# **ML Training Tutorial**

Micah Groh

Teaching machines to take over.

### Resources

All of the below can be found on the NOvA Tutorials page

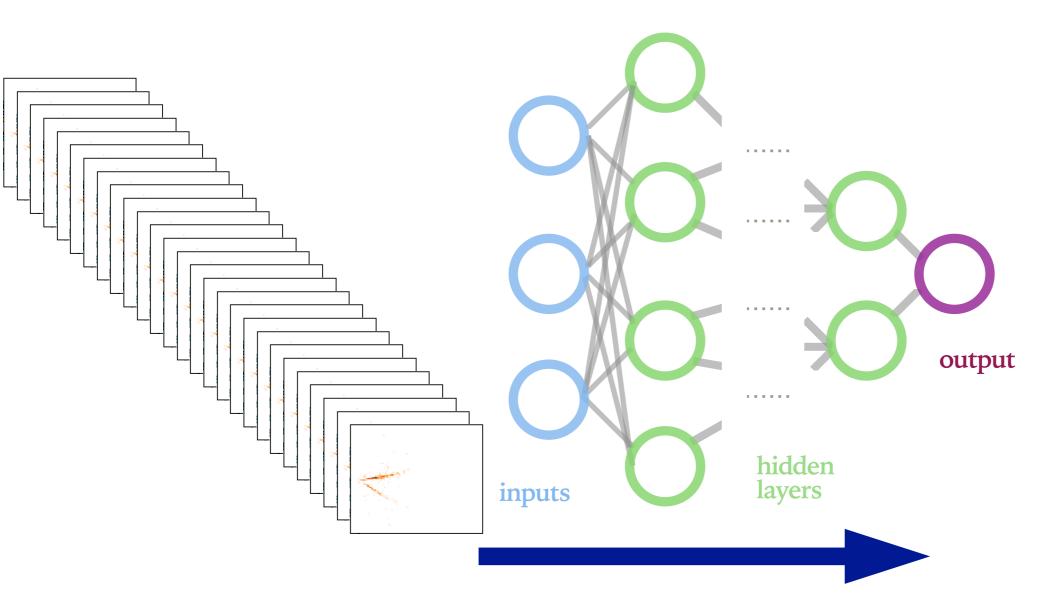
PandAna Tutorial - Micah Groh, Young NOvA Workshop 2019

CVN Tutorial - Micah Groh, Young NOvA Workshop 2018

Everything You Wanted to Know About CVN But Were Too Afraid to Ask - Fernanda Psihas, Young NOvA Workshop 2017

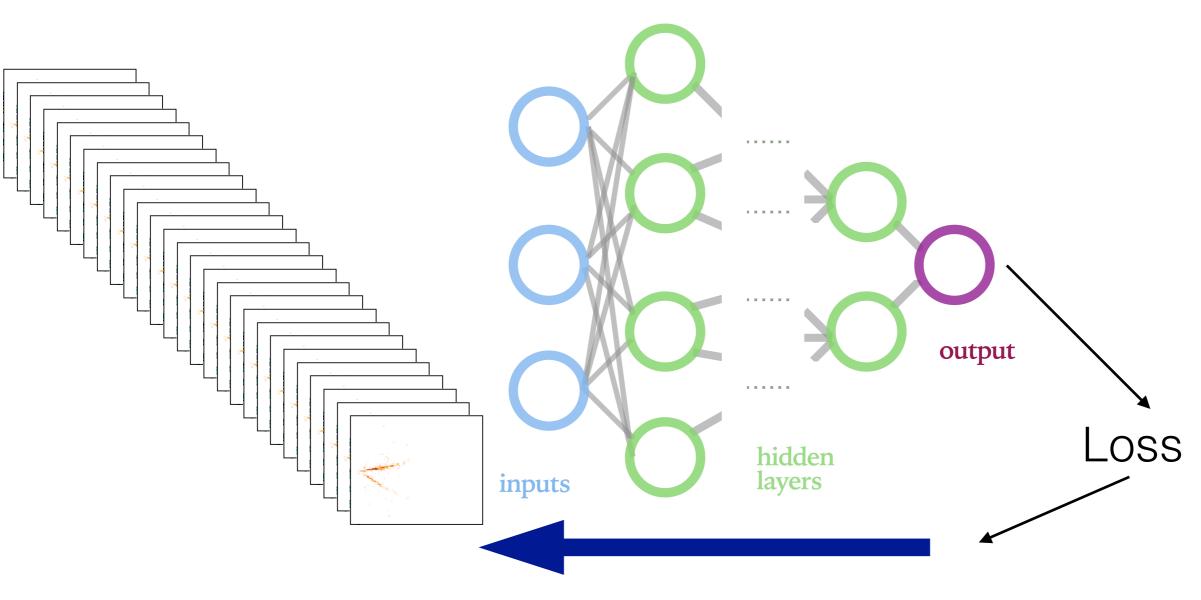
Deep Learning Workshop 2017

## **Batches**



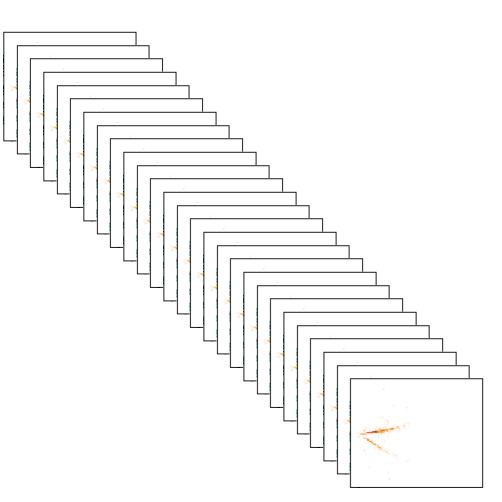
Feed Forward

## **Batches**



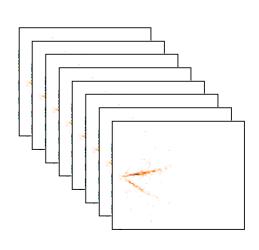
Propagate Backwards

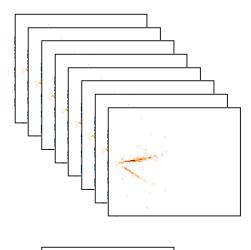
## **Batches**

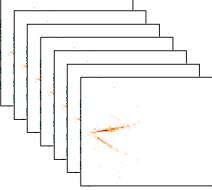


Storing the entire nova dataset in memory at once is impossible

Employ mini-batch training where each batch is representative of the full dataset







#### Convolution Convolution 5x5 stride 2 5x5 stride 2 32 filters 32 filters **Bottleneck Block Bottleneck Block** 16 filters 16 filters **Average Pooling Average Pooling** 2x2 2x2 **Bottleneck Block Bottleneck Block** 24 filters 24 filters Elementwise Maximum Pooling 1x1 Convolution **Average Pooling** 6x expansion 2x2 Depth-wise Bottleneck Block 3x3 Convolution 32 filters 1x1 Convolution **Average Pooling Bottleneck Filters** 2x2 Squeeze-Excite Bottleneck Block 48 filters Block Bottleneck Block 64 filters **Average Pooling** 2x2 **Bottleneck Block** 96 filters **Bottleneck Block** 160 filters Global Average **Pooling** Dense Layer 1024 Units Dense Layer 4 Units

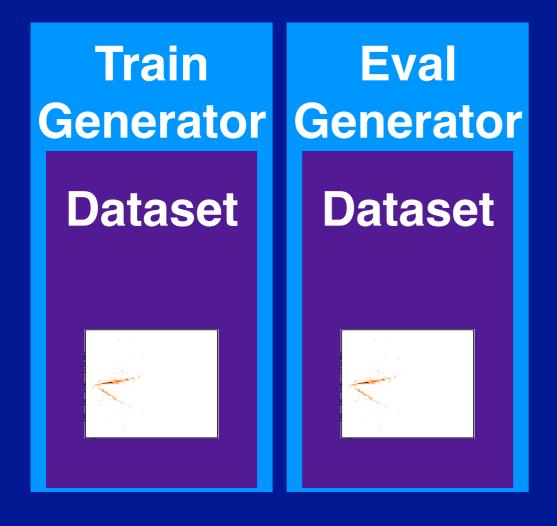
## Architecture

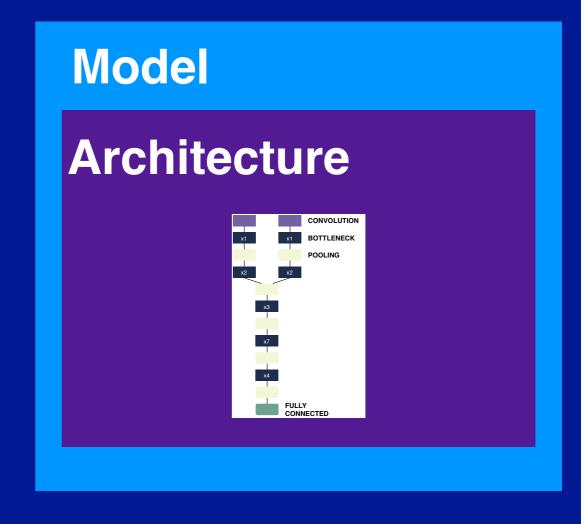
When you write out a network in keras, you are really defining a tensor flow graph.

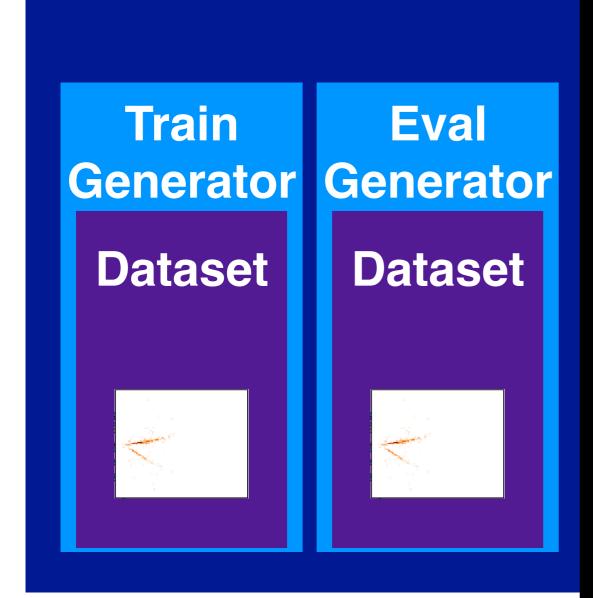
A tensor flow graph is just a series of operations that you can call from an input.

The inputs in this case are pixelmaps

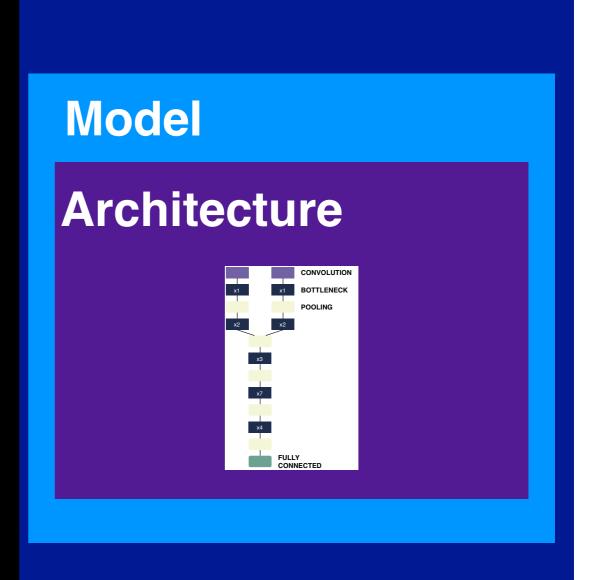
#### Python Script + Configuration







CPU-Generates Batches



GPU-Evaluates Model (if you do GPU training)

# Dataset

The dataset knows how to read inputs and labels from another file.

#### Train Generator

The generator knows how to use the dataset to construct a minibatch and pass it to the model.



The architecture defines the tensorflow graph to call for evaluation.

#### Model

The model knows how to call the architecture and make predictions.

## Python Script + Configuration

All objects are configured the same as defined by the script the user writes.

#### Python Script + Configuration

