Analysis of Algorithms - Homework I

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1 Instructions

1. The homework is due on September 14, in class.
2. Each question is worth 3 points.
3. Attempt as many problems as you can. You will be given partial credit, as per the policy discussed in class.

2 Problems

1. Write a recursive algorithm to check whether an integer x, exists in an array $\mathbf{A}$ of n integers.
2. Argue the correctness of your algorithm using induction.
3. Provide upper and lower bounds on $S = \sum_{i=1}^{n} i \cdot \log i$.
4. Let T denote a proper binary tree with n nodes having height h. Formally establish that $h \leq \frac{n-1}{2}$.
5. Consider the following recursive definition of $T(n)$.

$$\begin{aligned} T(1) &= 1 \\ T(n) &= n \cdot T(n-1),\ n \geq 2. \end{aligned}$$

Show that $\log(T(n)) \in \Omega(n \cdot \log n)$.