DESI Transient Identification Pipeline

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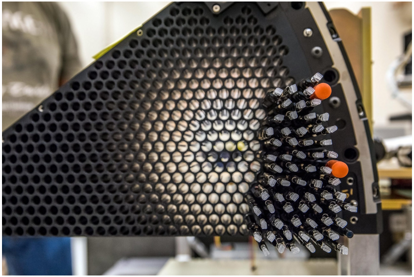
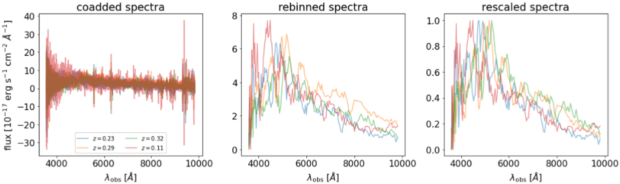
- Dark Energy Spectroscopic Instrument (DESI) will observe over 30 million galaxy spectra.
- A small percentage of these galaxies will contain transients such as supernovae.
- Our goal is to automate the process of identifying these transients using machine learning techniques.
- Why?
    - Release the data for others to follow up
    - Ensure correct estimates of redshift
    - Identifying transient types and comparing with photometric data sets



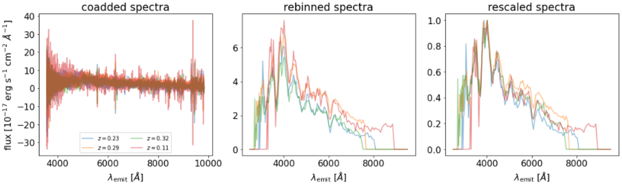
One of ten petals of the telescope's focal plane - LBNL

Prepossessing

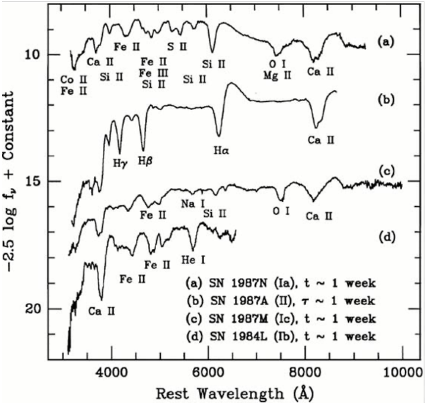
- Remove NaNs/zeroes
- Weighted Rebinning
  - Removes noise
- Clipping negative flux values
  - Comes from subtracting background
- Scale between zero and one
  - Data conditioning needed in machine learning
  - Reduces training time
- De-redshift
  - Zero padding



No de-redshifting



De-redshifting

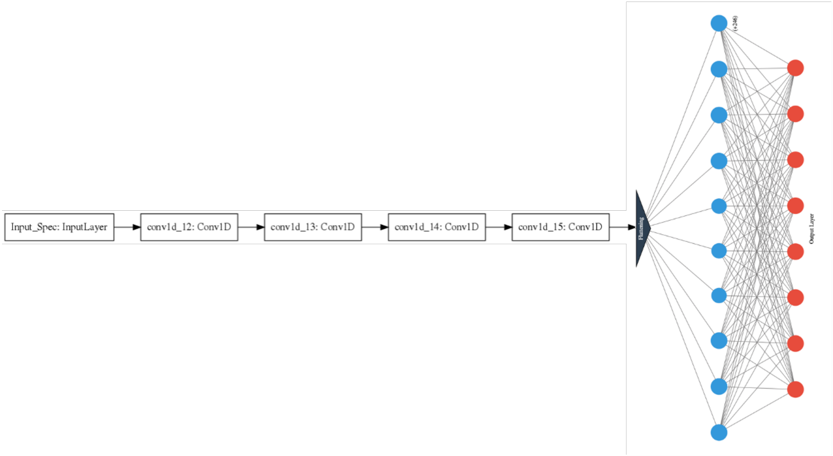


A variety of supernova spectra - Filippenko (1997)

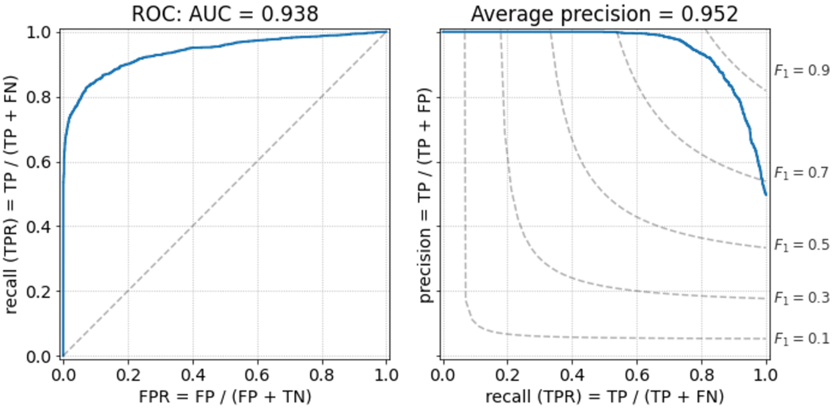
Our Deep Neural Network

Our Network's architecture:

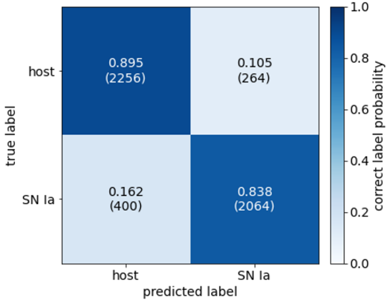
- 5 convolutional layer
- 1 dense layer (264 nodes)
- 1 output



Performance: 2 classes (galaxy + SNIa)



Performance: Confusion Matrix



- Upper left = "true negatives" (host only)
- Lower right = "true positives" (host + SN Ia)
- Upper right = false negatives.
Confuse SN Ia for host
- Lower left = false positives. Confuse host for SN Ia
- Ideally, the matrix is completely diagonal.
- Can improve precision, if willing to sacrifice some statistics.

Performance: Multiple Supernova Classes

- Classifying 7 different types of SN and hosts.

Summary / Next Steps

- Multilabel Classifier:
  - Optimize using different metrics (Precision, Accuracy, etc.)
  - Optimize the network architecture, hyper optimization, etc.
- Technical Note, DESI publication.
- Installation at the Spectro-Pipeline at the National Energy Research Scientific Computing Center (NERSC).

Acknowledgments

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Any Questions?