All quiz rules from the course syllabus are in effect for the real quiz, in addition to what follows.

If you have questions about the test, please ask *on Piazza* as a **private** post, viewable only by you and the instructors. The instructors will make an announcement via a pinned errata post if something needs to be said to the entire class. **Do not make comments on any non-private posts on Piazza during the quiz for any reason. Making such comments may subject you to a grade penalty.**

This quiz is to be individual effort. Students are permitted to use notes, electronics, and bring textbooks. The work you submit for each quiz is expected to be produced by *you, alone and solely for this assessment*. You may not reuse or repurpose anything you wrote at another time, nor may you ever use anything written by someone else during this quiz. However, despite being allowed notes and electronics, you may *not* seek out the answer to a question in any way, nor may you communicate with anyone during the exam, *for any reason*, with the exception of asking a question on Piazza *set as instructors-only for visibility*.

If you submit anything for free response that you did not produce during this exam, you must cite the source of any aspect(s) of it very clearly; failure to do so constitutes academic dishonesty.

You will have 40 minutes for this quiz, plus an additional ten minutes to upload your answers to GradeScope **and tag them**. Students who have timed accommodations, such as through DSC, should use the 50 minute total as a baseline and apply their accommodations from there.

When 30 minutes have passed from the start of the quiz, check Piazza to see if there is a pinned thread that has clarifications to the questions. Anything on that thread by that time is something you are responsible for.

Remember to upload your responses to GradeScope and tag your answers by the end of the quiz. The quiz is due at that time, not at the last time that GradeScope may or may not allow an upload. If you do not tag your response, or you do not upload one, your score for any untagged questions will be zero, regardless of other considerations.

1. (5 points) Suppose we have a set of n homework assignments, each of which have the **same deadline**. However, they do not all take the same amount of time to do: assignment i takes $t_i > 0$ minutes to do. For each assignment turned in prior to the deadline, we get zero penalty. For each assignment turned in after the deadline, we lose **one** point for each minute it is late. For example, if two homework assignments are late, one by one minute and the other by three minutes, we lose **four** points.

   Our goal is to minimize the number of points we lose. Prove that doing our homework assignments in order of shortest task first (i.e., non-decreasing value of t_i; we do shortest task, then second-shortest, and so on) will optimize this objective.

2. (4 points) Recall the following question from homework 3 (reproduced here in its entirety):

   Shindler gives lots of homework assignments, each of which have an easy version and a hard version. Each student is allowed, for each homework, to submit either their answer to the easy version (and get $e_i > 0$ points) or the hard version (and get $h_i > 0$ points, which is also guaranteed to always be more than e_i) or to submit neither (and get 0 points for the assignment). Note that e_i might have different values for each i, as might h_i. The values for all n assignments are known at the start of the quarter.

   The catch is that the hard version is, perhaps not surprisingly, more difficult than the easy version. In order for you to do the hard version, you must have not done the immediate previous assignment at all: neither the easy nor the hard version (and thus are more relaxed, de-stressed, etc). You are allowed to do the hard version of assignment one if you want. Your goal is to maximize the number of points you get from homework assignments over the course of the quarter.

   Consider the following **greedy** algorithm to attempt to solve this problem. Assume that $h_i = e_i = 0$ when $i > n$ (i.e., your answer may not depend on array out of bounds errors).

   ```
   i ← 1
   while i ≤ n do
     if h_{i+1} > e_i + e_{i+1} then
       Output "Do not do homework i"
       Output "Do the hard version of homework i + 1
       i ← i + 2
     else
       Output "Do the easy version of homework i
       i ← i + 1
   ```

   Demonstrate that this algorithm does not correctly achieve the optimal solution. We have covered how to do this in this class. You **do not** need to give a better greedy *algorithm*.