Tutorial 2

Math 330 midterm exam
due at 5pm on Thursday, November 16, 2023

Instructions: Suppose that the following questions are posed by the same individual who posed the previous questions (who took a course on partial differential equations many years ago). Write a thorough but succinct tutorial to help answer their questions. Your tutorial may take any form you like (e.g., LaTeX report, Beamer/Powerpoint presentation, video, blog/forum-style solution, annotated Mathematica notebook, carefully hand-written flowchart, etc.), so long as the medium enhances the presentation. You are encouraged to use software to aid with calculations and visualization, as long as you explain your reasoning and submit your commented code.

Questions: "I was impressed by your answers to my last question, so I have a new one for you. I have a thin electrical wire that's 1/4 meter long and coated in insulation, except at its ends. I let the wire sit at room temperature (22 °C) long enough that the whole wire was initially that temperature. Then I hooked up both ends of the wire to a circuit board that forced the temperature at both ends of the wire to stay at 87 °C. I know that the material my wire is made of has a diffusivity of 1/3 meter squared per hour. Can you show me what the temperature in the wire looked like over time? Can you tell me approximately how much time it took for the whole wire to reach at least 50 °C? Can you show me how you figured it out so I can answer the question next time? Please use pictures to help me understand."

Evaluation criteria:

- Did you appropriately translate the problem statement into a mathematical model? Did you communicate your reasoning for your model to your audience?
- Did you use appropriate mathematical terminology (e.g., equilibrium, trivial solution, Fourier series)? Did you remind the audience of the meaning of the jargon?
- Did you use appropriate mathematical techniques (e.g, separation of variables, superposition)? Did you explain every step of your methodology to the audience? Did you provide intuition and justification for why, and under what conditions, your methodology works?
- Did you explain any software used well enough that an audience comfortable with Mathematica could modify your code for a related question?
- Were the answers to the questions accurate? Did you present the answers to the questions in a clear fashion? Were visualizations clearly labeled and explained?
- Did you explain the physical intuition behind your solution to the audience?
- Is your presentation thorough (nothing important left out) and succinct (nothing extraneous put in)? Naturally, this is a matter of taste, so please seek feedback from the professor if you are unsure.

Policies: This tutorial is to be an individual project. You are expected to abide by the honor code. Either sign the Honor Pledge below and return this page, or clearly affirm the pledge in the document that you hand in.

Acceptable resources include only the following: homework and worksheet solutions, our textbook, materials linked from the course website, and your class notes. You may look up

specific Mathematica and LaTeX commands online in order to perform calculations and typeset your solutions. If you have any question about this policy, please ask the professor.

This tutorial will be graded on a scale of *Excellent*, *Meets Expectations*, *Revision Needed*, or *Not Assessable*. The professor will provide an initial grade and comments, after which you will have an opportunity to revise your tutorial.

St. Olaf Honor Pledge: I pledge my honor that on this examination I have neither given nor received assistance not explicitly approved by the professor and that I have seen no dishonest work.

Signed: _____

☐ I have intentionally not signed the pledge. (Check the box if appropriate.)