Evaluation Order in C++17

Now let's try and understand evaluation order in C++ 17!

WE'LL COVER THE FOLLOWING

The example case

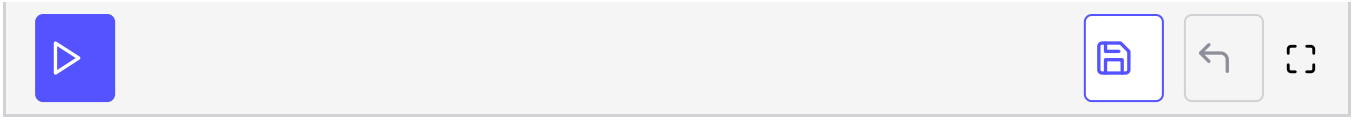
```
#include <iostream>

class Query
{
  public:
    Query& addInt(int i)
    {
      std::cout << "addInt: " << i << '\n';
      return *this;
    }
    Query& addFloat(float f)
    {
      std::cout << "addFloat: " << f << '\n';
      return *this;
    }
};

float computeFloat()
{
  std::cout << "computing float... \n";
  return 10.1f;
}

float computeInt()
{
  std::cout << "computing int... \n";
  return 8;
}

int main()
{
  Query q;
  q.addFloat(computeFloat()).addInt(computeInt());
}
```



You probably expect that using C++14 `computeInt()` happens after `addFloat`. Unfortunately, that might not be the case. For instance here's an output from GCC 4.7.3:

```
computing int...
computing float...
addFloat: 10.1
addInt: 8
```

The chaining of functions is already specified to work from left to right (thus `addInt()` happens after `addFloat()`), but the order of evaluation of the inner expressions can differ. To be precise:

> The expressions are indeterminately sequenced with respect to each other.

With C++17, function chaining will work as expected when they contain inner expressions, i.e., they are evaluated from left to right: In the expression:

```
a(expA).b(expB).c(expC)
```

`expA` is evaluated before calling `b()`.

Compiling the previous example with a conformant C++17 compiler, yields the following result:

```
    computing float...
    addFloat: 10.1
    computing int...
    addInt: 8
```

What about Operator Overloading?

Another result of this change is that when using operator overloading, the order of evaluation is determined by the order associated with the corresponding built-in operator.

For example:

For example:

```
std::cout << a() << b() << c();
```

The above code contains operator overloading and expands to the following function notation:

```
operator<<(operator<<(operator<<(std::cout, a()), b()), c());
```

Before C++17, `a()`, `b()` and `c()` could be evaluated in any order. Now, in C++17, `a()` will be evaluated first, then `b()` and then `c()`.

Here are more rules described in the paper P0145R3:

The following expressions are evaluated in the order a, then b:

- 1. `a.b`
- 2. `a->b`
- 3. `a->*b`
- 4. `a(b1, b2, b3) // b1, b2, b3 - in any order`
- 5. `b @= a // '@' means any operator`
- 6. `a[b]`
- 7. `a << b`
- 8. `a >> b`

If you're not sure how your code might be evaluated, then it's better to make it simple and split it into several clear statements. You can find some guides in the Core C++ Guidelines, for example ES.44 and ES.44.

> *Extra Info:* The change was proposed in: P0145R3.

Now that you've understood evaluation order let's take a look at the concept of Copy Elision in the next lesson.