

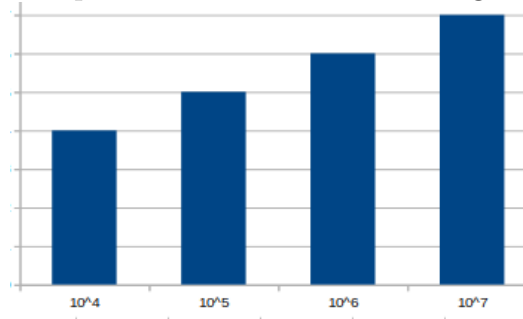
You can use either C or C++ to implement these assignments. However, in the final exam, you will need to code in C only, so you might want to consider that while making the choice.

Problem 0: Write a script to generate 100 random arrays each of lengths 10^4 , 10^5 , 10^6 and 10^7 as follows. For example, for the case of 10^4 , pick uniformly at random, a permutation of $1, 2, \dots, 10^4$. **(10 marks)**

“DSA” problems:

1. Implement the randomized quicksort algorithm. **(10 marks)**
Run the algorithm on the arrays generated in **Problem 0**, and plot the average number of comparisons and compute the standard deviation. **(10 marks)**
2. Implement a red-black tree **(10 marks)** and an AVL tree (for AVL, you are permitted to use any off-the-shelf code, but do submit the code). Insert in the order of the arrays generated in **Problem 0**.
 - Plot the average total number of rotations for inserting all elements in both the cases. **(10 marks)**
 - Plot the average heights in both cases. **(10 marks)**
 - Choose about $1/10^{th}$ of the array elements uniformly at random. Search and delete these elements from the trees. Replot the heights and average total number of rotations as before. **(10 marks)**

The plots would look like the image below:



The y-axis would be average number of comparisons, average height, number of rotations etc.

How the plots are generated from the data should be transparent, and reproducible.

Submit one tar-ball of codes, and one latex generated pdf file, reporting the plots and results.

In the pdf file, analyze your results and clearly state your conclusions.
(10 marks)