C++ - Current language status

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Who is that guy?

C++
THE C++ PROGRAMMING LANGUAGE
BJARNE STROUSTRUP
IBM
Programming – Principles and Practice Using C++

Pre iso times

- 1979 - c with classes

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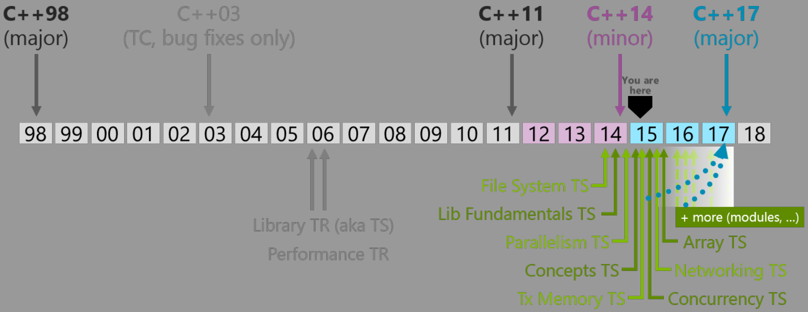
- 1991 - http://www.stroustrup.com/hopl2.pdf
- 2005 - „The Design and Evolution of C++”

C++ timeline



C++98 (major)

C++03 (TC, bug fixes only)

C++11 (major)

C++14 (minor)

C++17 (major)

You are here

98 | 99 | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18

Library TR (aka TS)

Performance TR

File System TS

Lib Fundamentals TS

Parallelism TS

Concepts TS

Tx Memory TS

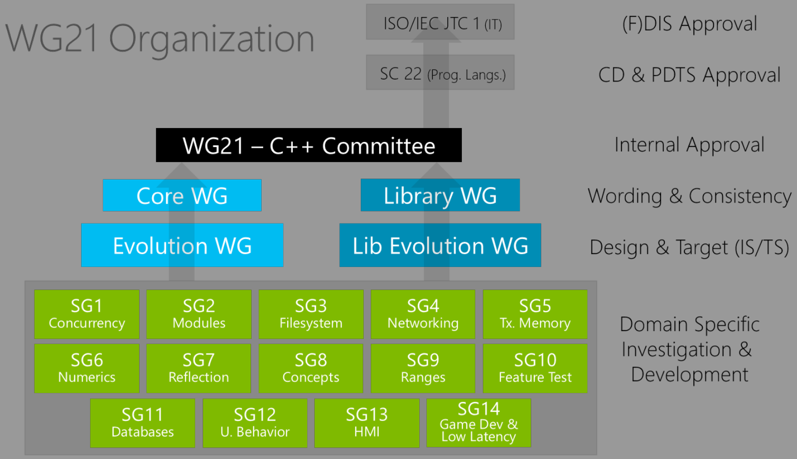
+ more (modules, ...)

Array TS

Networking TS

Concurrency TS

C++ committee structure



WG21 Organization

ISO/IEC JTC 1 (IT)

SC 22 (Prog. Langs.)

WG21 – C++ Committee

Core WG

Library WG

Evolution WG

Lib Evolution WG

SG1 Concurrency

SG2 Modules

SG3 Filesystem

SG4 Networking

SG5 Tx. Memory

SG6 Numerics

SG7 Reflection

SG8 Concepts

SG9 Ranges

SG10 Feature Test

SG11 Databases

SG12 U. Behavior

SG13 HMI

SG14 Game Dev & Low Latency

(F)DIS Approval

CD & PDTS Approval

Internal Approval

Wording & Consistency

Design & Target (IS/TS)

Domain Specific Investigation & Development

SG1 - Concurrency

- parallelism TS 1 and 2

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SG1 - Concurrency

Parallelism TS

- parallel versions of standard algorithms (for_each)

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Parallelism TS

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- execution policies (seq, par, par_vec)
- task regions (Parallelism TS 2)

SG1 - Concurrency

Parallelism TS - task region

```
void quicksort(int *v, int start, int end) {
   if (start < end) {

         int pivot = partition(v, start, end);


            quicksort(v, start, pivot - 1);



            quicksort(v, pivot + 1, end);


   }
}
```

SG1 - Concurrency

Parallelism TS - task region

```
void quicksort(int *v, int start, int end) {
   if (start < end) {
      task_region([&] (auto &r) {
         int pivot = partition(v, start, end);

         r.run([&] {
            quicksort(v, start, pivot - 1);
         });

         r.run([&] {
            quicksort(v, pivot + 1, end);
         });
      });
   }
}
```

SG1 - Concurrency

Concurrency TS

- std::future improvements (.then(), when_all(), when_any())

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- std::future improvements (.then(), when_all(), when_any())
- latches and barriers
- atomic shared pointers
- resumable functions (await)

SG1 - Concurrency

Concurrency TS - future improvements

```cpp
std::future<std::string> page = get("google.pl");
```

SG1 - Concurrency

Concurrency TS - future improvements

```cpp
std::future<std::string> page = get("google.pl");

std::future<int> someValue =
   page.then([](std::future<std::string> s) {
      int ret = use(s.get());
      return ret;
   });
```

SG1 - Concurrency

Concurrency TS - future improvements

```
std::future<std::string> page = get("google.pl");

std::future<int> someValue =
   page.then([](std::future<std::string> s) {
      int ret = use(s.get());
      return ret;
   });

someValue.then([](std::future<int> value) {
  // ... use value
});
```

SG1 - Concurrency

Concurrency TS - future improvements

```
auto page = get("google.pl");

auto someValue = page.then([](auto s) {
   int ret = use(s.get());
   return ret;
});

someValue.then([](auto value) {
  // ... use value
});
```

SG1 - Concurrency

Concurrency TS - resumable functions

```
                    void tcp_reader(int total) {
  char buf[64 * 1024];
  auto conn =      Tcp::Connect("127.0.0.1", 1337);
  do {
    auto bytesRead =      conn.read(buf, sizeof(buf));
    total -= bytesRead;
  } while (total > 0);
}

int main() { tcp_reader(1000 * 1000 * 1000)      ; }
```

SG1 - Concurrency

Concurrency TS - resumable functions

```cpp
std::future<void>      tcp_reader(int total) {
  char buf[64 * 1024];
  auto conn = await Tcp::Connect("127.0.0.1", 1337);
  do {
    auto bytesRead = await conn.read(buf, sizeof(buf));
    total -= bytesRead;
  } while (total > 0);
}

int main() { tcp_reader(1000 * 1000 * 1000).get(); }
```

SG2 - Modules

- inclusion vs. semantic model of access to libraries APIs

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- the „import” keyword

SG2 - Modules

- inclusion vs. semantic model of access to libraries APIs
- separation of definition and usage (ODR violations)
- compilation time (don’t pay for what you don’t use)
- two implementations: Microsoft and Google
- the „import” keyword
- problem with binary format of module description

SG3 - Filesystem

- based on boost::filesystem

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- based on boost::filesystem
- directory, hard link, soft link, regular file
- path, perms
- operations: copying files, creating links, deletion, renaming, etc.

SG4 - Networking

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- based on boost::asio
- networking using TCP and UDP, including support for multicast
- client and server applications
- scalability to handle many concurrent connections
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- name resolution (DNS)
- timers
- may use coroutines internally

SG5 - Transactional memory

- „synchronized” and „atomic” blocks

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- threading policies for atomic blocks

SG5 - Transactional memory

```
int sequence() {
   static int i = 0;
   synchronized { // begin transaction
      printf("before %d\n", i);
      ++i;
      printf("after %d\n", i);
      return i; // commit transaction
   }
}
```

SG5 - Transactional memory

```
// each call to f() retrieves a unique value of i, even when done in parallel
int f() {
  static int i = 0;
  atomic_noexcept { // begin transaction
// printf("before %d\n", i); // error: cannot call a non transaction-safe function
    ++i;
    return i; // commit transaction
  }
}
```

SG6 - Numerics

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- bounded and unbounded types

SG7 - Reflection

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SG8 - Concepts

- associate syntactic constraints with template type parameters

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- new syntax for defining concepts
- „auto” - empty constraint

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Simple constraints and overloading

```
void f(EqualityComparable&&); // (1) declaration of a constrained function

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    void f(EqualityComparable&&); // (1) declaration of a constrained function
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    void f(Incrementable&&); // (2) declaration of a constrained function

```

SG8 - Concepts

Simple constraints and overloading

```cpp
void f(EqualityComparable&&); // (1) declaration of a constrained function
f(MyNoncomparableType()); // ill-formed, simple compiler diagnostic
void f(Incrementable&&); // (2) declaration of a constrained function
f("string-literal"s); /* calls (1) - no ambiguity */
```

SG8 - Concepts

Placeholders

```
   std::pair<auto, auto> p2 = std::make_pair(0, ’a’);
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auto x = f(2);
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Placeholders

```
    std::pair<auto, auto> p2 = std::make_pair(0, 'a');
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    Sortable x = f(y);
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```cpp
std::pair<auto, auto> p2 = std::make_pair(0, 'a');
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Sortable x = f(y);
auto f(Container) -> Sortable;
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SG8 - Concepts
Placeholders

```
    std::pair<auto, auto> p2 = std::make_pair(0, ’a’);
    auto x = f(2);
    Sortable x = f(y);
    auto f(Container) -> Sortable;
    void f(std::pair<auto, EqualityComparable>);
```

SG8 - Concepts

Short notation

```
    void g1(const EqualityComparable*, Incrementable&);
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void g1(const EqualityComparable*, Incrementable&);

template<EqualityComparable T, Incrementable U>
void g1(const T*, U&);
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```
    void g1(const EqualityComparable*, Incrementable&);

    template<EqualityComparable T, Incrementable U>
    void g1(const T*, U&);

    template<typename T, typename U>
    void g1(const T*, U&) requires EqualityComparable<T>
        && Incrementable<U>;
```

SG8 - Concepts

Concept definition

```
// variable concept from the standard library
template <class T, class U>
concept bool Derived = std::is_base_of<U, T>::value;

// function concept from the standard library
template <class T>
concept bool EqualityComparable() {
   return requires(T a, T b) { {a == b} -> Boolean;
        {a != b} -> Boolean; };
}
```

SG8 - Concepts

Concept definition

```
template <class T, class U> concept bool Same =
    std::is_same<T,U>::value;

template <class B> concept bool Boolean =
requires(B b1, B b2) {
   { bool(b1) }; // direct initialization constraint
   { !b1 } nothrow -> bool; // compound constraint
   requires Same<decltype(b1 && b2), bool>;
   requires Same<decltype(b1 || b2), bool>;
};
```

SG9 - Ranges

- represents range of elements

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- represents range of elements
- single object replacement for pairs of iterators in STL (convenience, simplify interfaces)
- range is a concept (or set of concepts)
- composability (views - lazy adaptation, actions - eager mutation)
- views can be potentially infinite (view::ints(1))

SG9 - Ranges

```
std::vector<int> v{/*...*/};
std::sort(v.begin(), v.end());
std::sort(v);
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    | view::take(10);
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   | view::take(10);

v |= action::sort | action::unique;
```

SG10 - Feature test

Investigation into whether and how to standardize a way for portable code to check whether a particular C++ product implements a feature yet, as standard is going to be extended.

SG11 - Databases

- compile time SQL expressions

SG11 - Databases

- compile time SQL expressions
- database vendor provided implementation of standard DB interface

SG12 - Unspecified and undefined behavior

A systematic review to catalog cases of undefined and unspecified behavior in the standard and recommend a coherent set of changes to define and/or specify the behavior.

SG13 - Human/machine interface

- generic API for drawing library

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SG14 - Game development and low latency

- find interfaces in STL that do not play well with low latency applications

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- find interfaces in STL that do not play well with low latency applications
- exceptions and RTTI, virtual functions
- allocations (std::function)
- std::async - will spawn new thread or not?
- no worst case complexity for some std::algorithms

Thank you

Questions?