1 Quicksort Pivot Choice

1.1 For each pivot selection strategy below, what is the best, average and worst case runtime?

  (a) Always choose the first value in the list.

  (b) Always find and choose the median value in the list. Assume finding the median takes $O(N)$ time where N is the length of the list.

  (c) Always choose a random pivot.

2 QuickSort vs. Merge Sort

2.1 (a) What are the advantages and disadvantages of quicksort?

(b) What are the advantages and disadvantages of merge sort?

3 Maximal Spanning Trees

3.1 We have two algorithms, Kruskal's and Prim's, that allow us to find a Minimum Spanning Tree. Consider the problem of finding a Maximum Spanning Tree

(a) Describe a modification to Kruskal's algorithm that would allow us to find a Maximum Spanning Tree of a graph

(b) Can we use a similar approach to modify Djikstra's algorithm to find the Maximum Path between two nodes?

4 Radix Sort

Algorithm	Best-case	Worst-case	Stable
Counting Sort			
LSD Radix Sort			
MSD Radix Sort			

4.1 Run MSD and LSD radix sort on the following DNA sequence such that the output is sorted in alphabetical order ($A < C < G < T$).

ACAG
CTAG
ACAA
TGAG
CCTC
GAGT

ACAG
CTAG
ACAA
TGAG
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GAGT

4.2 Performing Radix Sort seems to be a fast sorting algorithm. Why don't we always use it?

5   Graph Usage

5.1   You are the king of a large kingdom! In order to manage your kingdom, you have appointed lords to rule towns within your kingdom. Every lord can govern over his town and any town that he is connected to by road. Your job as king is to figure out the optimal way to allocate lords and build roads.

Formally, consider a graph G with vertices V and edges E. Each vertex v represents a town. It has an associated cost c, the cost of installing a lord in the town. Each edge e represents a potential road. It has an edge weight w, the cost of building that road. Devise an algorithm that can efficiently compute which towns to install lords in and which roads to build, such that every town in the kingdom is governed (either has a lord in it or is connected by some number of roads to a town with a lord in it).