

Programming OpenMP

An Overview Of OpenMP

Christian Terboven



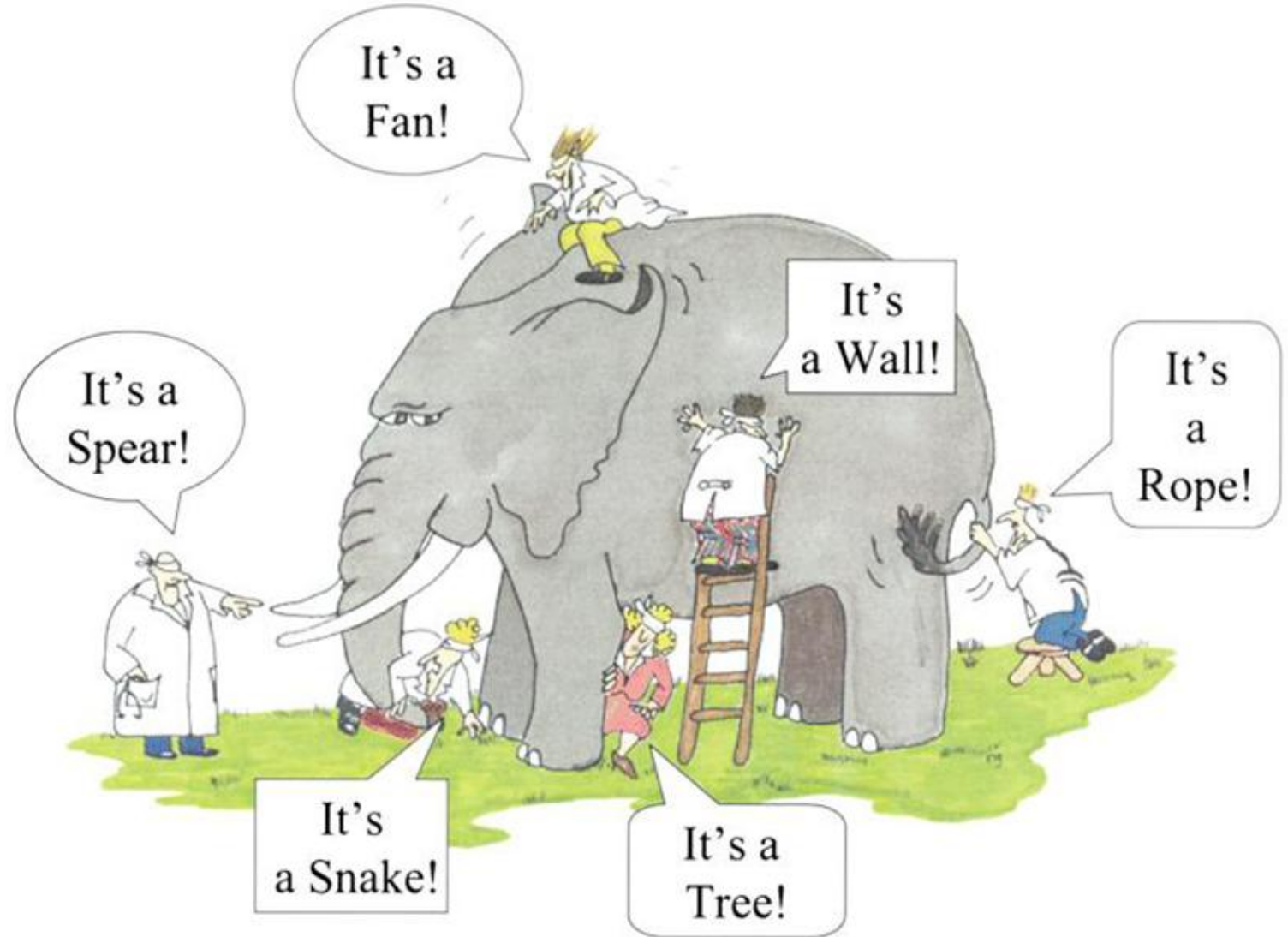
History

- De-facto standard for Shared-Memory Parallelization.
- 1997: OpenMP 1.0 for FORTRAN
- 1998: OpenMP 1.0 for C and C++
- 1999: OpenMP 1.1 for FORTRAN
- 2000: OpenMP 2.0 for FORTRAN
- 2002: OpenMP 2.0 for C and C++
- 2005: OpenMP 2.5 now includes both programming languages.
- 05/2008: OpenMP 3.0
- 07/2011: OpenMP 3.1
- 07/2013: OpenMP 4.0
- 11/2015: OpenMP 4.5



What is OpenMP?

- Parallel Region & Worksharing
- Tasking
- SIMD / Vectorization
- Accelerator Programming
- ...



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Covers all of OpenMP 5.0 / 5.1!

[illegible]

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OpenMP API 5.0

Directives and Constructs (continued)

- schedule:** The decision regarding scheduling is delegated to the compiler and/or runtime system.
- runtime:** The schedule and chunk size are taken from the run-sched-rvc.

master:

- monotonic:** Each thread executes the chunks that it is assigned in increasing logical iteration order. Default for static scheduling.
- nonmonotonic:** Chunks are assigned to threads in any order and the behavior of an application that depends on execution order of the chunks is unspecified. Default for all schedule kinds except static.

simd:

- simd:** Ignored when the loop is not associated with a SIMD construct, otherwise the `new_chunk_size` or `old_chunk_size` and `width` `1` `simd_width` where `simd_width` is an implementation defined value.

SIMD Directives

Simd (2.8.3.1) [2.8.3]

Applied to a loop to indicate that the loop can be transformed into a SIMD loop.

```
#pragma omp simd [clause] [ : [clause]... ]
for-loops
```

```
simd [clause] [ : [clause]... ]
do-loops
```

```
simd [clause] [ : [clause]... ]
forall-loops
```

```
simd [clause] [ : [clause]... ]
forall-loops
```

```
simd [clause] [ : [clause]... ]
forall-loops
```

```
simd [clause] [ : [clause]... ]
forall-loops
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simd [clause] [ : [clause]... ]
forall-loops
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simd [clause] [ : [clause]... ]
forall-loops
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simd [clause] [ : [clause]... ]
forall-loops
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simd [clause] [ : [clause]... ]
forall-loops
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simd [clause] [ : [clause]... ]
forall-loops
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simd [clause] [ : [clause]... ]
forall-loops
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simd [clause] [ : [clause]... ]
forall-loops
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simd [clause] [ : [clause]... ]
forall-loops
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simd [clause] [ : [clause]... ]
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simd [clause] [ : [clause]... ]
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simd [clause] [ : [clause]... ]
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simd [clause] [ : [clause]... ]
forall-loops
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simd [clause] [ : [clause]... ]
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simd [clause] [ : [clause]... ]
forall-loops
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simd [clause] [ : [clause]... ]
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simd [clause] [ : [clause]... ]
forall-loops
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simd [clause] [ : [clause]... ]
forall-loops
```

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simd [clause] [ : [clause]... ]
forall-loops
```

```
simd [clause] [ : [clause]... ]
forall-loops
```

distributed loop constructs

Distributed (2.8.4.1) [2.8.4]

Specifies loops which are executed by the thread teams.

```
#pragma omp distribute [clause] [ : [clause]... ]
for-loops
```

```
distribute [clause] [ : [clause]... ]
do-loops
```

```
distribute [clause] [ : [clause]... ]
forall-loops
```

```
distribute [clause] [ : [clause]... ]
forall-loops
```

```
distribute [clause] [ : [clause]... ]
forall-loops
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distribute [clause] [ : [clause]... ]
forall-loops
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distribute [clause] [ : [clause]... ]
forall-loops
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distribute [clause] [ : [clause]... ]
forall-loops
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distribute [clause] [ : [clause]... ]
forall-loops
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distribute [clause] [ : [clause]... ]
forall-loops
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distribute [clause] [ : [clause]... ]
forall-loops
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distribute [clause] [ : [clause]... ]
forall-loops
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distribute [clause] [ : [clause]... ]
forall-loops
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distribute [clause] [ : [clause]... ]
forall-loops
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distribute [clause] [ : [clause]... ]
forall-loops
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distribute [clause] [ : [clause]... ]
forall-loops
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distribute [clause] [ : [clause]... ]
forall-loops
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distribute [clause] [ : [clause]... ]
forall-loops
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distribute [clause] [ : [clause]... ]
forall-loops
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distribute [clause] [ : [clause]... ]
forall-loops
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forall-loops
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distribute [clause] [ : [clause]... ]
forall-loops
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distribute [clause] [ : [clause]... ]
forall-loops
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distribute [clause] [ : [clause]... ]
forall-loops
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distribute [clause] [ : [clause]... ]
forall-loops
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distribute [clause] [ : [clause]... ]
forall-loops
```

```
distribute [clause] [ : [clause]... ]
forall-loops
```

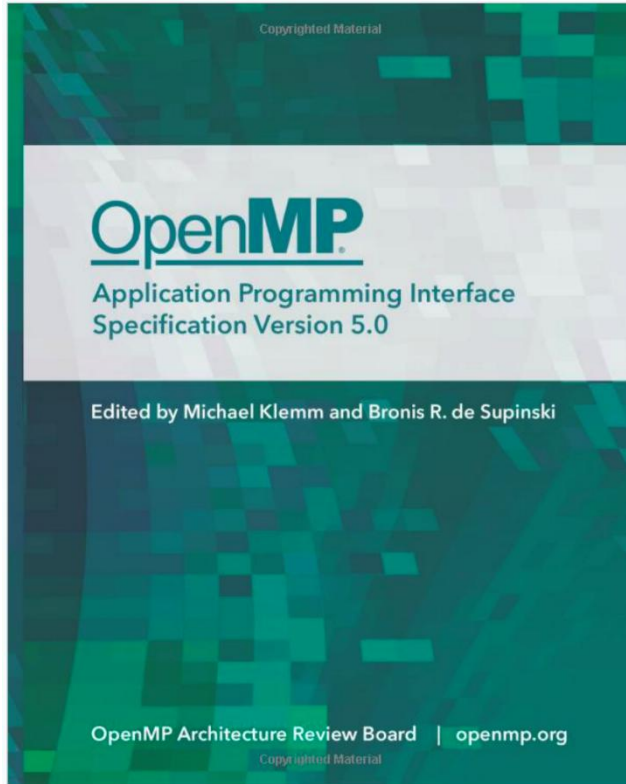
```
distribute [clause] [ : [clause]... ]
forall-loops
```

```
distribute [clause] [ : [clause]... ]
forall-loops
```

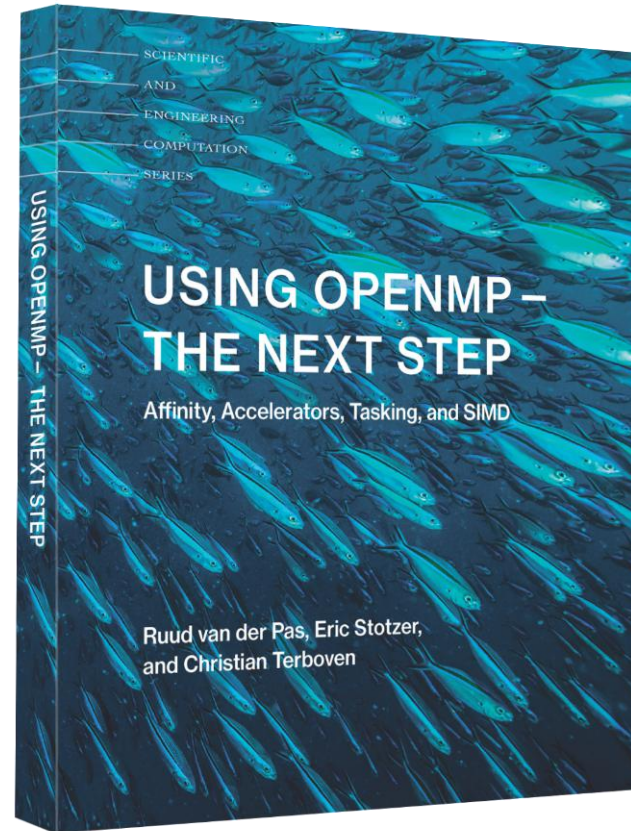
```
distribute [clause] [ : [clause]... ]
forall-loops
```

```
distribute [clause] [ : [clause]... ]
forall-loops
```

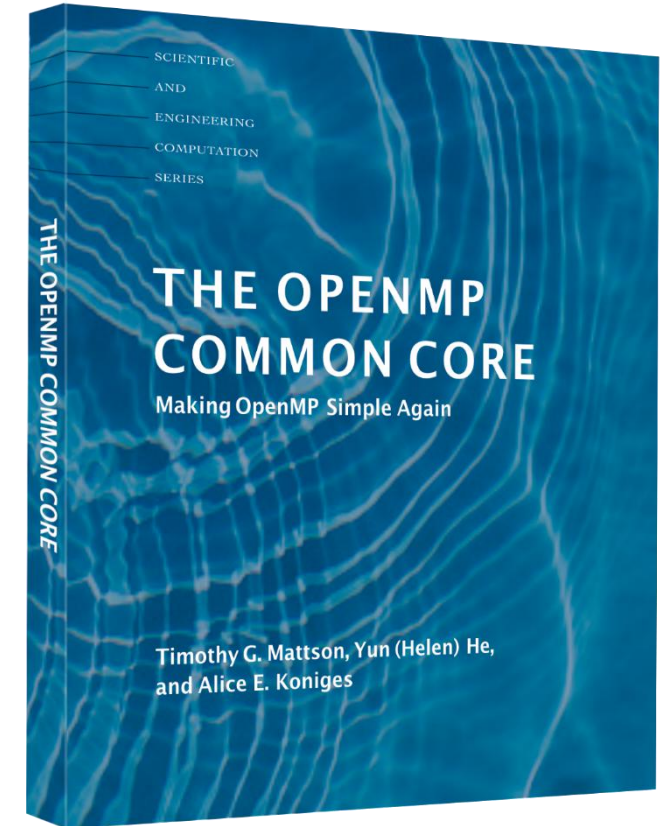

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A printed copy of the 5.0 specifications, 2019



A book that covers all of the OpenMP 4.5 features, 2017



A new book about the OpenMP Common Core, 2019