Neural Circuit Reconstruction using electron microscopy

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Introduction

- Electron microscopy (EM) is an imaging technique that can generate nanoscale images that contain enough details for reconstruction of the connectome, i.e., the wiring diagram of neural processes in the mammalian nervous system.

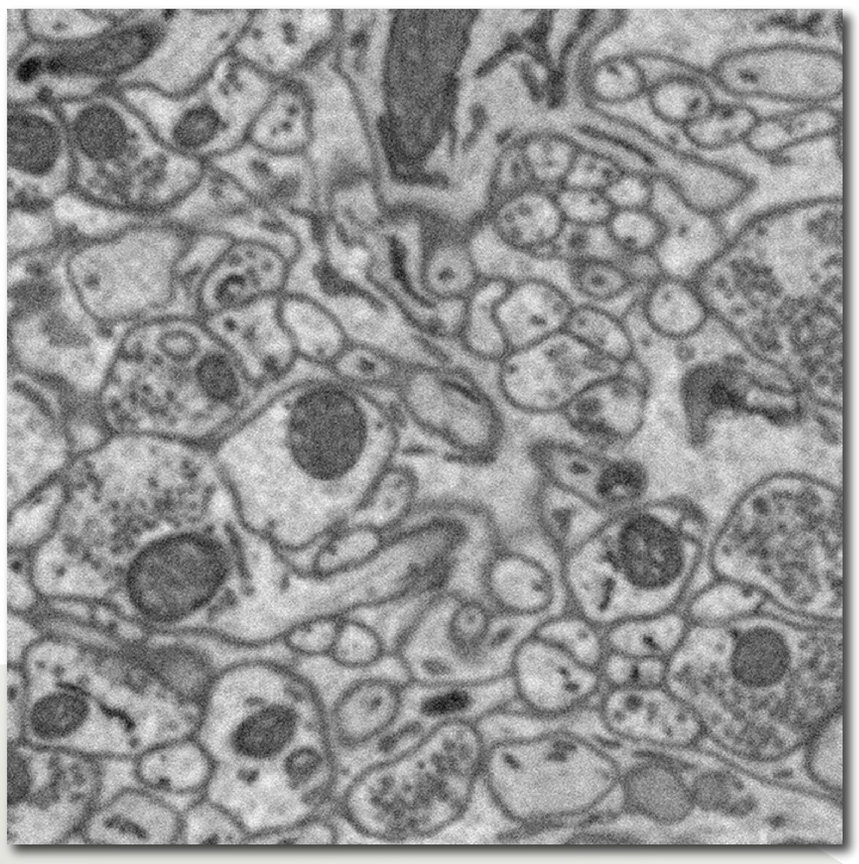

Fig 1: A sample of EM image.

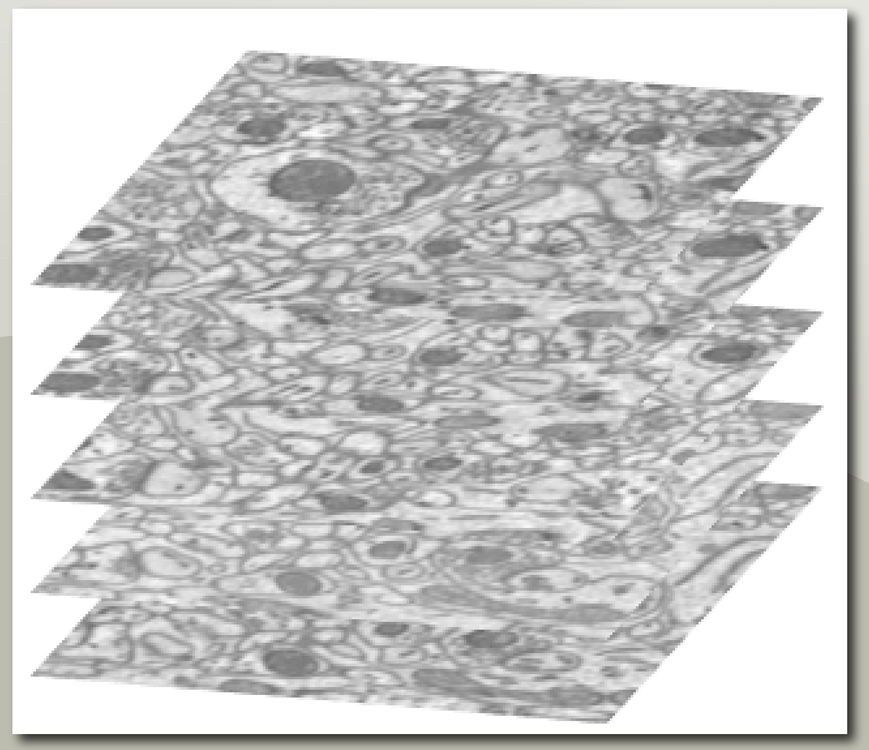

Fig 2: 3D EM neuropil.

- Fully automatic neuron segmentation is challenging because of complex intracellular structures, noise, and the large variation in the geometry of cells between serial sections due to anisotropy.
- Neural circuit reconstruction consists of two tasks:

1-Creating contours in each XY plane.

2-Linking contours in adjacent planes to build 3D objects.

Membrane Detection

- Cell membrane detection is a necessary step before segmentation.
- Supervised methods that use contextual information were shown to be promising for this problem.
- We propose a series-classifier architecture to improve the membrane detection accuracy.
- In this framework, each classifier uses the output of the previous classifier to improve the performance.
- We also present a multi-scale strategy to take advantage of context from a larger area while keeping the computational complexity tractable.
- The multi-scale method is more successful in removing undesired parts from inside cells

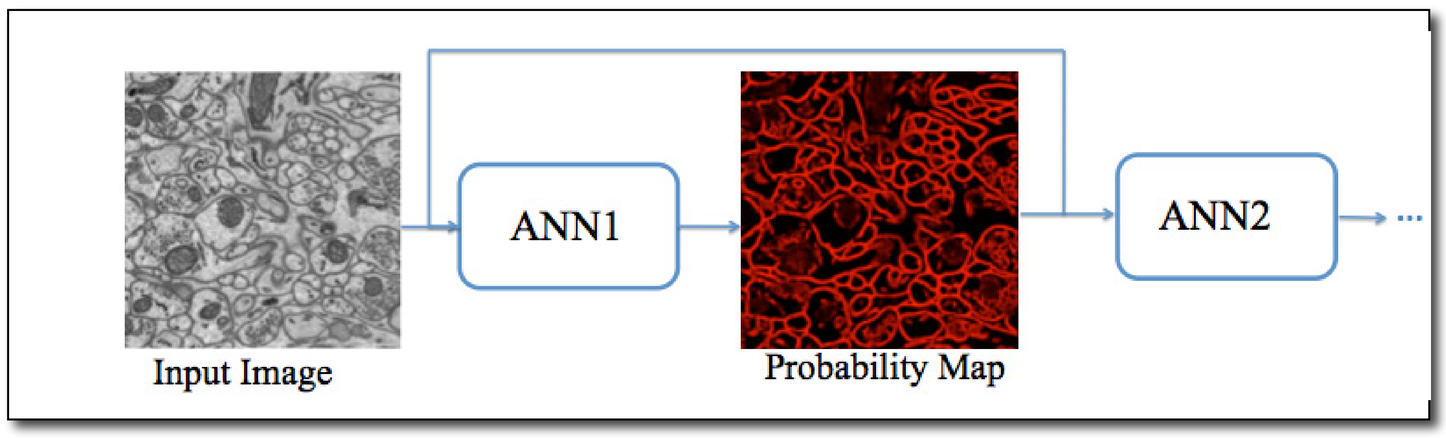

Fig 3: Illustration of series classifier architecture.

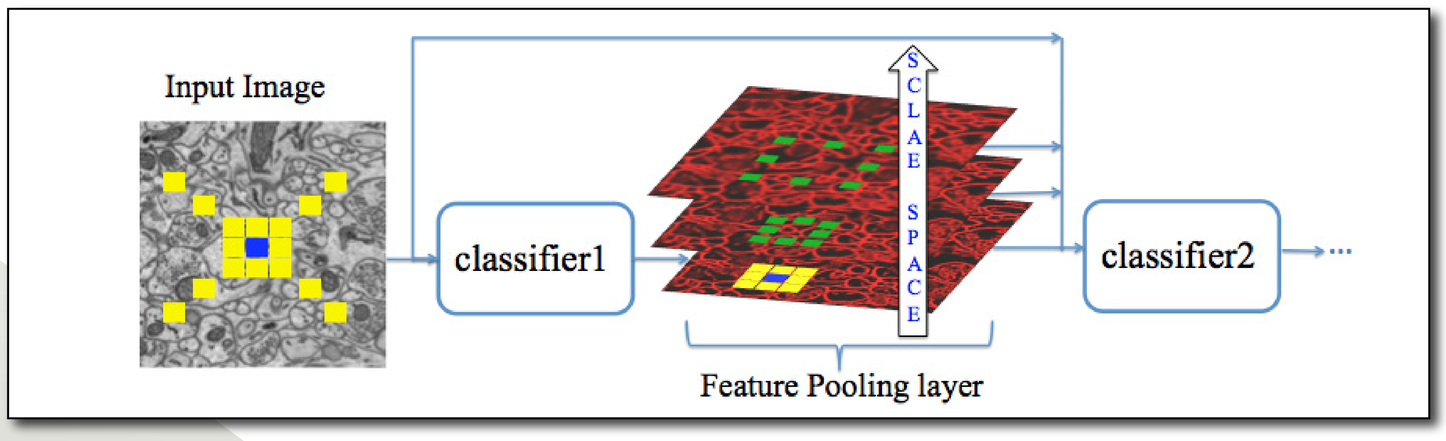

Fig 4: Illustration of the multi-scale contextual model.

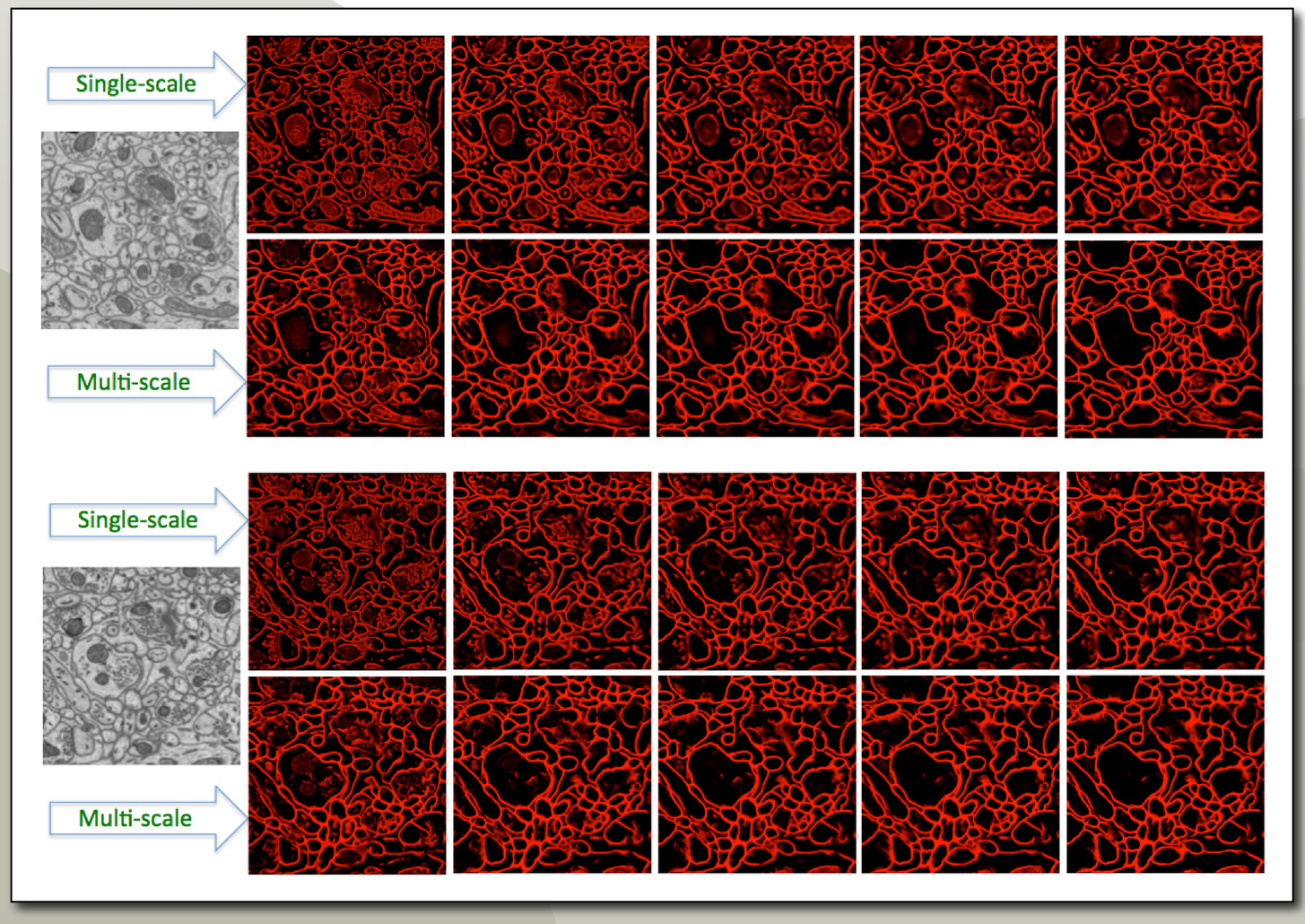

Fig 5: The first column shows the input image and the remaining columns show the output at different stages of the classifier.