CS3230: Assignment for Week 4

Due: Sunday, 13th Feb 2022, 11:59 pm SGT.

Please upload PDFs containing your solutions (hand-written & scanned, or typed) by 13th Feb, 11:59 pm to `Assignments/Assignment4/Submissions`. Name the file **Assignment4_SID.pdf**, where SID should be replaced by your student ID.

You may discuss the problems with your classmates or read material online, but you should write up your solutions on your own. Please note the names of your collaborators or online sources in your submission; failure to do so would be considered plagiarism.

Note: For all questions in this assignment, you should justify your answer.

1. (1 point) Let n be a positive integer. Determine the maximum number of comparisons that the deterministic version of Quicksort (which always chooses the first element of the array as the pivot) makes when sorting an array of n distinct numbers.

2. (1 point) Consider the following algorithm for sorting an array of n distinct numbers:

   ALG(A)
   1 **while** A is not sorted
   2 permute the numbers in the array uniformly at random
   3 **return** A

   Assume that the original array A is not sorted. What is the expected number of times that the **while** loop runs in ALG?

3. (1 point) Let X be a random variable over the positive integers such that for each positive integer n, the probability that $X = n$ is $\frac{1}{2^n}$. What is the expected value of X?