CompSci 260P Diagnostic Exam 2A, 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.

© CompSci 260P Fall 2022– Michael Shindler– University of California, Irvine
This exam may not be reposted without the express written permission of the professor teaching this course.
1. As you prepare to go on vacation for Summer Break, you need to pack. You have \( n \) items to pack; the \( i \)th item weighs \( w_i \) pounds. Every bag you can hold can hold a total of \( P \) pounds. This is the only constraint for what they can hold. You may assume that every \( w_i \) as well as \( P \) are positive integers and that every \( w_i \leq P \). Your goal is to pack every item into bags and use as few bags as possible.

You use the following algorithm to pack your bags: you take item one, place it into a bag. If the second item fits, you place that into the bag too. You repeat until the next item cannot fit into the bag, at which point you start a new bag. Prove that the algorithm given uses at most twice as many bags as possible for any input. For example, if you could have used three bags in some optimal solution, this algorithm will not use more than six.

In writing your proof, you may assume that every input uses an even number of bags. That isn’t true, but if your proof is correct for this assumption, you will get full credit.
Write your proof for question one here:
2. A book publisher is planning to bind the latest potential bestseller in three different bindings: paperback, book club, and library. Each book goes through a sewing and gluing process. The time required for each process, and the profit for each edition, is as follows.

<table>
<thead>
<tr>
<th></th>
<th>Paperback</th>
<th>Book Club</th>
<th>Library</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sewing (min)</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Gluing (min)</td>
<td>4</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>Profit</td>
<td>$0.50</td>
<td>$0.80</td>
<td>$1.20</td>
</tr>
</tbody>
</table>

Suppose the sewing process is available seven hours per day and the gluing process ten hours per day. We want to know how many books will be manufactured in each binding when the profit is maximized.

(a) Give a linear program that optimizes this. You may assume that it is okay to produce a fractional number of each type of book each day.

(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: