

COMPREHENSIVE GENERAL LUMI COURSE

24/4/2024

# INTRODUCTION TO ROCGDB

Nick Curtis, Justin Chang, Bob Robey, Suyash Tandon, George Markomanolis, Samuel Antao

ADVANCED MICRO DEVICES, INC.

**AMD**  
together we advance\_

slides on LUMI in /project/project\_465001098/Slides/AMD/

hands-on exercises: <https://hackmd.io/xcPUS3VpSZmFy5wwc9uRww?view#Debugging>

hands-on source code: /project/project\_465001098/Exercises/AMD/HPCTrainingExamples/

# rocgdb

- AMD ROCm source-level debugger for Linux®
- based on the GNU Debugger (GDB)
  - tracks upstream GDB master
  - standard GDB commands for both CPU and GPU debugging
- considered a prototype
  - focus on source line debugging
  - no symbolic variable debugging yet

# simple saxpy kernel

```

1  #include <hip/hip_runtime.h>
2
3  __constant__ float a = 1.0f;
4
5  __global__
6  void saxpy(int n, float const* x, int incx, float* y, int incy)
7  {
8      int i = blockDim.x*blockIdx.x + threadIdx.x;
9      if (i < n)
10         y[i] += a*x[i];
11 }
12
13 int main()
14 {
15     int n = 256; ← size of arrays = 256
16     std::size_t size = sizeof(float)*n;
17
18     float* d_x;
19     float* d_y;
20     hipMalloc(&d_x, size);
21     hipMalloc(&d_y, size);
22
23     int num_groups = 2; ← two groups
24     int group_size = 128;
25     saxpy<<<num_groups, group_size>>>(n, d_x, 1, d_y, 1);
26     hipDeviceSynchronize();
27 }
28

```

classic saxpy operation  
one array index = one work-item

size of arrays = 256

two groups  
each 128 work-items



# cause a page fault

```
1 #include <hip/hip_runtime.h>
2
3 __constant__ float a = 1.0f;
4
5 __global__
6 void saxpy(int n, float const* x, int incx, float* y, int incy)
7 {
8     int i = blockDim.x*blockIdx.x + threadIdx.x;
9     if (i < n)
10         y[i] += a*x[i];
11 }
12
13 int main()
14 {
15     int n = 256;
16     std::size_t size = sizeof(float)*n;
17
18     float* d_x;
19     float* d_y;
20     // hipMalloc(&d_x, size);
21     // hipMalloc(&d_y, size); ←
22
23     int num_groups = 2;
24     int group_size = 128;
25     saxpy<<num_groups>>(n, d_x, 1, d_y, 1);
26     hipDeviceSynchronize();
27 }
28 }
```

Break it by commenting out the allocations.  
(better to initialize the pointers to nullptr)

It's important to synchronize before exit.

Otherwise, the CPU thread may quit before the GPU gets a chance to report the error.

# compile with hipcc

```
1 #include <hip/hip_runtime.h>
2
3 __constant__ float a = 1.0f;
4
5 __global__
6 void saxpy(int n, float const* x, int incx, float* y, int incy)
7 {
8     int i = blockDim.x*blockIdx.x + threadIdx.x;
9     if (i < n)
10         y[i] += a*x[i];
11 }
12
13 int main()
14 {
15     int n = 256;
16     std::size_t size = sizeof(float)*n;
17
18     float* d_x;
19     float* d_y;
20     // hipMalloc(&d_x, size);
21     // hipMalloc(&d_y, size);
22
23     int num_groups = 2;
24     int group_size = 128;
25     saxpy<<n, group_size>>(n,
26     hipDeviceSynchronize());
27 }
28
```

Need be, set the target

- gfx906 – MI50, MI60, Radeon 7
- gfx908 – MI100
- fgx90a – MI200
- The --amdgpu-target is replaced with --offload-arch

```
saxpy$ hipcc --amdgpu-target=gfx906 -o saxpy saxpy.hip.cpp
```

# run

```
1 #include <hip/hip_runtime.h>
2
3 __constant__ float a = 1.0f;
4
5 __global__
6 void saxpy(int n, float const* x, int incx, float* y, int incy)
7 {
8     int i = blockDim.x*blockIdx.x + threadIdx.x;
9     if (i < n)
10         y[i] += a*x[i];
11 }
12
13 int main()
14 {
15     int n = 256;
16     std::size_t size = sizeof(float)*n;
17
18     float* d_x;
19     float* d_y;
20     // hipMalloc(&d_x, size);
21     // hipMalloc(&d_y, size);
22
23     int num_groups = 2;
24     int group_size = 128;
25     saxpy<<<num_groups, group_size>>>(n,
26     hipDeviceSynchronize());
27 }
28
```

```
saxpy$ hipcc --amdgpu-target=gfx906 -o saxpy saxpy.hip.cpp
saxpy$ ./saxpy
```

# get a page fault

```
1 #include <hip/hip_runtime.h>
2
3 __constant__ float a = 1.0f;
4
5 __global__
6 void saxpy(int n, float const* x, int incx, float* y, int incy)
7 {
8     int i = blockDim.x*blockIdx.x + threadIdx.x;
9     if (i < n)
10         y[i] += a*x[i];
11 }
12
13 int main()
14 {
15     int n = 256;
16     std::size_t size = sizeof(float)*n;
17
18     float* d_x;
19     float* d_y;
20     // hipMalloc(&d_x, size);
21     // hipMalloc(&d_y, size);
22
23     int num_groups = 2;
24     int group_size = 128;
25     saxpy<<num_groups, group_size>>(n,
26     hipDeviceSynchronize());
27 }
28
```

```
saxpy$ hipcc --amdgpu-target=gfx906 -o saxpy saxpy.hip.cpp
saxpy$ ./saxpy
Memory access fault by GPU node-4 (Agent handle: 0x19dee10) on address (nil). Reason: Page not
present or supervisor privilege.
Aborted (core dumped)
saxpy$ █
```

# run with rocgdb

```
1 #include <hip/hip_runtime.h>
2
3 __constant__ float a = 1.0f;
4
5 __global__
6 void saxpy(int n, float const* x, int incx, float* y, int incy)
7 {
8     int i = blockDim.x*blockIdx.x + threadIdx.x;
9     if (i < n)
10         y[i] += a*x[i];
11 }
12
13 int main()
14 {
15     int n = 256;
16     std::size_t size = sizeof(float)*n;
17
18     float* d_x;
19     float* d_y;
20     // hipMalloc(&d_x, size);
21     // hipMalloc(&d_y, size);
22
23     int num_groups = 2;
24     int group_size = 128;
25     saxpy<<<num_groups, group_size>>>(n,
26     hipDeviceSynchronize());
27 }
28
```

```
saxpy$ rocgdb saxpy
```

# get more info

```

1  #include <hip/hip_runtime.h>
2
3  __constant__ float a = 1.0f;
4
5  __global__
6  void saxpy(int n, float const* x, int incx, float* y, int incy)
7  {
8      int i = blockDim.x*blockIdx.x + threadIdx.x;
9      if (i < n)
10         y[i] += a*x[i];
11 }
12
13 int main()
14 {
15     int n = 256;
16     std::size_t size = sizeof(float)*n;
17
18     float* d_x;
19     float* d_y;
20     // hipMalloc(&d_x, size);
21     // hipMalloc(&d_y, size);
22
23     int num_groups = 2;
24     int group_size = 128;
25     saxpy<<num_groups, group_size>>(n,
26     hipDeviceSynchronize());
27 }
28

```

Reports segmentation fault in the saxpy kernel.

```

(gdb) run
Starting program: /mnt/shared/codes/saxpy/saxpy
[Thread debugging using libthread_db enabled]
Using host libthread_db library "/lib/x86_64-linux-gnu/libthread_db.so.1".
[New Thread 0x7fffff4d36700 (LWP 67093)]
Warning: precise memory violation signal reporting is not enabled, reported
location may not be accurate. See "show amdgpu precise-memory".

Thread 3 "saxpy" received signal SIGSEGV, Segmentation fault.
[Switching to thread 3, lane 0 (AMDGPU Lane 1:2:1:1/0 (0,0,0)[0,0,0])]
0x00007ffe8a01094 in saxpy(int, float const*, int, float*, int) () from file:///mnt/shared/co
des/saxpy/saxpy#ofset=8192&size=13992
(gdb) █

```

# compile with -ggdb

```
1 #include <hip/hip_runtime.h>
2
3 __constant__ float a = 1.0f;
4
5 __global__
6 void saxpy(int n, float const* x, int incx, float* y, int incy)
7 {
8     int i = blockDim.x*blockIdx.x + threadIdx.x;
9     if (i < n)
10         y[i] += a*x[i];
11 }
12
13 int main()
14 {
15     int n = 256;
16     std::size_t size = sizeof(float)*n;
17
18     float* d_x;
19     float* d_y;
20     // hipMalloc(&d_x, size);
21     // hipMalloc(&d_y, size);
22
23     int num_groups = 2;
24     int group_size = 128;
25     saxpy<<<num_groups, group_size>>>(n,
26     hipDeviceSynchronize());
27 }
28
```

```
saxpy$ hipcc -ggdb --amdgpu-target=gfx906 -o saxpy saxpy.hip.cpp
```

# get more details

```

1  #include <hip/hip_runtime.h>
2
3  __constant__ float a = 1.0f;
4
5  __global__
6  void saxpy(int n, float const* x, int incx, float* y, int incy)
7  {
8      int i = blockDim.x*blockIdx.x + threadIdx.x;
9      if (i < n)
10         y[i] += a*x[i];
11 }
12
13 int main()
14 {
15     int n = 256;
16     std::size_t size = sizeof(float)*n;
17
18     float* d_x;
19     float* d_y;
20     // hipMalloc(&d_x, size);
21     // hipMalloc(&d_y, size);
22
23     int num_groups = 2;
24     int group_size = 128;
25     saxpy<<num_groups, group_size>>(n,
26     hipDeviceSynchronize());
27 }
28

```

But where's my stack trace?

more details

- what kernel
- what file:line

```

(gdb) run
Starting program: /mnt/shared/codes/saxpy/saxpy
[Thread debugging using libthread_db enabled]
Using host libthread_db library "/lib/x86_64-linux-gnu/libthread_db.so.1".
[New Thread 0x7fffff4d36700 (LWP 67682)]
Warning: precise memory violation signal reporting is not enabled, reported
location may not be accurate. See "show amdgpu precise-memory".

Thread 3 "saxpy" received signal SIGSEGV, Segmentation fault.
[Switching to thread 3, lane 0 (AMDGPU Lane 1:2:1:1/0 (0,0,0)[0,0,0])]
0x00007ffffe8a01094 in saxpy (n=<optimized out>, x=<optimized out>, incx=<optimized out>, y=<optimized out>, incy=<optimized out>) at saxpy.hip.cpp:10
10          y[i] += a*x[i];
(gdb) █

```

To get exceptions reported precisely: `set amdgpu precise-memory` on

# list threads

```

1  #include <hip/hip_runtime.h>
2
3  __constant__ float a = 1.0f;
4
5  __global__
6  void saxpy(int n, float const* x, int incx, float* y, int incy)
7  {
8      int i = blockDim.x*blockIdx.x + threadIdx.x;
9      if (i < n)
10         y[i] += a*x[i];
11 }
12
13 int main()
14 {
15     int n = 256;
16     std::size_t size = sizeof(float)*n;
17
18     float* d_x;
19     float* d_y;
20     // hipMalloc(&d_x, size);
21     // hipMalloc(&d_y, size);
22
23     int num_groups = 2;
24     int group_size = 128;
25     saxpy<<num_groups, group_size>>(n,
26     hipDeviceSynchronize());
27 }
28

```

What segfaulted is a GPU wave.  
 It does not have your CPU stack.  
**List threads to see what's going on.**

```

(gdb) i th
Id  Target Id
1   Thread 0x7ffff7fb6880 (LWP 67674) "saxpy" 0x00007ffff57f5102 in rocr::core::InterruptSig
     from /opt/rocm-4.5.0/hip/11b/../../11b/libhsa-runtime64.so.1
2   Thread 0x7ffff4d36700 (LWP 67682) "saxpy" 0x00007ffff5f6d317 in ioctl () at ../sysdeps/un
* 3   AMDGPU Wave 1:2:1:1 (0,0,0)/0 "saxpy" 0x00007ffffe8a01094 in saxpy (n=<optimized out>,
     4   AMDGPU Wave 1.2.1.2 (0,0,0)/1 "saxpy" 0x00007ffffe8a01094 in saxpy (n=<optimized out>,
     5   AMDGPU Wave 1:2:1:3 (1,0,0)/0 "saxpy" 0x00007ffffe8a01094 in saxpy (n=<optimized out>,
     6   AMDGPU Wave 1:2:1:4 (1,0,0)/1 "saxpy" 0x00007ffffe8a01094 in saxpy (n=<optimized out>,
(gdb) 

```

# switch to the CPU thread

```
1 #include <hip/hip_runtime.h>
2
3 __constant__ float a = 1.0f;
4
5 __global__
6 void saxpy(int n, float const* x, int incx, float* y, int incy)
7 {
8     int i = blockDim.x*blockIdx.x + threadIdx.x;
9     if (i < n)
10         y[i] += a*x[i];
11 }
12
13 int main()
14 {
15     int n = 256;
16     std::size_t size = sizeof(float)*n;
17
18     float* d_x;
19     float* d_y;
20     // hipMalloc(&d_x, size);
21     // hipMalloc(&d_y, size);
22
23     int num_groups = 2;
24     int group_size = 128;
25     saxpy<<num_groups, group_size>>(n,
26     hipDeviceSynchronize());
27 }
28
```

t 1

(thread 1)

**It's in the HSA runtime.**

```
(gdb) t 1
[Switching to thread 1 (Thread 0x7ffff7fb6880 (LWP 67674))]
#0  0x00007ffff57f5102 in rocr::core::InterruptSignal::WaitRelaxed(hsa_signal_condition_t, long, unsigned long, hsa_wait_state_t) ()
    from /opt/rocm-4.5.0/hip/lib/../../../lib/libhsa-runtime64.so.1
(gdb) █
```

But how did it get there?

# see the stack trace of the CPU thread

```

1  #include <hip/hip_runtime.h>
2
3  __constant__ float a = 1.0f;
4
5  __global__
6  void saxpy(int n, float const* x, int incx, float* y, int incy)
7  {
8      int i = blockDim.x*blockIdx.x + threadIdx.x;
9      if (i < n)
10         y[i] += a*x[i];
11 }
12
13 int main()
14 {
15     int n = 256;
16     std::size_t size = std::size_t(n)*n;
17
18     float* d_x;
19     float* d_y;
20     // hipMalloc(&d_x, size);
21     // hipMalloc(&d_y, size);
22
23     int num_groups = 2;
24     int group_size = 128;
25     saxpy<<num_groups, group_size>>(n,
26     hipDeviceSynchronize();
27 }
28

```

HSA runtime

HIP runtime

where

```

(gdb) where
#0  0x00007ffff57f5102 in rocr::core::InterruptSignal::WaitRelaxed(hsa_signal_condition_t, long
g, unsigned long, hsa_wait_state_t) ()
   from /opt/rocm-4.5.0/hip/lib/.../lib/libhsa-runtime64.so.1
#1  0x00007ffff57f4eca in rocr::core::InterruptSignal::WaitAcquire(hsa_signal_condition_t, long
g, unsigned long, hsa_wait_state_t) ()
   from /opt/rocm-4.5.0/hip/lib/.../lib/libhsa-runtime64.so.1
#2  0x00007ffff57e58e9 in rocr::HSA::hsa_signal_wait_scacquire(hsa_signal_s, hsa_signal_condition_t, long, unsigned long, hsa_wait_state_t) ()
   from /opt/rocm-4.5.0/hip/lib/.../lib/libhsa-runtime64.so.1
#3  0x00007ffff67ac633 in ?? () from /opt/rocm-4.5.0/hip/lib/libamdhip64.so.4
#4  0x00007ffff67b593e in ?? () from /opt/rocm-4.5.0/hip/lib/libamdhip64.so.4
#5  0x00007ffff67b9347 in ?? () from /opt/rocm-4.5.0/hip/lib/libamdhip64.so.4
#6  0x00007ffff67bc2a5 in ?? () from /opt/rocm-4.5.0/hip/lib/libamdhip64.so.4
#7  0x00007ffff678d92d in ?? () from /opt/rocm-4.5.0/hip/lib/libamdhip64.so.4
#8  0x00007ffff678df28 in ?? () from /opt/rocm-4.5.0/hip/lib/libamdhip64.so.4
#9  0x00007ffff678dfdc in ?? () from /opt/rocm-4.5.0/hip/lib/libamdhip64.so.4
#10 0x00007ffff679146c in ?? () from /opt/rocm-4.5.0/hip/lib/libamdhip64.so.4
#11 0x00007ffff664ceed in hipDeviceSynchronize ()
   from /opt/rocm-4.5.0/hip/lib/libamdhip64.so.4
#12 0x0000000000020d9cd in main () at saxpy.hip.cpp:26
(gdb) ■

```

# Quick tip

- Frontier and LUMI CPUs have 64 cores / 128 threads.
- If you're debugging an app with OpenMP threading and OMP\_NUM\_THREADS is not set you will see 128 CPU threads in rocgdb.
- Set OMP\_NUM\_THREADS=1 when debugging GPU codes.
- If you want to use a breakpoint in a kernel and the assigned line is not correct, then declare the variable ***export HIP\_ENABLE\_DEFERRED\_LOADING=0*** this is required as HIP runtime performs deferred code object loading by default, thus if your source line corresponds to an unloaded object, ROCGDB could set the breakpoint to unrelated line.

# "GUIs"

rocgdb -tui saxpy

The screenshot shows the rocgdb -tui interface. On the left, a code editor displays the `saxpy.cpp` file with syntax highlighting for C++ code. On the right, a terminal window shows the GDB debugger interacting with the program. The word "source" is written vertically along the right edge of the code editor, and "console" is written vertically along the right edge of the terminal window.

```

saxpy.cpp: saxpy : rocgdb — Konsole
File Edit View Bookmarks Settings Help
1 #include <hip/hip_runtime.h>
2
3 __constant__ float a = 1.0f;
4
5 __global__
6 void saxpy(int n, float const* x, int incx, float* y, int incy)
7 {
8     int i = blockDim.x*blockIdx.x + threadIdx.x;
9     if (i < n)
10         y[i] += a*x[i];
11 }
12
13 int main()
14 {
15     int n = 256;
16     std::size_t size = sizeof(float)*n;
17
18     float* d_x;
19     float* d_y;
20     hipMalloc(&d_x, size);
21     hipMalloc(&d_y, size);
22
23     int num_groups = 2;
24     int group_size = 128;
25     saxpy<<(num_groups, group_size>>(n, d_x, 1, d_y, 1);
26     hipDeviceSynchronize();
27 }
28
29
30
31
32
exec No process In:
GNU gdb (rocm-rel-4.5-56) 11.1
Copyright (C) 2021 Free Software Foundation, Inc.
License GPLv3+: GNU GPL version 3 or later <http://gnu.org/licenses/gpl.html>
This is free software: you are free to change and redistribute it.
There is NO WARRANTY, to the extent permitted by law.
Type "show copying" and "show warranty" for details.
This GDB was configured as "x86_64-pc-linux-gnu".
Type "show configuration" for configuration details.
For bug reporting instructions, please see:
<https://github.com/ROCM-Developer-Tools/ROCgdb/issues>.
Find the GDB manual and other documentation resources online at:
<http://www.gnu.org/software/gdb/documentation/>.

For help, type "help".
Type "apropos word" to search for commands related to "word"...
Reading symbols from ./saxpy...
(gdb) [?2004h(gdb) ]

```

cgdb -d rocgdb saxpy

The screenshot shows the cgdb -d interface. On the left, a code editor displays the `saxpy.cpp` file with syntax highlighting for C++ code. On the right, a terminal window shows the GDB debugger interacting with the program. The word "source" is written vertically along the right edge of the code editor, and "console" is written vertically along the right edge of the terminal window.

```

saxpy.cpp: saxpy : cgdb — Konsole
File Edit View Bookmarks Settings Help
1 #include <hip/hip_runtime.h>
2
3 __constant__ float a = 1.0f;
4
5 __global__
6 void saxpy(int n, float const* x, int incx, float* y, int incy)
7 {
8     int i = blockDim.x*blockIdx.x + threadIdx.x;
9     if (i < n)
10         y[i] += a*x[i];
11 }
12
13 int main()
14 {
15     int n = 256;
16     std::size_t size = sizeof(float)*n;
17
18     float* d_x;
19     float* d_y;
20     hipMalloc(&d_x, size);
21     hipMalloc(&d_y, size);
22
23     int num_groups = 2;
24     int group_size = 128;
25     saxpy<<(num_groups, group_size>>(n, d_x, 1, d_y, 1);
26     hipDeviceSynchronize();
27
/mnt/shared/codes/saxpy/saxpy.hip.cpp
[35;1mGNU gdb (rocm-rel-4.5-56) 11.1[m
Copyright (C) 2021 Free Software Foundation, Inc.
License GPLv3+: GNU GPL version 3 or later <http://gnu.org/licenses/gpl.html>
This is free software: you are free to change and redistribute it.
There is NO WARRANTY, to the extent permitted by law.
Type "show copying" and "show warranty" for details.
This GDB was configured as "x86_64-pc-linux-gnu".
Type "show configuration" for configuration details.
For bug reporting instructions, please see:
<https://github.com/ROCM-Developer-Tools/ROCgdb/issues>.
Find the GDB manual and other documentation resources online at:
<http://www.gnu.org/software/gdb/documentation/>.

For help, type "help".
Type "apropos word" to search for commands related to "word"...
Reading symbols from [32m./saxpy[m...
[?2004h(gdb) ]

```

Source

Console

# rocgdb + gdbgui

breakpoint in CPU code



Load Binary /mnt/shared/codes/saxpy/saxpy

show filesystem fetch disassembly reload file jump to line /mnt/shared/codes/saxpy/saxpy.hip.cpp:22 (27 lines total)

```

1 #include <hip/hip_runtime.h>
2
3 __constant__ float a = 1.0f;
4
5 __global__
6 void saxpy(int n, float const* x, float* y)
7 {
8     int i = blockDim.x*blockIdx.x + threadIdx.x;
9     if (i < n)
10         y[i] += a*x[i];
11 }
12
13 int main()
14 {
15     int n = 256;
16     std::size_t size = sizeof(float)*n;
17
18     float* d_x;
19     float* d_y;
20     hipMalloc(&d_x, size);
21     hipMalloc(&d_y, size);
22
23     int num_groups = 2;
24     int group_size = 128;
25     saxpy<<<num_groups, group_size>>>(n, d_x, d_y);
26 }
27
(end of file)

```

running command: /opt/rocm/bin/rocgdb

GNU gdb (rocm-rel-4.5-56) 11.1  
Copyright (C) 2021 Free Software Foundation, Inc.  
License GPLv3+: GNU GPL version 3 or later <<http://gnu.org/licenses/gpl.html>>  
This is free software: you are free to change and redistribute it.  
There is NO WARRANTY, to the extent permitted by law.  
Type "show copying" and "show warranty" for details.  
This GDB was configured as "x86\_64-pc-linux-gnu".  
Type "show configuration" for configuration details.  
For bug reporting instructions, please see:  
<<https://github.com/ROCM-Developer-Tools/ROCGdb/issues>>.  
Find the GDB manual and other documentation resources online at:  
<<http://www.gnu.org/software/gdb/documentation/>>.

For help, type "help".  
Type "apropos word" to search for commands related to "word".  
New UI allocated  
(gdb) █

Source

Console

# hit CPU breakpoint

r  
(run)

hit the breakpoint in CPU code

```
Load Binary /mnt/shared/codes/saxpy/saxpy
show filesystem fetch disassembly reload file jump to line /mnt/shared/codes/saxpy/saxpy.hip.cpp:22 (27 lines total)
1 #include <hip/hip_runtime.h>
2
3 __constant__ float a = 1.0f;
4
5 __global__
6 void saxpy(int n, float const* x, float* y)
7 {
8     int i = blockDim.x*blockIdx.x + threadIdx.x;
9     if (i < n)
10         y[i] += a*x[i];
11 }
12
13 int main()
14 {
15     int n = 256;
16     std::size_t size = sizeof(float)*n;
17
18     float* d_x;
19     float* d_y;
20
21     (gdb) r
22 Starting program: /mnt/shared/codes/saxpy/saxpy
[Thread debugging using libthread_db enabled]
Using host libthread_db library "/lib/x86_64-linux-gnu/libthread_db.so.1".
23
24
25
26 }
27
Breakpoint 1, main () at saxpy.hip.cpp:22
22
(gdb) █
```

```
(gdb) r
Starting program: /mnt/shared/codes/saxpy/saxpy
[Thread debugging using libthread_db enabled]
Using host libthread_db library "/lib/x86_64-linux-gnu/libthread_db.so.1".

Breakpoint 1, main () at saxpy.hip.cpp:22
22
(gdb) █
```

# show CPU arch

show architecture

➤ x86-64

```
Load Binary /mnt/shared/codes/saxpy/saxpy
show filesystem fetch disassembly reload file jump to line /mnt/shared/codes/saxpy/saxpy.hip.cpp:22 (27 lines total)
1 #include <hip/hip_runtime.h>
2
3 __constant__ float a = 1.0f;
4
5 __global__
6 void saxpy(int n, float const* x, float* y)
7 {
8     int i = blockDim.x*blockIdx.x + threadIdx.x;
9     if (i < n)
10         y[i] += a*x[i];
11 }
12
13 int main()
14 {
15     int n = 256;
16     std::size_t size = sizeof(float)*n;
17
18     float* d_x;
19     float* d_y;
20     hipMalloc(&d_x, size);
21     hipMalloc(&d_y, size);
22
23     int num_groups = 2;
24     int group_size = 128;
25 } (gdb) show architecture
26 The target architecture is set to "auto" (currently "i386:x86-64").
27 (gdb) 
```

(gdb) show architecture  
The target architecture is set to "auto" (currently "i386:x86-64").  
(gdb) █

# show CPU thread

i th  
(info threads)

➤ one CPU thread in main()

```

Load Binary /mnt/shared/codes/saxpy/saxpy
show filesystem fetch disassembly reload file jump to line /mnt/shared/codes/saxpy/saxpy.hip.cpp:22 (27 lines total)
1 #include <hip/hip_runtime.h>
2
3 __constant__ float a = 1.0f;
4
5 __global__
6 void saxpy(int n, float const* x, float* y)
7 {
8     int i = blockDim.x*blockIdx.x + threadIdx.x;
9     if (i < n)
10         y[i] += a*x[i];
11 }
12
13 int main()
14 {
15     int n = 256;
16     std::size_t size = sizeof(float)*n;
17
18     float* d_x;
19     float* d_y;
20     hipMalloc(&d_x, size);
21     hipMalloc(&d_y, size);
22
23     int num_groups = 2;
24     int group_size = 128;
25
26 } (gdb) i th
27 Id Target Id Frame
(en * 1 Thread 0x7ffff7fb6880 (LWP 55024) "saxpy" main () at saxpy.hip.cpp:22
(gdb) 
```

```

(gdb) i th
Id Target Id Frame
* 1 Thread 0x7ffff7fb6880 (LWP 55024) "saxpy" main () at saxpy.hip.cpp:22
(gdb) 
```

# set GPU breakpoint

b saxpy  
(breakpoint saxpy)  
➤ set a breakpoint in saxpy

```
Load Binary /mnt/shared/codes/saxpy/saxpy
show filesystem fetch disassembly reload file jump to line /mnt/shared/codes/saxpy/saxpy.hip.cpp:22 (27 lines total)
1 #include <hip/hip_runtime.h>
2
3 __constant__ float a = 1.0f;
4
5 __global__
6 void saxpy(int n, float const* x, float* y)
7 {
8     int i = blockDim.x*blockIdx.x + threadIdx.x;
9     if (i < n)
10         y[i] += a*x[i];
11 }
12
13 int main()
14 {
15     int n = 256;
16     std::size_t size = sizeof(float)*n;
17
18     float* d_x;
19     float* d_y;
20     hipMalloc(&d_x, size);
21     hipMalloc(&d_y, size);
22
(gdb) b saxpy
Function "saxpy" not defined.
Make breakpoint pending on future shared library load? (y or [n]) y
Breakpoint 2 (saxpy) pending.
(gdb) █
```

```
(gdb) b saxpy
Function "saxpy" not defined.
Make breakpoint pending on future shared library load? (y or [n]) y
Breakpoint 2 (saxpy) pending.
(gdb) █
```

# hit GPU breakpoint

c

(continue)

➤ hit the kernel breakpoint



Load Binary /mnt/shared/codes/saxpy/saxpy

show filesystem fetch disassembly reload file jump to line /mnt/shared/codes/saxpy/saxpy.hip.cpp:6 (27 lines total)

```

1 #include <hip/hip_runtime.h>
2
3 __constant__ float a = 1.0f;
4
5 __global__
6 void saxpy(int n, float const* x, float* y)
7 {
8     int i = blockDim.x*blockIdx.x + threadIdx.x;
9     if (i < n)
10         y[i] += a*x[i];
11 }
12
13 int main()
14 {
15     int n = 256;
16     std::size_t size = sizeof(float)*n;
17
18     float* d_x;
19     float* d_y;
20
21
22 (gdb) c
Continuing.
[Switching to thread 3, lane 0 (AMDGPU Lane 1:2:1:1/0 (0,0,0)[0,0,0])]

Thread 3 "saxpy" hit Breakpoint 2, with lanes [0-63], saxpy (n=<optimized out>,
, incy=<optimized out>) at saxpy.hip.cpp:6
6     void saxpy(int n, float const* x, float* y)
(gdb) █

```

```

(gdb) c
Continuing.
[Switching to thread 3, lane 0 (AMDGPU Lane 1:2:1:1/0 (0,0,0)[0,0,0])]

Thread 3 "saxpy" hit Breakpoint 2, with lanes [0-63], saxpy (n=<optimized out>, x=<optimized out>, incx=<optimized out>, y=<optimized out>
, incy=<optimized out>) at saxpy.hip.cpp:6
6     void saxpy(int n, float const* x, float* y)
(gdb) █

```

# show GPU arch

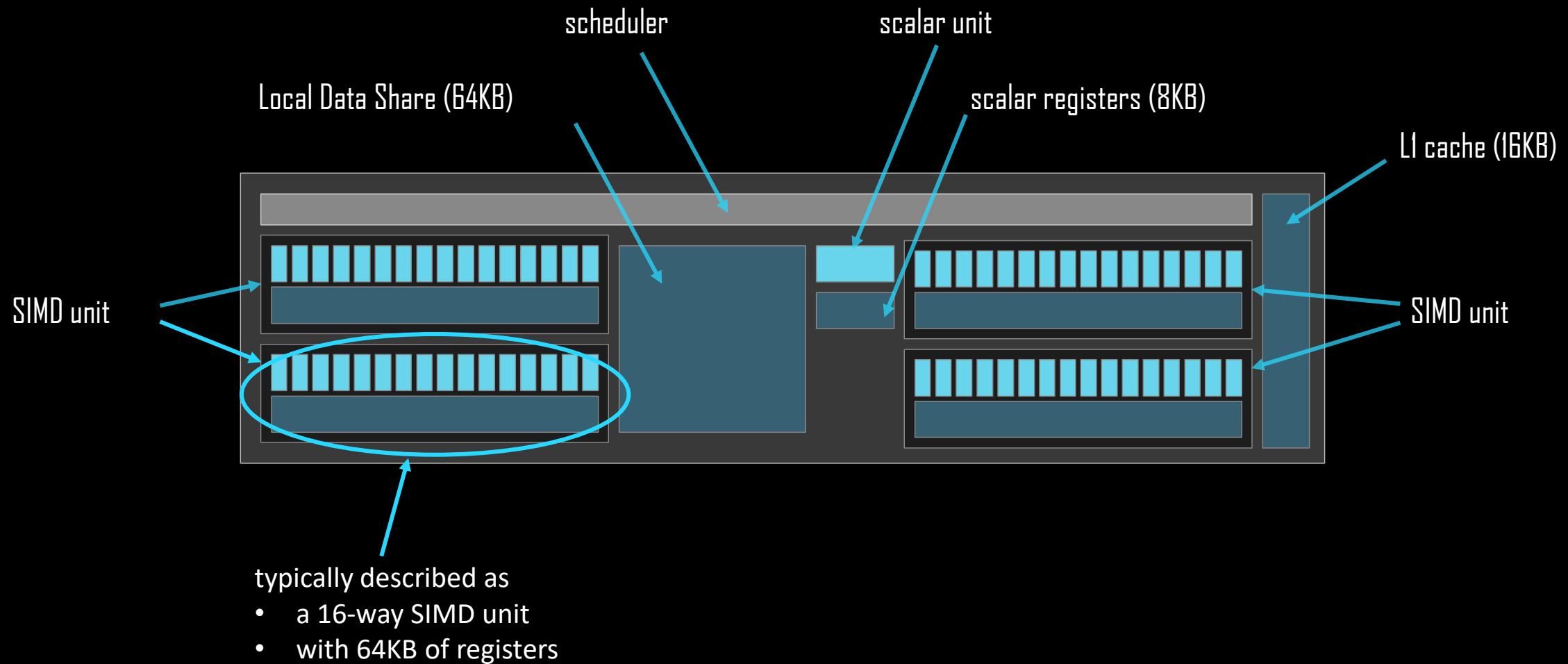
show architecture

➤ gfx906

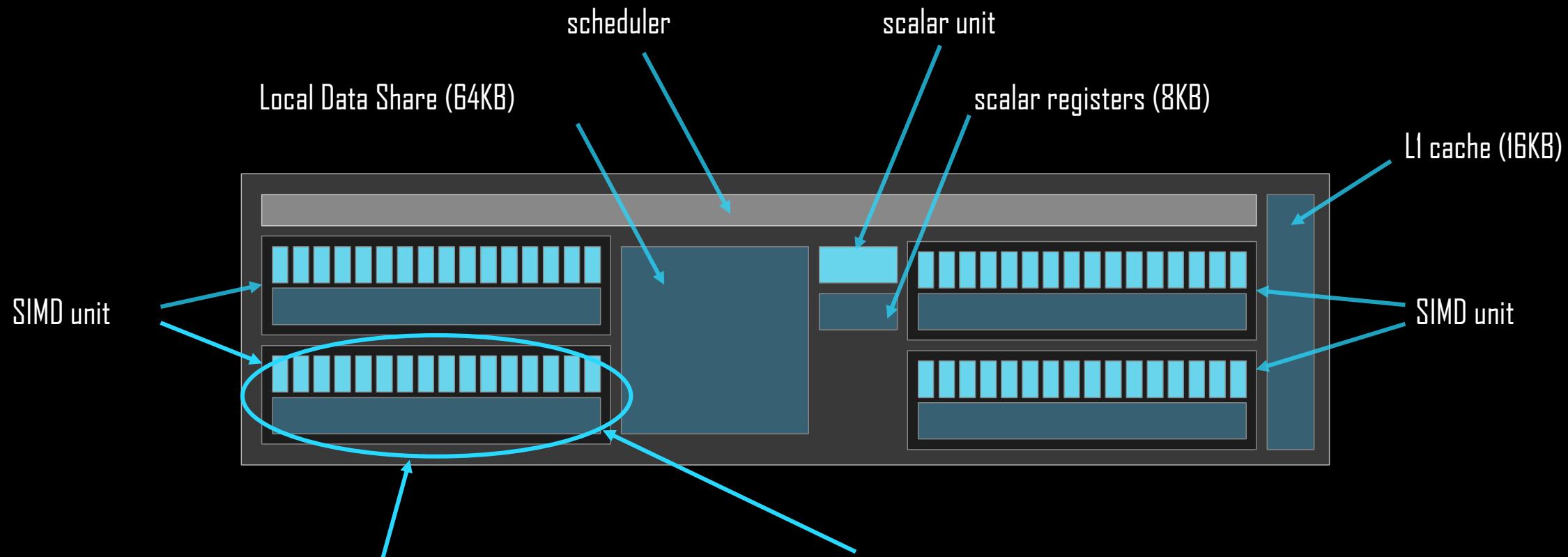
```
Load Binary /mnt/shared/codes/saxpy/saxpy
show filesystem fetch disassembly reload file jump to line /mnt/shared/codes/saxpy/saxpy.hip.cpp:6 (27 lines total)
1 #include <hip/hip_runtime.h>
2
3 __constant__ float a = 1.0f;
4
5 __global__
6 void saxpy(int n, float const* x, float* y)
7 {
8     int i = blockDim.x*blockIdx.x + threadIdx.x;
9     if (i < n)
10         y[i] += a*x[i];
11 }
12
13 int main()
14 {
15     int n = 256;
16     std::size_t size = sizeof(float)*n;
17
18     float* d_x;
19     float* d_y;
20     hipMalloc(&d_x, size);
21     hipMalloc(&d_y, size);
22
23     int num_groups = 2;
24     int group_size = 128;
25 } (gdb) show architecture
26 } (gdb) The target architecture is set to "auto" (currently "amdgn:gfx906"). (gdb) 
```

```
(gdb) show architecture
The target architecture is set to "auto" (currently "amdgn:gfx906").
(gdb) 
```

# MI200 compute unit



# MI200 compute unit



from the standpoint of rocGDB

- a **core**
- executing up to 10 **threads**
- with vector length of 64 **lanes**
- and containing 256 vector **registers**

# list threads / waves

i th  
(info threads)

some CPU threads  
4 GPU “threads” (waves)

```
Load Binary /mnt/shared/codes/saxpy/saxpy
show filesystem fetch disassembly reload file jump to line /mnt/shared/codes/saxpy/saxpy.hip.cpp:6 (27 lines total)
1 #include <hip/hip_runtime.h>
2
3 __constant__ float a = 1.0f;
4
5 __global__
6 void saxpy(int n, float const* x, float* y)
7 {
8     int i = blockDim.x*blockIdx.x + threadIdx.x;
9     if (i < n)
10         y[i] += a*x[i];
11 }
12
13 int main()
14 {
15     int n = 256;
16     std::size_t size = sizeof(float)*n;
17
(gdb) i th
   Id  Target Id                               Frame
20    1  Thread 0x7ffff7fb6880 (LWP 66369) "saxpy" 0x00007ffff662aefe in ?? ()
21    2  Thread 0x7ffff4d36700 (LWP 66378) "saxpy" 0x00007ffff5f6d317 in ioctl ()
22
23    * 3  AMDGPU Wave 1:2:1:1 (0,0,0)/0 "saxpy"  saxpy (n=<optimized out>, 
24        4  AMDGPU Wave 1:2:1:2 (0,0,0)/1 "saxpy"  saxpy (n=<optimized out>, 
25        5  AMDGPU Wave 1:2:1:3 (1,0,0)/0 "saxpy"  saxpy (n=<optimized out>, 
26        6  AMDGPU Wave 1:2:1:4 (1,0,0)/1 "saxpy"  saxpy (n=<optimized out>, 
(en)
(gdb) ■
```

```
(gdb) i th
   Id  Target Id                               Frame
1  Thread 0x7ffff7fb6880 (LWP 66369) "saxpy" 0x00007ffff662aefe in ?? () from /opt/rocm/lib/libamdhip64.so.4
2  Thread 0x7ffff4d36700 (LWP 66378) "saxpy" 0x00007ffff5f6d317 in ioctl () at ../sysdeps/unix/syscall-template.S:78
* 3  AMDGPU Wave 1:2:1:1 (0,0,0)/0 "saxpy"  saxpy (n=<optimized out>, x=<optimized out>, incx=<optimized out>, ) at saxpy.hip.cpp:6
4  AMDGPU Wave 1:2:1:2 (0,0,0)/1 "saxpy"  saxpy (n=<optimized out>, x=<optimized out>, incx=<optimized out>, ) at saxpy.hip.cpp:6
5  AMDGPU Wave 1:2:1:3 (1,0,0)/0 "saxpy"  saxpy (n=<optimized out>, x=<optimized out>, incx=<optimized out>, ) at saxpy.hip.cpp:6
6  AMDGPU Wave 1:2:1:4 (1,0,0)/1 "saxpy"  saxpy (n=<optimized out>, x=<optimized out>, incx=<optimized out>, ) at saxpy.hip.cpp:6
(gdb) ■
```

# wave details

agent-id:queue-id:dispatch-num:wave-id (work-group-x,work-group-y,work-group-z)/work-group-thread-index

```

Load Binary /mnt/shared/codes/saxpy/saxpy
show filesystem fetch disassembly reload file jump to line /mnt/shared/codes/saxpy/saxpy.hip.cpp:6 (27 lines total)
1 #include <hip/hip_runtime.h>
2
3 __constant__ float a = 1.0f;
4
5 __global__
6 void saxpy(int n, float const* x, float* y)
7 {
8     int i = blockDim.x*blockIdx.x + threadIdx.x;
9     if (i < n)
10         y[i] += a*x[i];
11 }
12
13 int main()
14 {
15     int n = 250;
16     std::size_t size = sizeof(float)*n;
17
(gdb) i th
  Id  Target Id                               Frame
  1  Thread 0x7ffff7fb6880 (LWP 66369) "saxpy" 0x00007ffff662aefe in ?? ()
  2  Thread 0x7ffff4d36700 (LWP 66378) "saxpy" 0x00007ffff5f6d317 in ioctl
* 3  AMDGPU Wave 1:2:1:1 (0,0,0)/0 "saxpy"    saxpy (n=<optimized out>,
  4  AMDGPU Wave 1:2:1:2 (0,0,0)/1 "saxpy"    saxpy (n=<optimized out>,
  5  AMDGPU Wave 1:2:1:3 (1,0,0)/0 "saxpy"    saxpy (n=<optimized out>,
  6  AMDGPU Wave 1:2:1:4 (1,0,0)/1 "saxpy"    saxpy (n=<optimized out>,
(gdb) ■

```

```

(gdb) i th
  Id  Target Id                               Frame
  1  Thread 0x7ffff7fb6880 (LWP 66369) "saxpy" 0x00007ffff662aefe in ?? () from /opt/rocm/lib/libamdhip64.so.4
  2  Thread 0x7ffff4d36700 (LWP 66378) "saxpy" 0x00007ffff5f6d317 in ioctl
* 3  AMDGPU Wave 1:2:1:1 (0,0,0)/0 "saxpy"    saxpy (n=<optimized out>, x=<optimized out>, cx=<optimized out>, ) at saxpy.hip.cpp:6
  4  AMDGPU Wave 1:2:1:2 (0,0,0)/1 "saxpy"    saxpy (n=<optimized out>, x=<optimized out>, incx=<optimized out>, ) at saxpy.hip.cpp:6
  5  AMDGPU Wave 1:2:1:3 (1,0,0)/0 "saxpy"    saxpy (n=<optimized out>, x=<optimized out>, incx=<optimized out>, ) at saxpy.hip.cpp:6
  6  AMDGPU Wave 1:2:1:4 (1,0,0)/1 "saxpy"    saxpy (n=<optimized out>, x=<optimized out>, incx=<optimized out>, ) at saxpy.hip.cpp:6
(gdb) ■

```

agent (GPU) ID  
(HSA) queue ID  
dispatch number  
workgroup (x, y, z)  
wave ID (within group)  
wave ID

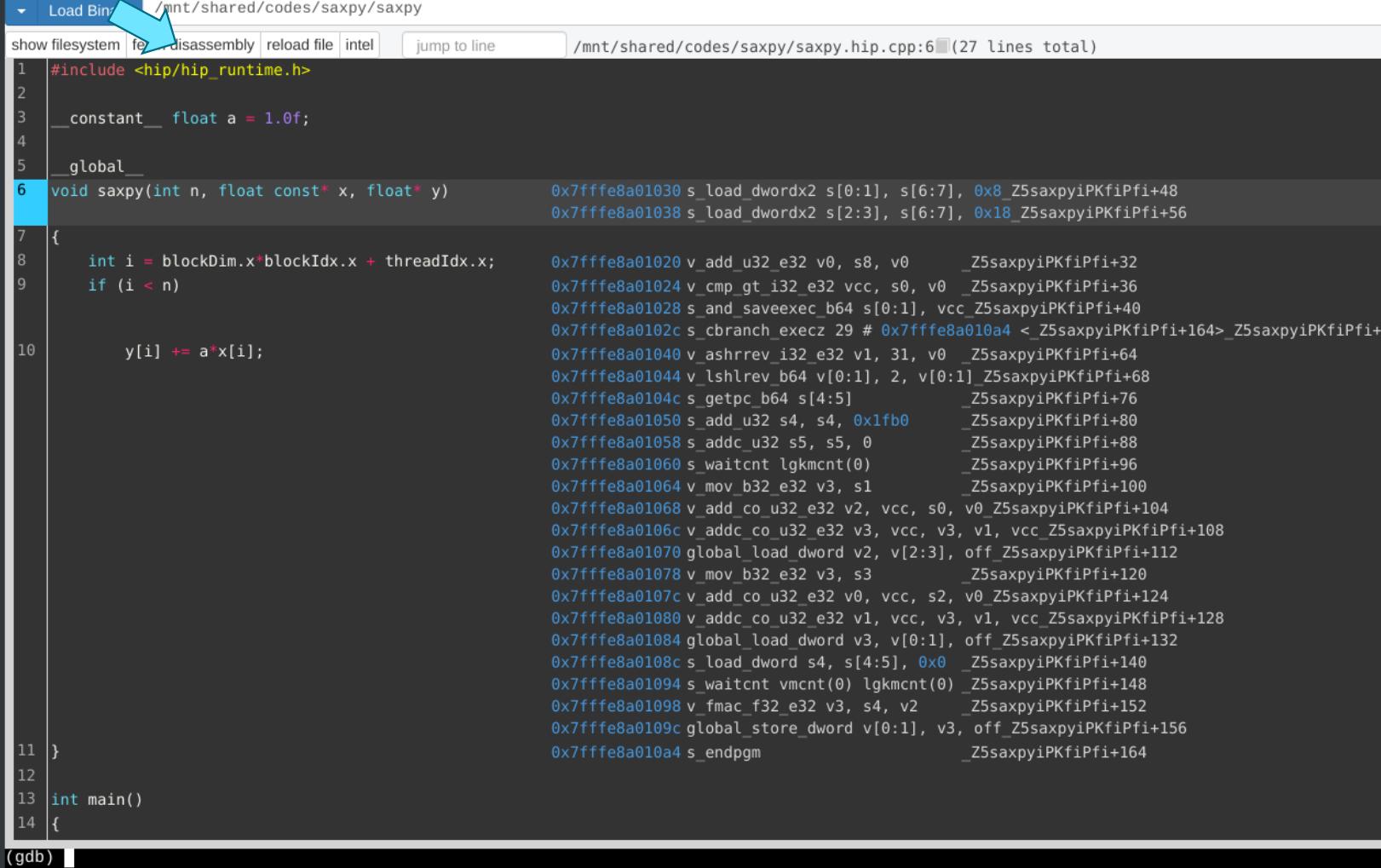
# show assembly

fetch disassembly

➤ assembly next to source

-O3 is the default for device code

-O0 gives better ISA-source correlation



The screenshot shows a debugger window with the title bar "Load Bin: /mnt/shared/codes/saxpy/saxpy". The top menu bar includes "show filesystem", "file", "disassembly", "reload file", "intel", "jump to line", and the current file path "/mnt/shared/codes/saxpy/saxpy.hip.cpp:6 (27 lines total)". The main area displays the C/C++ source code for a "saxpy" function and its corresponding assembly code. The assembly code is annotated with memory addresses and symbolic names. A blue arrow points to the "disassembly" tab in the top bar.

```

1 #include <hip/hip_runtime.h>
2
3 __constant__ float a = 1.0f;
4
5 __global__
6 void saxpy(int n, float const* x, float* y)      0x7ffffe8a01030 s_load_dwordx2 s[0:1], s[6:7], 0x8_Z5saxpyiPKfiPfi+48
7 {                                                 0x7ffffe8a01038 s_load_dwordx2 s[2:3], s[6:7], 0x18_Z5saxpyiPKfiPfi+56
8     int i = blockDim.x*blockIdx.x + threadIdx.x;    0x7ffffe8a01020 v_add_u32_e32 v0, s8, v0      _Z5saxpyiPKfiPfi+32
9     if (i < n)                                     0x7ffffe8a01024 v_cmp_gt_i32_e32 vcc, s0, v0  _Z5saxpyiPKfiPfi+36
10        y[i] += a*x[i];                            0x7ffffe8a01028 s_and_saveexec_b64 s[0:1], vcc _Z5saxpyiPKfiPfi+40
11    }                                              0x7ffffe8a0102c s_cbranch_execz 29 # 0x7ffffe8a010a4 <_Z5saxpyiPKfiPfi+164>_Z5saxpyiPKfiPfi+
12    int main()                                     0x7ffffe8a01040 v_ashrrev_i32_e32 v1, 31, v0  _Z5saxpyiPKfiPfi+64
13 {                                             0x7ffffe8a01044 v_lshlrev_b64 v[0:1], 2, v[0:1] _Z5saxpyiPKfiPfi+68
14 }
```

# list agents

info agents

➤ shows devices + properties

```

Load Binary /mnt/shared/codes/saxpy/saxpy
show filesystem fetch disassembly reload file intel jump to line /mnt/shared/codes/saxpy/saxpy.hip.cpp:6(27 lines total)
1 #include <hip/hip_runtime.h>
2
3 __constant__ float a = 1.0f;
4
5 __global__
6 void saxpy(int n, float const* x, float* y)      0x7ffe8a01030 s_load_dwordx2 s[0:1], s[6:7], 0x8_Z5saxpyiPKfiPfi+48
6                                         0x7ffe8a01038 s_load_dwordx2 s[2:3], s[6:7], 0x18_Z5saxpyiPKfiPfi+56
7 {
8     int i = blockDim.x*blockIdx.x + threadIdx.x;    0x7ffe8a01020 v_add_u32_e32 v0, s8, v0      _Z5saxpyiPKfiPfi+32
9     if (i < n)                                     0x7ffe8a01024 v_cmp_gt_i32_e32 vcc, s0, v0  _Z5saxpyiPKfiPfi+36
10    y[i] += a*x[i];                                0x7ffe8a01028 s_and_saveexec_b64 s[0:1], vcc_Z5saxpyiPKfiPfi+40
11 }                                                 0x7ffe8a0102c s_cbranch_execz 29 # 0x7ffe8a010a4 <_Z5saxpyiPKfiPfi+164>_Z5saxpyiPKfiPfi+
12                                         0x7ffe8a01040 v_ashrrev_i32_e32 v1, 31, v0  _Z5saxpyiPKfiPfi+64
13                                         0x7ffe8a01044 v_lshlrev_b64 v[0:1], 2, v[0:1]_Z5saxpyiPKfiPfi+68
14                                         0x7ffe8a0104c s_getpc_b64 s[4:5]      _Z5saxpyiPKfiPfi+76
15                                         0x7ffe8a01050 s_add_u32 s4, s4, 0x1fb0  _Z5saxpyiPKfiPfi+80
16                                         0x7ffe8a01058 s_adcc_u32 s5, s5, 0   _Z5saxpyiPKfiPfi+88
17                                         0x7ffe8a01060 s_waitcnt lgkmcnt(0)  _Z5saxpyiPKfiPfi+96
18                                         0x7ffe8a01064 v_mov_b32_e32 v3, s1  _Z5saxpyiPKfiPfi+100
19                                         0x7ffe8a01068 v_add_co_u32_e32 v2, vcc, s0, v0_Z5saxpyiPKfiPfi+104
20                                         0x7ffe8a0106c v_addc_co_u32_e32 v3, vcc, v3, v1, vcc_Z5saxpyiPKfiPfi+108
21                                         0x7ffe8a01070 global_load_dword v2, v[2:3], off_Z5saxpyiPKfiPfi+112
22                                         0x7ffe8a01078 v_mov_b32_e32 v3, s3  _Z5saxpyiPKfiPfi+120
23                                         0x7ffe8a0107c v_add_co_u32_e32 v0, vcc, s2, v0_Z5saxpyiPKfiPfi+124
24
(gdb) info agents
  Id State Target Id          Device Name Cores Threads Location
* 1 A     AMDGPU Agent (GPUID 63217) vega20      240    2400   43:00.0
(gdb) 
11 }
12
13 int main()
14 {



(gdb) info agents
  Id State Target Id          Device Name Cores Threads Location
* 1 A     AMDGPU Agent (GPUID 63217) vega20      240    2400   43:00.0
(gdb) 
```

# agent details

Load Binary /mnt/shared/codes/saxpy/saxpy

show filesystem fetch disassembly reload file intel jump to line /mnt/shared/codes/saxpy/saxpy.hip.cpp:6 (27 lines total)

```

1 #include <hip/hip_runtime.h>
2
3 __constant__ float a = 1.0f;
4
5 __global__
6 void saxpy(int n, float const* x, float* y)      0x7ffffe8a01030 s_load_dwordx2 s[0:1], s[6:7], 0x8_Z5saxpyiPKfiPfi+48
7 {                                                 0x7ffffe8a01038 s_load_dwordx2 s[2:3], s[6:7], 0x18_Z5saxpyiPKfiPfi+56
8     int i = blockDim.x*blockIdx.x + threadIdx.x;    0x7ffffe8a01020 v_add_u32_e32 v0, s8, v0      Z5saxpyiPKfiPfi+32
9     if (i < n)                                     0x7ffffe8a01024 v_cmp_gt_i32_e32 vcc, s0, v0      Z5saxpyiPKfiPfi+36
10    y[i] += a*x[i];                                0x7ffffe8a01028 s_and_saveexec_b64 s[0:1], vcc_Z5saxpyiPKfiPfi+40
11 }                                                 0x7ffffe8a0102c s_cbranch_execz 29 # 0x7ffffe8a010a4 <_Z5saxpyiPKfiPfi+164>_Z5saxpyiPKfiPfi+
12 }                                                 0x7ffffe8a01040 v_ashrrev_i32_e32 v1, 31, v0      Z5saxpyiPKfiPfi+64
13 int main()                                         0x7ffffe8a01044 v_lshlrev_b64 v[0:1], 2, v[0:1]  Z5saxpyiPKfiPfi+68
14 {                                                 0x7ffffe8a0104c s_getpc_b64 s[4:5]       Z5saxpyiPKfiPfi+76
15 }                                                 0x7ffffe8a01050 s_add_u32 s4, s4, 0x1fb0      Z5saxpyiPKfiPfi+80
16 }                                                 0x7ffffe8a01058 s_adcc_u32_s5, s5, 0        Z5saxpyiPKfiPfi+88
17 }                                                 0x7ffffe8a01060 s_waitcnt lgkmcnt(0)        Z5saxpyiPKfiPfi+96
18 }                                                 0x7ffffe8a01064 v_mov_b32_e32 v3, s1        Z5saxpyiPKfiPfi+100
19 }                                                 0x7ffffe8a01068 v_add_co_u32_e32 v2, vcc, s0, v0_Z5saxpyiPKfiPfi+104
20 }                                                 0x7ffffe8a0106c v_adcc_co_u32_e32 v3, vcc, v3, v1, vcc Z5saxpyiPKfiPfi+108
21 }                                                 0x7ffffe8a01070 global_load_dword v2, v[2:3], off_Z5saxpyiPKfiPfi+112
22 }                                                 0x7ffffe8a01078 v_mov_b32_e32 v3, s3        Z5saxpyiPKfiPfi+120
23 }                                                 0x7ffffe8a0107c v_add_co_u32_e32 v0, vcc, s2, v0_Z5saxpyiPKfiPfi+124

```

(gdb) info agents

Id	State	Target	Device	Name	Cores	Threads	Location
*	A	AMDGPU Agent (GPUID 63217)	vega20		240	2400	43:00.0

(gdb) ■

Vega 20  
(Radeon VII)

max waves  
(240 SIMDs x 10 waves/SIMD max)

SIMDs  
(60 CUs x 4 SIMDs/CU)

# list queues

info queues

➤ shows HSA queues

```

Load Binary /mnt/shared/codes/saxpy/saxpy
show filesystem fetch disassembly reload file intel jump to line /mnt/shared/codes/saxpy/saxpy.hip.cpp:6(27 lines total)
1 #include <hip/hip_runtime.h>
2
3 __constant__ float a = 1.0f;
4
5 __global__
6 void saxpy(int n, float const* x, float* y)      0x7ffffe8a01030 s_load_dwordx2 s[0:1], s[6:7], 0x8_Z5saxpyiPKfiPfi+48
6                                         0x7ffffe8a01038 s_load_dwordx2 s[2:3], s[6:7], 0x18_Z5saxpyiPKfiPfi+56
7 {
8     int i = blockDim.x*blockIdx.x + threadIdx.x;      0x7ffffe8a01020 v_add_u32_e32 v0, s8, v0      _Z5saxpyiPKfiPfi+32
9     if (i < n)                                     0x7ffffe8a01024 v_cmp_gt_i32_e32 vcc, s0, v0      _Z5saxpyiPKfiPfi+36
10    y[i] += a*x[i];                                0x7ffffe8a01028 s_and_saveexec_b64 s[0:1], vcc, _Z5saxpyiPKfiPfi+40
10                                         0x7ffffe8a0102c s_cbranch_execz 29 # 0x7ffffe8a010a4 <_Z5saxpyiPKfiPfi+164>_Z5saxpyiPKfiPfi+
10                                         0x7ffffe8a01040 v_ashrrev_i32_e32 v1, 31, v0      _Z5saxpyiPKfiPfi+64
10                                         0x7ffffe8a01044 v_lshlrev_b64 v[0:1], 2, v[0:1] _Z5saxpyiPKfiPfi+68
10                                         0x7ffffe8a0104c s_getpc_b64 s[4:5]      _Z5saxpyiPKfiPfi+76
10                                         0x7ffffe8a01050 s_add_u32_s4, s4, 0x1fb0      _Z5saxpyiPKfiPfi+80
10                                         0x7ffffe8a01058 s_addc_u32_s5, s5, 0      _Z5saxpyiPKfiPfi+88
10                                         0x7ffffe8a01060 s_waitcnt_lgkmcnt(0)      _Z5saxpyiPKfiPfi+96
10                                         0x7ffffe8a01064 v_mov_b32_e32 v3, s1      _Z5saxpyiPKfiPfi+100
10                                         0x7ffffe8a01068 v_add_co_u32_e32 v2, vcc, s0, v0      _Z5saxpyiPKfiPfi+104
10                                         0x7ffffe8a0106c v_adcc_co_u32_e32 v3, vcc, v3, v1, vcc, _Z5saxpyiPKfiPfi+108
10                                         0x7ffffe8a01070 global_load_dword v2, v[2:3], off_Z5saxpyiPKfiPfi+112
10                                         0x7ffffe8a01078 v_mov_b32_e32 v3, s3      _Z5saxpyiPKfiPfi+120
10                                         0x7ffffe8a0107c v_add_co_u32_e32 v0, vcc, s2, v0      _Z5saxpyiPKfiPfi+124
11 }
12
13 int main()
14 {
(gdb) info queues
  Id  Target Id          Type      Read  Write  Size   Address
  1  AMDGPU Queue 1:1 (QID 0) HSA (Multi) 4     4    262144  0x00007fffff7f40000
* 2  AMDGPU Queue 1:2 (QID 1) HSA (Multi) 0     1    65536   0x00007fffff7fa0000
(gdb) 
11 }
12
13 int main()
14 {
(gdb) info queues
  Id  Target Id          Type      Read  Write  Size   Address
  1  AMDGPU Queue 1:1 (QID 0) HSA (Multi) 4     4    262144  0x00007fffff7f40000
* 2  AMDGPU Queue 1:2 (QID 1) HSA (Multi) 0     1    65536   0x00007fffff7fa0000
(gdb) 
```

# queue details

```
Load Binary /mnt/shared/codes/saxpy/saxpy

show filesystem fetch disassembly reload file intel jump to line /mnt/shared/codes/saxpy/saxpy.hip.cpp:6 (27 lines total)

1 #include <hip/hip_runtime.h>
2
3 __constant__ float a = 1.0f;
4
5 __global__
6 void saxpy(int n, float const* x, float* y)
7 {
8     int i = blockDim.x*blockIdx.x + threadIdx.x;
9     if (i < n)
10         y[i] += a*x[i];
11 }

(gdb) info queues
  Id  Target Id          Type      Read  Write  Size   Address
  1  AMDGPU Queue 1:1 (QID 0) HSA (Multi) 4    4    262144 0x00007ffff7f40000
* 2  AMDGPU Queue 1:2 (QID 1) HSA (Multi) 0    1    65536  0x00007ffff7fa0000
(gdb) 
12
13 int main()
14 {

(gdb) info queues
  Id  Target Id          Type      Read  Write  Size   Address
  1  AMDGPU Queue 1:1 (QID 0) HSA (Multi) 4    4    262144 0x00007ffff7f40000
* 2  AMDGPU Queue 1:2 (QID 1) HSA (Multi) 0    1    65536  0x00007ffff7fa0000
(gdb) 
```

# list dispatches

info dispatches

➤ shows kernel dispatches

```
Load Binary /mnt/shared/codes/saxpy/saxpy
show filesystem fetch disassembly reload file intel jump to line /mnt/shared/codes/saxpy/saxpy.hip.cpp:6 (27 lines total)
1 #include <hip/hip_runtime.h>
2
3 __constant__ float a = 1.0f;
4
5 __global__
6 void saxpy(int n, float const* x, float* y)      0x7ffffe8a01030 s_load_dwordx2 s[0:1], s[6:7], 0x8_Z5saxpyiPKfiPfi+48
6                                         0x7ffffe8a01038 s_load_dwordx2 s[2:3], s[6:7], 0x18_Z5saxpyiPKfiPfi+56
7 {
8     int i = blockDim.x*blockIdx.x + threadIdx.x;      0x7ffffe8a01020 v_add_u32_e32 v0, s8, v0      _Z5saxpyiPKfiPfi+32
9     if (i < n)                                       0x7ffffe8a01024 v_cmp_gt_i32_e32 vcc, s0, v0      _Z5saxpyiPKfiPfi+36
10    y[i] += a*x[i];                                0x7ffffe8a01028 s_and_saveexec_b64 s[0:1], vcc      _Z5saxpyiPKfiPfi+40
10                                         0x7ffffe8a0102c s_cbranch_execz 29 # 0x7ffffe8a010a4 <_Z5saxpyiPKfiPfi+164>_Z5saxpyiPKfiPfi+
10                                         0x7ffffe8a01040 v_ashrrev_i32_e32 v1, 31, v0      _Z5saxpyiPKfiPfi+64
10                                         0x7ffffe8a01044 v_lshlrev_b64 v[0:1], 2, v[0:1]  _Z5saxpyiPKfiPfi+68
10                                         0x7ffffe8a0104c s_getpc_b64 s[4:5]      _Z5saxpyiPKfiPfi+76
10                                         0x7ffffe8a01050 s_add_u32_s4, s4, 0x1fb0      _Z5saxpyiPKfiPfi+80
10                                         0x7ffffe8a01058 s_addc_u32_s5, s5, 0      _Z5saxpyiPKfiPfi+88
10                                         0x7ffffe8a01060 s_waitcnt_lgkmcnt(0)      _Z5saxpyiPKfiPfi+96
10                                         0x7ffffe8a01064 v_mov_b32_e32 v3, s1      _Z5saxpyiPKfiPfi+100
10                                         0x7ffffe8a01068 v_add_co_u32_e32 v2, vcc, s0, v0_Z5saxpyiPKfiPfi+104
10                                         0x7ffffe8a0106c v_addc_co_u32_e32 v3, vcc, v3, v1, vcc      _Z5saxpyiPKfiPfi+108
10                                         0x7ffffe8a01070 global_load_dword v2, v[2:3], off_Z5saxpyiPKfiPfi+112
10                                         0x7ffffe8a01078 v_mov_b32_e32 v3, s3      _Z5saxpyiPKfiPfi+120
10                                         0x7ffffe8a0107c v_add_co_u32_e32 v0, vcc, s2, v0_Z5saxpyiPKfiPfi+124
10                                         0x7ffffe8a01080 v_addc_co_u32_e32 v1, vcc, v2, v1, vcc      _Z5saxpyiPKfiPfi+128
```

```
(gdb) info dispatches
Id Target Id          Grid      Workgroup Fence   Kernel Function
* 1 AMDGPU Dispatch 1:2:1 (PKID 0) [256,1,1] [128,1,1] B|Aa   saxpy(int, float const*, int, float*, int)
(gdb) 
```

```
12
13 int main()
14 {
```

```
(gdb) info dispatches
Id Target Id          Grid      Workgroup Fence   Kernel Function
* 1 AMDGPU Dispatch 1:2:1 (PKID 0) [256,1,1] [128,1,1] B|Aa   saxpy(int, float const*, int, float*, int)
(gdb) 
```

# dispatch details

```
(gdb) info dispatches
  Id  Target Id          Grid      Workgroup Fence  Kernel Function
* 1  AMDGPU Dispatch 1:2:1 (PKID 0) [256,1,1] [128,1,1] B|Aa    saxpy(int, float const*, int, float*, int)
(gdb) █
```

# list registers

info registers

➤ shows registers in use

vector registers

scalar registers

program counter, exec mask, ...

```
Load Binary /mnt/shared/codes/saxpy/saxpy
show filesystem fetch disassembly reload file intel jump to line /mnt/shared/codes/saxpy/saxpy.hip.cpp:6(27 lines total)
1 #include <hip/hip_runtime.h>
2
3 __constant__ float a = 1.0f;
4
5 __global__
6 void saxpy(int n, float const* x, float* y)      0x7ffe8a01030 s_load_dwordx2 s[0:1], s[6:7], 0x8_Z5saxpyiPKfiPfi+48
6                                         0x7ffe8a01038 s_load_dwordx2 s[2:3], s[6:7], 0x18_Z5saxpyiPKfiPfi+56
7 {
8     int i = blockDim.x*blockIdx.x + threadIdx.x;    0x7ffe8a01020 v_add_u32_e32 v0, s8, v0      _Z5saxpyiPKfiPfi+32
9     if (i < n)                                     0x7ffe8a01024 v_cmp_gt_i32_e32 vcc, s0, v0  _Z5saxpyiPKfiPfi+36
10    y[i] += a*x[i];                                0x7ffe8a01028 s_and_saveexec_b64 s[0:1], vcc_Z5saxpyiPKfiPfi+40
10                                         0x7ffe8a0102c s_cbranch_execz 29 # 0x7ffe8a010a4 <_Z5saxpyiPKfiPfi+164>_Z5saxpyiPKfiPfi+
10                                         0x7ffe8a01040 v_ashrrev_i32_e32 v1, 31, v0  _Z5saxpyiPKfiPfi+64
10                                         0x7ffe8a01044 v_lshlrev_b64 v[0:1], 2, v[0:1]_Z5saxpyiPKfiPfi+68
10                                         0x7ffe8a0104c s_getpc_b64 s[4:5]   _Z5saxpyiPKfiPfi+76
10                                         0x7ffe8a01050 s_add_u32_s4, s4, 0x1fb0 _Z5saxpyiPKfiPfi+80
10                                         0x7ffe8a01058 s_adcc_u32_s5, s5, 0  _Z5saxpyiPKfiPfi+88
10                                         0x7ffe8a01060 s_waitcnt lgkmcnt(0) _Z5saxpyiPKfiPfi+96
10                                         0x7ffe8a01064 v_mov_b32_e32 v3, s1  _Z5saxpyiPKfiPfi+100
10                                         0x7ffe8a01068 v_add_co_u32_e32 v2, vcc, s0, v0_Z5saxpyiPKfiPfi+104
10                                         0x7ffe8a0106c v_adcc_co_u32_e32 v3, vcc, v3, v1, vcc_Z5saxpyiPKfiPfi+108
10                                         0x7ffe8a01070 global_load_dword v2, v[2:3], off_Z5saxpyiPKfiPfi+112
10                                         0x7ffe8a01078 v_mov_b32_e32 v3, s3  _Z5saxpyiPKfiPfi+120
```

```
(gdb) info registers
v0          {0x0, 0x1, 0x2, 0x3, 0x4, 0x5, 0x6, 0x7, 0x8, 0x9, 0xa, 0xb, 0xc, 0xd, 0xe, 0xf, 0x10, 0x11, 0x12, 0x13, 0x14, 0x15, 0x16, 0
x17, 0x18, 0x19, 0x1a, 0x1b, 0x1c, 0x1d, 0x1e, 0x1f, 0x20, 0x21, 0x22, 0x23, 0x24, 0x25, 0x26, 0x27, 0x28, 0x29, 0x2a, 0x2b, 0x2c, 0x2d, 0x
2e, 0x2f, 0x30, 0x31, 0x32, 0x33, 0x34, 0x35, 0x36, 0x37, 0x38, 0x39, 0x3a, 0x3b, 0x3c, 0x3d, 0x3e, 0x3f}
v1          {0x72646461, 0x5f737365, 0x63617073, 0x6c67a665, 0x6c61626f, 0x616e2ea5, 0x73a3656d, 0x2ea76372, 0x7366666f, 0xa5007465, 0x7
a69732e, 0x2eaa0865, 0x65707974, 0x6d616e5f, 0x6975a565, 0xab2a746e, 0x6c61762e, 0x6b5f6575, 0xad646e69, 0x626f6c67, 0x625f6c61, 0x65666675
, 0x2eae8672, 0x72646461, 0x5f737365, 0x63617073, 0x6c67a665, 0x6c61626f, 0x616e2ea5, 0x64a3656d, 0x2ea77473, 0x7366666f, 0xa5087465, 0x746
9732e, 0x2eaa0865, 0x65707974, 0x6d616e5f, 0x6975a565, 0xab2a746e, 0x6c61762e, 0x6b5f6575, 0xad646e69, 0x626f6c67, 0x625f6c61, 0x65666675
, 0x2ea58572, 0x656d616e, 0x637273a9, 0x6769724f, 0x2ea76e69, 0x7366666f, 0xa5107465, 0x7a69732e, 0x2eaa0865, 0x65707974, 0x6d616e5f, 0x6c75a
565, 0xab676e6f, 0x6c61762e, 0x6b5f6575, 0xa8646e69, 0x765f7962, 0x65756c61, 0x6e2ea585}
v2          {0xf7f99470, 0xf7f99471, 0xf7f99472, 0xf7f99473, 0xf7f99474, 0xf7f99475, 0xf7f99476, 0xf7f99477, 0xf7f99478, 0xf7f99479, 0xf
7f9947a, 0xf7f9947b, 0xf7f9947c, 0xf7f9947d, 0xf7f9947e, 0xf7f9947f, 0xf7f99480, 0xf7f99481, 0xf7f99482, 0xf7f99483, 0xf7f99484, 0xf7f99485
, 0xf7f99486, 0xf7f99487, 0xf7f99488, 0xf7f99489, 0xf7f9948a, 0xf7f9948b, 0xf7f9948c, 0xf7f9948d, 0xf7f9948e, 0xf7f9948f, 0xf7f99490, 0xf7f
99491, 0xf7f99492, 0xf7f99493, 0xf7f99494, 0xf7f99495, 0xf7f99496, 0xf7f99497, 0xf7f99498, 0xf7f99499, 0xf7f9949a, 0xf7f9949b, 0xf7f9949c
, 0xf7f9949d, 0xf7f9949e, 0xf7f9949f, 0xf7f994a0, 0xf7f994a1, 0xf7f994a2, 0xf7f994a3, 0xf7f994a4, 0xf7f994a5, 0xf7f994a6, 0xf7f994a7, 0xf7f99
48, 0xf7f994a9, 0xf7f994aa, 0xf7f994ab, 0xf7f994ac, 0xf7f994ad, 0xf7f994ae, 0xf7f994af}
v3          {0x7ff <repeats 64 times>}
s0          0x0          0
s1          0x80000000  -2147483648
s2          0x0          0
s3          0xea4fac  15355820
s4          0xf7fa0000 -134610944
s5          0x7fff      32767
s6          0xf4100000 -200278016
s7          0x7fff      32767
s8          0x0          0
s9          0x0          0
m0          0x80000000  2147483648
pc          0x7ffe8a01000 0x7ffe8a01000 <saxpy(int, float const*, int, float*, int)>
exec        0xfffffffffffffff 18446744073709551615
vcc         0x7ffe8a06000 140737096212480
(gdb)
```

# v0 = theadIdx.x

t 3

info reg v0

➤ values from 0 to 63

t 4

info reg v0

➤ values from 64 to 127

t 5

info reg v0

➤ values from 0 to 63

t 6

info reg v0

➤ values from 64 to 127

```

Load Binary /mnt/shared/codes/saxpy/saxpy
show filesystem fetch disassembly reload file intel jump to line /mnt/shared/codes/saxpy/saxpy.hip.cpp:6 (27 lines total)
1 #include <hip/hip_runtime.h>
2
3 __constant__ float a = 1.0f;
4
5 __global__
(gdb) t 3
[Switching to thread 3, lane 0 (AMDGPU Lane 1:2:1:1/0 (0,0,0)[0,0,0])]
#0 saxpy (n=<optimized out>, x=<optimized out>, incx=<optimized out>, y=<optimized out>, incy=<optimized out>) at saxpy.hip.cpp:6
6     void saxpy(int n, float const* x, float* y)
(gdb) info reg v0
v0 [0x0, 0x1, 0x2, 0x3, 0x4, 0x5, 0x6, 0x7, 0x8, 0x9, 0xa, 0xb, 0xc, 0xd, 0xe, 0xf, 0x10, 0x11, 0x12, 0x13, 0x14, 0x15, 0x16, 0x17, 0x18, 0x19, 0x1a, 0x1b, 0x1c, 0x1d, 0x1e, 0x1f, 0x20, 0x21, 0x22, 0x23, 0x24, 0x25, 0x26, 0x27, 0x28, 0x29, 0x2a, 0x2b, 0x2c, 0x2d, 0x2e, 0x2f, 0x30, 0x31, 0x32, 0x33, 0x34, 0x35, 0x36, 0x37, 0x38, 0x39, 0x3a, 0x3b, 0x3c, 0x3d, 0x3e, 0x3f]
(gdb) t 4
[Switching to thread 4, lane 0 (AMDGPU Lane 1:2:1:2/0 (0,0,0)[64,0,0])]
#0 saxpy (n=<optimized out>, x=<optimized out>, incx=<optimized out>, y=<optimized out>, incy=<optimized out>) at saxpy.hip.cpp:6
6     void saxpy(int n, float const* x, float* y)
(gdb) info reg v0
v0 [0x40, 0x41, 0x42, 0x43, 0x44, 0x45, 0x46, 0x47, 0x48, 0x49, 0x4a, 0x4b, 0x4c, 0x4d, 0x4e, 0x4f, 0x50, 0x51, 0x52, 0x53, 0x54, 0x55, 0x56, 0x57, 0x58, 0x59, 0x5a, 0x5b, 0x5c, 0x5d, 0x5e, 0x5f, 0x60, 0x61, 0x62, 0x63, 0x64, 0x65, 0x66, 0x67, 0x68, 0x69, 0x6a, 0x6b, 0x6c, 0x6d, 0x6e, 0x6f, 0x70, 0x71, 0x72, 0x73, 0x74, 0x75, 0x76, 0x77, 0x78, 0x79, 0x7a, 0x7b, 0x7c, 0x7d, 0x7e, 0x7f]
(gdb) 
0x7fff8a01084 global_load_dword v3, v[0:1], off _Z5saxpyiPKfiPfi+132
0x7fff8a0108c s_load_dword s4, s[4:5], 0x0 _Z5saxpyiPKfiPfi+140
0x7fff8a01094 s_waitcnt vmcnt(0) lgkmcnt(0) _Z5saxpyiPKfiPfi+148

(gdb) t 5
[Switching to thread 5, lane 0 (AMDGPU Lane 1:2:1:3/0 (1,0,0)[0,0,0])]
#0 saxpy (n=<optimized out>, x=<optimized out>, incx=<optimized out>, y=<optimized out>, incy=<optimized out>) at saxpy.hip.cpp:6
6     void saxpy(int n, float const* x, float* y)
(gdb) info reg v0
v0 [0x0, 0x1, 0x2, 0x3, 0x4, 0x5, 0x6, 0x7, 0x8, 0x9, 0xa, 0xb, 0xc, 0xd, 0xe, 0xf, 0x10, 0x11, 0x12, 0x13, 0x14, 0x15, 0x16, 0x17, 0x18, 0x19, 0x1a, 0x1b, 0x1c, 0x1d, 0x1e, 0x1f, 0x20, 0x21, 0x22, 0x23, 0x24, 0x25, 0x26, 0x27, 0x28, 0x29, 0x2a, 0x2b, 0x2c, 0x2d, 0x2e, 0x2f, 0x30, 0x31, 0x32, 0x33, 0x34, 0x35, 0x36, 0x37, 0x38, 0x39, 0x3a, 0x3b, 0x3c, 0x3d, 0x3e, 0x3f]
(gdb) t 6
[Switching to thread 6, lane 0 (AMDGPU Lane 1:2:1:4/0 (1,0,0)[64,0,0])]
#0 saxpy (n=<optimized out>, x=<optimized out>, incx=<optimized out>, y=<optimized out>, incy=<optimized out>) at saxpy.hip.cpp:6
6     void saxpy(int n, float const* x, float* y)
(gdb) info reg v0
v0 [0x40, 0x41, 0x42, 0x43, 0x44, 0x45, 0x46, 0x47, 0x48, 0x49, 0x4a, 0x4b, 0x4c, 0x4d, 0x4e, 0x4f, 0x50, 0x51, 0x52, 0x53, 0x54, 0x55, 0x56, 0x57, 0x58, 0x59, 0x5a, 0x5b, 0x5c, 0x5d, 0x5e, 0x5f, 0x60, 0x61, 0x62, 0x63, 0x64, 0x65, 0x66, 0x67, 0x68, 0x69, 0x6a, 0x6b, 0x6c, 0x6d, 0x6e, 0x6f, 0x70, 0x71, 0x72, 0x73, 0x74, 0x75, 0x76, 0x77, 0x78, 0x79, 0x7a, 0x7b, 0x7c, 0x7d, 0x7e, 0x7f]
(gdb) 

```

# s8 = blockIdx.x

t 3/4  
info reg s8  
➤ blockIdx.x = 0

```

Load Binary /mnt/shared/codes/saxpy/saxpy
show filesystem fetch disassembly reload file intel jump to line /mnt/shared/codes/saxpy/saxpy.hip.cpp:6 (27 lines total)
1 #include <hip/hip_runtime.h>
2
3 __constant__ float a = 1.0f;

(gdb) t 3
[Switching to thread 3, lane 0 (AMDGPU Lane 1:2:1:1/0 (0,0,0)[0,0,0])]
#0 saxpy (n=<optimized out>, x=<optimized out>, incx=<optimized out>,
6 void saxpy(int n, float const* x, float* y)
(gdb) info reg s8
s8 0x0 0

(gdb) t 4
[Switching to thread 4, lane 0 (AMDGPU Lane 1:2:1:2/0 (0,0,0)[64,0,0])]
#0 saxpy (n=<optimized out>, x=<optimized out>, incx=<optimized out>,
6 void saxpy(int n, float const* x, float* y)
(gdb) info reg s8
s8 0x0 0

(gdb) ■

```

+164 \_Z5saxpyiPKfiPfi+  
+108

```

(gdb) t 5
[Switching to thread 5, lane 0 (AMDGPU Lane 1:2:1:3/0 (1,0,0)[0,0,0])]
#0 saxpy (n=<optimized out>, x=<optimized out>, incx=<optimized out>,
6 void saxpy(int n, float const* x, float* y)
(gdb) info reg s8
s8 0x1 1

(gdb) t 6
[Switching to thread 6, lane 0 (AMDGPU Lane 1:2:1:4/0 (1,0,0)[64,0,0])]
#0 saxpy (n=<optimized out>, x=<optimized out>, incx=<optimized out>,
6 void saxpy(int n, float const* x, float* y)
(gdb) info reg s8
s8 0x1 1

(gdb) ■

```

y.hip.cpp:6  
y.hip.cpp:6

t 5/6  
info reg s8  
➤ blockIdx.x = 1

## other things you can do

- inspect / modify registers
- inspect / modify memory
- inspect / modify LDS
- step through the assembly one instruction at a time

## more info

- /opt/rocm<-version>/share/doc/rocgdb/
  - **rocgdb.pdf**
    - basically GDB manual +
      - section 20 “*Debugging Heterogeneous Programs*”
      - section 22.4.10 “*AMD GPU*”
    - rocrefcard.pdf
  - [https://www.olcf.ornl.gov/wp-content/uploads/2021/04/rocgdb\\_hipmath\\_ornl\\_2021\\_v2.pdf](https://www.olcf.ornl.gov/wp-content/uploads/2021/04/rocgdb_hipmath_ornl_2021_v2.pdf)
    - ROCgdb presentation by Justin Chang
  - <https://lpc.events/event/11/contributions/997/attachments/928/1828/LPC2021-rocgdbdemo.pdf>  
<https://youtu.be/lGWFph4SlpU?si=zxFMVAWG8JKVLowV>
    - debugging video by Andrew Stubbs

# gdb cheat sheet

## Start GDB (GNU Debugger)

**gdb <program> [core dump]**  
**gdb –args <program> <args>**  
**gdb -help**

## Run commands

**r[un]** - Runs the program until a breakpoint or error  
**c[ontinue]** - Continues running the program until the next breakpoint or error  
**q[uit] or kill** - Quits gdb  
**fin[ish]** - Runs until current function or loop is finished  
**n[ext]** - Runs the next line of the program  
  **n N** - Runs the next N lines of the program  
**s[tep]** - Runs the next line of the program, stepping into any called routines  
**until N** - Runs until you get N lines after the current line

## Breakpoint commands

**b[reakpoint] <where>** – set breakpoint  
  **b main** - Puts a breakpoint at the beginning of the program  
  **b** - Puts a breakpoint at the current line  
  **b N** - Puts a breakpoint at line N  
  **b +N** - Puts a breakpoint N lines down from the current line  
  **b fn** - Puts a breakpoint at the beginning of function "fn"

**b/w <where> if <condition** – conditional breakpoint or watch  
**i[nfo] b[reak]** - list breakpoints  
**dis[able] N** - disable breakpoint number N  
**en[able] N** – enables breakpoint number N  
**d[elete] N** – delete breakpoint number N  
**clear** – clear all breakpoints

## Print commands

**[h]elp <command>**  
**[p]rint var** - Prints the current value of the variable "var"  
**[!]list** – list lines  
**bt (backtrace)** - Prints a stack trace

## Movement

**up** - Goes up a level in the stack  
**[do]wn** - Goes down a level in the stack

# AMD\_LOG\_LEVEL=3

saxpy : bash — Konsole

File Edit View Bookmarks Settings Help

```
jakurzak@jakurzak-MS-7B09:/mnt/shared/codes/saxpy$ AMD_LOG_LEVEL=3 ./saxpy
:3:rocdevice.cpp :432 : 714826105802 us: Initializing HSA stack.
:3:comgrctx.cpp :33 : 714826149967 us: Loading COMGR library.
:3:rocdevice.cpp :204 : 714826155354 us: Numa selects cpu agent[2]=0x10ae220(fine=0x10ae430,coarse=0x10aebb0, kern_arg=0x10e7e20) for gpu
:1:rocdevice.cpp :1573: 714826155633 us: HSA_AMD_AGENT_INFO_SVM_DIRECT_HOST_ACCESS query failed.
:3:rocdevice.cpp :1577: 714826155640 us: HMM support: 0, xnack: 0, direct host access: 0

:3:hip_context.cpp :49 : 714826157657 us: Direct Dispatch: 1
:3:rocdevice.cpp :2047: 714826157883 us: device=0x1107c60, freeMem_ = 0xfeffffc00
:3:hip_memory.cpp :480 : 714826157896 us: 123767: [7f5b72543880] hipMalloc: Returned hipSuccess : 0x7f5b6e200000
:3:hip_memory.cpp :478 : 714826157916 us: 123767: [7f5b72543880] hipMalloc ( 0x7fff555f25c0, 1024 )
:3:rocdevice.cpp :2047: 714826157926 us: device=0x1107c60, freeMem_ = 0xfeffff800
:3:hip_memory.cpp :480 : 714826157930 us: 123767: [7f5b72543880] hipMalloc: Returned hipSuccess : 0x7f5b6e201000: duration: 14 us
:3:hip_platform.cpp :202 : 714826157940 us: 123767: [7f5b72543880] __hipPushCallConfiguration ( {2,1,1}, {128,1,1}, 0, stream:<null> )
:3:hip_platform.cpp :206 : 714826157950 us: 123767: [7f5b72543880] __hipPushCallConfiguration: Returned hipSuccess :
:3:hip_platform.cpp :213 : 714826157958 us: 123767: [7f5b72543880] __hipPopCallConfiguration ( {1,0,2153245}, {2,0,2157640}, 0x7fff555f25d8,
:3:hip_platform.cpp :222 : 714826157961 us: 123767: [7f5b72543880] __hipPopCallConfiguration: Returned hipSuccess :
:3:hip_module.cpp :492 : 714826157970 us: 123767: [7f5b72543880] hipLaunchKernel ( 0x2007b8, {2,1,1}, {128,1,1}, 0x7fff555f2610, 0, stream
:3:devprogram.cpp :2668: 714826158275 us: Using Code Object V4.
:3:hip_module.cpp :363 : 714826167980 us: 123767: [7f5b72543880] ihipModuleLaunchKernel ( 0x0x1141e20, 256, 1, 1, 128, 1, 1, 0, stream:<nu
:3:rocdevice.cpp :2623: 714826168023 us: number of allocated hardware queues with low priority: 0, with normal priority: 0, with high pri
:3:rocdevice.cpp :2695: 714826186484 us: created hardware queue 0x7f5b72558000 with size 1024 with priority 1, cooperative: 0
:3:devprogram.cpp :2668: 714826439826 us: Using Code Object V4.
:3:rocvirtual.cpp :748 : 714826441265 us: [7f5b72543880]! Arg0: = val:256
:3:rocvirtual.cpp :669 : 714826441274 us: [7f5b72543880]! Arg1: = ptr:0x7f5b6e200000 obj:[0x7f5b6e200000-0x7f5b6e200400]
:3:rocvirtual.cpp :748 : 714826441277 us: [7f5b72543880]! Arg2: = val:1
:3:rocvirtual.cpp :669 : 714826441279 us: [7f5b72543880]! Arg3: = ptr:0x7f5b6e201000 obj:[0x7f5b6e201000-0x7f5b6e201400]
:3:rocvirtual.cpp :748 : 714826441281 us: [7f5b72543880]! Arg4: = val:1
:3:rocvirtual.cpp :2677: 714826441284 us: [7f5b72543880]! ShaderName : _Z5saxpyiPKfiPfi
:3:hip_platform.cpp :667 : 714826441300 us: 123767: [7f5b72543880] ihipLaunchKernel: Returned hipSuccess :
:3:hip_module.cpp :495 : 714826441313 us: 123767: [7f5b72543880] hipLaunchKernel: Returned hipSuccess :
:3:hip_device_runtime.cpp :460 : 714826441318 us: 123767: [7f5b72543880] hipDeviceSynchronize ( )
:3:rocdevice.cpp :2573: 714826441324 us: No HW event
:3:rocvirtual.hpp :61 : 714826441330 us: Host active wait for Signal = (0x7f5b72576a00) for -1 ns
:3:hip_device_runtime.cpp :472 : 714826441344 us: 123767: [7f5b72543880] hipDeviceSynchronize: Returned hipSuccess :
jakurzak@jakurzak-MS-7B09:/mnt/shared/codes/saxpy$
```

# how to use rocgdb + gdbgui + Chrome

## test if X forwarding works

```
ssh -X USERNAME@home.ccs.ornl.gov
ssh -X login1._____.olcf.ornl.gov
srun -A VEN113 -N 1 -n 1 -c 64 --x11 --pty bash
xmmessage -center hello!
```

## install gdbgui

```
python3 -m pip install --user pipx
python3 -m userpath append ~/.local/bin
pipx install gdbgui
```

## install Chrome

- Go to <https://www.google.com/chrome/>
- Click *Download Chrome*
- Click *64 bit .rpm (For Fedora/openSUSE)*
- Click *Accept and Install*

```
scp google-chrome-stable_current_x86_64.rpm USERNAME@home.ccs.ornl.gov:
ssh -X USERNAME@home.ccs.ornl.gov
mkdir ~/chrome
cd ~/chrome
rpm2cpio ../google-chrome-stable_current_x86_64.rpm | cpio -id
```

## run rocgdb with gdbgui in Chrome

```
ssh -X USERNAME@home.ccs.ornl.gov
ssh -X login1._____.olcf.ornl.gov
srun -A VEN113 -N 1 -n 1 -c 64 --x11 --pty bash
gdbgui -g /opt/rocm/bin/rocgdb --no-browser &
~/chrome/opt/google/chrome/google-chrome 2>/dev/null &
• In Chrome, go to: http://127.0.0.1:5000
• Click Load Binary to load your binary (compiled with -ggdb)
• Step into a kernel
• Click fetch disassembly
show architecture
info threads
info queues
info dispatches
info registers
info reg vcc
info reg exec
s
si
n
ni
...
...
```

# DISCLAIMERS

The information presented in this document is for informational purposes only and may contain technical inaccuracies, omissions, and typographical errors. The information contained herein is subject to change and may be rendered inaccurate for many reasons, including but not limited to product and roadmap changes, component and motherboard version changes, new model and/or product releases, product differences between differing manufacturers, software changes, BIOS flashes, firmware upgrades, or the like. Any computer system has risks of security vulnerabilities that cannot be completely prevented or mitigated. AMD assumes no obligation to update or otherwise correct or revise this information. However, AMD reserves the right to revise this information and to make changes from time to time to the content hereof without obligation of AMD to notify any person of such revisions or changes.

THIS INFORMATION IS PROVIDED ‘AS IS.’ AMD MAKES NO REPRESENTATIONS OR WARRANTIES WITH RESPECT TO THE CONTENTS HEREOF AND ASSUMES NO RESPONSIBILITY FOR ANY INACCURACIES, ERRORS, OR OMISSIONS THAT MAY APPEAR IN THIS INFORMATION. AMD SPECIFICALLY DISCLAIMS ANY IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY, OR FITNESS FOR ANY PARTICULAR PURPOSE. IN NO EVENT WILL AMD BE LIABLE TO ANY PERSON FOR ANY RELIANCE, DIRECT, INDIRECT, SPECIAL, OR OTHER CONSEQUENTIAL DAMAGES ARISING FROM THE USE OF ANY INFORMATION CONTAINED HEREIN, EVEN IF AMD IS EXPRESSLY ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

Third-party content is licensed to you directly by the third party that owns the content and is not licensed to you by AMD. ALL LINKED THIRD-PARTY CONTENT IS PROVIDED “AS IS” WITHOUT A WARRANTY OF ANY KIND. USE OF SUCH THIRD-PARTY CONTENT IS DONE AT YOUR SOLE DISCRETION AND UNDER NO CIRCUMSTANCES WILL AMD BE LIABLE TO YOU FOR ANY THIRD-PARTY CONTENT. YOU ASSUME ALL RISK AND ARE SOLELY RESPONSIBLE FOR ANY DAMAGES THAT MAY ARISE FROM YOUR USE OF THIRD-PARTY CONTENT.

© 2023 Advanced Micro Devices, Inc. All rights reserved. AMD, the AMD Arrow logo, AMD CDNA, AMD ROCm, AMD Instinct, and combinations thereof are trademarks of Advanced Micro Devices, Inc. in the United States and/or other jurisdictions. Other names are for informational purposes only and may be trademarks of their respective owners.

# ATTRIBUTIONS

Linux is the registered trademark of Linus Torvalds in the U.S. and other countries.

The OpenMP name and the OpenMP logo are registered trademarks of the OpenMP Architecture Review Board.

AMD