Problem 1 (Divide and Conquer)

A.

The k-percentiles of a sequence x_i, $0 \leq i < n$, is the $k-1$ elements of a sequence that evenly partition a sorted sequence (+- 1 element). For example the 3-percentiles of the following sorted sequence are the elements 7 and 21.

2 5 7 10 17 21 34 48

(a) Give a closed formula that gives the position of i-th k-percentile of a sorted sequence of length n (for $1 \leq i < k$).
(b) Give an algorithm with complexity $O(n \log k)$ which outputs the k percentiles of an unsorted sequence of length n.

B.

The problem of maximum increased sub-sequence is defined as follows: Given an array A of integers (positive or negative numbers) of length n find the sub-array with maximum summation, i.e., two indexes i, j (where $0 \leq i \leq j < n$), such that the following summation is maximized:

$$A[i:j] = \sum_{k=i}^{j} A[k]$$

Give a divide and conquer algorithm that solves the aforementioned problem in $\Theta(n \log n)$ time.

Problem 2 (Quicksort)

1. CLRS 7.3-1
2. CLRS Problem 7-2
3. CLRS Problem 7-4

Problem 3 (Randomized Algorithms)

1. CLRS 5.1-2
2. CLRS 5.2-1
3. CLRS 5.4-1
4. CLRS 5.4-2