Q8. Linear Interpolation (40 marks):

A sensor node can be deployed to a remote location to sense the environmental data, such as temperature, humidity, etc, in that area, and then transfer the data back to a server for processing. The sensor node may sometimes experience intermittent network errors which cause some of the data missing during the transmission. In this case, the server can apply **linear interpolation** to fill the missing data.

Assume that the sensor node will ensure the first point and the last point of a series of data to be safely received by the server, and the data points are evenly spaced. Code a program to fill the missing data using the linear interpolation approach.

Hint. With reference to Fig. 1, consider the known values of y1 and y2 at points x1 and x2, respectively. The unknown value of y at any point x between x1 and x2 can be computed based on the straight line from (x1, y1) to (x2, y2), as shown in Fig.1.
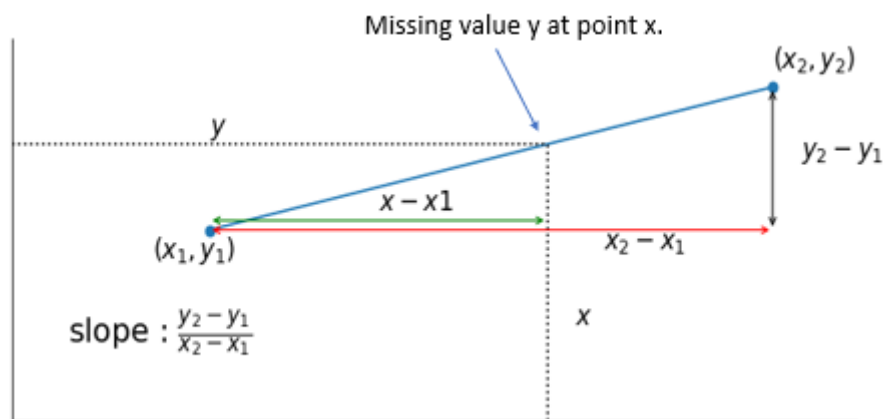

Fig 1: Linear Interpolation

Write a programme to

Input, in sequence

- The first number indicates how many inputs will be received subsequently
- For each of the subsequent inputs, if it is a number, then it is a correct sensor data; however, if it is a character '#', then it is a missing data. Note that there are a maximum of only 5 unknown data in each series of input.

Output, in sequence, the estimated values of the missing data, using the linear interpolation approach. The estimated values must be displayed in the same order of the corresponding "#" received.

Note 1: You are required to round all your answers to two decimal places.

Note 2: The graphs in the examples are for illustration purposes only. You do not need to draw the graph in your program.

试题 8. 线性插值（40 分）：

传感器节点可以部署到远程位置，以感知该区域的环境数据，例如温度、湿度等，然后将数据传输回服务器进行处理。传感器节点有时可能会遇到间歇性网络错误，导致传输过程中丢失一些数据。在这种情况下，服务器可以应用**线性插值**来填充缺失的数据。

假设传感器节点会保证服务器安全接收到一系列数据的第一个点和最后一个点，并且数据点之间的间隔是均匀的。利用线性插值法，编写一个程式以填充缺失的数据。

提示：请参考图 1，考虑点 x1 和 x2 处的数据 y1 和 y2 是已知的值。在 x1 和 x2 之间其他点 x 的数据 y，可以根据从(x1, y1) 到(x2, y2) 的直线来计算。
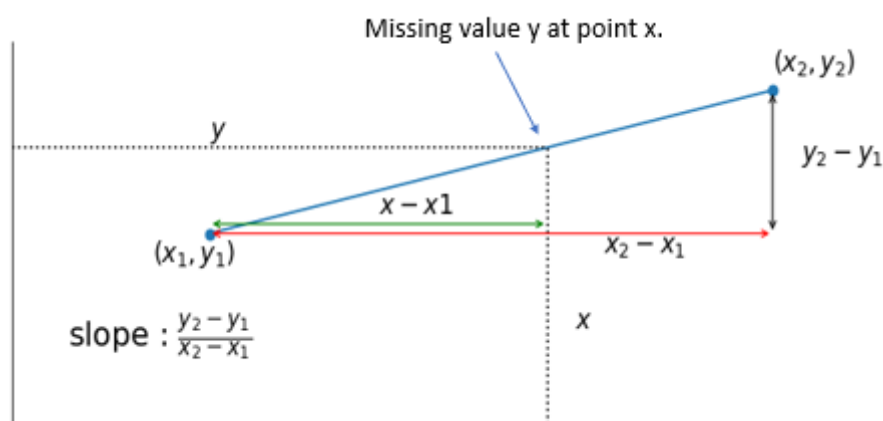

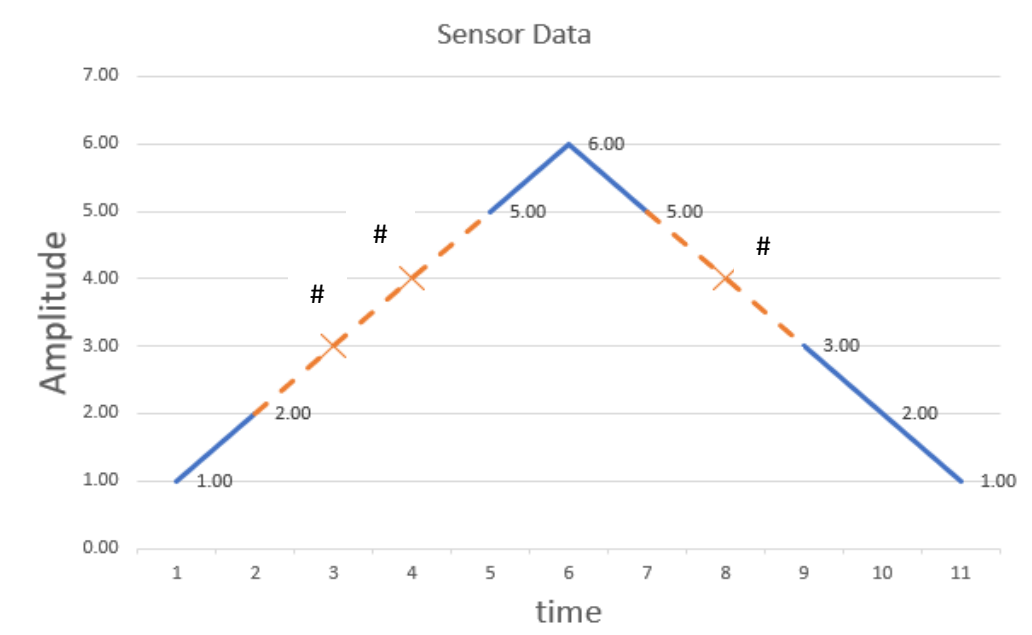图 1：线性插值

试写一程式以

依序输入

- 第一个数字表示服务器将会接收到多少个输入。
- 在接着的输入里，若输入是一个数字，那就是一个正确的传感器数据；但若输入的是一个 # 的符号，那就表示一个丢失了的数据。注意的是，每一组数据中，最多只会有 5 个未知的数据。

依序输出 使用线性插值方法估算的缺失数据估计值。显示答案的顺序必须与相应的 # 出现的顺序相同。请将您的答案四舍五入到小数点后两位 。

注意事项 1：所有的输出必须近似/显示至小数点后二位数。

注意事项 2：示例中的图表仅用于说明， 您不需要在程式中绘制图形。

Example (例子)

Sensor Data

Input (输入)	Output (输出)
10 1 2 # # 5 6 5 # 3 2	3.00 4.00 4.00

Input (输入)	Output (输出)
11 1 1 # 1 2 1 #	1.00 1.00 1.00

# 1 3 1	
12 1.11 # 1.35 # 1.65 # 2.01 # 2.46 # 3.00 3.10	1.23 1.50 1.83 2.24 2.73
13 1.50 2.45 # # 5.01 3.99 5.00 6.10 2.70 4.10 # # 7.01	3.30 4.16 5.07 6.04
11 12.44 # # 5.82 3.62 1.41 -0.80 # # -7.41 -9.62	10.23 8.03 -3.00 -5.21