

Data Structure & Algorithms

Assignment 1. Innopolis University, Spring 2019

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Section 2.3: Tournament Rankings

1. **Submission Number:** 50038906

Submission Link: <https://codeforces.com/group/lk8Ud0ZeBu/contest/238197/submission/50038906>.

2. **Bonus Question**

In this case, the sorting algorithm which can be easily modified is the **selection sort** as the selection sort choose the best suitable element for the position and swap it with the element in that position.

Section 3: Asymptotic Notation

3. (a) In the Worst case the first loop will have $n-1$ iterations and the second loop will have $n-1$ iterations. So, as the second loop is nested in the first loop. Then $T(n) = (n-1)^2$. So, in worst case, it will be $O(n^2)$.

The explanation:

Num. line	Cost	Time of repetition
1	$c1$	$n+1$
2	$c2$	n
3	$c3$	$(n+1) * n$
4	$c4$	n^2
5	$c5$	n
6	$c6$	1

$$\begin{aligned}
 T(n) &= c1 * (n + 1) + c2 * n + c3 * (n + 1) * n + c4 * (n^2) + c5 * n + c6 \\
 &= (c3 + c4) * n^2 + (c1 + c2 + c3 + c5) * n + (c1 + c6)
 \end{aligned}$$

$$= n^2 + n + c = O(n^2)$$

(b) In order to make the best case equals to n^2 ($\Omega(n^2)$), then $B = 1, 2, 3, \dots, n$. B should have at least one element from A which is 1. This makes the if condition in line 4 true in every loop in 1st loop. So, the return in line 5 is not getting executed.

(c) **Yes**, because $T(n) = n^2 + n$ (without any constants) and $g(n) = n^2$. Then the answer will be Yes if and only if $T(n) = \theta(g(n))$ if and only if $0 \leq c_1 * g(n) \leq T(n) \leq c_2 * g(n)$ where $c_1, c_2, n_0 \neq 0$ and for all $n > n_0$.

Then:

$$c_1 * n^2 \leq n^2 + n \leq c_2 * n^2$$

$c_1 \leq 1 + \frac{1}{n} \leq c_2$ It is correct when $n \geq n_0 = 1$. Then, $c_1 = 1$ and $c_2 = 2$

Then, the worst-case run-time of the algorithm is $\theta(n^2)$