MoEDAL and GridPP

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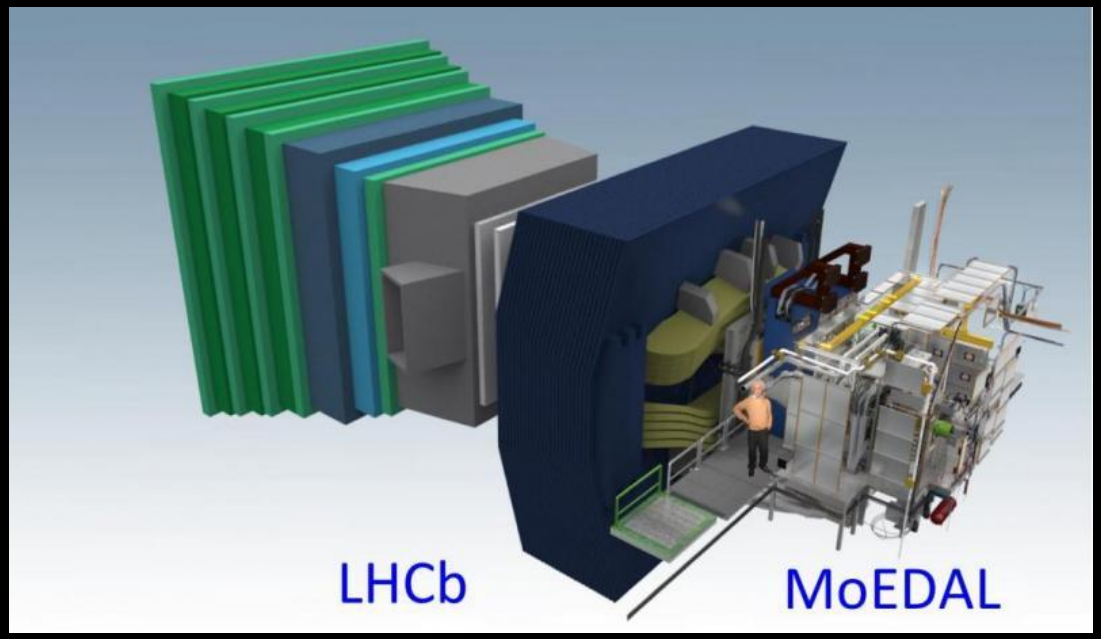
MoEDAL and Monopoles

MoEDAL = The Monopole & Exotics Detector at the LHC



Search for highly ionizing particles such as magnetic monopoles and other exotic avatars of new physics

Nuclear track detectors and aluminium trapping detectors

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MoEDAL and Grid

Current usage is very modest and negligible compared to the big LHC experiments

- Monte-Carlo generation
- Limit calculations

Future plans

- Continue to run MC and limit calculations
- Expanding machine learning activity – new subgroup formed for ML to investigate
  - Use GPUs for training
  - Challenge from user perspective = memory usage

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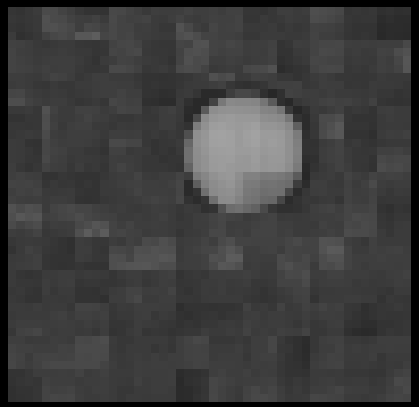
Machine Learning to find Holes



Task is to spot holes of a few microns in size in $20m^2$ of etched plastic

Something ML should be able to do well

Training data constructed by resampling images from beam tests

(Will also need overlay of noisy images from LHC environment)

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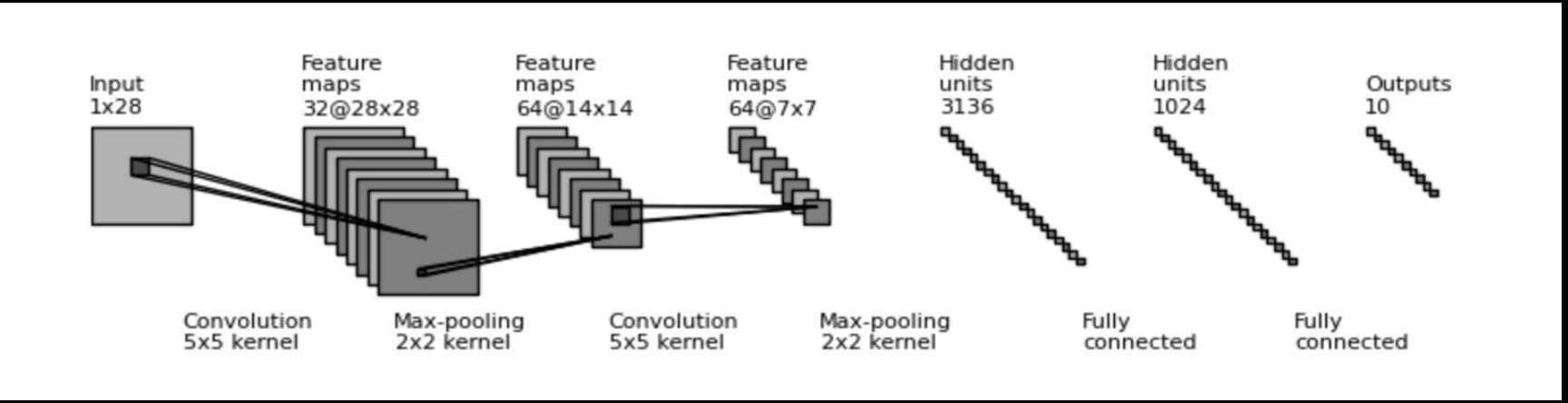
Convolutional Neural Networks

Deep artificial neural network inspired by biological function – has been successfully applied to image processing and categorization tasks



Challenges in this context:

- image preparation and resources – how to deal with very large images
- optimizing network structure
- supervised learning technique needs (lots of) training data

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Convolutional Neural Networks

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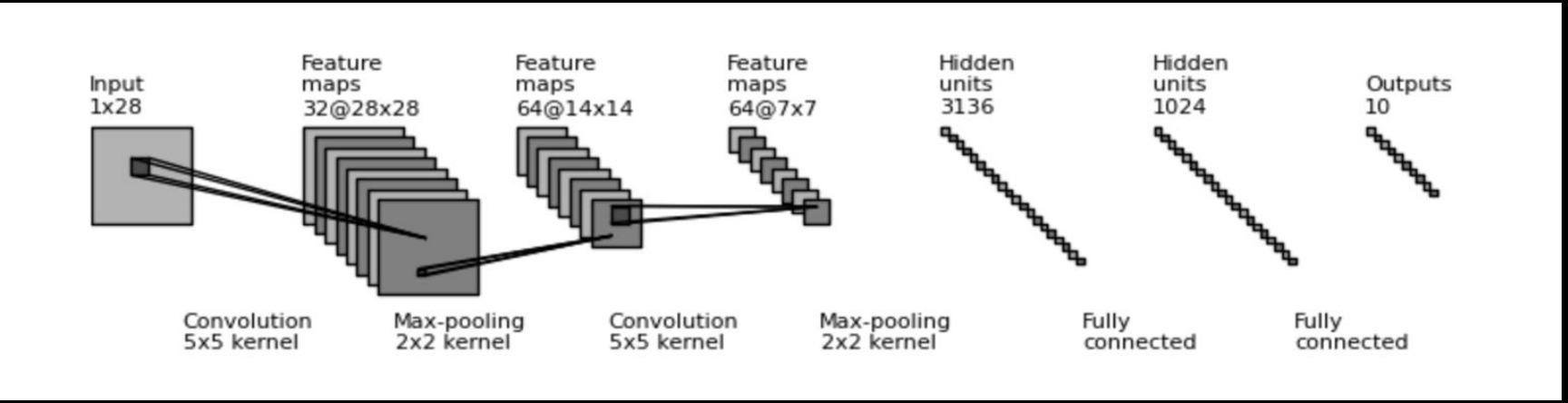

Applying CNNs very fast – training is slow. GPUs can really make a difference

K40, K80, 1080Ti used at QMUL (though not via grid for our studies so far) using TensorFlow

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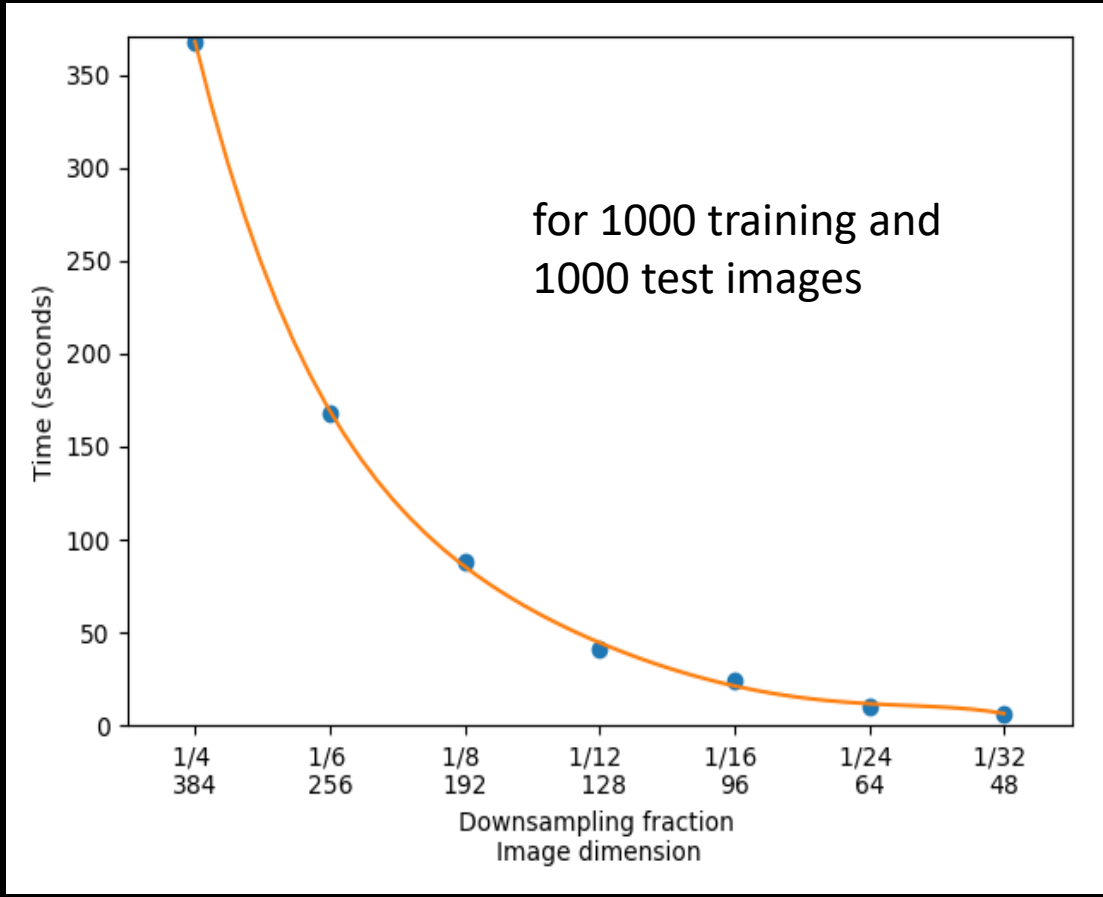
Performance: Timing



Note: 1080 Ti much faster for these jobs than K40 (and much cheaper)

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GPU workflows

Training data preparation workflow

- Initial training image uploaded to grid storage
- Image generation via resampling etc via CPU queues
- Save results to grid storage

Training workflow:

Training data uploaded to grid storage
Software distributed via CVMFS
Training job submitted to GPU queue
Trained ML configuration to grid storage
Retrieve configuration from storage

Analysis workflow:

Large images uploaded to grid storage
Software distributed via CVMFS
Analysis job with ML config submitted to CPU/GPU queue
Results back to grid storage

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Summary

MoEDAL makes opportunistic use of grid for MC and limit calcluations

Future activities involve analyzing large images ($20\ m^2$) at a resolution of a few microns

Training will require GPUs

(Also using this to learn/develop techniques that could be used on ATLAS)

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