算法设计与应用基础：作业 4

杨博，林小拉

2020 年 7 月 21 日

DUE：下学期开学考试前

提交说明

- 请将作业以 **PDF** 附件形式发送到邮箱：algo2020@163.com
- 邮件主题及作业文件统一命名：第几次作业 _ 学号 _ 姓名，如，4_18XXXXXX_ 张
- 编程题一般是 OJ 平台 LeetCode 上的题目，点击题名即可跳转到题目对应的页面。对于编程题，要求在作业中写出四项内容：算法思路，复杂度分析，代码和 Accepted 截图。
- 第 4 题在 Virtual Judge。

作业

1. Generate Parentheses

   Given n pairs of parentheses, write a function to generate all combinations of well-formed parentheses.

   For example, given $n = 3$, a solution set is:

   [
   “((()))”,
   “(()())”,
   “(())()”,
   “()(())”,
   “()()()”
   ]

2. Combination Sum

   Given a set of *candidate* numbers (candidates) (without duplicates) and a target number (*target*), find all unique combinations in *candidates* where the candidate numbers sums to *target*.

   The same repeated number may be chosen from *candidates* unlimited number of times.

   Note:

- All numbers (including $target$) will be positive integers.
- The solution set must not contain duplicate combinations.

Example 1:

Input: $candidates = [2, 3, 6, 7], target = 7$

A solution set is:

[
[7],
[2, 2, 3]
]

Example 2:

Input: $candidates = [2, 3, 5], target = 8$

A solution set is:

[
[2, 2, 2, 2],
[2, 3, 3],
[3, 5]
]

3. Container With Most Water

Given n non-negative integers $a_1, a_2, ..., a_n$, where each represents a point at coordinate (i, a_i). n vertical lines are drawn such that the two endpoints of line i is at (i, a_i) and $(i, 0)$. Find two lines, which together with x-axis forms a container, such that the container contains the most water.

Note: You may not slant the container and n is at least 2.

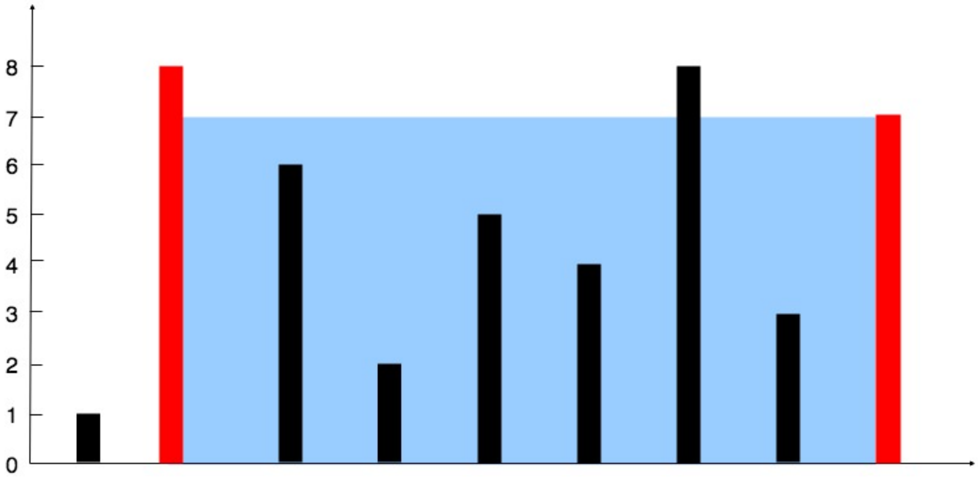

图 1: The above vertical lines are represented by array $[1, 8, 6, 2, 5, 4, 8, 3, 7]$. In this case, the max area of water (blue section) the container can contain is 49.

Example:

Input: $[1, 8, 6, 2, 5, 4, 8, 3, 7]$

Output: 49

4. ## Cashier Employment

A supermarket in Tehran is open 24 hours a day every day and needs a number of cashiers to fit its need. The supermarket manager has hired you to help him, solve his problem. The problem is that the supermarket needs different number of cashiers at different times of each day (for example, a few cashiers after midnight, and many in the afternoon) to provide good service to its customers, and he wants to hire the least number of cashiers for this job.

The manager has provided you with the least number of cashiers needed for every one-hour slot of the day. This data is given as $R(0), R(1), ..., R(23) : R(0)$ represents the least number of cashiers needed from midnight to $1 : 00A.M.$, $R(1)$ shows this number for duration of $1 : 00A.M.$ to $2 : 00A.M.$, and so on. Note that these numbers are the same every day. There are N qualified applicants for this job. Each applicant i works non-stop once each 24 hours in a shift of exactly 8 hours starting from a specified hour, say $t_i(0 \leq t_i \leq 23)$, exactly from the start of the hour mentioned. That is, if the i-th applicant is hired, he/she will work starting from t_i o'clock sharp for 8 hours. Cashiers do not replace one another and work exactly as scheduled, and there are enough cash registers and counters for those who are hired.

You are to write a program to read the $R(i)$'s for $i = 0..23$ and t_i 's for $i = 1..N$ that are all, non-negative integer numbers and compute the least number of cashiers needed to be employed to meet the mentioned constraints. Note that there can be more cashiers than the least number needed for a specific slot.

Input: The first line of input is the number of test cases for this problem (at most 20). Each test case starts with 24 integer numbers representing the $R(0), R(1), ..., R(23)$ in one line ($R(i)$ can be at most 1000). Then there is N, number of applicants in another line ($0 \leq N \leq 1000$), after which come N lines each containing one t_i ($0 \leq t_i \leq 23$). There are no blank lines between test cases.

Output: For each test case, the output should be written in one line, which is the least number of cashiers needed. If there is no solution for the test case, you should write No Solution for that case.

Sample Input:

1

1 0 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1

5

0

23

22

1

10

Sample Output:

1

5. 什么是 NP 问题？简单描述 P 与 NP 的关系，以及如何证明一个问题是 NP-完全性。