New features in Intel C/C++ Compiler 16.0 Beta

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Agenda

Compile time improvements

SSE operators

Honoring Parenthesis

Current state of C++14 and C11 support (15.0)

C++14 and C11 support (16.0 beta)

Feature macros

Comparison to GNU/Microsoft

Future plans and C/C++ standard features

Q & A

Compile Time Improvements

Intrinsic headers provided by Intel

emmintrin.h, immintrin.h, etc.

Prototypes are now automatically disabled in headers, i.e.:

```
extern __m128  _mm_shuffle_ps(__m128, __m128,unsigned int);
extern __m128  _mm_unpackhi_ps(__m128, __m128);
```

Use –D__INTEL_COMPILER_USE_INTRINSIC_PROTOTYPES to restore old behaviour (enhanced type checking)

SIMD Operator Support

Using operators with the SSE integer types will now work

- These operators now supported: + - * / & | ^ += -= *= /= &= |= ^= == != > < >= <=
- Example:
  - `__m128i x,y,z;`
  - `X = y + z;`

Restrictions:

- Only supports 128 and 256 bit SIMD types
- Only supports the two operand operators listed above
- The operands must have the same type (i.e. Our SSE types cannot be combinable with GNU types declared with vector_size attribute)

Honoring Parentheses

Some Intel floating point optimizations (like –fp-model fast) do not require parentheses to be honored in real and complex expressions, i.e.

```
double a , b =1;
a = (1 + b) + 3;
```

Switch:

-f[no-]protect-parens (Linux) –Qprotect-parens[-] (Windows)

enable/disable(DEFAULT) a reassociation optimization for REAL and COMPLEX expression evaluations by not honoring parenthesis

Current Support (15.0)

Full C++11 support

Very limited C11 support (only binary literals)

Minimal C++14 support (decltype auto, lambda init capture, deduced return types for routines)

Comparison to GNU and Microsoft can be found at:

- https://software.intel.com/en-us/articles/c0x-features-supported-by-intel-c-compiler

C11 Features

_Alignment features (_Alignas, _Alignof)

_Static_assert

_Thread_local keyword

Type generic selections (_Generic)

```
#define  pow(X) _Generic((X), long double: powl, \
                default: pow, \
                float: powf)(X)
```

Noreturning functions (_Noreturn)

Unicode strings

C11 anonymous unions

_Atomic keyword*** NOT IN 16.0 (used in stdatomic.h)

C++14 Features in 16.0

Generic Lambdas

- auto glambda = [] (auto a) { return a; };

Generalized lambda captures

```
int x = 4;
int z = [&r = x, y = x+1] {
        r += 2; // set x to 6; "R is for Renamed Ref"
        return y+2; // return 7 to initialize z
    }(); // invoke lambda
```

Digit Separators

- auto million = 1’000’000;

C++14 Features in 16.0

The [[deprecated]] attribute

```
[[deprecated]] void foo() {;}  // warning on call to foo()
```

Function return type deduction, i.e.:

```
auto foo(int i) {
     if (i ==1) return i;
     else return foo(i-1)+i;
}
```

C++14 features not yet implemented in 16.0

Relaxed constexpr restrictions, i.e.:

- Local variable declarations (except for static or __thread_local)
- if, switch, for, while, do-while statements (not goto)
- constexpr member functions are not implicitly const

Variable templates, i.e.:

- template<typename T>
- constexpr T pi = T(3.14159265358979323385);
- template<class T> T area_of_circle_with_radius(T r) { return pi<T> * r * r; }

Feature Test Macros

Testing for existence of header files:

```
#if __has_include("shared_mutex")  // use standard header
#elif __has_include("boost/shared_mutex.h") // use BOOST header
#endif
```

Testing for existence of compiler features:

```
#ifndef __cpp_constexpr
// no constexpr functionality available
#elif __cpp_constexpr == 200704
// c++11 constexpr functionality available
#else
// c++14 relaxed constexpr functionality available
#endif
```

GNU Compatibility

To enable c11 or c++14 support you need to use –std=c11 or –std=c++14 switch

We currently support all C++14 features used in the GNU 5.0 versions of the headers enabled when you use the switch and all c11 features except _Atomic which is used in <stdatomic.h>

Depending upon the GNU on your system (i.e. g++ in your PATH) you may get different features enabled

Microsoft Compatibility

Microsoft has been slower than GNU in implementing new C++11, C++14, and C11 features although MSVC++ 2015 has added many of them.

- Still missing are C++11 standard attributes, char16_t and char32_t, full constexpr, unicode string literals, expression SFINAE, and most of the C++14 features

No special command line switch to access C11 or C++11 or C++14 functionality

Intel® C++ compiler is compatible by default

- Whatever features are provided by the reference Microsoft compiler are available with Intel Windows* compiler

To get additional C++14 functionality with our compiler use Intel-specific /Qstd=c++11 or /Qstd=c++14 or /Qstd=c11 switches

Intel C++ Compiler is fully compatible with the Microsoft Visual C++ 2015 with respect to C++14 and C11 functionality

Future C++ Features (C++17 & beyond)

resumable/await

Terse range-based for loop

Nested namespaces

Removal of trigraphs

Addition of a default text message for static_assert

Attributes for namespaces and enumerators

UTF-8 character literals

Constant evaluation for all non-type template arguments

C++ Technical Reports in Progress

Concepts

File System Utilities

Networking Utilities

Library Fundamentals

Array Extensions

Extensions for Parallelism

Extensions for Concurrency

Transactional Memory

References

C++14 FDIS

http://www.open-std.org/JTC1/SC22/WG21/docs/papers/2013/n3690.pdf

Individual papers

http://www.open-std.org/JTC1/SC22/WG21/docs/papers/

Technical Report on Feature Macros:

https://isocpp.org/std/standing-documents/sd-6-sg10-feature-test-recommendations

C++ FAQ

http://www.stroustrup.com/bs_faq.html

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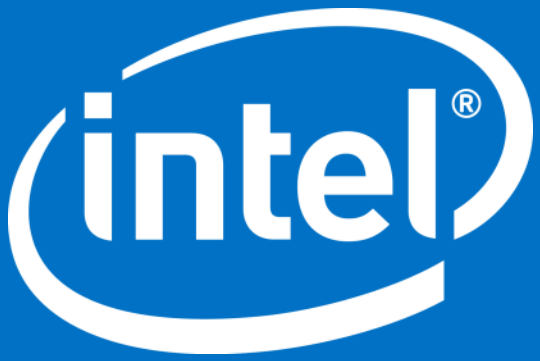
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