

CECS 528, Quiz 1, Spring 2026, Friday Dr. Ebert

Directions. Please show all work. Make sure your name is on each solution sheet and number your problems.

Unit 1 LO Problems

LO1. Solve the following.

- (a) Use the Master Theorem to determine the big- Θ growth of $T(n)$ if it satisfies

$$T(n) = 9T(n/3) + n^{\log_5(25)}.$$

- (b) Use the Substitution method to prove that if

$$T(n) = 4T(n/2) + 3\sqrt{n},$$

Then $T(n) = O(n^2)$.

LO2. Solve the following.

- (a) For the **Find Statistic** algorithm describe using **one or two sentences** how the pivot M is obtained for the partitioning step. Also, the inequality

$$3(\lfloor \frac{1}{2} \lceil \frac{n}{5} \rceil \rfloor - 2) \geq 3(\frac{1}{2} \cdot \frac{n}{5} - 3) = \frac{3n}{10} - 9$$

was provided to establish that, for the partitioning step, about 30% of the array elements are less than or equal (respectively, greater than or equal) to M . Explain the significance of each of the following constants that make up the left expression: i) $\frac{1}{2}$, ii) -2 , iii) 3 . Provide a few sentences for each one.

- (b) Draw the recursion tree that results when applying Mergesort to the array

$$a = 5, 4, 12, 8, 7, 11, 13, 9, 10, 16,$$

Label each node with the sub-problem to be solved at that point of the recursion. Assume arrays of size 1 and 2 are base cases. Assume that odd-sized arrays are split so that the left subproblem has one more integer than the right. Next to each node, write the solution to its associated subproblem.