fMRI Connectome Methods

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Mission

To accelerate functional connectomics by identifying and describing the best-practice methods for the analysis of brain graphs, and provide a comprehensive and well-documented package to simplify the process of analyzing functional connectomes going forward

Motivation

Graphs provide intuitive and mathematically favorable representations of many real world networks

There exist entire fields dedicated to the analysis of graphs, and many algorithms are well-developed and well-understood in the context of a graph

Brains can be represented as graphs (known as connectomes)

Early research suggests that connectomes may hold the key to identifying many facets of the brain, such as intelligence, mental illness, and many other facets

Problem

Modern statisticians have produced state-of-the-art graph analytics algorithms, yet many of these algorithms are not accessible to neuroscientists and psychologists

Very little cross-pollination between statisticians and neuroscientists, leading to a disconnect between neuroscientists and the best practices of connectomics research

Causes

Providing neuroscientists with the best practices of connectomics requires a full assay of many available options in the field

- requires technical expertise in statistics, as well as knowledge of what does and does not work in the context of neuroscience

No common APIs and documentation for many statistical packages

- Statisticians may insufficiently document or espouse the benefits and limitations of their algorithms to many of their less mathematically or computer savvy users
- Several existing tools provide core functions but insufficient generalizability to neuroscience problems

Current Best Practices

iGraph

- Graph analytics package providing graph objects and a number of useful graph algorithms (embeddings, statistics, etc)
- Not specific to neuroscience data
  - Requires users to have heavy knowledge of the limitations and advantages of their chosen algorithms
  - Provides no context for which algorithms to use (or not use) in a given situation

What's missing

What works:

- Graph analytics packages (iGraph, FlashGraph, etc)
- Local code bases for neuroscience data (Youngser, etc)

What doesn't:

- No centralized composition of all best practices for functional connectomics
- No set of guidelines of what to do, and what not to do, given some set of data and a question the researcher wants to answer
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Solution

A comprehensive manuscript comparing and contrasting existing functional connectomics methods

- Provides common problems that may befall neuroscientists for connectome problems
- Answers with a best-practice solution and demonstrates the effectiveness of said solution

A complementary package providing intuitive functionality and tutorials detailing best practice coding

Impact

Statisticians

- facilitates common questions neuroscientists seek to answer, along with current best practices
- Provide a benchmark to compare for future algorithm development

Computer Scientists

- Provides a common APi for functional connectomics, making it far easier to have people actually use your code

Neuroscientists

- recommendations for best practice statistical methods to perform on a first pass at dadta
- Easy-to-use package and tutorials to facilitate the consistent analysis of graphs