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A Hands-on Introduction to Deep Learning with DeepForge

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Overview

- What is DeepForge?
  - Overview
  - Core Concepts
- CIFAR-10 Tutorial
- Advanced Topics
  - Infrastructure Integration
  - Data Provenance
  - Interactive Editing
- Demos
- Q&A

Questions welcome at any time!

Background

Deep Learning

- A *deep neural network* is an artificial neural network with multiple hidden layers
- Flexible enough to be applied to a number of problems including:
  - Speech-to-text
  - Image segmentation
  - Image classification
  - Learning embeddings
  - Styling images
- State of art in almost everything

DeepForge

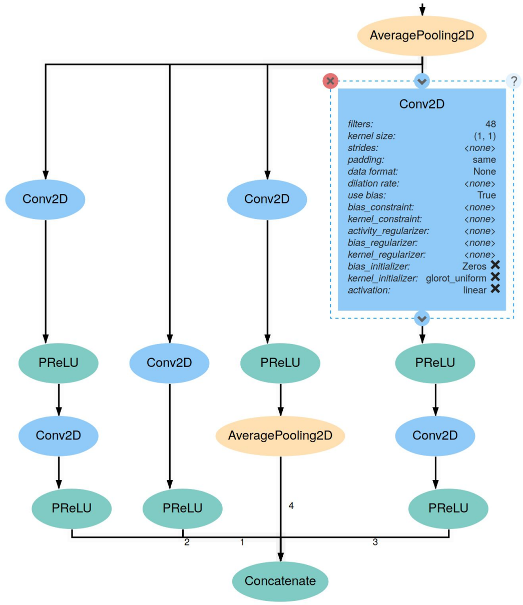
What is DeepForge?

DeepForge is a platform for applying deep learning within diverse scientific domains that integrates with existing infrastructure.

The goal is to promote simplicity, collaboration, and reproducibility through:

- Domain specific visual/textual editors
  - Design neural networks (with error, shape feedback)
  - Create and execute workflows from the browser
- Automatic version control
- Data provenance
- Real-time collaborative editing
- Integration with existing HPC and storage resources

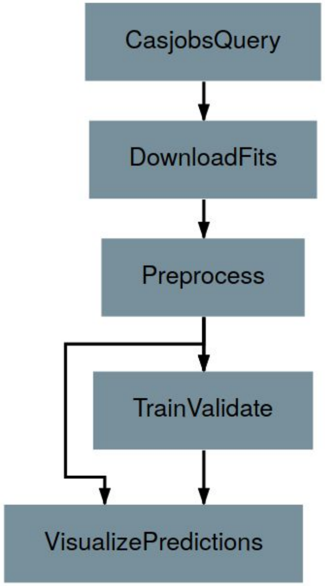
High-Level Overview



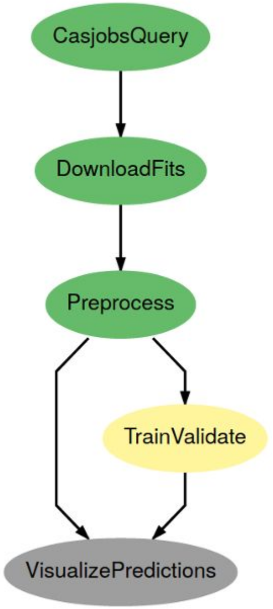
Conv2D

filters: 48
kernel size: (1, 1)
strides: ‹none›
padding: same
data format: None
dilation rate: ‹none›
use bias: True
bias_constraint: ‹none›
kernel_constraint: ‹none›
activity_regularizer: ‹none›
bias_regularizer: ‹none›
kernel_regularizer: ‹none›
bias_initializer: Zeros ✕
kernel_initializer: glorot_uniform ✕
activation: linear ✕

Design **Architectures**



Build Training/Testing **Pipelines**
(from **Operations**)



Execute Pipelines

Core Concepts

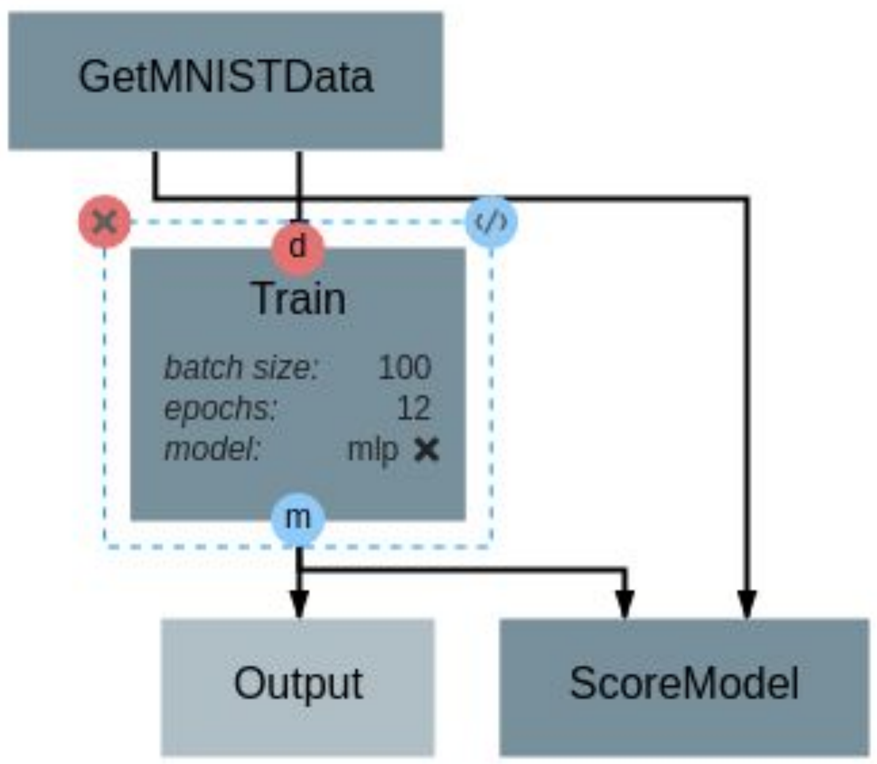
Core Concepts

- Two different types of concepts:
  - Concepts for creating executable pipelines
  - Concepts for designing neural network architectures
- Four main concepts are creating executable pipelines
  - Operations
  - Pipelines
  - Jobs
  - Executions
- Two high-level concepts for designing neural networks architectures
  - Architectures
  - Layers

Pipeline Concepts

- **Operations** are functions with multiple, named inputs and outputs
- Attributes and references can be set at design time to specify configurable parameters
  - For example, *iterations* may be specified in a training operation
- **Pipelines** represent some machine learning task composed of operations
  - Examples include training, prediction, or data augmentation
- Pipelines can also contain *Input* and *Output* operations to specify inputs/outputs of the entire pipeline

Example Pipeline



batch size: 100
epochs: 12
model: mlp ✕

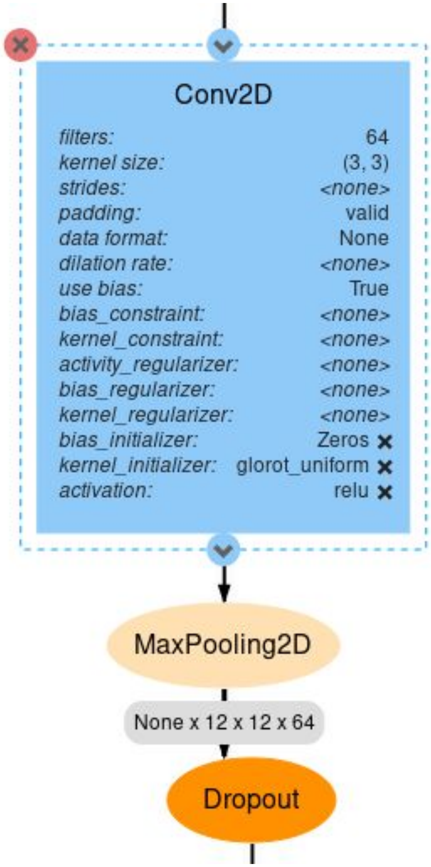
Pipeline Concepts

- **Jobs** are executable operations which contain the operation definition and metadata about the execution
  - This includes console output and plots
- **Executions** represent an executable instance of a pipeline (composed of jobs)

Neural Network Concepts

- The neural network concepts are pretty standard.
- Neural network architectures are composed of layers.
- Layers are parameterized in a variety of ways including the number of units, kernel size, dropout ratio, etc.

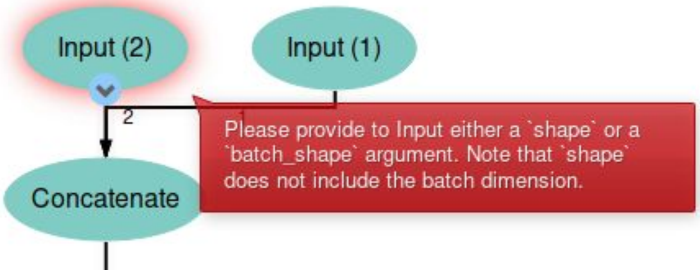
Neural Network Examples



Conv2D

filters: 64
kernel size: (3, 3)
strides: <none>
padding: valid
data format: None
dilation rate: <none>
use bias: True
bias_constraint: <none>
kernel_constraint: <none>
activity_regularizer: <none>
bias_regularizer: <none>
kernel_regularizer: <none>
bias_initializer: Zeros ✖
kernel_initializer: glorot_uniform ✖
activation: relu ✖

Dimensionality Feedback



Please provide to Input either a `shape` or a `batch_shape` argument. Note that `shape` does not include the batch dimension.

Error Messages
(During Construction)

Hands-on with CIFAR-10!

Advanced Topics

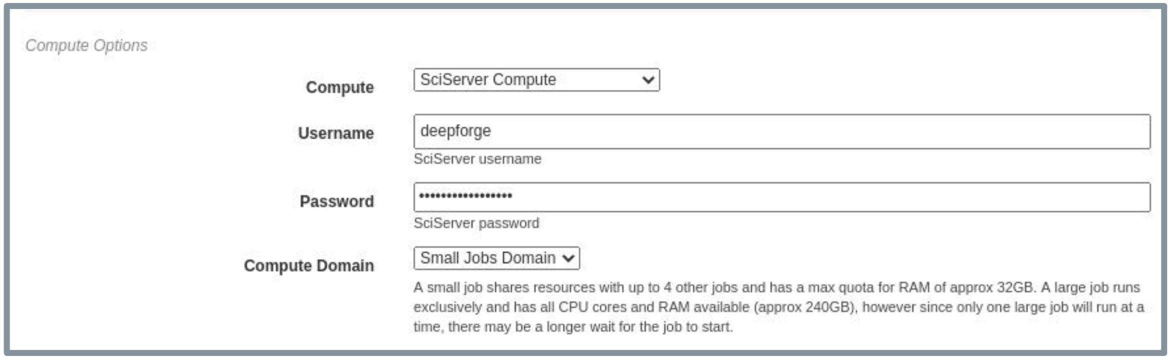
Infrastructure Integration

- DeepForge does not provide any compute or storage resources for use when executing pipelines*
- As shown in the tutorial, these capabilities are provided by integrating with existing platforms like SciServer.
- This integration is supported through the use of *compute adapters* and *storage adapters.*

* Technically, DeepForge can be configured to use a notebook-style of execution and storage but this is disabled on the public deployment.

Compute Adapters

- Compute adapters are used to execute jobs and pipelines. Each job will use the appropriate storage adapters for fetching and storing relevant data.
- Supported compute adapters:
  - SciServer Compute
  - WebGME Executor Framework (Connect your own machine)
  - Server execution (disabled on the public deployment)

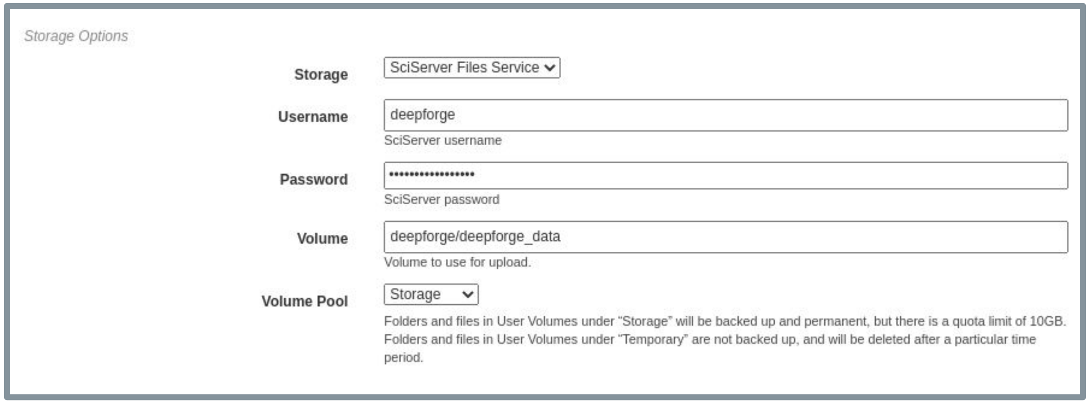


Compute Options

Compute	SciServer Compute
Username	deepforge SciServer username
Password	•••••••••••••••• SciServer password
Compute Domain	Small Jobs Domain A small job shares resources with up to 4 other jobs and has a max quota for RAM of approx 32GB. A large job runs exclusively and has all CPU cores and RAM available (approx 240GB), however since only one large job will run at a time, there may be a longer wait for the job to start.

Storage Adapters

- Storage adapters are used to fetch and store data - DeepForge does not store any associated data (such as training data or trained models).
- Supported storage adapters:
  - SciServer Files
  - S3 Object Storage
  - WebGME Blob Storage (disabled on the public deployment)



Storage Options

Storage: SciServer Files Service

Username: deepforge
SciServer username

Password: ••••••••••••••••
SciServer password

Volume: deepforge/deepforge_data
Volume to use for upload.

Volume Pool: Storage
Folders and files in User Volumes under "Storage" will be backed up and permanent, but there is a quota limit of 10GB. Folders and files in User Volumes under "Temporary" are not backed up, and will be deleted after a particular time period.

Demos

Questions?

- Related Resources and Links:
  - Website: https://deepforge.org
  - Documentation: http://deepforge.readthedocs.org/
  - Deployment: https://editor.deepforge.org
  - Source Code: https://github.com/deepforge-dev/deepforge
  - Slack Channel: https://slack.deepforge.org