Undergraduate Software Project

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# Overview

The project is a "capstone" that pulls together the data, analysis, and programming elements of the course by re-analyzing and extending an existing ODE kinetic model of a biological process. It is recommended that you use one of the [manually curated BioModels](https://www.ebi.ac.uk/biomodels/search?query=*%3A*%20AND%20curationstatus%3A%22Manually%20curated%22%20AND%20modelformat%3A%22SBML%22%20AND%20modellingapproach%3A%22Ordinary%20differential%20equation%20model%22&domain=biomodels&offset=0&numResults=10).

# Elements of the Project

Your project will be delivered as a Colab Notebook that abides by the [Rules for Writing Software](https://docs.google.com/document/d/16ODqwI4uPduJmquQMCBFsmvvzyyRzcZX9GD1d93T9FY/edit#). The notebook should have the following sections. The numbers in parentheses indicate the percent contribution to the project grade.

## Re-analysis (30%)

This is a re-analysis of a computational result in the published paper. For example, you might demonstrate that the published model can produce a key figure in the paper.

* Generate synthetic data for the model with different standard deviations. If your paper has experimental data, then you’ll be adding various levels of noise to the experimental data. If the paper does not have experimental data, then you will generate synthetic data as we have done in class.
* Calculate the model R2 and parameter variances for the different standard deviations. Use this to assess the robustness of the model to variability in the data.

## New Study Question (10%)

This is a text description of a new science or methodology question based on the paper. You should describe the problem, why you think it’s important, and an experimental design to study the problem.

## Computational Study (50%)

This is a computational study of the new question. So, this section should include details of a simulation model you construct and output from it. Your study of the new question or methodology should draw on elements of the course such as: simulation technology, design of experiments, model accuracy, parameter estimation, and model validation. The elements here are analogous to what you did in parts of homework 2:

* Identify the factors and levels appropriate for your study
* Conduct the experiment, and provide visualizations to see interactions between factors.

## Discussion of Results (10%)

This is a discussion of the results, especially how they address your science question.

# Grading Rubric

Projects will be evaluated based on the following criteria:

* Project is organized as described above
* Compliance [Rules for Writing Software](https://docs.google.com/document/d/16ODqwI4uPduJmquQMCBFsmvvzyyRzcZX9GD1d93T9FY/edit#)
* Quality of the science question and the interpretation of the results

# Example Project

* Project: "[Investigating interventions in Alzheimer's disease with computer simulation models"](https://colab.research.google.com/drive/1fVZVC4XfTQIENVRdRHDJy_WEmWDFPygl)

# Project Presentation

You will give a 6 minute presentation on your project in the last week of class.

Given the number of presenters tomorrow (10), we’ll have to manage our time carefully to ensure that everyone can present during the 80min of class.

1. There will be a strict 6 min/presenter (including questions). I will limit my questions to issues that impact your project grade.
2. You should have the current version of your colab notebook in your student folder. Name the notebook “FinalSoftwareProject-SamDoe” (where SamDoe is your name). I**f you need for us to see the results of code executions, you should run the notebook BEFORE class.**
3. I will open your presentation (without code execution). You’ll tell me to go up/down or to a specific cell.
4. We will proceed in order of the student folders as they appear when the name column is sorted. This is mostly an alphabetical order by your given name.
5. If you are not prepared (e.g., your colab notebook isn’t in your student folder), we’ll skip you and come back after we’ve had the other presentations.

As I’ve mentioned before, this presentation is not graded. Mostly, it’s an opportunity to provide some early feedback (but not an early grading). You are welcome to use the time to just get feedback on specific questions. Ideally, I’d like you to do a “lightning” presentation, a common format in academic conferences. This is 1-3min in which you cover the following:

* 1-2 sentences about the research addressed in the paper. (Obviously, you don’t have time for a lot of background)
* The results of your re-analysis. This can be short, like I found results similar to the authors. Or, there’s a significant discrepancy in some aspect of the model.
* Your science question and its significance.
* The results of your study.

However you choose to use your time, it would be a good idea to be prepared. 6 min goes very quickly.