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Offloading Computation to a GPU with OpenMP

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Offloading to GPU – A first encounter

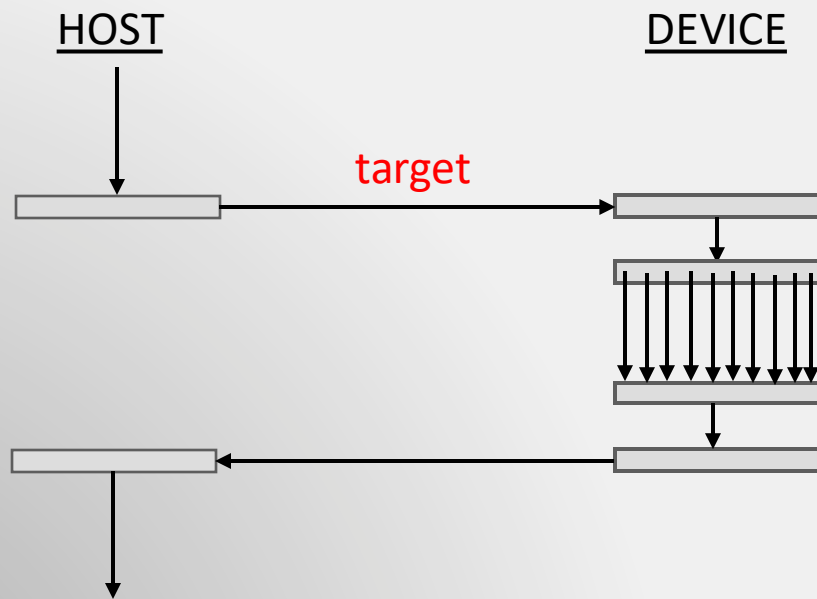
```
pi = 0;
double start = omp_get_wtime();
#pragma omp target map(to: num_intervals, step) map(tofrom: pi)
{
#pragma omp teams distribute parallel for simd reduction(+:pi)
for (int i = 0; i < num_intervals; ++i) {
    double x = (i + 0.5) * step;
    pi += 4.0 / (1.0 + x * x) * step;
}
}
```

→ Marked for the device execution

→ Input/output data for the computation

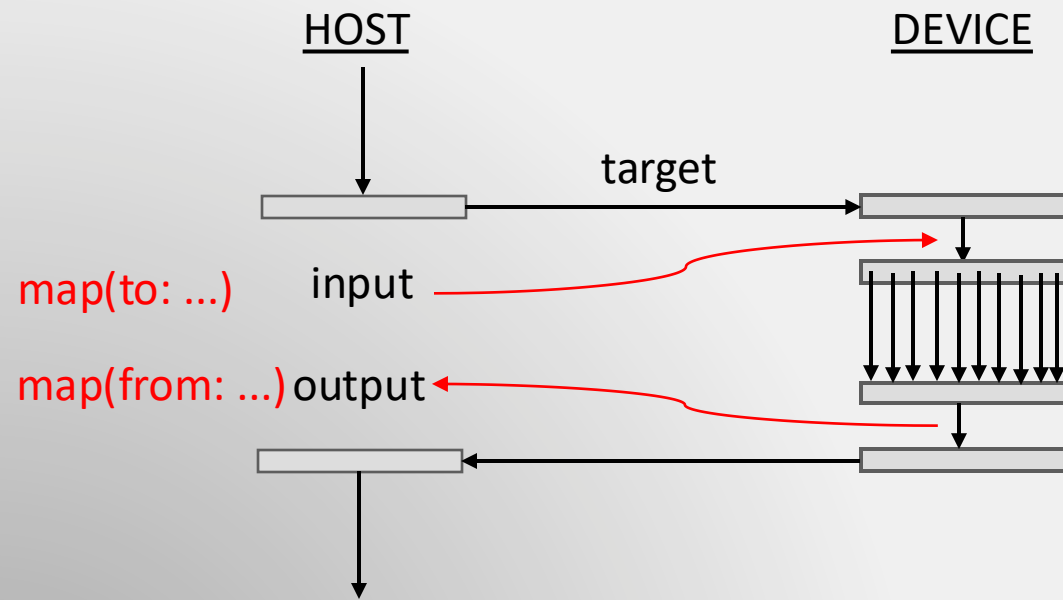
→ Teams of threads are created

Offloading to GPU – Step by step



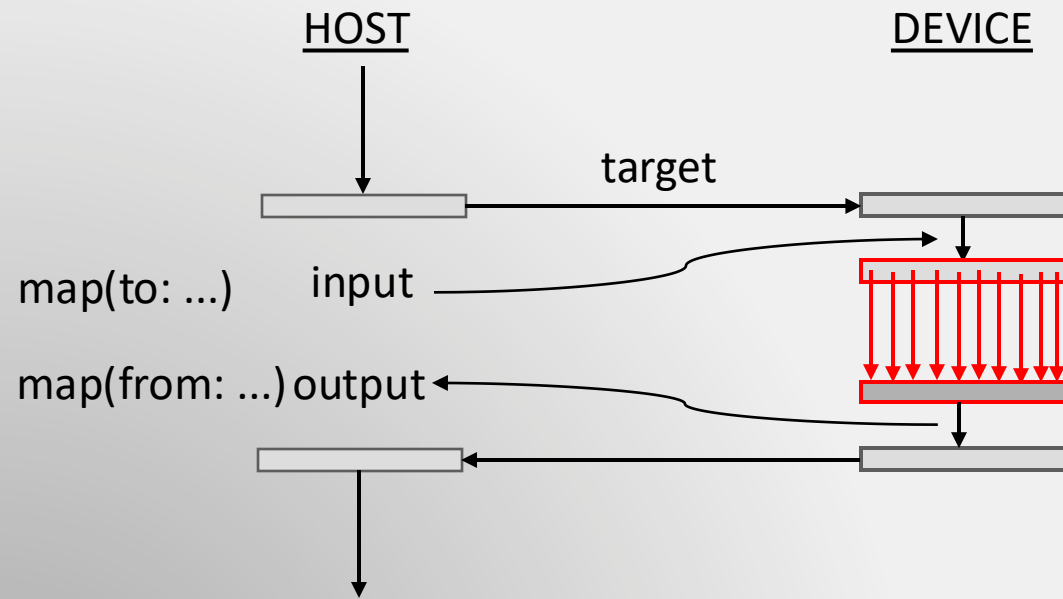
- When the host thread encounters a **target** region, it creates a **target task** for offloading to the device.
- Host temporarily suspends its own execution. The device generates an initial task, which is executed by its initial thread.
- Once the task on the accelerator is completed, the host thread resumes its previously suspended work.

Offloading to GPU – Step by step



- When data from the host's environment is mapped to the device, a corresponding data is created within the device data environment.
- Throughout the execution, data are dynamically mapped and unmapped, with changes reflecting this process.
- The original host data and its device counterpart may or may not occupy the same physical memory location.

Offloading to GPU – Step by step



- Create teams – each team is a single thread
- Distribute the work, the iterations, to the teams
- teams distribute parallel
- Activate more threads in teams and execute the distributed iterations in parallel.

Example: Pi via OpenMP Offloading

- **Let's go over the OpenMP-to-GPU offloading code.**

Thanks



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