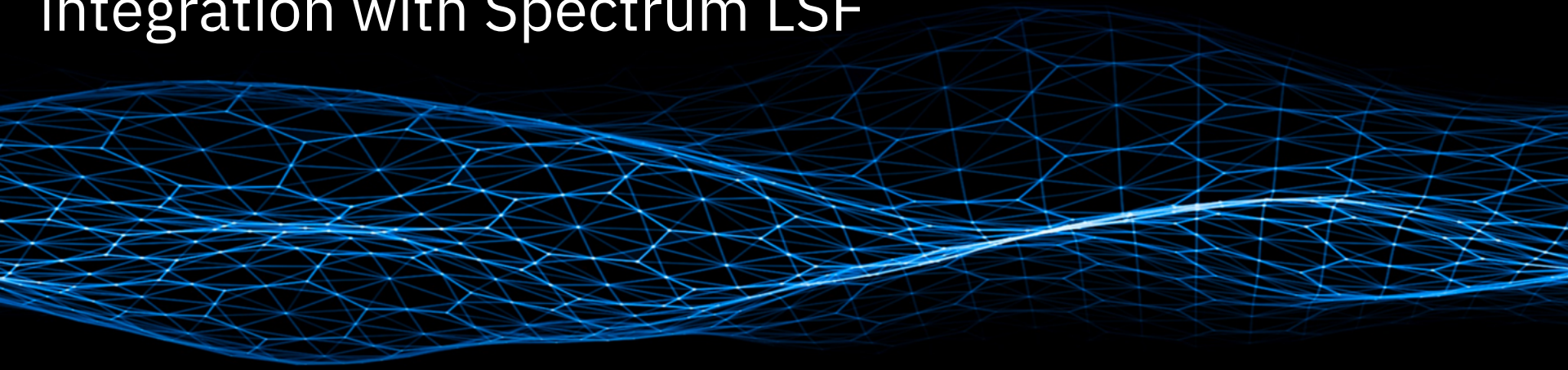
IBM Watson ML Community Edition
integration with Spectrum LSF



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IBM Systems Hardware Europe
Member of the IBM Academy of Technology (AoT)

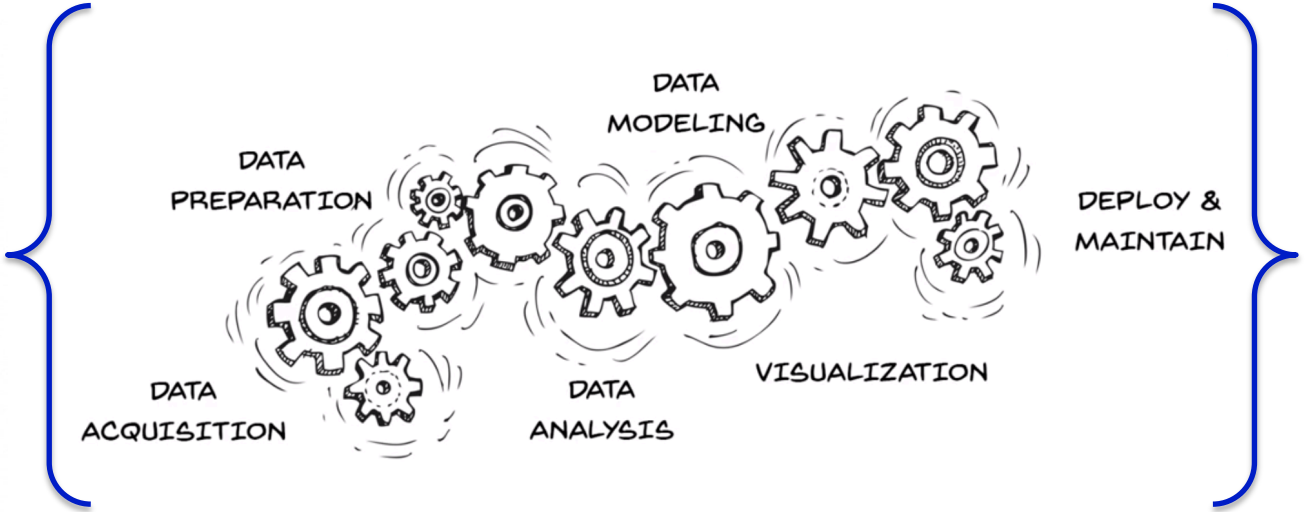
Frankfurt am Main, June 17, 2019

IBM

Observation #1

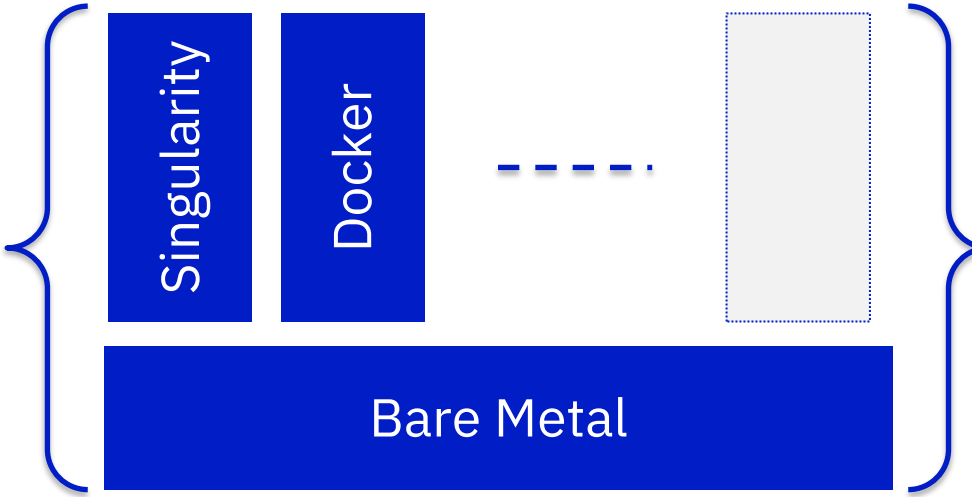
The Problem

Data Scientist



The Problem

Data Scientist



Workload Manager
=
Data Scientist

The Problem

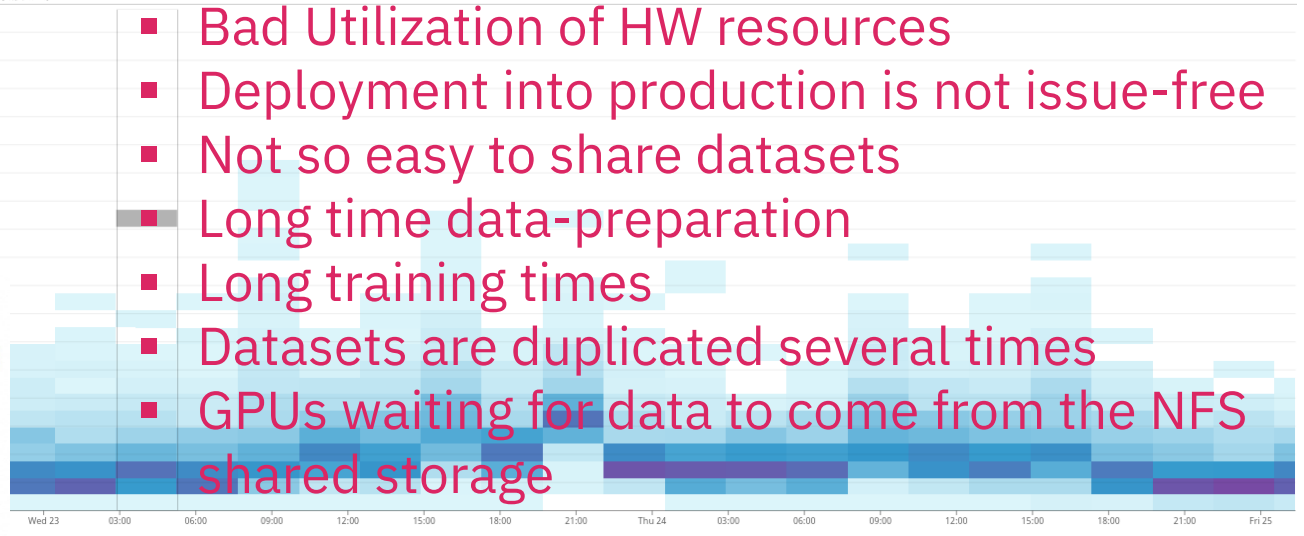
Data Scientist

- Typical Power Consumption: 1,500 W
- Ambient temperature 28-30°C
- Very good electrical power circuit is needed to avoid overloading the circuit

Accelerated Workstation

Issues with this operational model

Data Scientists

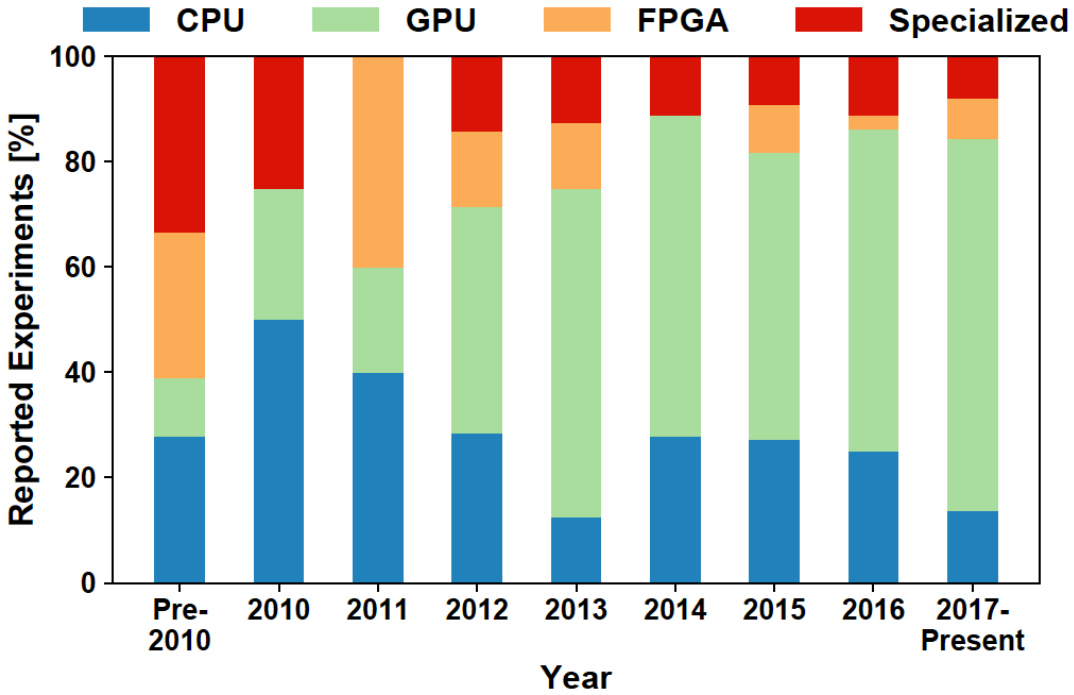


- Bad Utilization of HW resources
- Deployment into production is not issue-free
- Not so easy to share datasets
- Long time data-preparation
- Long training times
- Datasets are duplicated several times
- GPUs waiting for data to come from the NFS shared storage

Observation #2

Parallel Architecture in Deep Learning

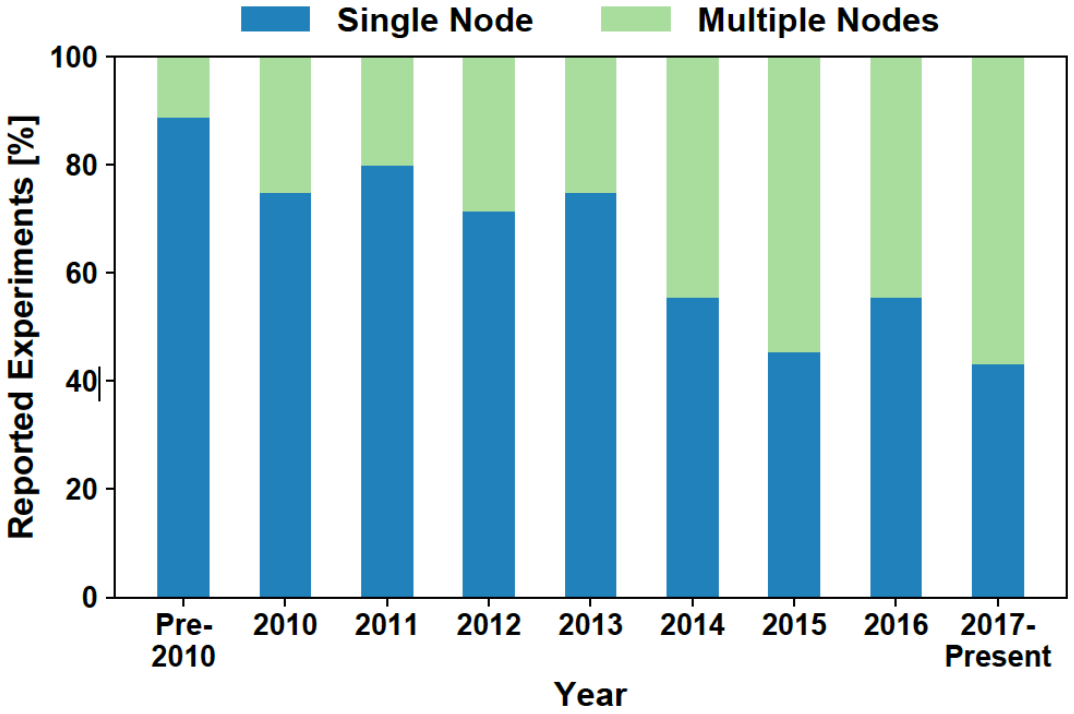
Hardware Architecture



Source: ETH Zurich (T. Ben-Nun and T. Hoefler. Demystifying Parallel and Distributed Deep Learning)

Parallel Architecture in Deep Learning

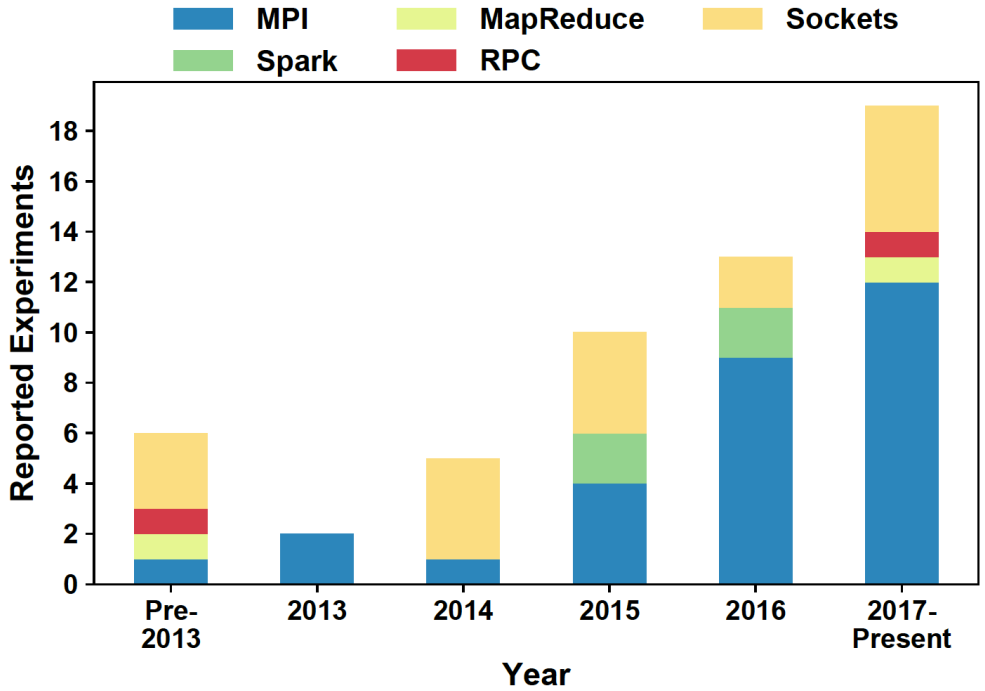
Training with Single vs. Multiple Nodes



Source: ETH Zurich (T. Ben-Nun and T. Hoefler. Demystifying Parallel and Distributed Deep Learning)

Parallel Architecture in Deep Learning

Communication Layer



Source: ETH Zurich (T. Ben-Nun and T. Hoefler. Demystifying Parallel and Distributed Deep Learning)

Distributed Deep Learning

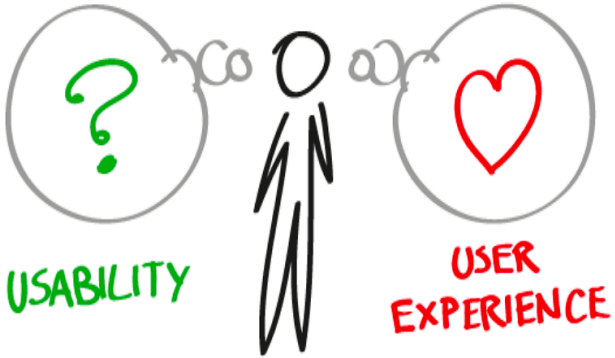
Goals

The overall goal of distributed deep learning is to

reduce the training time

To this end the primary features:

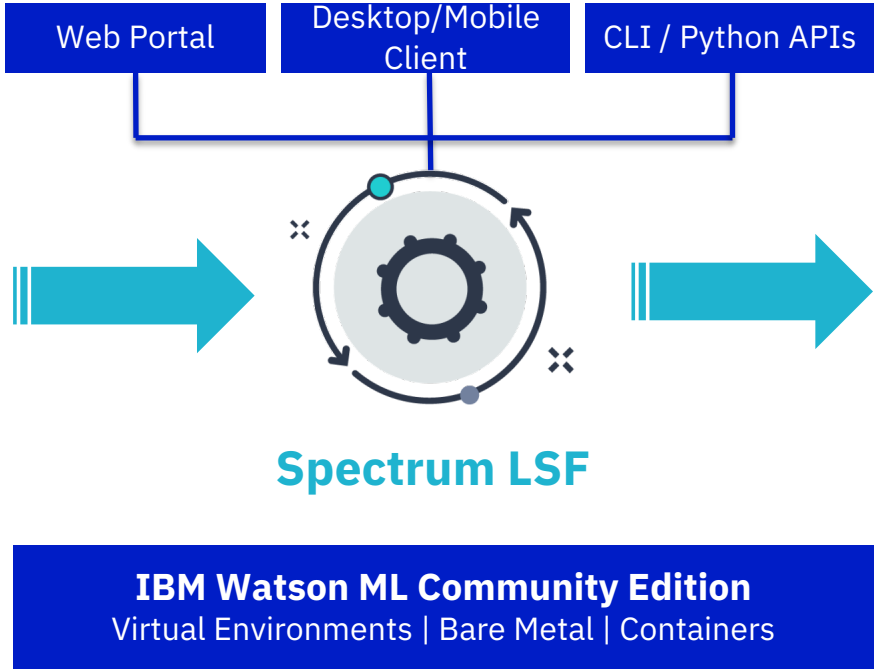
- Automatic Topology Detection
- Rankfile generation
- Automatic mpirun option handling
- Efficiency in scalability

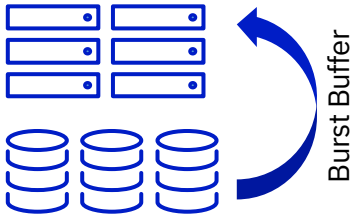


Solution

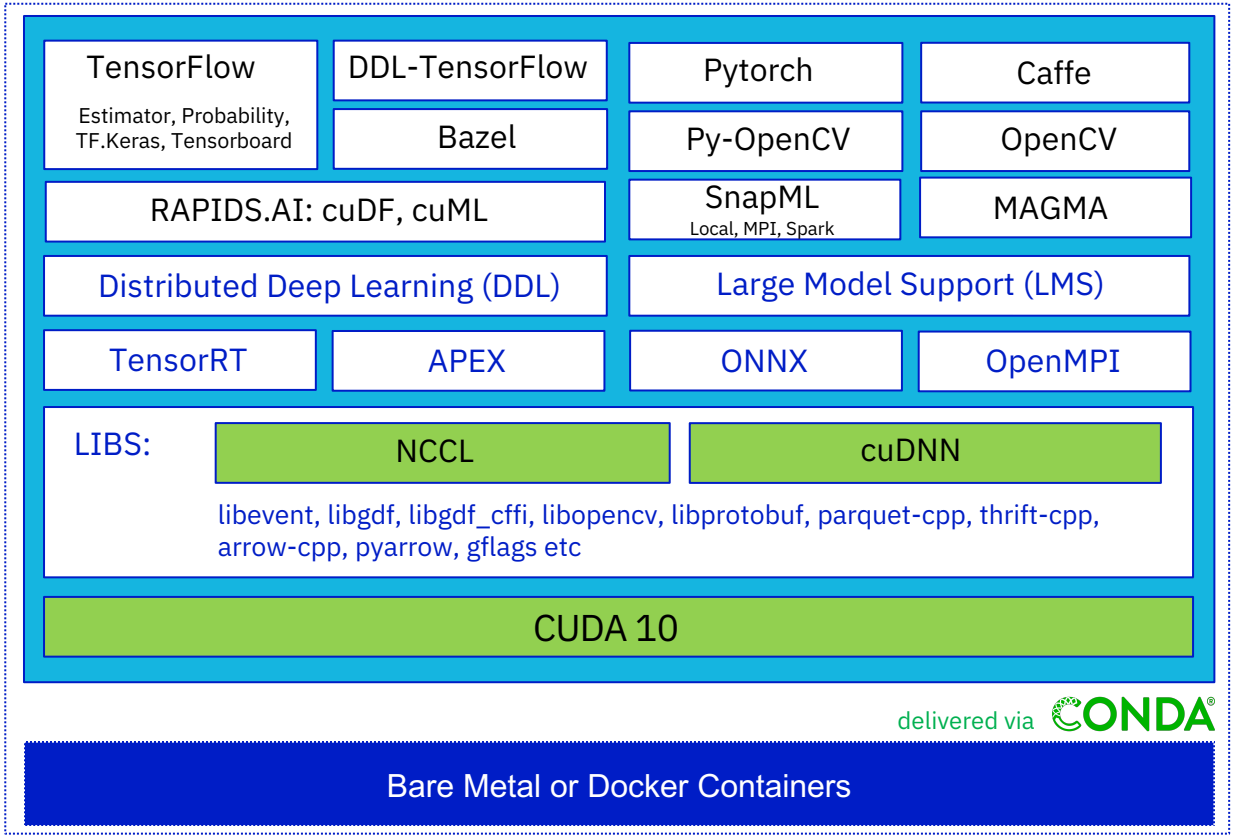
IBM Watson ML Community Edition

integration with with Spectrum LSF





IBM Watson Machine Learning
Community Edition



IBM Watson Machine Learning
Community Edition

Deep learning training takes days to weeks

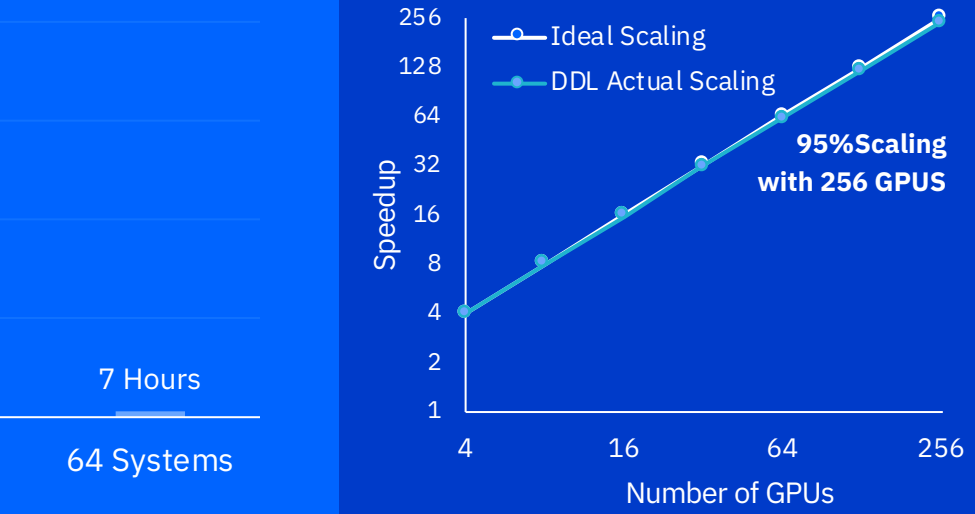
Limited scaling to multiple x86 servers

PowerAI with DDL enables scaling to 100s of GPUs

16 Days Down to 7 Hours
58x Faster

ResNet-101, ImageNet-22K

Near Ideal Scaling to 256 GPUs



ResNet-50, ImageNet-1K

Caffe with PowerAI DDL, Running on Minsky (S822Lc) Power System

IBM Watson ML Community Edition

Spectrum LSF Integration

- LSF support has been added to the ddlrun tool
- When using ddlrun from a LSF job, the list of hosts no longer has to be provided. ddlrun will detect the hosts that the job should run on.
- Example:
  - ddlrun python my_script.py

NO NEED TO SPECIFY RUNNING HOSTS

IBM Watson ML Community Edition

Spectrum LSF Integration

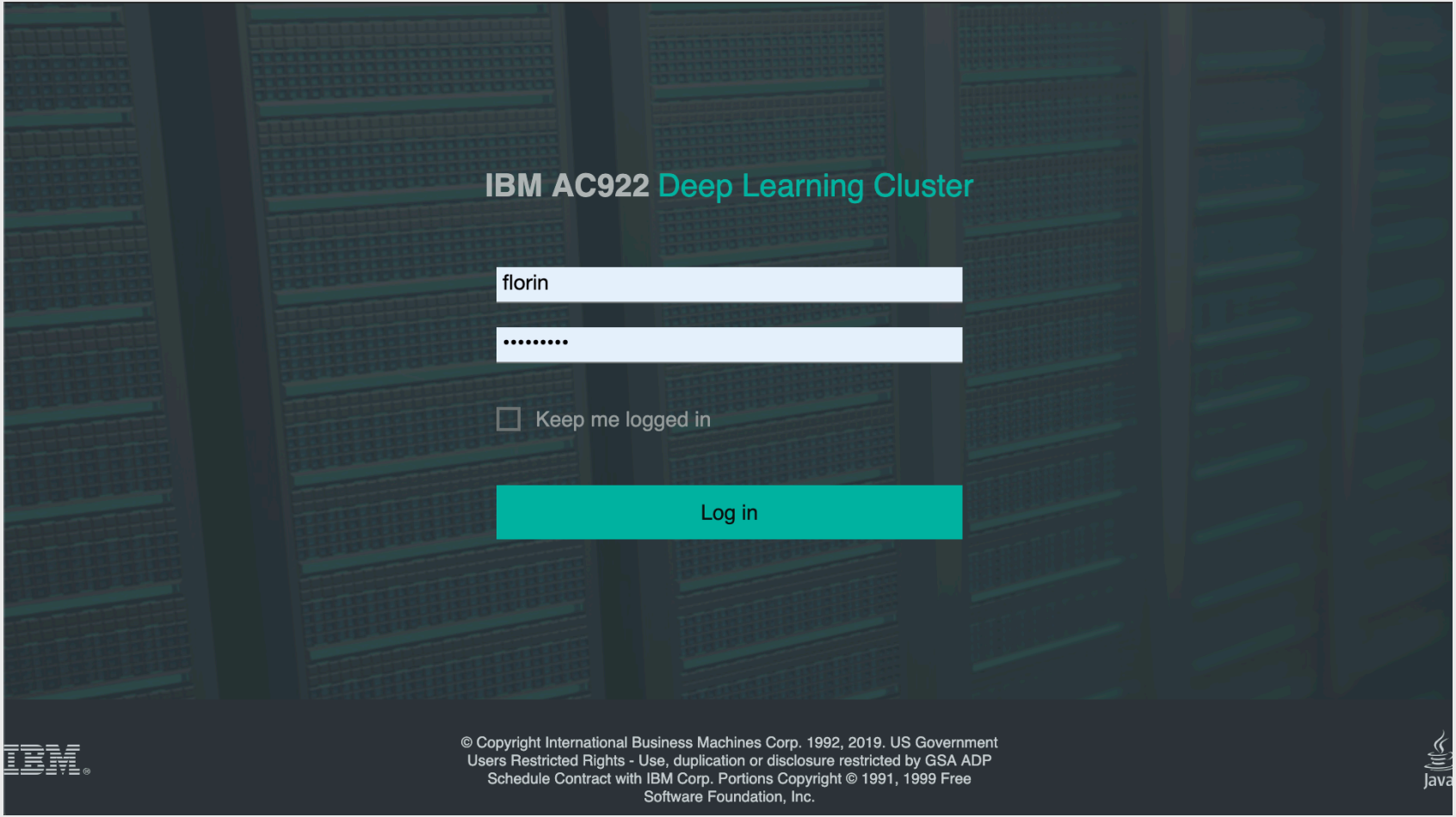
```python
from pythonlsf import lsf


def run_job(command):
    """
    Run a job...
    """
    submitreq = lsf.submit()
    submitreq.command = command
    submitreq.options = 0
    submitreq.options2 = 0

    limits = []
    for i in range(0, lsf.LSF_RLIM_NLIMITS):
        limits.append(lsf.DEFAULT_RLIMIT)

    submitreq.rLimits = limits

    submitreq.beginTime = 0
    submitreq.termTime = 0
    submitreq.numProcessors = 1
    submitreq.maxNumProcessors = 1

    submitreply = lsf.submitReply()

    if lsf.lsb_init("test") > 0:
        exit(1)

    job_id = lsf.lsb_submit(submitreq, submitreply)
    return job_id


if __name__ == '__main__':
    print("LSF Clustername is :", lsf.ls_getclustername())
    print(run_job("/bin/sleep 10"))
```

Spectrum LSF Python Integration

https://github.com/IBMSpectrumComputing/lsf-python-api

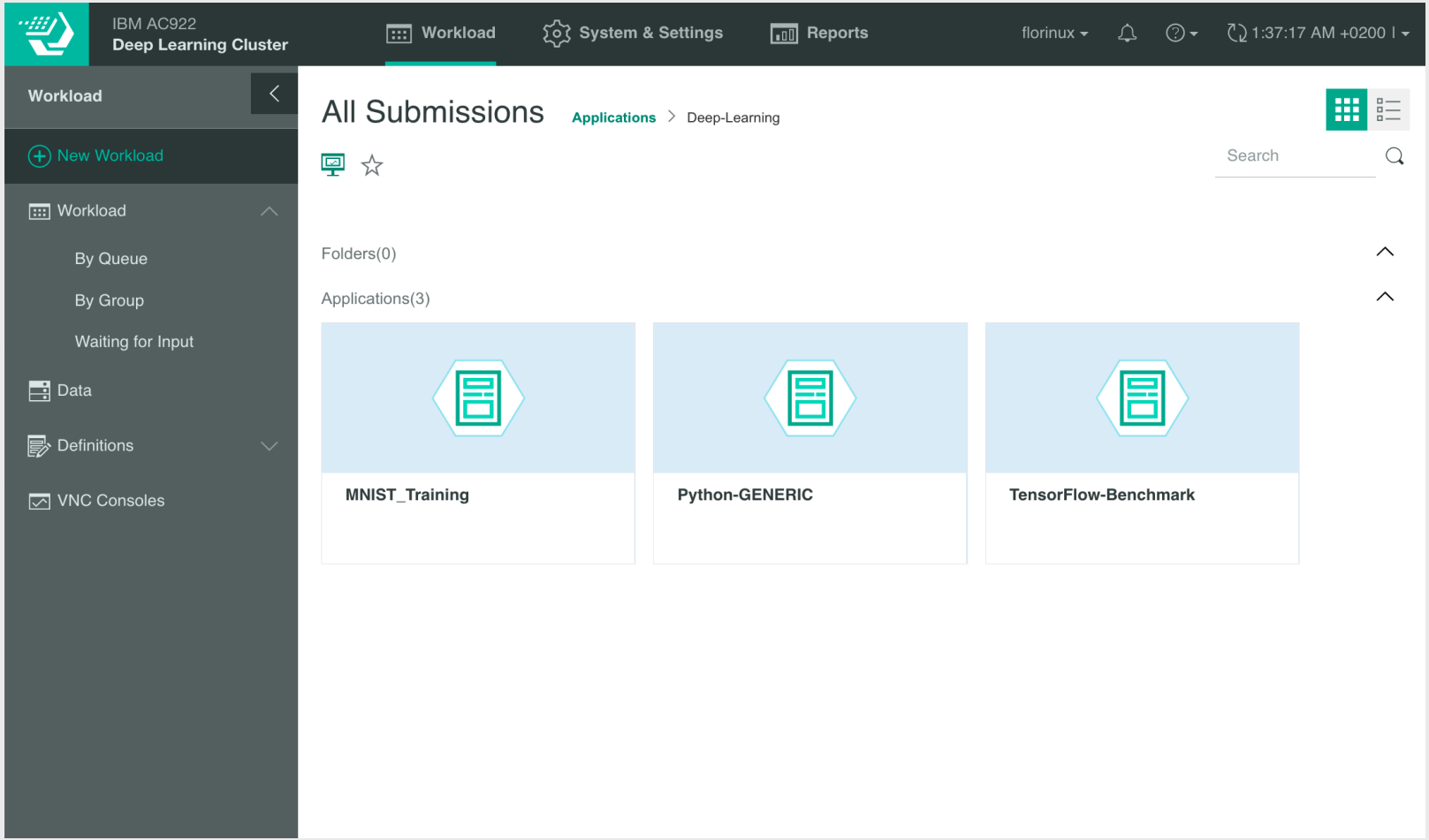
Portal Login

Watson ML Community Edition Templates



Submission Forms

Watson ML Community Edition Templates



GENERIC Python Scripts

Watson ML Community Edition Templates

Submission Form: Python-GENERIC

Basic Job Options

Job Name

PowerAI Virtual Environment Name: powerai_env

Python Script: Add Local File | Add Server File

Script Options

Advanced

Requirements

Resource Requirement string: rusage[mem=32GB]

Additional Job Options

Submit to this Queue: normal

Project: ai_training

Other bsub options: -n 10 -gpu 'num=1:mode=exclusive_process' -W 1:

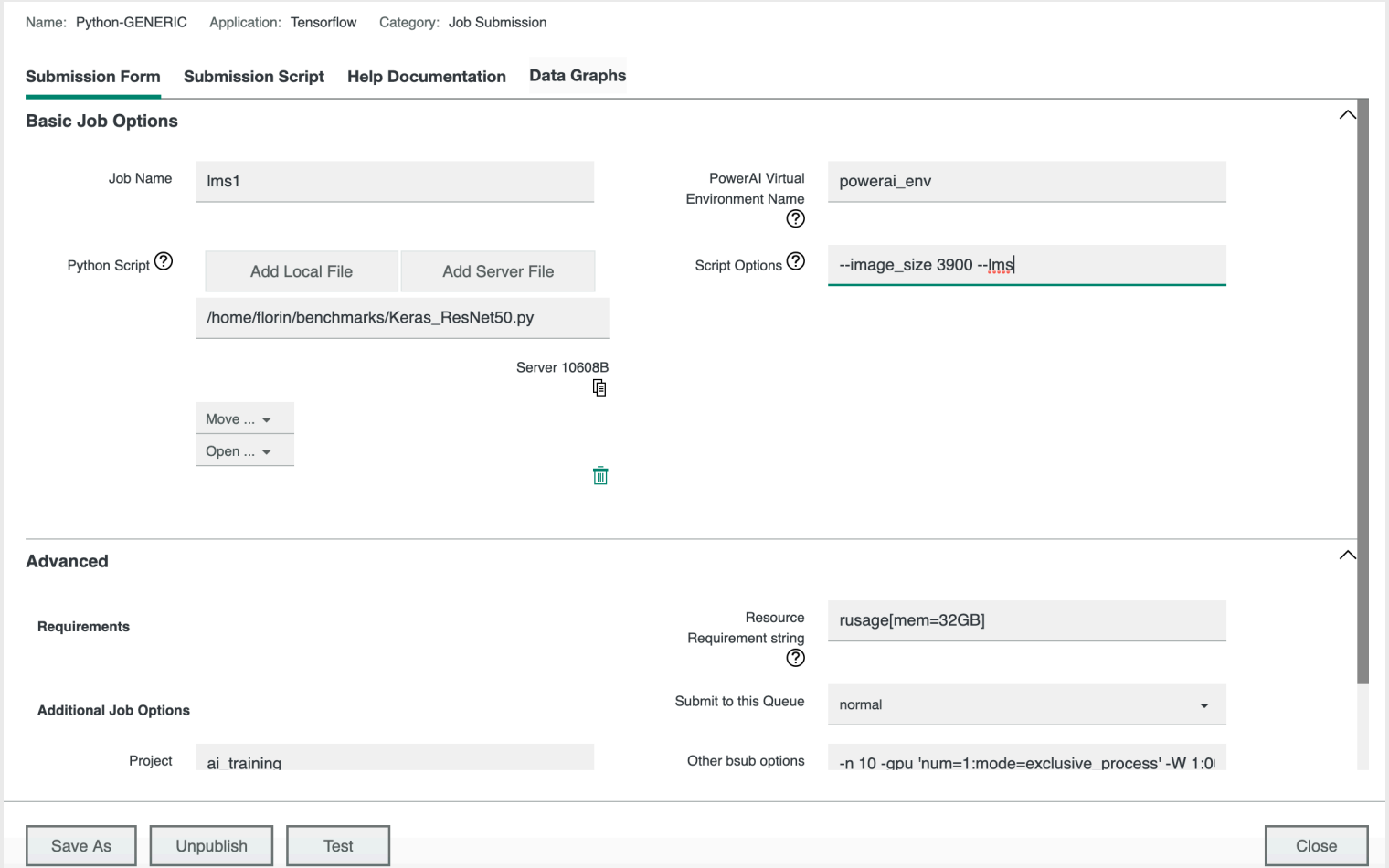
Data

Notification

Submit | Save As | Revert | Close

GENERIC Python Scripts

Watson ML Community Edition Templates



CUSTOM Python Script

Watson ML Community Edition Templates

Submission Form: MNIST_Training

Basic Job Options

Job Name

Data Directory: ./mnist_data Browse...

How many training steps: 10000

Tensorboard

PowerAI Virtual Environment Name: powerai_env

Advanced

Requirements

Resource Requirement string: rusage[mem=5GB]

Additional Job Options

Project: mnist_train

Submit to this Queue: normal

Other bsub options: -n 10 -gpu 'num=1:mode=exclusive_process' -W 1:

Data

Submit | Save As | Revert | Close

CUSTOM Python Script

Watson ML Community Edition Templates

Submission Form: TensorFlow-Benchmark

Basic Job Options

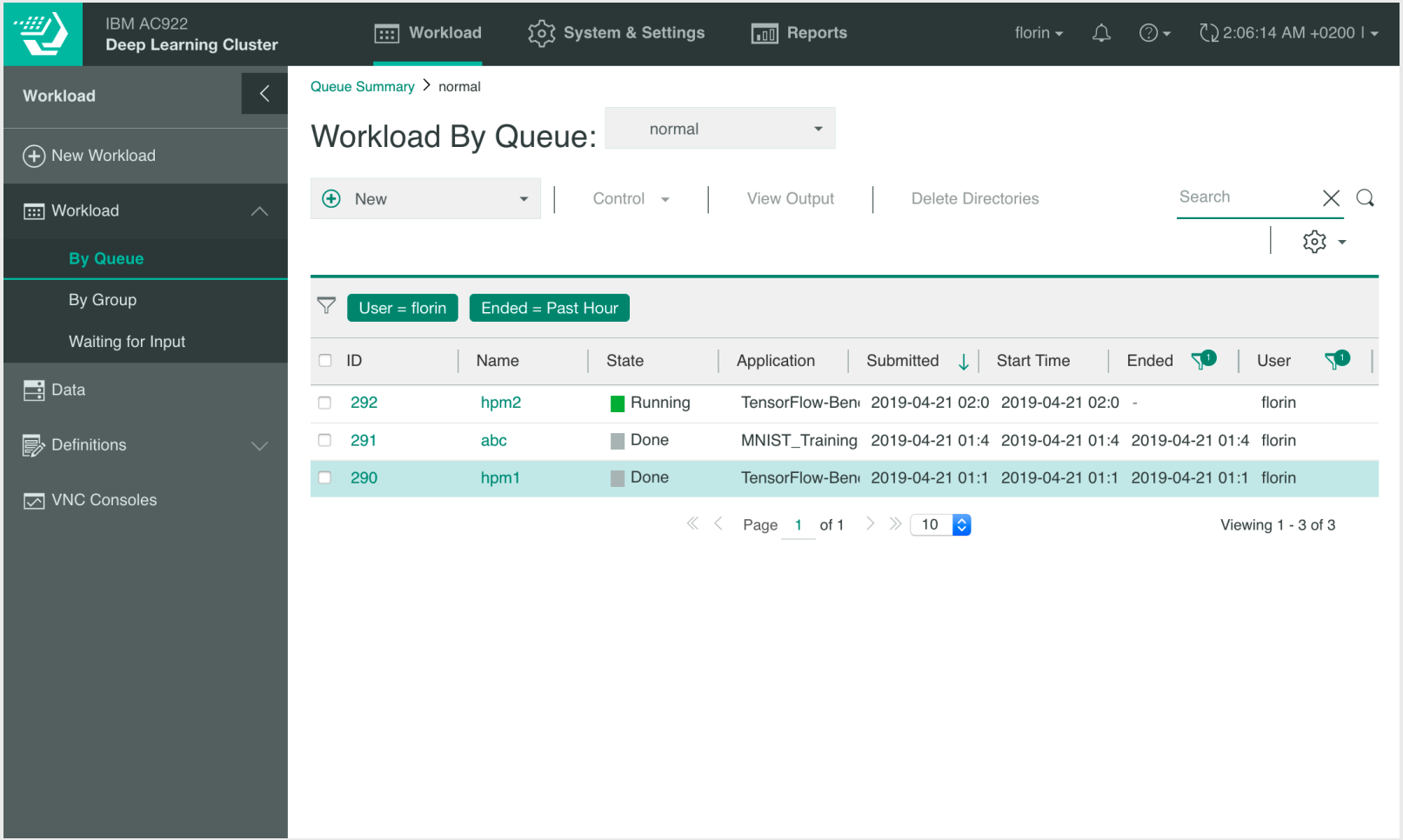
Job Name		TensorFlow Batch Size	256
TensorFlow No of Batches	200	Number of Warmup Batches	1
Used Data Format	NCHW	TensorFlow Optimizer	sgd
TensorFlow Variable Update	replicated	Number of GPUs for benchmark	1
		CNN Model	alexnet
Single Precision	true	Python Version	anaconda3
PowerAI Virtual Environment Name	powerai_env		

Advanced

Submit | Save As | Revert | Close

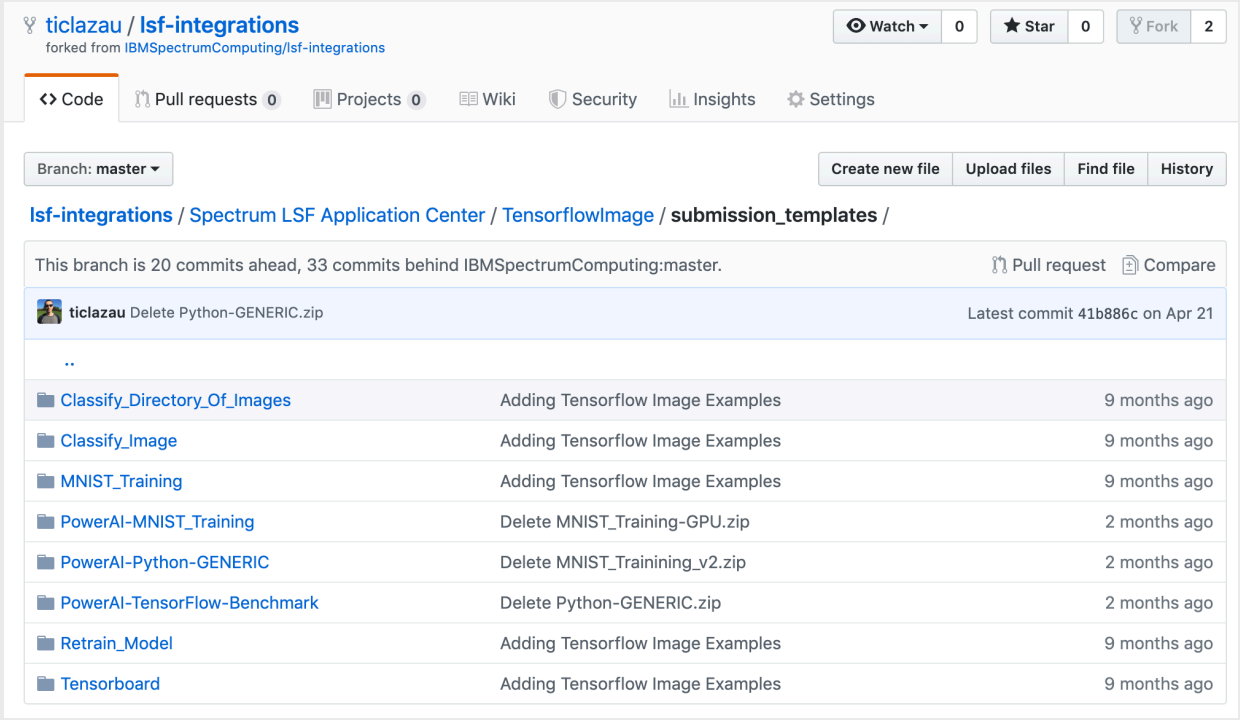
Training JOB Monitoring

Watson ML Community Edition Templates



Integration Code is Open Sourced

https://github.com/ticlazau/lsf-integrations



Python-GENERIC.zip
MNIST_Training.zip
TensorFlow-Benchmark.zip

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