alpaka Parallel Programming – Online Tutorial

Lecture 30 – Portability with alpaka

Lesson 36: Programming Heterogeneous Systems

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Recap

- Accelerator provides abstraction for a programming model and compatible physical devices
- Device represents a single physical device
- Queue enables communication between Host and a single Device
- Platform is a union of Accelerator, Device and Kernel
- Question: How to use multiple back-ends?

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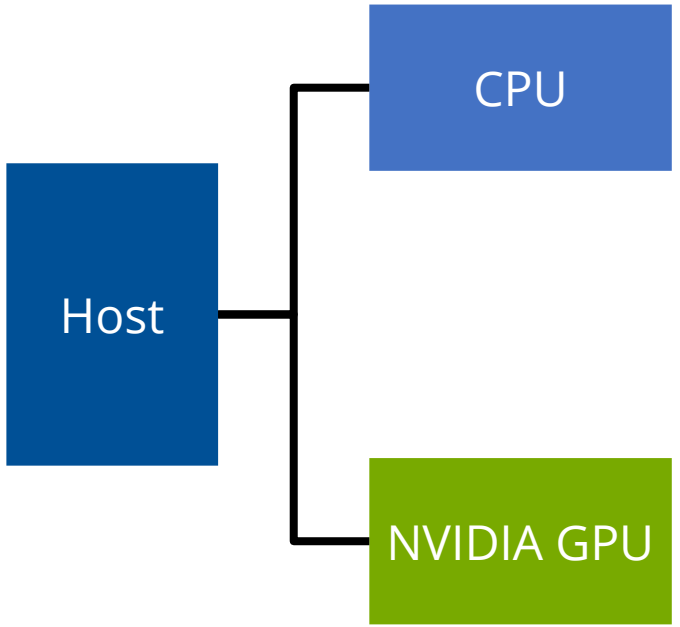
Heterogeneous Systems

- Real-world scenario: Use all available compute power
- Also real-world scenario: Multiple different hardware types available
- Requirement: Usage of one back-end per hardware platform
- Requirement: Back-ends need to be interoperable



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Using multiple Platforms

- alpaka enables easy heterogeneous programming!
- Create one Accelerator per back-end
- Acquire at least one Device per Accelerator
- Create one Queue per Device

```
// Define Accelerators
using AccCpu = acc::AccCpuOmp2Blocks<Dim, Idx>;
using AccGpu = acc::AccGpuCudaRt<Dim, Idx>;

// Acquire Devices
auto devCpu = pltf::getDevByIdx<AccCpu>(0u);
auto devGpu = pltf::getDevByIdx<AccGpu>(0u);

// Create Queues
using QueueProperty = queue::NonBlocking;
using QueueCpu = queue::Queue<AccCpu, QueueProperty>;
using QueueGpu = queue::Queue<AccGpu, QueueProperty>;

auto queueCpu = QueueCpu{devCpu};
auto queueGpu = QueueGpu{devGpu};
```

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Communication

- Buffers are defined and created per Device
- Buffers can be copied between different Devices / Queues
- Not restricted to a single platform!
- **Restriction**: CPU to GPU copies (and vice versa) require GPU queue

```
// Allocate buffers
auto bufCpu = mem::buf::alloc<float, Idx>(devCpu, extent);
auto bufGpu = mem::buf::alloc<float, Idx>(devGpu, extent);

/* Initialization … */

// Copy buffer from CPU to GPU - destination comes first
mem::view::copy(gpuQueue, bufGpu, bufCpu, extent);

// Execute GPU kernel
queue::enqueue(gpuQueue, someKernelTask);

// Copy results back to CPU and wait for completion
mem::view::copy(gpuQueue, bufCpu, bufGpu, extent);

// Wait for GPU, then execute CPU kernel
wait::wait(cpuQueue, gpuQueue);
queue::enqueue(cpuQueue, anotherKernelTask);
```

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Heterogeneous programming with alpaka

- alpaka gives you access to all of your system's computation resources
- alpaka eases programming for different device types
- alpaka enables simple data transfers between different devices
- alpaka makes your code reusable
- alpaka makes your code portable

Run once, scale everywhere!

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