An Automated Images to Graphs Pipeline for High Resolution Connectomics

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Summary

- Connectomics is a field where research tools are diverse and difficult to interface with each other
  Creation of a pipeline to synchronize tools would be quite helpful
- Additionally, these tools may perform well in isolation, but may perform poorly in conjunction with other tools
  Coordination tools and tune algorithms for best overall performance
- Error metrics for these tools are only interpretable for the individual pieces
  Implementation of an interpretable pipeline-wide error metric

Opportunity

- Look at all of these great tools in the exciting new field of connectomics!

- I bet we could make a bunch of scientific progress with these.

- How much progress?
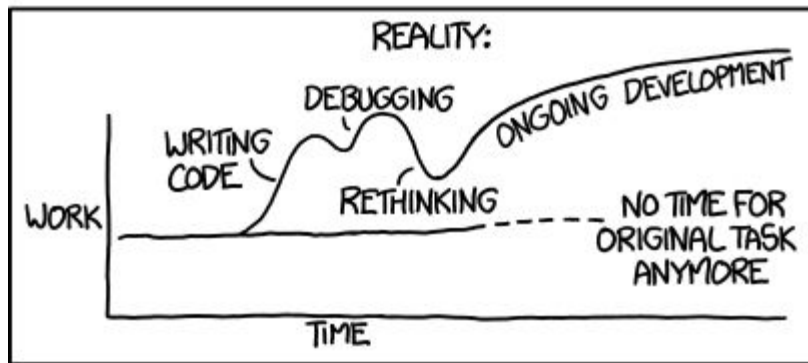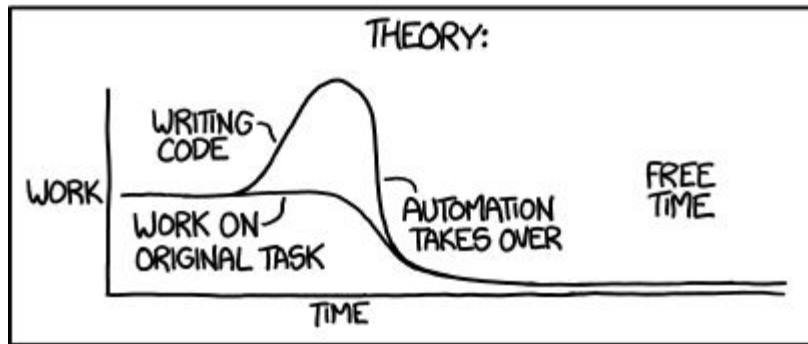
- So much progress!

Challenge

- It's a shame none of these tools work together. That would be so convenient.
  - Imagine trying to build a doghouse without blueprints…
  - With only a hammer and screws…
  - And with wood of all different shapes and sizes…
 - With no saw.

Action

- Create a pipeline to automate the process
  - Fit all of the pieces together
  - Standardize output and process

- But that's too easy
  - Include variable parameter sets
  - Calculate appx. error in final product
  - Distribute computations for faster results
  - Create custom synapse detector

"I SPEND A LOT OF TIME ON THIS TASK.
I SHOULD WRITE A PROGRAM AUTOMATING IT!"

THEORY:

WRITING CODE

WORK

WORK ON ORIGINAL TASK

AUTOMATION TAKES OVER

FREE TIME

TIME

REALITY:

WRITING CODE

DEBUGGING

ONGOING DEVELOPMENT

WORK

RETHINKING

NO TIME FOR ORIGINAL TASK ANYMORE

TIME

Pipeline Overview

- Begin with cortical tissue image volume
- Membrane Detection -> Neuron Segmentation -> Segment Assembly
- Grey items are computed once
- Green items are parameter based
- White items are computed with every run
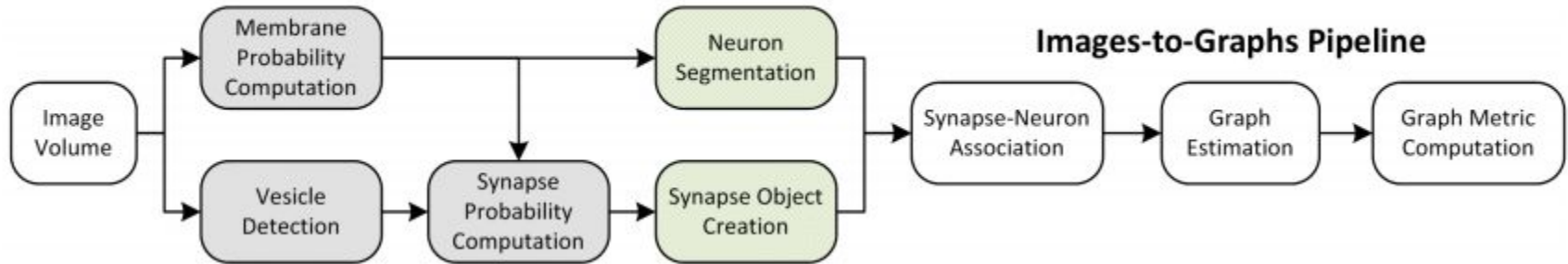
Error Measurement

- Effective parameters require a fitness
- This is tricky due to tool diversity
- *"As we demonstrate, the optimal results for a subtask may not translate to optimal results for the overall pipeline."*
- Topographical vs Segmentation Errors
- Parameter Tuning
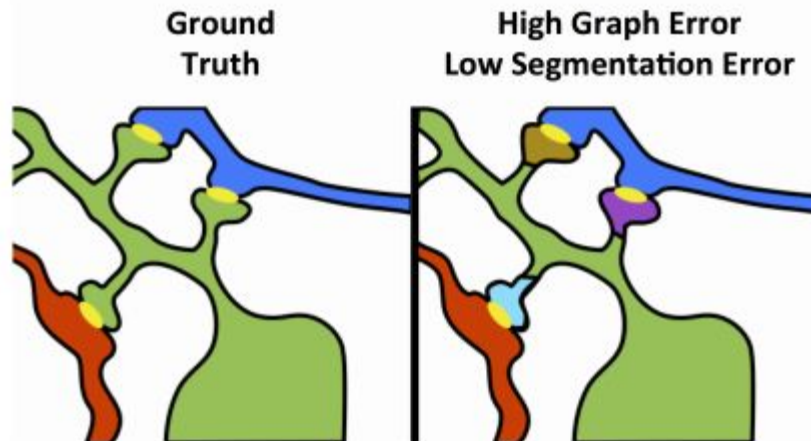
Resolution & Future Work

- Pipeline is created and open for use!
- Graph error is a difficult issue, but parameter tuning allows error minimization
- Graphs with some error can still be useful
- Scaffolding for algorithm error optimization is now in place
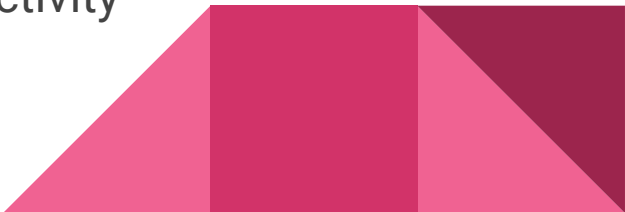- Speed & efficiency increase

Discussion

PROS

- Automation
- Standardization
- Error Metric
- Applicable to future work

CONS

- Advances in process may render pipeline obsolete
- Questionable ability for pipeline evolution
- Synapse occurrence may not always imply connectivity

QUESTIONS?

As a total expert on connectomics with TWO (2) whole classes of experience and training. I will now attempt to answer your difficult and insightful questions.