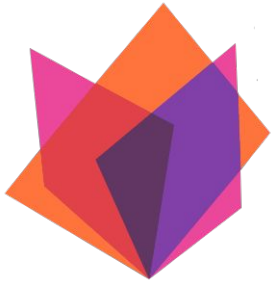
OpenMP

SC'20 Booth Talk Series



#pragma omp [begin] assume[s]

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`#pragma omp [begin] assume[s]`

Or, how to talk to your compiler(s).

Motivation

How to convey information to the compiler beyond types?

Compilers have non-portable “built-in assumes”:

MSVC: `__assume(<expression>)`

GCC: `__builtin_assume_aligned(<expression>, <alignment>, …)`

Clang: `__builtin_assume_aligned(<expression>, <alignment>, …)`
`__builtin_assume(<expression>)`

The OpenMP `assume` directive [OpenMP 5.1]

Different “kinds” of properties can be expressed:

1) Provide a portable low-level “built-in assume”:

```
#pragma omp assume holds(<expression>)
```

2) Provide high-level “assumptions” for better code generation:

```
#pragma omp assume no_openmp absent(<directive>) ...
```

3) Provide a portable hook for extensions:

```
#pragma omp assume ext_IMPLEMENTATION_DEFINED
```

The OpenMP `assume` directive [OpenMP 5.1]

Several forms/spelling, always affects code transitively:

1) Global scope, affect “everything”:

```
#pragma omp assumes <clause>
```

2) Begin-end range scope for declarations:

```
#pragma omp begin assumes <clause>
#pragma omp end assumes
```

3) Structured-block scope inside functions:

```
#pragma omp assume <clause>
<structured-block>
```

Use Cases [1/3]

```
for (int i = 0; i < N; ++i) {
   A[i] += B[i];
}
```

Use Cases [1/3]

```
// To indicate vectorization is legal
#pragma omp simd
for (int i = 0; i < N; ++i) {
   A[i] += B[i];
}
```

Use Cases [1/3]

```
// To indicate no remainder loop is necessary (for VF=8)
#pragma omp assume holds(N % 8 == 0 && N > 0)

// To indicate vectorization is legal
#pragma omp simd
for (int i = 0; i < N; ++i) {
   A[i] += B[i];
}
```

Use Cases [2/3] [implementation specific]

```
#pragma omp target teams
{
  // some C++ code with function calls that “could” throw.
}
```

Use Cases [2/3] [implementation specific]

```
// Tell the compiler the C++ code on the target will not
// throw exceptions. No need to proof it, it can be assumed.
// Will not affect host compilation (unlike -fno-exceptions).
#pragma omp assumes ext_target_no_exceptions

#pragma omp target teams
{
  // some C++ code with function calls that “could” throw.
}
```

NOTE: This is an illustrative example and not implemented (yet).

Use Cases [3/3]

[implementation specific]

```
#pragma omp target teams
foo();
```

Use Cases [3/3]

[implementation specific]

```
#pragma omp target teams
foo();

void foo() {
  #pragma omp parallel for
  { … }
}
```

Use Cases [3/3] [implementation specific]

```
#pragma omp target teams
foo();

void foo() {
  #pragma omp parallel for
  { … }
}
```

```
>> clang -Rpass=openmp -fopenmp -fopenmp-targets=nvptx64 foo.c
foo.c:5:3: Parallel region could be called from external target region,
will not rewrite the state machine use. Employ `static` linkage for `foo`
or add `#pragma omp assume ext_no_external_target_region_caller`.
```

NOTE: This is an illustrative example and not implemented (yet).

LLVM/Clang Implementation

LLVM/Clang will support `assume` in version 12, development branch before already.

Try the `llvm-openmp-advisor` for code analyses and `assume` suggestions.

Visit http://openmp.llvm.org/docs/ for more information, implementation status, extensions, use cases, remarks, ...

Reach out if this sounds interesting and you want to know more or collaborate!

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