



Sabancı University Faculty of Engineering and Natural Sciences

CS301 – Algorithms

Homework 1

Due: April 2, 2023 @ 23.55 (Upload to SUCourse - no late submission)

PLEASE NOTE:

- Provide only the requested information and nothing more. Unreadable, unintelligible and irrelevant answers will not be considered.
- 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.

Question	Points	Score
1	20	
2	20	
3	50	
4	10	
Total:	100	

Question 1 [20 points]

[5 points] What is the form of the input array that triggers the worst case of the insertion sort?
[5 points] What is the complexity of this worst–case behavior in Θ notation?
[10 points] Explain how this particular form of the array results in this complexity
on 2 [20 points]
[5 points] What is the form of the input array that triggers the best case of the insertion sort?
[5 points] What is the complexity of this best–case behavior in Θ notation?

(c) [10 points] Explain how this particular form of the array results in this complexity.



Question 3 [50 points]

Suppose that you are trying to prove $(5n + 4)^2 = O(n^2)$ by using the formal definition of O-notation, where $n \ge 0$.

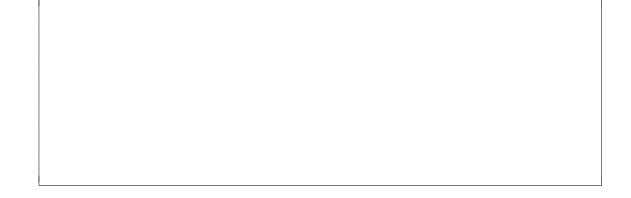
In order to show that $(5n + 4)^2 = O(n^2)$ by using the formal definition of O-notation, we need to pick constants c and n_0 such that for any $n \ge n_0$ we have

$$(5n+4)^2 \le cn^2 \tag{1}$$

(a) [25 points] If you use $n_0 = 2$, what is the smallest c value that makes the proof go through?



(b) [25 points] If you use c = 36, what is the smallest n_0 value that makes the proof go through?



Question 4 [10 points]

Rank the following functions in descending order with respect to their growth rates.

 $\lg(n!)$

n!

 $n2^n$

 $2^{2^{n}}$

 $\lg^2 n$

 $(\lg n)!$