



**CSD2181/CSD2183  
Structures**

**Data**

**Please write clearly:**

**Name: Bryan Ang Wei Ze**

**Student ID: 2301397**

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**Homework 1, Exercise 1.4 – Trimester 2, AY2024/25**

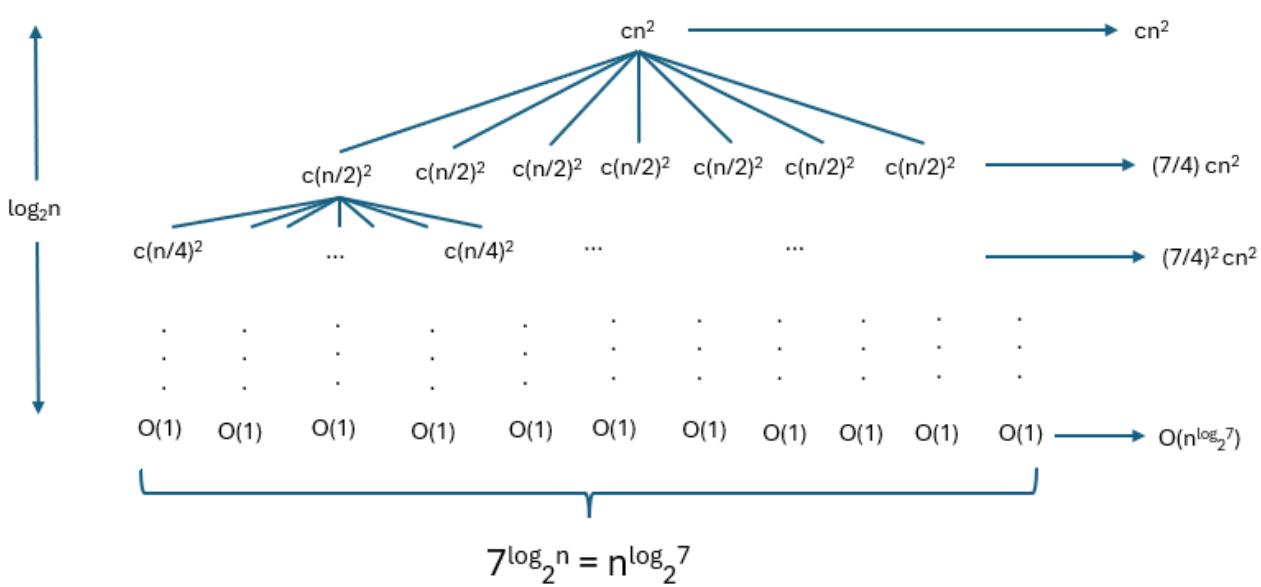
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**Instructions to students:**

Your answers must fit within the designated boxes. Do not resize them. Gradescope requires your answers to be placed precisely in these locations.

- (a) Following the example of Figure 4.1 in the textbook [Cormen et al. (2022); Figure 4.5 in the third edition], sketch the recursion tree for Strassen's algorithm. Clearly indicate the total cost at each level, the number of levels, and the number of leaves at the bottom of the tree.

(15 points)



(b) Based on the recursion tree, derive that the total running time of Strassen's algorithm is  $O(n \log_7 7)$ .

(10 points)

Total Cost Analysis:

Level 0:  $n^2$

Level 1:  $7n^2/4$

Level 2:  $49n^2/16$

...

Level i:  $7^i * n^2 / 4^i = (7/4)^i * n^2$

Geometric series with ratio  $r = 7/4 > 1$

Therefore, the last term dominates

Last level is at  $i = \log_2 n$

Final Complexity:  $\Theta(n^{\log_2 7})$