Homework 1 CS301

Sabancı University Faculty of Engineering and Natural Sciences

CS301 – Algorithms

Homework 1

Due: March 6, 2024 @ 23.55 (upload to SUCourse)

PLEASE NOTE:

- Provide only the requested information and nothing more. Unreadable, unintelligible, and irrelevant answers will not be considered.
- Submit only a PDF file. (-20 pts penalty for any other format)
- Not every question of this homework will be graded. We will announce the question(s) that will be graded after the submission.
- You can collaborate with your TA/INSTRUCTOR ONLY and discuss the solutions of the problems. However, you have to write down the solutions on your own.
- Plagiarism will not be tolerated.

Late Submission Policy:

- Your homework grade will be decided by multiplying what you normally get from your answers by a "submission time factor (STF)".
- If you submit on time (i.e. before the deadline), your STF is 1. So, you don't lose anything.
- If you submit late, you will lose 0.01 of your STF for every 5 mins of delay.
- We will not accept any homework later than 500 mins after the deadline.
- SUCourse's timestamp will be used for STF computation.
- If you submit multiple times, the last submission time will be used.



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Question 1

The recurrence relation of a recursive divide and conquer algorithm is given. Explain this recurrence, verbally, in terms of the size of each sub-problem, the cost of dividing the problem, and combining solutions.

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

Answer:

- J Each sub problem have quarky size of the original patien.

Thates 2n the to divide the pollens.

Thates ((n) = no time to contine the sources for the sub problems.



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Question 2

Find an asymptotically tight lower bound for the following recurrence by using the substitution method.

$$T(n) = T(\frac{n}{3}) + T(\frac{2n}{3}) + \Theta(n)$$

Answer:

-> Make a guess for the law band T(n)=12 (nlgn)

-> claim hypothesis based on my guess

The potteris to be true with substitution reflect

· lets substitue T(n) into the recourence

· T(n) 7 T(3) + 7 (3) + @(n)

· Assuming los T(n) > c n/gen

Cngn 2/C(含)(字(含)+c(含)(字(含)+(n)

lets simplify right how side

= c (分)10gn - c 子は3 + c (子)10gn - c 子の(の) = cnlogn - (= nlog3 - 2 nlog3) + o(n)

= . CN/290 - CN/23 + O(n)

We can choose c as $C \leq \frac{1}{1099}$ to ensure that T(n) penligh. Now we proved that $T(n) \neq c$ night solutions with c = 1/193 so we accost our initial assumption.

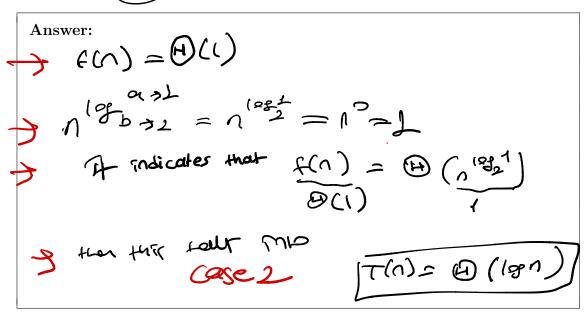
Answers R (nlogn)



Question 3

For the following recurrences, either solve it by using the master method or show that it cannot be solved with the master method.

(a)
$$T(n) = T(\frac{n}{2}) + O(1)$$



(b)
$$T(n) = 3T(\frac{n}{4}) + n \lg n$$

