Name: Student ID:

Instructions:

1. The duration of the exam is 2 hours.
2. There are three questions.
3. You are advised to solve the questions on a rough sheet first and then copy them here.

Q1] Given a list of n natural numbers, how will you determine the k^{th} smallest number in the list. Describe your algorithm in simple English, and also discuss its computational complexity. [10 marks]

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Q2] Given an integer array $A[1 \cdots n]$ with n elements, describe in simple English how will you find two indices i and j such that $i < j$ and it is the case that $A[i] - A[j]$ is the minimum. Also, discuss the computational complexity of your algorithm. [10 marks]

Q3] Given an $m \times n$ matrix A and a target value k. Write an efficient algorithm that finds the value k in the matrix. The matrix has the following properties. (1) The numbers in each row are sorted from left to right. (2) The numbers in each column are sorted from top to bottom. [10 marks]