Introduction to C++

Fundamental Principles and Building Blocks for Experienced Programmers

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Preface

This talk...

- ...expects that you have seen C++ code before, but have not necessarily developed in C++ before.
- ...is intended for experienced (but not expert) programmers in some language. It will tend away from covering basic syntax, logic, and control statements.
- ...will occasionally use Python as a reference for comparison, but you don't need to understand Python to get the main points.
- ...is based on modern C++ techniques and best practices. C++ has been widely used for over 20 years. You will find plenty of C++ code and training resources that do not adhere to these practices.

Today's Topics

1. Types
2. Objects and Lifetimes
3. Mythbusting

Types

Types

C++ typing is strong and static.

- **Strong** - Types are checked for compatibility in assignment and use.
- **Static** - Expressions and variables cannot change type at runtime.

Types

For comparison,
Python typing is strong and dynamic.

See: Duck Typing

Types

Every named entity in C++ has a type

Example

```
int a = 10;
 ^

double sum(list<double>& numbers);
  ^         ^     ^
```

Types

Tips about types:

- Types should enforce semantically meaningful code.
- Type names should be very clear for human readers.
- Consider making types even without unique behavior.

Example

```
using Location3D = std::array<double,3>;
using OrientationRPY = std::array<double,3>;
```

auto

Sometimes, being overly explicit with type names can leave code hard to read.

Example

```
MyVeryLongTypeName a = createMyVeryLongTypeName(...
```

auto

The **auto** keyword

- Introduced in C++11
- Asks the compiler to infer types
- Does **NOT** suddenly make C++ dynamically typed
- Types must be known (if only to the compiler) at compile time

Example

```
MyVeryLongTypeName a = createMyVeryLongTypeName(...
auto b = createMyVeryLongTypeName(...);
auto c; // Does not compile! No type info.
```

auto

auto shows up in a lot of code because it can clean up redundant type specifications from the human reader's point of view while still explicitly conveying type information to the compiler.

Example

```
std::vector<int> numbers = ...

for(std::vector<int>::iterator iter = numbers.begin
    iter != numbers.end();
    iter++)
{ ... }

for(auto iter = numbers.begin();
    iter != numbers.end();
    iter++)
{ ... }
```

Templates

Sometimes, we genuinely don't know the type of an object when we **write** our code.

However, the compiler will know all of the types when we **compile** our code.

Templates

Templated entities...

- Use a placeholder type to be filled at compile time.
- Are duplicated for each unique set of template parameters used.
- Cannot be extended with new instantiations at runtime.

Example

```
template<typename T>
T add(const T& a, const T& b) {
        return a + b;
}
```

Templates

Example

```
template<typename T>
T add(const T& a, const T& b) {
        return a + b;
}

auto a = 10;
auto b = 5;
auto c = 7.0;

add<int>(a,b); // OK, a & b are both int's
add<int>(a,c); // OK, c is cast to int
add<>(a,b); // OK, a & b are both int's
add<>(a,c); // BAD, int or double?
```

Example: Boost.Units

- Types facilitate semantic operations
- Boost.Units is a library for dimensional analysis

Example

```
auto distance = 30.0 * meter;
auto elapsed = 10.0 * second;
std::cout << (distance / elapsed) << "\n";
// Output: 3 m s^-1
```

http://www.boost.org/doc/libs/1_65_0/doc/html/boost_units/Quick_Start.html

Types Recap

- Types facilitate semantically meaningful code.
- Types are enforced at compile time.
- **auto** allows us to have clean code without losing types.
- Templates allow us to share code and behavior across types.

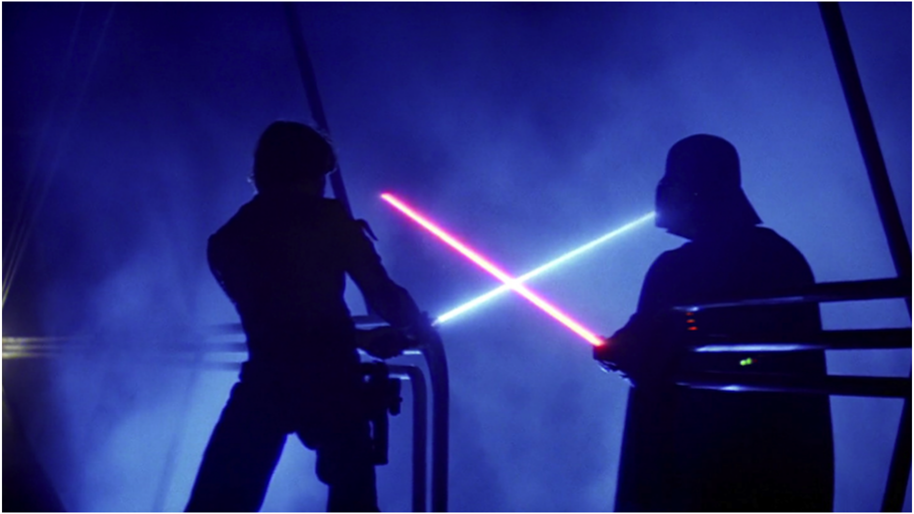
Objects and Lifetimes

Why C++?

Why C++?

Deterministic Object Lifetimes

A brief tangent about lightsabers...



Lifetimes

finish reading
`https://akrzemi1.wordpress.com/2013/07/18/cs-best-feature/`

Mythbusting