SYCL, DPC++, XPUs, oneAPI

a view from Intel
James Reinders, engineer

IWOCL / SYCLcon 2021
SYCL, DPC++, XPUs, oneAPI

a book to teach SYCL programming,

many thanks to those of you who helped with your feedback!
What is “Data Parallel C++”?  

DPC++ is an open-source project to add SYCL to LLVM.

Join in the fun!  
Help Out!  
Try it out!
Why name “Data Parallel C++”

“SYCL” was taken. 😊

DPC++ name is perfectly descriptive.
Adding Data Parallelism to C++

“SYCL 2020’s primary goal is to achieve closer convergence with ISO C++, furthering our work to bring parallel heterogeneous programming to modern C++ through open standards.”

- Michael Wong
goal

bring

SYCL into LLVM
What is an XPU?

XPU ≈ *.* processing units

e.g., CPU, GPU, FPGA, DSP, ASIC
Our Quest

make

*heterogeneous programming*

ubiquitous.
Our Quest

make

heterogeneous programming
(XPU programming)

ubiquitous.
Can we *really* program XPUs?

1. Freedom:

Use any XPU that I choose.

(regardless of XPU type or vendor)
Can we really program XPUs?

1. Freedom
2. Value:

  Regardless of my XPU choice, I consistently can obtain a reasonable level of performance.

  (regardless of XPU type or vendor)
Can we *really* program XPUs?

1. Freedom
2. Value
3. Trustworthy:

My coding choices can be made with confidence, and my code is maintainable.
SYCL embraces this vision

vision / goal:

✓ Freedom
✓ Value
✓ Trustworthy

SYCL explicitly supports XPU-specific coding and tuning.
embracing also: oneAPI

vision / goal:
✓ Freedom
✓ Value
✓ Trustworthy

Like SYCL, oneAPI explicitly supports XPU-specific coding and tuning.
*.* processing units (XPUs)
programming

Languages and Libraries

CPU
GPU
FPGA
Other Accelerators
higher level programming
Applications, workloads

Middleware and Frameworks

Languages and Libraries

oneAPI
An open specification and initiative to standardize programming of accelerated processing units (XPU)

XPU

CPU
GPU
FPGA
Other Accelerators
Applications, workloads

Middleware and Frameworks
- TensorFlow
- PyTorch
- mxnet
- logit
- NumPy
- dask
- XGBoost
- OpenVINO

Languages and Libraries
oneAPI

Intel's first product implementation of oneAPI released in 2020. Free downloads.

XPUs
- CPU
- GPU
- FPGA
- Other Accelerators
Applications, workloads

Middleware and Frameworks
- TensorFlow
- PyTorch
- mxnet
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- NumPy
- XGBoost
- OpenVINO
- ...

Intel® oneAPI

Languages

Hardware Abstraction Layer

XPUs
- CPU
- GPU
- FPGA
- Other Accelerators
For instance... We see this coming: a profound impact on FPGA programming in addition to SYCL, we have familiar and powerful profilers, debuggers, library APIs...
high enough performance

+ 

productivity

+ 

ability to adapt/adjust

=

better results in practice
Applications, workloads

Middleware and Frameworks

TensorFlow, PyTorch, MXNet, Numpy, XGBoost, OpenVINO...

Intel® oneAPI

Intel® oneAPI Toolkits
A complete set of proven developer tools expanded from CPU to XPU

Intel® oneAPI Base Toolkit
Native Code Developers

Intel® oneAPI Base Toolkit
A core set of high-performance tools for building C++, Data Parallel C++, applications & oneAPI library-based applications

Add-on Domain-specific Toolkits

Intel® oneAPI Tools for HPC
Deliver fast Fortran, OpenMP & MPI applications that scale

Intel® oneAPI Tools for IoT
Build efficient, reliable solutions that run at network's edge

Intel® oneAPI Rendering Toolkit
Create performant, high-fidelity visualization applications

Toolkits powered by oneAPI

Intel® AI Analytics Toolkit
Accelerate machine learning & data science pipelines with optimized DL frameworks & high-performing Python libraries

Intel® Distribution of OpenVINO™ Toolkit
Deploy high performance inference & applications from edge to cloud

Intel® oneAPI
Latest version is 2021.2
Applications, workloads

Middleware and Frameworks
- TensorFlow
- PyTorch
- mxnet
- logit
- NumPy
- dask
- XGBoost
- OpenVINO
- ...

Intel® oneAPI

Languages
Analysis & Debug Tools
Libraries

Hardware Abstraction Layer

Over 100 Billion Transistors
47 Magical Tiles
Alchemy of Technologies

Our Most Advanced Packaging
Applications, workloads

Middleware and Frameworks

- TensorFlow
- PyTorch
- mxnet
- logit
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- XGBoost
- OpenVINO

Intel® oneAPI

- Languages
- Analysis & Debug Tools
- Libraries

Hardware Abstraction Layer

more info: https://www.alcf.anl.gov/aurora
Together – let’s help the industry embrace heterogeneity
- to adopt the best XPUss for the job openly and universally
much of oneAPI rests solidly on SYCL
We are committed to SYCL.

thank you
SYCL committee

(and thank you for
"my heros"
the Intel engineers,
who sold Intel on this)
Our support for an open XPU future is sincere, runs deep, and will help the entire industry.

Please work with me, to ensure our enthusiasm is always a positive force.

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Thank you

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