CompSci 260P Diagnostic Exam 2B, Fall 2022

DO NOT OPEN EXAM UNTIL INSTRUCTED TO DO SO

SILENCE MOBILE PHONE AND OTHER DEVICES

This is a diagnostic exam intended to help you evaluate your readiness for the real exam.

Write the following information **clearly**. You may write **this information only** before the instructor calls to begin the exam. You **may not** write this information after the instructor calls to stop writing.

Name: ____________________________________________

UCI Email Address: ____________________________________________@uci.edu

UCI Student ID #: ____________________________________________

Read and understand the following rules; failure to abide by these rules, or directions given by course staff during the exam, may result in disciplinary action, including but not limited to a failing grade in the class.

- This exam is solely for students enrolled in this lecture. Anyone not enrolled in this lecture may not take an exam.
- Keep your UCI ID readily accessible during the test. Proctors may request to see it.
- This exam is closed book, closed notes, and is individual effort. Once course staff begin passing out exams, you may not communicate with anyone other than proctors for any reason, nor may you have electronics, including calculators watches and phones, available to you during the test for any reason.
  **YOU DO NOT NEED A CALCULATOR!**
- If you leave your seat during the test for any reason, your instructor may collect it and deem you to have turned it in. Do not ask proctors for an exemption to this, they are not authorized to grant such.
- If you are still seated at 4:35 PM at the real quiz, you may not leave your seat until explicitly dismissed by the instructor. Leaving after 4:35 PM and before being dismissed may result in a penalty.
- You must take the exam in your assigned seat unless the professor (not a TA) tells you otherwise. You may not open the exam until explicitly told to do so by the professor. The instructor will call to cease writing at 4:45 PM, at which point you must immediately cease writing and close the exam. You may not write any further at that point, including finishing one’s current sentence.
- If you believe a question is ambiguous, write at least two reasonable interpretations and indicate clearly which one you will be using. Then answer your question with that assumption. Unless your interpretation makes the problem much more trivial than intended, we will grade your response as if one of us had made that clarification.
- The purpose of the real exam is to evaluate how well you understand the material presented in the course. It is an academic integrity violation to do anything that subverts the goals of this assessment including, but not limited to, not doing your own work or submitting that of anyone else.
- Write your answers in the space provided for each question.
- Please write your UCI email at the top of each answer page. You may not do this until the exam has begun. There is a small amount of credit for doing this.

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1. We are given a set of positive integers $A = \{a_1, a_2, \ldots, a_n\}$ and a positive integer $B$. It is always the case for this problem that $a_i \leq B$ for all $i$ and also $\sum a_i > B$.

A subset $S \subseteq A$ is called feasible if the sum of numbers in $S$ does not exceed $B$:

$$\sum_{a_i \in S} a_i \leq B$$

Our goal is to find a feasible set with the largest sum.

Consider the following algorithm to solve the problem: we find the largest value of $i$ such that the sum of $a_1 \ldots a_i \leq B$ but $a_1 + \ldots + a_{i+1} > B$. We return either the set $\{a_1 \ldots a_i\}$ or the set $\{a_{i+1}\}$ (just the one element), whichever has a larger sum.

Prove that the algorithm given obtains at least half the value of the optimal feasible set.
Write your proof for question one here:
2. Consider the following problem that can be solved by a linear program. A tea packer blends Assam Tea and Darjeeling Tea to prepare two products: Super and Deluxe brands. Each pound of Super Tea contains 0.5 pounds of Assam Tea and 0.5 pounds of Darjeeling Tea. Each pound of Deluxe Tea contains 0.25 pound of Assam Tea and 0.75 pound of Darjeeling Tea. The packer has 120 pounds of Assam and 160 pounds of Darjeeling on hand. The profit on each pound of Super is $2 and on each pound of Deluxe is $3. How many pounds of each should they produce in order to maximize profit?

(a) Give a linear program that optimizes this. You may assume that it is okay to produce a fractional number of pounds of the mixes.

(b) Give the dual of this linear program.

(c) Give a brief interpretation of the dual, including what the dual variables represent and a problem related to the original that this solves.
Write the linear program here:

Write the dual of the linear program here:

Provide your brief interpretation of the dual here: