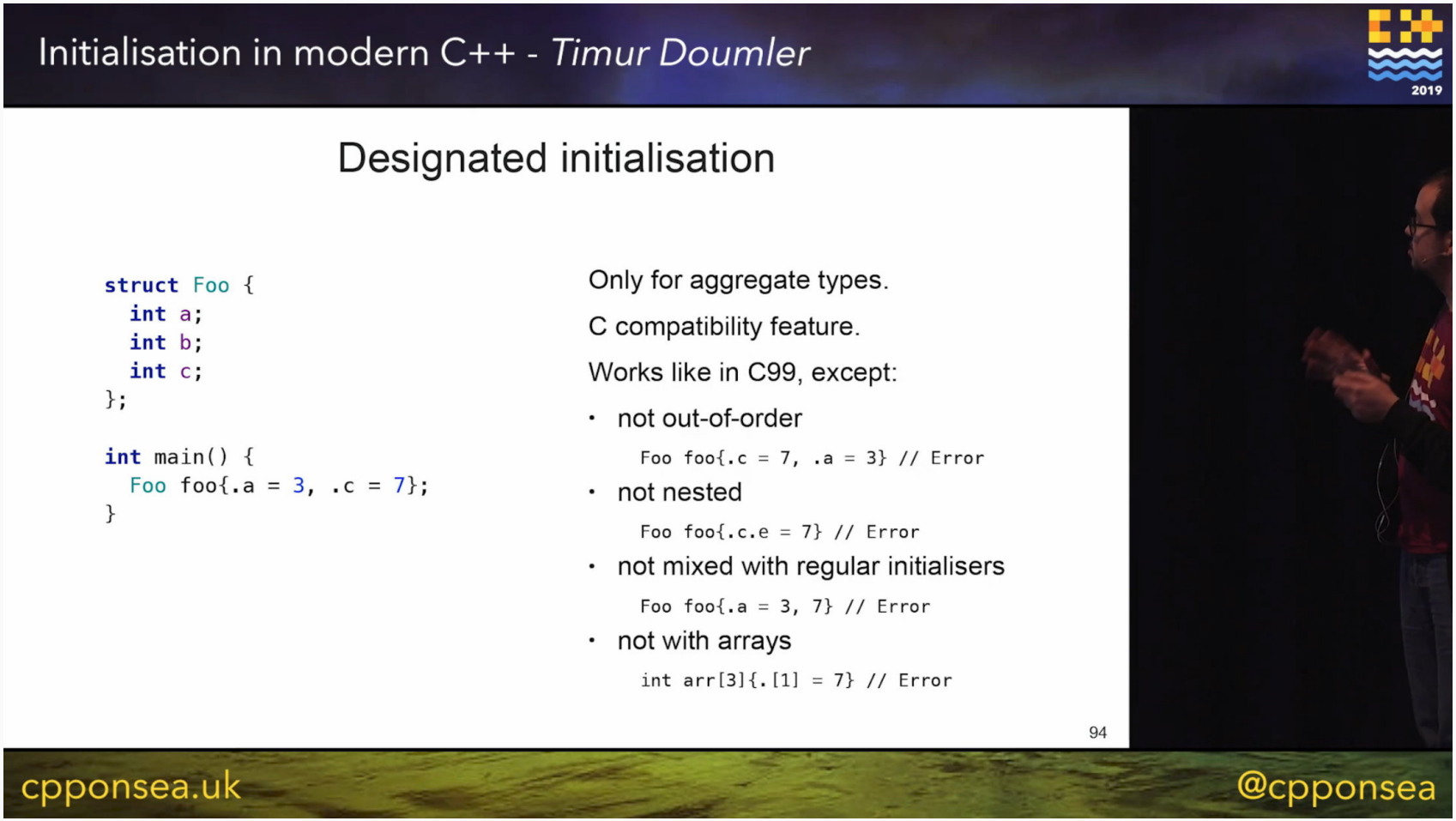
C++ Club Meeting Notes

Gleb Dolgich

2020-01-30

CppOnSea 2019: Timur Doumler - Initialisation in modern C++

Video


Initialisation in modern C++ - Timur Doumler
2019
Designated initialisation
struct Foo {
int a;
int b;
int c;
};
int main() {
Foo foo{.a = 3, .c = 7};
}
Only for aggregate types.
C compatibility feature.
Works like in C99, except:
• not out-of-order
Foo foo{.c = 7, .a = 3} // Error
• not nested
Foo foo{.c.e = 7} // Error
• not mixed with regular initialisers
Foo foo{.a = 3, 7} // Error
• not with arrays
int arr[3]{.[1] = 7} // Error
94
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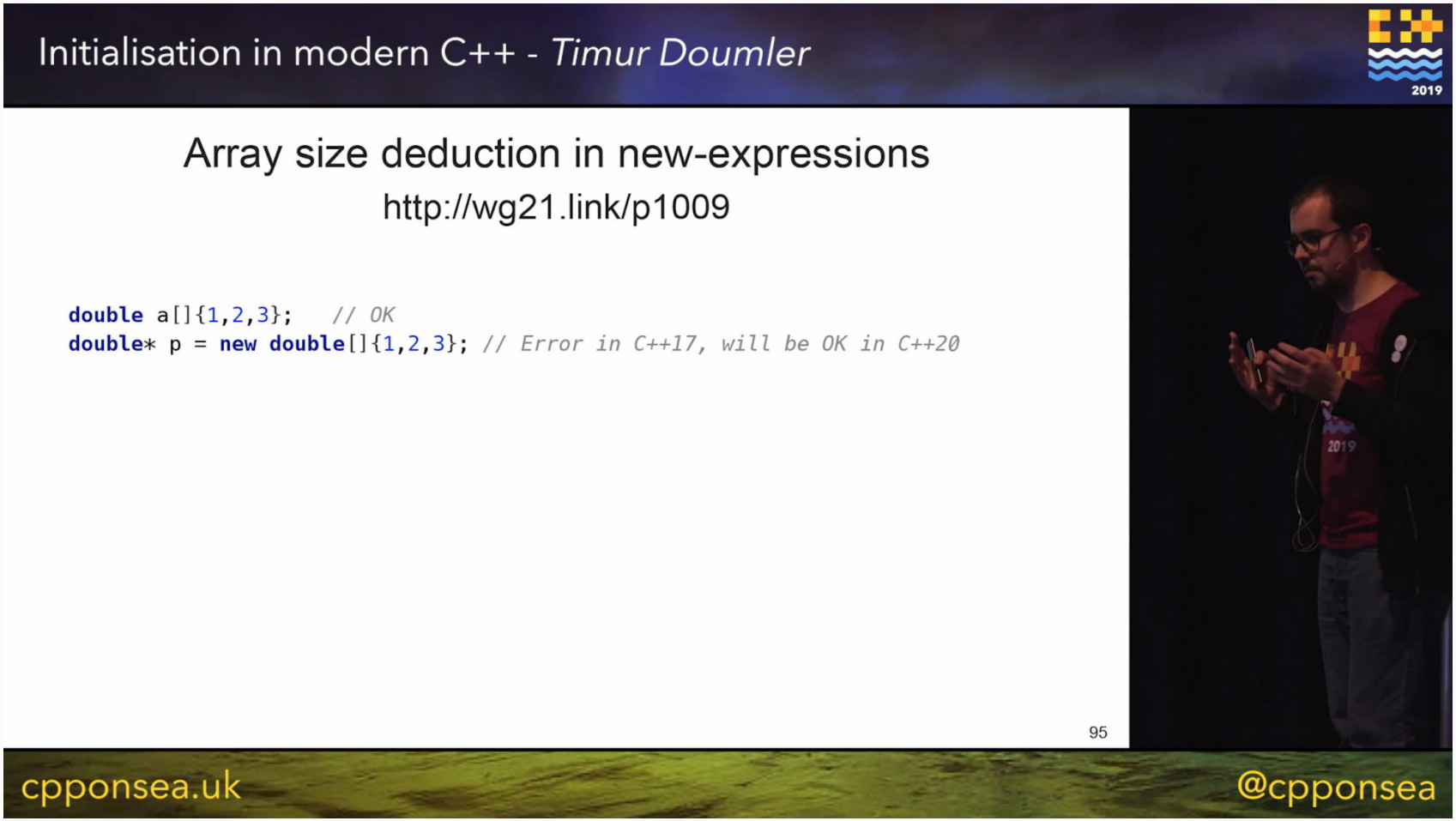
Initialisation in modern C++ - Timur Doumler
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Array size deduction in new-expressions
http://wg21.link/p1009
double a[]{1,2,3}; // OK
double* p = new double[]{1,2,3}; // Error in C++17, will be OK in C++20
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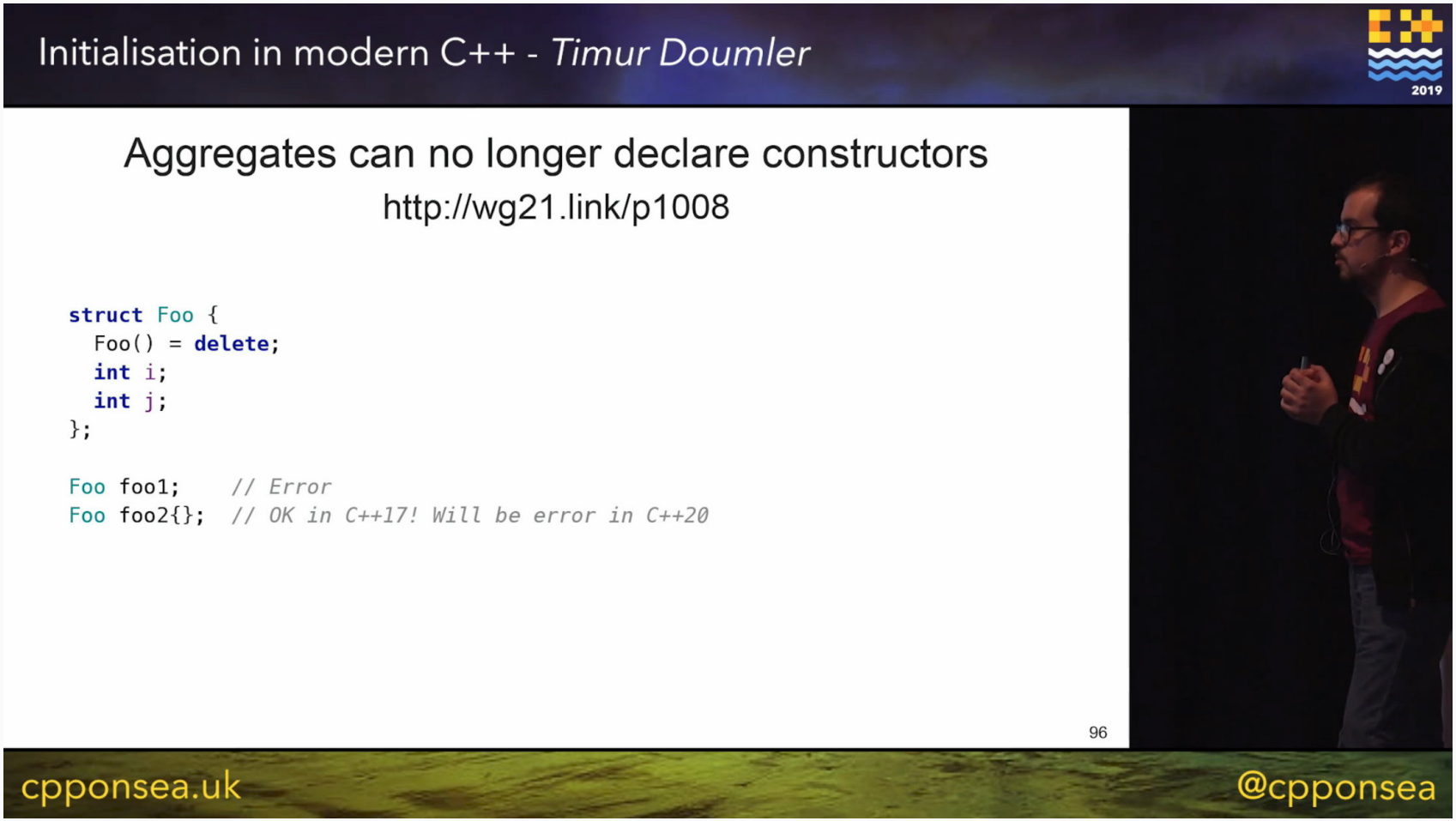
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Aggregates can no longer declare constructors
http://wg21.link/p1008
struct Foo {
Foo() = delete;
int i;
int j;
};
Foo foo1; // Error
Foo foo2{}; // OK in C++17! Will be error in C++20
96
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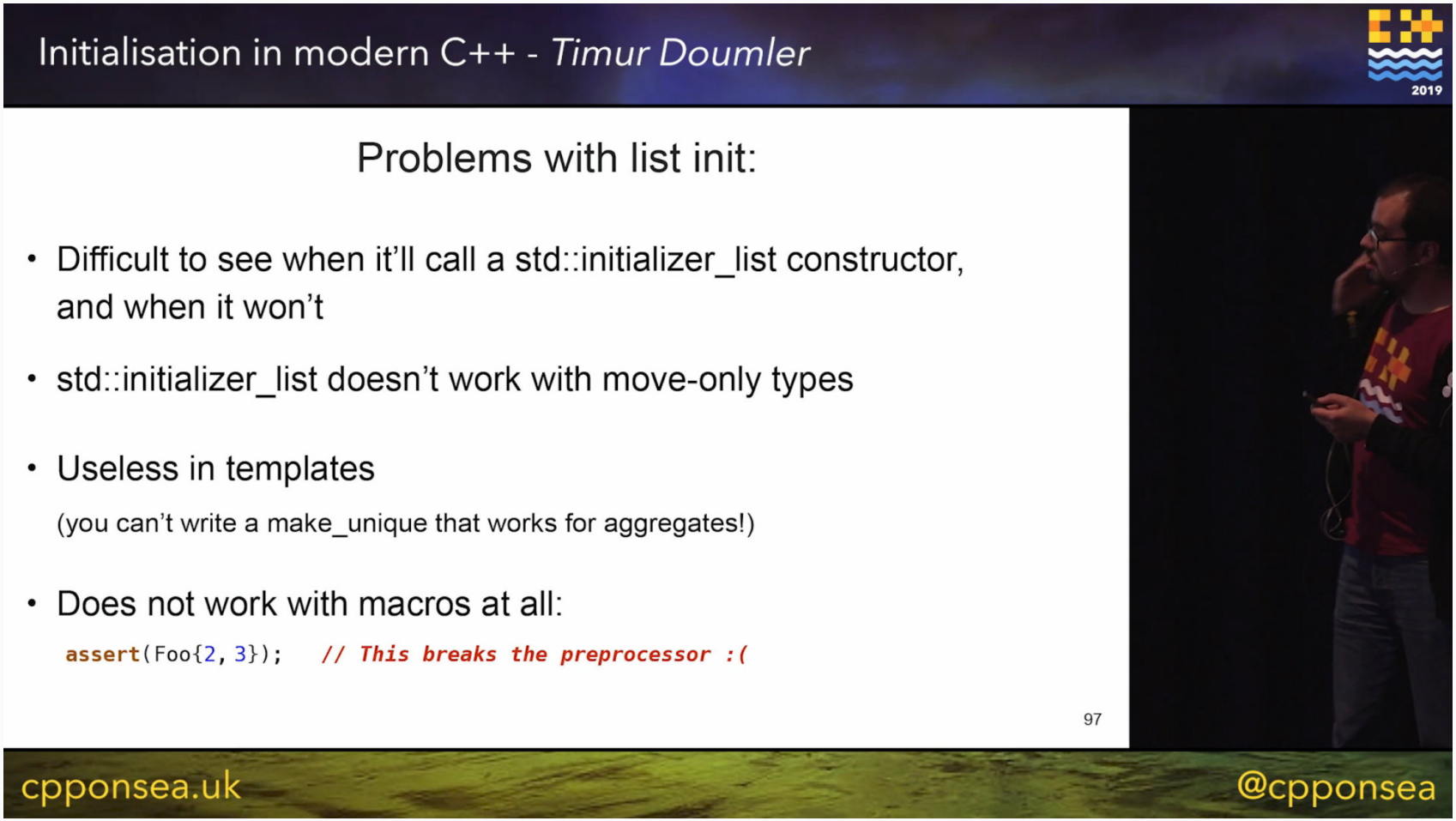
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Problems with list init:
• Difficult to see when it'll call a std::initializer_list constructor, and when it won't
• std::initializer_list doesn't work with move-only types
• Useless in templates
(you can't write a make_unique that works for aggregates!)
• Does not work with macros at all:
assert(Foo{2, 3}); // This breaks the preprocessor :(
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Aggregate initialisation from parens

http://wg21.link/p0960

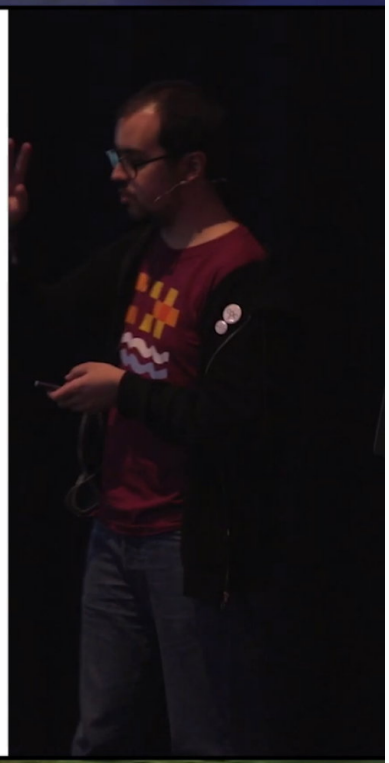
```
struct Foo {
  int i;
  int j;
};

Foo foo(1, 2);   // will work in C++20!
int arr[3](0, 1, 2);  // will work in C++20!
```

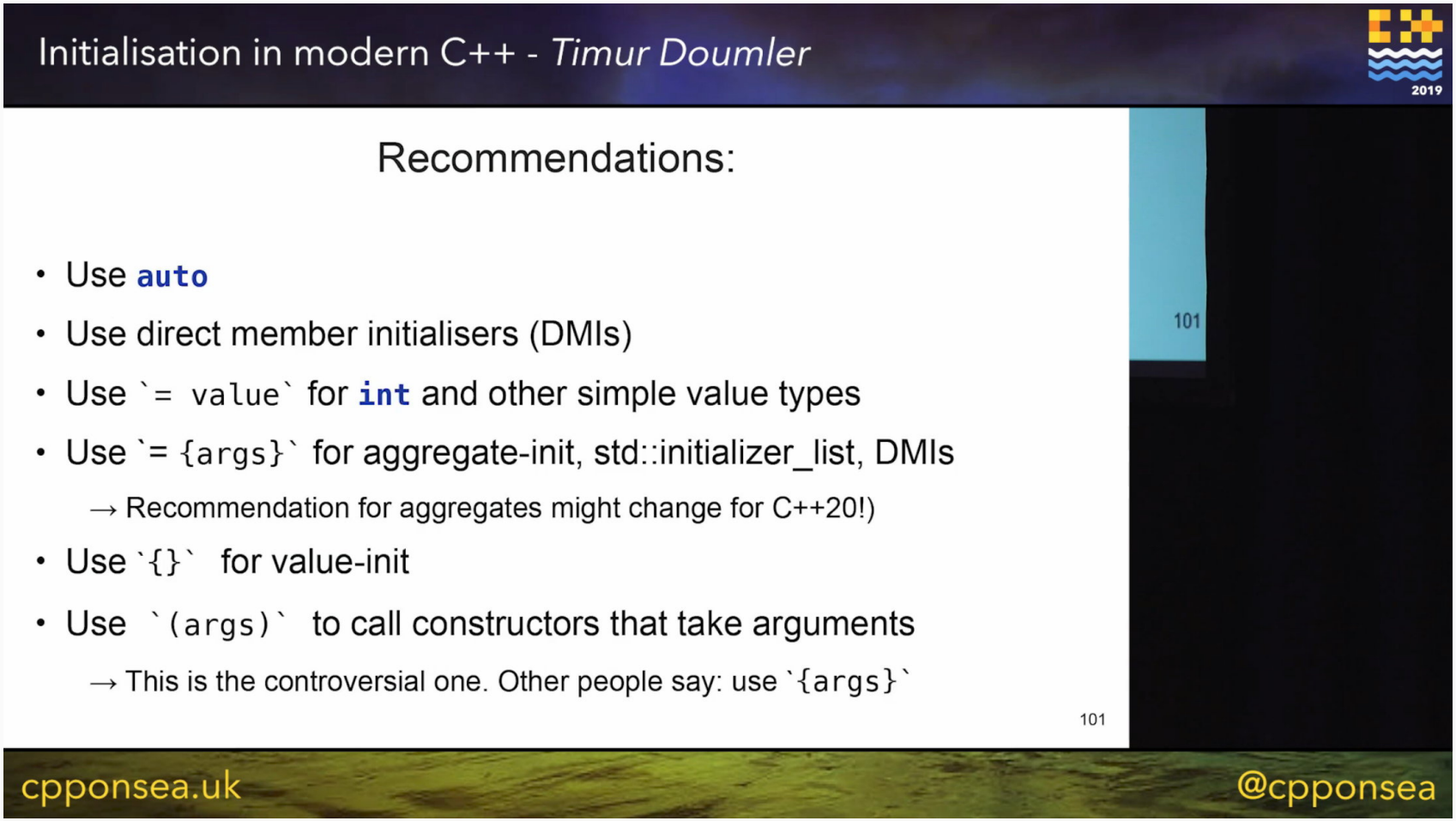
Idea: in C++20, ( ) and {} will do the same thing!

Except:

- ( ) does not call std::initializer_list constructors
- {} does not consider narrowing conversions

100

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Recommendations:
• Use auto
• Use direct member initialisers (DMIs)
• Use `= value` for int and other simple value types
• Use `= {args}` for aggregate-init, std::initializer_list, DMIs
→ Recommendation for aggregates might change for C++20!)
• Use `{}` for value-init
• Use `(args)` to call constructors that take arguments
→ This is the controversial one. Other people say: use `{args}`
101
101
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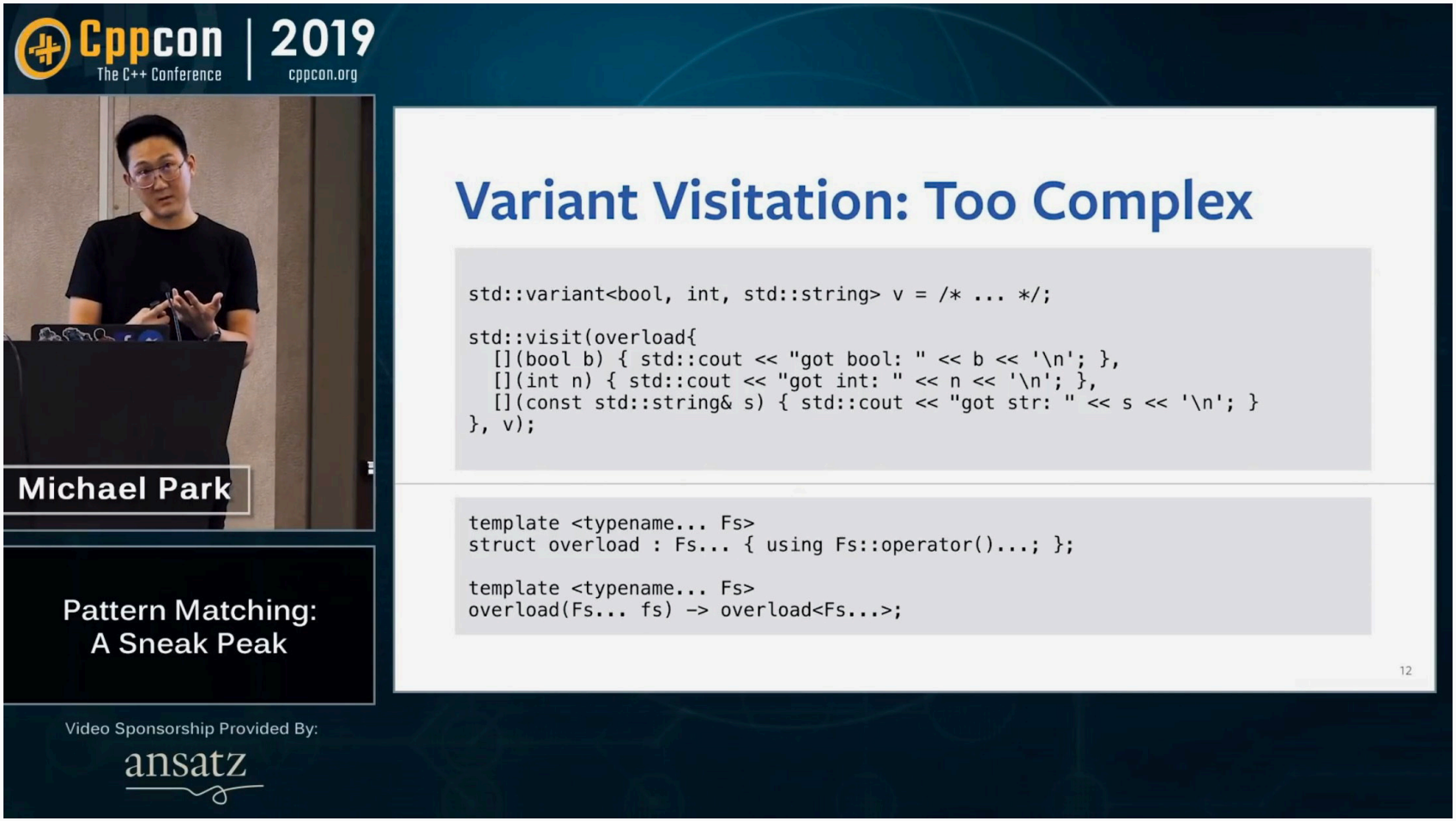
Video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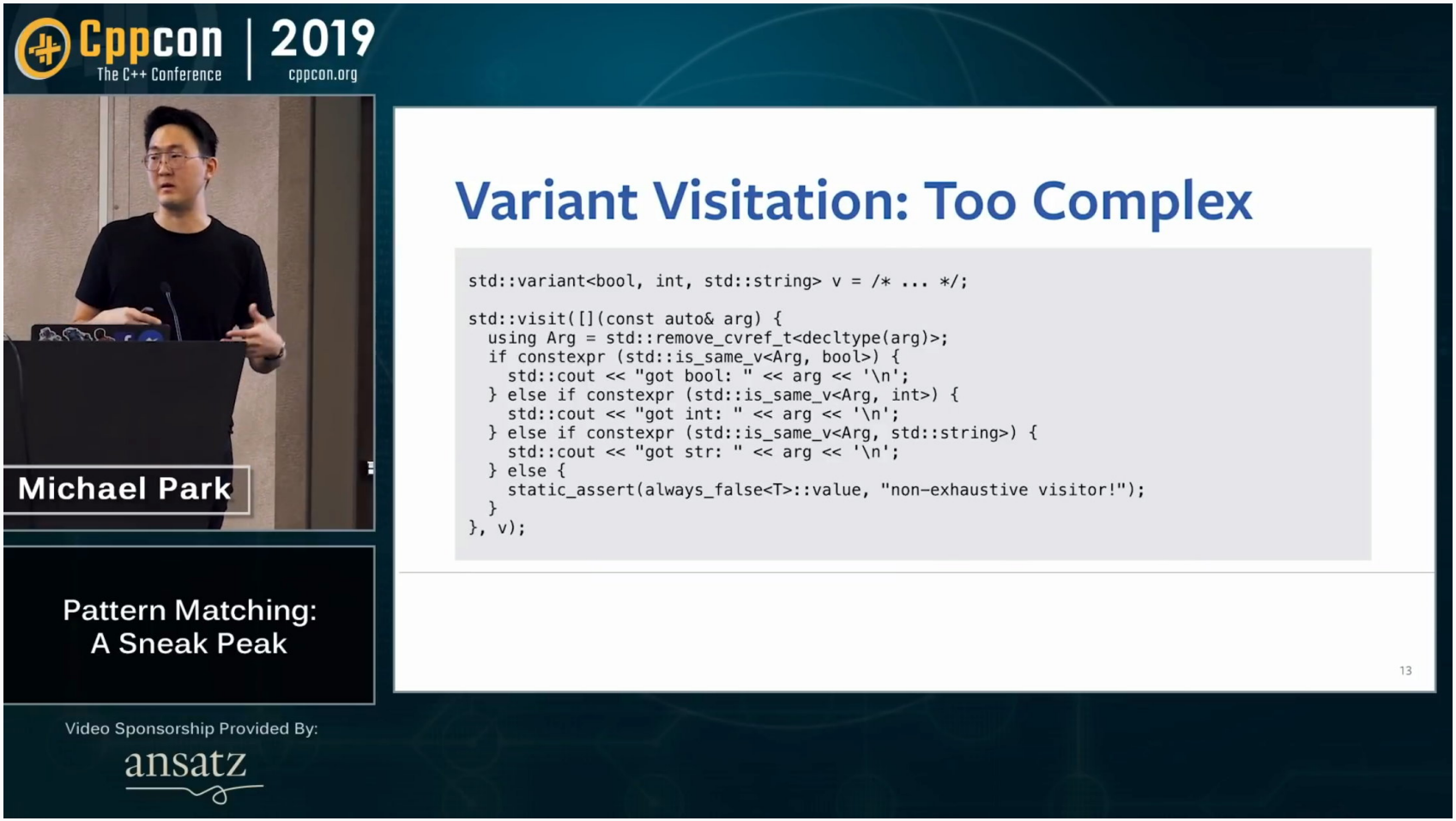
Variant Visitation: Too Complex
std::variant<bool, int, std::string> v = /* ... */;
std::visit(overload{
[](bool b) { std::cout << "got bool: " << b << '\n'; },
[](int n) { std::cout << "got int: " << n << '\n'; },
[](const std::string& s) { std::cout << "got str: " << s << '\n'; }
}, v);
template <typename... Fs>
struct overload : Fs... { using Fs::operator()...; };
template <typename... Fs>
overload(Fs... fs) -> overload<Fs...>;
12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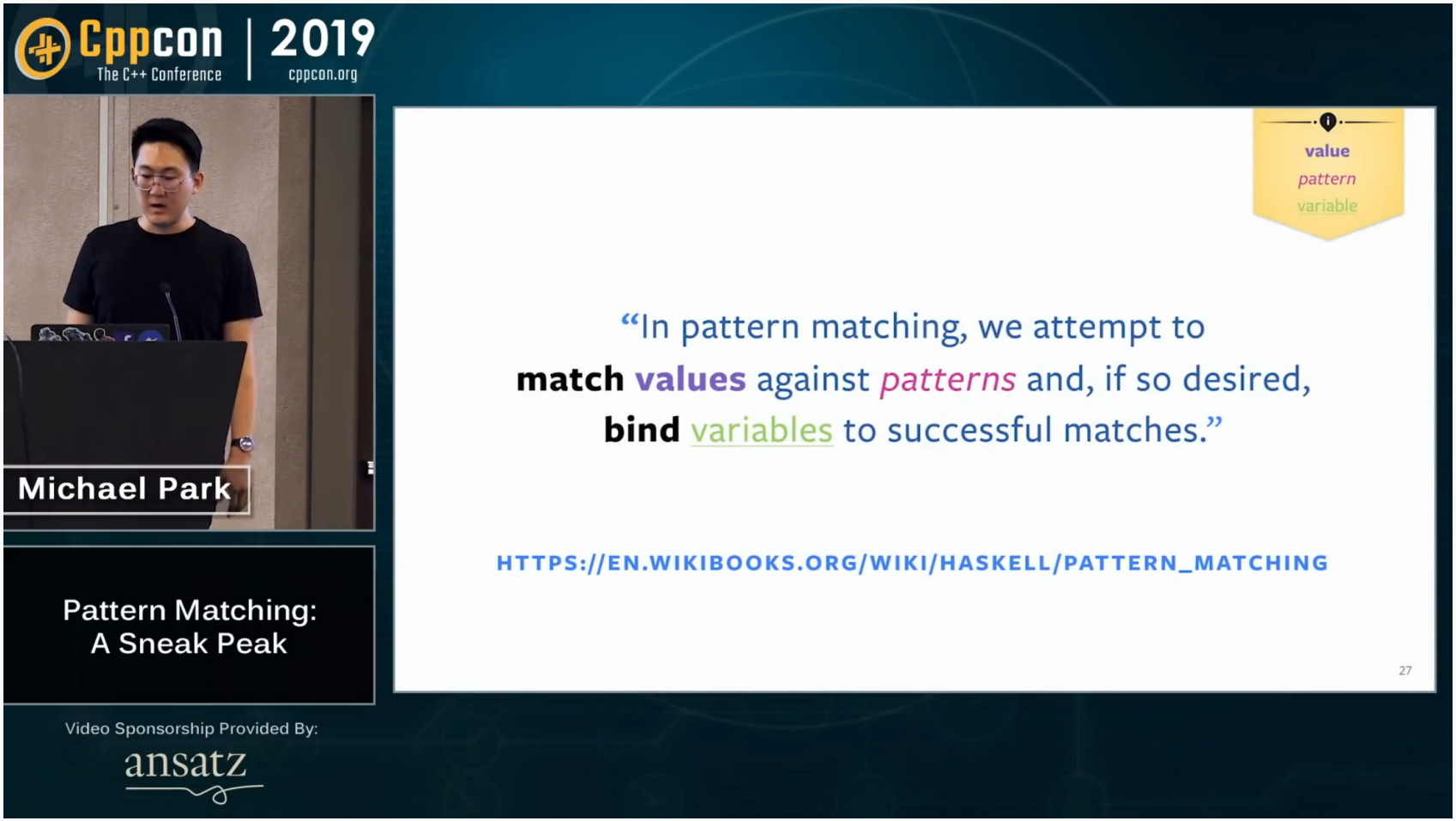
Variant Visitation: Too Complex
std::variant<bool, int, std::string> v = /* ... */;
std::visit([](const auto& arg) {
using Arg = std::remove_cvref_t<decltype(arg)>;
if constexpr (std::is_same_v<Arg, bool>) {
std::cout << "got bool: " << arg << '\n';
} else if constexpr (std::is_same_v<Arg, int>) {
std::cout << "got int: " << arg << '\n';
} else if constexpr (std::is_same_v<Arg, std::string>) {
std::cout << "got str: " << arg << '\n';
} else {
static_assert(always_false<T>::value, "non-exhaustive visitor!");
}
}, v);
13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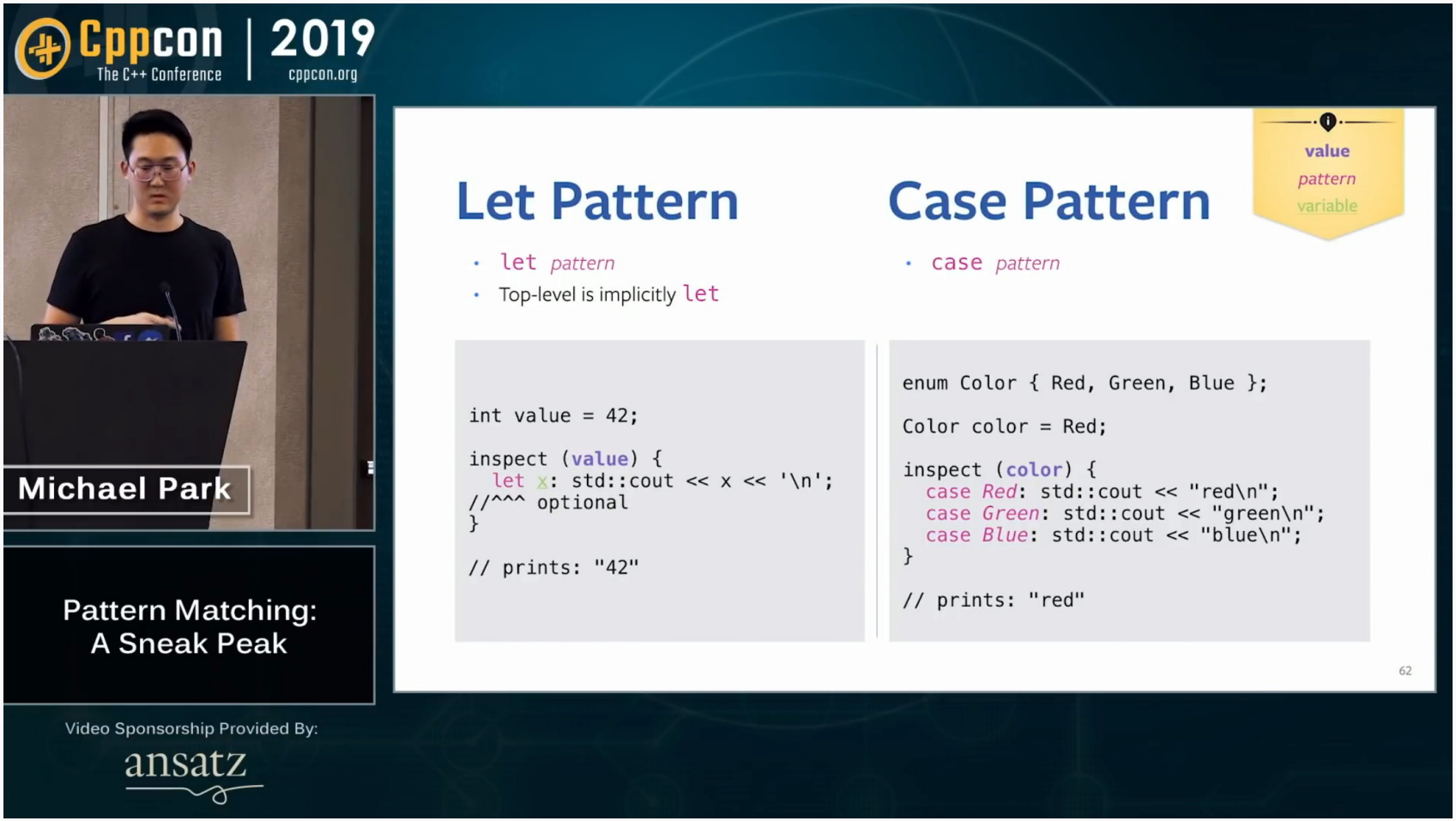
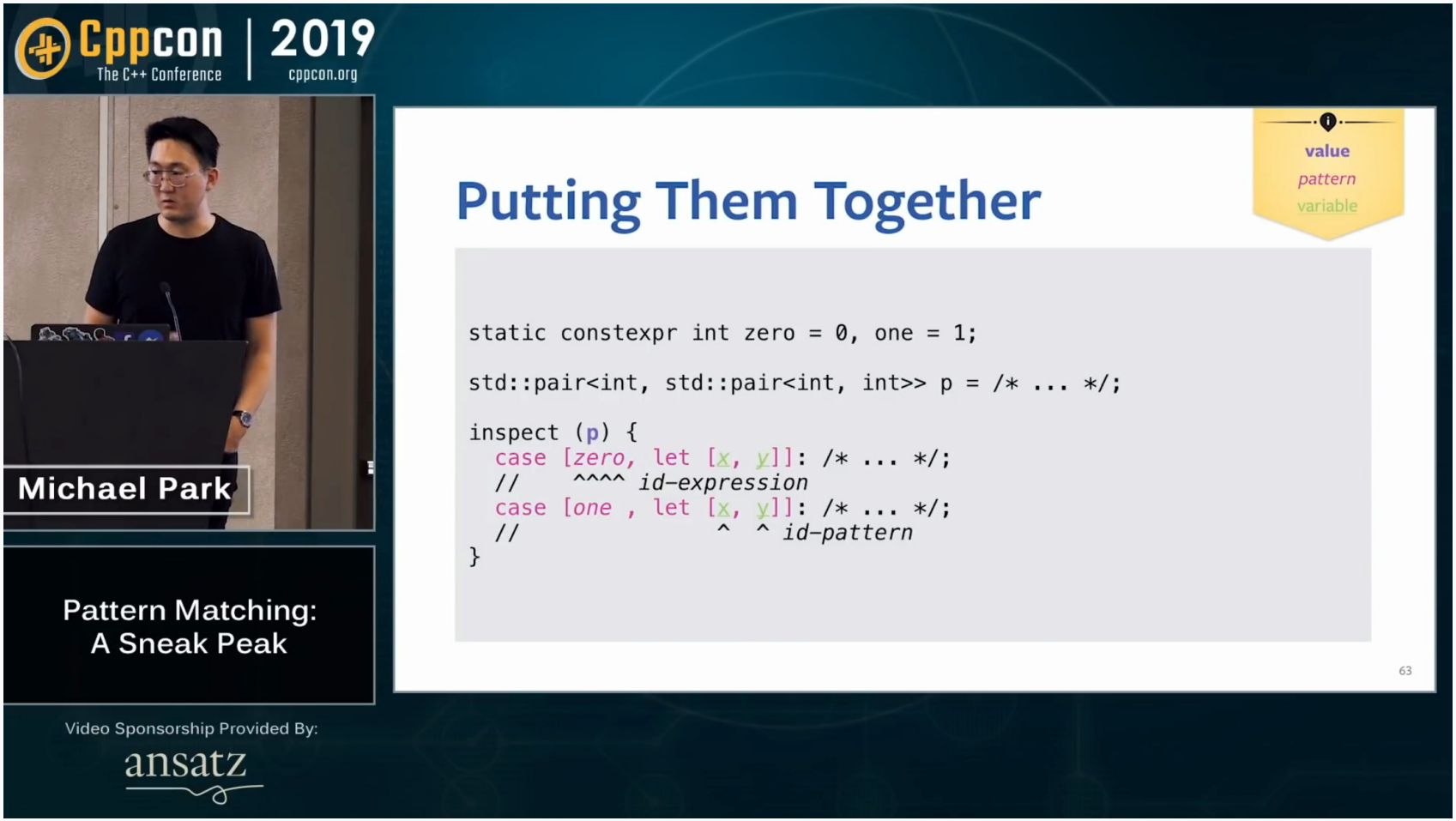
value
pattern
variable
"In pattern matching, we attempt to
match values against patterns and, if so desired,
bind variables to successful matches."
HTTPS://EN.WIKIBOOKS.ORG/WIKI/HASKELL/PATTERN_MATCHING
27

CppCon 2019: Michael Park – Pattern Matching: A Sneak Peek

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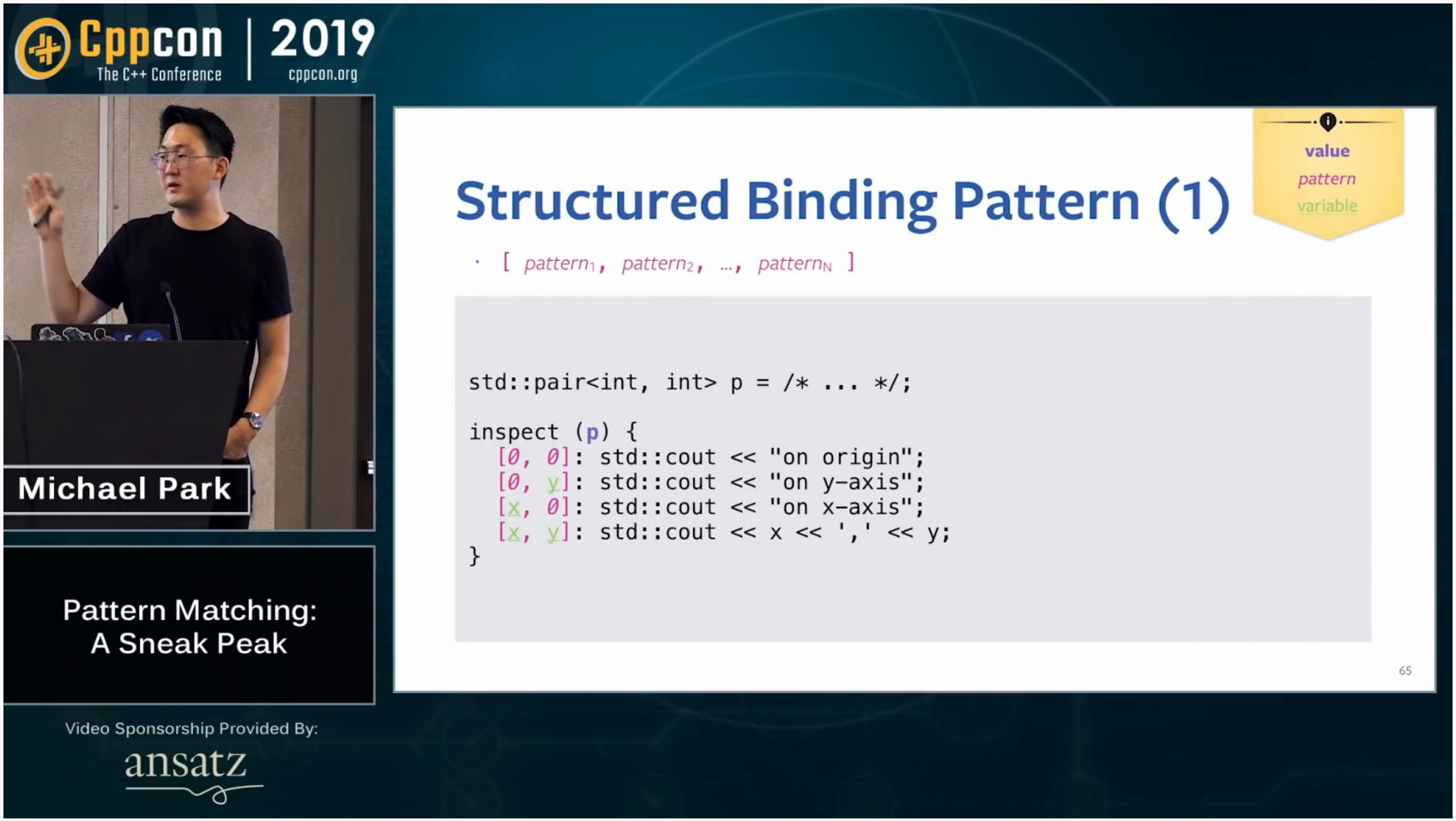
Putting Them Together
value
pattern
variable
static constexpr int zero = 0, one = 1;
std::pair<int, std::pair<int, int>> p = /* ... */;
inspect (p) {
case [zero, let [x, y]]: /* ... */;
// ^^^^ id-expression
case [one , let [x, y]]: /* ... */;
// ^ ^ id-pattern
}
63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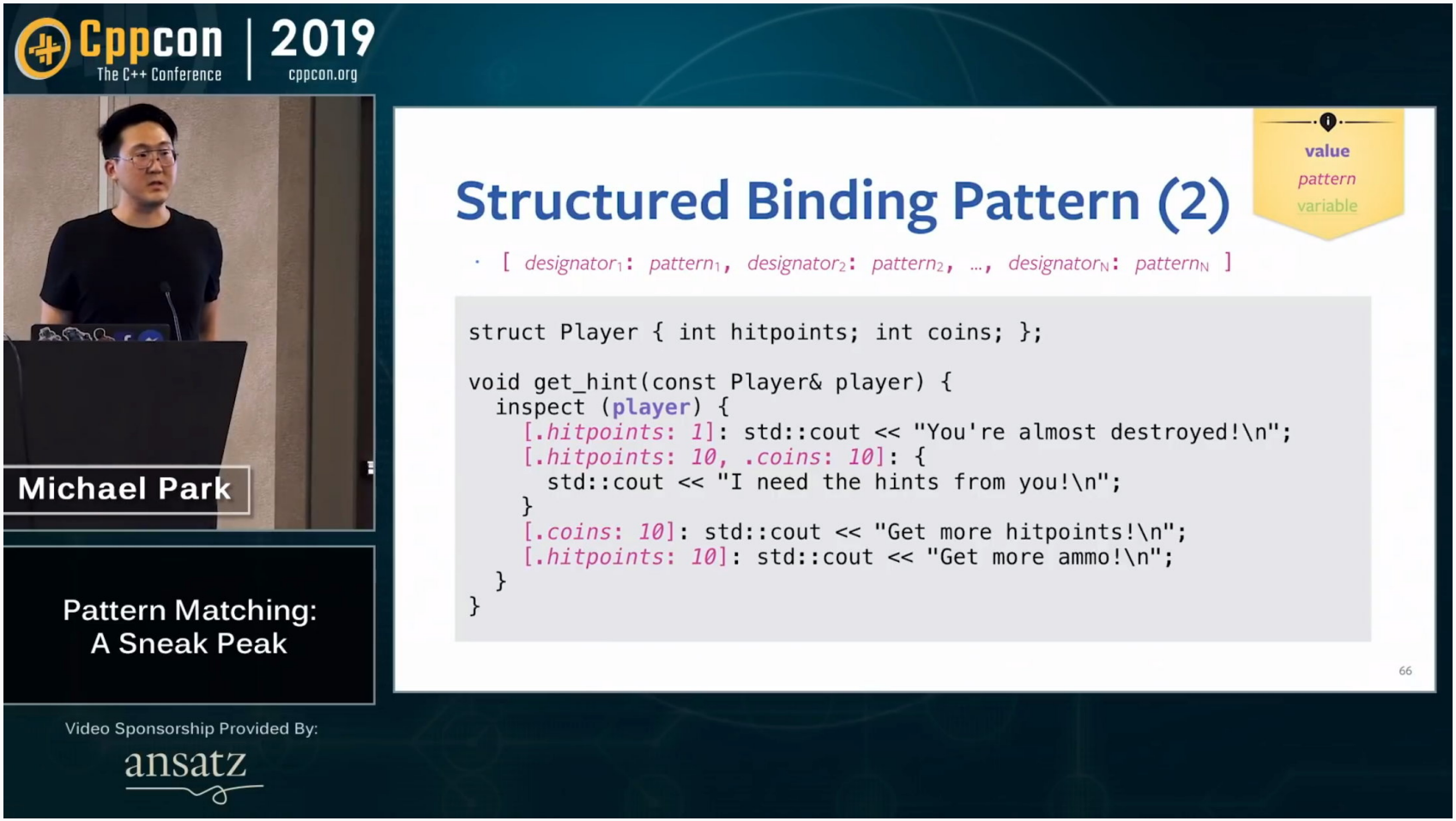
Structured Binding Pattern (1)
value
pattern
variable
[pattern1, pattern2, ..., patternN]
std::pair<int, int> p = /* ... */;
inspect (p) {
[0, 0]: std::cout << "on origin";
[0, y]: std::cout << "on y-axis";
[x, 0]: std::cout << "on x-axis";
[x, y]: std::cout << x << ',' << y;
}
65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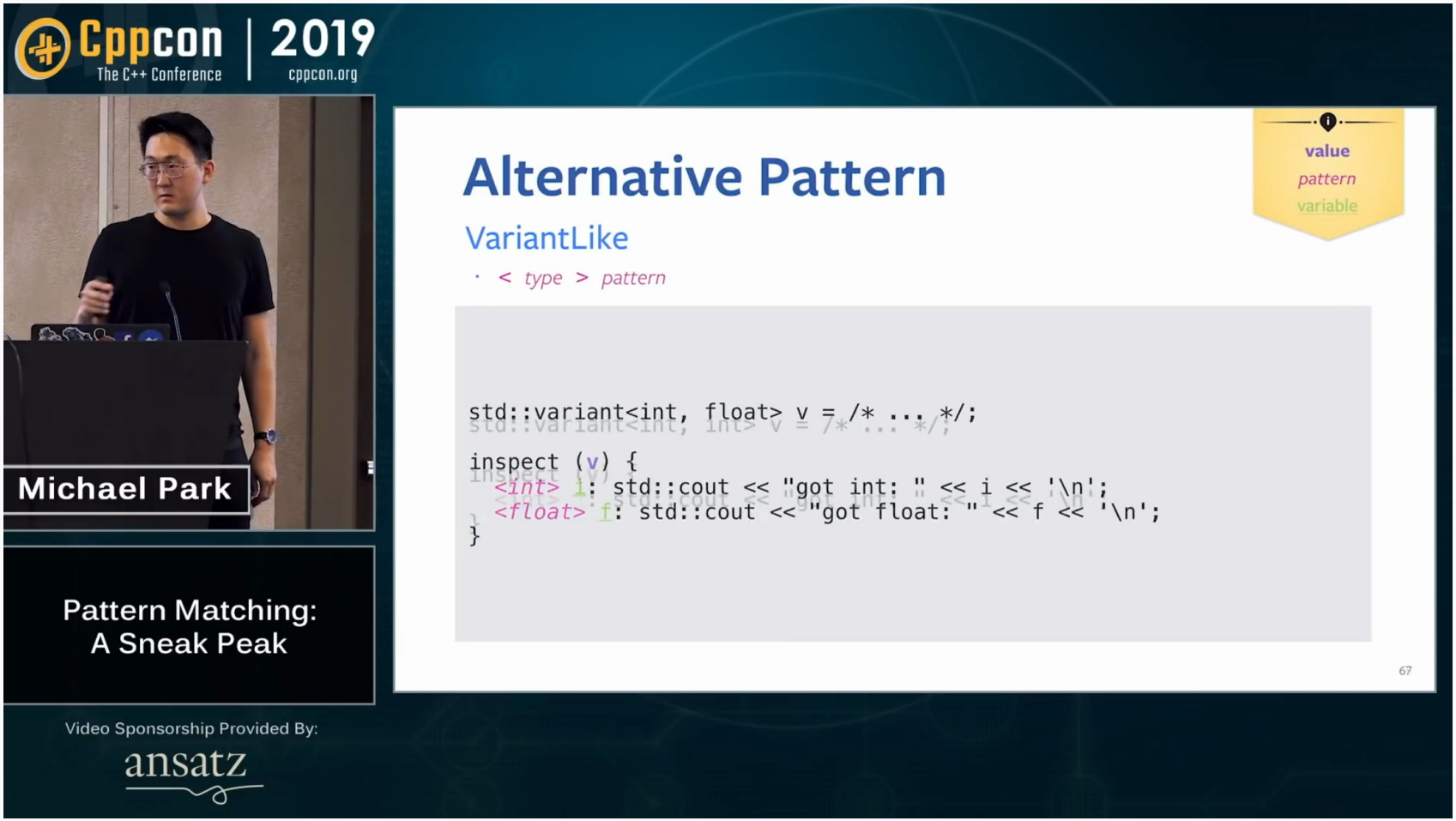
Structured Binding Pattern (2)
value
pattern
variable
[designator1: pattern1, designator2: pattern2, ..., designatorN: patternN]
struct Player { int hitpoints; int coins; };
void get_hint(const Player& player) {
inspect (player) {
[.hitpoints: 1]: std::cout << "You're almost destroyed!\n";
[.hitpoints: 10, .coins: 10]: {
std::cout << "I need the hints from you!\n";
}
[.coins: 10]: std::cout << "Get more hitpoints!\n";
[.hitpoints: 10]: std::cout << "Get more ammo!\n";
}
}
66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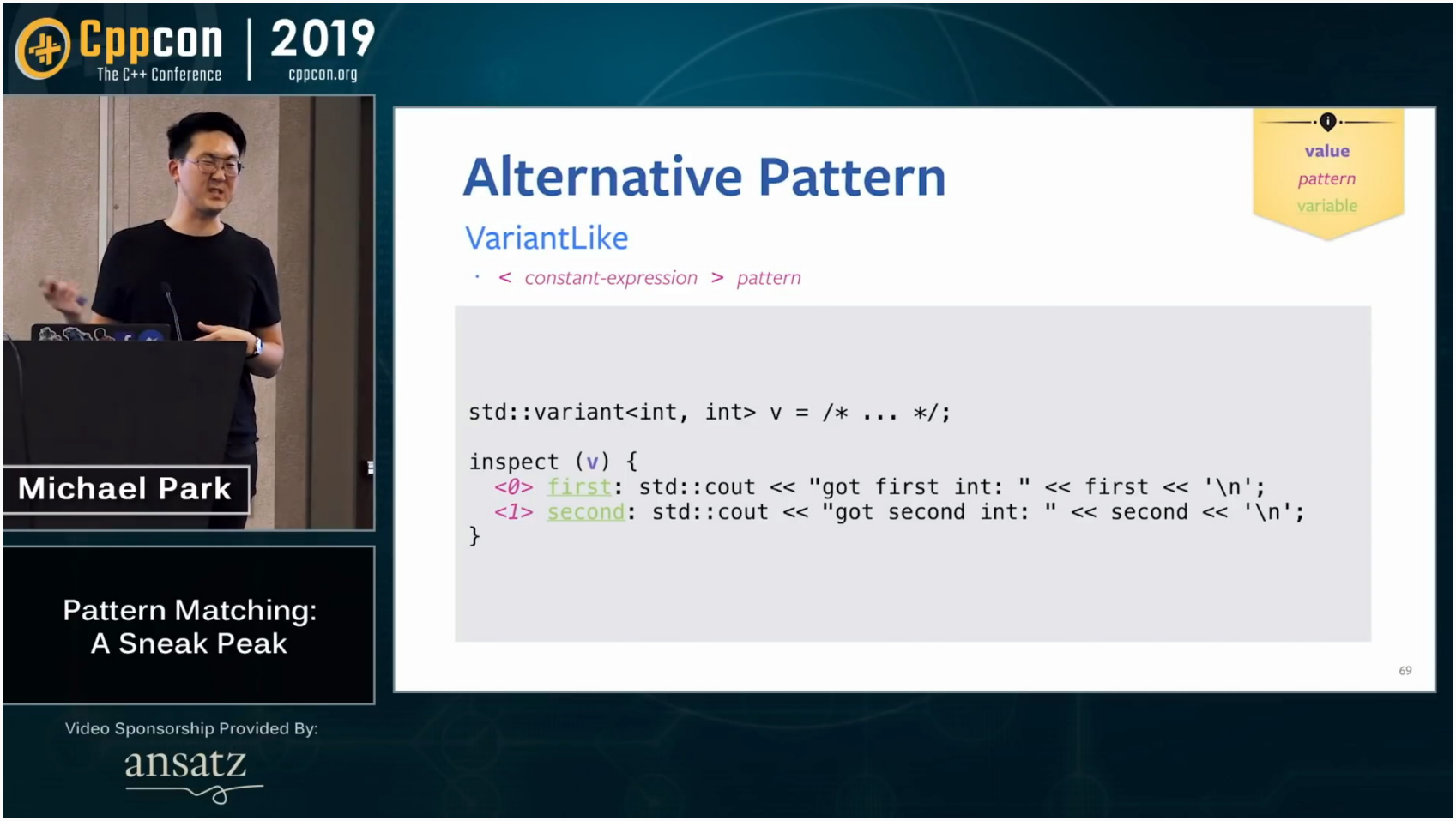
Alternative Pattern
VariantLike
· < type > pattern
value
pattern
variable
std::variant<int, float> v = /* ... */;
inspect (v) {
<int> i: std::cout << "got int: " << i << '\n';
<float> f: std::cout << "got float: " << f << '\n';
}
67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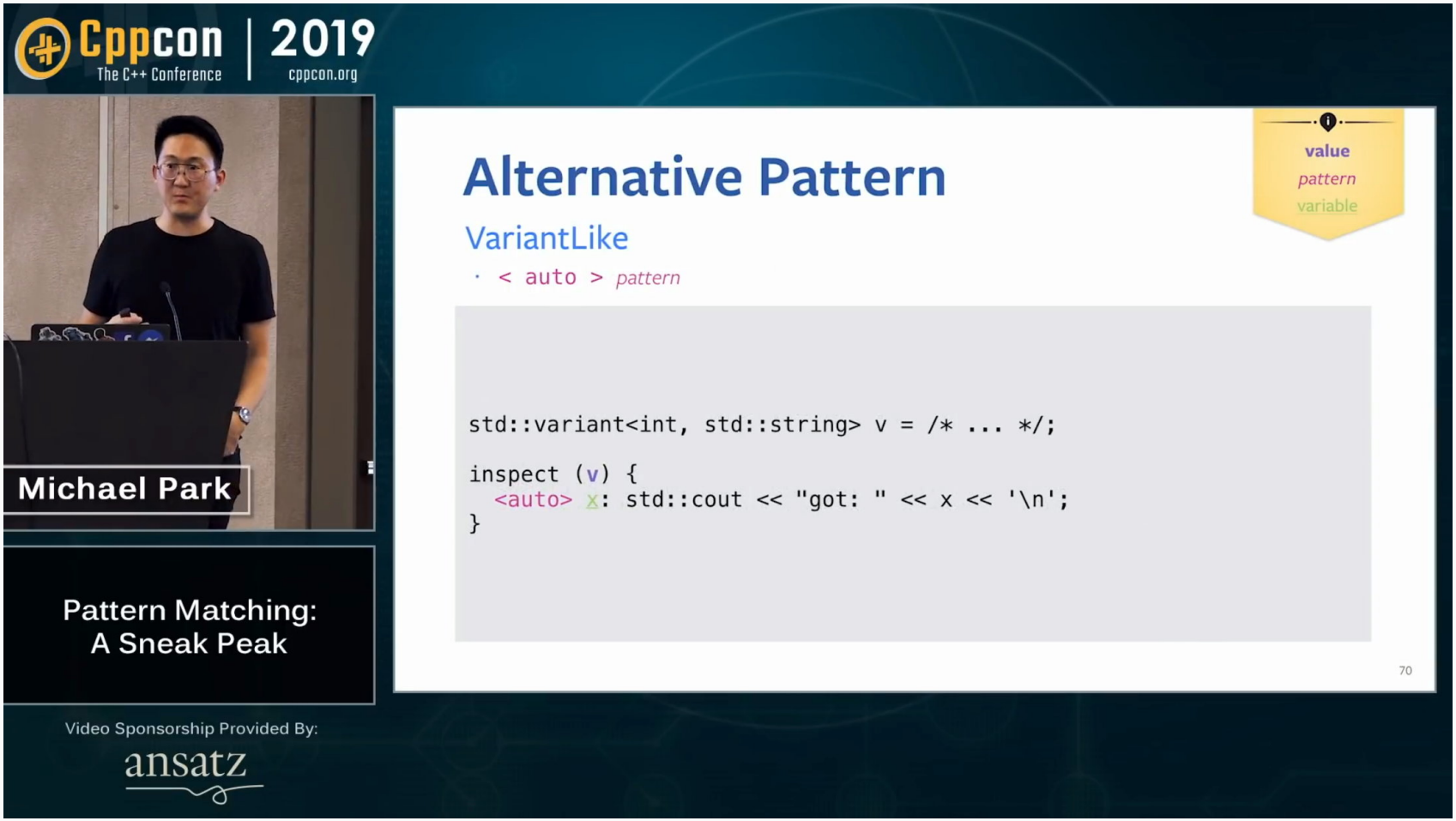
Alternative Pattern
VariantLike
· < constant-expression > pattern
value
pattern
variable
std::variant<int, int> v = /* ... */;
inspect (v) {
<0> first: std::cout << "got first int: " << first << '\n';
<1> second: std::cout << "got second int: " << second << '\n';
}
69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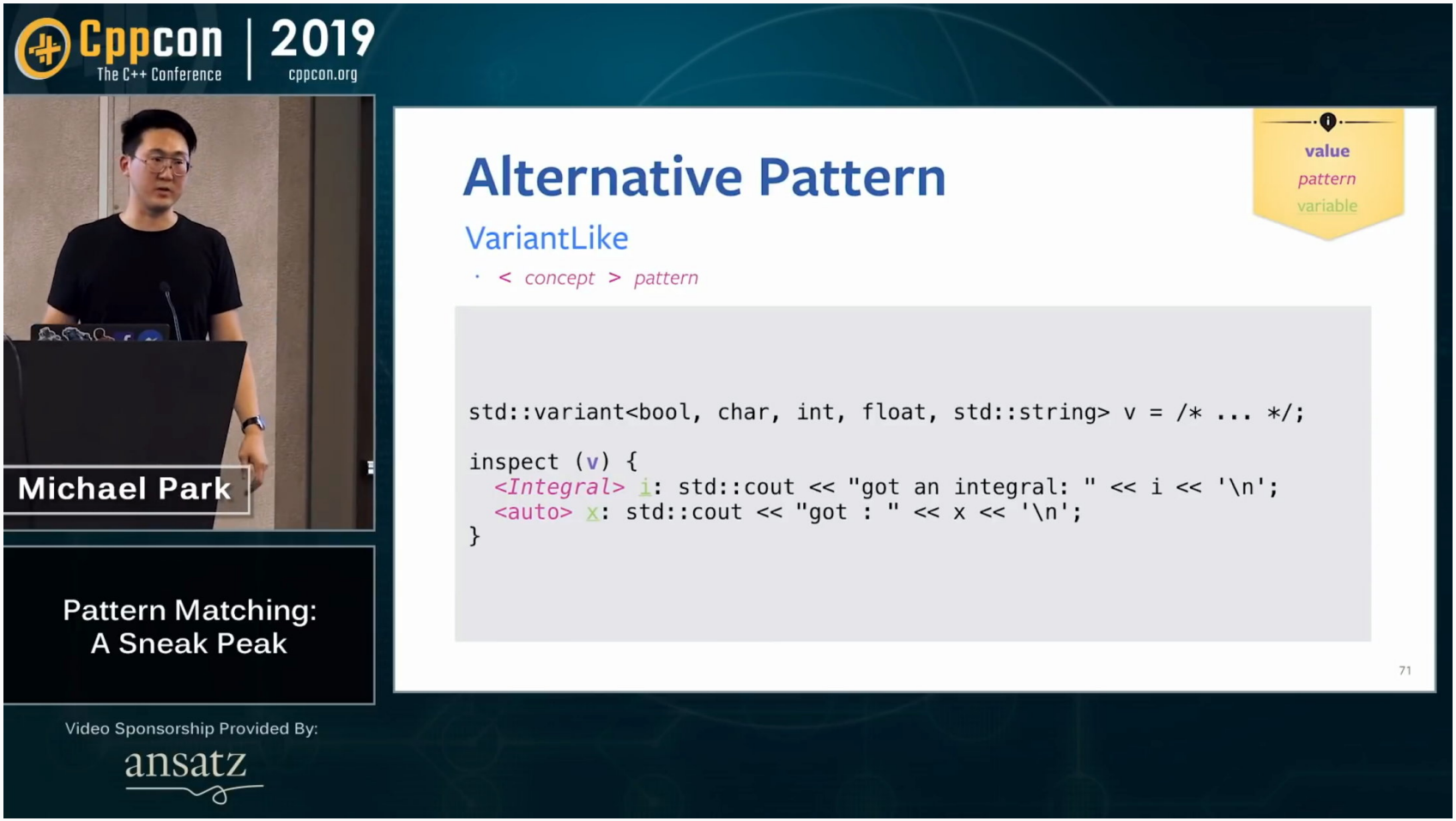
Alternative Pattern
VariantLike
· < auto > pattern
value
pattern
variable
std::variant<int, std::string> v = /* ... */;
inspect (v) {
<auto> x: std::cout << "got: " << x << '\n';
}
70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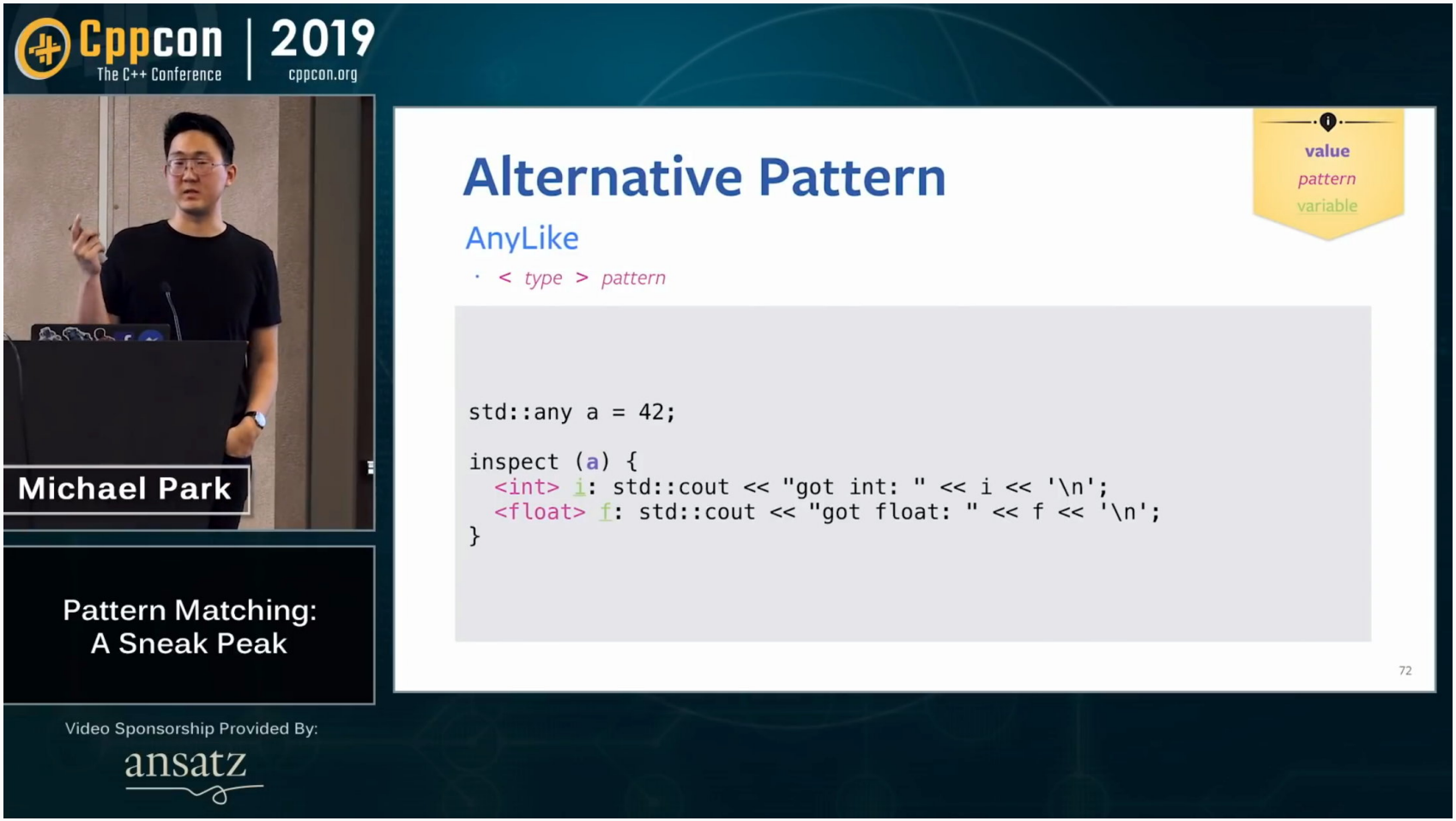
Alternative Pattern
VariantLike
· < concept > pattern
value
pattern
variable
std::variant<bool, char, int, float, std::string> v = /* ... */;
inspect (v) {
<Integral> i: std::cout << "got an integral: " << i << '\n';
<auto> x: std::cout << "got : " << x << '\n';
}
71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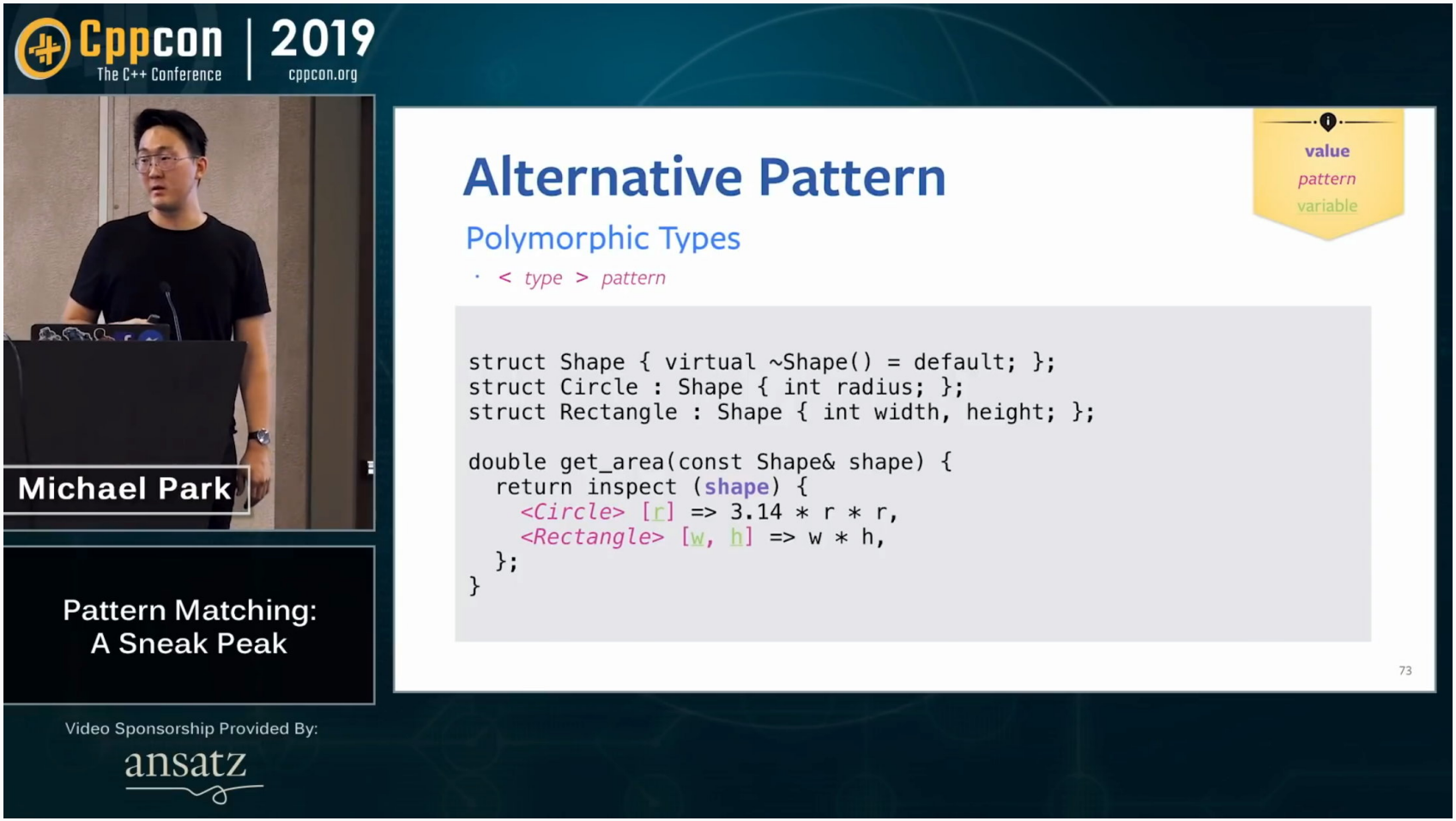
Alternative Pattern
value
pattern
variable
AnyLike
· < type > pattern
std::any a = 42;
inspect (a) {
<int> i: std::cout << "got int: " << i << '\n';
<float> f: std::cout << "got float: " << f << '\n';
}
72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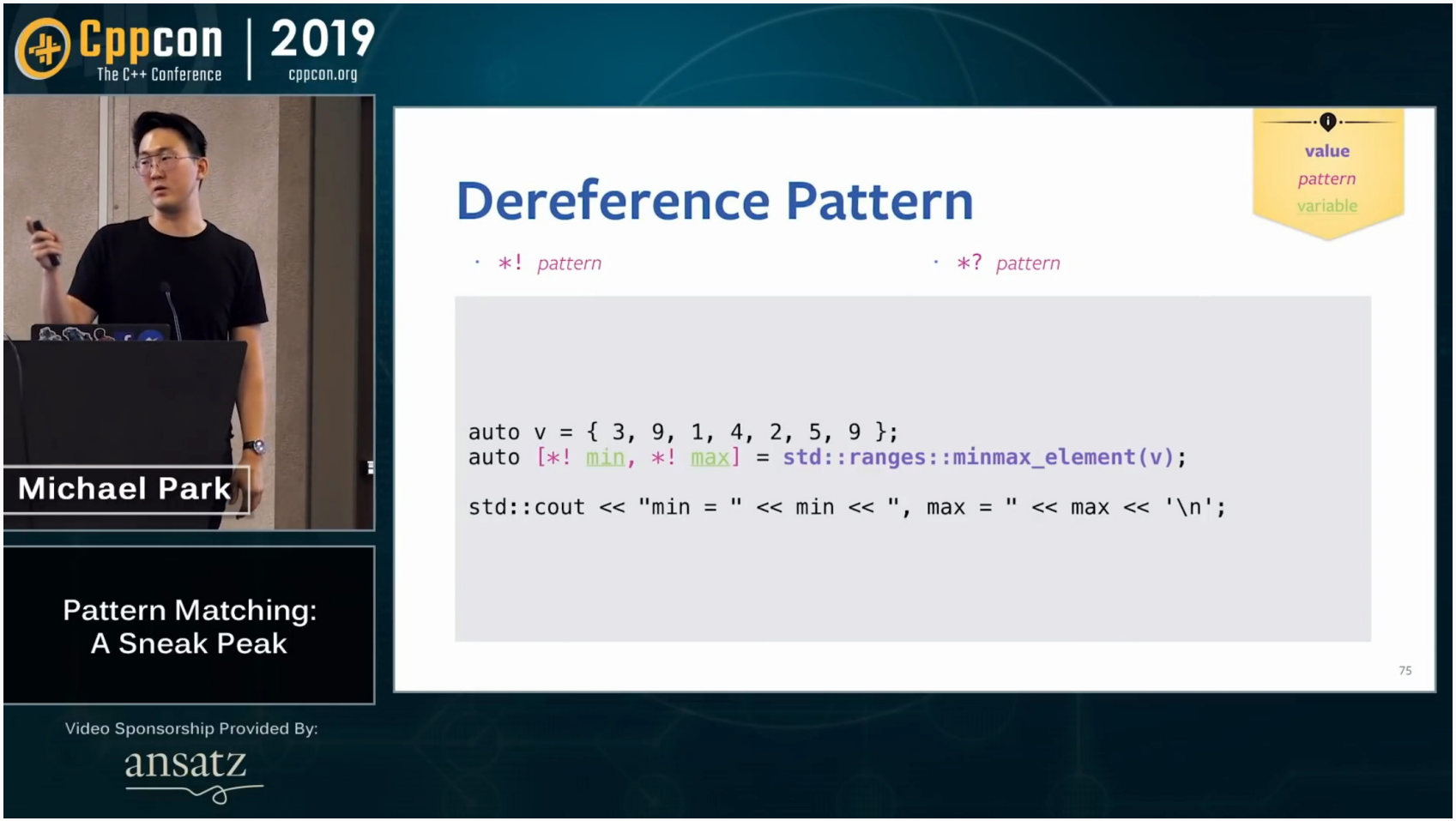
Alternative Pattern
Polymorphic Types
< type > pattern
value
pattern
variable
struct Shape { virtual ~Shape() = default; };
struct Circle : Shape { int radius; };
struct Rectangle : Shape { int width, height; };
double get_area(const Shape& shape) {
return inspect (shape) {
<Circle> [r] => 3.14 * r * r,
<Rectangle> [w, h] => w * h,
};
}
73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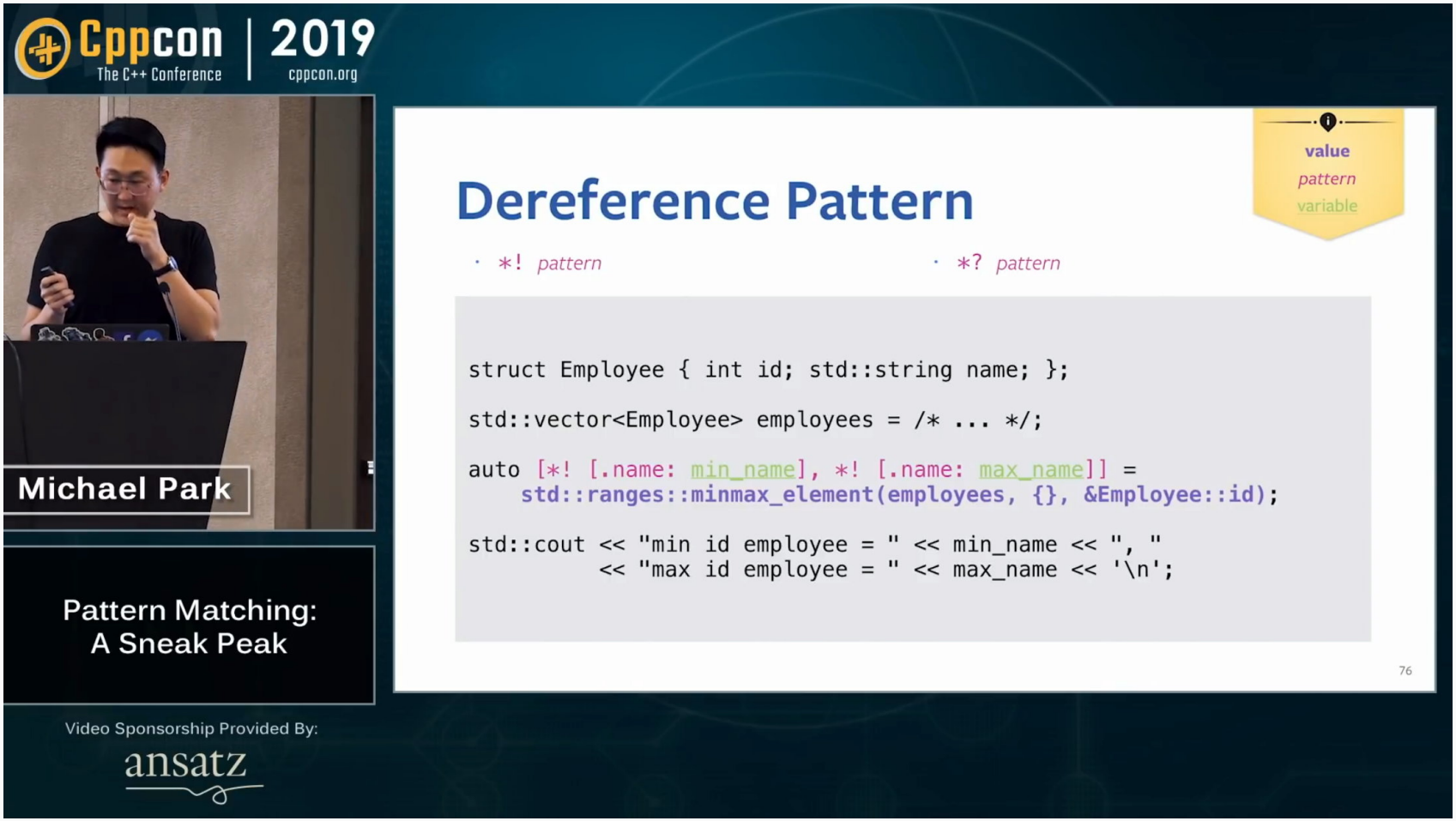
Dereference Pattern
value
pattern
variable
· *! pattern
· *? pattern
auto v = { 3, 9, 1, 4, 2, 5, 9 };
auto [*! min, *! max] = std::ranges::minmax_element(v);
std::cout << "min = " << min << ", max = " << max << '\n';
75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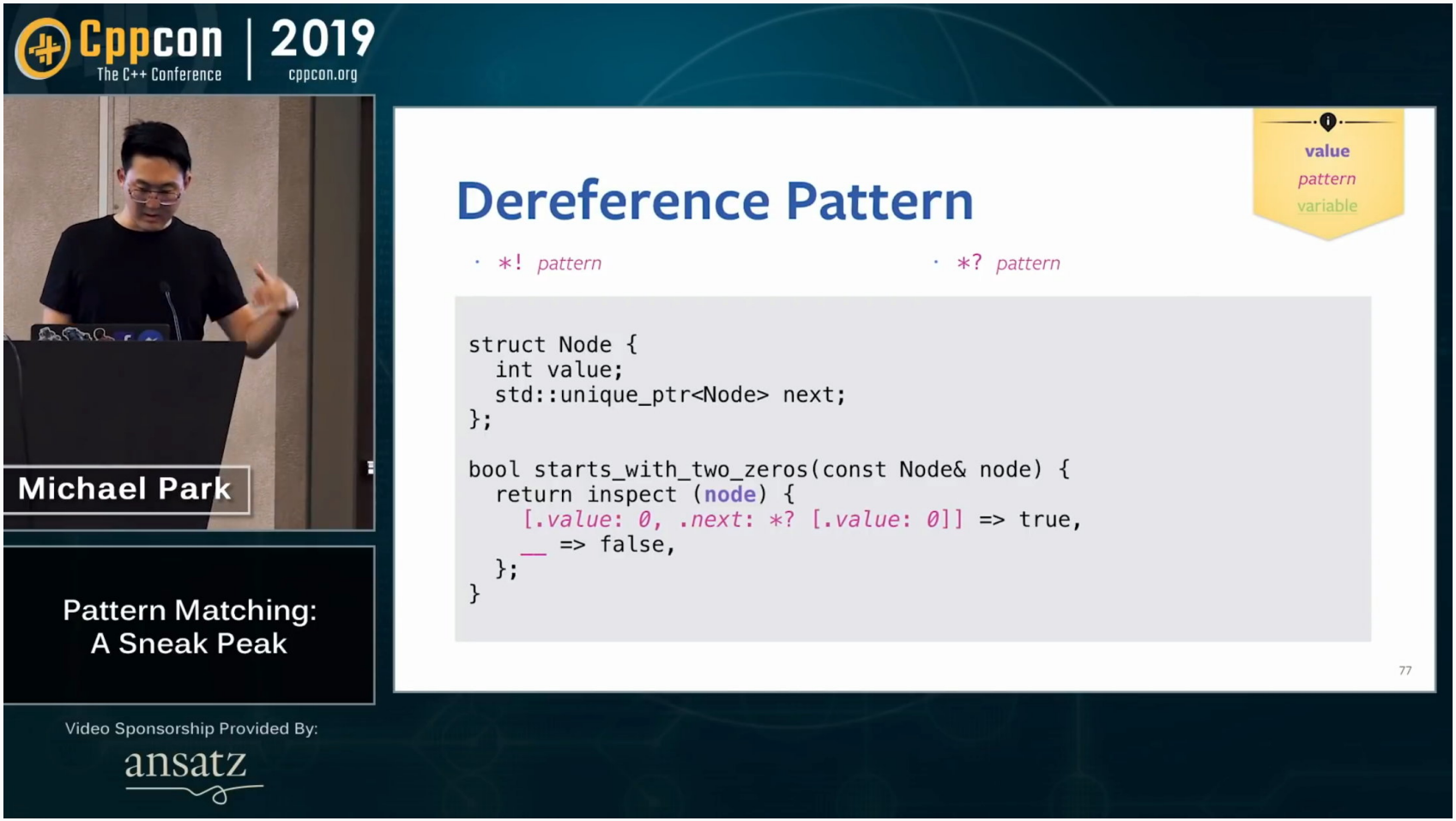
Dereference Pattern
value
pattern
variable
· *! pattern
· *? pattern
struct Employee { int id; std::string name; };
std::vector<Employee> employees = /* ... */;
auto [*! [.name: min_name], *! [.name: max_name]] =
std::ranges::minmax_element(employees, {}, &Employee::id);
std::cout << "min id employee = " << min_name << ", "
<< "max id employee = " << max_name << '\n';
76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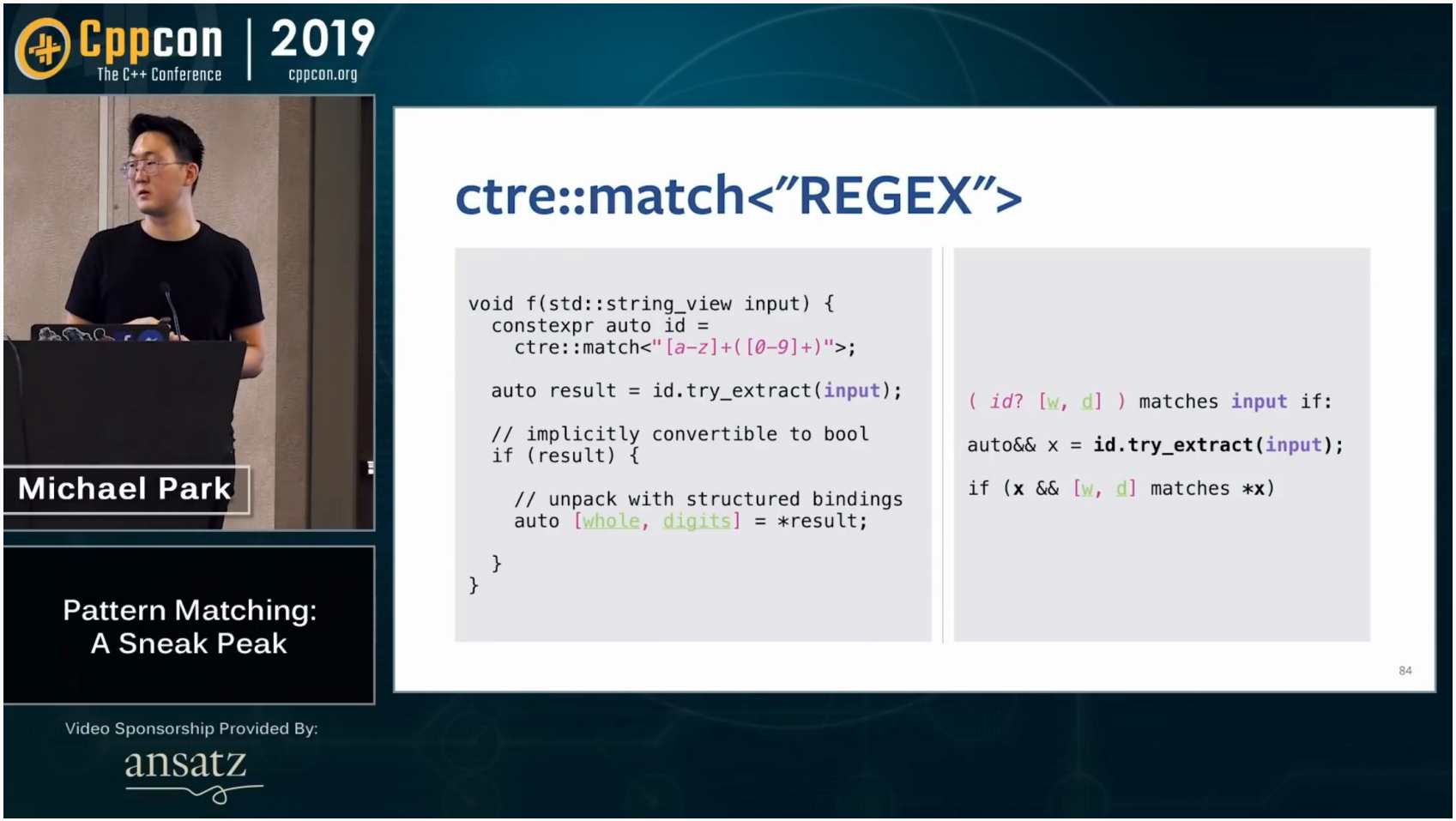
Dereference Pattern
value
pattern
variable
· *! pattern
· *? pattern
struct Node {
int value;
std::unique_ptr<Node> next;
};
bool starts_with_two_zeros(const Node& node) {
return inspect (node) {
[.value: 0, .next: *? [.value: 0]] => true,
__ => false,
};
}
77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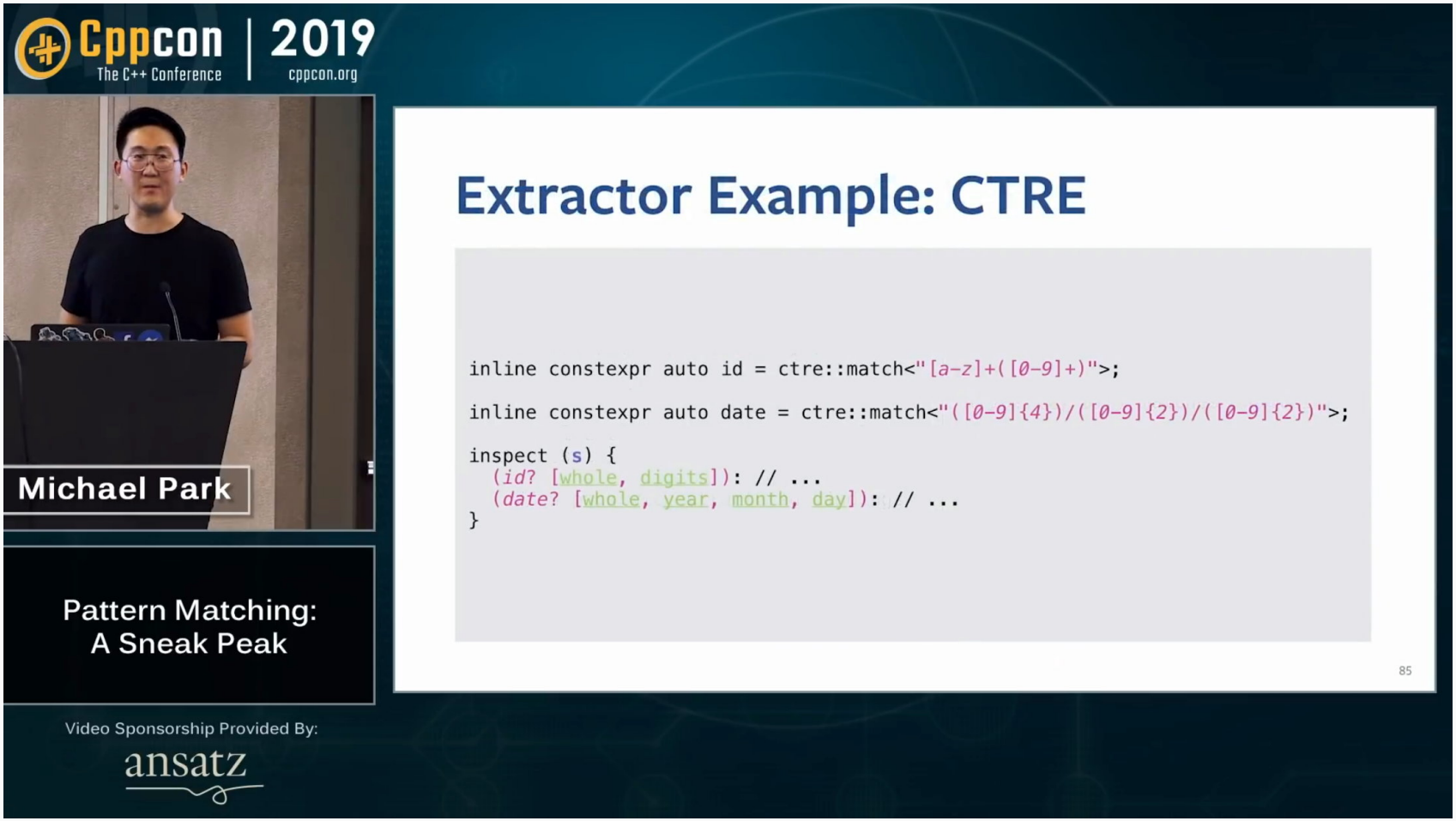
ctre::match<"REGEX">
void f(std::string_view input) {
constexpr auto id =
ctre::match<"[a-z]+([0-9]+)">;
auto result = id.try_extract(input);
// implicitly convertible to bool
if (result) {
// unpack with structured bindings
auto [whole, digits] = *result;
}
}
(id? [w, d]) matches input if:
auto&& x = id.try_extract(input);
if (x && [w, d] matches *x)
84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Extractor Example: CTRE
inline constexpr auto id = ctre::match<"[a-z]+([0-9]+)">;
inline constexpr auto date = ctre::match<"([0-9]{4})/([0-9]{2})/([0-9]{2})">;
inspect (s) {
(id? [whole, digits]): // ...
(date? [whole, year, month, day]): // ...
}
85

Lucid C++ index

Lingo 0.1.0: Text encoding for modern C++

- GitHub: C++11, MIT
- Reddit

Argumentum

> *Argumentum is a C++17 library for writing command-line program interfaces, inspired by Python argparse*

- GitHub: C++17, MPL
- Reddit

Book: C++ Move Semantics - The Complete Guide, by Nicolai Josuttis

- Website

> *Move semantics, introduced with C++11, has become a hallmark of modern C++ programming. However, it also complicates the language in many ways. Even after several years of support of move semantics experienced programmers struggle with all the details of move semantics. And style guides still don't recommend the right consequences for programming even of trivial classes.*

- Reddit

> *Happy there is a book. Not happy this requires a book.*

Twitter: Testing Boeing 777

My first exposure to this was a story told to me by Gail Murphy, then my professor in a third-year software engineering course, about the production of the Boeing 787's predecessor, the 777. The 777 was Boeing's first "fly-by-wire" plane. In other words, the software had to work, as it was purely software that was controlling the flaps and rudder and preventing the plane from falling out of the sky. Gail recounted that, due to the criticality of the software, Boeing decided to put all the heads of software engineering on the test flight. During the test flight, the plane started shaking, and the software engineers were able to implement a midflight fix via the turbulence control software.[13] I have yet to find a better example of an organization putting software leaders' skin in the game of high-stakes product development.

The depth of Boeing's understanding of the business implications of