

Segmenting Neuronal Structure in Electron Microscopy Images

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Dataset

Background of dataset

- “ISBI Challenge: Segmentation of Neuronal Structures in EM stacks”
- The images are electron microscopy (EM) stacks of *Drosophila* first instar larva ventral nerve cord (VNC), containing some noise and small image alignment errors.
- Each pixel of the images is labeled manually by the experts.

Training set

Training images:

$\text{num_image} = 30$

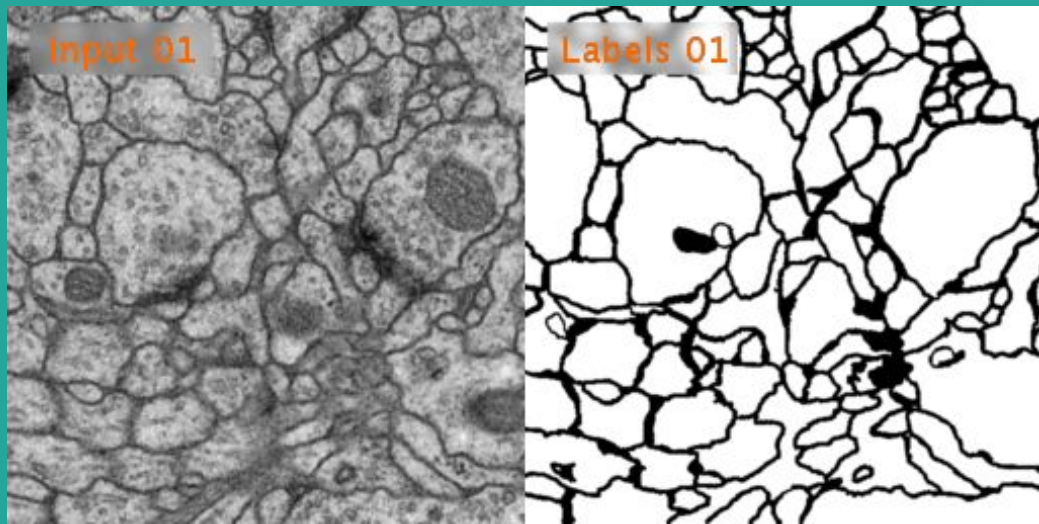
$\text{Size_image} = 512 \times 512$

Labels:

$\text{num_label} = 30$

$\text{size_label} = 512 \times 512$

(white for the pixels of segmented objects and black for the rest of pixels (which correspond mostly to membranes.)

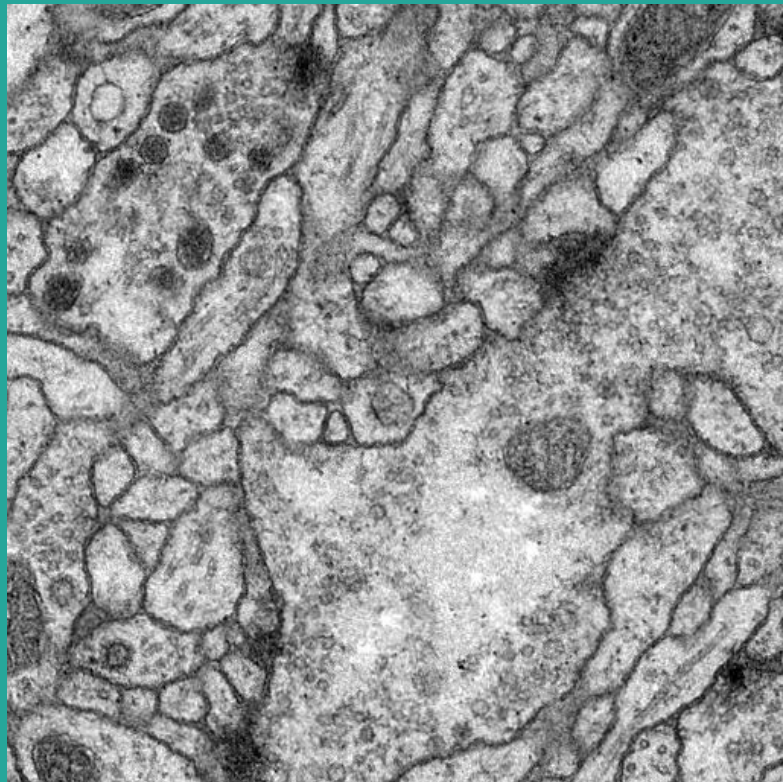


Input training data and corresponding labels.

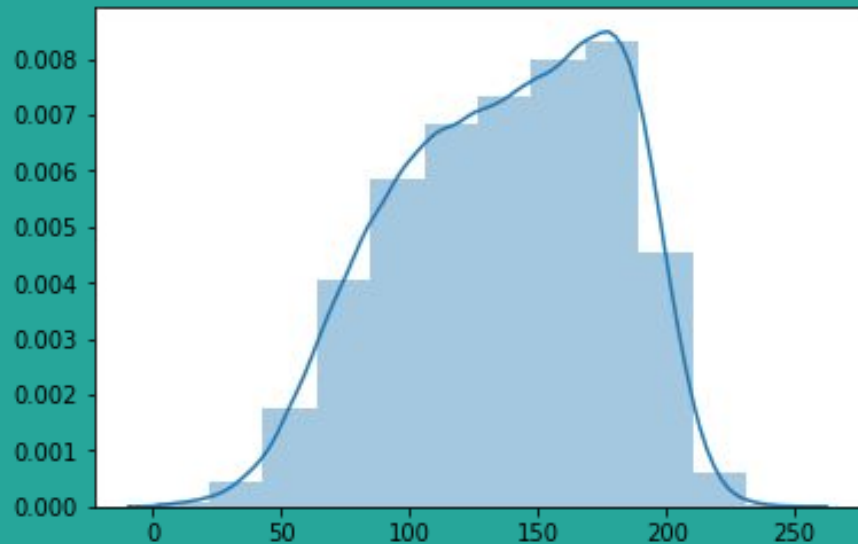
Test set

`num_image = 30`

`size_image = 512*512`

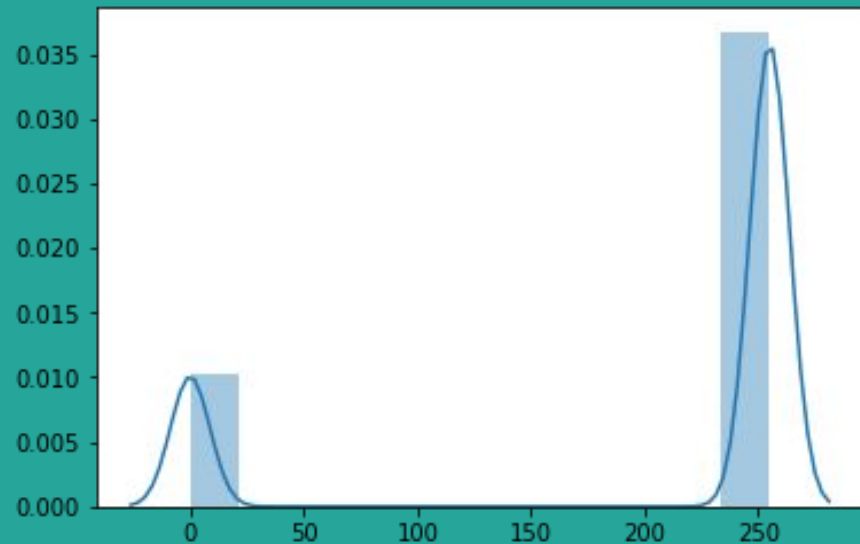


Basic exploration



Histogram for pixel matrix from first training image

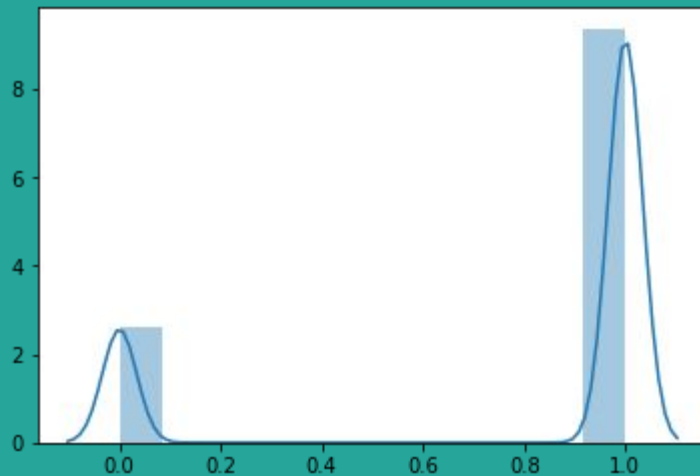
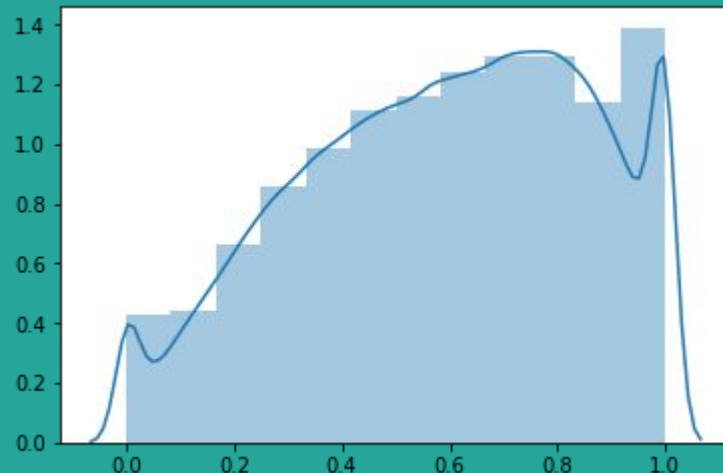
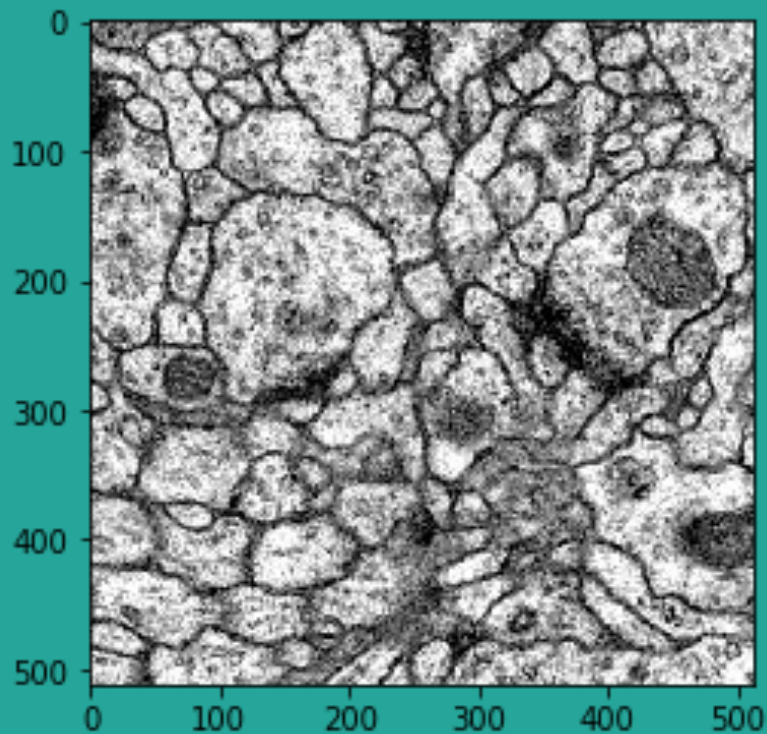
Noisy!



Histograms for pixel matrix from the label of the first training label

Basic exploration

After using MinMaxScaler:



Training

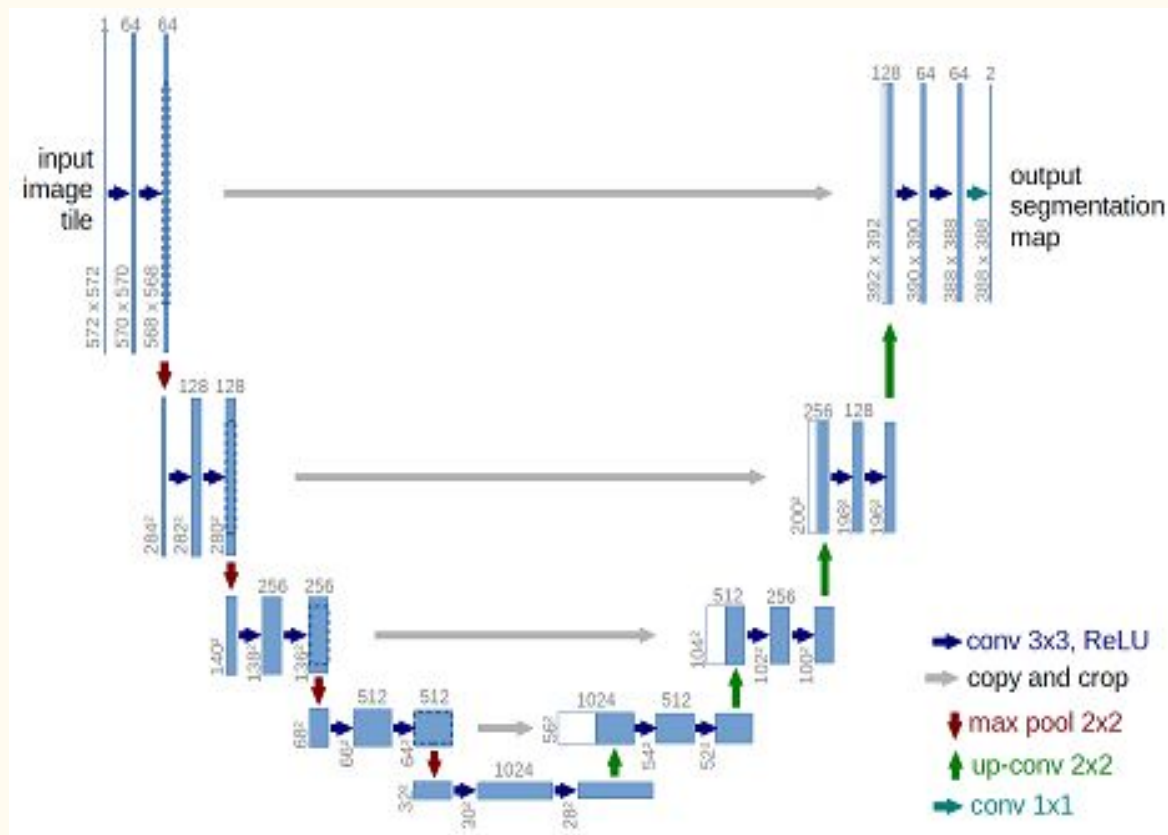
Methods

To be used.

- SVM
 - Random Forest
 - U-net (DNN)
 - Seg-net (DNN)
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First: U-net (Pytorch on Google Colab)

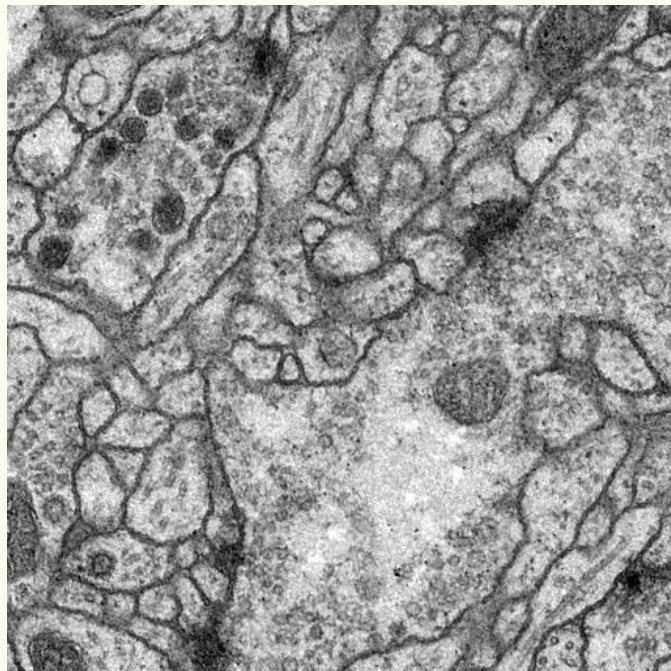
1. Split original images into small patches ($20 * 96 * 96$)
2. Build U-net
3. Fit the model : train:
0.9, validation:
0.1, MSE loss, epoch = 12
4. Predict
5. Combine the outputs into a label image



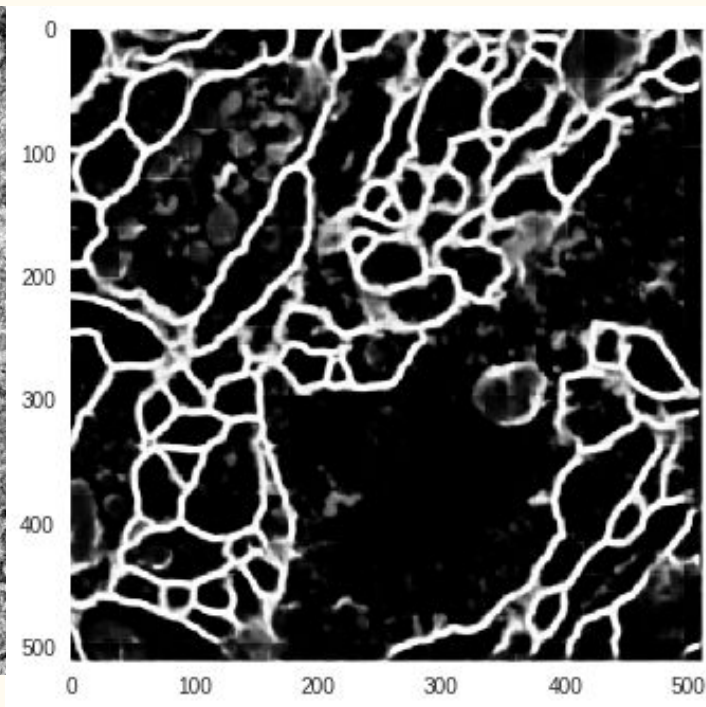
Results

Total training Loss:
4.02

Average training
time for each
epoch: 600s



Test image 0



Predicted Label

Reference

1. Albert Cardona, Stephan Saalfeld, Stephan Preibisch, Benjamin Schmid, Anchi Cheng, Jim Pulokas, Pavel Tomancak and Volker Hartenstein (10, 2010), "An Integrated Micro- and Macroarchitectural Analysis of the Drosophila Brain by Computer-Assisted Serial Section Electron Microscopy", PLoS Biol (Public Library of Science) 8 (10): e1000502, doi:10.1371/journal.pbio.1000502
2. Ronneberger, O., Fischer, P., & Brox, T. (2015, October). U-net: Convolutional networks for biomedical image segmentation. In International Conference on Medical image computing and computer-assisted intervention (pp. 234-241). Springer, Cham.

Questions