BIOEN 599 Final Project Guidelines and Schedule

In the last few weeks of class you will be working on a final report. In this guide you will find some suggestions of projects. You may choose one of these, or you may design your own. If you want to design your own, you MUST schedule a time to speak with Dr. Thickman before the project proposal is due, on April 27. If you do not do so, you will not be allowed to design your own project.

You will be performing this project as an individual.

During this course you have or will learned about some of the currently available technologies for sequencing DNA. The limitations of these technologies are myriad. Researchers and clinicians are seeking better tools to sequence DNA. You will have learned about some of these limitations and unmet needs. You will also have learned how to use some of the analysis tools in this area and about available data. During this project, you will have an opportunity to explore one aspect of this area more deeply.

Suggested project ideas:
1. **Report on the engineering design of a DNA sequencing technology we did not discuss.**
    There are genomics technologies on the market and in development that we did not discuss. Examples include 10xGenomics, Agena MassArray, and Illumina Genotyping Arrays, among others. You report on the engineering design of one of these. This report will include what technologies are needed to make this system work. What they had to develop and what adapt from other technologies. It should include what the design criteria and constraints were and how they team demonstrated that those criteria were met.

2. **Describe an engineering problem in the high-throughput DNA sequencing space and delineate criteria and constraints of a design that would solve this problem.**
    There are many unmet needs in the genomics space. Choose one of these needs and identify the criteria and constraints of a solution to this need. Research and discuss the prior art in this area. Describe what data you would need to demonstrate success at meeting these criteria. Describe the technologies available to help meet these criteria and the technology you would need to develop to extend them to meet this need.

3. **Perform and describe an analysis of publically available high-throughput DNA sequence data to address a biological or biomedical question.**
    Identify a biological question that can be answered with genomic data. Find a publically available dataset that will allow you to address this question. Using analytical tools we used in class, or one you identify, address this question with your data. As this project is as much about learning how to think about research as it is about how to get results, you will not be penalized for experiments that don't work. As long as you can troubleshoot what went wrong and either try to fix it, or explain how to fix it, you will not be docked.

4. **Perform an analysis of genomic data from your research laboratory.**
   Using data from your research or another member of your research team, analyze genomic data to answer a biological question. Using analytical tools we used in class, or one you identify, address this question with your data. As this project is as much about learning how to think about research as it is about how to get results, you will not be penalized for experiments that don't work. As long as you can troubleshoot what went wrong and either try to fix it, or explain how to fix it, you will not be docked.

Over the course of the next few weeks you will have a series of short assignments that will enable you to prepare for the project, so that you can be organized and efficient during the end of quarter. The final report guideline will be distributed separately.

Assignment 1: Identify your topic
Due Fri. 4/28, 5:00PM
For this assignment, you need to identify a technology you want to review, a question you will attempt to answer, or a problem you will attempt to solve. You also need to generate a simple hypothesis or plan. This hypothesis or plan might change as you look into the project more, which is fine, be sure to note when and why it evolved for your final report.

You will need to turn in a short write-up with the above information in it. This should be written in paragraph form, but does not need to be in a formal style of writing. The write-up should be less than 2 pages. You and your partner should turn in the same write-up, but be sure to indicate that it came from both of you.

If you are doing option 1 (the back-engineering projects), here are some things to keep in mind about your problem. 1) You will need to do some extensive primary literature reading. Not only the initial publications for the technology, but also background reading on the technologies these are built on, so be sure to give yourself time to chase down these rabbit holes. 2) You are going to have to deduce what the criteria and constraints of this technology are based on literature information. 3) You're going to spend the next month or so working on this and you're going to be writing a paper on it, make sure that you are going to find it interesting.

If you are doing option 2 (the design project), here are some things to keep in mind. 1) You do not have to have all the answers about how to build a better sequencer, but you need to think about the technology available and what technology is missing. 2) You do not have to solve all the problems, but you should try to identify them. 3) This is an opportunity for thinking about crazy ideas, however, you need to find a way to ground them in physical and biological realities.

If you are doing option 3 or 4 (the research project), here are some things to keep in mind about your question or problem and hypothesis. 1) Your hypothesis needs to be testable with the tools you have learned in this course and with the resources available to you. Do not generate a hypothesis that requires the use of a month of computation time on a supercomputer to test or access to a $10,000 piece of software. 2) You are not going to

have time to solve a big problem. Testing of this hypothesis should take you around one class period and likely another 8-12 outside of class. Do not try to tackle something huge. 3) Make sure your question or problem, though manageable, is still interesting. You're going to spend the next month or so working on this and you're going to be writing a paper on it, make sure that you are going to find it interesting.

Assignment 2: Progress Report
Due Fri. 5/12, 5:00PM
You will turn in a short progress report, so we can be sure you are on track. These will look different for each project.

Option 1:
Submit a 2-page summary of the primary paper about this technology. Also submit a list of references you plan to use to better understand the background technologies that underlie this technology.

Option 2:
Submit a 2-page summary of the problem you will be addressing. This should include significance of solving this problem and an overview of why the main technologies in the field are unable to solve this problem.

Option 3:
Submit a 2-page summary of the data set you have chosen to use and why. Also submit a list and references for the analytical tools you will be using.

Optional Draft submission
Drafts of the final report may be submitted 5/20 for review and revision advice.

Final Report and Presentation
May 31: In class Presentation
On May 31, you will give a 10-minute presentation with 2 additional minutes for questions. Rubric for presentation will be given out separately.

Due Fri. 6/2, 11:59PM
Final 8-10 page report.
Details on report will be given out separately.