

## Quiz- Standard 20

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Due Date ..... TODO  
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### 1 Instructions

- The solutions **should be typed**, using proper mathematical notation. We cannot accept hand-written solutions. Here's a short intro to L<sup>A</sup>T<sub>E</sub>X.
- You should submit your work through the **class Canvas page** only. Please submit one PDF file, compiled using this L<sup>A</sup>T<sub>E</sub>X template.
- You may not need a full page for your solutions; pagebreaks are there to help Gradescope automatically find where each problem is. Even if you do not attempt every problem, please submit this document with no fewer pages than the blank template (or Gradescope has issues with it).
- You **may not collaborate with other students. Copying from any source is an Honor Code violation. Furthermore, all submissions must be in your own words and reflect your understanding of the material.** If there is any confusion about this policy, it is your responsibility to clarify before the due date.
- Posting to **any** service including, but not limited to Chegg, Discord, Reddit, StackExchange, etc., for help on an assignment is a violation of the Honor Code.
- You **must** virtually sign the Honor Code (see Section 2). Failure to do so will result in your assignment not being graded.

## 2 Honor Code (Make Sure to Virtually Sign)

### Problem 1.

- My submission is in my own words and reflects my understanding of the material.
- I have not collaborated with any other person.
- I have not posted to external services including, but not limited to Chegg, Discord, Reddit, StackExchange, etc.
- I have neither copied nor provided others solutions they can copy.

*Agreed John Blackburn.*

□

### 3 Standard 20- Quicksort

**Problem 2.** Consider a modification of QUICKSORT, where we modify PARTITION so that the algorithm chooses the maximum as the pivot for three levels of recursion, then the median as the pivot at the next level, and this repeats so the maximum is the pivot for the next three levels, then the median for one level, etc.

**Your job** is to write down a recurrence relation for the running time of this version of QUICKSORT given an array  $n$  distinct elements and solve it asymptotically, i.e. give your answer as  $\Theta(f(n))$  for some function  $f$ . Show your work.

*Answer.* We know that for the worst case run time of quicksort  $T(n) \leq cn^2$  and for the best case  $T(n) \leq cn \log(n)$  from lecture and previous homeworks. We also know that the probability of the worst case happening in this modification is that it will be run 3/4 of the time and likewise the best case is run 1/4 of the time because we know that for every 3 out of 4 depths of the tree the worst case scenario is being run. Thus,  $T(n) = 3/4cn^2 + 1/4cn \log(n)$ . This can be simplified to:  $T(n) = n/4(3cn + c \log(n))$  from here we can see that:

$$T(n) \leq \frac{n}{4}(3cn + cn)$$

$$T(n) \leq \frac{n^2}{4}(3c + c)$$

Therefore from there we know that  $T(n) \in \Theta(n^2)$

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