alpaka Parallel Programming – Online Tutorial

Lecture 10 – The alpaka Programming Model

Lesson 16: Thread Hierarchy

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Lesson 16: Thread Hierarchy

The “magic” Thread index

```
template <typename Acc>
ALPAKA_FN_ACC void operator()(Acc const & acc) const {
    using namespace alpaka;

    uint32_t threadIdx = idx::getIdx<Grid, Threads>(acc)[0];
    printf("Hello, World from alpaka thread %u!\n", threadIdx);
}
```

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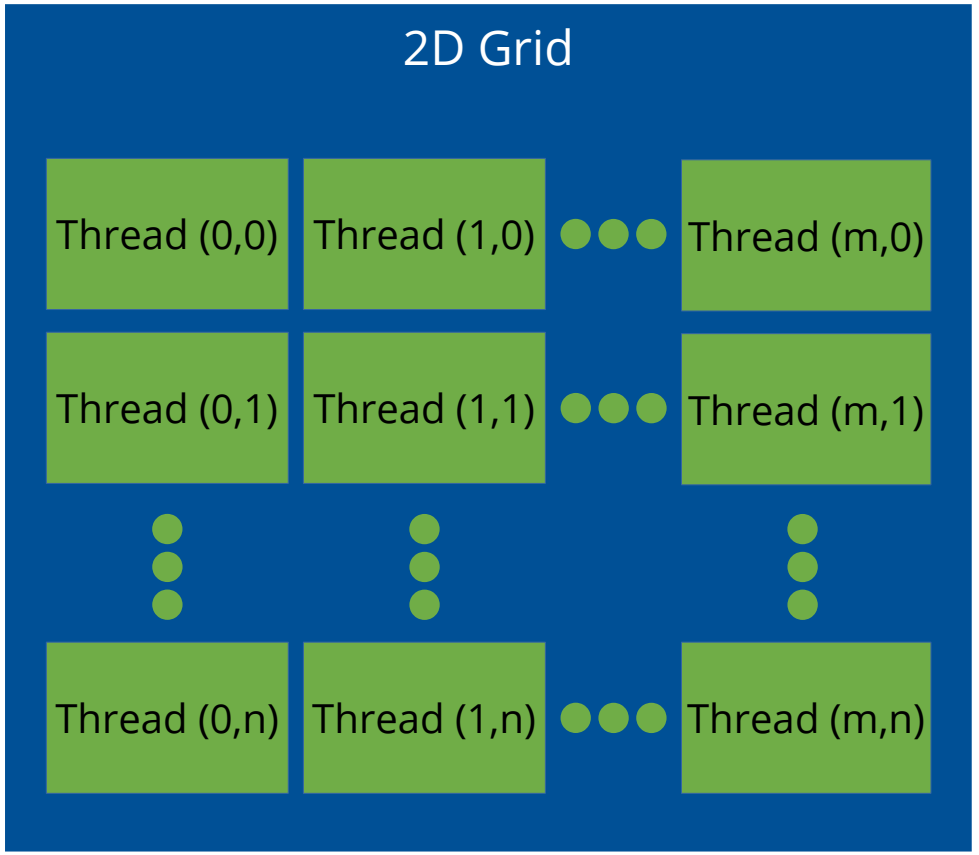
Understanding the index

- Understanding alpaka's Thread indices is the key to understanding alpaka!
- After this lesson, you will understand:
  - How to navigate the grid
  - How to form Thread Blocks (and why)
  - The relations between Threads, Blocks and the Grid
  - How to compute Thread indices yourself

Lesson 16: Thread Hierarchy

Threads and the Grid

- A Grid consists of all Threads executing the same kernel
  → One Grid per Kernel execution
- Threads are distributed along one, two or three dimensions
- Each Thread on the Grid is identified by its unique index (`gridThreadIdx`)
- All Threads have access to (large but high-latency) global memory



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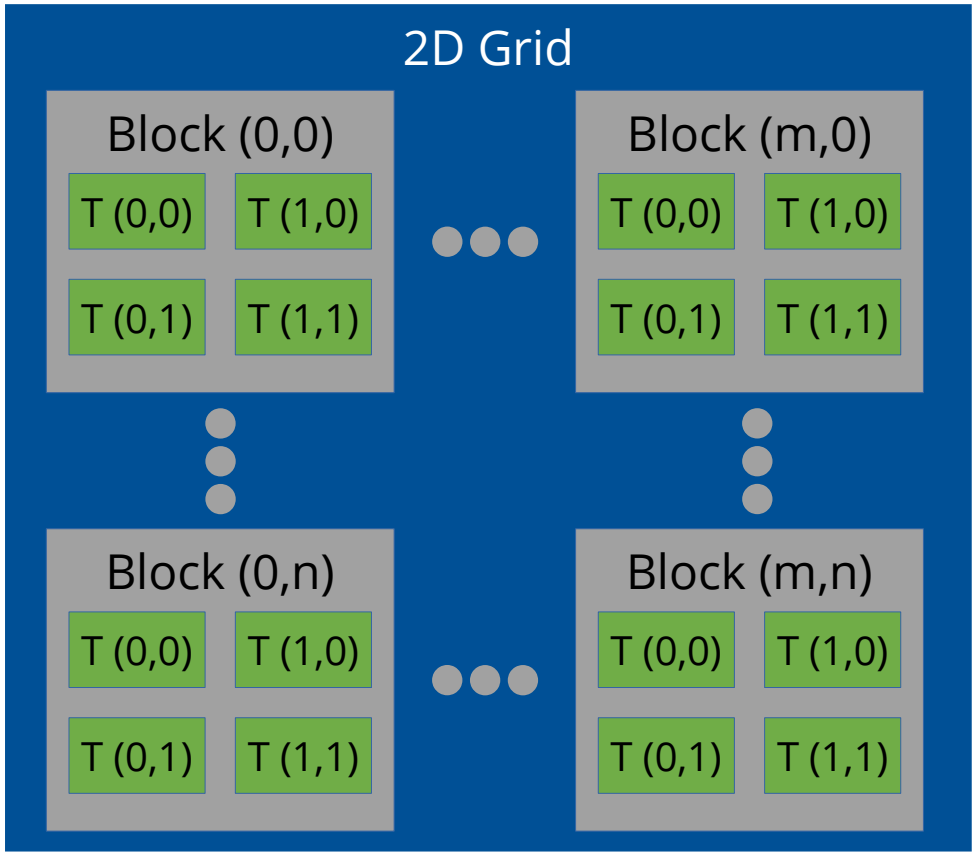
Thread Blocks

- Threads can be grouped into Thread Blocks
- All Blocks on the same Grid have the same size
- Each Block on the Grid is identified by its unique index (`gridBlockIdx`)
- Each Thread inside a Block is identified by its Block-local unique index (`blockThreadIdx`)
- Threads inside a Block have access to (small but low-latency) shared memory
- Threads inside a Block can be synchronized



Lesson 16: Thread Hierarchy

Obtaining the indices

- alpaka provides several API functions for obtaining indices:
  - Index of Thread on the Grid: `idx::getIdx<alpaka::Grid, alpaka::Threads>(acc)[dim];`
  - Index of Thread on a Block: `idx::getIdx<alpaka::Block, alpaka::Threads>(acc)[dim];`
  - Index of Block on the Grid: `idx::getIdx<alpaka::Grid, alpaka::Blocks>(acc)[dim];`
- You can also obtain the extents of the Grid or the Blocks:
  - Number of Threads on the Grid: `workdiv::getWorkDiv<alpaka::Grid, alpaka::Threads>(acc)[dim];`
  - Number of Threads on a Block: `workdiv::getWorkDiv<alpaka::Block, alpaka:Threads>(acc)[dim];`
  - Number of Blocks on the Grid: `workdiv::getWorkDiv<alpaka::Grid, alpaka::Blocks>(acc)[dim];`
- Exercise: compute the index of a Thread on the Grid yourself using a combination of the remaining indices and extents!

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