Final Paper   **BIOE 391, Spring 2022**

Teams of 4 to 6 students will be working together on a final paper for the remainder of the semester and it represents 25% of your grade for the course.

This report is a review paper on the application of numerical methods to a real-world bioengineering or biomedical problem. The application should involve <u>at least</u> 2 classes (see definition below) of numerical methods and include a detailed review of <u>at least 2</u> papers published over the last 10 years. In addition, the introduction and background section of the report must include literature review that justifies how the problem and application addresses contemporary issues in the field.

Your report is expected to be around 10 to 12 pages long (not including references/tables).

Here is the basic approach I would recommend:
- Pick an area of bioengineering you are interested in or familiar with, search for problems in which numerical methods/modeling would be useful.
- Find the papers in which these problems have already been solved using numerical methods.
- Ensure that at least 2 different classes of numerical methods were used. **Make sure the methods are not too complicated for you to understand and explain.**
- Perform an additional literature search (e.g., Pubmed or Google Scholar) to make sure that you would be able to justify the importance of the problem. Please note that two major references you're using for your review should be the original publications rather than review papers. It does not make sense to review the review papers. It is perfectly acceptable to use review papers in the background/justification section.

The grade of your final term paper may be affected by the "contribution score" your team-mates gave you (aka CATME system). Therefore, it is up to you to decide how to split up the work, to make sure that everyone does their fair share and contributes in a meaningful way to the preparation of the term paper. It is recommended that you define and agree on your roles well in advance. If you have questions about this team effort, please see your Instructor/TAs for suggestions.

<u>Contents:</u>
~1/2 page   Abstract
2-3 pages   Introduction/background: This section is to include literature review and an evaluation of how the reviewed solution would <u>address contemporary issues in the field of Bioengineering</u>. Justify the importance of the problem by reviewing a wide range of BIOE literature. At least 12 citations are expected including the two main papers you choose to review.
3-4 pages   Explain underlying equations, basis for model, variables, parameters– explain differences in problem formulation and/or approaches between the sources used. Be quantitative in your description of the model variables

and parameters. What are the normal ranges for these? Include figures <u>if helpful</u>. Explain and justify any assumptions.

2-3 pages	Discuss two numerical methods used.
1-2 pages	Discussion and Conclusions. Include caveats and possible numerical problems that could arise.

<u>Style and formatting:</u>
- The page limits above assumes several figures sized to a standard journal size (1/2*1/4 page with text wrapped around them. They may go up a bit if very large figures are included). Ensure good trade-off of figure readability and space constraints.
- The term paper should be written so that your classmates (who are not experts on this subject) can understand and follow your presentation of the problem and model.
- Summarize the background from the references/sources in sufficient detail so that the report is self-contained and does not require the person reading it to look up additional material.
- 1-inch margins on all sides of the paper.
- Please use a standard font, such as Times/Times New Roman or Arial/Helvetica. Other easily readable fonts are acceptable, but very narrow or large fonts such as Arial Narrow or Courier will not be accepted.
- The recommended font size is 11.
- The recommended line spacing is 1.2.
- <u>Please use numbered reference format (i.e. [1], [2] etc)</u> with a reference list that includes list of authors, titles, and all the bibliographical info at the end. The reference list <u>does not</u> count towards your page limit.

<u>Potential classes of numerical methods:</u>
- Root-finding methods or optimization
- Linear algebra
- Curve-fitting (regression or interpolation)
- Numerical differentiation or integration
- Ordinary differential equations
- Partial differential equations
- Transformations (Fourier, Laplace, etc.)
- Other numerical approaches are possible, please discuss with the instructor if in doubt

<u>Choice of Papers:</u>
    March 11th or prior, turn in the name of the two papers chosen by your group. Please explicitly indicate which two classes of numerical methods will be discussed.

    The final reports are due on the final day of finals period, **May 3rd.**

Grading criteria:
- Content
  - Sufficient level of detail
  - Bioengineering relevance, justification of problem importance and relevance to contemporary BIOE issues
  - Both numerical methods are relevant, clearly outlined, and justified
  - Equations clearly explained
  - Assumptions, advantages, and pitfalls of these approaches are discussed
  - Summarize either results or expected results
  - Discussion regarding how choice and application of numerical methods may have influenced results
- Logical organization
- Explained in language that general class members can understand

Content (75)	Grades
▪ Bioengineering relevance, justification of importance, relevance to contemporary BIOE issues and literature review	20
▪ Model basis and equations clearly explained	15
▪ Both numerical method classes are relevant, clearly outlined, and justified	10
▪ Assumptions, advantages, and pitfalls of these approaches are discussed ▪ Discussion regarding how choice and application of methods may have influenced results	15
▪ Results or expected results are clearly summarized	15
Presentation (25)	
▪ Logical organization	10
▪ Clear language, grammatically correct	10
▪ Well referenced	5
	Total: 100

Individual scores may be reduced/increased based on CATME survey.