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Project Title: Predicting Evolving Graphs from an Inverse Perspective

In searching through the application of inverse problems in my field of interest, I stumbled upon the use of inverse techniques in generating evolving graphs[1]. In particular, the range of two vertices in the graph is computed based upon the current state of the graph. Our input x would be the range of the two systems, the model A (which is generally approximated) is given as some way to view the range as a probability distribution. Finally, our solution b is the graph in its current state. Given b and approximating for A, the researchers sought to approximate what possible range values x could hold for the graph.

Given this application of inverse problems in graph theory, I feel that I could apply similar logic to evolving graphs. The paper focused on only one potential way of modeling A, which greatly impacted the results that could be derived. Given that not all graphs have similar ranges, my project plans on experimenting with other approximations for A in order to find a suitable solution range x. The paper also applied this knowledge by performing simulations on the evolving graphs using this data. Similarly, my project aims to try out these approximations for x by running simulations to determine if the evolving graphs seem to be reasonable predictions for what has already occurred.

By doing this project, I hope to learn a lot of information in my field - including more about evolving graphs, random algorithms, and large-scale graph programming. I also hope to apply some of the skills I've learned in this course to a problem that interests me. In evaluating its success, I mostly plan on looking at a few datasets (likely related to hyperlink networks) and seeing if my predictions for x result in a reasonable evolving graph that applies to some problems. I also hope to try out some other methods for approximating A and completing the inverse problem, even if not many of them lead to a successful approximation.

I plan to write a bit of software in either MATLAB or python when it comes to running tests on the approximations. However, I first plan on attempting solving the inverse problem using various techniques to see what I can derive analytically. I am hopeful that I can find at least a couple of reasonable approximations for the data.

Finally, if this project ends up being far too daunting, I may also be open to writing part of the regularization toolkit in python. But I do hope to at least attempt this project for now and learn a lot from it.

[1] https://royalsocietypublishing.org/doi/pdf/10.1098/rspa.2009.0456#purchaseArea