alpaka Parallel Programming – Online Tutorial

Lecture 10 – The alpaka Programming Model

Lesson 14: alpaka Kernels

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Lesson 14: alpaka Kernels

What is a Kernel?

- Contains the algorithm
- Written on per-data-element basis
- alpaka Kernels are functors (function-like C++ structs / classes)
- `operator()` is annotated with `ALPAKA_FN_ACC` specifier
- `operator()` must return `void`
- `operator()` must be `const`

```
struct HelloWorldKernel {

    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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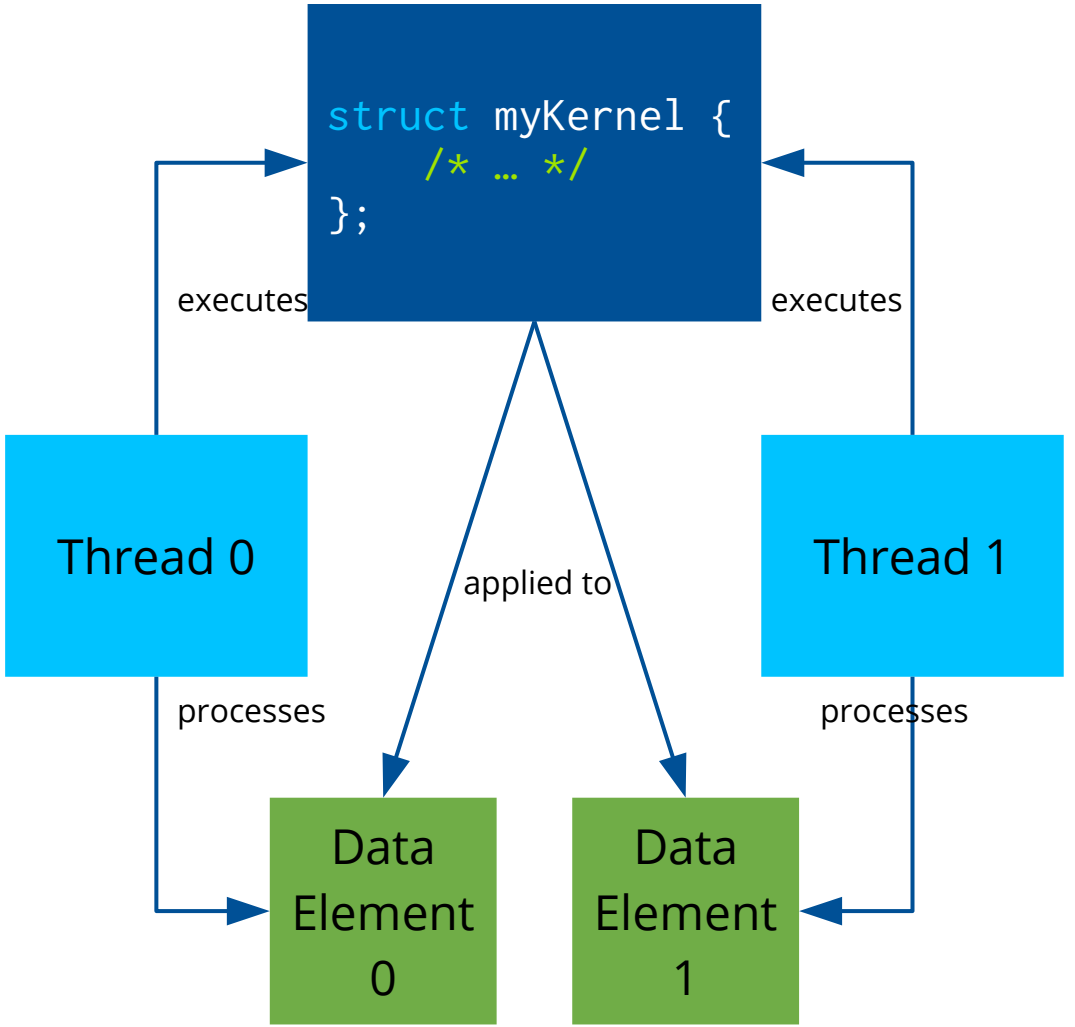
Threads and Kernels

- A Kernel is executed by a number of Threads
- Threads are executing the same algorithm for different data elements

- A Kernel **defines** an algorithm
- A Thread **applies** an algorithm



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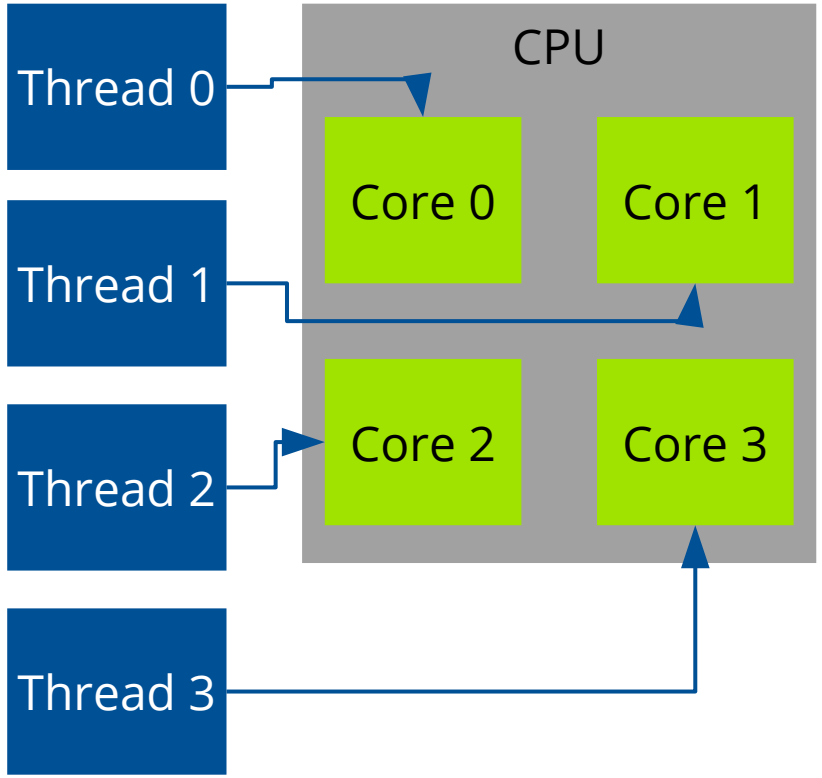
Scheduling

- Threads are mapped to cores
- Many more Threads than cores → Thread scheduling required
- **Thread order is unspecified!**

  → Programmer cannot control the order of data element processing
- Hardware specifics need to be taken into account

Example: Thread mapping on CPUs

- CPU consists of multiple cores
  - Because of simultaneous multithreading there can be more logical than physical cores!
- alpaka Threads are executed by CPU cores



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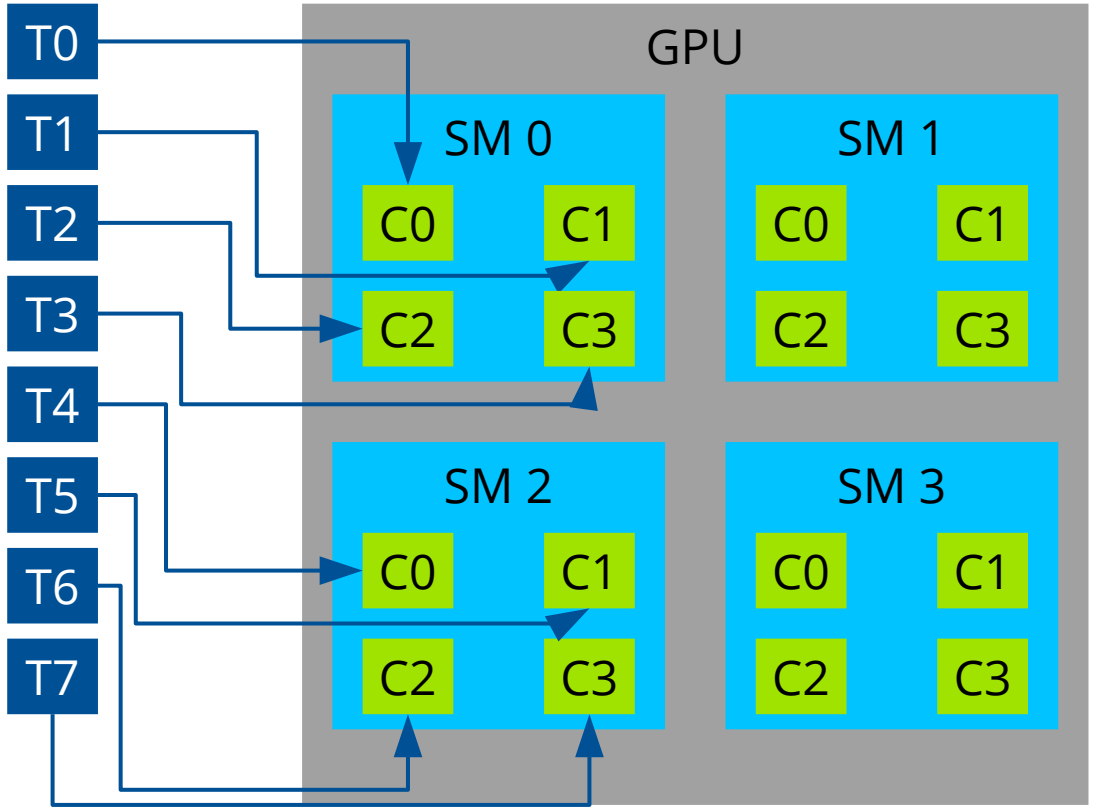
Example: Thread mapping on GPUs

- GPU consists of streaming multiprocessors (SMs)
- Each SM consists of multiple cores
- alpaka Threads are executed by individual SM cores



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