

Lambdas

Chapter 2 Conditionally Safe Features

Note that a variable named in a lambda capture isn’t automatically *captured*. A variable is captured only if it is ODR-used within the lambda expression:

```
#include <algorithm> // std::min

void f9()
{
    int a = 0; // a is not a compile-time constant.
    const int b = 2; // b is a compile-time constant.

    auto c1 = [&]{ return 2 * a; }; // a is ODR-used; implicitly captured.
    auto c2 = [&]{ return sizeof(a); }; // a is not ODR-used; not captured.
    auto c3 = [&]{ return 2 * b; }; // b is not ODR-used; not captured.
    auto c4 = [&]{ return &b; }; // b is ODR-used; implicitly captured.
    auto c5 = [&]{ std::min(b, 5); }; // b is ODR-used; implicitly captured.
}
```

In the above example, the lambda body for `c1` ODR-uses `a` by reading its value and thus captures `a`. Conversely, `c2` does *not* capture `a` despite its name being used in the lambda body because it is only used in the unevaluated operand of the `sizeof` operator, which does not constitute the variable’s ODR-use. Similarly, `c3` does *not* capture `b` because (1) `b` is a compile-time constant and (2) `c3` only uses `b`’s value, which also does not constitute ODR-use of `b` (see Section 2.1. “`constexpr` Variables” on page 302). Finally, taking the address of or binding a reference to a variable *always* constitutes the variable’s ODR-use; hence, both `c4`, which directly takes the address of `b`, and `c5`, which passes `b` by `const&` to `std::min`, capture `b`.

Finally, a lambda capture within a **variadic function template** (see Section 2.1. “Variadic Templates” on page 873) may contain a **pack expansion**:

```
#include <utility> // std::forward

template <typename... ArgTypes>
int f10(const char* s, ArgTypes&&... args);

template <typename... ArgTypes>
int f11(ArgTypes&&... args)
{
    const char* s = "Introduction";
    auto c1 = [=]{ return f9(s, args...); }; // OK, args... captured by copy
    auto c2 = [s,&args...]{ return f9(s, std::forward<ArgTypes>(args)...); };
    // OK, explicit capture of args... by reference
}
```

In the example above, the variadic arguments to `f11` are *implicitly captured* using capture by copy in the first lambda expression. Capturing by copy means that, regardless of the **value category** (*rvalue*, *lvalue*, and so on) of the original arguments, the captured variables are all *lvalue* members of the resulting *closure*. Conversely, the second lambda expression captures