# Mapping the Brain: An Introduction to Connectomics Progress Report: A Map to Graph Cortical Columns

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January 16, 2016

## 1 Summary

So far we have developed a preliminary pipeline from brain to graph, including the storage and processing of the data that is recorded. Alongside this pipeline, we will provide an estimation of costs for doing so. However, at the moment, the complete mapping of the brain is not feasible due to high cost and time investment. Therefore, we will be continuing to look towards more efficient ways to image, store and process data in order to make our proposal more plausible. The difficulty of this project lies mainly in the fact that literature specific to each step of the process is either not written or lacking in providing a general foundation applicable to our problem. In addition, there are pros and cons to each method we select, particularly in the case of imaging and processing, since certain traits outweigh others depending on the intended purpose for each step. Figuring out the most time and cost efficient process to achieve our goal relies on thorough research to support our future actions.

## 2 Updated Goals

Our project has shifted from an examination of the imaging and analysis process to the process by which a human brain will be processed and mapped from start to finish. Previously, we had planned to deliver a pipeline that would optimize the techniques involved in imaging and mapping the brain to create a connectome using cortical columns. Our current efforts are aimed at creating a plan from start to finish that would result in a fully mapped brain. This plan includes presenting facilities to house equipment and operations, hardware to store and retrieve data, the imaging technique to use, the program and interface by which we will be processing the images to turn into graphs and finally uploading and saving those resulting graphs.

## 3 Updated Timeline

We have changed our general distribution of goals. We originally allocated tasks through a separate flowchart among ourselves. Preservation, Cutting, Imaging, Identification,

Graphing, and Analysis. However, after having investigated preservation and cutting methods, we have now moved onto finding facilities, scanning, hardware, processing (creating graphs), uploading, and saving (we modeled our project after one performed by Frank Wood at Oxford University)[1].

We have all agreed that scanning would be most effective through a Zeiss Scanning Electron Microscope. It is the quickest electron microscope currently, scanning a $1cm^2$ area in under 3 hours. However, we must now find around 10-15 facilities (at a minimum) that have scanning electron microscopes, preferably a MultiSEM. Additionally, these facilities will all be stationed within the US. We must also have the necessary hardware to store data at 4nm x 4nm resolution [2]. Currently, it takes about 3 zettabytes to store all the necessary information [3]. So, we must also find a logical place to store data, aside from the Amazon Cloud which will cost trillions of dollars over a couple months[4]. Afterwards, we will need to process the information, which we will hopefully use an existing pipeline. Or we will need to cooperate with the Open Connectome Project[5]. Currently, we are researching a way to process the images and overlay these images and create a 3-D graph (likely through the LONI pipeline). We will need to have enough storage space to save these additional graphs. Lastly, we must have some way to share our information in a public database. Although Amazon Cloud would be ideal, it is currently too expensive, so we are investigating new ways to do so.

Thus, our timeline is this: finding facilities in the US, finding a way to store images and graphs, process these graphs, and share them. Currently, we have solutions for each of them, although obviously this will cost an unreasonable sum of money. The end result is that we will have a full human connectome, from which we can then extrapolate information about cortical columns.

## References


[1]http://www.robots.ox.ac.uk/f̃wood/teaching/3YP_2015/
[2]http://www.zeiss.com/microscopy/en_us/products/scanning-electron-microscopes/multisem.html#highli
[3]http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4412267/
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