CSE 40171:
Artificial Intelligence

Connectomics: Anatomical Imaging in Neuroscience

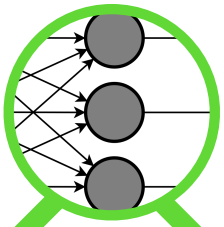
Homework #5 has been released
It is due at 11:59PM on 11/13

Course Roadmap

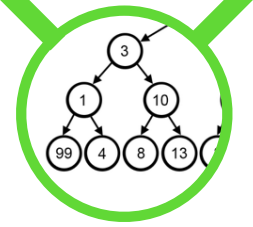
Introduction
(week 1)

Bio. Intelligence
(week 2)

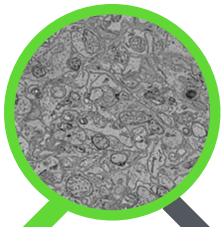
Neural Networks
(week 3)



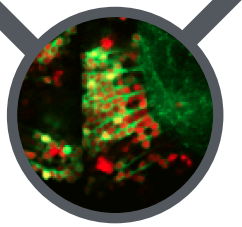
Search Problems
(weeks 4 - 9)



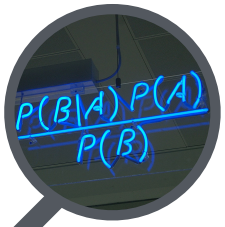
Brain Structure
(weeks 12 - 13)



Brain Function
(weeks 14 - 15)



Decisions
(week 16)



The connectome in 5 takes

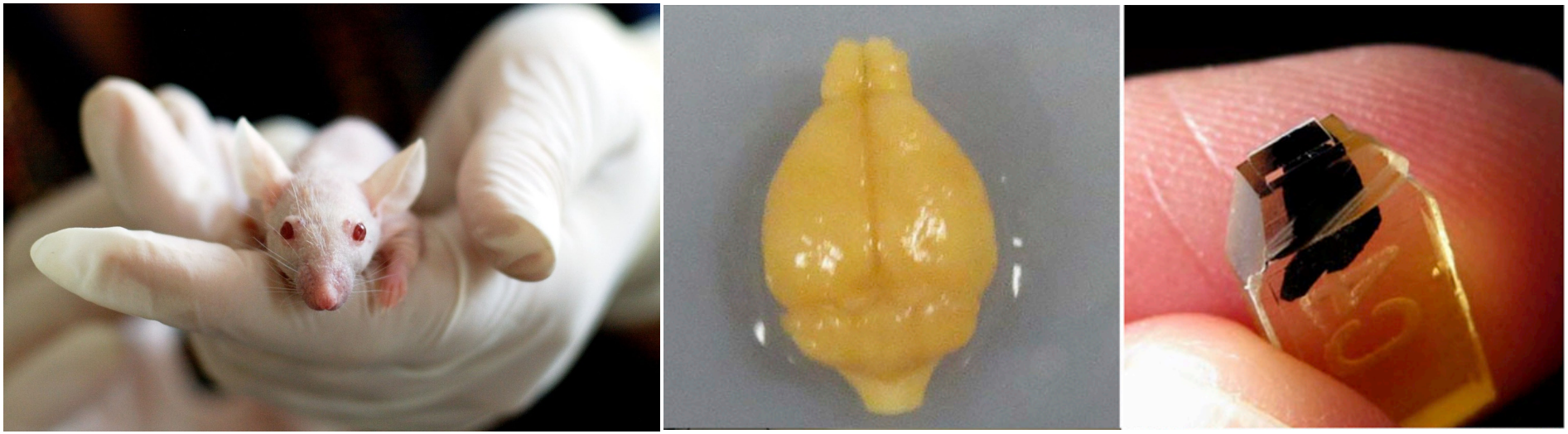
https://www.youtube.com/watch?v=opqIa5Jiwuw

Is connectomics a viable path forward for AI?

Is it possible to read out memories from a biological brain?

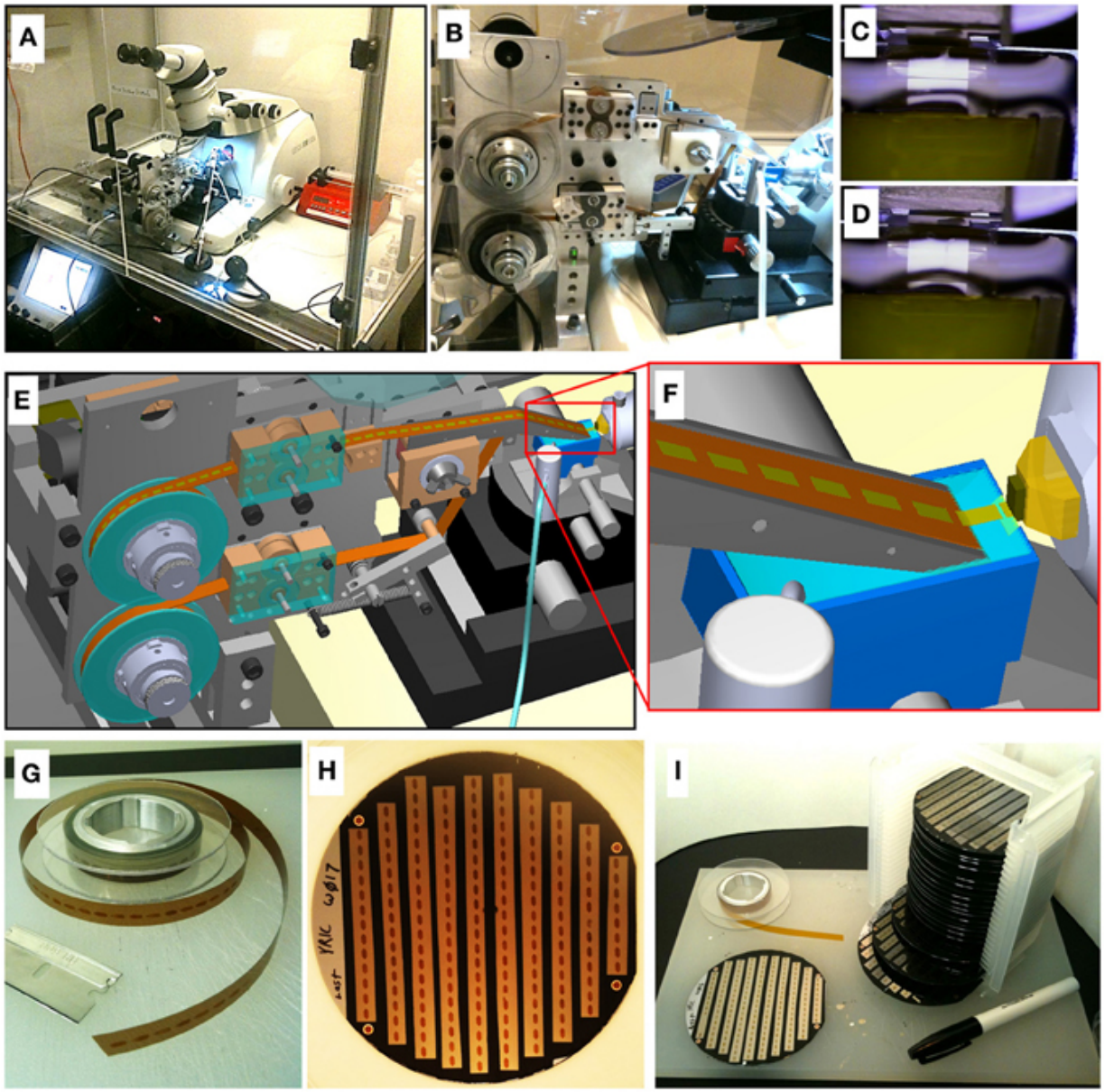
Why is this an AI problem on multiple fronts?

Preparing a brain



N. Kasthuri et al. Cell 2015

Automatic Tape-collecting Ultra-Microtome



K. Hayworth et al. Frontiers in Neural Circuits 2014

Scanning Electron Microscopy

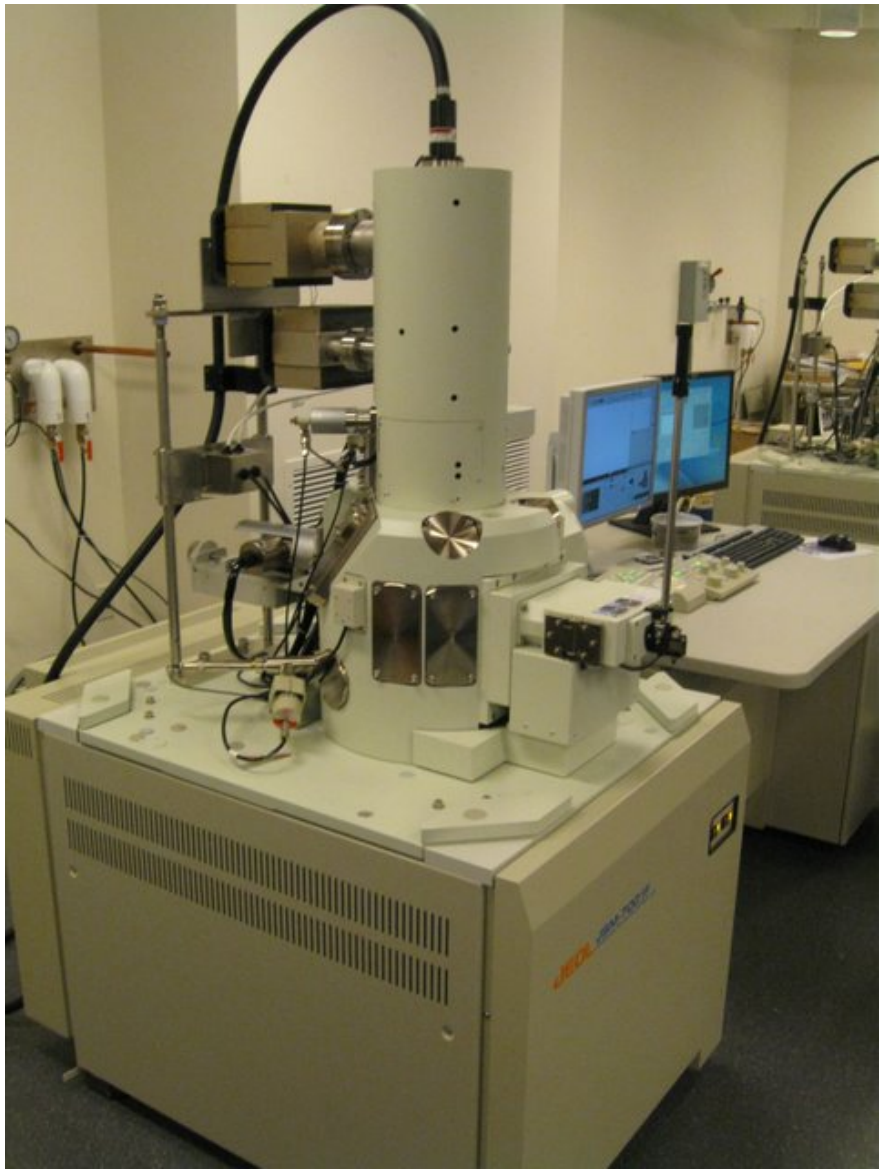
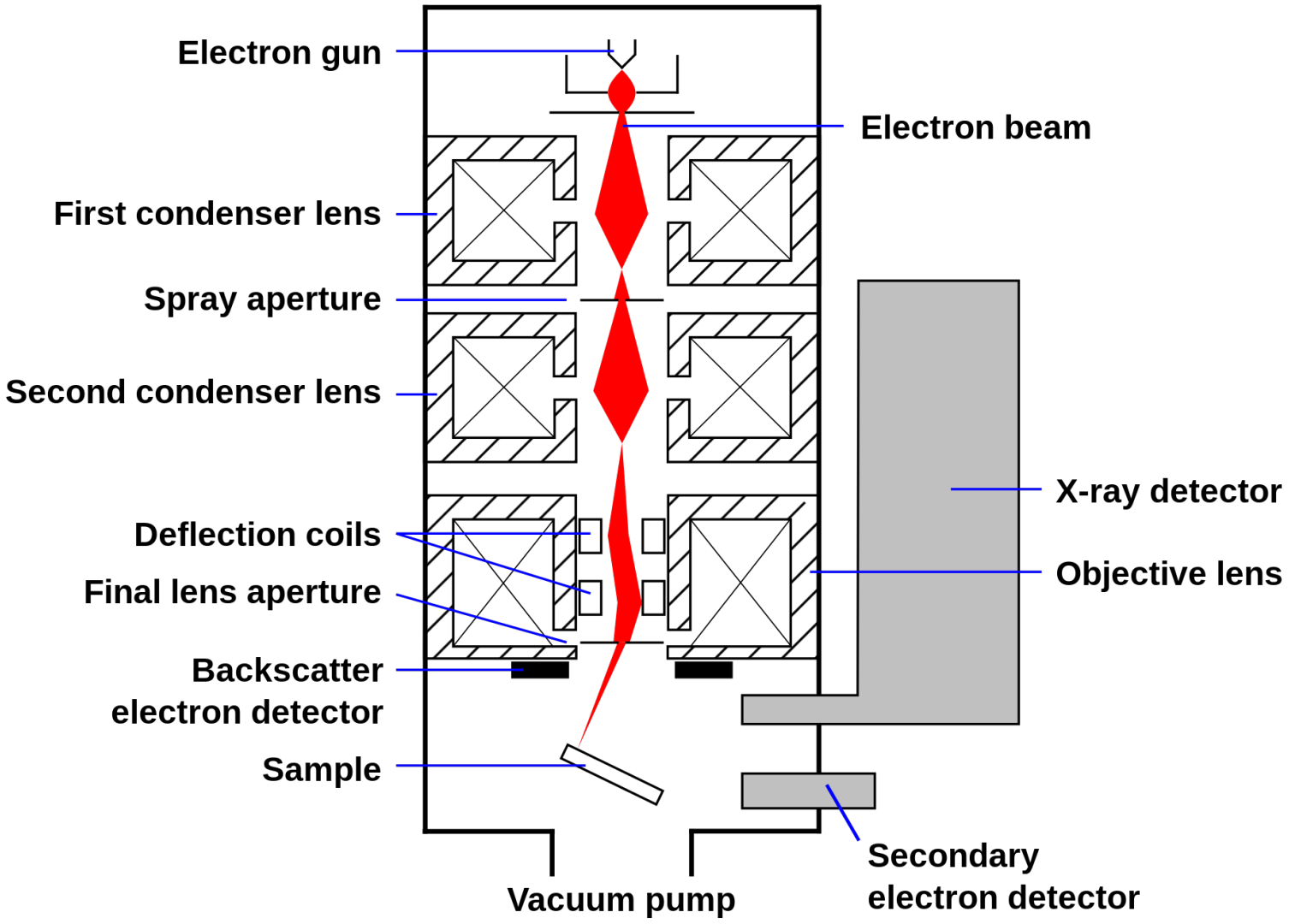
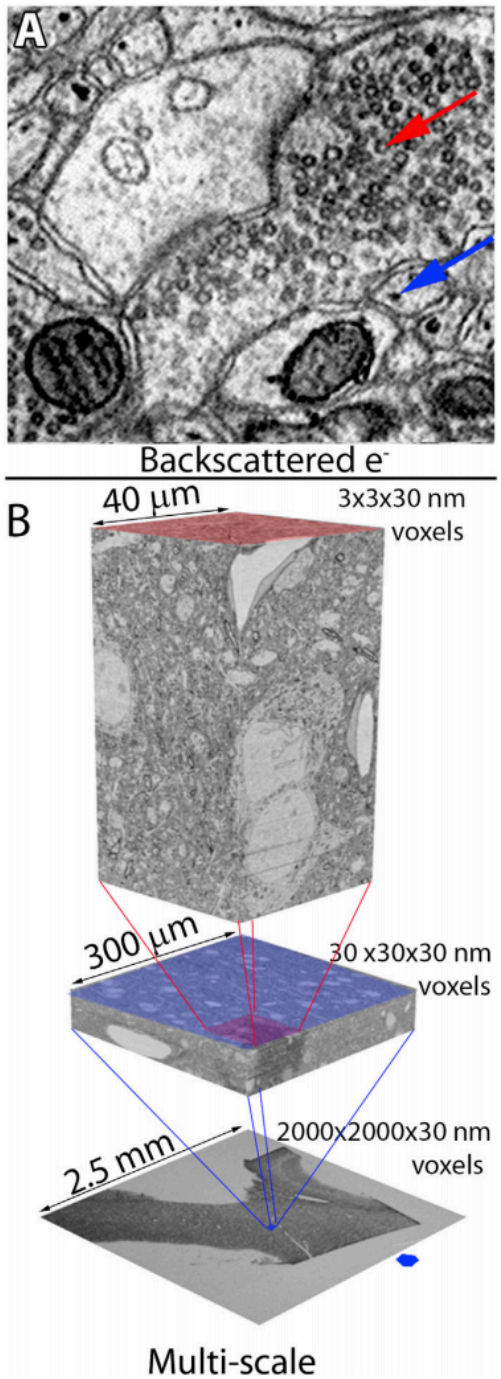


Image Credit: Harvard University Center for Brain Science

Schematic of an SEM





N. Kasthuri et al. Cell 2015

Scaling up…

Image Credit: ZEISS, https://stories.zeiss.com/en/jeff-lichtman-interview/

Multibeam SEM

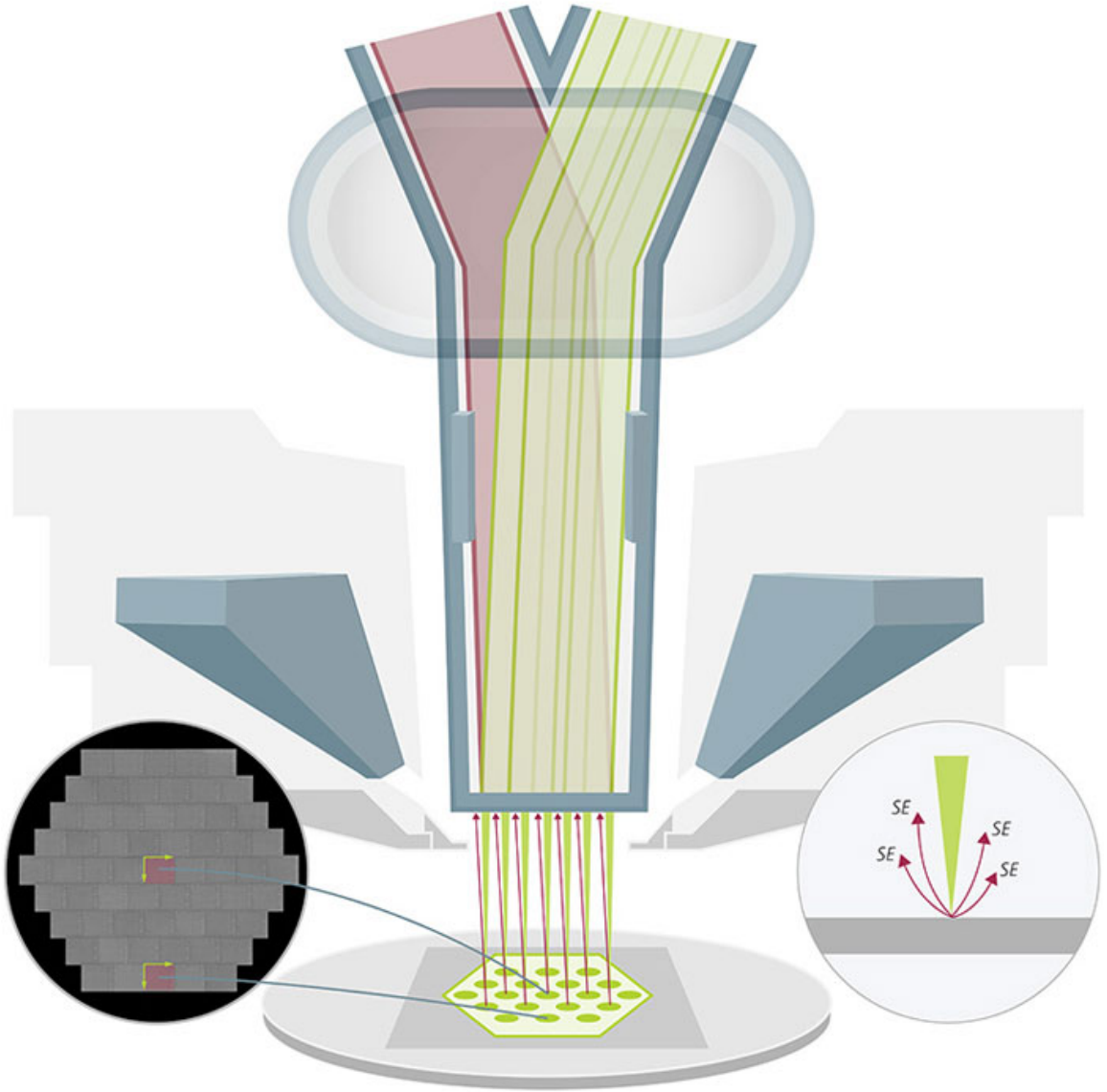
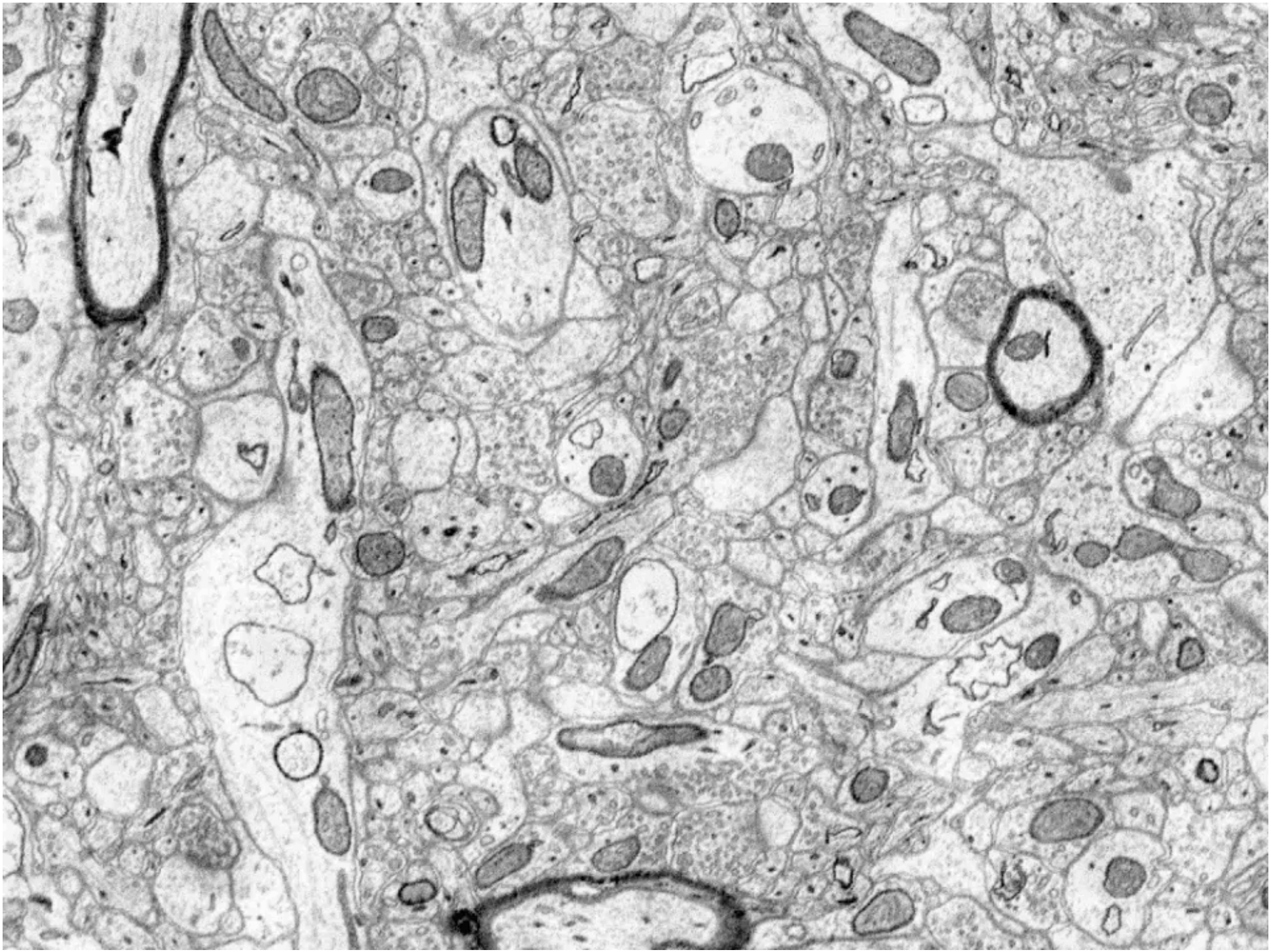
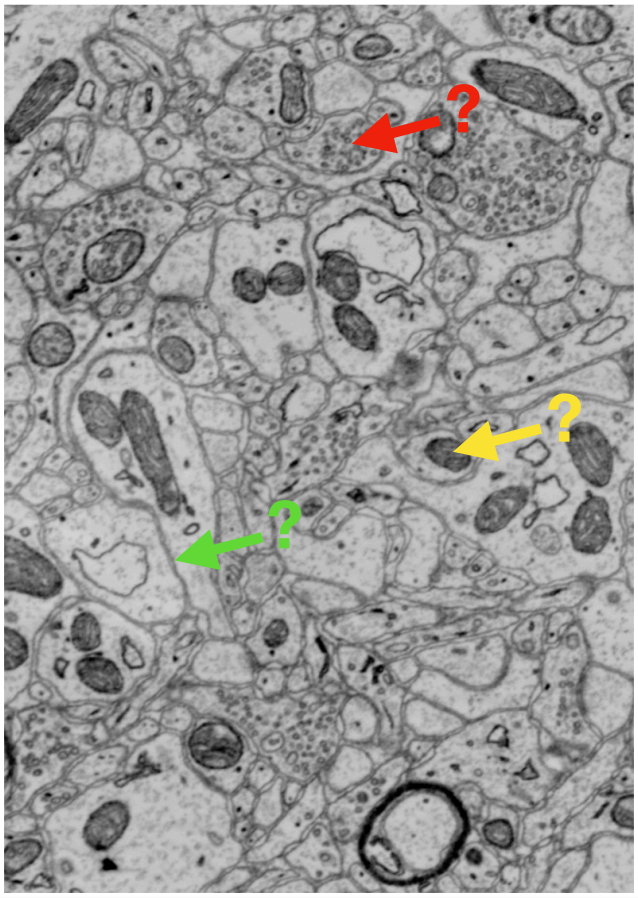


Image Credit: ZEISS, https://www.zeiss.com/microscopy/int/products/scanning-electron-microscopes/multisem.html



N. Kasthuri et al. Cell 2015

Anatomy Quiz



A. Vazquez-Reina et al. ICCV 2011

Differences Across Species

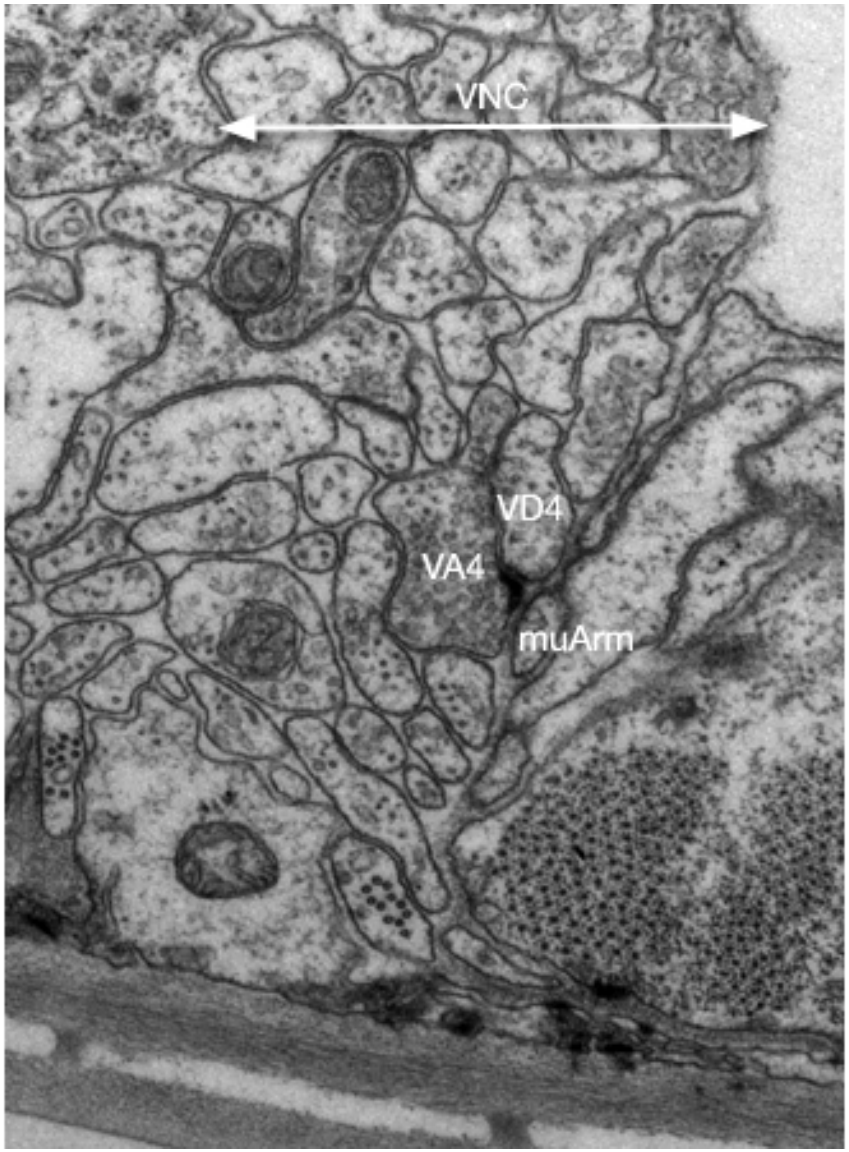


Image Credit: https://www.wormatlas.org/neuronalwiring.html

Differences Across Species

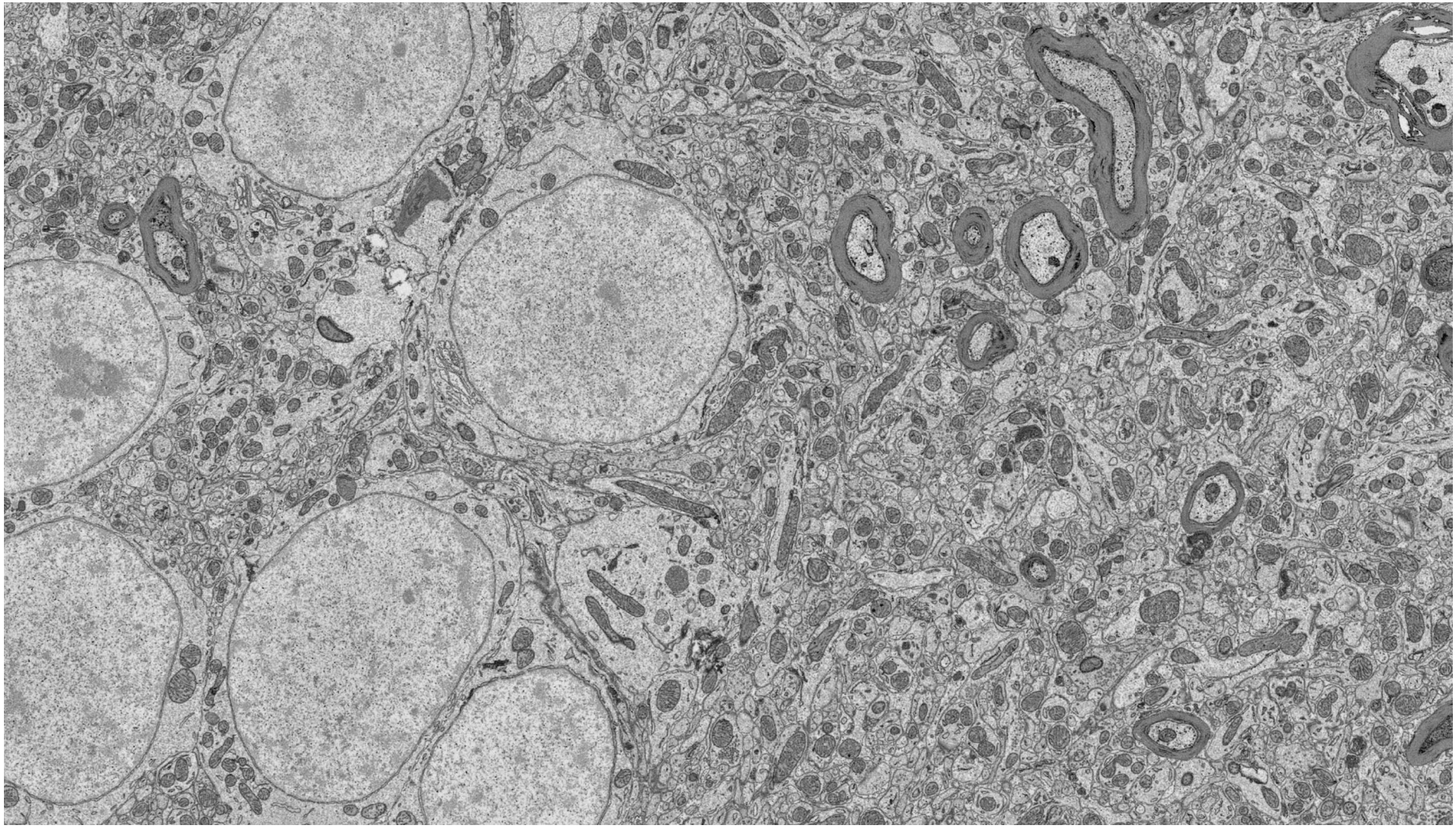
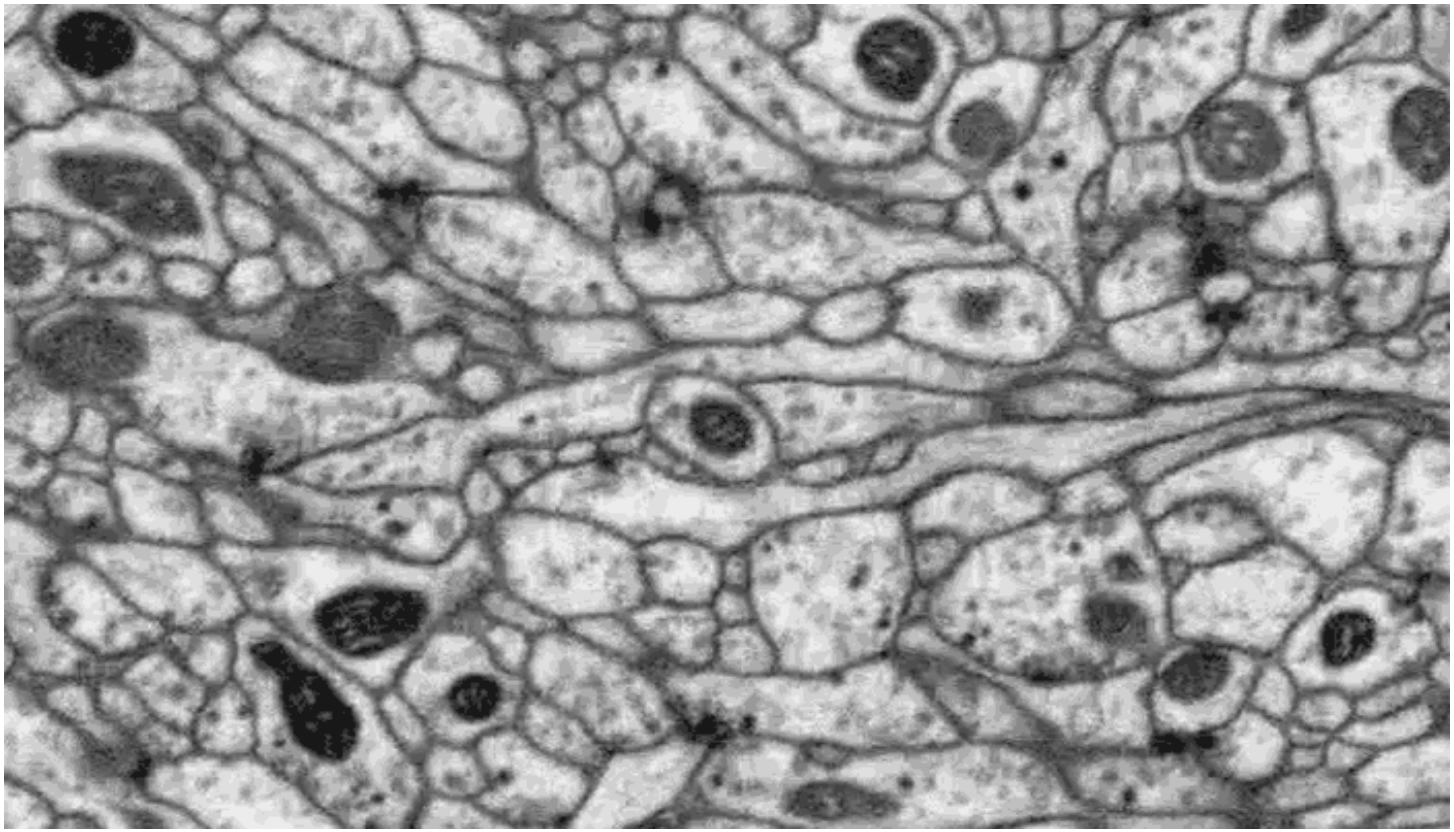


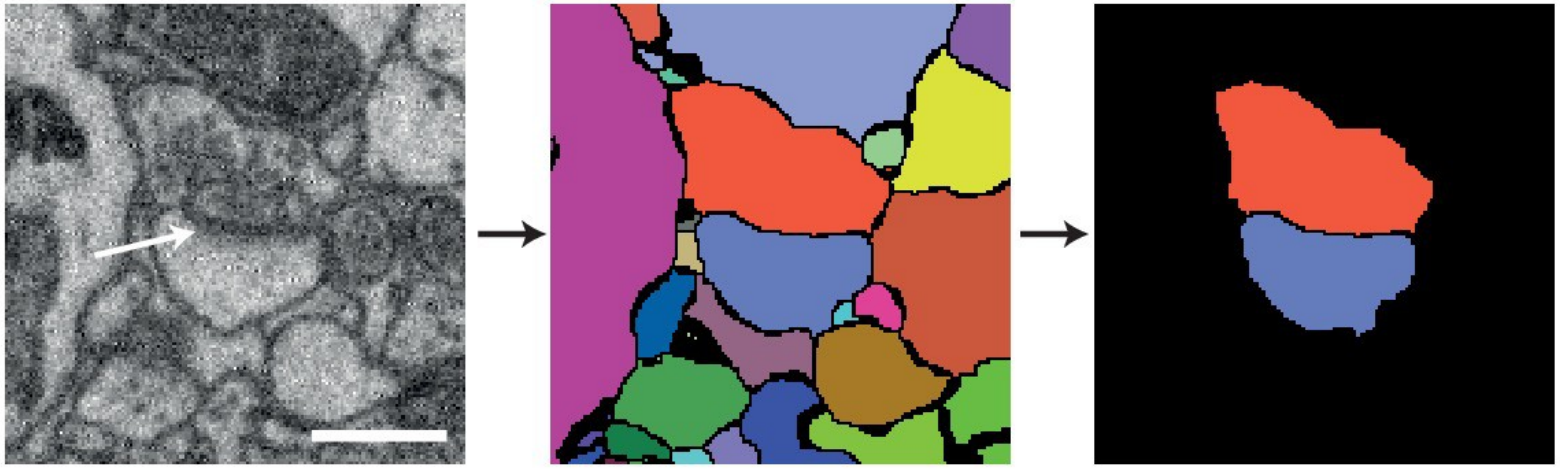
Image Credit: Fee Lab, MIT https://feelaboratory.org/research-project/connectomic-analysis-of-songbird-circuits/20180706

Differences Across Species

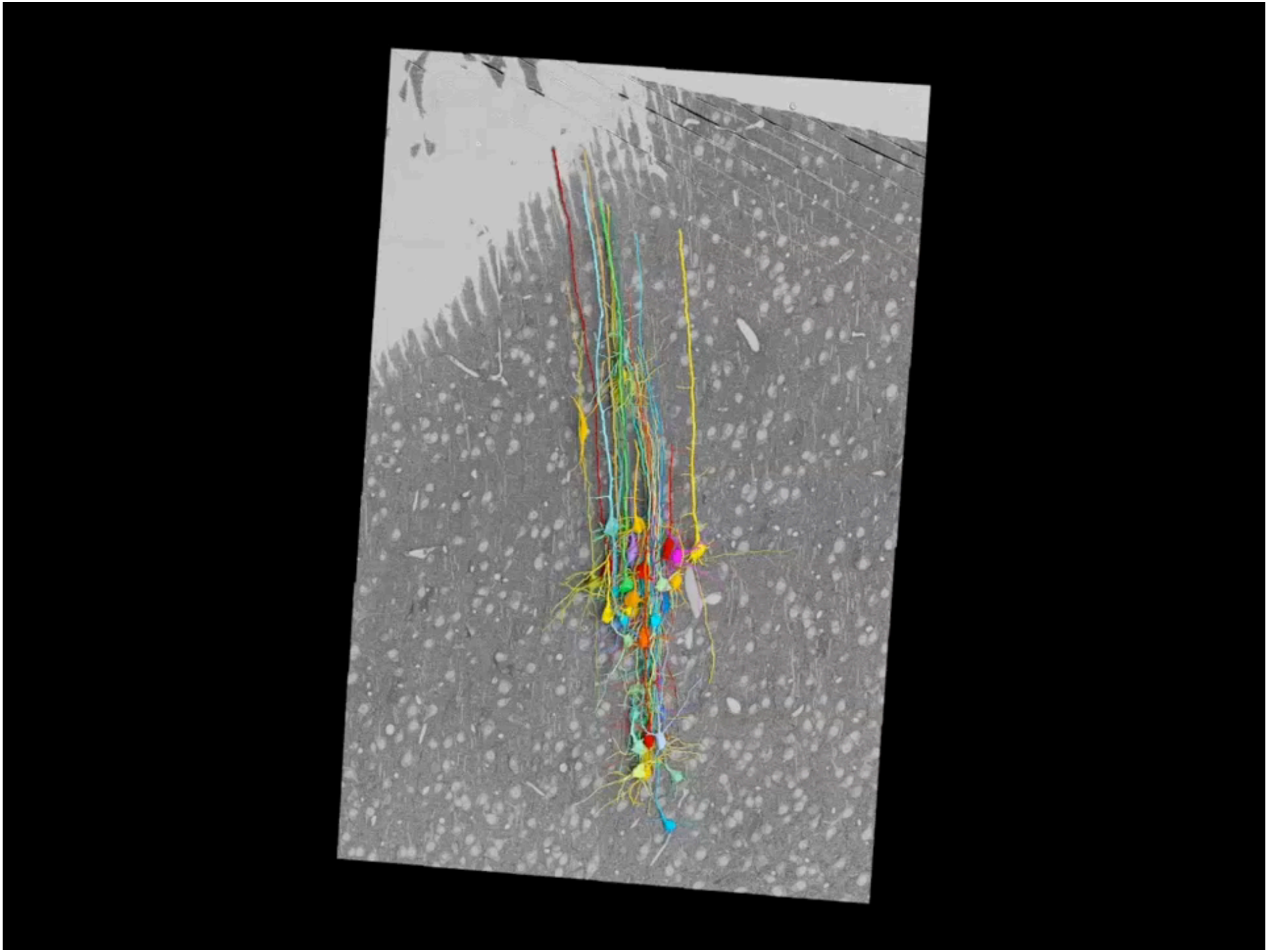


S. Takemura et al. eLife 2017

Synapse Identification



B. Staffler et al. eLife 2017



N. Kasthuri et al. Cell 2015

So how are we going to do this **automatically**?