1.

Write the code of Quicksort. Analyze and describe its complexity.

Solution:

2.

Given a sequence of **K** integers **{N_1, N_2, ..., N_K}**. A continuous subsequence is defined to be **{N_i, N_{i+1}, ..., N_j}**, where **1** $\leq$ **i** $\leq$ **j** $\leq$ **K**. The **Minimum Subsequence** is the continuous subsequence which has the minimum sum of its elements. For example, given sequence {-5, 3, -12, 11, 4, -5, -5, 2, -6}, its minimum subsequence is { -5, 3, -12 } with the minimum sum being -14.

Now you are supposed to find the minimum sum, together with the first and the last numbers of the minimum subsequence.

Notes:

```
Input:
Each input file contains one test case.Each case occupies two lines.
The first line contains a positive integer K(≤10000). The second line contains K numbers, separated by a space.

Output:
For each test case, output in one line the minimum sum,
together with the first and the last numbers of the minimum subsequence.
The numbers must be separated by one space, and no extra space should be allowed at the end of a line.
In case that the minimum subsequence is not unique,
output the one with the smallest indices i and j (as shown by the sample case).
```

Sample:

```
Input:
9
-5 3 -12 11 4 -5 -5 2 -6

Answer:
-14 0 2
```

Solution:

3.

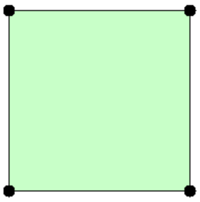
Given a list of points that form a polygon when joined sequentially, find if this polygon is convex

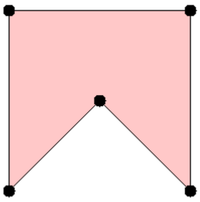
Notes:

- There are at least 3 and at most 10,000 points.
- Coordinates are in the range from -10,000 to 10,000.

Example :

```
1.                                      2.
Input: [[0,0],[0,1],[1,1],[1,0]]        Input: [[0,0],[0,10],[10,10],[10,0],[5,5]]
Answer: True                            Answer: False
```





Solution:

4.

A tree (i.e. a connected graph without cycles) with vertices numbered by the integers 1, 2, ..., n is given.

The "Prufer" code of the tree is built as follows: **the leaf (a vertex that is incident to only one edge) with the minimal number is taken.** This leaf, together with its incident edge is removed from the graph, while the number of the vertex that was adjacent to the leaf is written down. **In the obtained graph, this procedure is repeated, until there is only one vertex left (which, by the way, always has number n)**.

The written down sequence of n-1 numbers is called the Prufer code of the tree.

Your task is, given a tree, to compute its Prufer code.

Note that, according to the definition given above, the root of a tree may be a leaf as well. It is only for the ease of denotation that we designate some vertex to be the root. Usually, what we are dealing here with is called an **"unrooted tree"**.

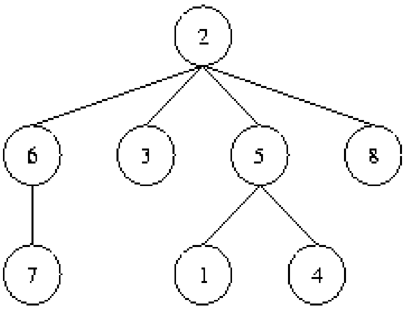
Notes:

```
Input:

The input contains several test cases.
Each test case specifies a tree as described above on one line of the input file.
Input is terminated by EOF. You may assume that 1<=n<=50.

Output:
```

```
For each test case generate a single line containing the Prufer code of the specified tree.
The numbers must be separated by one space, and no extra space should be allowed at the end of a line.
```

Sample:

```
Input:
(2 (6 (7)) (3) (5 (1) (4)) (8))
(1 (2 (3)))
(6 (1 (4)) (2 (3) (5)))

Answer:
5 2 5 2 6 2 8
2 3
2 1 6 2 6
```



Solution:

5.

Suppose there is a **50-layer CNN**, trained on a **16GB** GPU. Training time is **5.5 hours**, and inference time is **0.5 second** per image. If we fine-tune the net, adding **Dropout** on the first **10-layer**, what is inference time per image on the **single** GPU?

A. < 0.5 second

B. > 0.5 second

C. = 0.5 second

D. The time depends on the probability of **Dropout**.

6.

Suppose there is a **two-stage** target detection system responsible for detecting the **background** and **foreground** targets. In the candidate-boxes provided in the **first stage**, the probabilty of the foreground boxes is **98%**. In the **second stage**, the probability of determing a foreground box as the background is **2%**, and the probability of determining a background box as the foreground is **5%**. So what is the ultimate probability that a bounding box is judged as a foreground box when it is **indeed** a foreground box?

A. 0.9989

B. 0.9991

C. 0.96

D. 0.9855

7.

Please explain the definition of **accuracy** and **recall** in the target detection system.

8.

Please explain how to use the **Hough transform** to detect lines on images.

9.

Suppose that X_1, X_2, X_3, X_4 is a random sample from $X \sim N(0, 1)$. $Y = (X_1 + X_2 + X_3)^2 + (X_4 + X_5 + X_6)^2$ and ***cY*** has a χ^2 distribution. Then ***c*** = ?

10.

Suppose that the size of an image **P** is `h = 790, w = 1824`, and the 2-d convolution **Q**'s parameters are

```
h_kernel = 28,  w_kernel = 41    h_padding = 6,  w_padding = 11    h_stride = 3,   w_stride = 5
```

Then `R = P * Q`, when * represents the **convolution operator**.

What is the size of the result **R** ?