C++ Club Meeting Notes

Gleb Dolgich

2018-05-03

Cpp.chat

- Website

CppEurope

- YouTube channel

GCC 8.1 released

- Announcement

John Bandela:

> *This is a truly exciting time to be a C++ programmer. We are getting a new standard every 3 years with 3 popular compilers that are all committed to implementing the standard as fast as possible. This is truly a welcome change from C++98 <...> Kudos to the GCC team for this release.*

Webkit is on C++17

- Announcement

Microsoft GSL 1.0.0

- Release
- Reddit
  - GSL = Gnu Scientific Library
  - Beware

Span-lite

A single-file header-only version of a C++20-like span for C++98, C++11 and later

- GitHub (MIT)
- Reddit

Trailing Return Types, East Const, and Code Style Consistency

- Post by Arne Mertz

PGI Community Edition Version 18.4

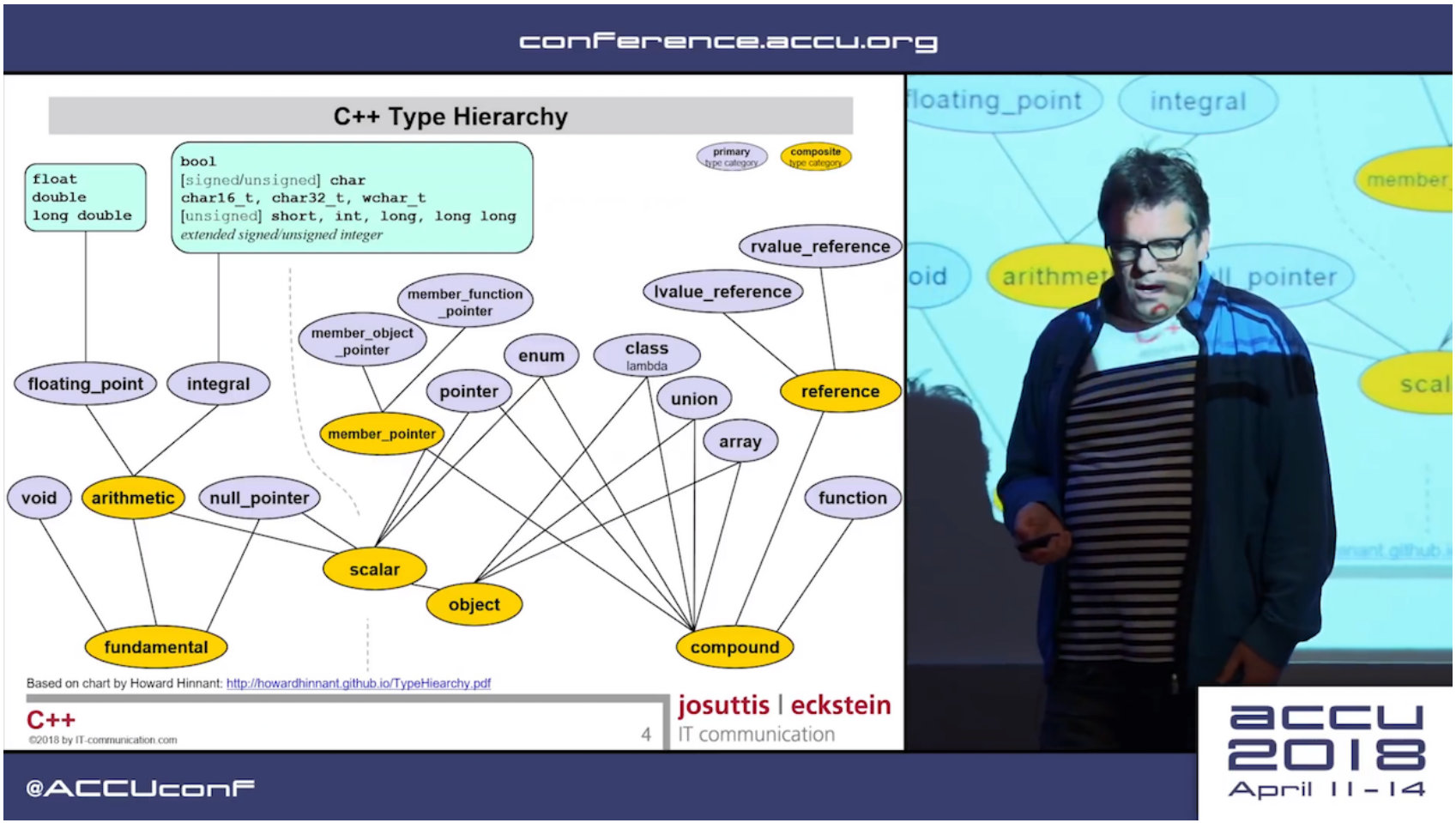
- Website
- OpenACC YouTube channel
- New in this version:
  - Support for Intel Skylake, IBM POWER9, and AMD Zen
  - AVX-512 code generation on compatible Intel processors
  - Full OpenACC 2.6 directives-based parallel programming on both NVIDIA® Tesla® GPUs and multicore CPUs
  - OpenMP 4.5 for x86-64 and OpenPOWER multicore CPUs
  - Integrated NVIDIA CUDA® 9.1 toolkit and libraries for Tesla GPUs, including V100 with NVIDIA Volta
  - Partial C++17 support and GCC 7.2 interoperability
  - New PGI fastmath intrinsics library, including AVX-512 support

Rea

Rea is a lightweight library of data structures implemented in C++11, designed for constant time insertion, erasure, lookup, and fastest possible iteration. Great for using in games or any other software which needs to manage thousands upon thousands of objects.

- GitHub
- Reddit

- YouTube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C++ Type Hierarchy
primary type category
composite type category
float
double
long double
bool
[signed/unsigned] char
char16_t, char32_t, wchar_t
[unsigned] short, int, long, long long
extended signed/unsigned integer
rvalue_reference
lvalue_reference
member_function_pointer
member_object_pointer
enum
class
lambda
floating_point
integral
pointer
union
reference
member_pointer
array
void
arithmetic
null_pointer
function
scalar
object
fundamental
compound
Based on chart by Howard Hinnant: http://howardhinnant.github.io/TypeHiearchy.pdf
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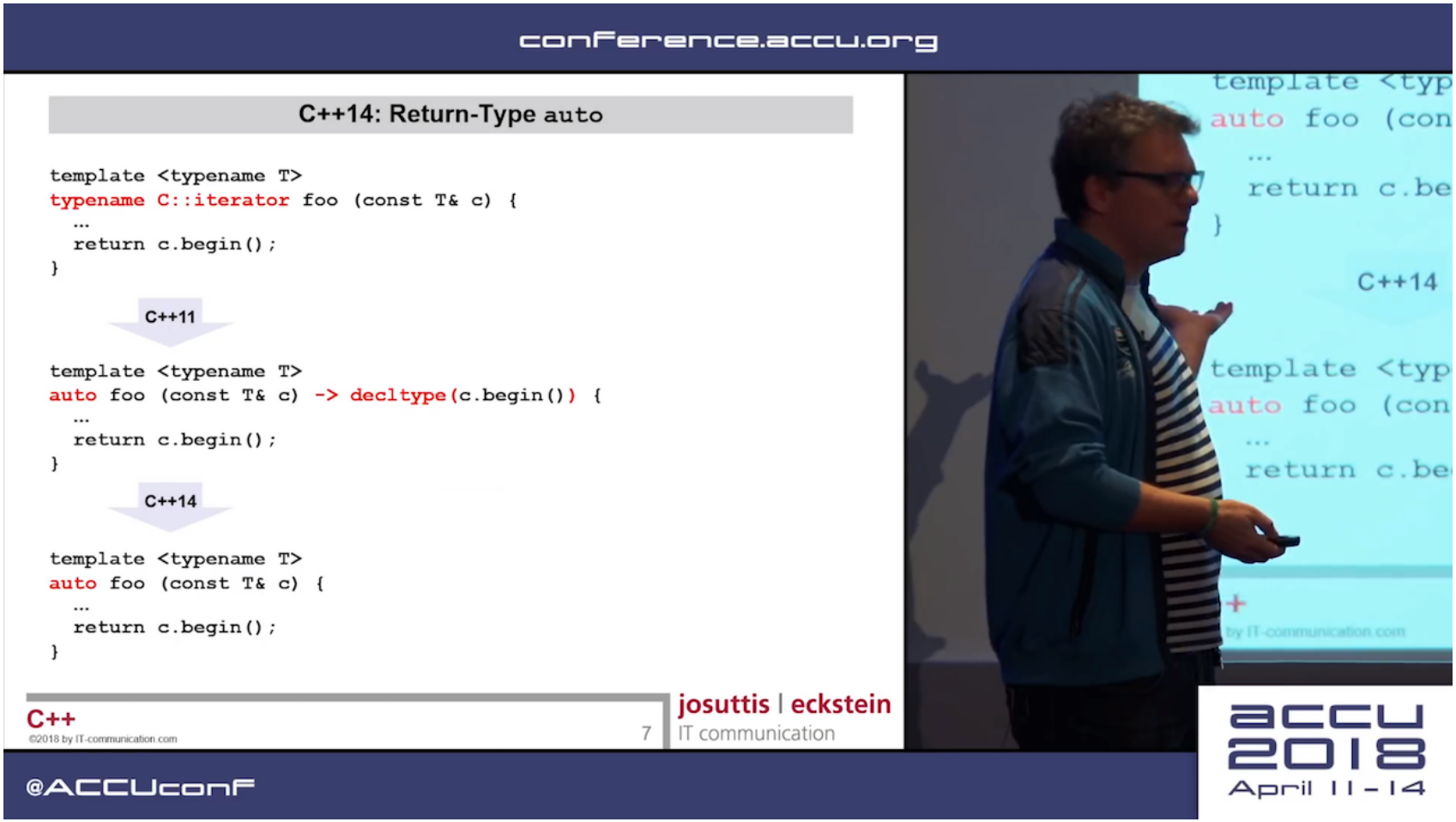
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C++14: Return-Type auto
template <typename T>
typename C::iterator foo (const T& c) {
...
return c.begin();
}
C++11
template <typename T>
auto foo (const T& c) -> decltype(c.begin()) {
...
return c.begin();
}
C++14
template <typename T>
auto foo (const T& c) {
...
return c.begin();
}
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template <typ
auto foo (con
...
return c.be
}
C++14
template <typ
auto foo (con
...
return c.be
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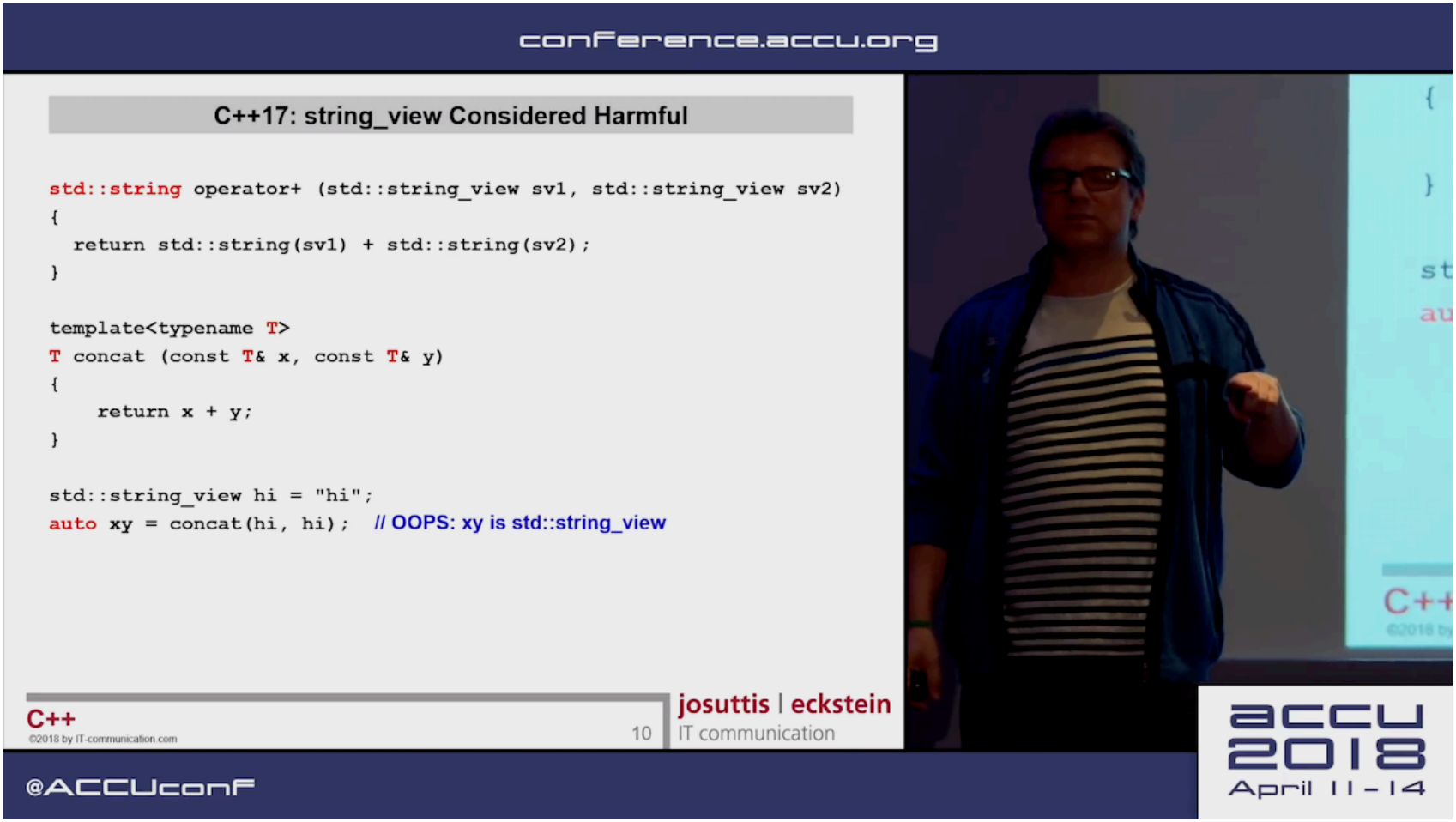
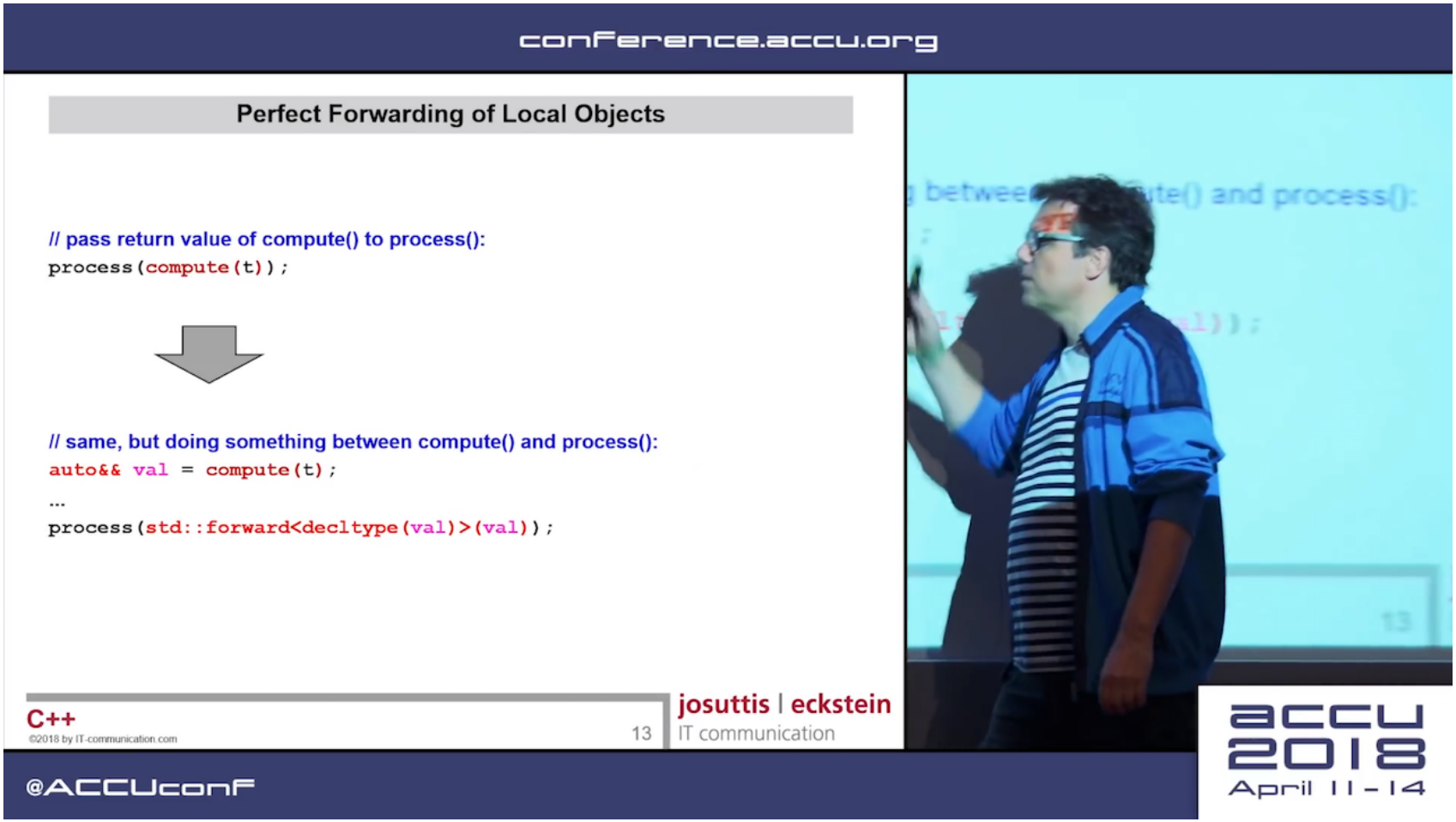
C++ Templates Revised - Nicolai Josuttis (ACCU 2018) (cont.)

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Perfect Forwarding of Local Objects
// pass return value of compute() to process():
process(compute(t));
// same, but doing something between compute() and process():
auto&& val = compute(t);
...
process(std::forward<decltype(val)>(val));
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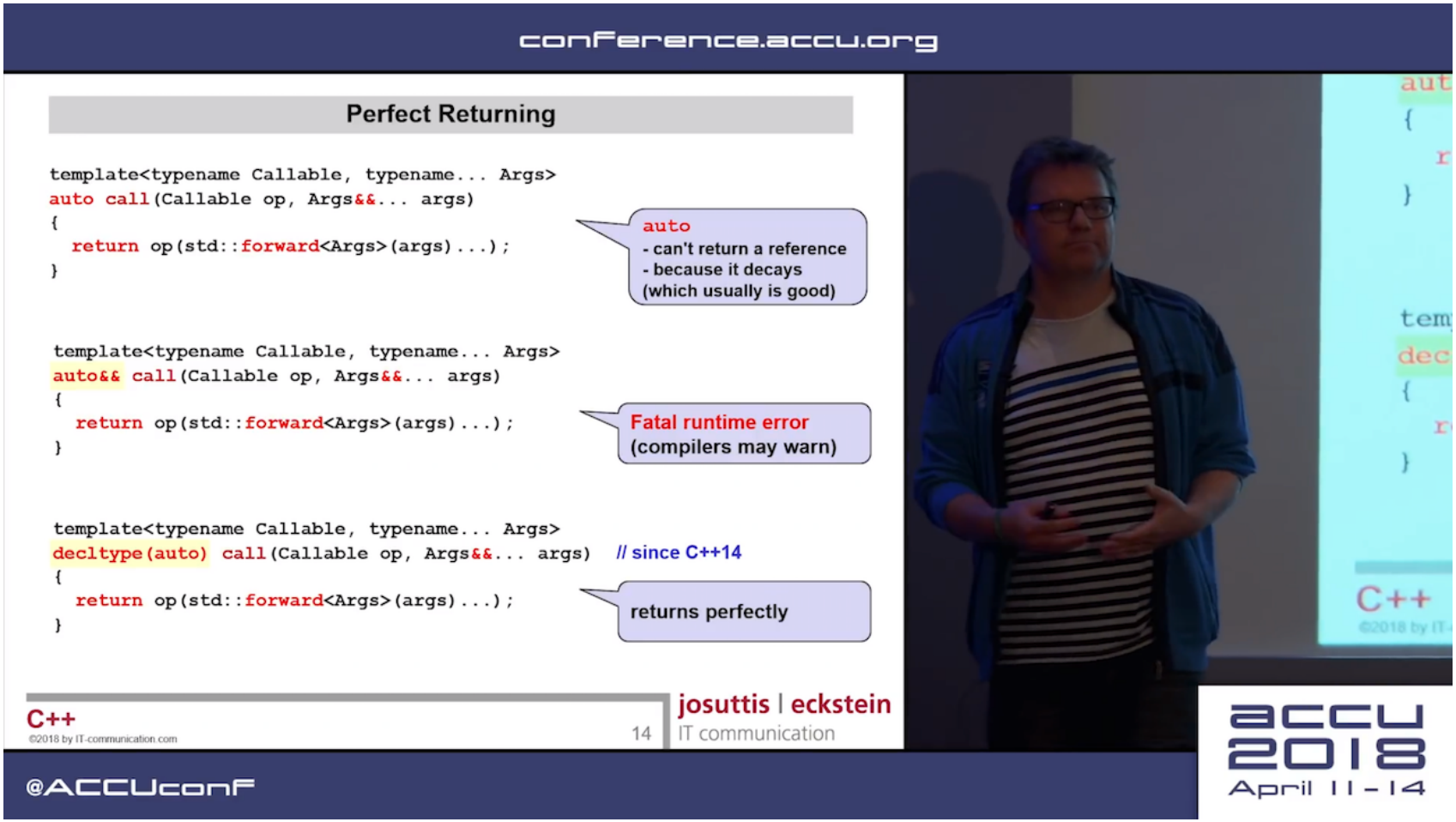

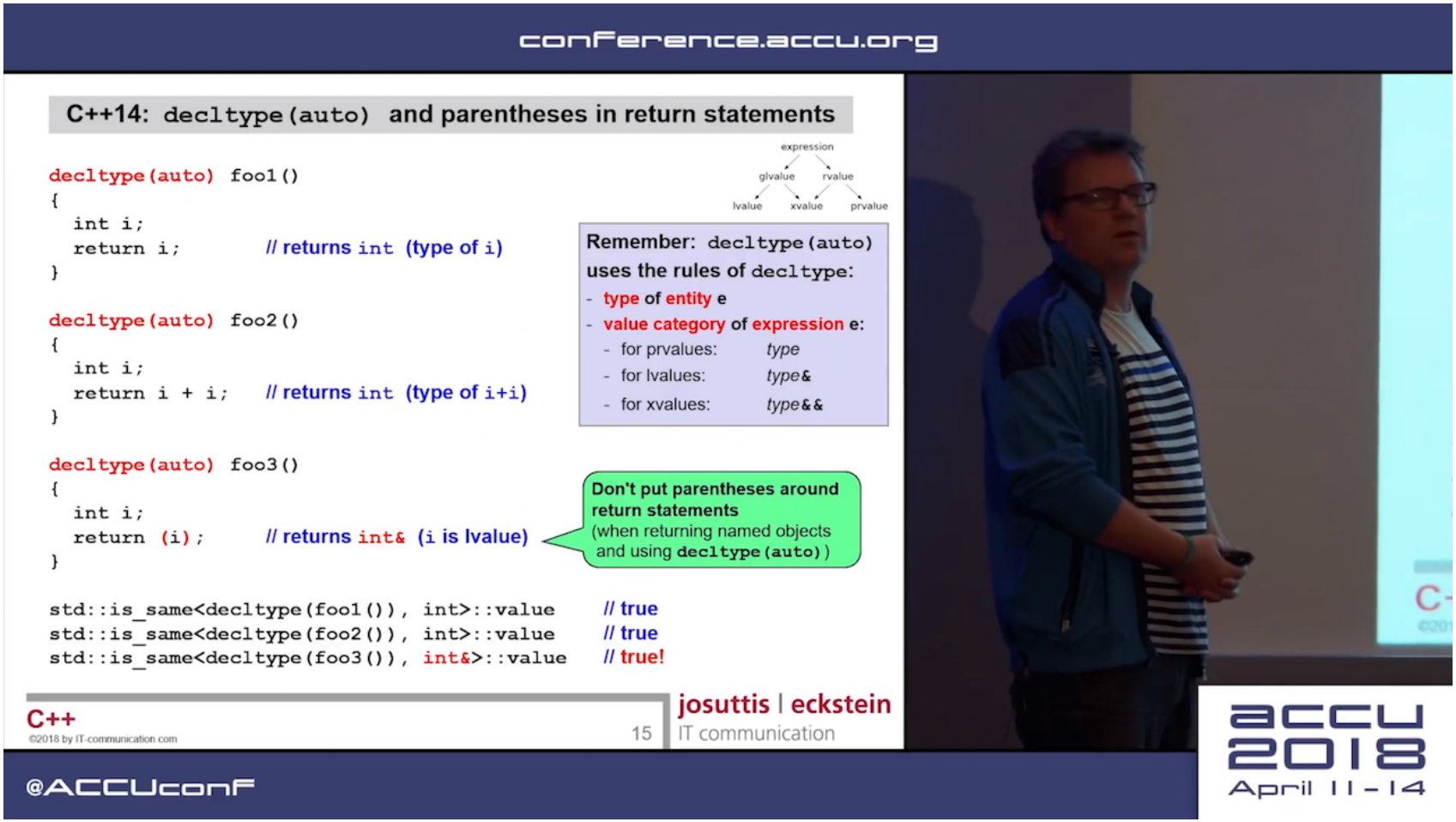
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C++14: decltype(auto) and parentheses in return statements
decltype(auto) foo1()
{
int i;
return i; // returns int (type of i)
}
decltype(auto) foo2()
{
int i;
return i + i; // returns int (type of i+i)
}
decltype(auto) foo3()
{
int i;
return (i); // returns int& (i is lvalue)
}
std::is_same<decltype(foo1()), int>::value // true
std::is_same<decltype(foo2()), int>::value // true
std::is_same<decltype(foo3()), int&>::value // true!
expression
glvalue
rvalue
lvalue
xvalue
prvalue
Remember: decltype(auto) uses the rules of decltype:
- type of entity e
- value category of expression e:
- for prvalues: type
- for lvalues: type&
- for xvalues: type&&
Don't put parentheses around return statements (when returning named objects and using decltype(auto))
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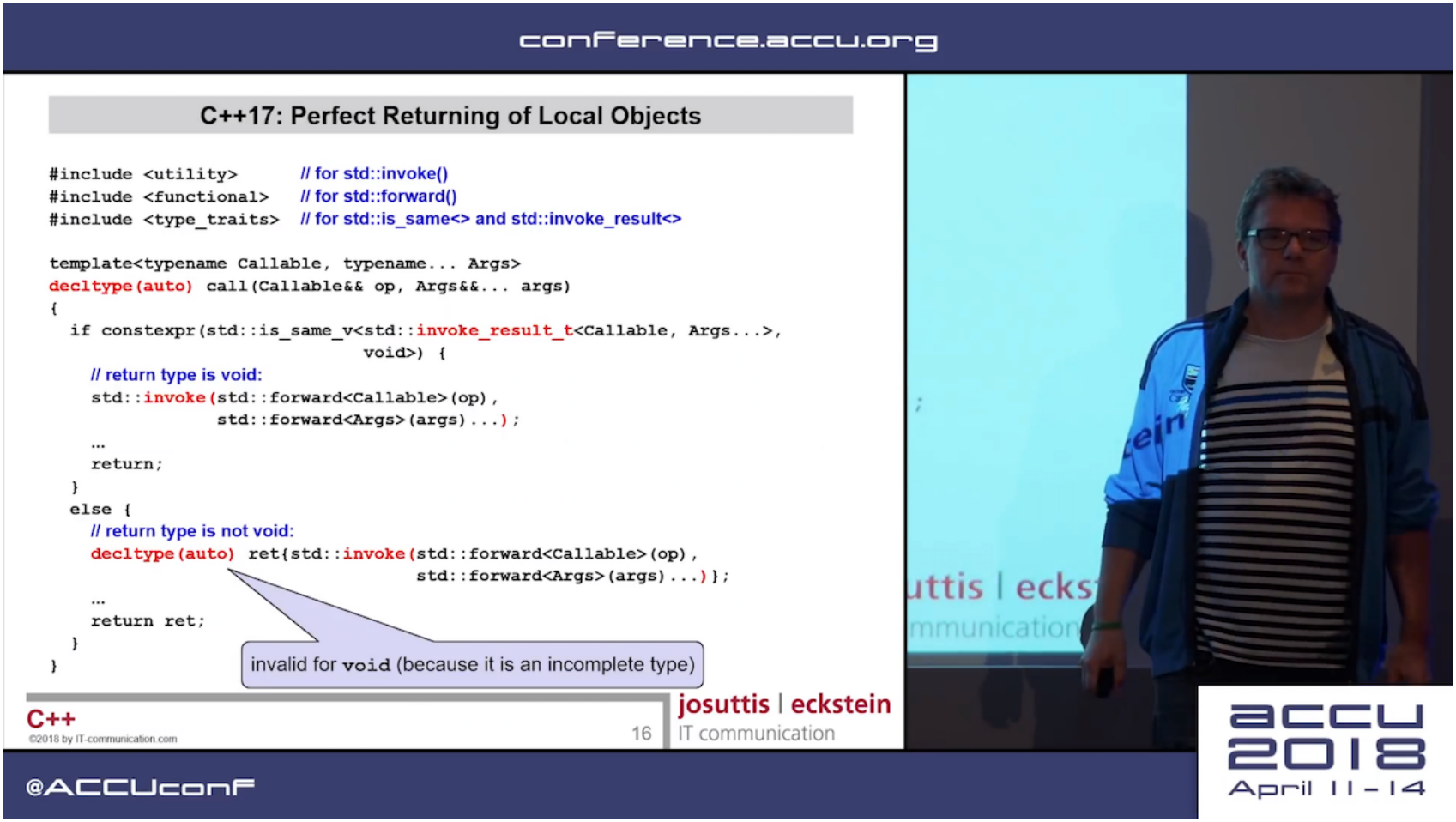
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C++17: Perfect Returning of Local Objects
#include <utility> // for std::invoke()
#include <functional> // for std::forward()
#include <type_traits> // for std::is_same<> and std::invoke_result<>
template<typename Callable, typename... Args>
decltype(auto) call(Callable&& op, Args&&... args)
{
if constexpr(std::is_same_v<std::invoke_result_t<Callable, Args...>,
void>) {
// return type is void:
std::invoke(std::forward<Callable>(op),
std::forward<Args>(args)...);
...
return;
}
else {
// return type is not void:
decltype(auto) ret{std::invoke(std::forward<Callable>(op),
std::forward<Args>(args)...)};
...
return ret;
}
}
invalid for void (because it is an incomplete type)
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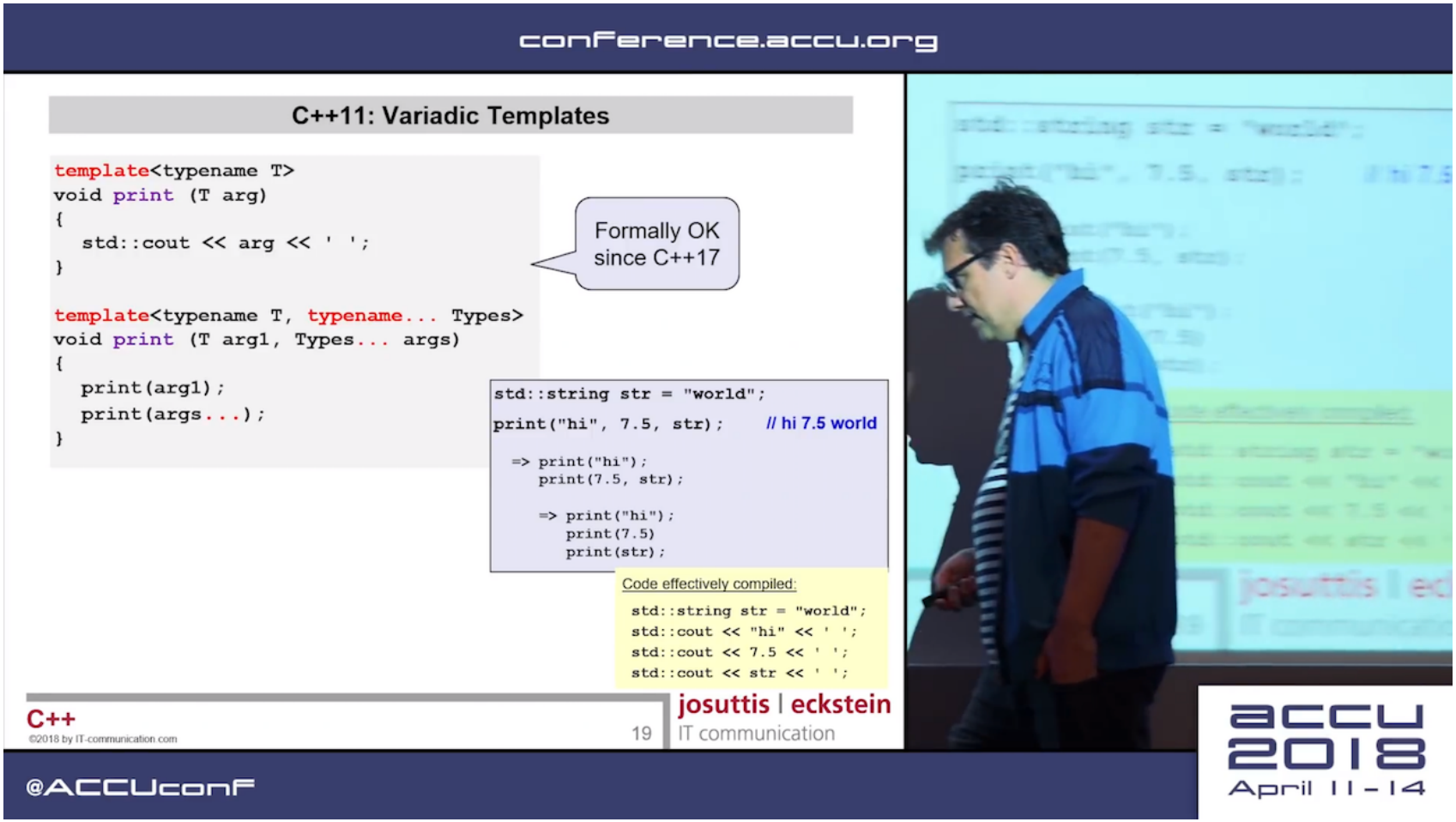

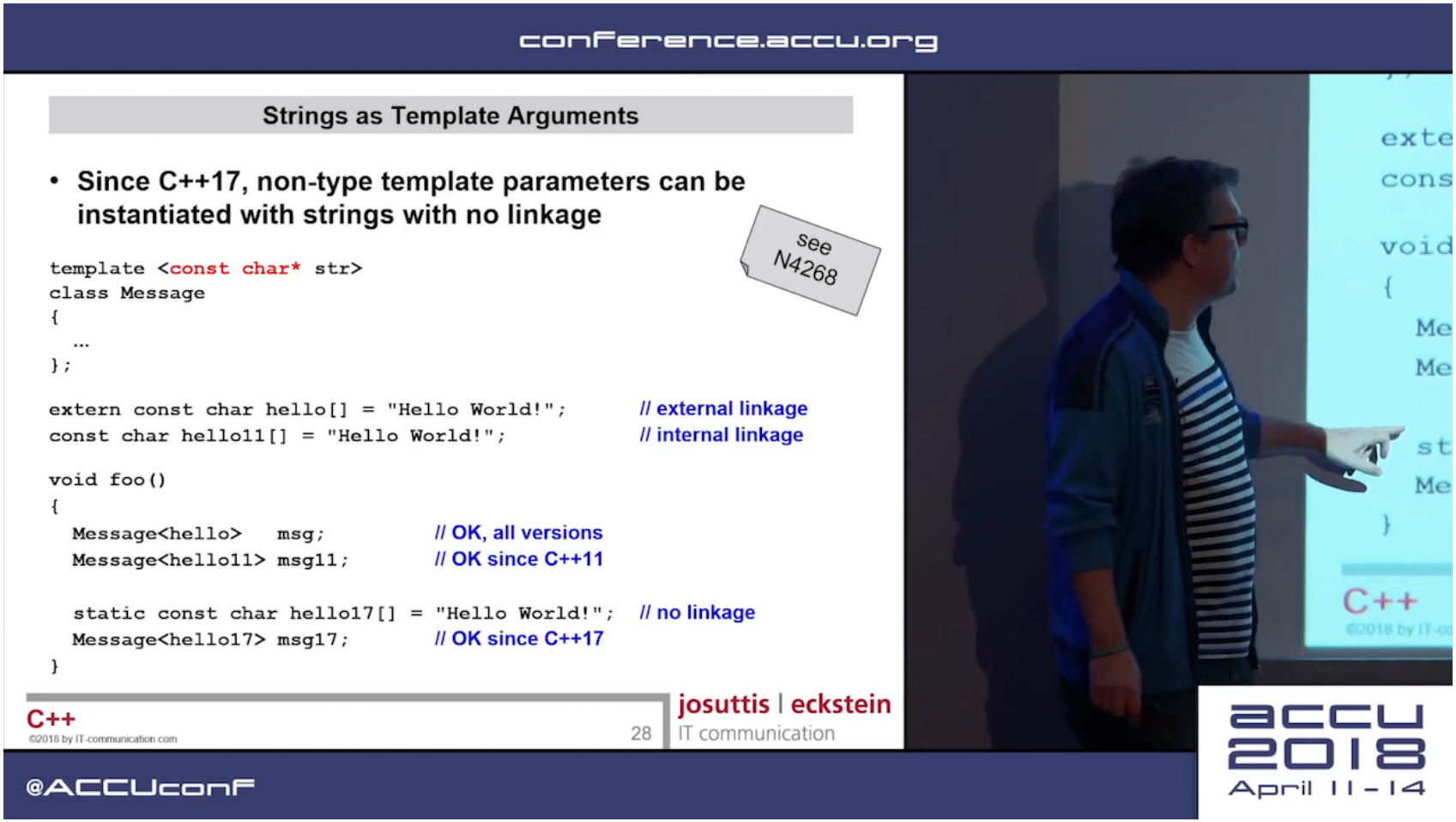
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Strings as Template Arguments
• Since C++17, non-type template parameters can be instantiated with strings with no linkage
see N4268
template <const char* str>
class Message
{
...
};
extern const char hello[] = "Hello World!"; // external linkage
const char hello11[] = "Hello World!"; // internal linkage
void foo()
{
Message<hello> msg; // OK, all versions
Message<hello11> msg11; // OK since C++11
static const char hello17[] = "Hello World!"; // no linkage
Message<hello17> msg17; // OK since C++17
}
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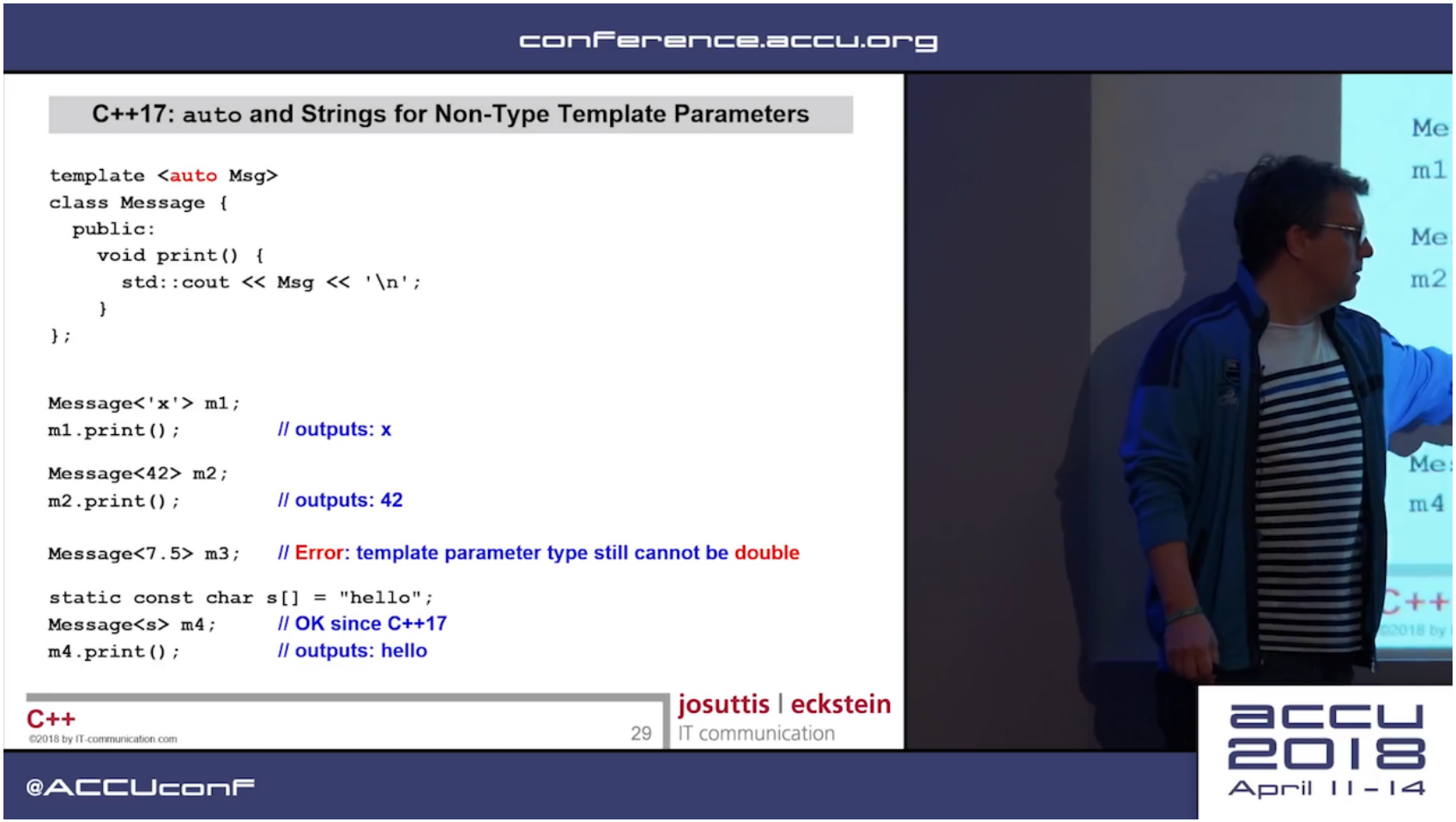
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C++17: auto and Strings for Non-Type Template Parameters
template <auto Msg>
class Message {
public:
void print() {
std::cout << Msg << '\n';
}
};
Message<'x'> m1;
m1.print(); // outputs: x
Message<42> m2;
m2.print(); // outputs: 42
Message<7.5> m3; // Error: template parameter type still cannot be double
static const char s[] = "hello";
Message<s> m4; // OK since C++17
m4.print(); // outputs: hello
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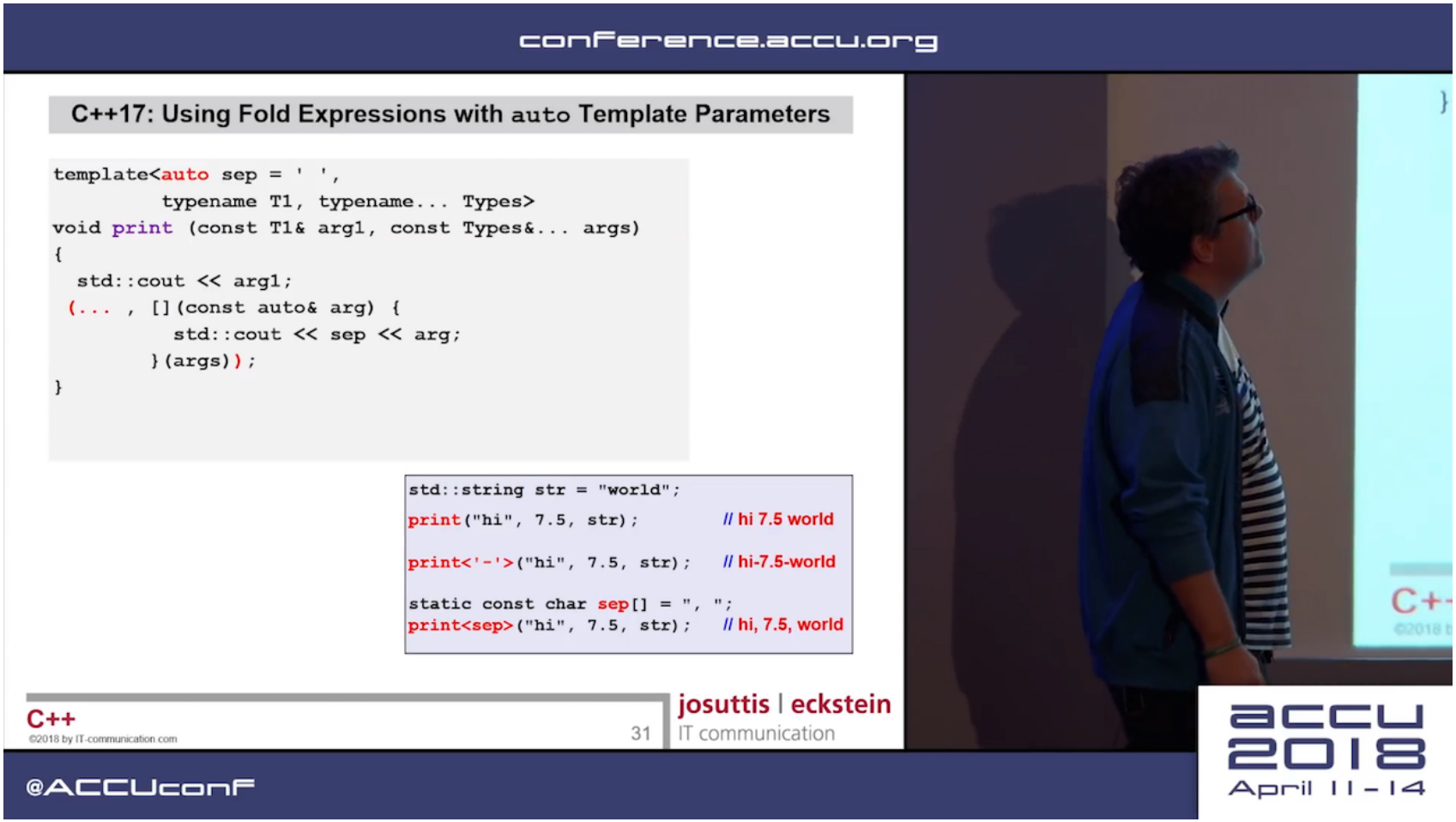
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C++17: Using Fold Expressions with auto Template Parameters
template<auto sep = ' ',
typename T1, typename... Types>
void print (const T1& arg1, const Types&... args)
{
std::cout << arg1;
(... , [](const auto& arg) {
std::cout << sep << arg;
}(args));
}
std::string str = "world";
print("hi", 7.5, str); // hi 7.5 world
print<'-'>("hi", 7.5, str); // hi-7.5-world
static const char sep[] = ", ";
print<sep>("hi", 7.5, str); // hi, 7.5, world
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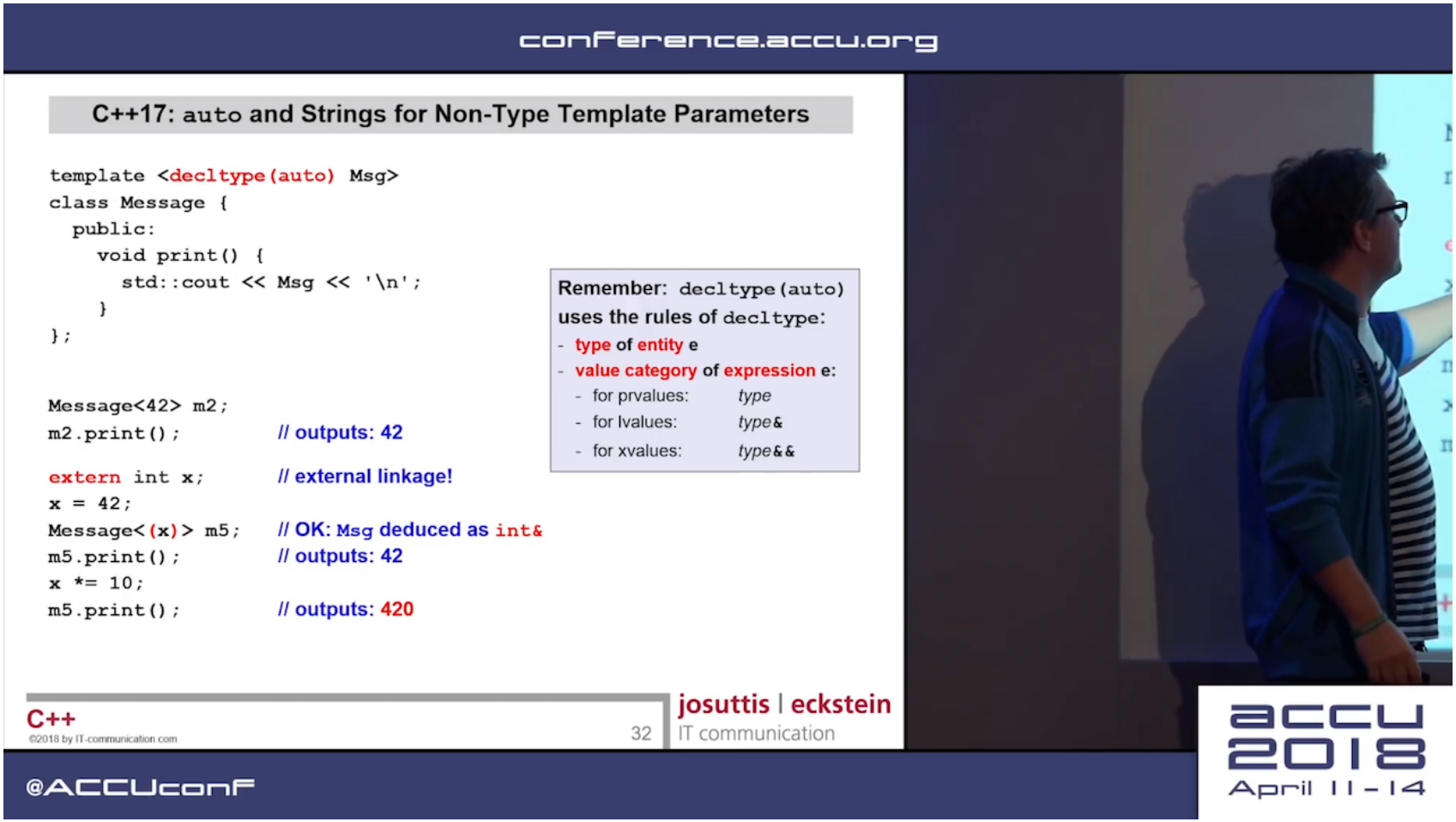
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C++17: auto and Strings for Non-Type Template Parameters
template <decltype(auto) Msg>
class Message {
public:
void print() {
std::cout << Msg << '\n';
}
};
Message<42> m2;
m2.print(); // outputs: 42
extern int x; // external linkage!
x = 42;
Message<(x)> m5; // OK: Msg deduced as int&
m5.print(); // outputs: 42
x *= 10;
m5.print(); // outputs: 420
Remember: decltype(auto)
uses the rules of decltype:
- type of entity e
- value category of expression e:
- for prvalues: type
- for lvalues: type&
- for xvalues: type&&
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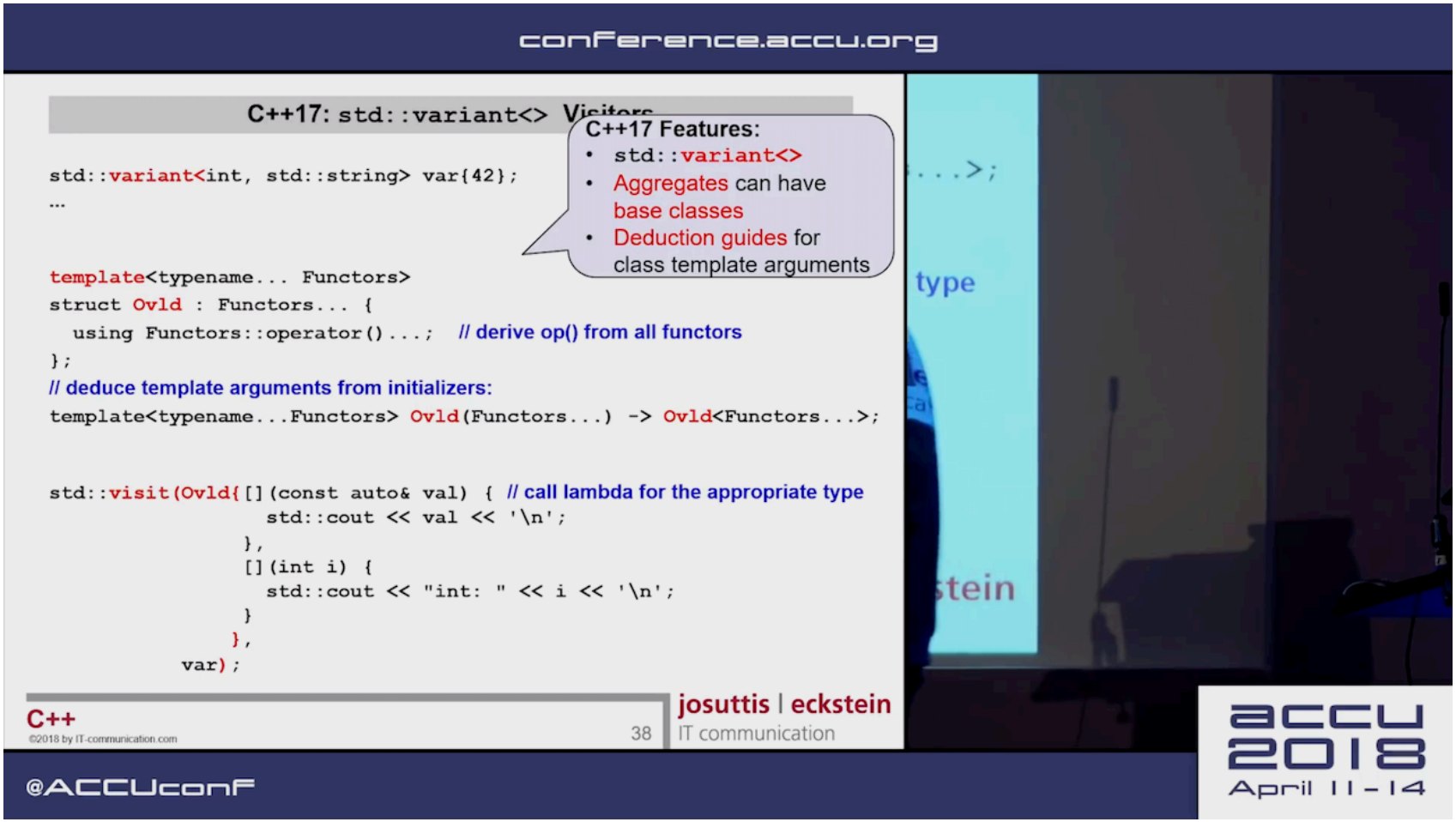

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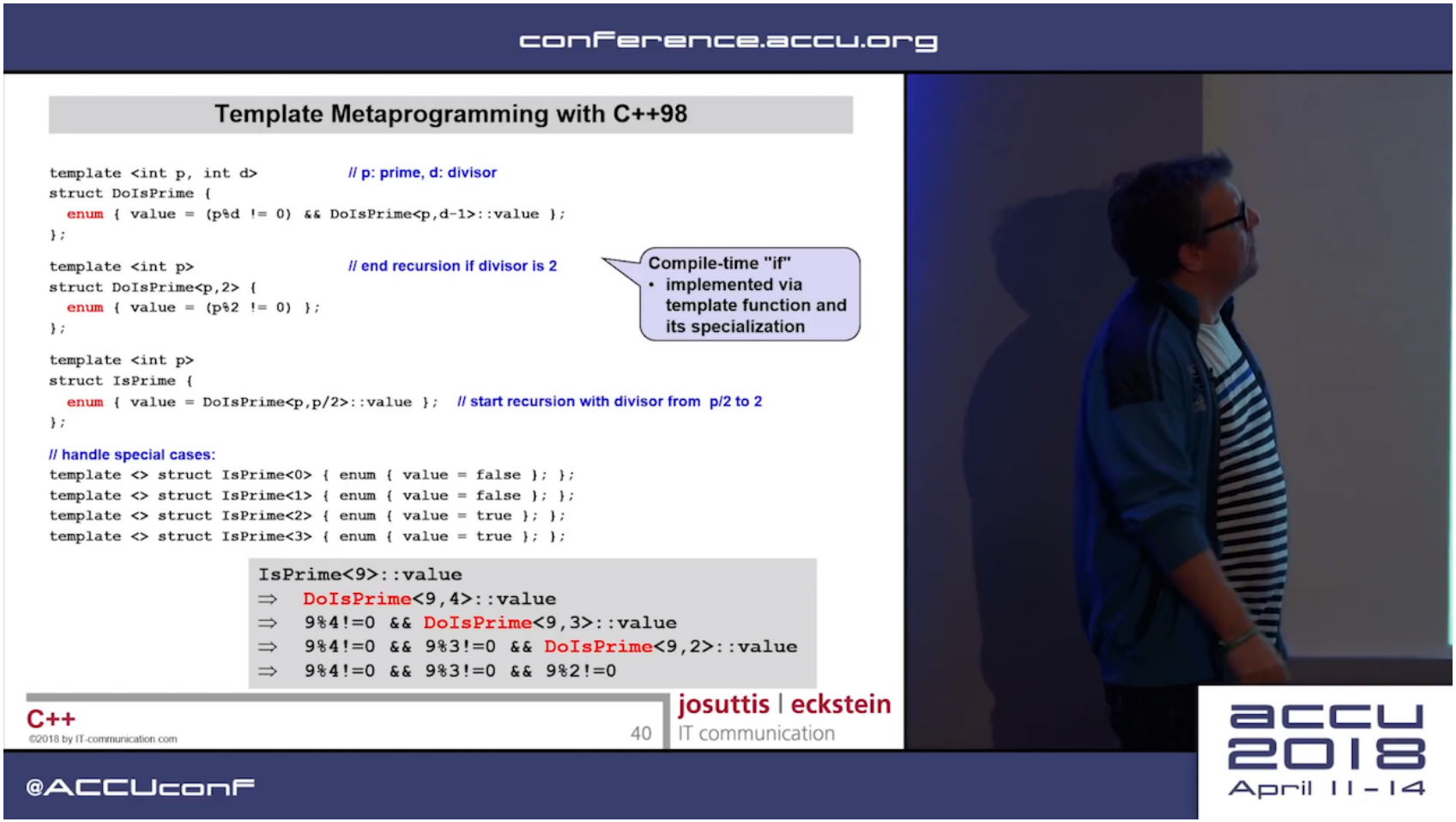

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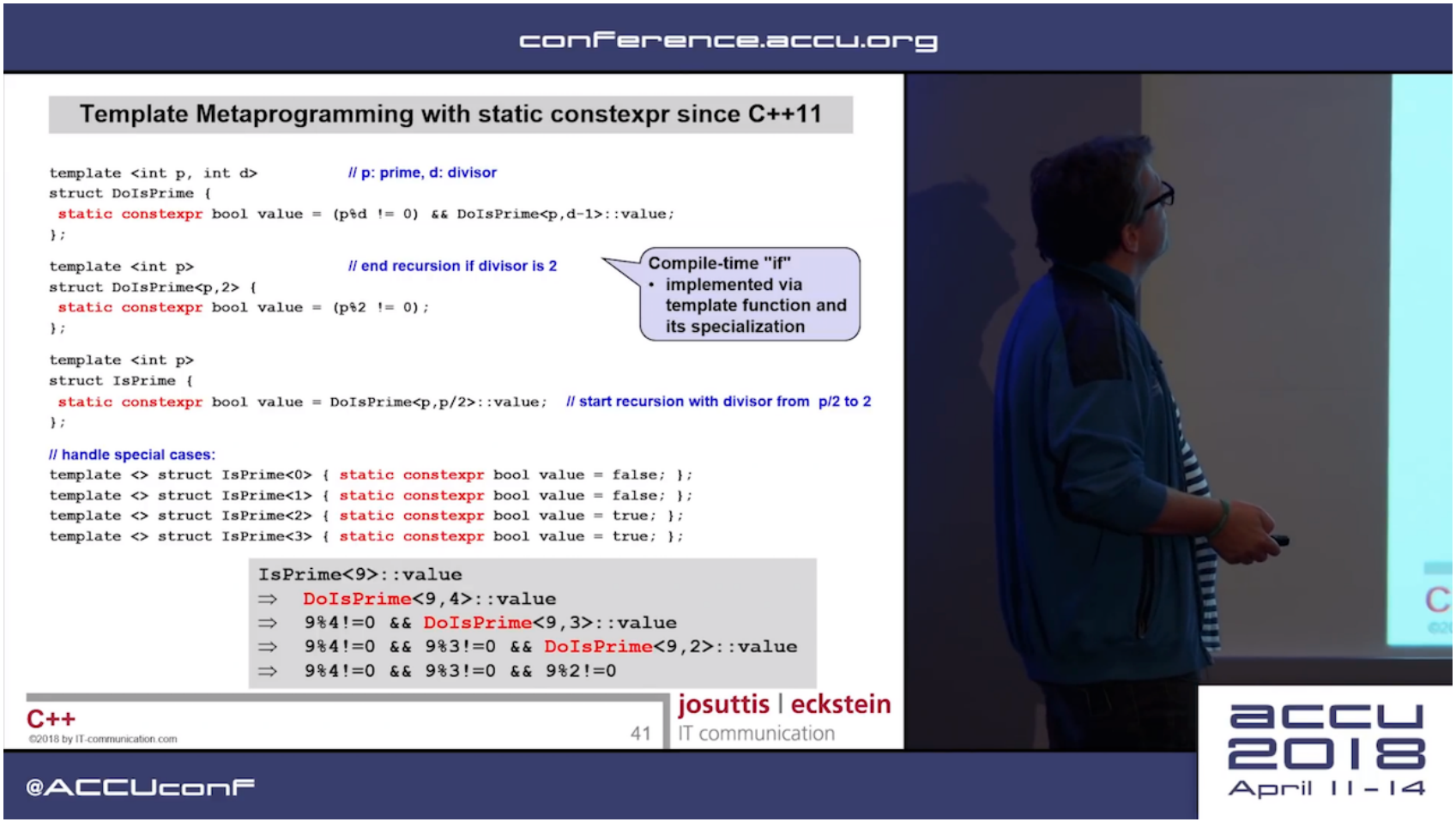

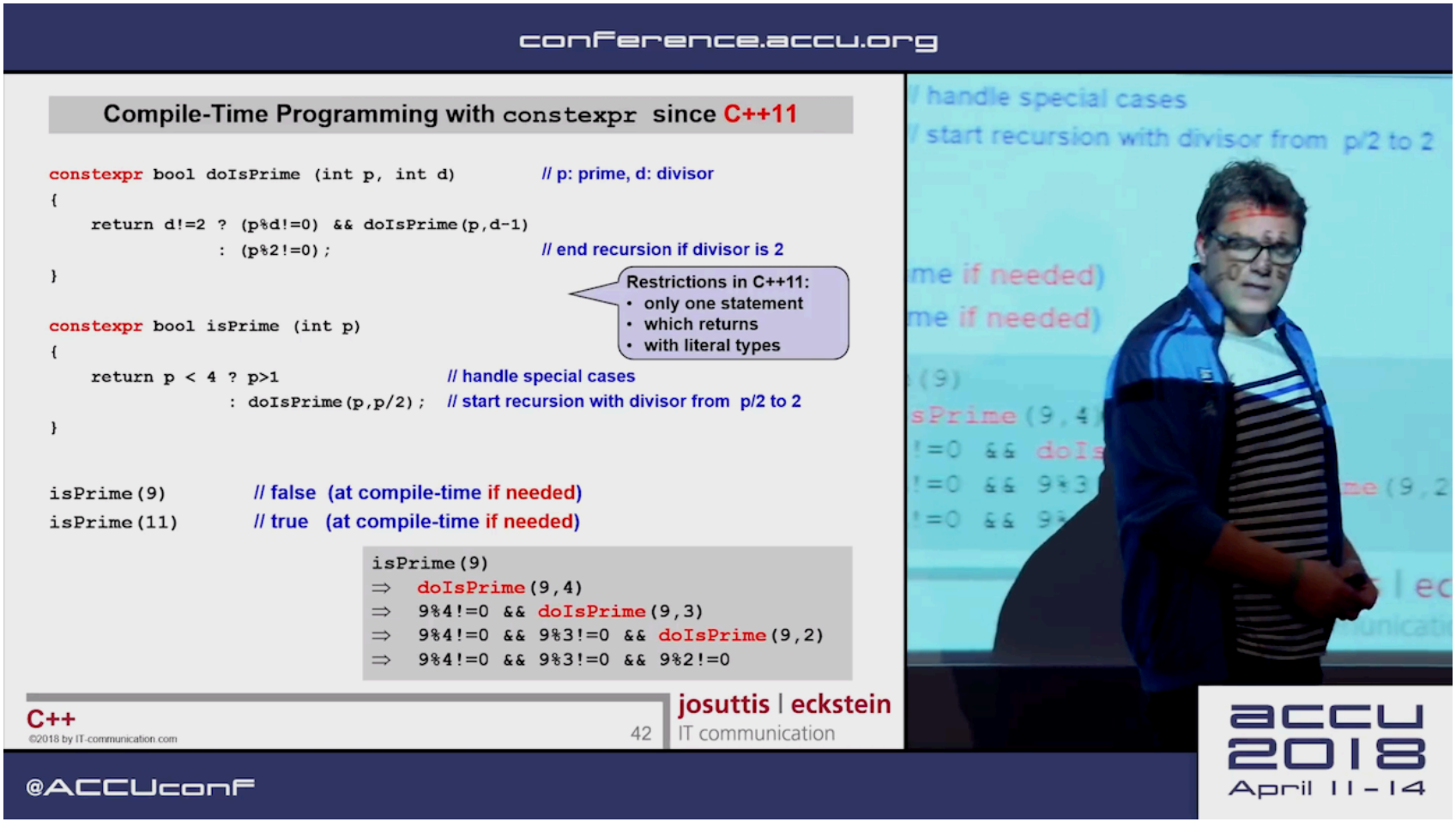
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Compile-Time Programming with constexpr since C++11
constexpr bool doIsPrime (int p, int d) // p: prime, d: divisor
{
return d!=2 ? (p%d!=0) && doIsPrime(p,d-1)
: (p%2!=0); // end recursion if divisor is 2
}
constexpr bool isPrime (int p)
{
return p < 4 ? p>1 // handle special cases
: doIsPrime(p,p/2); // start recursion with divisor from p/2 to 2
}
isPrime(9) // false (at compile-time if needed)
isPrime(11) // true (at compile-time if needed)
Restrictions in C++11:
• only one statement
• which returns
• with literal types
isPrime(9)
⇒ doIsPrime(9,4)
⇒ 9%4!=0 && doIsPrime(9,3)
⇒ 9%4!=0 && 9%3!=0 && doIsPrime(9,2)
⇒ 9%4!=0 && 9%3!=0 && 9%2!=0
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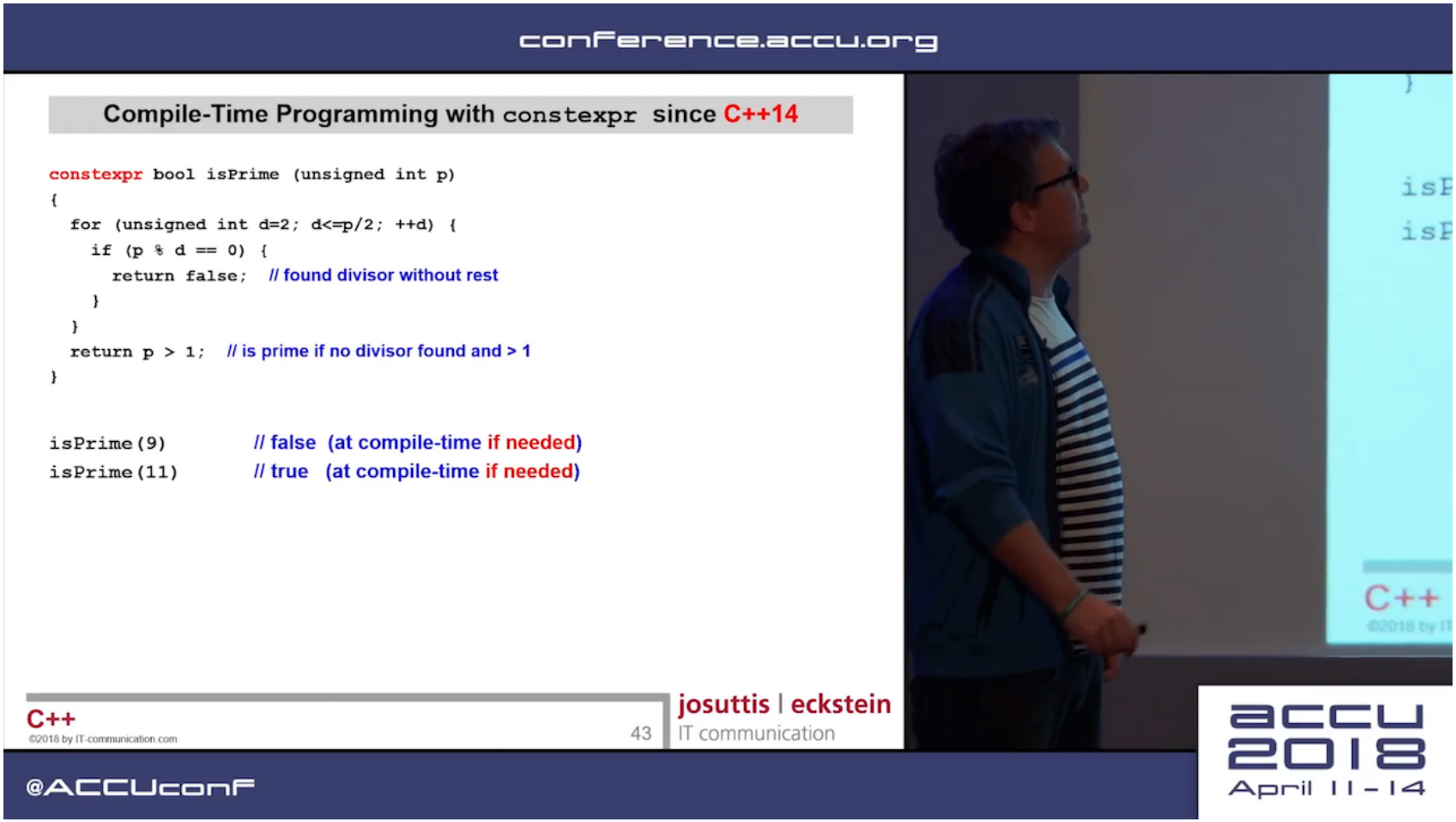
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Compile-Time Programming with constexpr since C++14
constexpr bool isPrime (unsigned int p)
{
for (unsigned int d=2; d<=p/2; ++d) {
if (p % d == 0) {
return false; // found divisor without rest
}
}
return p > 1; // is prime if no divisor found and > 1
}
isPrime(9) // false (at compile-time if needed)
isPrime(11) // true (at compile-time if needed)
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Your handy cut-out-and-keep guide to std::forward and std::move

- Article

CRTP refresher by Jonathan Boccara

- Part 1
- Part 2
- Part 3
- Part 4

Favourite C++ coding standards

- Reddit
- C++ Core Guidelines
- High Integrity C++ Coding Standard
- Geosoft C++ Programming Practice Guidelines
- Webkit Code Style Guidelines

Twitter

Dan Luu
@danluu

1 Reply, 7 Quotes

A creator of the C++ STL says they might've used more cache-friendly data structures if HP Labs had the budget to buy HP PA-RISC machines?

(via @daniel_bilar)

06/03/2018, 20:27 (6 days ago)
Twitter Web Client

Retweeted by @AlisdairMered
10/03/2018, 16:10

381 Likes | 174 Retweets | Thread >

Alex: STL is "only" two decades old, but yes, there have been important changes during that period that would lead to some different decisions. STL was actually designed on a Leading Edge PC with no cache and 640K memory. (Our group at HP Labs didn't have enough money in the budget for an HP PC. When HP CEO Lew Platt came to visit me, HP Labs' director rushed in beforehand to hide the Leading Edge PC.)

One of the biggest changes since then has been the growth of caches. Cache misses are very costly, so locality of reference is much more important now. Node-based data structures, which have low locality of reference, make much less sense. If I were designing STL today, I would have a different set of containers. For example, an in-memory B*-tree is a far better choice than a red-black tree for implementing an associative container.