

## **SFSU Math 400 (Kotas)**

### **Final Project**

The purpose of the final project is for students to synthesize knowledge of topics discussed this semester in our class with an application area of their choosing. Pick an application from your field of study or one that is interesting to you, that can be described mathematically. You will need to use Matlab or Python to implement one or more methods from our class to solve the equations or otherwise analyze your system numerically. Then, write a short report of your findings.

#### **Deliverables:**

Turn in your report and all associated Matlab/Python files in iLearn by Monday December 12, 2022, 12:15PM. (This is the time slot scheduled by SFSU for the final exam for our class. We are not having a final exam, this assignment takes the place of the exam.) Late entries won't be accepted. I have tight deadlines of when I have to read them all and then turn in grades myself, so please make sure everything is in on time.

#### **Report:**

Your report should be a PDF or MS Word file of maximum 4 pages, single spaced. The 4 pages should include everything—all figures, math equations, etc. except do NOT include your entire code, only individual lines of code snippets (optional, as necessary). There is no minimum as long as you clearly explain what you've done.

The components of the report should be as follows:

- Application background. Explain the application and what makes it interesting to you. Explain the mathematical equation, problem, system, etc.
- Numerical analysis. Explain what technique(s) from our class, and what Matlab/Python functions that you used to solve or analyze your system. You must use at least one technique we discussed but are highly encouraged to use more than one. You don't need to describe how the techniques work back to me but just name them and include any derivation that is particular to your problem. You can include single lines or snippets of code as needed but do not copy-paste large sections of code. Your code should be turned in as a separate file, so it doesn't need to all be in the report.
- Results. Explain the results of your simulation. You are highly encouraged to include figure(s), graph(s), charts of data, etc. Make visuals pretty and easy to understand. Depending on your application, this may not be possible.
- Conclusion. Interpret your results and explain the importance of your findings.
- References. There is no reference requirement but if you use any sources you should cite them. Format doesn't matter, just make sure I can look it up if I need to.

#### **Matlab/Python files:**

You should include all Matlab/Python file(s) that you coded up. Code should be well-commented so that I can understand it easily. If I need to dig through your code to figure out what you did, that will be reflected negatively in the grade.

#### **Choosing your application:**

The final project is your chance to show off what you've learned. I expect that it will take you about as much time as about 2 to 3 of the weekly homework assignments combined. I will give higher grades for people who attempted more ambitious topics even if their results are less accurate, over people who

chose excessively simple or short topics. That being said, don't choose a topic that's so complex that you can't get a working code by the due date. You'll need to strike a balance between doing something to really impress me versus being realistic about the constraints (time, energy, etc.) that we are operating under.

Just throwing out a few ideas for the types of applications you might consider.

- Use splines to model your favorite animated character.
- Predict the stock market using regressions on some actual data.
- Model the trajectory of a projectile by solving the equations of motion with realistic effects of air drag and friction.
- Use Monte Carlo simulation to model how people move in a crowd.
- Use iterative root-finding methods to generate fractals, or to approximate pi to lots of digits.

Creativity is encouraged!

### Grade

The grade on a project like this is inherently subjective, but I will take into account the following questions when I grade.

- Is your application appropriate and of interest to you/others?
- Which and how many techniques from our class were used?
- Were the techniques that you chose appropriate for the type of problem chosen?
- Does your code run without bugs and give the result that was desired?
- Is the code clear and well-commented?
- Does your report explain in sufficient detail what you did?
- Were figures, charts, equations, etc. used appropriately in the report?
- Have you demonstrated that you delved deep enough into your topic, and is the topic of reasonable difficulty?

The project is deliberately somewhat open-ended. If you have questions as you work on your project, please reach out to me. Good luck.