Intel OneAPI Workshop : FocusCoE

Intel® Distribution for GDB* A Cross-Architecture Application Debugger

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Agenda

System Requirements Overview
DPC++ Linux* Demo
C++: Debugging OpenMP* offload
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

Intel® Distribution for GDB* Release Notes
Intel® Distribution for GDB* System Requirements

Linux*

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

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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 x n
- b: n x 1
- x: n x 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!

Other Debug Capabilities

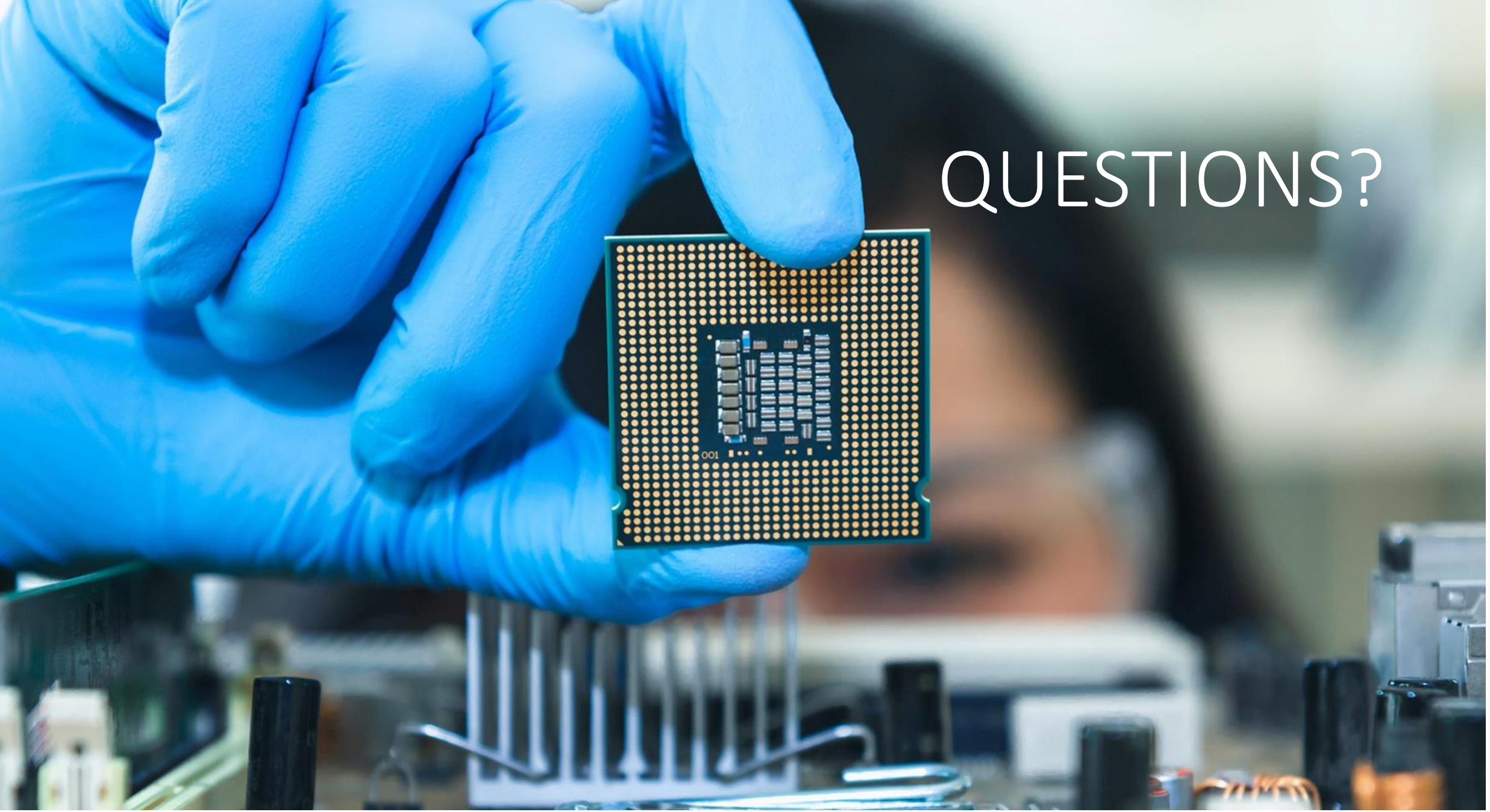
oneAPI Debug Tools and Variables

- 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`

Intel LLVM Compiler: Environment Variables docs

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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