CSCI 8360 Data Science Practicum

Project 3: Neuron Finding

Team Shirley

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Technologies

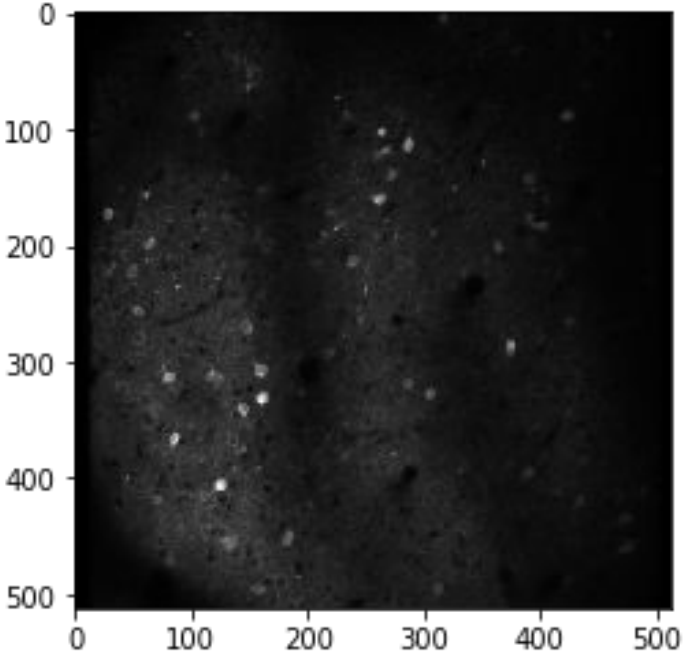
- keras
- thunder-python
- thunder-extraction

Overview

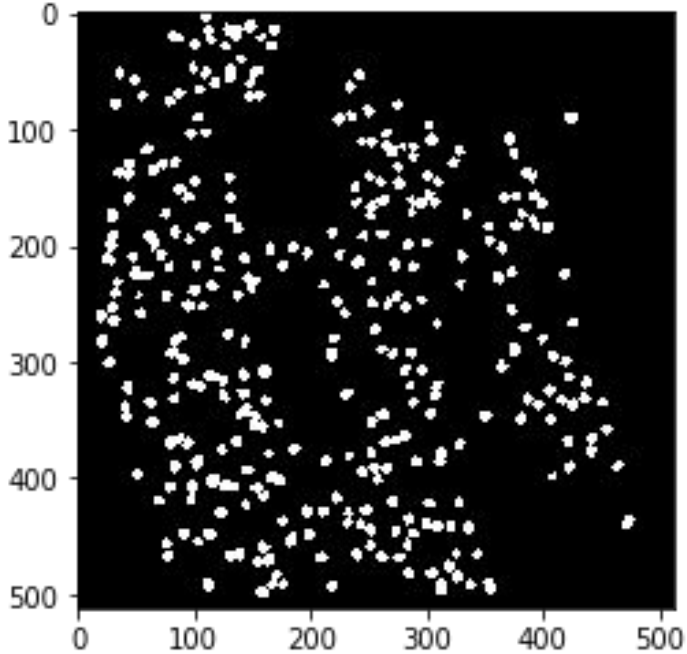
- Find neurons in a large time series calcium fluorescence dataset
- Image segmentation

Data

Average over all frames
for 00.00 dataset

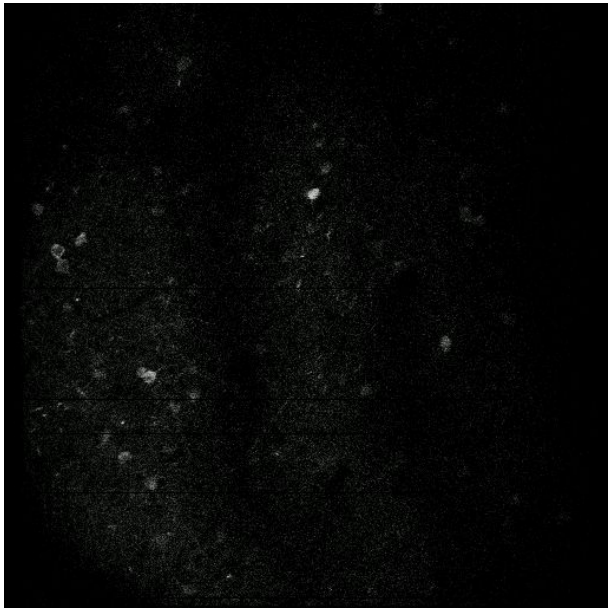


Corresponding label

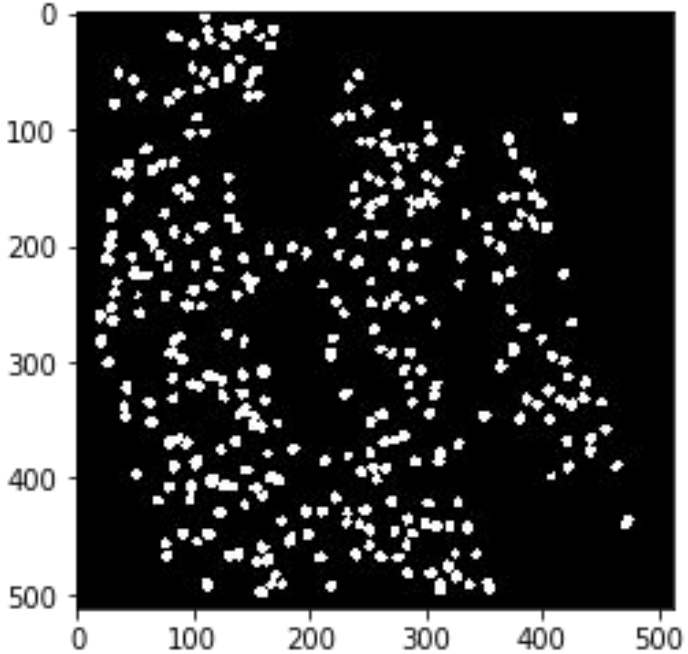


Data

Animation



Corresponding label



Preprocessing

- Median filter
- Gaussian filter
- 64 - 64x64 Region Cropping
- Filtering of all regions that do not contain at least 40% neurons

NMF (Non-negative matrix factorization)

- NMF is a dimensionality reduction algorithm where a matrix **V** is factorized into two matrices **W** and **H**
- Attempts to cluster the columns of the input data
- Feature extractor

Inderjit S. Dhillon; Suvrit Sra (2005). Generalized Nonnegative Matrix Approximations with Bregman Divergences. NIPS.
Tandon, Rashish; Suvrit Sra (2010). "Sparse nonnegative matrix approximation: new formulations and algorithms". TR.

Implementation

- NMF package
  - https://github.com/thunder-project/thunder
  - https://github.com/thunder-project/thunder-extraction

- `NMF(k=5, max_iter=20, max_size='full', min_size=20, percentile=95, overlap=0.1)`
- `algorithm.fit(data, chunk_size, padding)`
- `model.merge(overlap=0.5, max_iter=2, k_nearest=10)`

Results

- By varying the chunk size for each individual dataset, our best result is

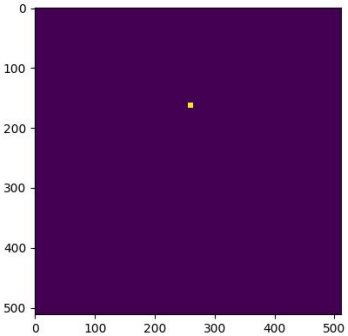
TOTAL SCORE	AVG PRECISION	AVG RECALL	AVG INCLUSION	AVG EXCLUSION
3.1648	0.85672	0.98383	0.56825	0.756

CNN

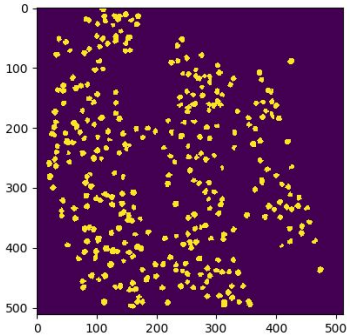
- FCN8 architecture utilized
- Inputs are 64x64 regions from the averaged samples

512x512 Output Masks

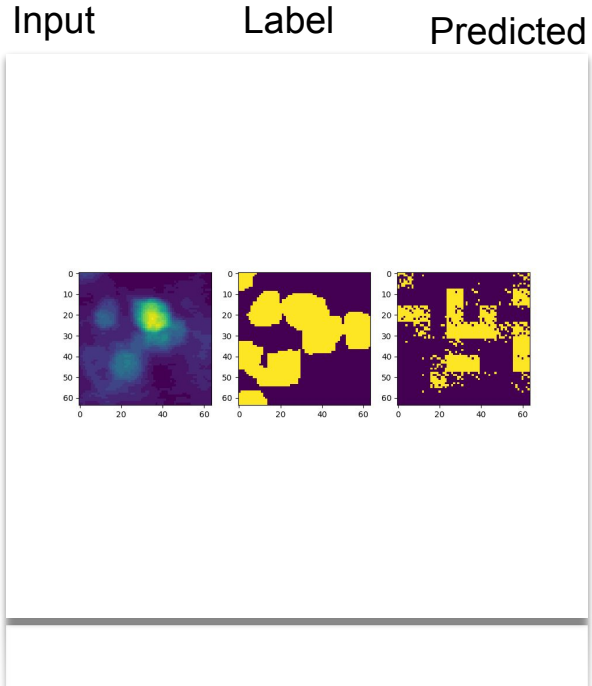
Predicted Mask



Label



64x64 Region Output Masks



Future

- Use CNN as a feature extractor, then feed to NMF
- Use NMF as a feature extractor, then feed to CNN
- Overcome the data imbalance