CS 630, Fall 2024, Homework 3
Due Wednesday, October 2, 2024, 11:59 pm EST, via Gradescope

Homework Guidelines

Collaboration policy Collaboration on homework problems, with the exception of programming assignments and reading quizzes, is permitted, but not encouraged. If you choose to collaborate on some problems, you are allowed to discuss each problem with at most 5 other students currently enrolled in the class. Before working with others on a problem, you should think about it yourself for at least 45 minutes. Finding answers to problems on the Web or from other outside sources (including generative AI tools or anyone not enrolled in the class) is strictly forbidden.

You must write up each problem solution by yourself without assistance, even if you collaborate with others to solve the problem. You must also identify your collaborators. If you did not work with anyone, you should write "Collaborators: none." It is a violation of this policy to submit a problem solution that

Typesetting Solutic Gradescope. You may use any program you li only used for technical writing (`overleaf.co` since it handles math very well. Word, Goog

Solution guidelines hm, you must provide:

1. pseudocode and, n English. As always, pseudocode shou
   - A clear desc
   - Any assump ample)
   - Instructions ought about the problem yet wou Inputs and outputs of any subrout ned, etc.

   If the algorithm it may not be graded.
2. a proof of correctness
3. an analysis of running time and space

You may use algorithms from class as subroutines. You may also use facts that we proved in class.

You should be as clear and concise as possible in your write-up of solutions. A simple, direct analysis is worth more points than a convoluted one, both because it is simpler and less prone to error and because it is easier to read and understand.

Problem 1 *Polling (10 points)*

As the elections are coming near new polls are published every day. As part of a research group at BU you are conducting experiments on how belonging to a social group influences ones' vote. For this you will select some known groups and survey every one of its members. To get unbiased results you decide that none of the groups you select can share any members. From the Registrar at BU you get a list of all sanctioned groups within BU along with their member lists. Design an approximation algorithm to select the largest number of groups.

1. Design an approximation algorithm for this problem. (*For proof you have to show that the output of the algorithm indeed yields a valid solution for the problem. Don't forget to analyze the running time.*)

2. Clearly state and prove the approximation ratio of your algorithm. (*Any approximation ratio correlated with o* *get full credit.*)

Problem 2 *Catering*

You are a caterer have a list of entrees and drinks (fancy stea ink pairings from your sommelier. You also nks (list of acceptable choices), but the prefe the pairs.

(For some reason yo ste of food or drinks...)

1. Design an appro ntrees and drinks, such that each pair is the pairs. (*Prove that your algorithm i nning time analysis.*)

2. Clearly state and

3. Now suppose tha ks in pairs. However, guests can mix-and-match; they may take an entree from one pair with a drink from another pair as long as both are on their preference lists. Design an approximation algorithm to cater this scenario with the fewest possible number of pairs selected. (*Prove that your algorithm indeed yields a valid solution, but you can omit the running time analysis.*)

4. Clearly state and prove the approximation ratio of your second algorithm.