CSCI E-25
Fall 2020
Skills Check Assignment
September 2020
Time Limit: Take-home

Name (Print): _____

This assignment contains 6 pages (including this cover page) and 5 problems.
Please note that this should be used to determine your readiness to take the course CSCI E-25. You may use any resources available to solve these problems (e.g., online resources, books).

Have fun!

Problem	Points	Score
1	5	
2	5	
3	10	
4	10	
5	10	
Total:	40	

1. (5 points) Calculate the gradient of the function $f(\mathbf{x}) = \frac{1}{2}\mathbf{x}^T\mathbf{A}\mathbf{x} + \mathbf{x}^T\mathbf{b}$ with respect to the vector $\mathbf{x} \in \mathbb{R}^n$. Note that $\mathbf{A}$ is a $n \times n$ matrix and $\mathbf{b}$ is an $n \times 1$ vector. (Hint: Write out the expression using sums and differentiate componentwise.)

2. (5 points) Prove that the function $f(x) = \log\left(\frac{1}{x}\right)$ is convex.

3. (10 points) How many rolls of a fair die will it take on average to see a 3? (Hint: Use the geometric distribution to model waiting time to see a 3.)

4. (10 points) Assume two sorted arrays are given, e.g., $A = [0, 4, 6, 24, 100]$, $B = [-10, 0, 6, 10, 24, 101]$. Write a function to compute the intersection of these two arrays, e.g., $C = [0, 6, 24]$. Try to make the code as efficient as possible. Python code is preferred but pseudocode is also acceptable.

5. (10 points) Consider a string s. A string is palindromic if it reads the same front to back (ignoring case). Write a function to check if a given string is palindromic. Python code is preferred but pseudocode is also acceptable.