();
      }

      A* getA(){
            return a;
      }

      ~B(){
            delete a; // !!!
      }
};
```

```
class A;

std::shared_ptr<A> aFactory(){
      std::shared_ptr<A> result(new A));
      return result;
}

class B{
      std::shared_ptr<A> a;
      void doStuff(){
            a = aFactory();

            a->method1();
      }

      std::shared_ptr<A> getA(){
            return a;
      }
};
```

Special Math Functions TR1

- Riemann Zeta Function
- Beta Function
- Incomplete Elliptic Integral of the First / Second/Third Kind
- Exponential Integral
- Hermite Polynomials
- …