Lesson 13: Handling Parallelism

Threads and cores

- alpaka Threads are different from pthreads, std::thread, 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:

<table>
<thead>
<tr>
<th>Hello, World from alpaka thread 2!</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hello, World from alpaka thread 3!</td>
</tr>
<tr>
<td>Hello, World from alpaka thread 14!</td>
</tr>
<tr>
<td>Hello, World from alpaka thread 5!</td>
</tr>
<tr>
<td>Hello, World from alpaka thread 11!</td>
</tr>
<tr>
<td>Hello, World from alpaka thread 13!</td>
</tr>
<tr>
<td>Hello, World from alpaka thread 8!</td>
</tr>
<tr>
<td>Hello, World from alpaka thread 6!</td>
</tr>
<tr>
<td>Hello, World from alpaka thread 7!</td>
</tr>
<tr>
<td>Hello, World from alpaka thread 4!</td>
</tr>
<tr>
<td>Hello, World from alpaka thread 0!</td>
</tr>
<tr>
<td>Hello, World from alpaka thread 1!</td>
</tr>
</tbody>
</table>

... 

• You have successfully increased the number of alpaka threads!