

Homework 3

APPM 4720/5720 Spring 2019

Randomized Algorithms

Due date: Friday, Feb 1 2019
Theme: Background

Instructor: Stephen Becker

Instructions Collaboration with your fellow students is allowed and in fact recommended, although direct copying is not allowed. Please write down the names of the students that you worked with. The internet is allowed for basic tasks only, not for directly looking for solutions.

An arbitrary subset of these questions will be graded.

Problem 1: [READING] The reading is Petros Drineas and Michael W. Mahoney, *Lectures on Randomized Numerical Linear Algebra*, The Mathematics of Data, IAS/Park City Math. Ser., vol. 25, Amer. Math. Soc., Providence, RI, 2018. These are the notes used in that summer school. An electronic copy is available for free at <http://arxiv.org/abs/1712.08880>.

Read the short introduction (section 1), and then skim section 2 on “Linear Algebra” and section 3 on “Discrete Probability.” If any of that material looks new to you, or you are rusty on it, read it in more detail.

Deliverable: Do the reading. You do not need to turn in anything.

Problem 2: [PROGRAMMING] Let $U \in \mathbb{R}^{n \times 2}$ be a matrix where the first column is $\ln(1), \ln(2), \dots, \ln(n)$ and the second column is $\ln(n+1), \ln(n+2), \dots, \ln(2n)$. This is the same matrix as in last week’s homework, so you can re-use your code.

Deliverable: For $n = 10^5$, compute $\|UU^T\|$ to 4 significant digits (where $\|\cdot\|$ is the spectral norm)

Hints: You might find it helpful to compare with the naive implementation for a small n to make sure your code is correct.

On my laptop, the norm computation takes 0.05 seconds for $n = 10^5$.

Problem 3: [PROGRAMMING] Request a research computing (RC) account from <https://rcamp.rc.colorado.edu/accounts/account-request/create/organization> or go to the main page <https://www.colorado.edu/rc/> and click “Request an account to use RC Resources”. **This may take a few days, so do not leave this until the end of the week!** If it asks you for a reason you are requesting the account, tell them it is for this class, and that you expect to use one of the applied math nodes on the “Blanca” cluster. Once you have the account, login to a login node, and look at the file `/rc_scratch/stbe1590/secretMessage.txt`

Deliverable: what is the message in the file `secretMessage.txt`?

Hints: you’ll need to get an account, learn what the login node is, know very basic `ssh` commands, use the “duo” two-factor authentication app, do basic command line usage in a linux shell, and view the contents of a file (with `cat` or a text editor). Depending on your background, this ranges from trivial to overwhelming. If you are new to these tools, I can give hands-on help in office hours, but please **read the documentation on the rc website first!** They have worked very hard to document every step of the process, so please take the time to read their instructions before you ask for help.