

Weekly Problems: 2.

Due: 2pm on 18/08/25

Instructions

- Discussion is allowed and infact encouraged
- Answers must be written by yourself.
- All sources that are used to reach the solution must be mentioned.

① Consider the problem of searching for a value among a given tuple of numbers.

Input: A seq. of n numbers $A = \langle a_1, \dots, a_n \rangle$ and a value v .

Output: An index i such that $v = A[i]$ or the value 'NIL' if v does not appear in A .

i) Write a pseudo code and explain in words what each line of the pseudo code is doing. [4]

ii) Analyse the complexity of the pseudo code you have written. [1]

② Show that for any constants $k, k' > 0$,

i) $\log_k n = \Theta(\log_{k'} n)$ [1.5]

ii) $\log^k n = o(n^{k'})$ [3.5]

③ Assuming $f, g: \mathbb{N} \rightarrow \mathbb{R}$ are such that $\lim_{n \rightarrow \infty} f/g$ exists, show that $f = \Theta(g) \Leftrightarrow \exists c_1, c_2 > 0$

s.t. $c_1 \leq \lim_{n \rightarrow \infty} f/g \leq c_2$ [2]

④ Show that the time complexity of Bubble Sort is $\Theta(n^2)$. [4]
