

# Concurrent CUDA Streams

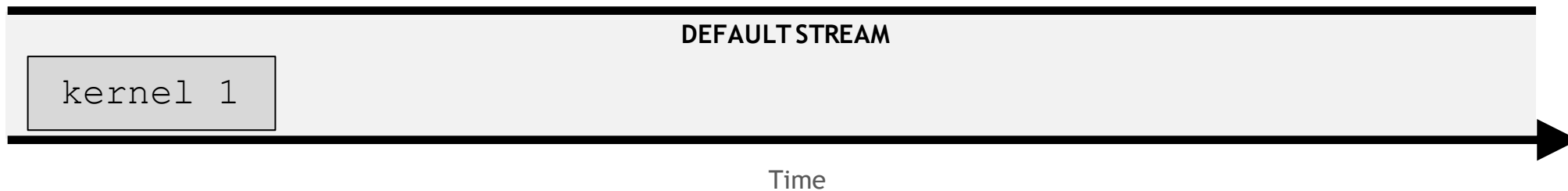
A **stream** is a series of instructions,  
and CUDA has a **default stream**



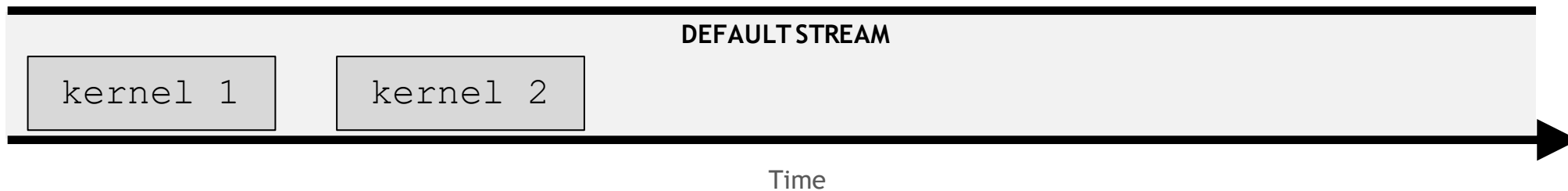
**DEFAULT STREAM**

Time

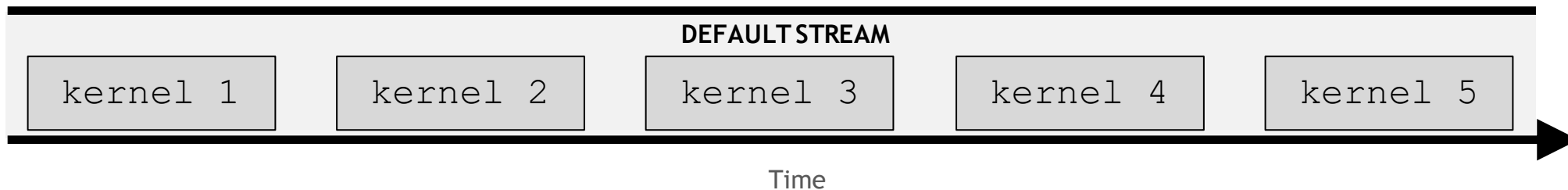
By default, CUDA kernels run in the  
**default stream**



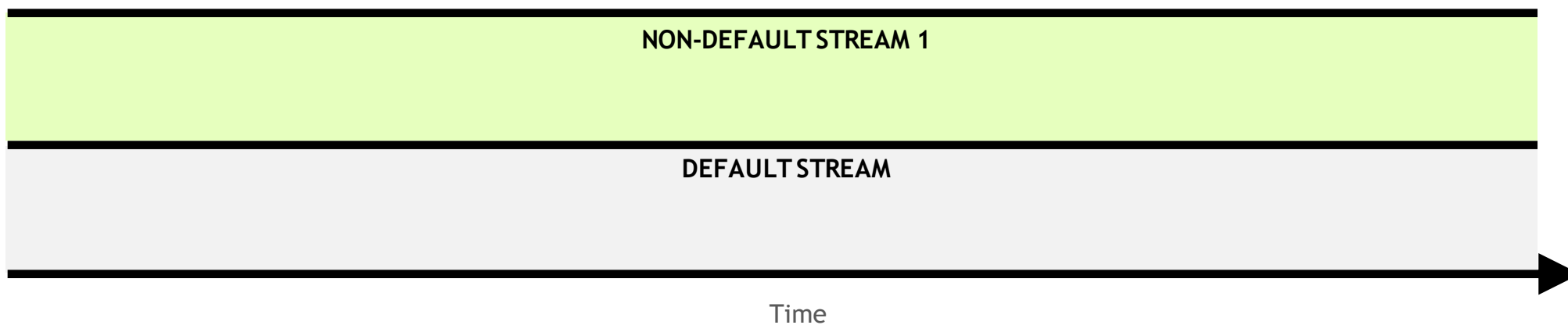
In any stream, including the default, an instruction in it (here a kernel launch) must complete before the next can begin



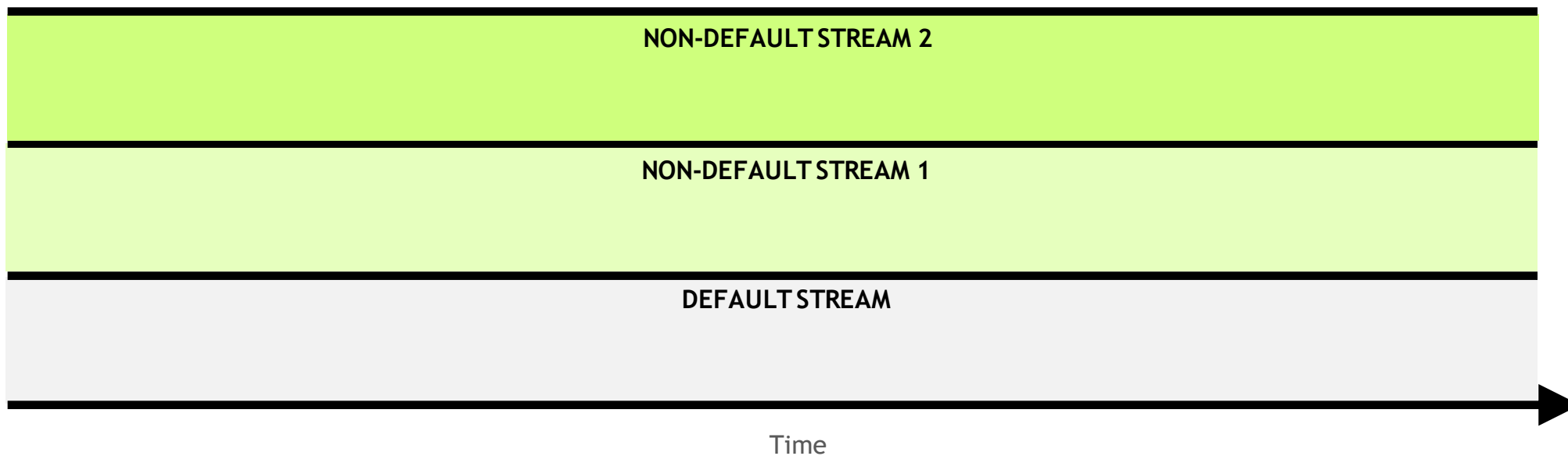
In any stream, including the default, an instruction in it (here a kernel launch) must complete before the next can begin



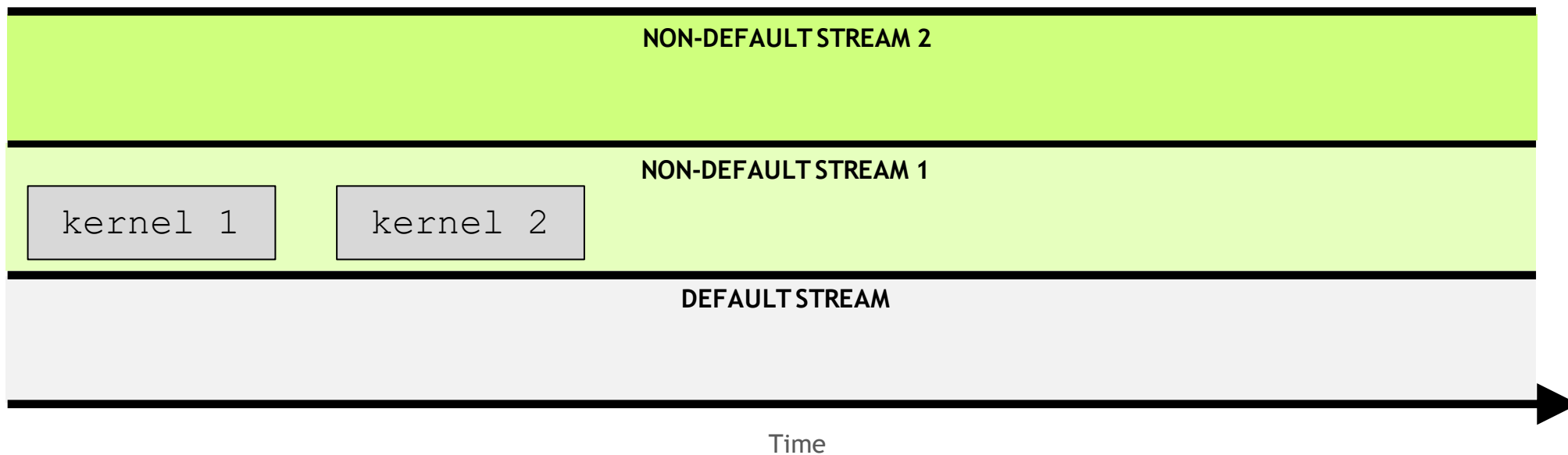
**Non-default streams** can also be created for kernel execution



**Non-default streams** can also be created for kernel execution

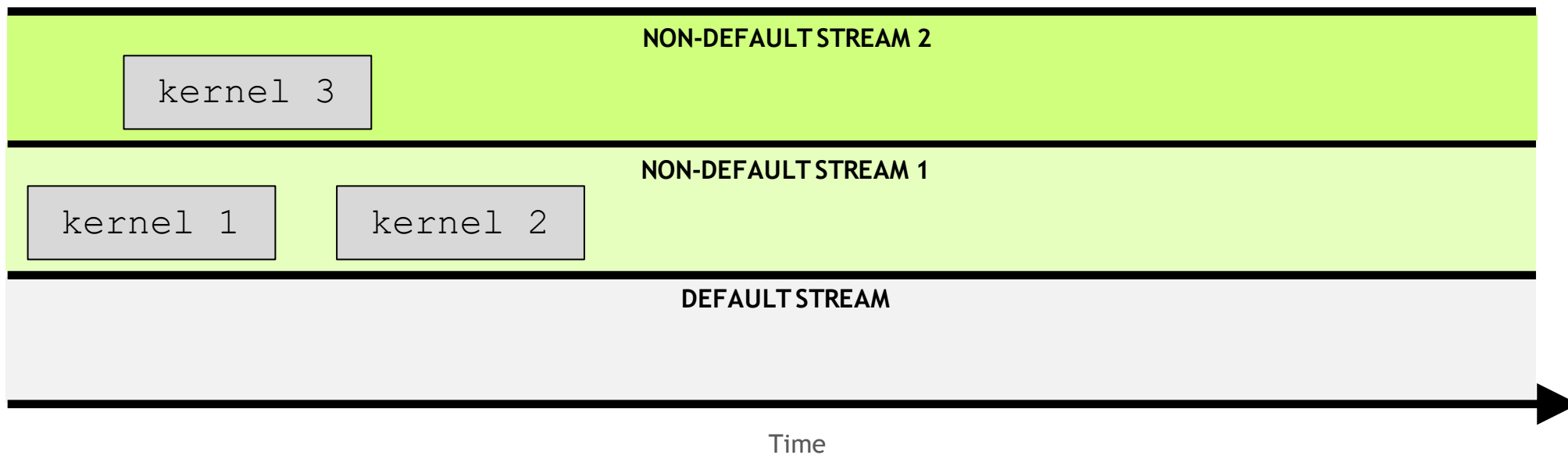


Kernels within any single stream must execute in order

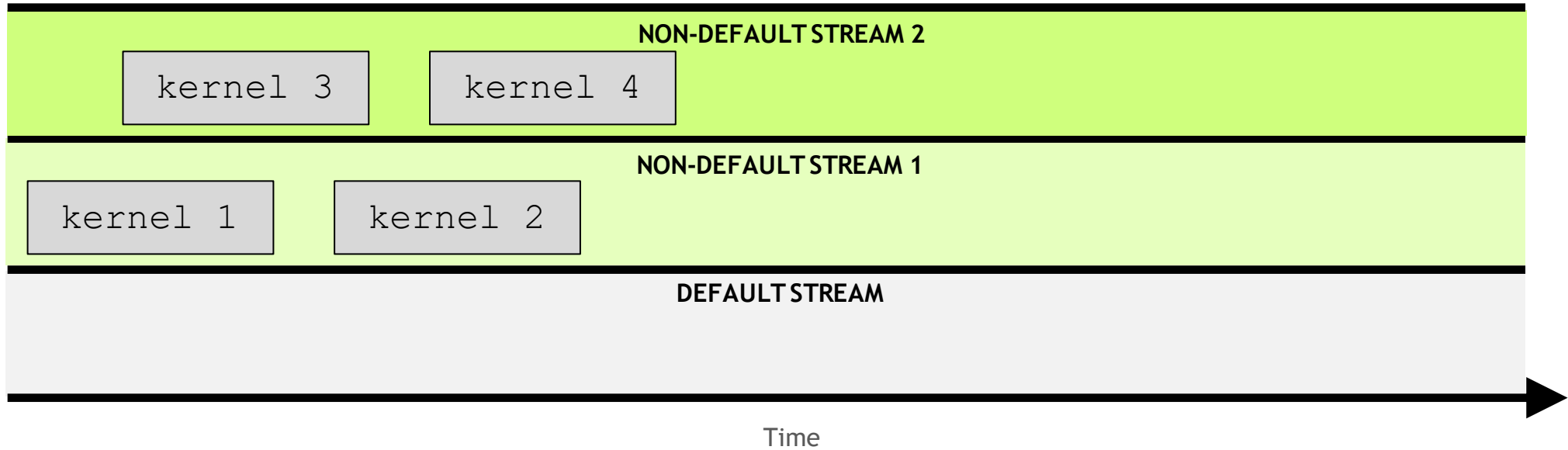




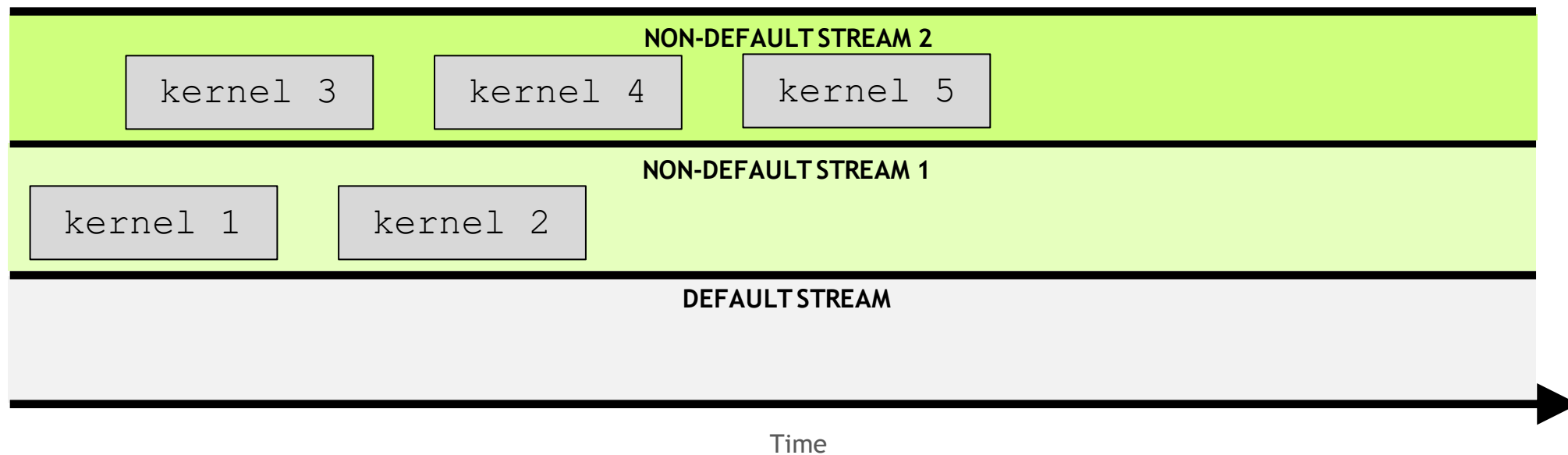
However, kernels in **different, non-default streams**, can interact concurrently



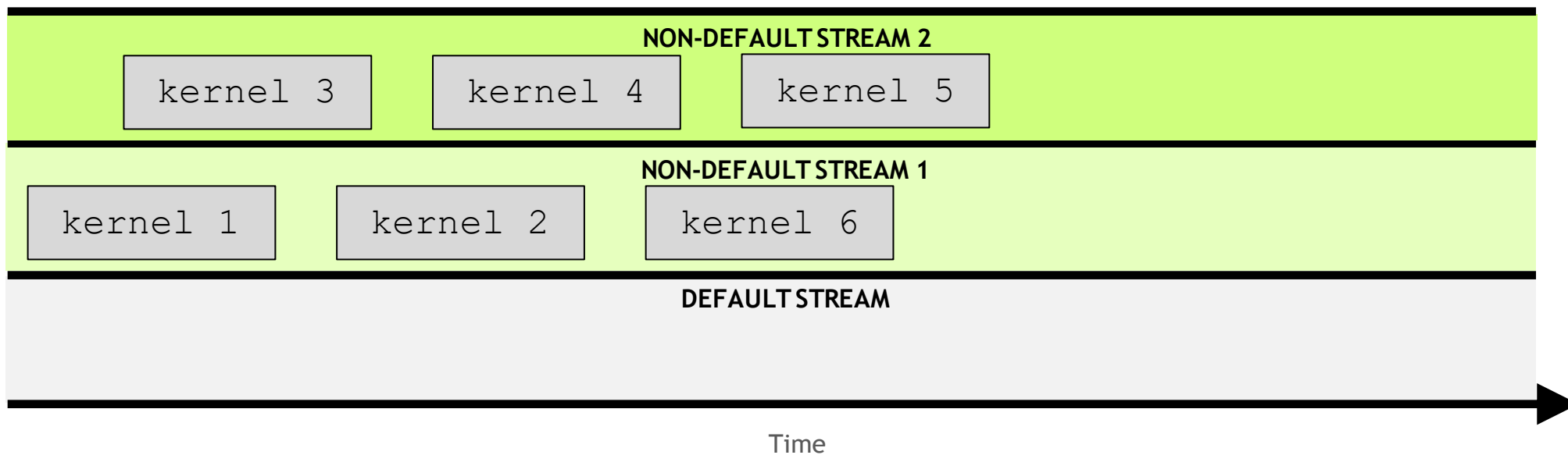
However, kernels in **different, non-default streams**, can interact concurrently



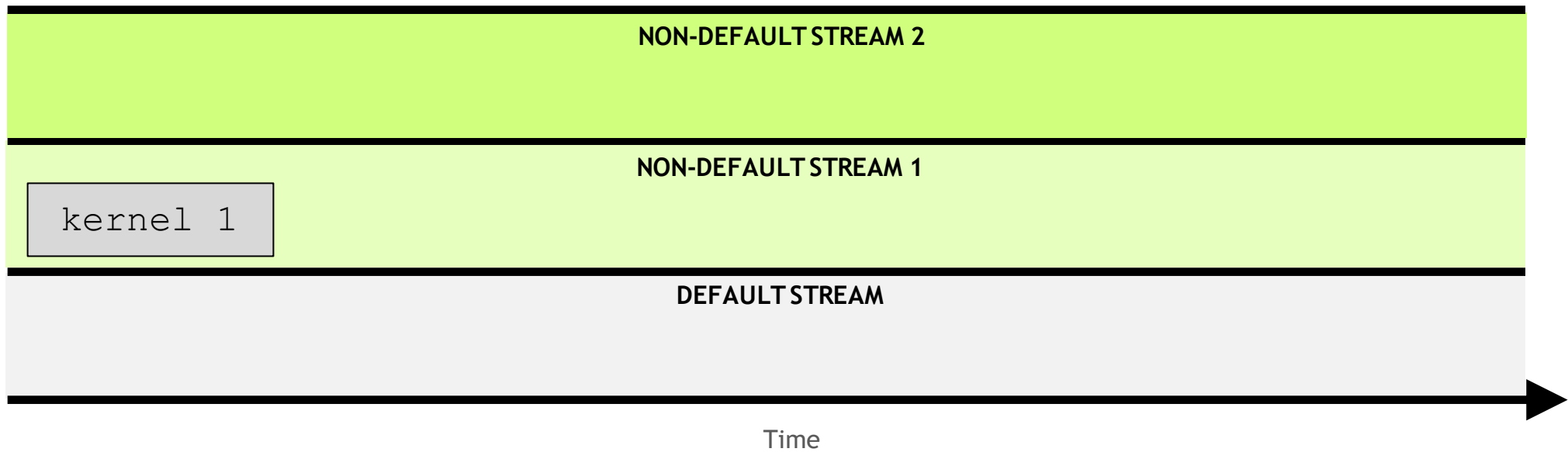
However, kernels in **different, non-default streams**, can interact concurrently



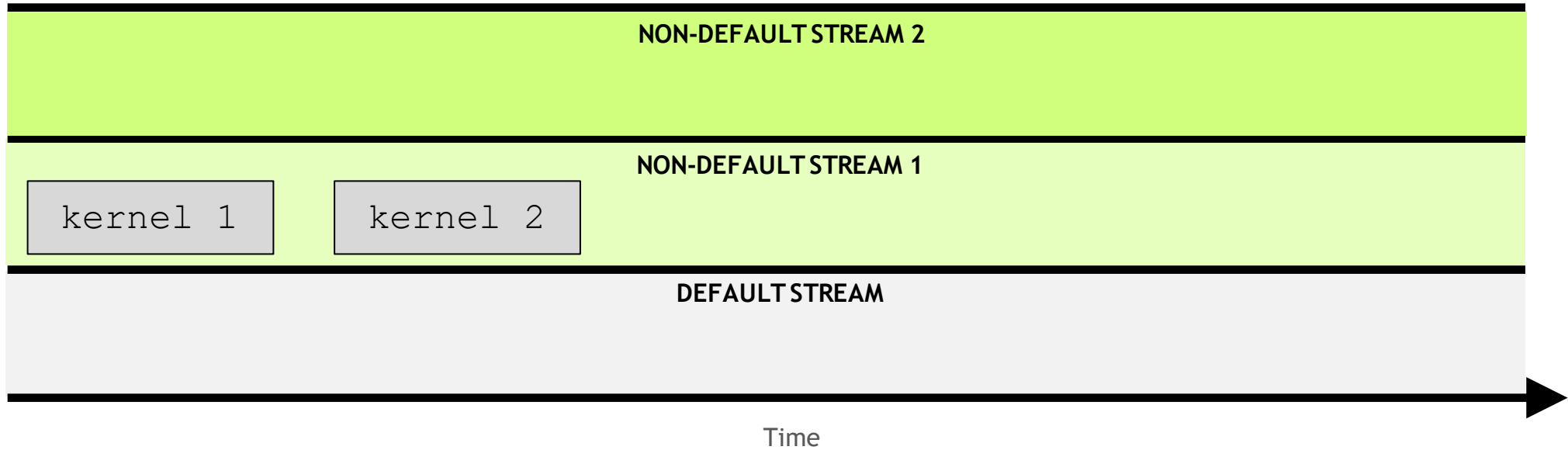
However, kernels in **different, non-default streams**, can interact concurrently



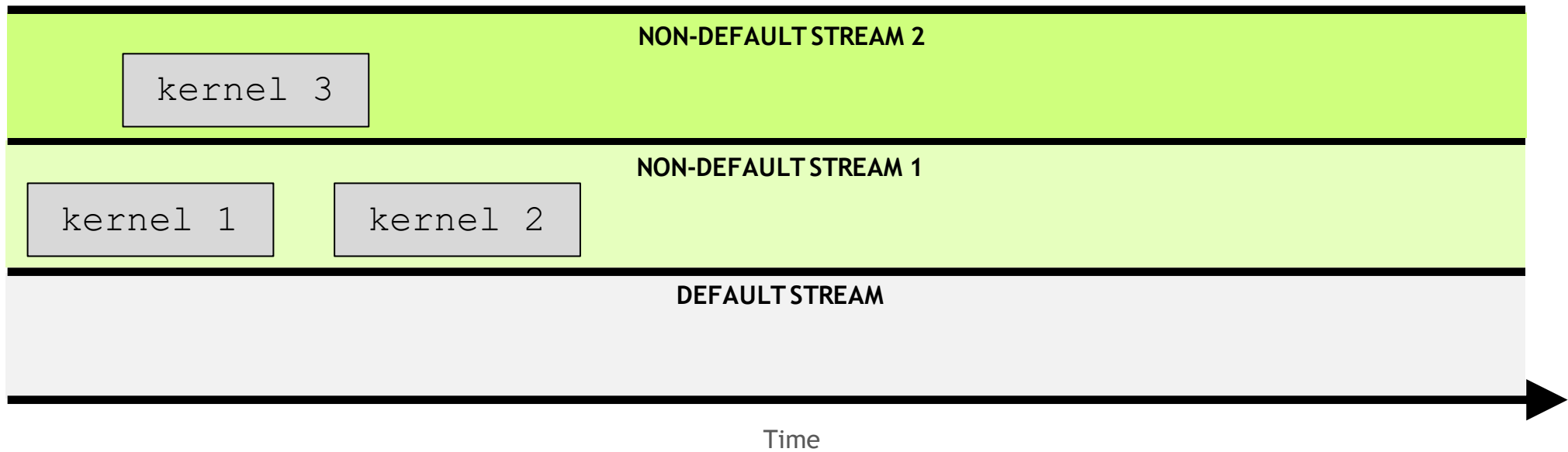
The default stream is special: **it blocks all kernels in all other streams**



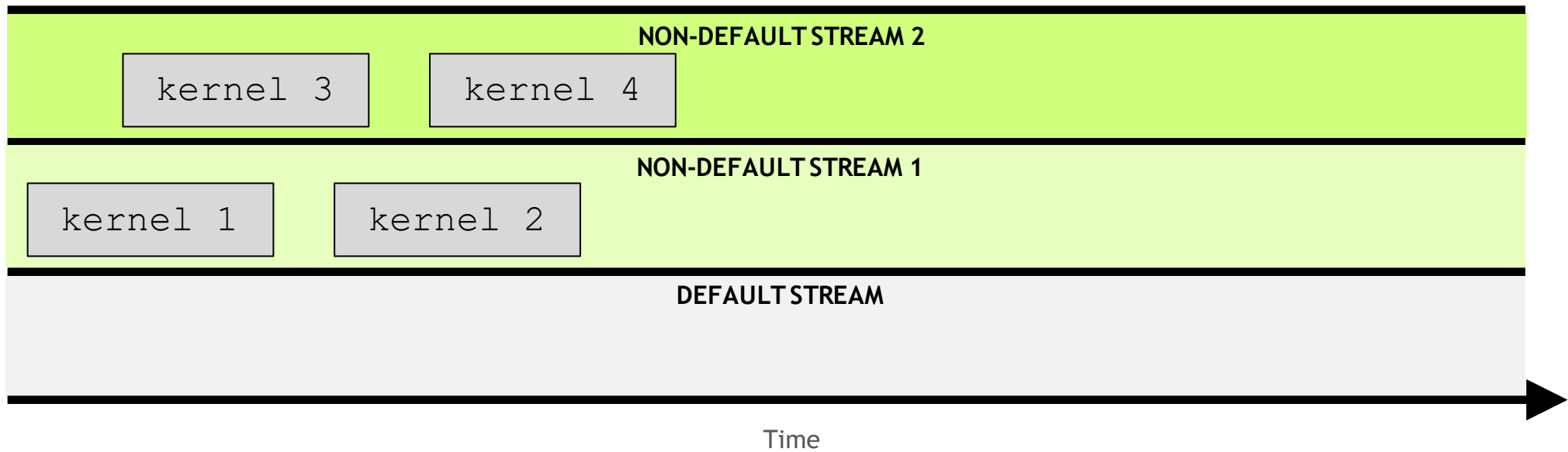
The default stream is special: **it blocks all kernels in all other streams**



The default stream is special: **it blocks all kernels in all other streams**

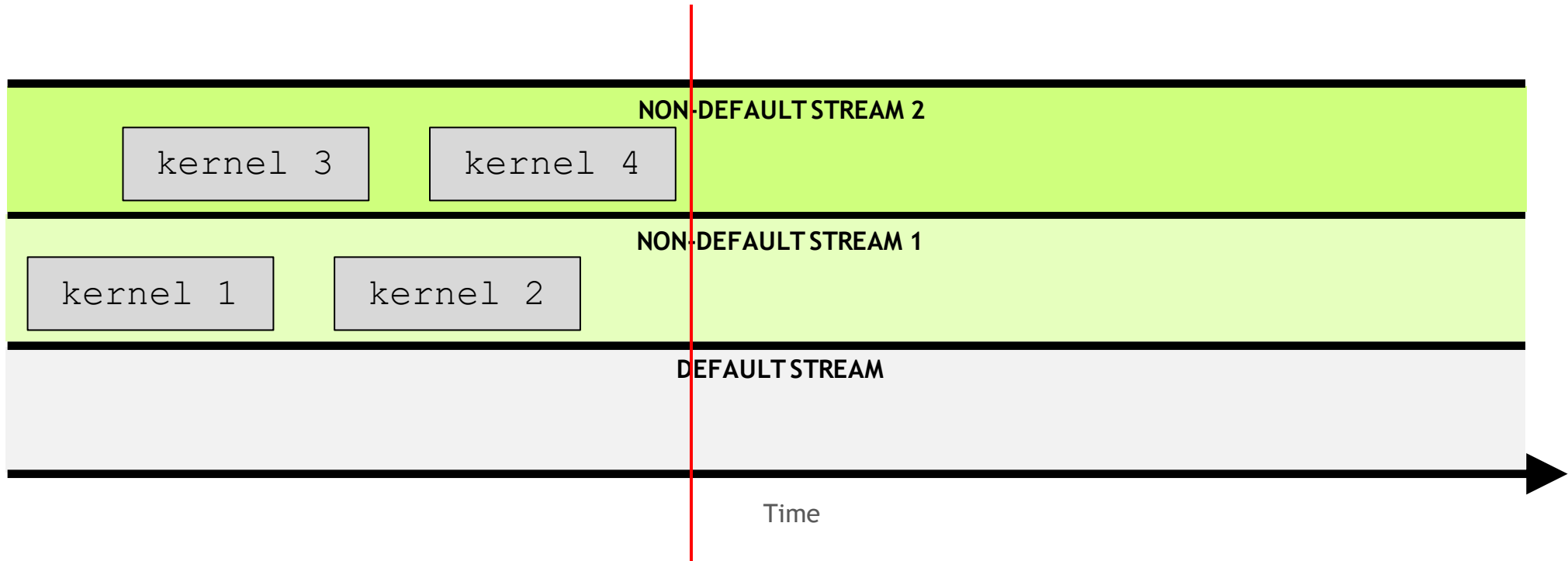


The default stream is special: **it blocks all kernels in all other streams**

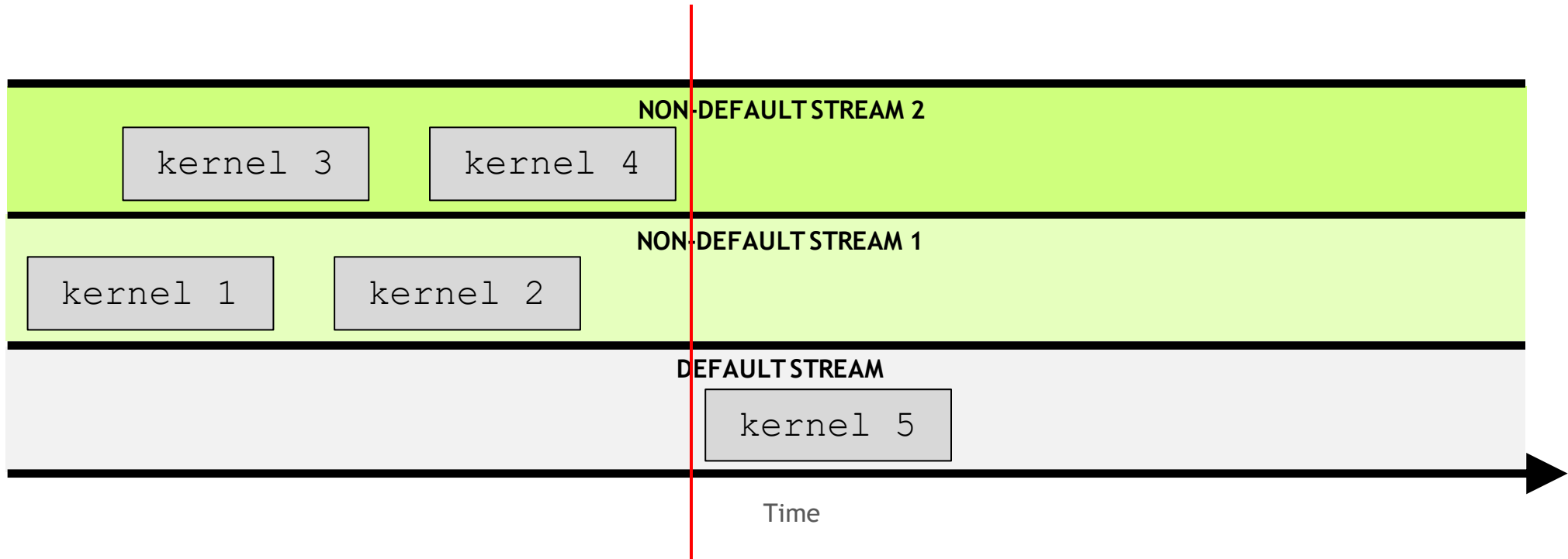




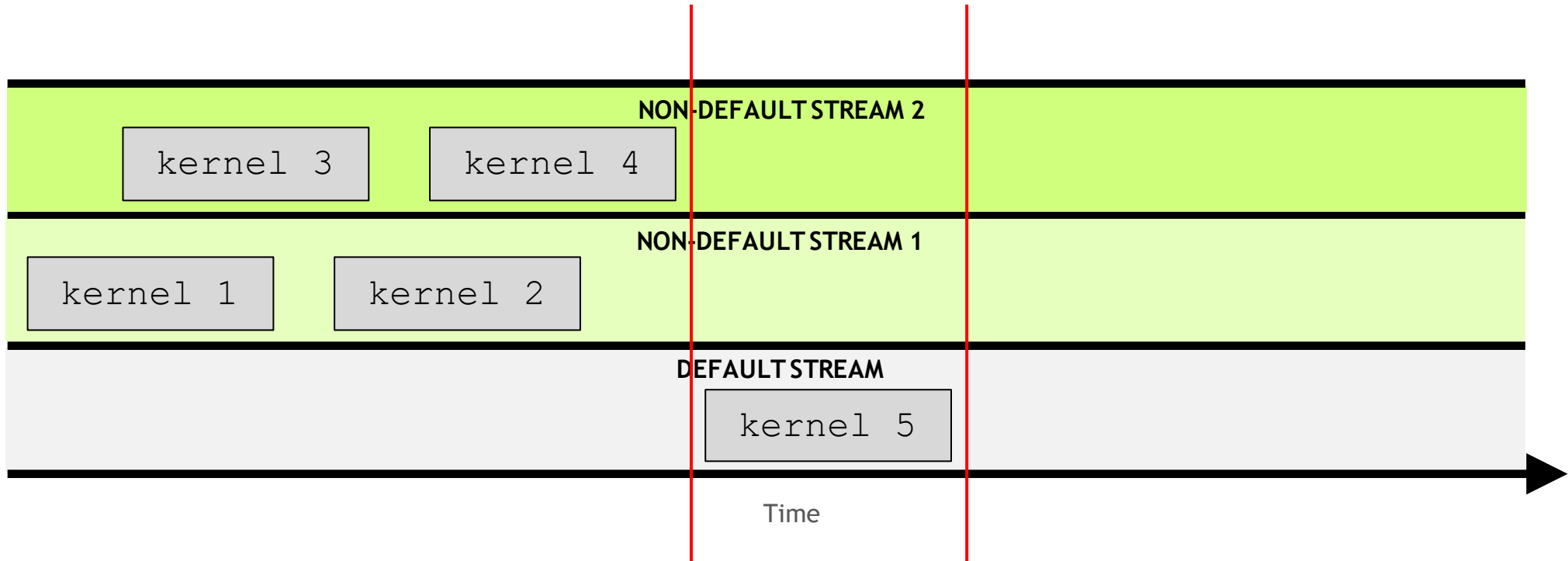
The default stream is special: **it blocks all kernels in all other streams**



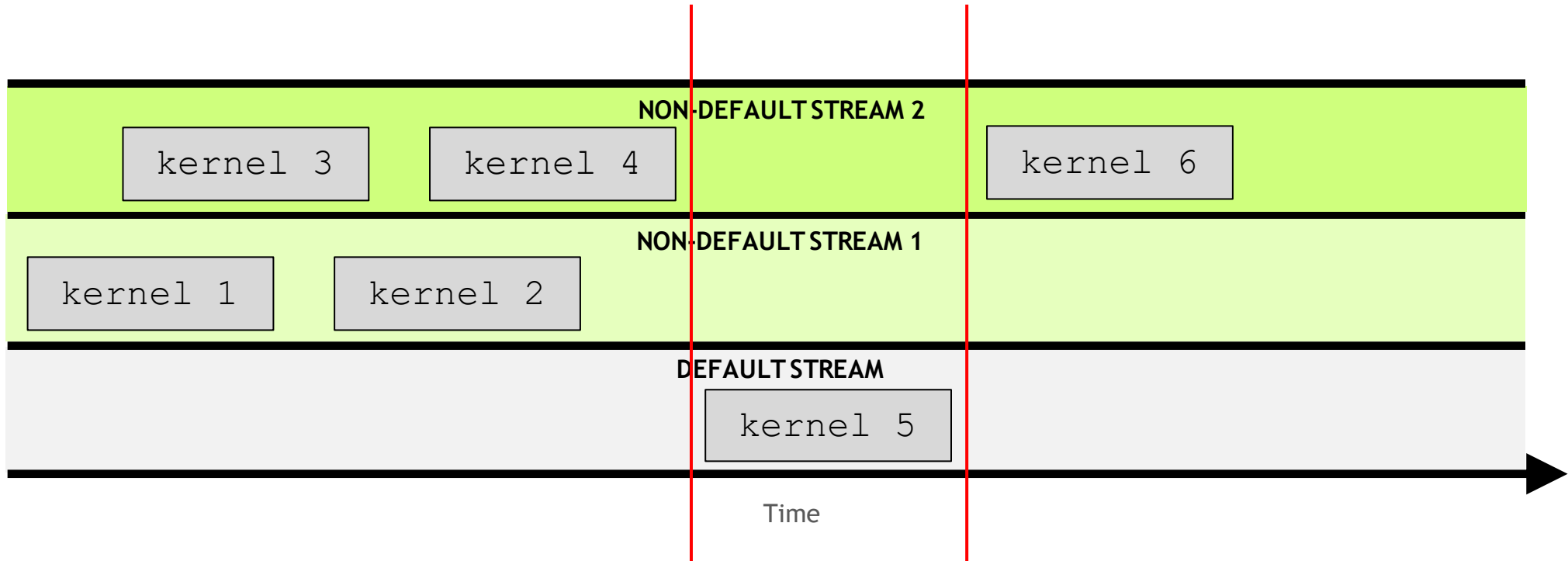
The default stream is special: **it blocks all kernels in all other streams**



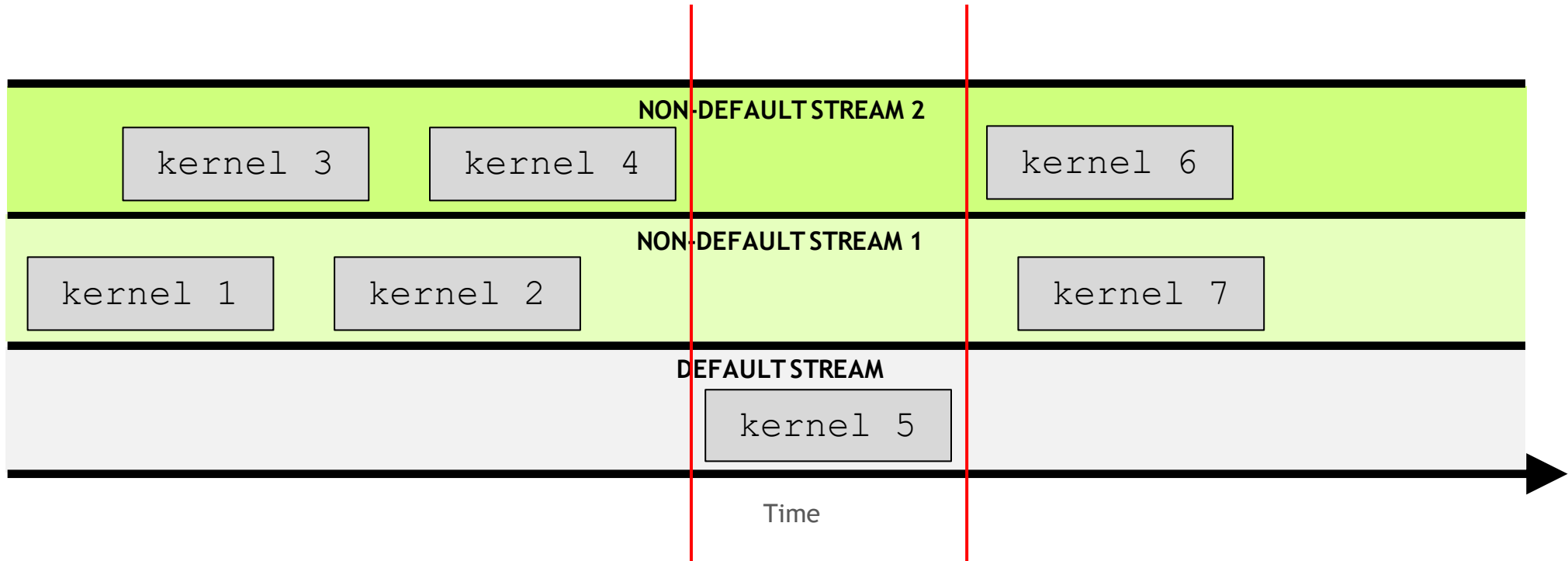
The default stream is special: **it blocks all kernels in all other streams**



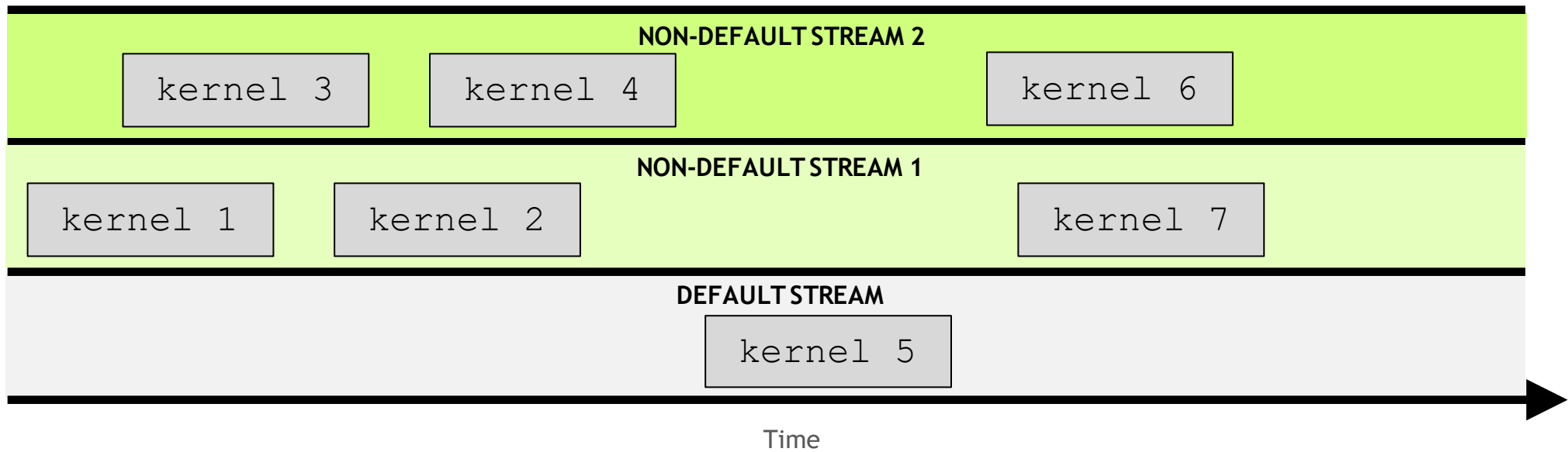
The default stream is special: **it blocks all kernels in all other streams**



The default stream is special: **it blocks all kernels in all other streams**

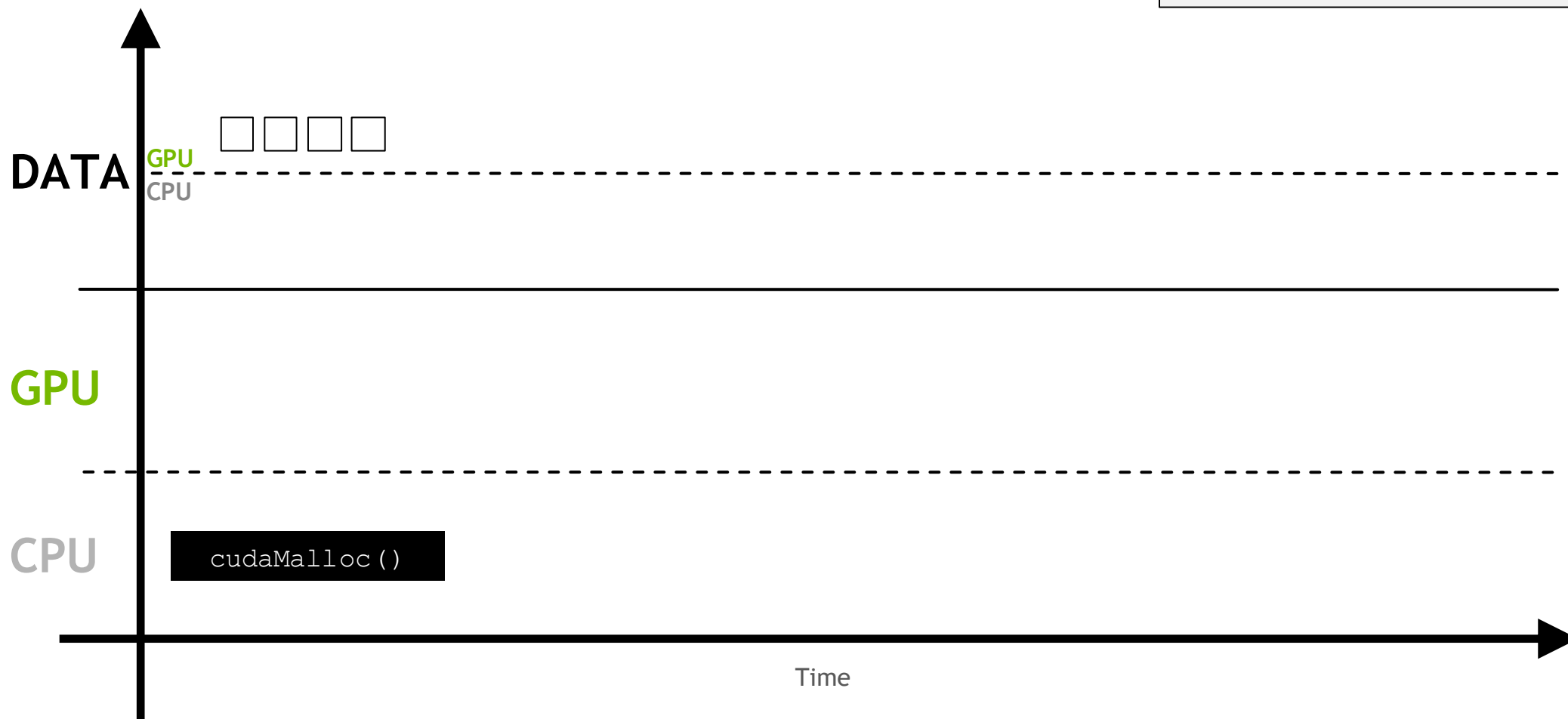


The default stream is special: **it blocks all kernels in all other streams**



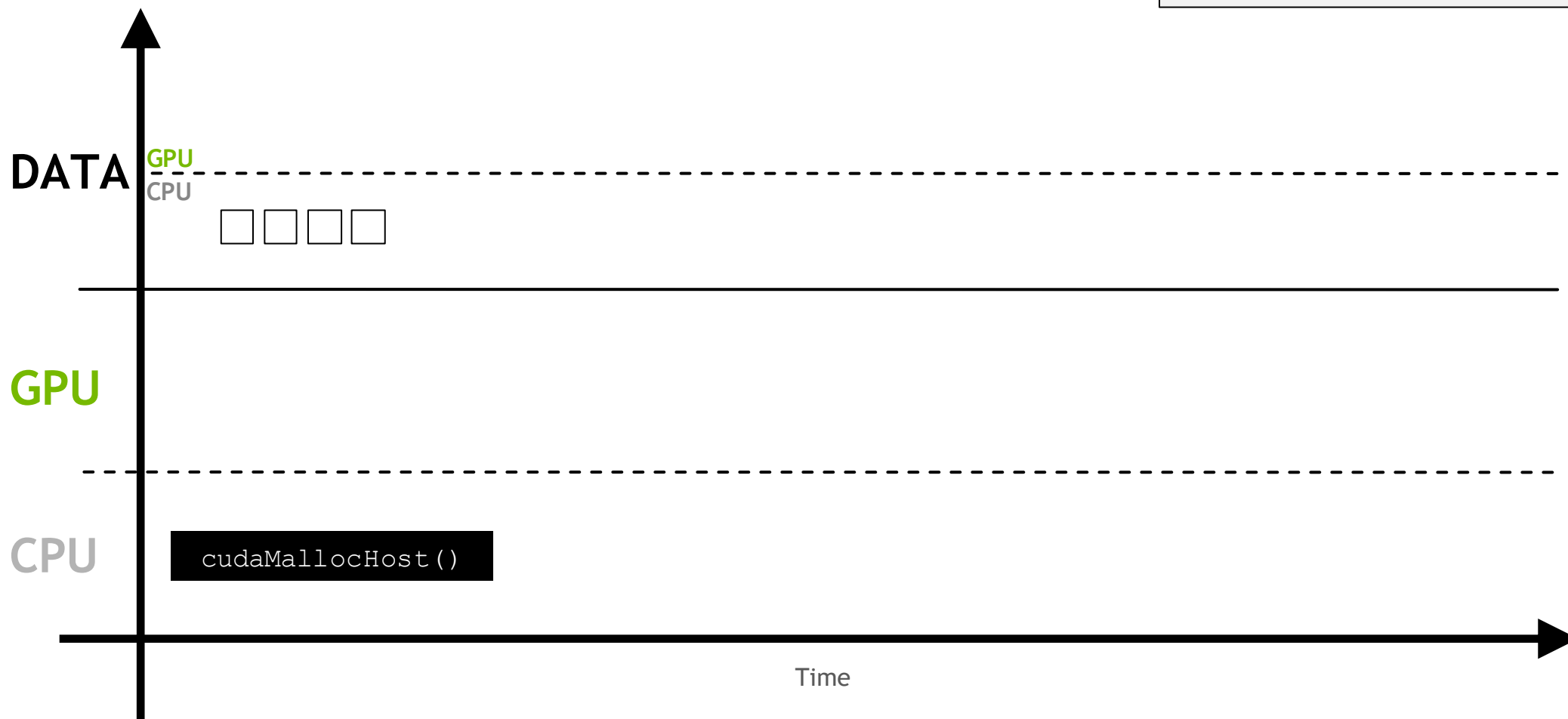
# Non-Unified Memory

Memory can be allocated directly to the GPU with `cudaMalloc`





Memory can be allocated directly to the host with `cudaMallocHost`



DATA

GPU  
CPU



Memory allocated in either of these ways can be **copied** to other locations in the system with `cudaMemcpy`

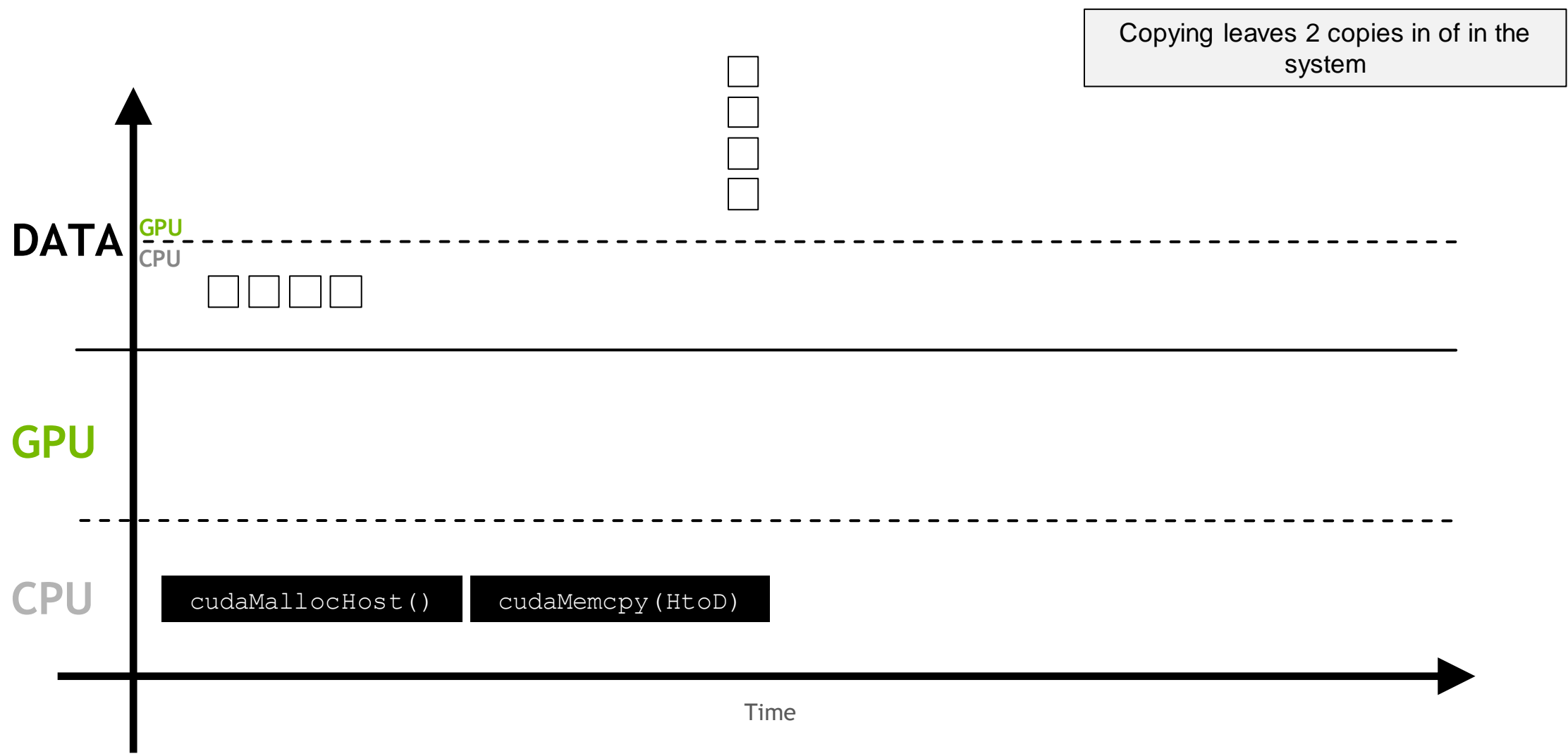
GPU

CPU

`cudaMallocHost()`

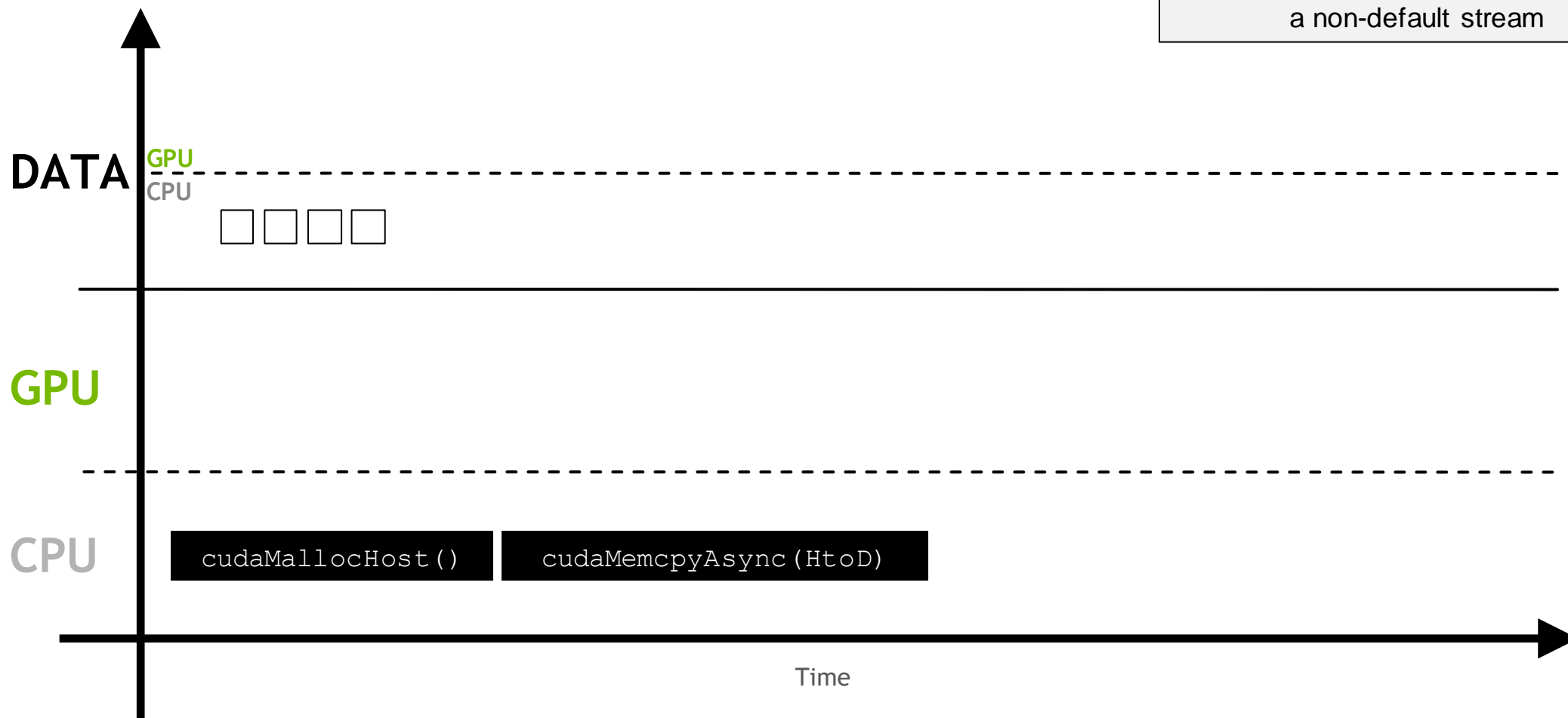
`cudaMemcpy(HtoD)`

Time



**cudaMemcpyAsync**

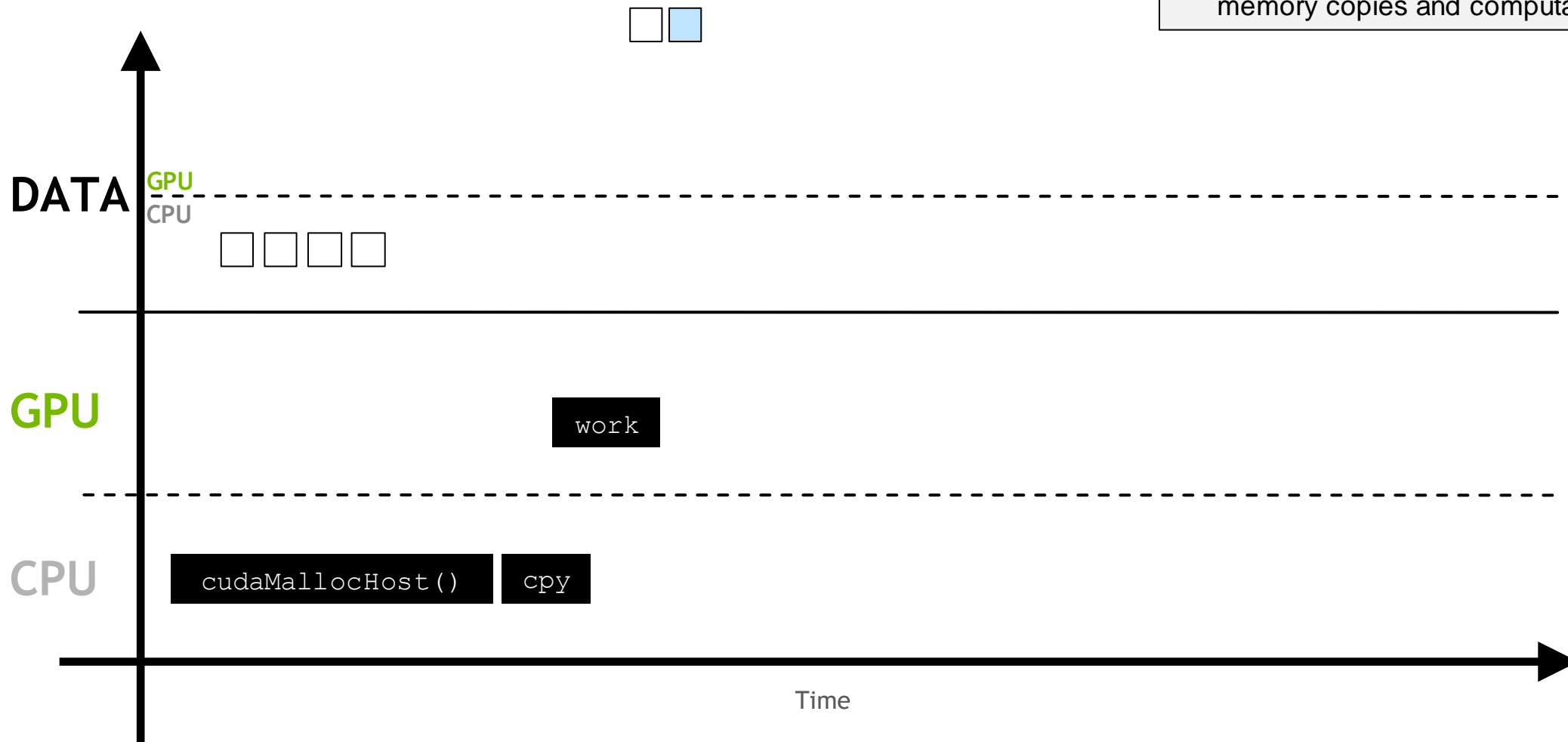
`cudaMemcpyAsync` can  
asynchronously transfer memory over  
a non-default stream



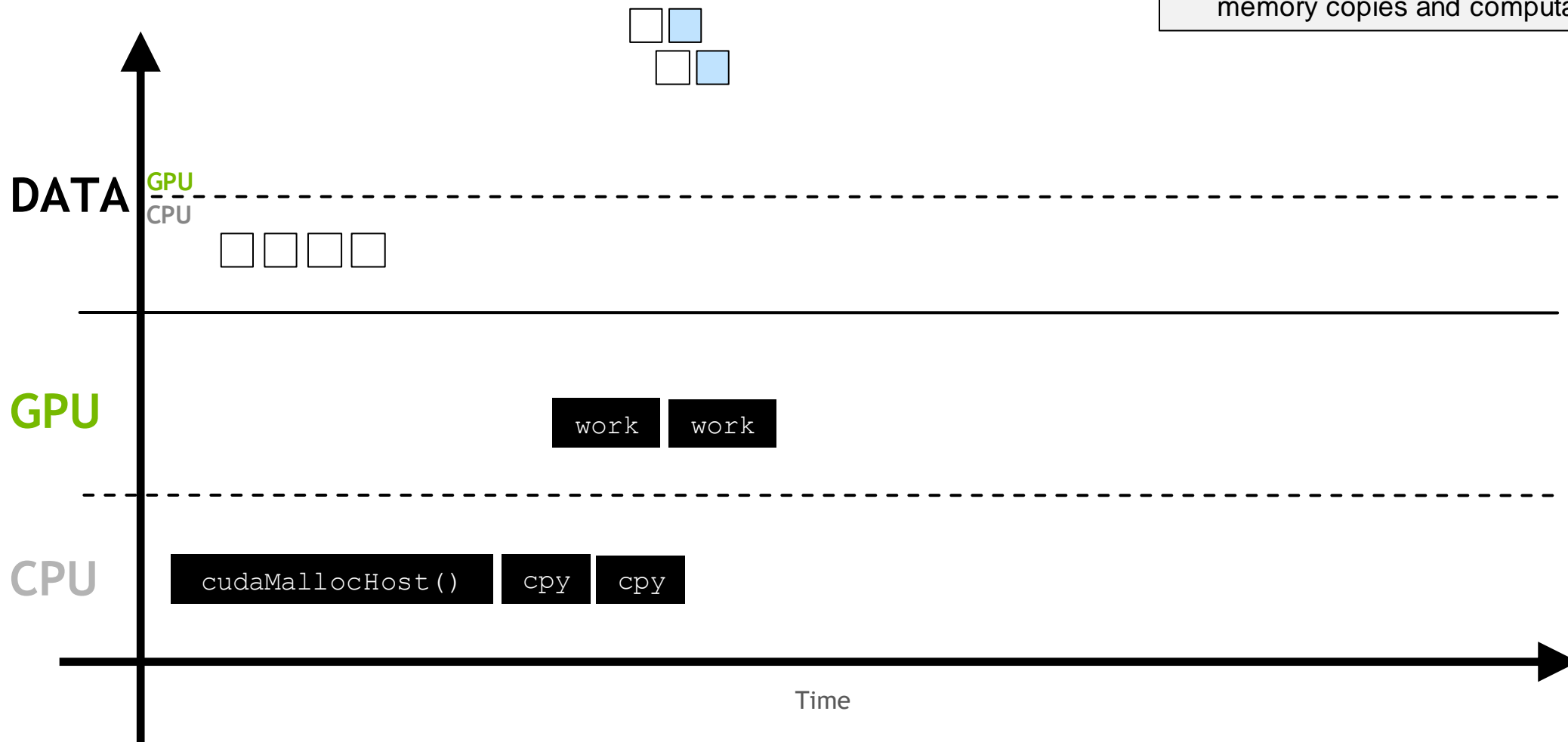
This can allow the **overlapping** memory copies and computation



This can allow the **overlapping** memory copies and computation

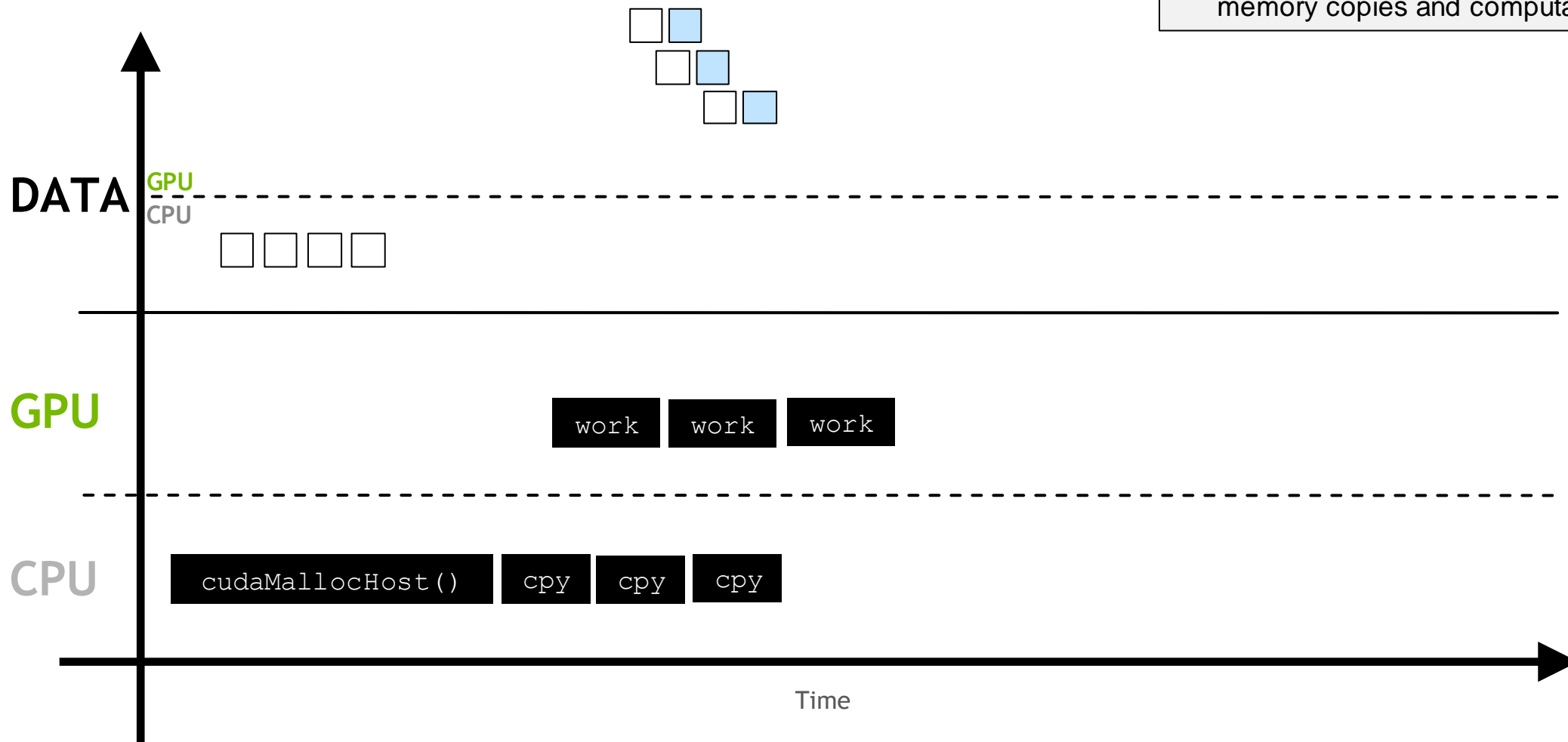


This can allow the **overlapping** memory copies and computation

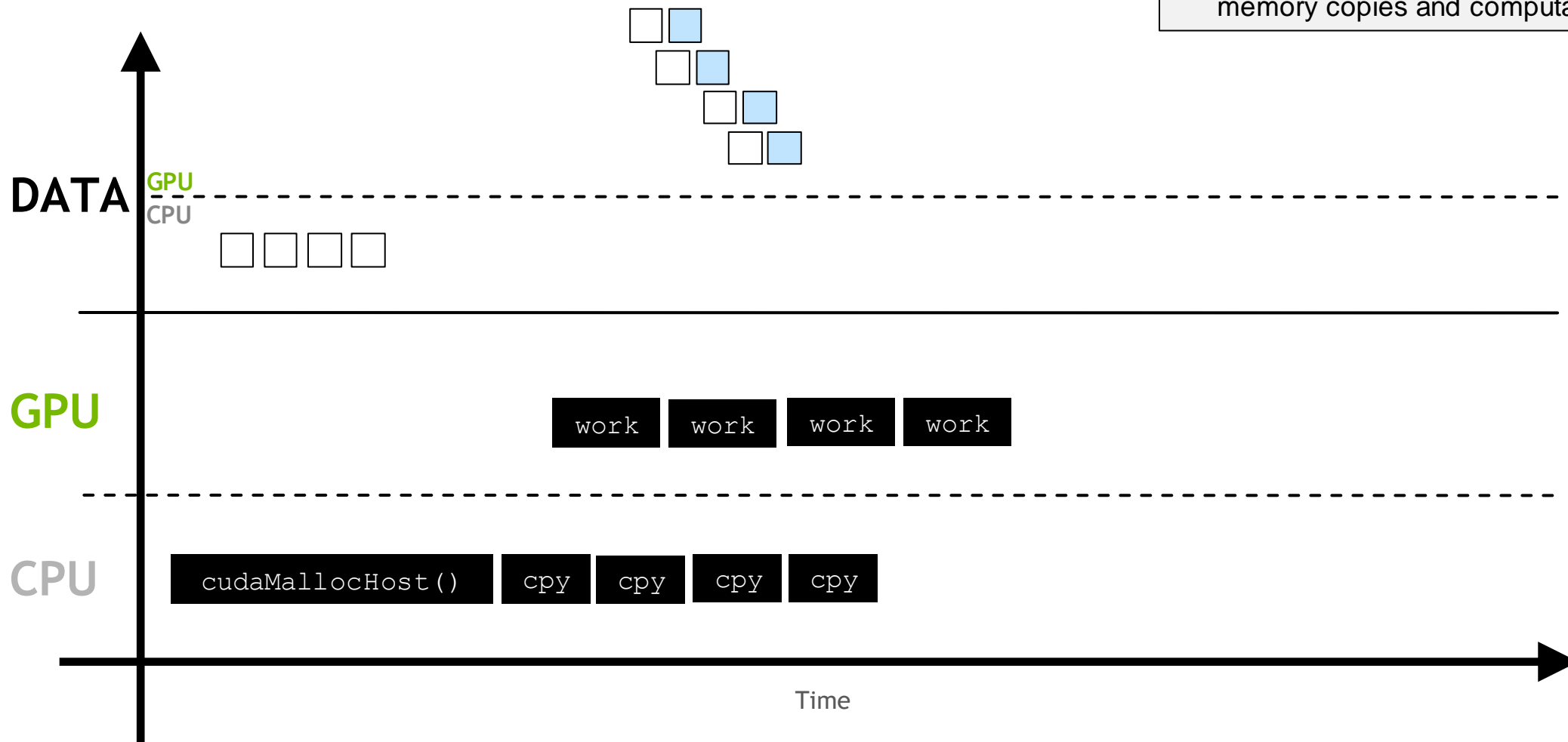




This can allow the **overlapping** memory copies and computation



This can allow the **overlapping** memory copies and computation





DEEP  
LEARNING  
INSTITUTE

[www.nvidia.com/dli](http://www.nvidia.com/dli)