# ACM 通识课(上) --- Homework 1

1. 算法导论第二章问题 2-4
2. Sorting a Somewhat-Sorted Array
   a) What is the best case run-time of MergeSort? That is, find the largest function $g(n)$ such that for every array of length $n$, MergeSort takes at least $\Omega(g(n))$ operations to sort the array.
   b) Define an array to be "$k$-somewhat-sorted" if it is possible to remove $k$ elements from the array and obtain a sorted array. Suppose you are given a $k$-somewhat-sorted array of length $n$, but you don't know $k$. Design an algorithm that runs in time $O(n)$ and takes as input a length $n$ "$k$-somewhat sorted array", and identifies a set of $O(k)$ elements (i.e. indices into the input array) with the property that after removing those elements, the array is sorted. Your solution should contain both the pseudo-code, a clear and succinct proof of the correctness of your algorithm (this can just be 2 sentences!), and a clear proof that the runtime is $O(n)$.
   c) Give an algorithm that sorts a $k$-somewhat-sorted array of length $n$ in time $O(n + k \log(k))$ time. Your solution should contain both the pseudo-code, a clear and succinct proof of the correctness of your algorithm (this can just be 2 sentences!), and a clear proof that the runtime is $O(n + k \log k)$ [Hint: leverage the result from the previous part of the problem. Even if you didn't solve part (b), you can still do this part, assuming the existence of a solution to the previous part.]

下面两题，请设计数据结构和算法。建议首先简单陈述算法思路，然后用伪码描述。非常规数据结构（队列、链表、树等）请用伪码仔细说明。分析自己算法的最坏情况大 O 复杂度，如果想到多个算法最坏复杂度一样，可以考虑平均复杂度。非最优算法不能得全分。加分题可不做，做对有加分。

3. 总共有 n 个数，分布在 k 个已经排序好的队列中，请将这 n 个数排序。
4. 一个数组有 n 个正整数，和一个目标整数 s，请问最短连续子数组的长度，使得它的和大于 s。比如数组 [1, 6, 1, 2, 3, 2, 1], s = 8，那答案就是 3: [6, 1, 2]。
5. 【加分题】总共有 n 个没有排序的数，请找出大小相邻两个数的最大差值。比如 [1, 9, 3, 2, 11, 5]，那差值就是 9-5 = 4。