

# CSE 332 Summer 18

## Exercise 04

### Algorithm Analysis – Tree Method

Version 3 (updated 7/6)

Due Date: Wednesday July 11, **at noon**

Submit as a pdf to gradescope.

In this exercise, we will find an exact closed form of the following recurrence using the tree method.

$$T(n) = \begin{cases} 7 & \text{if } n \leq 3 \\ 5T(n/3) + n & \text{otherwise} \end{cases}$$

0. Draw at least the first two levels of the recursion tree, and the leaf level of the tree. [2 points]
1. Let the root node be at level 0. Give a formula for the size of the input at level  $i$ . [2 points]
2. What is the number of nodes at level  $i$ ? [2 points]
3. What is the work done at the  $i^{\text{th}}$  recursive level? [3 points]
4. What is the last level of the tree? [2 points]
5. What is the work done at the base case? [2 points]
6. Write an expression for the total work done. Your expression should include a summation. [2 points]
7. Find a “closed form” of the formula in the previous part. To qualify as a closed form, it must not have any summations or recursion, but it does not have to “look nice.” [3 points]
8. In this part we’ll use the Master Theorem to check our answer [2 points]
  - i) What are  $a, b, c$  in the Master Theorem statement for this recurrence? (see slide 17 of lecture 5)
  - ii) What is the  $\Theta()$  bound?