LRZ oneAPI Workshop, June 4th

Intel® DevCloud for oneAPI

Overview

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Agenda

- DevCloud overview
- DevCloud: how to get an account
- DevCloud: how to access with ssh
- Outlook: new Intel Developer Cloud IDC

Intel® DevCloud for oneAPI

Free Access, A Fast Way to Start Coding

A development sandbox to develop, test and run workloads across a range of Intel® CPUs, GPUs, and FPGAs using Intel's oneAPI software

For customers focused on data-centric workloads on a variety of Intel® architecture

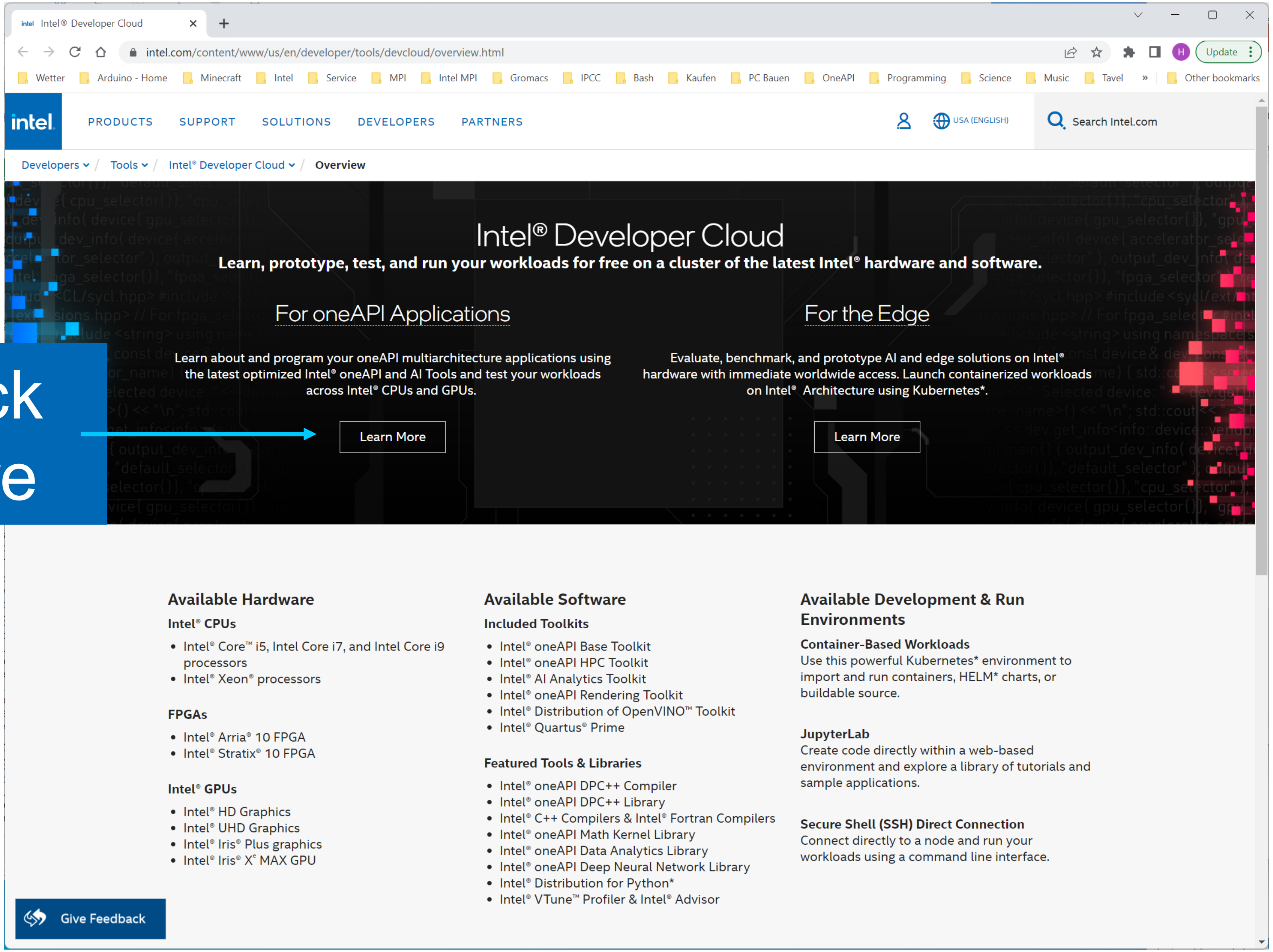
- Learn Data Parallel C++
- Use Intel® oneAPI Toolkits
- Evaluate Workloads
- Prototype Your Project
- Build Cross-architecture Applications

No Downloads | No Hardware Acquisition | No Installation | No Set-up & Configuration

Get Up & Running in Seconds! -- click on "Get Free Access"

https://devcloud.intel.com/oneapi/home/

Click here


Intel® Developer Cloud
intel.com/content/www/us/en/developer/tools/devcloud/overview.html
Wetter
Arduino - Home
Minecraft
Intel
Service
MPI
Intel MPI
Gromacs
IPCC
Bash
Kaufen
PC Bauen
OneAPI
Programming
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Intel® Developer Cloud
Learn, prototype, test, and run your workloads for free on a cluster of the latest Intel® hardware and software.
For oneAPI Applications
Learn about and program your multiarchitecture applications using the latest optimized Intel® oneAPI and AI Tools and test your workloads across Intel® CPUs and GPUs.
Learn More
For the Edge
Evaluate, benchmark, and prototype AI and edge solutions on Intel® hardware with immediate worldwide access. Launch containerized workloads on Intel® Architecture using Kubernetes*.
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Available Hardware
Intel® CPUs
Intel® Core™ i5, Intel Core i7, and Intel Core i9 processors
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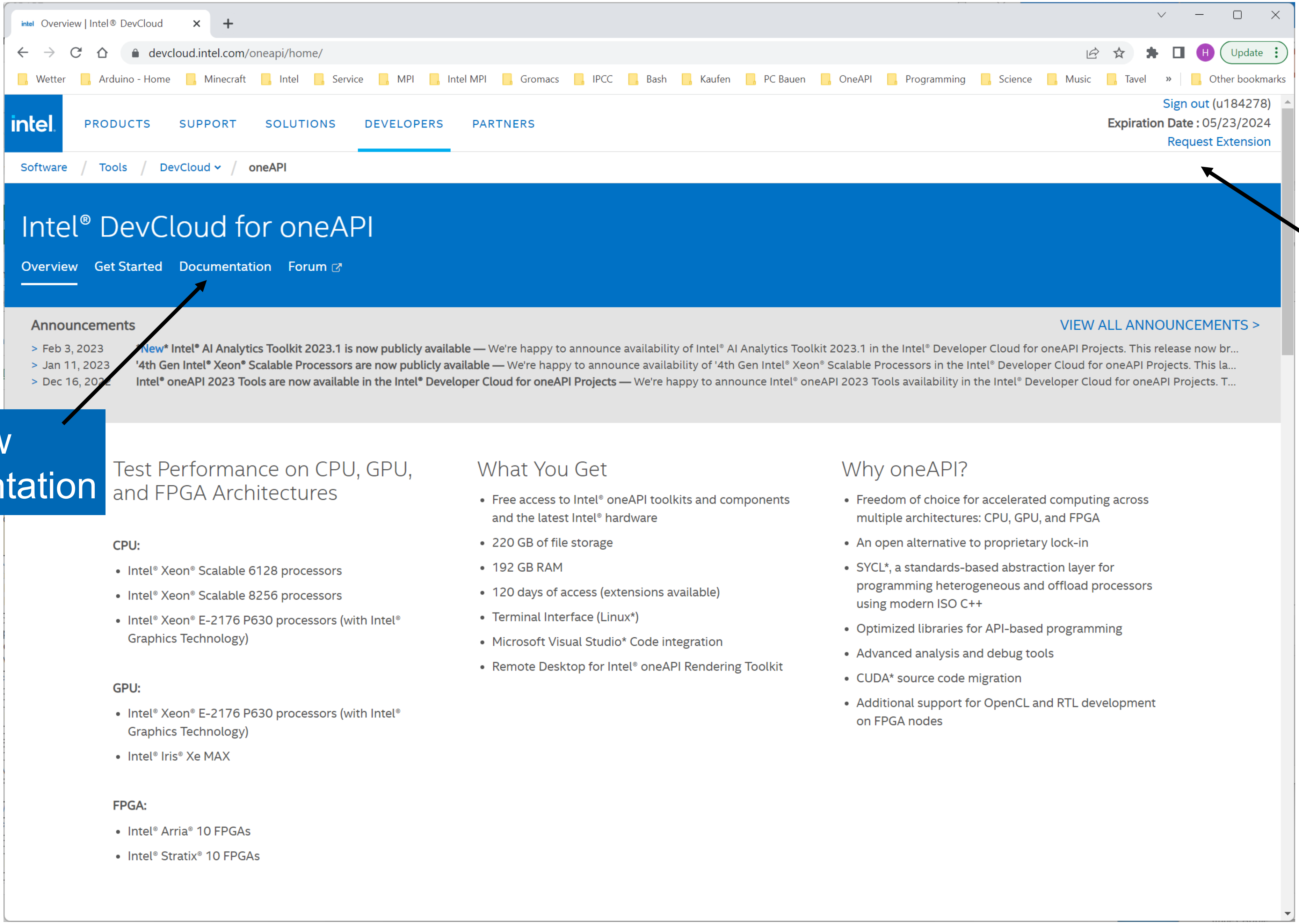
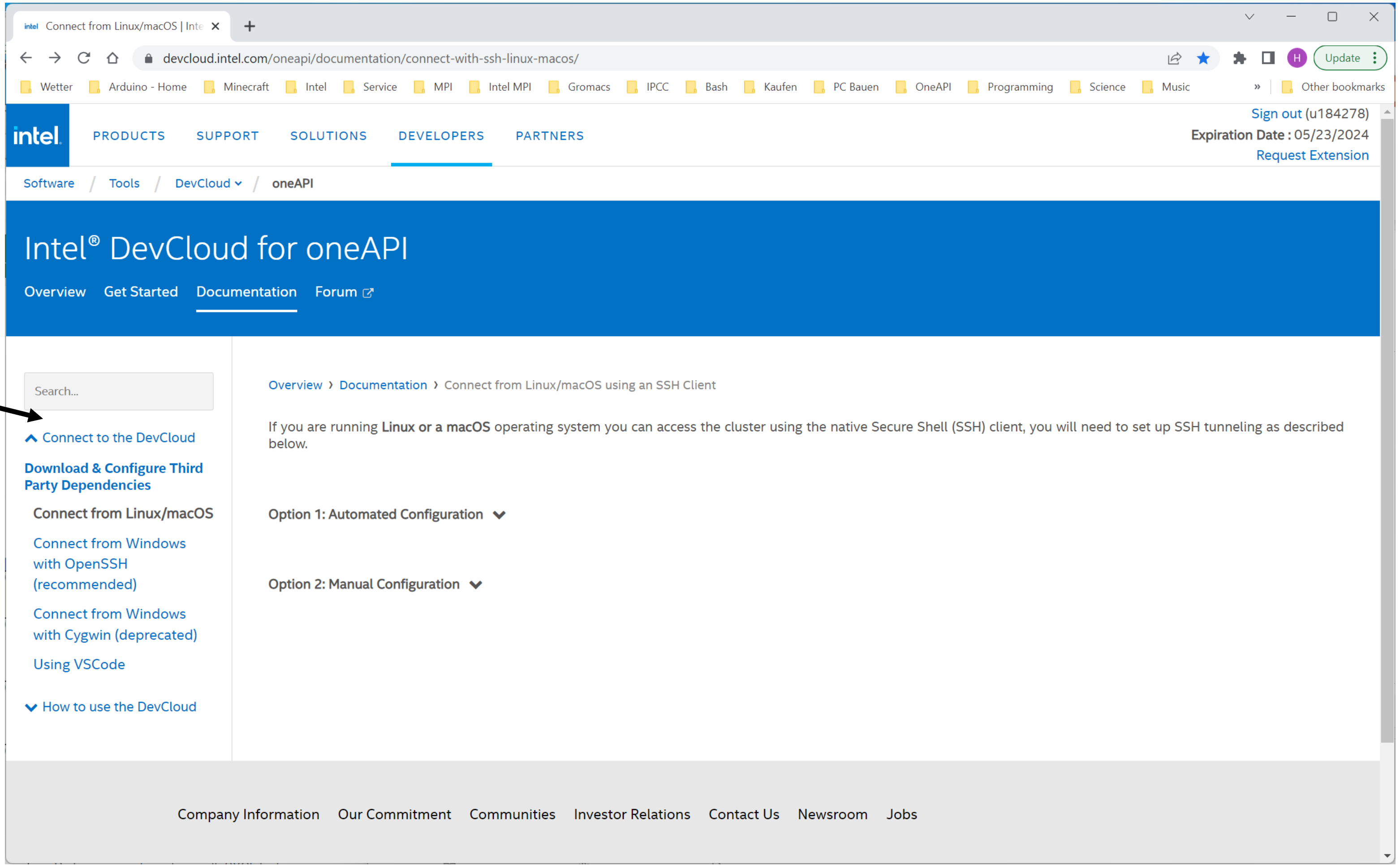
FPGAs
Intel® Arria® 10 FPGA
Intel® Stratix® 10 FPGA
Intel® GPUs
Intel® HD Graphics
Intel® UHD Graphics
Intel® Iris® Plus graphics
Intel® Iris® Xe MAX GPU
Available Software
Included Toolkits
Intel® oneAPI Base Toolkit
Intel® oneAPI HPC Toolkit
Intel® AI Analytics Toolkit
Intel® oneAPI Rendering Toolkit
Intel® Distribution of OpenVINO™ Toolkit
Intel® Quartus® Prime
Featured Tools & Libraries
Intel® oneAPI DPC++ Compiler
Intel® oneAPI DPC++ Library
Intel® C++ Compilers & Intel® Fortran Compilers
Intel® oneAPI Math Kernel Library
Intel® oneAPI Data Analytics Library
Intel® oneAPI Deep Neural Network Library
Intel® Distribution for Python*
Intel® VTune™ Profiler & Intel® Advisor
Available Development & Run Environments
Container-Based Workloads
Use this powerful Kubernetes* environment to import and run containers, HELM* charts, or buildable source.
JupyterLab
Create code directly within a web-based environment and explore a library of tutorials and sample applications.
Secure Shell (SSH) Direct Connection
Connect directly to a node and run your workloads using a command line interface.
Give Feedback



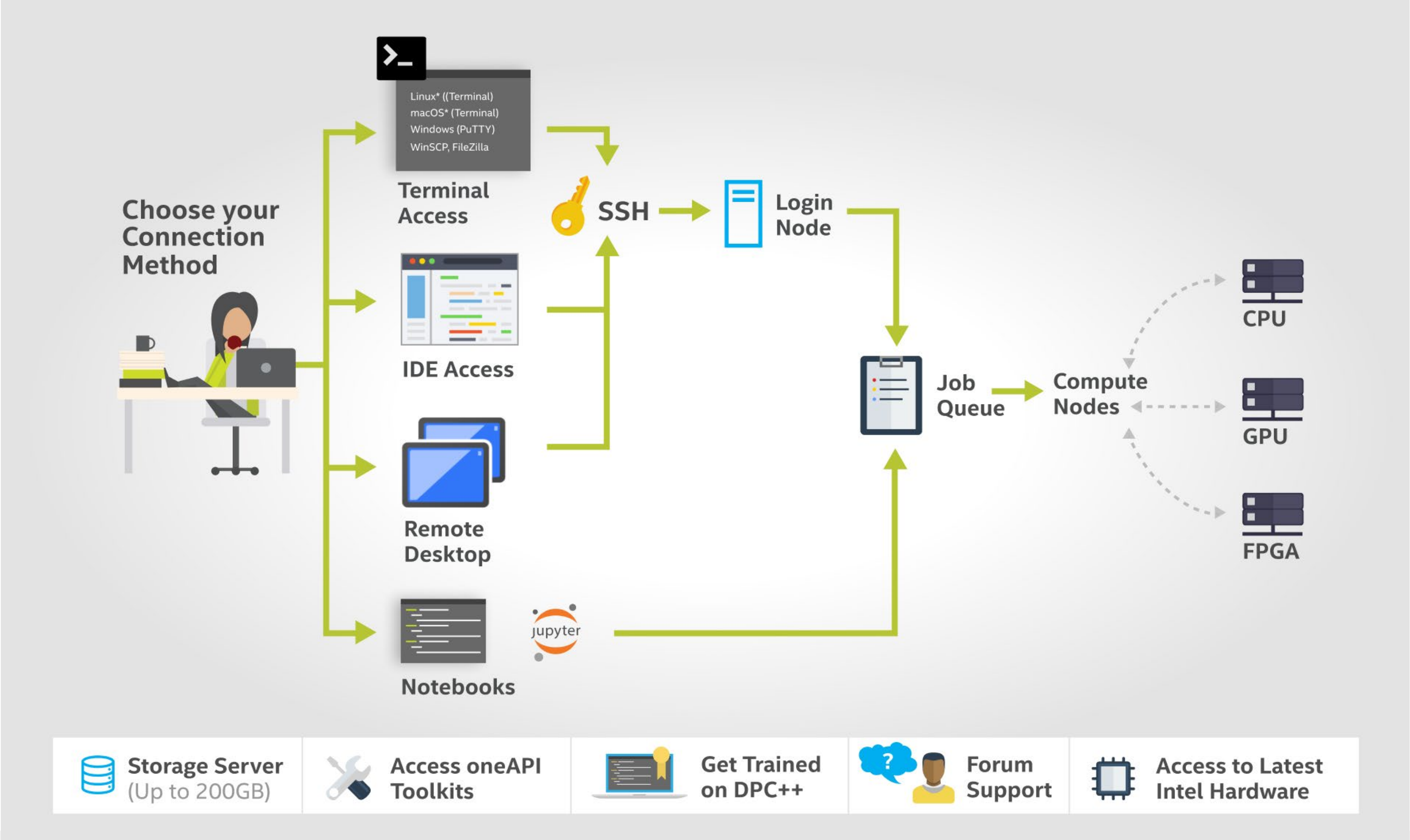
User name and Expiration Date

View Documentation

View: Connect to DevCloud



Connection Methods



Get Started (ssh)

https://devcloud.intel.com/oneapi/get_started/baseToolkitSamples

1 Connect to DevCloud

Connect to the DevCloud using SSH Clients.

2 Hello World! Get Started by running a simple sample on DevCloud.

Use this simple sample to confirm that you are connected to oneAPI DevCloud

2.1. CPU/GPU Vector-Add sample walkthrough

1. Connect to the DevCloud.

```bash
[myname@myhomecomputer] $ ssh devcloud
```

2. Download the samples.

```bash
[u115975@login-2] $ git clone https://github.com/oneapi-src/oneAPI-samples.git
```

3. Go to the vector-add sample.

```bash
[u115975@login-2] $ cd oneAPI-samples/DirectProgramming/DPC++/DenseLinearAlgebra/vector-add/
```

Build and run the sample in batch mode

PBS Batch System

- DevCloud uses the PBS Batch System for node access
- Interactive jobs are possible (6 hours default)
- https://devcloud.intel.com/oneapi/documentation/job-submission

How to submit a batch job

```
[u115975@login-2] $ qsub -l nodes=1:gpu:ppn=2 -d . job.sh
```

Note: `-l nodes=1:gpu:ppn=2` (lower case L) is used to assign one full GPU node to the job.
Note: The `-d .` is used to configure the current folder as the working directory for the task.
Note: `job.sh` is the script that gets executed on the compute node.

How to request interactive mode

```
[u115975@login-2] $ qsub -I -l nodes=1:gpu:ppn=2 -d .
```

Note: `-I` (upper case i) is the argument used to request an interactive session.

Basic PBS Queries

- Query available nodes

```
> pbsnodes | grep '^s'
s001-n001
…
```

- Check node characteristics

```
> pbsnodes | grep properties | sort -u
     properties = core,tgl,i9-11900kb,ram32gb,netgbe,gpu,gen11
     properties = xeon,cfl,e-2176g,ram64gb,net1gbe,gpu,gen9
     properties = xeon,clx,ram192gb,net1gbe,batch,extended,fpga,stratix10,fpga_runtime
     properties = xeon,icx,gold6348,ramgb,netgbe,jupyter,batch
     properties = xeon,icx,plat8380,ram2tb,net1gbe,batch
     properties = xeon,skl,gold6128,ram192gb,net1gbe,fpga_runtime,fpga,agilex
     properties = xeon,skl,gold6128,ram192gb,net1gbe,fpga_runtime,fpga,arria10
     properties = xeon,skl,gold6128,ram192gb,net1gbe,jupyter,batch
     properties = xeon,skl,gold6128,ram192gb,net1gbe,jupyter,batch,fpga_compile
     properties = xeon,skl,ram384gb,net1gbe,renderkit
     properties = xeon,spr,max9480,ram256gb,netgbe,batch,hbm
     properties = xeon,spr,ram1024gb,netgbe,dnp50
```

Basic oneAPI Queries

- oneAPI environment on node
  - ➢ **`source /opt/intel/oneapi/setvars.sh   # or load module`**
  - ➢ **`which icpx`**

```
/glob/development-tools/versions/oneapi/2023.1.2/oneapi/compiler/2023.1.0/linux/bin/icpx
```

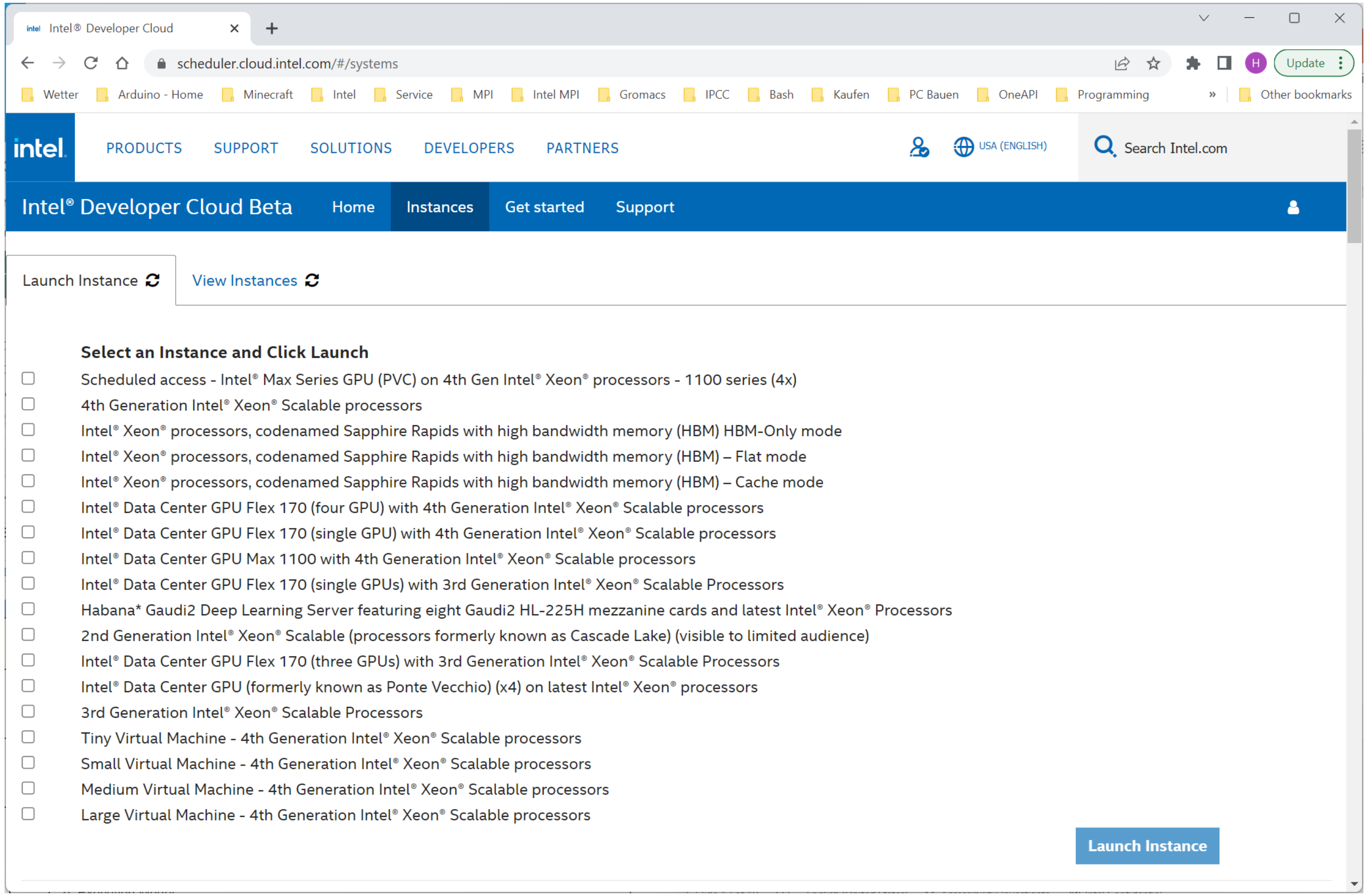
- Check GPU characteristics

```
> sycl-ls --verbose
...
Platform [#3]:
    Version  : 1.3
    Name     : Intel(R) Level-Zero
    Vendor   : Intel(R) Corporation
    Devices  : 1
        Device [#0]:
        Type       : gpu
        Version    : 1.3
        Name       : Intel(R) UHD Graphics [0x9a60]
        Vendor     : Intel(R) Corporation
        Driver     : 1.3.24595
default_selector()      : gpu, Intel(R) Level-Zero, Intel(R) UHD Graphics [0x9a60] 1.3 [1.3.24595]
accelerator_selector()  : No device of requested type available. Please chec...
cpu_selector()          : cpu, Intel(R) OpenCL, 11th Gen Intel(R) Core(TM) i9-11900KB @ 3.30GHz 3.0 [2023.15.3.0.20_160000]
gpu_selector()          : gpu, Intel(R) Level-Zero, Intel(R) UHD Graphics [0x9a60] 1.3 [1.3.24595]
custom_selector(gpu)    : gpu, Intel(R) Level-Zero, Intel(R) UHD Graphics [0x9a60] 1.3 [1.3.24595]
custom_selector(cpu)    : cpu, Intel(R) OpenCL, 11th Gen Intel(R) Core(TM) i9-11900KB @ 3.30GHz 3.0 [2023.15.3.0.20_160000]
```

Notes:

- Login nodes have very low limits: please compile etc. on compute nodes!
- Please use tools only on compute nodes for same reason!
- Jupyter notebooks also offer a terminal – in case of trouble with ssh.
- Mark Expiration Date in your Calendar!

New Intel Developer Cloud – cloud.intel.com



Notices & Disclaimers

Texas Advanced Computing Center (TACC) Frontera references
Article: *HPCWire: Visualization & Filesystem Use Cases Show Value of Large Memory Fat Notes on Frontera*.
www.intel.com/content/dam/support/us/en/documents/memory-and-storage/data-center-persistent-mem/Intel-Optane-DC-Persistent-Memory-Quick-Start-Guide.pdf
software.intel.com/content/www/us/en/develop/articles/introduction-to-programming-with-persistent-memory-from-intel.html
wreda.github.io/papers/assise-osdi20.pdf

Performance varies by use, configuration and other factors. Learn more at www.Intel.com/PerformanceIndex.

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Code Samples

- OpenMP offload

MandelbrotOMP sample
This sample demonstrates how to accelerate program performance with SIMD and parallelization using OpenMP*, in the context of calculating the Mandelbrot set.

View code on GitHub*

openMP Reduction Sample
The openmp_reduction code sample is a simple program that calculates pi. This program is implemented using C++ and openMP for Intel CPU and accelerators.

View code on GitHub*

ISO3DFD Open MP Offload Sample
The ISO3DFD sample refers to Three-Dimensional Finite-Difference Wave Propagation in Isotropic Media. It is a three-dimensional stencil to simulate a wave propagating in a 3D isotropic medium and shows some of the more common challenges and techniques when targeting OMP Offload devices (GPU) in more complex applications to achieve good performance.

View code on GitHub*

- DPC++

Direct Programming/DPC++

Vector-Add
This simple vector-add program in Data Parallel C++ (DPC++) supports FPGAs, GPUs, and CPUs.

View code on GitHub*

Mandelbrot Sample
Mandelbrot is an infinitely complex fractal patterning that is derived from a simple formula. It demonstrates using DPC++ for offloading computations to a GPU (or other devices) and shows how processing time can be optimized and improved with parallelism.

View code on GitHub*

Complex Multiplication Sample
Complex multiplication is a program that multiplies two large vectors of Complex numbers in parallel and verifies the results. It also implements a custom device selector to target a specific vendor device. This program is implemented using C++ and DPC++ language for Intel CPU and accelerators. The Complex class is a custom class, and this program shows how we can use custom types of classes in a DPC++ program.

Sepia Filter
A program that converts an image to sepia tone.

View code on GitHub*

Connection with Jupyter* Notebook

- JupyterLab*

Connect with Jupyter* Lab

Connect with Jupyter* Notebook

Use Jupyter Notebook to learn about how oneAPI can solve the challenges of programming in a heterogeneous world and understand the Data Parallel C++ (DPC++) language and programming model.

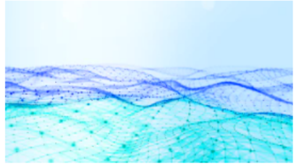
Launch JupyterLab*

- JupyterLabs* for AI

AI Sample Applications

Find sample applications for your specific market needs with examples of how to optimize, tune, and accelerate your applications.

Learn More



Connect and Create

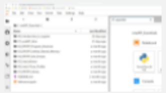
Develop your own machine learning solutions using Jupyter* Notebooks or a containerized launch environment. Benchmark your code and optimize it for Intel® hardware.

Connect to JupyterLab
Connect to Container Playground

Basic Training Modules in JupyterLab*

- https://devcloud.intel.com/oneapi/get_started/baseTrainingModules

Learn the Essentials of Data Parallel C++



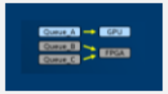
Module 0
Introduction to JupyterLab* and Notebooks.
Learn to use Jupyter notebooks to modify and run code as part of learning exercises.

Try it in Jupyter

Module 1
Introduction to DPC++

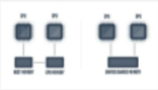
- Articulate how oneAPI can help to solve the challenges of programming in a heterogeneous world.
- Use oneAPI solutions to enable your workflows.
- Understand the DPC++ language and programming model.
- Become familiar with using Jupyter notebooks for training throughout the course.

Try it in Jupyter



Module 2
DPC++ Program Structure

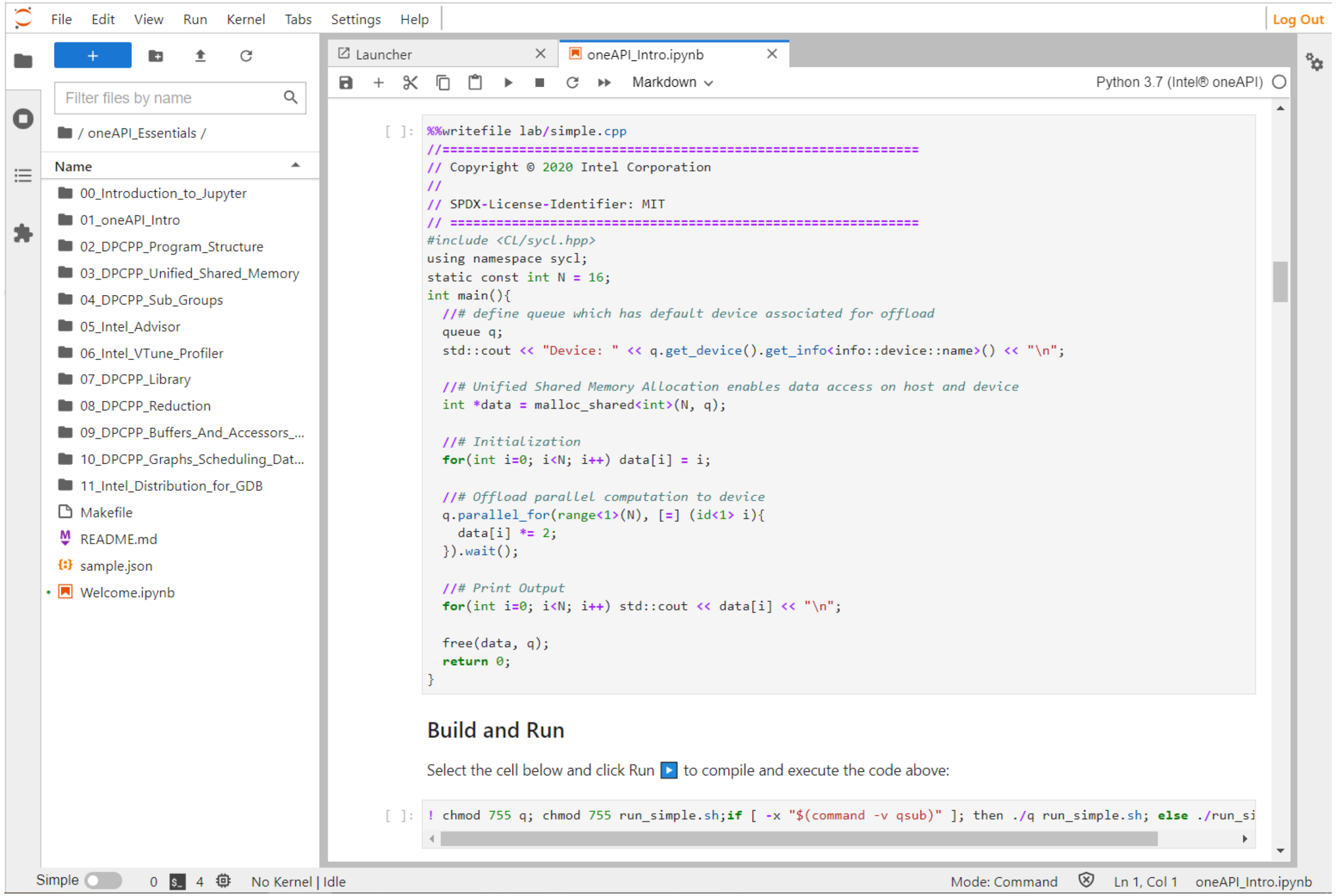
- Articulate the SYCL* fundamental classes.



Module 3
DPC++ Unified Shared Memory

- Use new DPC++ features like Unified Shared Memory (USM) to

oneAPI Essentials in JupyterLab*



Connection with Visual Studio Code*

Connect to DevCloud with Visual Studio Code

NOTE: Windows users must first download and install Cygwin before proceeding. Once it has been installed, return to this page to configure your connection.

Requirements:

- Windows users install Cygwin from the installation page
- VS Code
- VS Code SSH extension
- VS Code DevCloud Connector extension

Cygwin Installation

The Cygwin* environment offers a convenient way of connecting to the Intel® DevCloud from a local machine running Windows*, whether you have a direct connection or find yourself behind a proxy. If you already have Cygwin installed, please skip to the SSH connection instructions.

NOTE: Your Cygwin installation requires the openssh (ssh), nc and nano packages.

The following instructions will help you install a minimal version of Cygwin for accessing Intel DevCloud. For your convenience we're providing a simple script that automates the installation of Cygwin.

Download install_cygwin.bat from the installation page. It can be run from anywhere on your disk, either by executing it from the terminal or by double clicking on it.

The script uses curl to download the Cygwin setup file. When asked to provide proxy details, you can do so by entering proxy:port when asked, or by simply hitting enter to continue without a proxy.

The default installation path is c:\cygwin64. The script will prompt you to change this if you wish to install elsewhere.

Several Cygwin packages are downloaded during the installation. The script is configured to use mirrors.kernel.org as the default download site. A full list of Cygwin mirror sites can be found on the Cygwin homepage https://www.cygwin.com/.