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

The following rules apply to you, whether you think they do or not. Read and understand them; 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.
- You may not open the exam or begin writing until the instructor has explicitly given you permission to do so.
- 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 7:35, you may not leave your seat until explicitly dismissed by the instructor. Leaving after 7:35 and before being dismissed may result in a grade penalty.
- 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.
- We will only grade responses marked in the space provided for each question.
Nothing you write on this page will be graded. The next page in this booklet contains a spot to answer these questions. You may use this page as scratch paper if you would like, and room to do so exists.

There are $n$ student workers at the library, each of whom performs a daily shift defined by a start time and a finish time. You must select a subset of these workers to be supervisors, such that every worker’s shift overlaps, at least partially, with the shift of a supervisor.

Prove that the following greedy algorithm will correctly select the minimum number of supervisors while still achieving that goal: we begin with the worker with the earliest finish time. Of all the workers whose shift overlaps, at least in part, with this worker, we take the one with the maximum finish time to be a supervisor. We remove from consideration anyone who overlaps with that person and recurse.

This question counts towards the Greedy portion of the Competency of Core Topics in your grade.
Write your answer to question 1 on this page
Nothing you write on this page will be graded. The next page in this booklet contains a spot to answer these questions. You may use this page as scratch paper if you would like, and room to do so exists.

Suppose you are given a description of rectangular, overlapping buildings and you would like to draw the corresponding skyline with no overlapping lines. A skyline is a list of tuples, each consisting of alternating $x$ coordinates and the heights connecting them.

The input is a series of 3-tuples; each tuple describes the left coordinate of the building, the height, and the right coordinate. For example, the input \{(1, 4, 3), (2, 5, 5), (4, 3, 5), (4.5, 1, 14), (7, 3, 9), (12, 2, 13)\} would represent the following buildings:

![Diagram of buildings](image)

You may assume that each building’s left-coordinate is strictly before its right-coordinate, that there are no gaps in the buildings, and that each height value is positive. Give an efficient divide and conquer algorithm that, given the description of $n$ buildings, forms the corresponding skyline; that is, the overlapping lines are removed. In the case of the above input, the result would be:

![Diagram of skyline](image)

Express the running time of your algorithm as both a recurrence relation and in closed form.

This question counts towards the Divide and Conquer portion of the Competency of Core Topics in your grade.
Write your answer to question 2 on this page