alpaka Parallel Programming – Online Tutorial

Lecture 10 – The alpaka Programming Model

Lesson 13: Handling Parallelism

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Threads and cores

- alpaka Threads are different from pthreads, `std::threads`, OpenMP threads, CUDA threads, etc.
- alpaka Thread: execution of command sequence
- Command sequence: algorithm performed on single data element (Kernel)
- Cores are physical execution units
- Cores are capable of executing alpaka Threads
- Example: AMD Threadripper 3990X with 64 CPU cores
- Example: NVIDIA Tesla V100 with 5,120 CUDA cores

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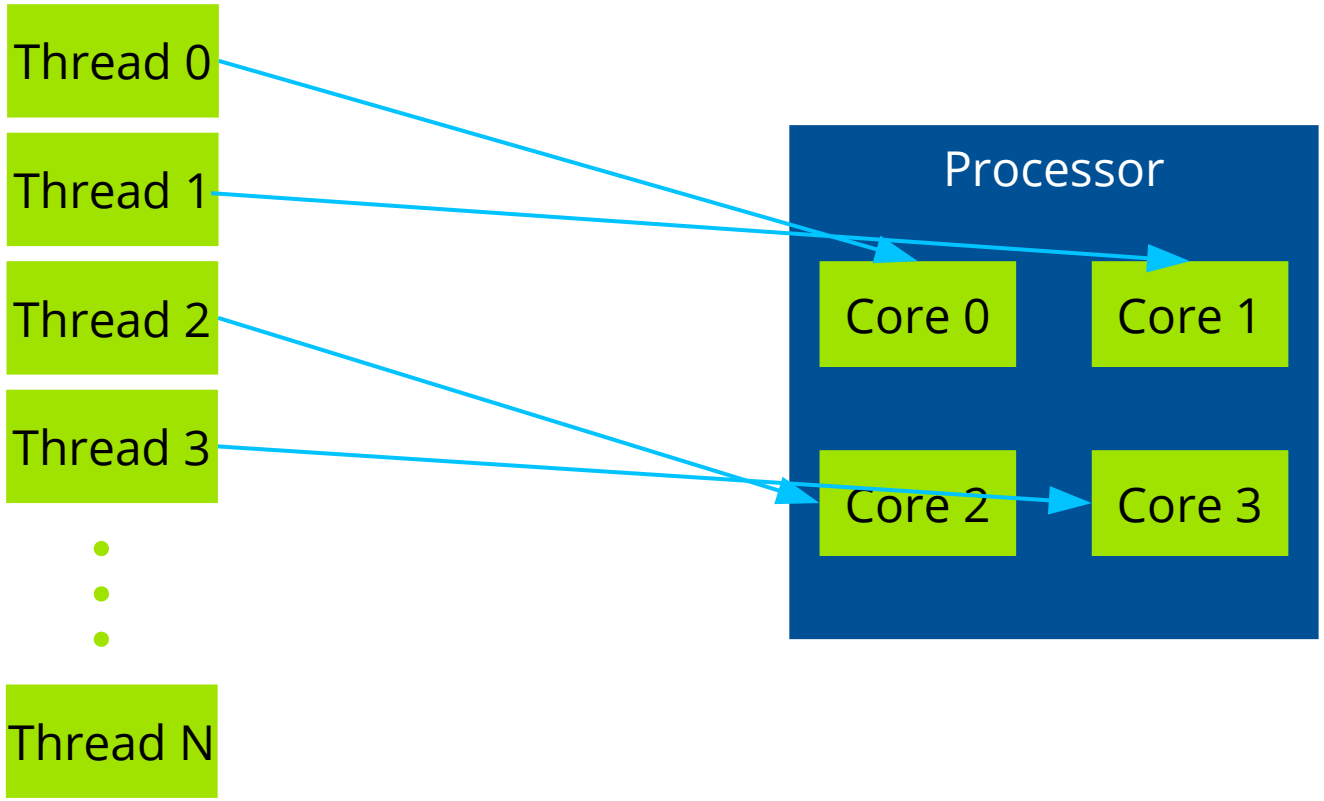
Mapping Threads to cores

- alpaka Threads are mapped to hardware cores
- While running, one Thread is executed by exactly one core
- Threads may run on other cores after rescheduling
- Usually many more Threads than cores (*oversubscription*)
- Waiting Threads make room for ready Threads



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alpaka Devices

- A set of cores is called a Device
- A single core can only belong to exactly one Device (N:1 mapping)
- All cores on the Device have access to global memory
- alpaka Devices correspond to physical devices
- Example: AMD Threadripper 3990X with 64 CPU cores is a Device with 128 cores (simultaneous multithreading!)
- Example: NVIDIA Tesla V100 with 5,120 CUDA cores is a Device with 5,120 cores

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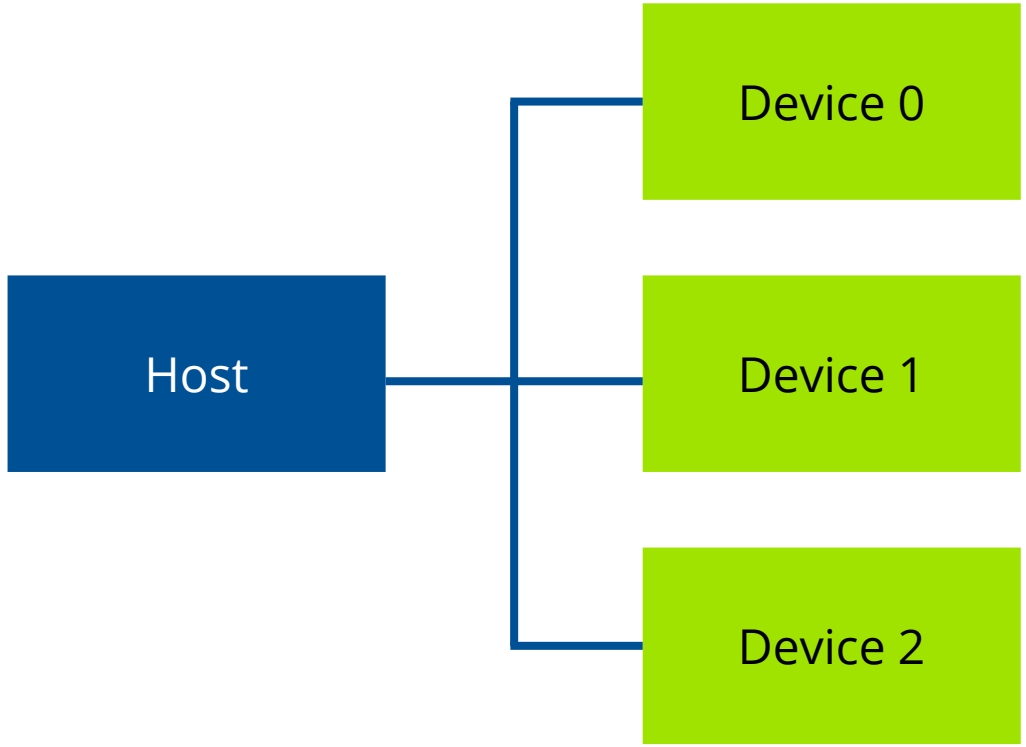
Host and Device

- An alpaka Host controls the overall program flow
- An alpaka Device executes Kernels
- All Devices are attached to a single Host
- It is impossible to have more than one Host



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Modifying Hello World

- From your `build` directory, switch to the `src` directory and open `helloWorld.cpp` with your favourite editor:

```
cd ../src
vim helloWorld.cpp
```

- Go to line 73 and change the number of threads (we will explain the Block-Grid terminology later):

```
Idx blocksPerGrid = 16;
```

- Go back to `build`, rebuild (`cmake --build . --config Release`) and execute again

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Results

- Example output:

```
Hello, World from alpaka thread 2!
Hello, World from alpaka thread 3!
Hello, World from alpaka thread 14!
Hello, World from alpaka thread 5!
Hello, World from alpaka thread 11!
Hello, World from alpaka thread 13!
Hello, World from alpaka thread 8!
Hello, World from alpaka thread 6!
Hello, World from alpaka thread 7!
Hello, World from alpaka thread 4!
Hello, World from alpaka thread 0!
Hello, World from alpaka thread 1!
…
```

- You have successfully increased the number of alpaka threads!

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