Discussion 1: July 12th, 2017

Instructions: The class is split into groups of 3 students; the TA will have a list of the groups. As a group, you will answer several questions, one of which will be turned in for credit. You will each have an assigned role in your group. The roles are:

1. Manager - Keep your group “on-track.” Make sure everyone participates. Watch the time spent on each problem.
2. Skeptic - Help your group avoid coming to agreement too quickly. Make sure all possibilities are explored. Suggest alternative ideas.
3. Recorder/checker - Act as a scribe for your group. Check for understanding from all group members. Make sure all group members agree. Turn in the assignment to Gradescope and make sure all group member names are included in Gradescope!
4. (If a 4th student) Energizer/summarizer - Energize your group when motivation is low by suggesting a new idea, using humor or being enthusiastic. Summarize your group’s discussion and conclusions.

The first question set you will not turn in. The second question set you will turn in. Those question(s) will be graded half as participation points. Solutions for those question(s) will be posted on the course website.

As a group, complete the question(s) that will not be turned in first. Your TA will confirm that you have the correct answer, and will initial your paper for the solutions you will turn in. Once you have that, work on the question that will be turned in. The recorder will write the group’s answer on the initialed paper (and more paper, if you need), then will take one (or more) photo(s) of it to turn it into Gradescope. Submitting this is like submitting homework, but you will be able to add additional students to your submission, after you upload the photo. Make sure all students’ names are on the solution sheet! Also make sure to add all students in your group in Gradescope so they get credit! Then, spend a few minutes as a group discussing how your group work went: what went well and what you each could do better next time. (Be polite.) Once you are done, you may continue to work on homework questions, or you may leave.

Not to be turned in:

1. Consider a string of 3 carts separated by springs, and attached to fixed walls by springs. The springs between the cars have spring constant of 1 N/m, while those attached to the walls have spring constant of 5 N/m. If the middle cart is pushed to the right with a force of 5 N, how far from their equilibrium positions will each cart move?
2. By hand, find the Cholesky decomposition of the following s.p.d. matrix.
   \[ A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 13 & 27 \\ 3 & 27 & 83 \end{bmatrix} \]

   Then use that decomposition to solve
   \[ A \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 8 \\ 28 \\ 77 \end{bmatrix}. \]
   (Don’t just use normal row reduction! Use the Cholesky decomposition! Hint: The numbers should work out nicely.)

Discussion 1: Questions to be turned in.

Make sure to write your names on the sheet(s) with your solutions! Also, get your TA to initial it to show you did the earlier problems.

1. Though I don’t expect you to understand the specifics, briefly explain what “block matrix operations” are and why they can be useful computationally. (I’m only looking for a paragraph or two.)
2. Explain what it means for an algorithm to be \(O(n^{1.5})\). As part of that, what happens if you double the size of the matrices involved?
3. What is a banded matrix? What advantages does a specialized Cholesky decomposition algorithm for banded matrices have over the standard algorithm? (There are at least two major advantages. Give quantitative details about these advantages.)