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To ensure that the compiler is allowed to even auto-vectorize your code, be sure that:

1. You are building in release mode (i.e. at least optimisation level `-O3`)
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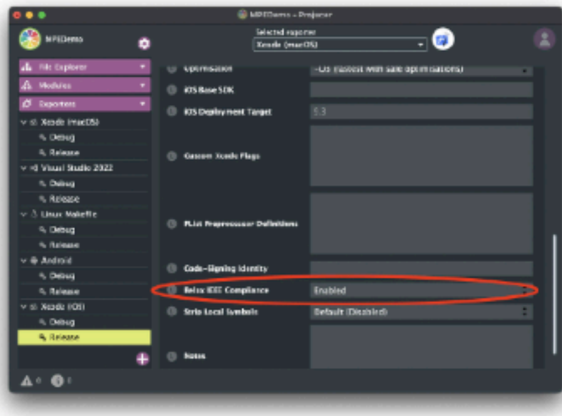

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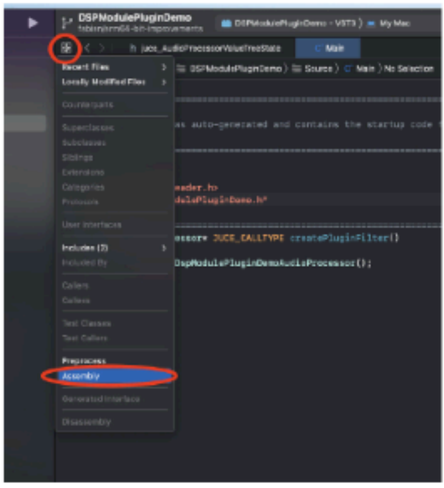

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What you will often see, is that the compiler will generate two versions of your code: one uses SIMD and the other doesn't. This is because the compiler does not know if your audio buffer pointers are SIMD-aligned. Hence, the compiler creates a non-SIMD "pre-amble" until the buffer pointers are SIMD-aligned, the core of the algorithm (which uses SIMD) and then a non-SIMD epilogue to finish up any remaining elements that didn't fit into a full SIMD register.

If your loop involves multiple buffer pointers then, depending on your exact algorithm, the compiler may need to create multiple versions of pre-ambles/epilogues (i.e. only the first buffer is SIMD aligned, but the second isn't etc.). If this gets too complicated, the compiler will give up and just do two completely separate versions of your code (one with SIMD and the other without).

To avoid this, you can use C++20's `std::assumed_aligned` (earlier compiler versions may have `__builtin_assume_aligned`) to tell the compiler that you know that the buffer pointers will be SIMD aligned. This is recommended even for simple loops as it will avoid at least one conditional (to check for alignment) and it has the extra benefit of reducing your code-size by getting rid of the pre-ambles/epilogues.

As mentioned, the compiler is pretty good at auto-vectorizing even moderately complex loops. However, here are a few examples, where I have seen the compiler fail at auto-vectorizing:

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   This means, however, that certain transformations are off-limits to the compiler - for example, heap memory allocations - as requiring to allocate memory is a different outcome of your program than not allocating memory.

   For example, a compiler is not allowed to *auto-vectorize* a direct convolution. This is because, as you move through your array, most of the time, the kernel and the array will not be SIMD aligned with respect to each other. However, by storing N copies of your kernel (where N is the number of elements in a SIMD vector) with each copy being shifted by one element, you can now always find a kernel that is SIMD aligned with your input vector. However, even a hypothetical god compiler would not be allowed to do this transformation as the compiler would need to allocate memory for the extra copies of your kernel. Here, you would need to program the convolution by hand using `SIMDRegister`.
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2 Replies 12 Reply

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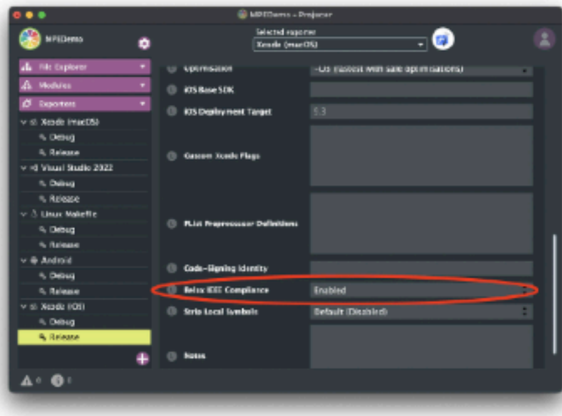

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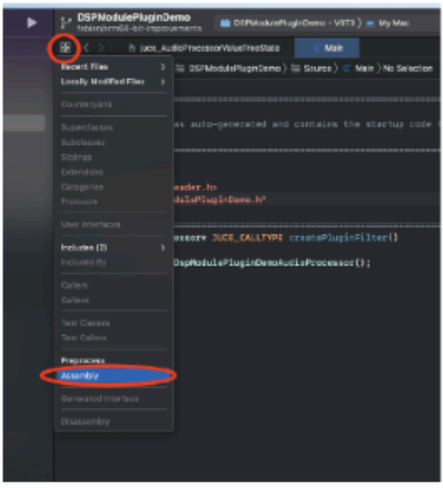

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```cpp
#include <iostream>
#include <numeric>
#include <cmath>

int main()
{
  double a = std::numeric_limits<double>::infinity();

  if (std::isinf(a))
    std::cout << "Inf detected.\n";
  else
    std::cout << "Inf NOT detected.\n";

  if (std::isfinite(a))
    std::cout << "Is finite.\n";
  else
    std::cout << "Is NOT finite.\n";

  return 0;
}
```

https://godbolt.org/z/Y56o6ffE4