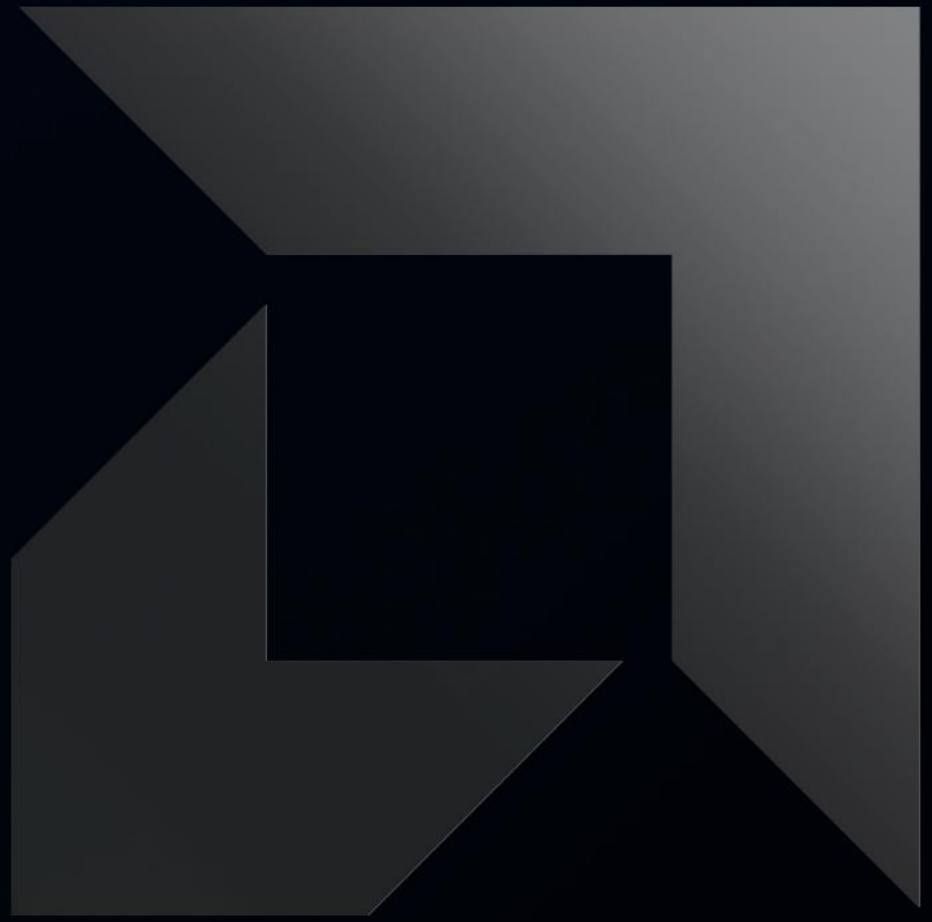


Overview of AI and ML on AMD GPUs

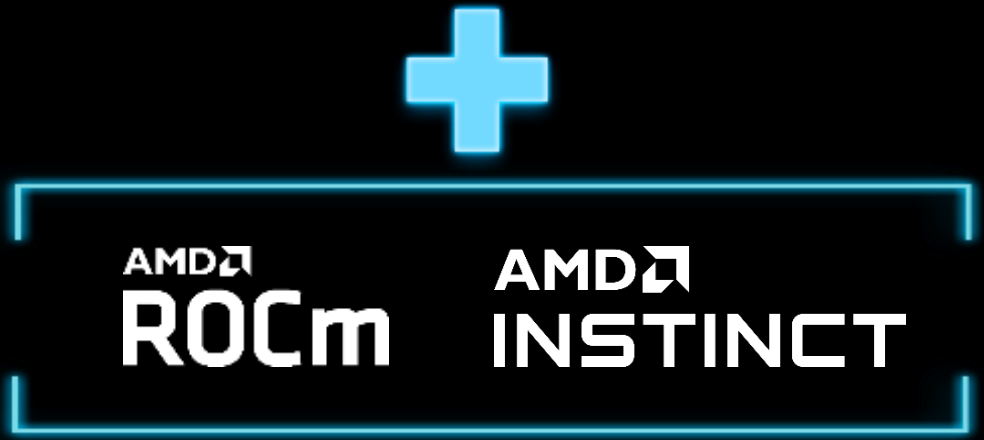
Presenter: Giacomo Capodaglio
Date: October 13th, 2025
AMD @ CASTIEL

AMD
together we advance_

ML ECOSYSTEM FOR AMD GPUS

SOURCE & BINARY implementations available upstream!

MIOPEN| RCCL | MIVisionX | MIGraphX
DEEPSPEED | AITemplate | openAI Triton|CuPy | XGBoost | hip-Python
flash-attention | vLLM | bitsandbytes|MPI4Py



What is PyTorch

- PyTorch is a Python™ package that provides two high-level features:
  - Tensor computation (like NumPy) with strong GPU acceleration
  - Deep neural networks built on a tape-based autograd system

- You can reuse your favorite Python™ packages such as NumPy, SciPy, and Cython to extend PyTorch when needed

source: [pytorch github repo]

PyTorch

At a granular level, PyTorch is a library that consists of the following components:

Component	Description
torch	A Tensor library like NumPy, with strong GPU support
torch.autograd	A tape-based automatic differentiation library that supports all differentiable Tensor operations in torch
torch.jit	A compilation stack (TorchScript) to create serializable and optimizable models from PyTorch code
torch.nn	A neural networks library deeply integrated with autograd designed for maximum flexibility
torch.multiprocessing	Python multiprocessing, but with magical memory sharing of torch Tensors across processes. Useful for data loading and Hogwild training
torch.utils	DataLoader and other utility functions for convenience

Usually, PyTorch is used either as:

- A replacement for NumPy to use the power of GPUs.
- A deep learning research platform that provides maximum flexibility and speed.

What is JAX

- JAX is a Python™ library for accelerator-oriented array computation and program transformation, designed for HPC and large-scale ML
- It can automatically **differentiate** native Python and NumPy functions
- It uses the Accelerated Linear Algebra (**XLA**) compiler to compile and scale your NumPy programs on TPUs, GPUs, and other hardware accelerators
- It is a research project, not an official Google product. Expect sharp edges

source: jax github repo

JAX vs. NumPy

Key concepts:

- JAX provides a NumPy-inspired interface for convenience.
- Through duck-typing, JAX arrays can often be used as drop-in replacements of NumPy arrays.
- Unlike NumPy arrays, JAX arrays are always immutable.

NumPy, lax & XLA: JAX API layering

Key concepts:

- `jax.numpy` is a high-level wrapper that provides a familiar interface.
- `jax.lax` is a lower-level API that is stricter and often more powerful.
- All JAX operations are implemented in terms of operations in XLA – the Accelerated Linear Algebra compiler.

To JIT or not to JIT

Key concepts:

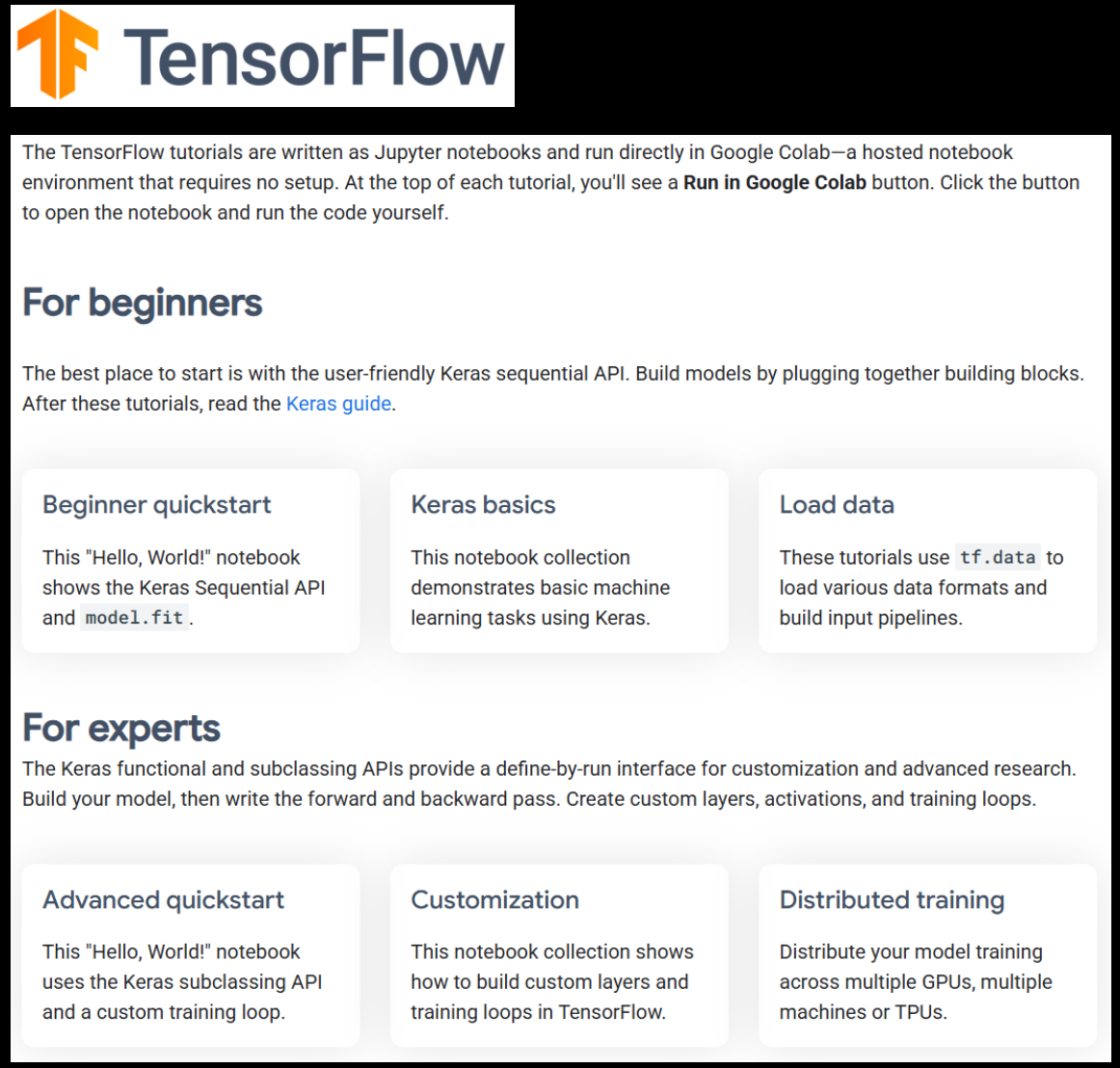
- By default JAX executes operations one at a time, in sequence.
- Using a just-in-time (JIT) compilation decorator, sequences of operations can be optimized together and run at once.
- Not all JAX code can be JIT compiled, as it requires array shapes to be static & known at compile time.

source: thinking_in_jax

What is TensorFlow

- TensorFlow is an end-to-end open-source platform for machine learning
- It has a comprehensive, flexible ecosystem of **tools**, **libraries**, and **community resources** to easily build and deploy ML-powered applications
- TensorFlow was originally developed by researchers and engineers working within the Machine Intelligence team at Google Brain
- It provides stable Python and C++ APIs, as well as a non-guaranteed backward compatible API for other languages.

source: [tensorflow github repo]



source: [tensorflow_tutorials]

What is ONNX

- Open Neural Network Exchange (**ONNX**) provides an open source format for AI models, both for deep learning and traditional ML.

- It defines an extensible computation graph model, as well as definitions of built-in operators and standard data types.

Use ONNX

- Documentation of ONNX Python Package
- Tutorials for creating ONNX models
- Pre-trained ONNX models

source: onnx github repo

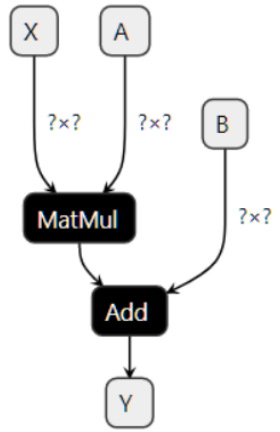
ONNX

ONNX Concepts

ONNX can be compared to a programming language specialized in mathematical functions. It defines all the necessary operations a machine learning model needs to implement its inference function with this language. A linear regression could be represented in the following way:

```
def onnx_linear_regressor(X):
    "ONNX code for a linear regression"
    return onnx.Add(onnx.MatMul(X, coefficients), bias)
```

This example is very similar to an expression a developer could write in Python. It can be also represented as a graph that shows step-by-step how to transform the features to get a prediction. That's why a machine-learning model implemented with ONNX is often referenced as an **ONNX graph**.



source: onnx_documentation

What is CuPy

- NumPy is a python interface to optimized routines written in C that provide arrays, multi-dimensional arrays and common numerical operations on them. These are much faster than operating on Python lists
- SciPy provides fundamental algorithms common in scientific and numerical computing. The underlying code is a mixture of Fortran, C and C++
- CuPy is a NumPy/SciPy-compatible array library for GPU-accelerated computing with Python
- CuPy acts as a drop-in replacement to run existing NumPy/SciPy code on NVIDIA CUDA or AMD ROCm™ platforms
- CuPy provides the `ndarray`, sparse matrices, and the associated routines for GPU devices, most having the same API as NumPy and SciPy.
- CuPy provides interfaces to GPU optimized libraries such as rocBLAS, rocSPARSE, rocFFT, and RCCL

source: [cupy documentation]

click here for differences between CuPy and NumPy

CuPy functions

CuPy vs NumPy API

CuPy-specific functions

Comparison Table

Here is a list of NumPy / SciPy APIs and its corresponding CuPy implementations.

`-` in CuPy column denotes that CuPy implementation is not provided yet. We welcome contributions for these functions.

NumPy / CuPy APIs

Module-Level

NumPy	CuPy
`numpy.DataSource`	`cupy.DataSource` (*alias of* `numpy.DataSource`)
`numpy.ScalarType`	-
`numpy.abs`	`cupy.abs`
`numpy.absolute`	`cupy.absolute`
`numpy.add`	`cupy.add`
`numpy.all`	`cupy.all`
`numpy.allclose`	`cupy.allclose`

full list here: cupy_documentation

CuPy-specific functions

CuPy-specific functions are placed under `cupyx` namespace.

`cupyx.rsqrt`	Returns the reciprocal square root.
`cupyx.scatter_add` (a, slices, value)	Adds given values to specified elements of an array.
`cupyx.scatter_max` (a, slices, value)	Stores a maximum value of elements specified by indices to an array.
`cupyx.scatter_min` (a, slices, value)	Stores a minimum value of elements specified by indices to an array.
`cupyx.empty_pinned` (shape[, dtype, order])	Returns a new, uninitialized NumPy array with the given shape and dtype.
`cupyx.empty_like_pinned` (a[, dtype, order, ...])	Returns a new, uninitialized NumPy array with the same shape and dtype as those of the given array.

full list here: cupy_documentation

CuPy-Xarray: Xarray on GPUs

- Xarray: Python™ library to work with labelled multi-dimensional arrays
  - Popular for applications where multi-dimensional data needs to be handled (such as climate modeling)
  - Built on top of NumPy
  - Has built-in support for NetCDF
  - Can wrap custom duck array objects (i.e. NumPy-like arrays) that follow specific protocols.

- When used together, Xarray and CuPy can provide an easy way to take advantage of GPU acceleration for scientific computing tasks.

- CuPy-Xarray provides an interface for using CuPy in Xarray, providing accessors on the Xarray objects.
  - CuPy-Xarray relies on an existing CuPy installation, install CuPy first

- Cupy-Xarray github repo: https://github.com/xarray-contrib/cupy-xarray
  - Install with `pip install cupy-xarray --no-deps` after installing CuPy

- Issue with `dask`: https://github.com/xarray-contrib/cupy-xarray/pull/62
  - Did not make it into the latest release
  - Make sure to install dask with `pip install dask`

source: cupy-xarray documentation

ML ecosystem for AMD GPUs

Frameworks	Libraries & Tools	LLM Runtimes & Serving	Platform & Deployment
Tensorflow	MIOpen (primitives)	Ollama, LM Studio (local LLM hosting & UI)	**ROCm** – open-source driver & runtime
PyTorch	RCCL (collectives)	LangChain (orchestration)	**AMD Instinct** – MI200, MI250(X), MI300(X)
JAX	rocBLAS, rocFFT, rocSOLVER, rocPRIM, rocRAND	Triton Inference Server, KServe	**AMD Radeon** – RDNA2/RDNA3 (Navi-based) desktop & edge GPUs
ONNX Runtime	HIP & hipify (CUDA→HIP porting)		Docker/Singularity containers
MXNet	MIVisionX & MIGraphX (CV)		Slurm, MPI, Kubernetes scheduling
Horovod (distributed training)	DeepSpeed & AI Template		
Hugging Face Transformers & Diffusers	OpenAI Triton & CuPy		
	XGBoost & HIP-Python		
	FlashAttention, vLLM & BitsAndBytes		
	rocprofiler, roctracer (profiling / tracing) or rocprofiler-sdk, rocprofiler-systems, rocprofiler-compute		
	AMD uProf (system-level profiling)		

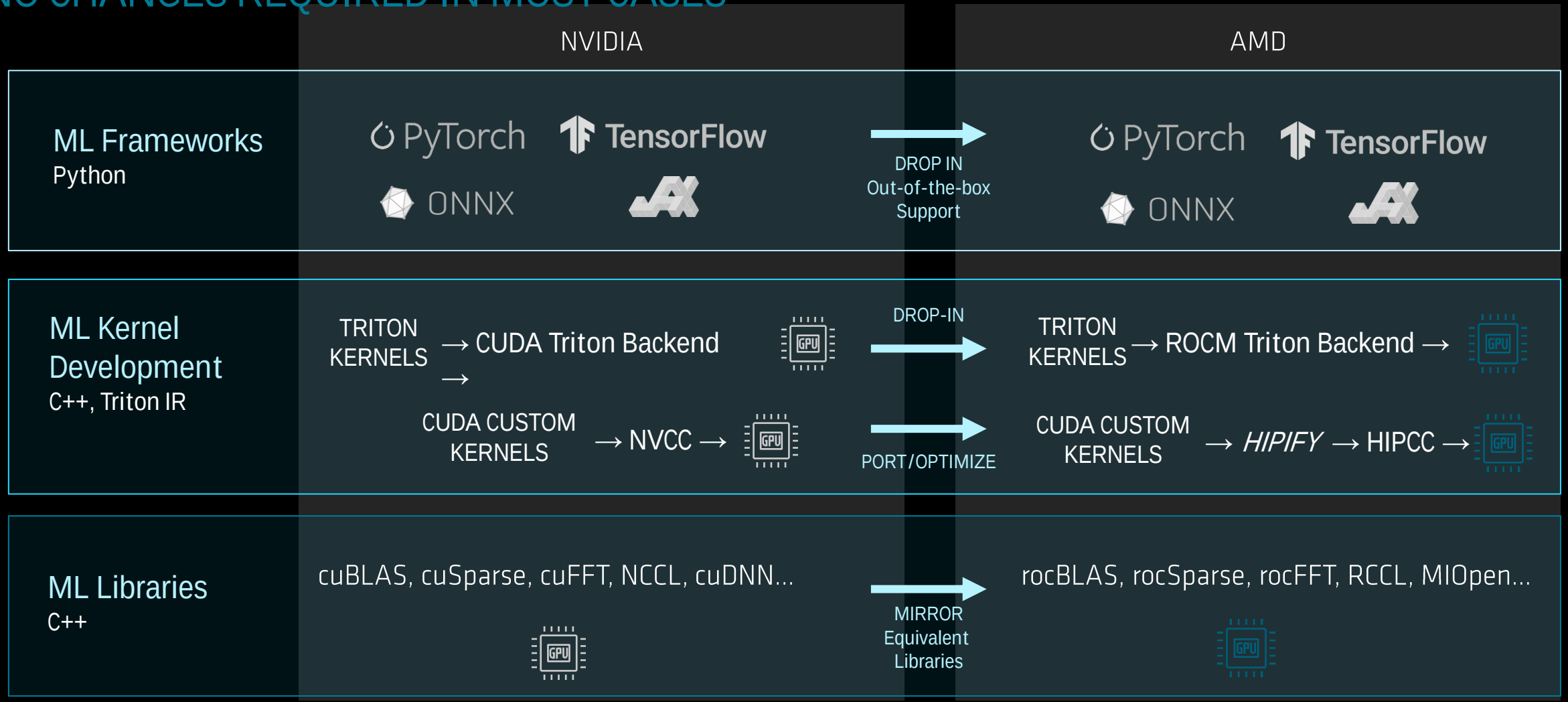
What is MPI4Py

- The Message Passing Interface (MPI) is a standardized and portable message-passing system designed to function on a wide variety of parallel computers
- The MPI standard defines the syntax and semantics of library routines and allows users to write portable programs in the main scientific programming languages (Fortran, C, or C++).
- MPI for Python™ provides (MPI4Py) MPI bindings for the Python™ programming language, allowing any Python program to exploit multiple processors across multiple nodes.
- MPI4Py can send data directly from one GPU to another GPU by using GPU-aware MPI.
- MPI4Py can be configured to use any MPI implementation

source: mpi4py documentation

Porting your ML application

NO CHANGES REQUIRED IN MOST CASES



Porting your ML application

API COMPATIBLE LIBRARIES

CUDA Library	ROCm Library	Description
cuBLAS	rocBLAS	Basic Linear Algebra Subroutines
cuFFT	rocFFT	Fast Fourier Transform Library
cuSPARSE	rocSPARSE	Sparse BLAS + SPMV
cuSolver	rocSolver	LAPACK Library
AmgX	rocALUTION	Algebraic Multi-Grid Accelerated Linear Solvers
Thrust	hipThrust	C++ parallel algorithms library
CUB	rocPRIM	Low Level Optimized Parallel Primitives
cuDNN	MIOpen	Deep learning Solver Library
cuRAND	rocRAND	Random Number Generator Library
NCCL	RCCL	Communications Primitives Library based on the MPI equivalents
cuTensor	hipTensor	Library to accelerate tensor primitives

Linear Algebra Libraries supporting both AMD and NVIDIA GPUs	
Eigen	C++ template library for linear algebra
MAGMA	Dense linear algebra library on GPU and Multicore Architectures
SuperLU_DIST	Direct solution of large, sparse, nonsymmetric systems of linear equation
HYPRE	Scalable Linear Solvers and Multigrid Methods
ELPA	Highly efficient and highly scalable direct eigensolvers for symmetric (Hermitian) matrices.
…	

Where can I get AI frameworks from?

BINARY AND SOURCE DISTRIBUTIONS AVAILABLE

	Source	Container	PIP wheel
PyTorch	PyTorch GitHub	Docker Hub	pytorch.org
JAX	JAX GitHub	Docker Hub	ROCm GitHub
TensorFlow	TensorFlow GitHub	Docker Hub	pypi.org
ONNX RUNTIME	ONNX-RT GitHub	Docker Hub	onnxruntime.ai
DeepSpeed	DeepSpeed GitHub	Docker Hub	deepspeed.ai
CuPy	CuPy Github	Docker Hub	cupy.dev

Not an NVIDIA product →

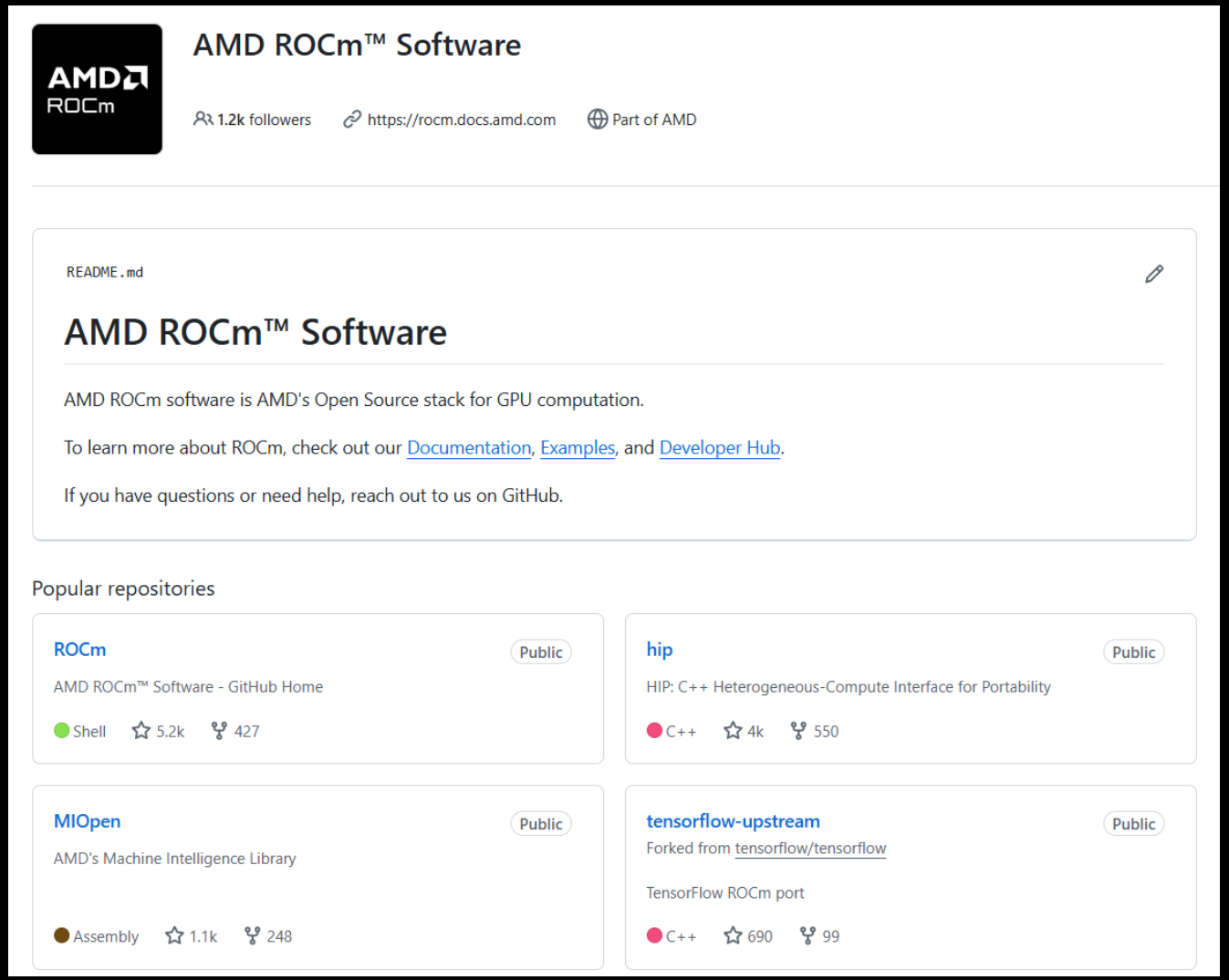
- Source builds can sometimes be……tricky
- Leveraging containers or pre-built wheel files for Python installs is recommended if possible

Where can I get AI frameworks from?

ROCm GITHUB HOSTS MOST AMD GPU PORTS

- https://github.com/ROCm
- https://github.com/ROCm/pytorch
- https://github.com/ROCm/jax
- https://github.com/ROCm/tensorflow-upstream
- https://github.com/ROCm/cupy
  - https://github.com/cupy/cupy

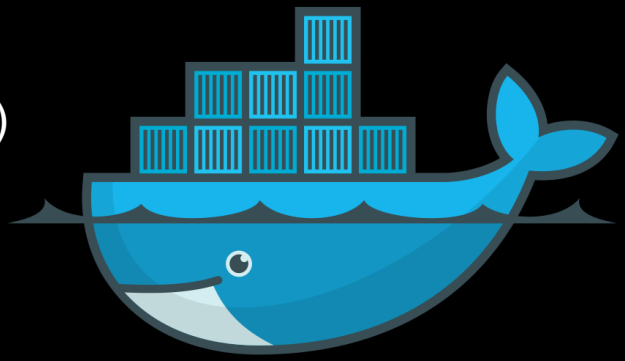
Not all of the above branches are updated with the same frequency, please make sure you use the release of branch tag that is most appropriate to your needs and ROCm version



CONTAINER -ROCm ML FRAMEWORK IMAGES

ROCm DOCKERHUB PROVIDES SEVERAL IMAGES READY TO USE

- There are instructions on DockerHub on what commands to use



- Docker command:

```
sudo docker run -it \
  --network=host \
  --device=/dev/kfd \
  --device=/dev/dri \
  --group-add=video \
  --ipc=host \
  --cap-add=SYS_PTRACE \
  --security-opt seccomp=unconfined \
  rocm/<FRAMEWORK>:<TAG>
```

Allow container to access network (dist. learning)

Allow access to the GPU drivers

Security options - may need to be expanded depending on the host system configuration

Replace `<FRAMEWORK>:<TAG>` with your choice—e.g. `rocm/pytorch:latest` or `rocm/tensorflow:5.4.0`.

- Docker images with different tags/versions are available on ROCm DockerHub

Wheel – pre-built with ROCm support

ROCm DOCKERHUB PROVIDES SEVERAL IMAGES READY TO USE

Prerequisites

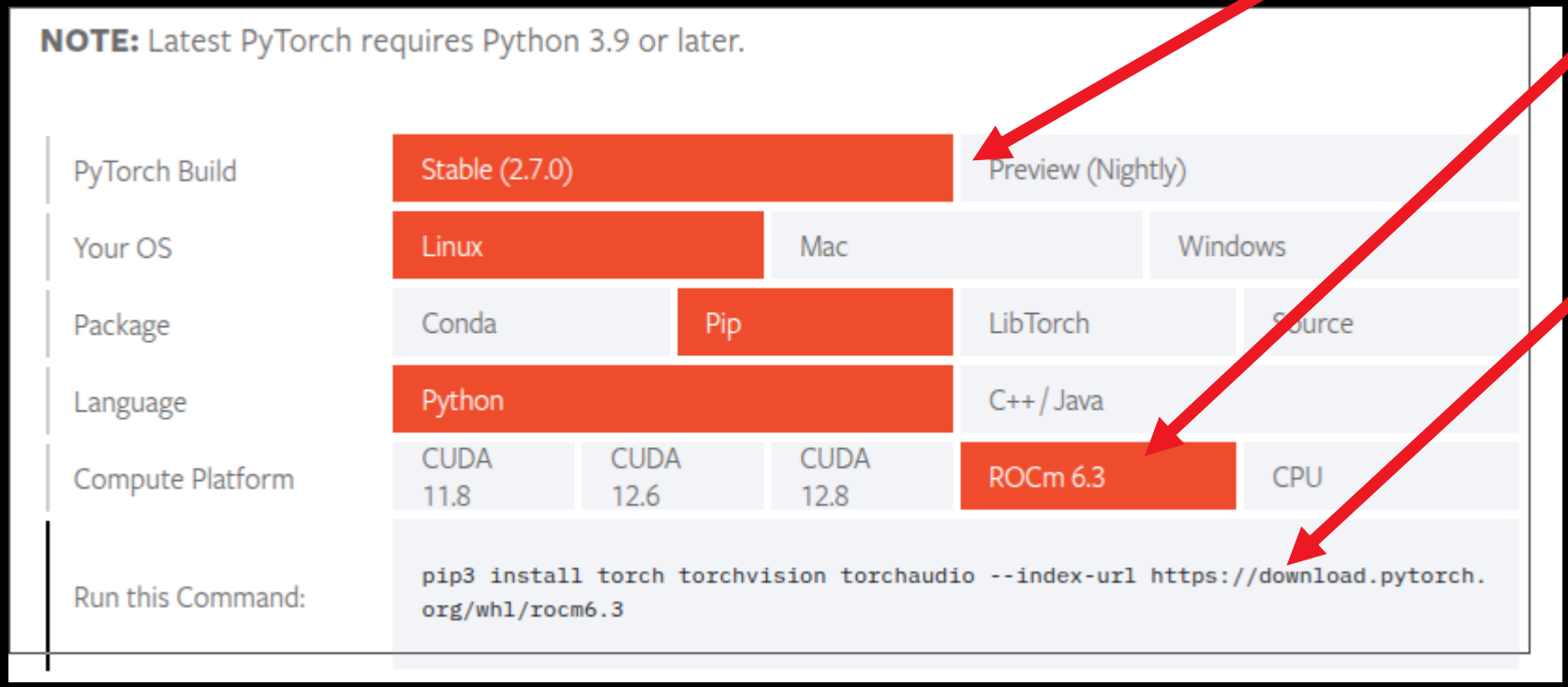
- System dependencies need to be met:
  - GPU drivers
  - ROCm libraries, RCCL, and MIOpen should be installed:
    - rocm-dev
    - hiplibsdk
    - mlsdk
- ROCm and Python versions must match the wheel file

ROCm Docs for AI

- Use ROCm for AI
- AI Tutorials
- ROCm Libraries
- ROCm for AI Training
- ROCm for AI Inference
- ROCm for AI Inference Optimization
- Deep Learning Frameworks

Example for PyTorch install with wheel

- PyTorch official docs: https://pytorch.org/ in Get Started



Choice for a stable or a preview build

Supporting ROCm version

Suggested install command

- More combinations available! Check here https://download.pytorch.org/whl/torch/
  - E.g. PyTorch 2.7.0 with ROCm 6.3
  - Older versions
- Even more combinations available in https://repo.radeon.com/rocm/manylinux.

PyTorch wheel install – sys Python™

- Native install from PyTorch Python™ wheels

Where do we want to install things - don't use your home folder!

Package install version can mix the PyTorch version as well as the ROCm it was built against.

This is where the wheel will be pulled from

```
pip3 install -t $wd/pip-installs --pre torch==2.7.0+rocm6.3        --index-url https://download.pytorch.org/whl/
```

```
Looking in indexes: https://download.pytorch.org/whl/
Collecting torch==2.7.0+rocm6.3
  Downloading https://download.pytorch.org/whl/rocm6.3/torch-2.7.0%2Brocm6.3-cp310-cp310-manylinux_2_28_x86_64.whl (4543.9 MB)
```

Make the freshly installed PyTorch available to your Python™ runs
NOTE: better to setup a module file

```
PYTHONPATH=$wd/pip-installs \
        srun -n1 --gpus=4 \
        python3 -c 'import torch; print("I have this many devices:", torch.cuda.device_count())'
```

```
> I have this many devices: 4
```

Should yield the number of GCDs requested from the node.

PyTorch wheel install – virtual environments

- Virtual environments are convenient to manage Python™ package installation in your user-space

Leverage the venv module to create the virtual environment

We are happy to leverage system's already installed packages. We could also leave this off for a completely self-contained installation in the virtual environment.

```
python3 -m venv --system-site-packages python-virtualenv
```

```
source python-virtualenv/bin/activate
```

Activate the environment. It will be leveraged by the install and run.

Install and run as before. No need to specify install location – the environment is doing it for you.

```
pip3 install --pre torch==2.7.0+rocm6.3 --index-url https://download.pytorch.org/whl/
srun -n1 –gpus=4 \
 python3 -c 'import torch; print("I have this many devices:", torch.cuda.device_count())'
```

PyTorch wheel install – conda environment

- Conda environment adds the package-manager functionality to a virtual environment
- One can tune the Python version to use as we won't be leveraging the system one anymore.

Download and install a minimal conda (miniconda) specific version.

```
curl -LO https://repo.anaconda.com/miniconda/Miniconda3-py310_24.1.2-0-Linux-x86_64.sh
```

```
curl -LO https://repo.anaconda.com/miniconda/Miniconda3-latest-Linux-x86.sh
bash ./Miniconda3-* -b -p miniconda3 -s
```

Download and install a minimal conda (miniconda) latest version.

```
source $wd/miniconda3/bin/activate base
```

Activate the conda environment

```
conda create -y -n pytorch python=3.10
source $wd/miniconda3/bin/activate pytorch
```

Create and activate a conda environment to install PyTorch based on Python 3.10

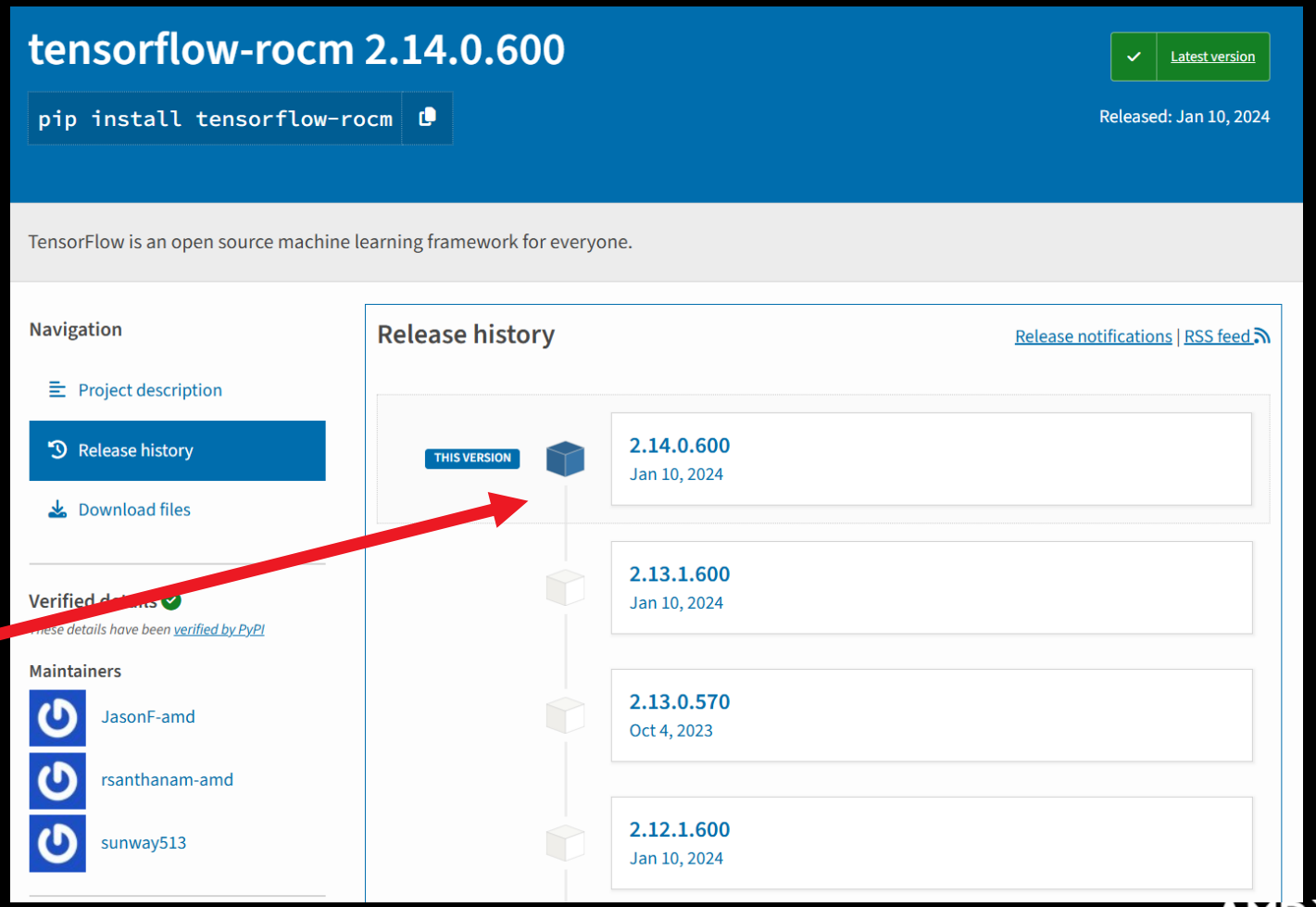
Install and run as before - Conda package manager doesn't have ROCm-enabled PyTorch installs

```
pip3 install --pre torch==2.7.0+rocm6.3 --index-url https://download.pytorch.org/whl/
srun --jobid=$jobid -n1 --gpus 8 \
 python3 -c 'import torch; print("I have this many devices:", torch.cuda.device_count())'
```

TensorFlow wheel install

- Requirements similar to PyTorch install.
- Unlike PyTorch, TensorFlow packages for ROCm have a specific name:
  - **`tensorflow-rocm`**

Check the available versions from https://pypi.org/project/tensorflow-rocm/#history



Package version example:

- TensorFlow version 2.14.0
- Built on top of ROCm 6.0.0

TensorFlow wheel install

- Installing TensorFlow 2.14.0 for ROCm 6.0.0:
  `pip3 install tensorflow-rocm==2.14.0.600`

- One can leverage pip command to get the available versions
  `pip3 install tensorflow-rocm==`

```
ERROR: Could not find a version that satisfies the requirement tensorflow-rocm== (from versions: 2.8.0, 2.8.1, 2.8.2, 2.8.3, 2.8.4, 2.9.1, 2.9.2, 2.9.3, 2.9.4
, 2.10.0.520, 2.10.0.530, 2.10.1.540, 2.10.1.550, 2.11.0.530, 2.11.0.540, 2.11.1.550, 2.12.0.560, 2.12.1.570, 2.12.1.600, 2.13.0.570, 2.13.1.600, 2.14.0.600)
ERROR: No matching distribution found for tensorflow-rocm==
```

- Checking number of GPUs:
  `python3 -c 'from tensorflow.python.client import device_lib ; device_lib.list_local_devices()'`

```
Created device /device:GPU:0 with 63922 MB memory:  -> device: 0, name: AMD Instinct MI210, pci bus id: 0000:63:00.0
Created device /device:GPU:1 with 63922 MB memory:  -> device: 1, name: AMD Instinct MI210, pci bus id: 0000:43:00.0
Created device /device:GPU:2 with 63922 MB memory:  -> device: 2, name: AMD Instinct MI210, pci bus id: 0000:03:00.0
Created device /device:GPU:3 with 63922 MB memory:  -> device: 3, name: AMD Instinct MI210, pci bus id: 0000:26:00.0
```

JAX wheel install

- JAX GPU support comes from the package **`jaxlib`**
- **`jaxlib`** requires building from source upstream
- You can leverage the wheel files from ROCm Github:
  - https://github.com/ROCm/jax/releases

JAX wheel install for Python™ 3.10

- Example installing commands for JAX version 0.5.0 :
  - jaxlib

```
python3 -m pip install \
    https://github.com/ROCm/jax/releases/download/rocm-jax-v0.5.0/jaxlib-0.5.0-cp310-cp310-manylinux_2_28_x86_64.whl
```

JAX package doesn't have any GPU software dependency

  - JAX ROCm Plugin

```
python3 -m pip install \
    https://github.com/ROCm/jax/releases/download/rocm-jax-v0.5.0/jax_rocm60_plugin-0.5.0-cp310-cp310-manylinux_2_28_x86_64.whl
```

  - JAX

```
python3 -m pip install \
    https://github.com/ROCm/jax/archive/refs/tags/rocm-jax-v0.5.0.tar.gz
```

- Checking number of GPUs:

```
python -c 'import jax ; print("I have this many GPUs:", jax.local_device_count())'
```

- Should yield depending on the system:

```
I have this many GPUs: 8
```

Build from source

CHECK OUR HPCTRAININGDOCK REPO

HPCTrainingDock repo: https://github.com/amd/HPCTrainingDock

Builds from source for:

- PyTorch:
  https://github.com/amd/HPCTrainingDock/blob/main/extras/scripts/pytorch_setup.sh
- JAX:
  https://github.com/amd/HPCTrainingDock/blob/main/extras/scripts/jax_setup.sh
- CuPy:
  https://github.com/amd/HPCTrainingDock/blob/main/extras/scripts/cupy_setup.sh
- MPI4Py:
  https://github.com/amd/HPCTrainingDock/blob/main/comm/scripts/mpi4py_setup.sh
- Tensorflow:
  https://github.com/amd/HPCTrainingDock/blob/main/comm/scripts/tensorflow_setup.sh

TensorFlow source install (tested with ROCm 6.4.0)

```
# Clone desired version of TensorFLow
git clone --recursive -b merge-250318  https://github.com/ROCm/tensorflow-upstream

# Install system and Python™ requirements
apt-get install python3-dev python3-pip openjdk-8-jdk openjdk-8-jre unzip wget git python-is-python3 patchelf
pip3 install numpy wheel mock future pyyaml setuptools requests keras_preprocessing keras_applications  jupyter

# Download Bazelisk: https://github.com/bazelbuild/bazelisk/blob/master/README.md  and put it in your PATH:
curl -Lo bazelisk https://github.com/bazelbuild/bazelisk/releases/latest/download/bazelisk-$(uname -s | tr '[:upper:]' '[:lower:]')-amd64
chmod +x bazelisk && sudo mv bazelisk /usr/local/bin/bazel

# Set USE_BAZEL_VERSION env variable to what is needed by TensorFlow
export USE_BAZEL_VERSION=`cat tensorflow-upstream/.bazelversion | head -n 1`

# Load necessary modules and set env variables
module load rocm amdclang

# Configure TensorFlow
cd tensorflow-upstream
yes "" | TF_NEED_CLANG=1 ROCM_PATH=$ROCM_PATH TF_NEED_ROCM=1 PYTHON_BIN_PATH=/usr/bin/python3 ./configure

# Install TensorFlow
bazel build --config=opt --config=rocm --repo_env=WHEEL_NAME=tensorflow_rocm --action_env=project_name=tensorflow_rocm/
//tensorflow/tools/pip_package:wheel --verbose_failures --repo_env=CC=`which clang` --repo_env=BAZEL_COMPILER=`which clang`
--repo_env=CLANG_COMPILER_PATH=`which clang`  && pip3 install --upgrade bazel-bin/tensorflow/tools/pip_package/wheel_house/tensorflow*.whl
```

Might need sudo

Can also move it to a different dir as long as it is in your PATH

Module definitions at:
https://github.com/amd/HPCTrainingDock/blob/main/rocm/scripts/rocm_setup.sh

If this command fails, you might need to manually edit the clang path in the .bazelrc file located in the tensorflow-upstream repo dir

Horovod install

- Horovod is a framework to enable distributed deep-learning training with TensorFlow, Keras, PyTorch, and Apache MXNet. The goal of Horovod is to make distributed deep learning fast and easy to use.

Step 1: configure ROCm details

```
# Configure for ROCm
export HOROVOD_WITHOUT_MXNET=1
export HOROVOD_WITHOUT_GLOO=1
export HOROVOD_GPU=ROCM
export HOROVOD_ROCM_HOME=$ROCM_PATH
export HOROVOD_GPU_OPERATIONS=NCCL
export HOROVOD_CPU_OPERATIONS=MPI
export HOROVOD_WITH_MPI=1
export HOROVOD_ROCM_PATH=$ROCM_PATH
export HOROVOD_RCCL_HOME=$ROCM_PATH/rccl
export RCCL_INCLUDE_DIRS=$ROCM_PATH/rccl/include
export HOROVOD_RCCL_LIB=$ROCM_PATH/rccl/lib
export HCC_AMDGPU_TARGET=gfx90a
export CMAKE_PREFIX_PATH=$MPICH_PATH
```

Step 2: configure for your favorite framework details

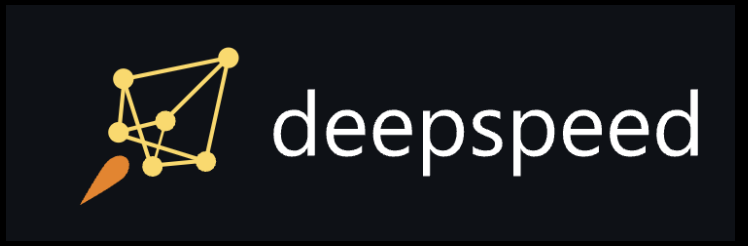
```
# Configure for TensorFlow
export HOROVOD_WITH_TENSORFLOW=1
export HOROVOD_WITHOUT_PYTORCH=1

# Configure for PyTorch
export HOROVOD_WITHOUT_TENSORFLOW=1
export HOROVOD_WITH_PYTORCH=1
```

Horovod needs MPI at launch

Step 3: install

```
# Install
pip install --no-cache-dir --force-reinstall --verbose horovod==$HOROVOD_VERSION
```

DeepSpeed install



- DeepSpeed is a framework to optimize distributed deep-learning training and inference

```
DS_BUILD_AIO=0 \
DS_BUILD_CCL_COMM=1 \
DS_BUILD_CPU_ADAM=0 \
DS_BUILD_CPU_LION=0 \
DS_BUILD_EVOFORMER_ATTN=0 \
DS_BUILD_FUSED_ADAM=1 \
DS_BUILD_FUSED_LION=1 \
DS_BUILD_CPU_ADAGRAD=0 \
DS_BUILD_FUSED_LAMB=1 \
DS_BUILD_QUANTIZER=0 \
DS_BUILD_RANDOM_LTD=0 \
DS_BUILD_SPARSE_ATTN=0 \
DS_BUILD_TRANSFORMER=0 \
DS_BUILD_TRANSFORMER_INFERENCE=0 \
DS_BUILD_STOCHASTIC_TRANSFORMER=1 \
pip install deepspeed==0.14.0 \
--global-option="build_ext" --global-option="-j32"

ds_report
```

Select all the optimizations
not all are enabled for GPUs

Allow multiple process builds

Utility to report supported capabilities

```
--------------------------------------------------
op name ................ installed .. compatible
--------------------------------------------------
async_io ............... [NO] ....... [NO]
fused_adam ............. [YES] ...... [OKAY]
cpu_adam ............... [NO] ....... [OKAY]
cpu_adagrad ............ [NO] ....... [OKAY]
cpu_lion ............... [NO] ....... [OKAY]
evoformer_attn ......... [NO] ....... [NO]
fused_lamb ............. [YES] ...... [OKAY]
fused_lion ............. [YES] ...... [OKAY]
inference_core_ops ..... [NO] ....... [OKAY]
cutlass_ops ............ [NO] ....... [OKAY]
transformer_inference .. [NO] ....... [OKAY]
quantizer .............. [NO] ....... [OKAY]
ragged_device_ops ...... [NO] ....... [OKAY]
ragged_ops ............. [NO] ....... [OKAY]
random_ltd ............. [NO] ....... [OKAY]
sparse_attn ............ [NO] ....... [NO]
spatial_inference ...... [NO] ....... [OKAY]
transformer ............ [NO] ....... [OKAY]
stochastic_transformer . [YES] ...... [OKAY]
--------------------------------------------------
```

Exercises

- Two sets of exercises on your own
  - **HPCTrainingExamples/MLExamples/README_AAC6.md**
    - -- Overview of ML and AI on AMD GPUs in Exercises Doc
  - **HPCTrainingExamples/MLExamples/README_OnInstinctNode.md**
    - -- AI and ML exercises in Exercises Doc

- Please be considerate and free up resources when you are done with an exercise

DISCLAIMERS AND ATTRIBUTIONS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