

Joint INTEL / EuroCC/Castiell oneAPI Workshop

Intel® Distribution for GDB*

A Cross-Architecture Application Debugger

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Agenda

System Requirements Overview

DPC++ Linux* Demo

C++: Debugging openMP offload

Fortran: Function Expression Evaluator

Other Debug Capabilities

System Requirements Overview

Windows*

Language Support

Data Parallel C++ (DPC++)

C \ C++

Fortran

OpenMP

IDE Support

Microsoft Visual Studio 2017*

Microsoft Visual Studio 2019*

Microsoft Visual Studio 2022*

Visual Studio Code *

OS Support

Windows* 10, 64-bit

Windows* 11, 64-bit

GPUs

Intel® HD Graphics Gen9

Intel® Iris® Xe Graphics

CPUs

Intel® Core™ Processor family

Intel® Xeon® Processor family

Intel® Xeon® Scalable
Performance processors

FPGA

Emulation device only



Language Support

Data Parallel C++ (DPC++)

C \ C++

Fortran

OpenMP

IDE Support

Eclipse *

Visual Studio Code *

OS Support

Ubuntu* 18.x, 20.04

CentOS* 7

Fedora* 34

SLES 15

GPUs

Intel® HD Graphics Gen9

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DPC++ Linux* Demo (Command Line)

Jacobi Sample

- Prerequisites:

- [Get Started Guide](#) to configure the debugger
- [array-transform](#) sample

- Clone [oneAPI-samples/Tools/ApplicationDebugger/jacobi/](#)

- `source /opt/intel/oneapi/setvars.sh`

Jacobi Sample

A	x	=	b
[5 1 1 0 0 ... 0 0 0 0]	[1]		[7]
[1 5 1 1 0 0 0 ... 0 0 0 0]	[1]		[8]
[1 1 5 1 1 0 0 ... 0 0 0 0]	[1]		[9]
[0 1 1 5 1 1 0 0 ... 0 0 0]	[1]		[9]
[0 0 1 1 5 1 1 0 0 ... 0 0]	[1]	=	[9]
[...]	[...]		[...]
[0 0 0 0 ... 0 1 1 5 1 1 0]	[1]		[9]
[0 0 0 0 ... 0 0 1 1 5 1 1]	[1]		[8]
[0 0 0 0 ... 0 0 0 0 1 1 5]	[1]		[7]

linear system of equations

$$Ax=b$$

Where:

A : $n \times n$

b : $n \times 1$

x : $n \times 1$ – solution vector

Jacobi Sample on CPU

- **Build** `dpcpp -g -O0 jacobi-bugged.cpp -o jacobi-bugged.exe`
- **Run** `./jacobi-bugged.exe cpu`
- **Check output.** It indicates some bugs

```
fail; Bug 1. Fix this on CPU: components of x_k are not close to 1.0.  
Hint: figure out which elements are farthest from 1.0.
```

- **Open sources**
- **Run under the debugger:**

```
gdb-oneapi --args ./jacobi-bugged.exe cpu
```

Debugging on GPU

- `info inferiors` - to make sure you are on gpu now
- `info threads` - to inspect threads
- `thread 2.<Thread_number>:<SIMD_lane>` - switching between threads
- `info locals` - to print local threads variables
- `disassemble` - to see disassemble
- `set scheduler-locking step` - step to the next

Debugging OpenMP Offload (C++)

Matmul build and run

■ Build:

- `icx -O0 -g -fiopenmp -fopenmp-targets=spir64 matmul_offload.cpp -o matmul_debug`

■ Disable device optimizations:

- `export LIBOMPTARGET_OPENCL_COMPILATION_OPTIONS="-g -cl-opt-disable"`
- `export LIBOMPTARGET_LEVEL0_COMPILATION_OPTIONS="-g -cl-opt-disable"`

■ Set up offloading:

- `export OMP_TARGET_OFFLOAD="MANDATORY"`

■ Debug:

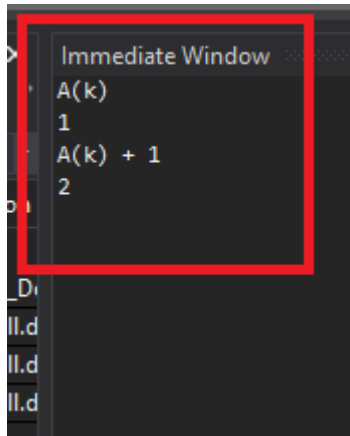
- `gdb-oneapi ./matmul_debug`

Debugging OpenMP offload for Fortran is not supported yet!

Function Expression Evaluator for Fortran

Fortran Expression Evaluator

- Set a breakpoint
- Start Debugging
- Open: **Debug -> Windows -> Immediate**
- Use **Immediate Window** to evaluate expressions:



Background tasks (Ctrl+E, Ctrl+T)

Build 1

Debug

Test

Analyze

Tools

Extensions

Window

Help

2 Windows

Graphics

Continue With Intel Inspector Analysis

Continue F5

Break All Ctrl+Alt+Break

Stop Debugging Shift+F5

Detach All

Terminate All

Restart Ctrl+Shift+F5

Performance Profiler... Alt+F2

Relaunch Performance Profiler Shift+Alt+F2

Attach to Process... Ctrl+Alt+P

Other Debug Targets

Step Into F11

Step Over F10

Step Out Shift+F11

QuickWatch... Shift+F9

View Array

Toggle Breakpoint F9

New Breakpoint

Delete All Breakpoints Ctrl+Shift+F9

Disable All Breakpoints

Clear All DataTips

Export DataTips ...

Import DataTips ...

Save Dump As...

Options...

FEE_Demo_EuroCC Debug Properties

Problem Details

Problem Details2

Breakpoints Alt+F9

Exception Settings Ctrl+Alt+E

Output

Show Diagnostic Tools Ctrl+Alt+F2

GPU Threads

Tasks Ctrl+Shift+D, K

Parallel Stacks Ctrl+Shift+D, S

Parallel Watch

Watch

Autos Ctrl+Alt+V, A

Locals Alt+L

3 Immediate Ctrl+Alt+I

Array Visualizer

Call Stack Alt+7

Threads Ctrl+Alt+H

Modules Ctrl+Alt+U

Processes Ctrl+Shift+Alt+P

Diagnostic Analysis Ctrl+Shift+Alt+D

Memory

Disassembly Alt+8

Registers Alt+5

Stack Frame: FEE0

Disassembly FEE_Demo_EuroCC.f90

G (Global Scope)

fee

16

17 implicit none

18

19 integer :: A(5) = [1,2,3,4,5]

20 integer :: b(2) = [2, 4]

21 integer :: k

22

23 do k=1,5

24 A(k) = A(k) + 1

25 write(*,*) k, A(k)+1

26 end do

27

28 print *, "-----"

29

30 write (*,*) A(b)

31

32 end program fee

33

90 %

No issues found

Threads

Group by: Process ID

Columns

Search

Process ID: 8568 (4 threads)

1532 0 Main Thread Main Thread FEE_D

15772 0 Worker Thread ntdll.dll thread ntdll.d

12440 0 Worker Thread ntdll.dll thread ntdll.d

16860 0 Worker Thread ntdll.dll thread ntdll.d

Immediate Window

A(k)

1

A(k) + 1

2

Other Debug Capabilities

oneAPI Debug Tools and Variables

- Specified level of tracing for SYCL Plugin Interface:
 - `SYCL_PI_TRACE={1, 2, -1}`
- GPU backends:
 - Profiling Tools Interfaces for GPU (PTI GPU) - [Level Zero Tracer ze_tracer](#)
 - Intercept Layer for OpenCL - [How to Use the Intercept Layer for OpenCL™ Applications](#)
- OpenMP Offload: `LIBOMPTARGET_DEBUG`

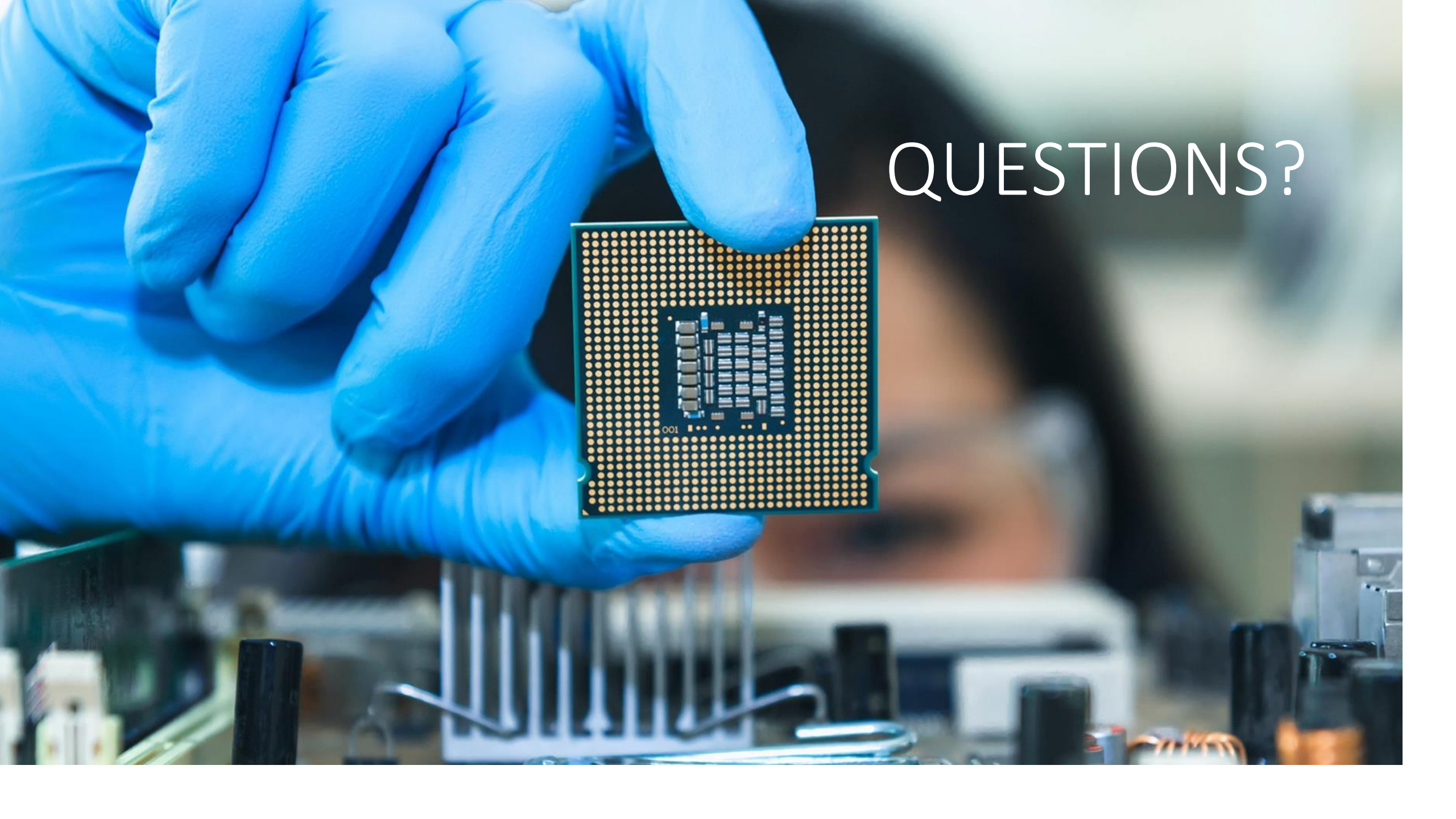
Useful Links

■ Basic:

- [Documentation & Code Samples](#)
- [Intel® Distribution for GDB* Release Notes](#)
- [Intel® Distribution for GDB* System Requirements](#)

■ Advanced:

- [oneAPI Debug Tools at Intel® oneAPI Programming Guide](#)
- [Get Started with OpenMP* Offload to GPU for the Intel® oneAPI DPC/C++ Compiler and Intel® Fortran Compiler](#)



QUESTIONS?

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