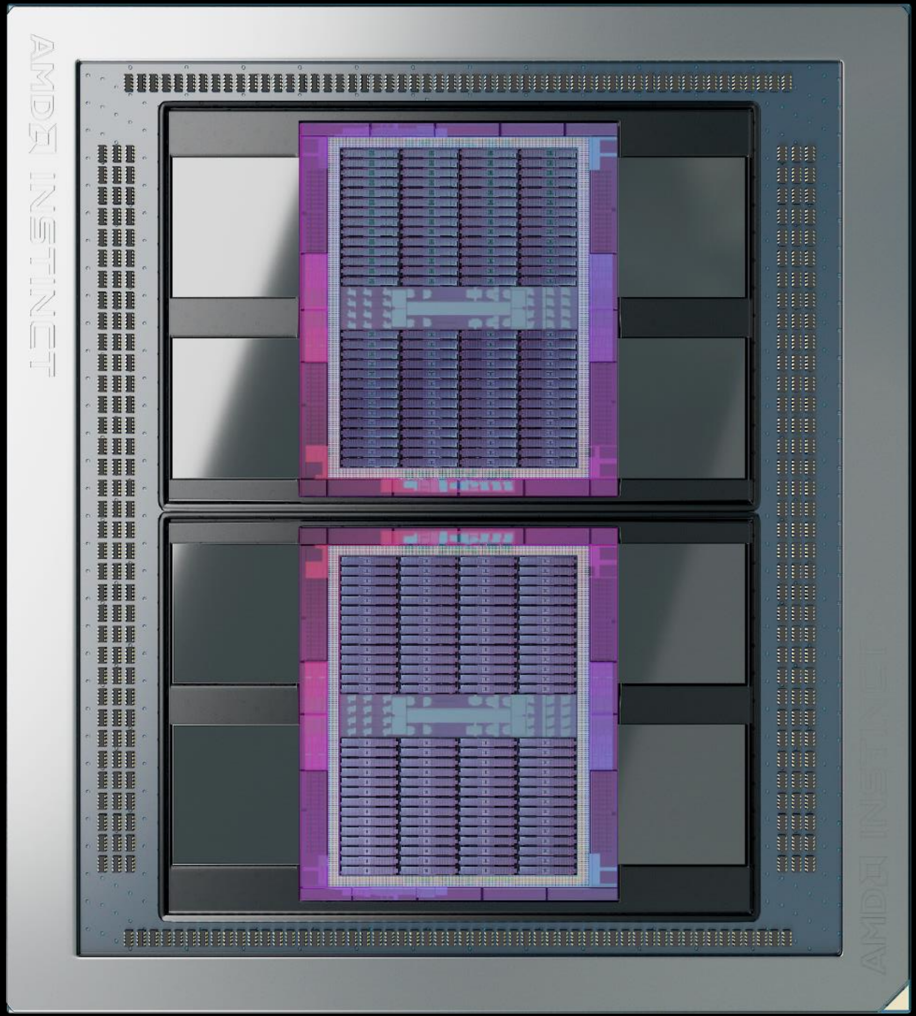
AMD

Understanding GPU activity & checking jobs

Paul Bauer, Samuel Antao

LUMI AI Workshop
Norway, Trømso, Jun. 11-12th, 2026

AMD Instinct™ GPUs



AMD INSTINCT™ MI250X

TWO COMPUTE CHIPLETS – 2 GCDs

58B
Transistors in 6nm

220
Compute Units

880
2nd Gen Matrix Cores

128
GB HBM2E @ 3.2 TB/s

https://www.amd.com/system/files/documents/amd-cdna2-white-paper.pdf

AMD
together we advance_

AMD Instinct™ GPUs

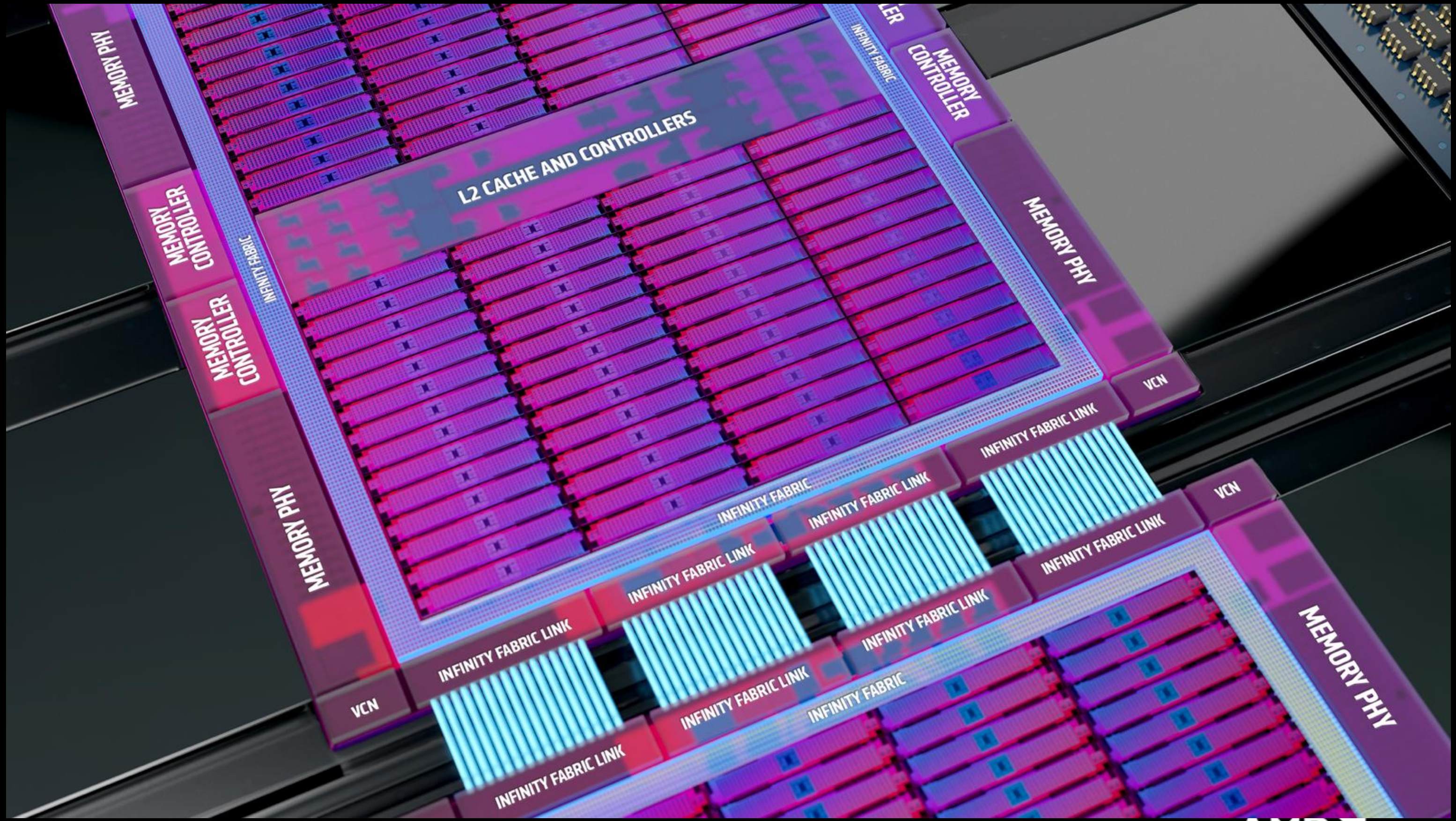
MULTI-CHIP DESIGN

TWO GPU DIES IN PACKAGE TO MAXIMIZE COMPUTE & DATA THROUGHPUT

INFINITY FABRIC FOR CROSS-DIE CONNECTIVITY

4 LINKS RUNNING AT 25GBPS

400GB/S OF BI-DIRECTIONALBANDWIDTH



AMD
together we advance_

Multiple GCD design has implications on monitoring strategy!

- GPUs have a given power budget for the two GCDs
- What is happening in one GCD will limit power in the other
- Drawn power is the best indicator of GPU activity:
  - A kernel waiting idle for data shows in the driver as 100% GPU utilization
  - Drawn power oscillating around 500W indicates that compute capabilities in the full GPU are being leveraged
  - For single GCD, 300W should be a good indication
- rocm-smi or amd-smi is the easiest way to peek at GPU utilization – but not the most accurate!

As reported by the driver – doesn't indicate how well the resource is used

Average power consumption

```
====================== ROCm System Management Interface ======================
================================ Concise Info ================================
GPU  Temp    AvgPwr  SCLK     MCLK     Fan  Perf    PwrCap  VRAM%  GPU%
0    58.0c   324.0W  1650Mhz  1600Mhz  0%   manual  500.0W   98%   100%
1    49.0c   N/A     800Mhz   1600Mhz  0%   manual  0.0W      0%   0%
==============================================================================
============================ End of ROCm SMI Log =============================
```

Frequency will shift to observe GPU power/thermal budget

AMD together we advance_

Starting a SLURM parallel session

- Staring session in specific nodes to monitor
  - For first node of allocation:

```
srun --interactive \
   --pty \
   /bin/bash
```

  - For other nodes (GPU’s won’t be visible):

```
srun --pty \
   --jobid <jobid> \
   -w <target_node> \
   --overlap \
   /usr/bin/bash
```

Get your job ID and allocated nodes (squeue --me)

↓

Start parallel session (srun --interactive…)

↓

Monitor node activity: rocm-smi for GPU top or similar to CPU

AMD together we advance_

Logging from the environment

- HIP runtime and GPU dispatch information can be logged with AMD_LOG_LEVEL=4

Number of blocks and threads of the dispatch

```
:3:hip_module.cpp          :662 : 117659918626 us: 8088 : [tid:0x14b2015e9700]
    hipLaunchKernel ( 0x14b5ec183ed0, {32768,1,1}, {512,1,1}, 0x14b2015e71b0, 0, stream:<null> )
...
:3:rocvirtual.cpp          :786 : 117659918634 us: 8088 : [tid:0x14b2015e9700] Arg0:   = val:16777216
:3:rocvirtual.cpp          :786 : 117659918636 us: 8088 : [tid:0x14b2015e9700] Arg1:   = val:22689590804480

... ShaderName : _ZN2at6native6legacy18elementwise_kernelILi512ELi1EZNS0_15gpu_kernel_implIZZZNS0_23direct_copy_kernel

:3:hip_module.cpp          :663 : 117659918649 us: 8088 : [tid:0x14b2015e9700] hipLaunchKernel: Returned hipSuccess :
```

Arguments

Kernel mangled name

Return error

AMD together we advance_

AMD Profilers

ROC-profiler (rocprof)

Hardware Counters	Raw collection of GPU counters and traces	
	Counter collection with user input files	Counter results printed to a CSV
Traces and timelines	Trace collection support for	
	CPU copy, HIP API, HSA API, GPU Kernels	
Visualisation	Traces visualized with Perfetto	

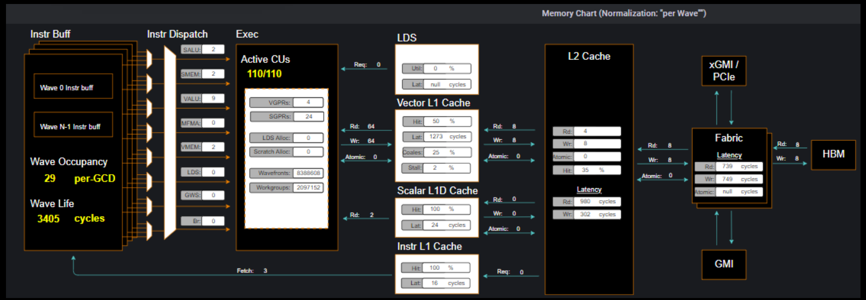
	A	B	C	D	E
1	Name	Calls	TotalDura	AverageN:	Percentage
2	hipMemcpyAsync	99	3.22E+10	3.25E+08	44.14872
3	hipEventSynchronize	330	2.42E+10	73394557	33.225
4	hipMemsetAsync	87	7.76E+09	89232696	10.64953
5	hipHostMalloc	9	5.41E+09	6.01E+08	7.415198
6	hipDeviceSynchronize	28	1.32E+09	47006288	1.805515
7	hipHostFree	17	1.05E+09	61534688	1.435014
8	hipMemcpy	41	8.11E+08	19791876	1.113161
9	hipLaunchKernel	1856	58082083	31294	0.079676
10	hipStreamCreate	2	46380834	23190417	0.063625
11	hipMemset	2	18847246	9423623	0.025854
12	hipStreamDestroy	2	15183338	7591669	0.020828
13	hipFree	38	8269713	217624	0.011344
14	hipEventRecord	330	2520035	7636	0.003457
15	hipMalloc	30	1484804	49493	0.002037
16	__hipPopCallConfigura	1856	229159	123	0.000314
17	__hipPushCallConfigur	1856	224177	120	0.000308
18	hipGetLastError	1494	100458	67	0.000138
19	hipEventCreate	330	76675	232	0.000105
20	hipEventDestroy	330	64671	195	8.87E-05
21	hipGetDevicePropertie	47	51808	1102	7.11E-05
22	hipGetDevice	64	11611	181	1.59E-05
23	hipSetDevice	1	401	401	5.50E-07
24	hipGetDeviceCount	1	220	220	3.02E-07

rocprof-sys

Trace collection	Comprehensive trace collection	
	CPU	GPU
Supports	CPU copy, HIP API, HSA API, GPU Kernels	
	OpenMP®, MPI, Kokkos, p-threads, multi-GPU	
Visualisation	Traces visualized with Perfetto	

rocprof-compute

Performance Analysis	Automated collection of hardware counters	
	Analysis	Visualisation
Supports	Speed of Light, Memory chart, Rooflines, Kernel comparison	
Visualisation	CLI or GUI	



Recent improvements to AMD profilers

Focus of this talk

	ROCm 6.2	ROCm 6.3	ROCm 6.4 +
GPU performance analysis for ROCm based apps	rocprof rocprofv3 beta (new RocProfiler tool)	rocprov3 and rocprof deprecation	rocprov3 default profiler
Holistic overview of CPU, GPU and system activity	omnitrace integrated to official ROCm	omnitrace renamed to rocprof-sys	rocprof-sys default
GPU kernel profiling	omniperf integrated to official ROCm	omniperf renamed to rocprof-compute	rocprof-compute default

More recent versions of the tools comprise improvement for better support of Python-based applications

Profiling with Rocprofv3

- Rocprofv3 profiler client is the easiest way to get started with GPU profiling
- It is available as part of the ROCm stack and, therefore, available in the containers
  - some dependencies might be missing – more on that latter
- It is seldomly useful to profile every single process/rank of your app:
  - Profiling more than needed = more potential profiling overhead
  - Misleading conclusions

Pick representative process/rank → Profile → Interpret and identify what is actionable

Command to prepend to my application instantiation

We want to profile only for one rank – in this case rank #2

```
pcmd=''
if [ $RANK -eq 2 ] ; then
  pcmd='rocprofv3 --hip-trace --kernel-trace --memory-copy-trace --output-format=pftrace -- '
fi
```

Run command as before except to the prepended profiling command

```
$pcmd python -u myapp.py
```


AMD
together we advance_

Profiling with Rocprofv3

- Understanding profiler options:

```
pcmd=''
if [ $RANK -eq 2 ] ; then
  pcmd='rocprofv3 --hip-trace --kernel-trace --memory-copy-trace --output-format=pftrace -- '
fi

$pcmd python -u myapp.py
```

- `--hip-trace`: collect information about the HIP runtime calls. Pytorch uses the HIP runtime to interact and queues GPU activity.
- `--kernel-trace`: collect information about GPU kernels.
- `--memory-copy-trace`: collect information about data movement between host and GPU as well as between GPUs.
- `--output-format`: select output format, pftrace is the most compatible with Perfetto UI web app.
- `--help` is your friend and provides a description of the pain options.

AMD
together we advance_

Profiling with Rocprof – Perfetto UI

API activity

GPU kernels

Data copies

https://ui.perfetto.dev/

Leveraging framework profiler infrastructure

- AI frameworks typically provide hooks for developers to gather profiling information
- An example with Pytorch:

```
from torch.profiler import profile, record_function, ProfilerActivity

for epoch in range(args.epochs):

    prof = None
    if epoch == 3:
        print("Starting profile...")
        prof = profile(activities=[ProfilerActivity.CPU, ProfilerActivity.CUDA])
        prof.start()

    for imgs, labels in dataloader:
        with torch.amp.autocast('cuda',enabled=args.amp):
            imgs, labels = imgs.cuda(), labels.cuda()
            outputs = model(imgs)
        loss = criterion(outputs, labels)
        loss = scaler.scale(loss)
        loss.backward()
        scaler.step(optimizer)
        scaler.update()

    if prof:
        prof.stop()
        prof.export_chrome_trace("trace.json")
```

Invoke the profiler

Enable profiling for epoch number 3

Training for an epoch

Finish profiling and generate trace

Trace file can be viewed in Perfetto UI tool

AMD together we advance_

Pytorch profiled– Perfetto UI

API activity
+
Pytorch labels

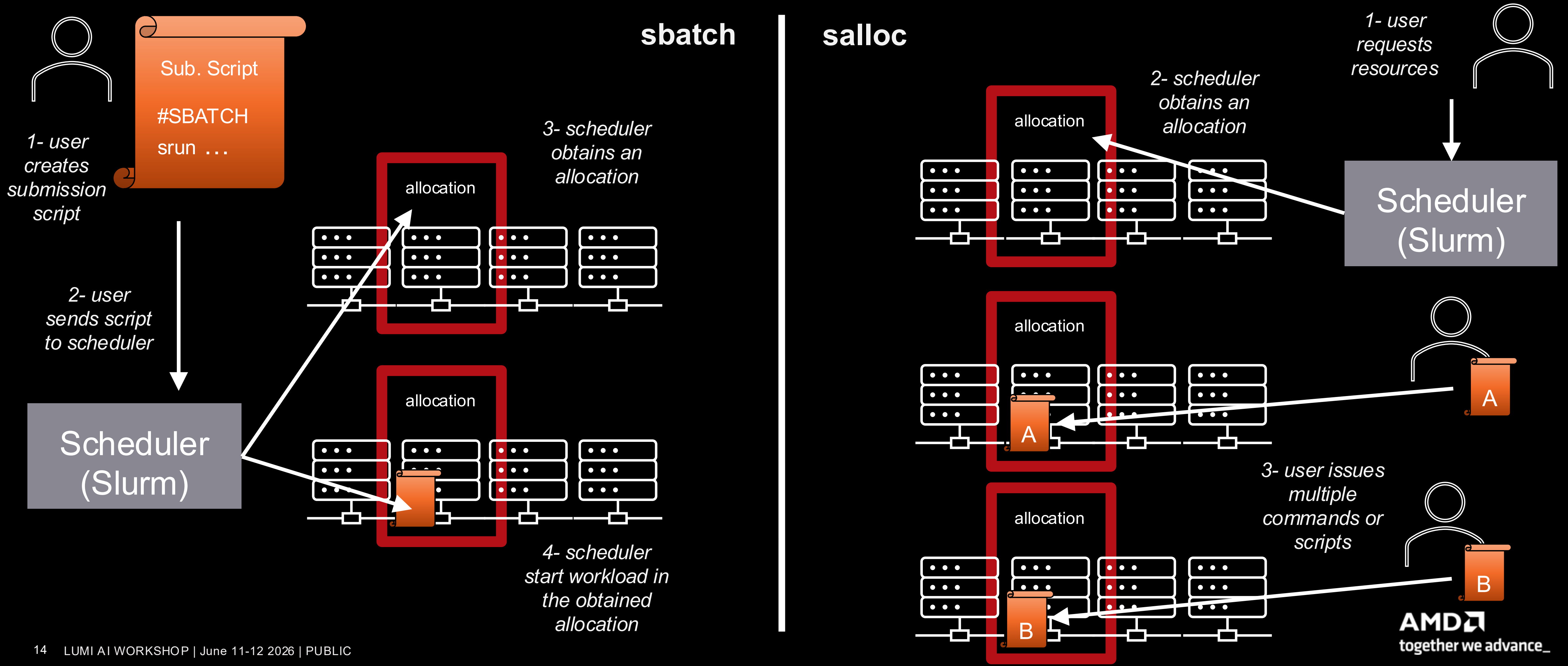
GPU kernels

https://ui.perfetto.dev/

AMD
together we advance_

Before jumping to the exercises… sbatch vs salloc

- In previous exercises you used batch jobs (with sbatch) – for this session we introduce interactive jobs (with salloc)



AMD
together we advance_

Before jumping to the exercises… sbatch vs salloc

- In previous exercises you used batch jobs (with sbatch) – for this session we introduce interactive jobs (with salloc)

!!!

While using salloc don’t forget to release your allocation at the end

!!!

AMD
together we advance_

Disclaimer and Attributions

The information contained herein is for informational purposes only and is subject to change without notice. While every precaution has been taken in the preparation of this document, it may contain technical inaccuracies, omissions and typographical errors, and AMD is under no obligation to update or otherwise correct this information. Advanced Micro Devices, Inc. makes no representations or warranties with respect to the accuracy or completeness of the contents of this document, and assumes no liability of any kind, including the implied warranties of noninfringement, merchantability or fitness for particular purposes, with respect to the operation or use of AMD hardware, software or other products described herein. No license, including implied or arising by estoppel, to any intellectual property rights is granted by this document. Terms and limitations applicable to the purchase or use of AMD products are as set forth in a signed agreement between the parties or in AMD's Standard Terms and Conditions of Sale. GD-18

AMD
together we advance_