PYTHON: REVIEW

Review

- Input-Process-Output
- Basic Data Type
- Decision Structures
  - Selection Structures
  - Repetition Structures
- String, Sequence and List
- Functions
  - Parameters and Scope of Variables
- Other Data Models
  - Tuples, Dictionaries and Sets
- File Processing

PROBLEM SOLVING EXAMPLES

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[Mean Normalization] Given a group of numbers, X, a group of normalized values, X', are transformed from X by the equation below:

$$X'_i = \frac{X_i - \bar{X}}{X^+ - X^-}$$

where $\bar{X}$, X^+, X^- is the mean, maximum and minimum of all the numbers in X. In the sample input, $X^+ - X^- > 0$.

Write a Python program on the numbers in X, and output the normalized values. Your output number should be rounded to 3 digits in display.

Sample Input	Sample Output
514,324,764,42,120,836,527,935,83,155,453,648,14	0.106,-0.100,0.377,-0.407,-0.322,0.455,0.120,0.563,-0.362,-0.284,0.040,0.251,-0.437
542,914,436,973,605,813,678,237,285,296,372	-0.023,0.482,-0.167,0.562,0.062,0.345,0.161,-0.438,-0.373,-0.358,-0.254
373,520,111,417,954,572,796,897,469,281,931,925,697,905	-0.307,-0.133,-0.618,-0.255,0.382,-0.071,0.195,0.314,-0.193,-0.416,0.355,0.348,0.077,0.324

514,324,764,42,120,836,527,935,83,155,453,648,14
542,914,436,973,605,813,678,237,285,296,372
373,520,111,417,954,572,796,897,469,281,931,925,697,905

[Total distance across locations]

Given the locations identified by object IDs, find the total distance across all locations. The distance between two locations (x1, y1) and (x2, y2) is calculated as below:

$$\sqrt{(x1 - x2)^2 + (y1 - y2)^2}$$

Write a Python program to input a sequence of locations with object IDs, and output the distance from one location to the next location and the final path with total distance. The sequence is irrespective of the name but based on the data input order. The result is rounded to 2 decimal places in display. The formats are shown as below.

Sample Input	Sample Output
A1,41.16,24.88 A2,73.04,84.98 A3,64.62,88.43 A4,85.34,47.73 end	(A1->A2):68.03 (A2->A3):9.10 (A3->A4):45.67 A1->A2->A3->A4:122.80
A1,97.05,36.74 A2,88.76,35.59 A3,89.6,36.68 A4,85.02,44.73 A5,36.65,42.24 end	(A1->A2):8.37 (A2->A3):1.38 (A3->A4):9.26 (A4->A5):48.43 A1->A2->A3->A4->A5:67.44

A1,41.16,24.88
A2,73.04,84.98
A3,64.62,88.43
A4,85.34,47.73
end

A1,97.05,36.74
A2,88.76,35.59
A3,89.6,36.68
A4,85.02,44.73
A5,36.65,42.24
end

[Fraction numbers multiplication]

Given that two fraction numbers are multiplied, the Python program should generate the output as the product fraction number in its simplest form.

The input is four non-zero integer numbers, where the first two numbers are the numerator and the denominator of the first fraction number and the remaining two numbers for the second fraction number.

The output is the expression of the multiplication of two fraction numbers, which is equal to the fraction result in its simplest form. You need to pay attention to the spaces used in the output expression.

Denominator of 1 will not be shown. Minus sign is only shown before the fraction number. Minus sign is cancelled if both numerator and denominator inputs in a fraction number are negative. The improper fraction format is used instead of mixed fraction.

Examples are shown as below.

Sample Input	Sample Output
6,1,6,-3	(6) x (-6/3) = (-12)
-6,-2,-2,-3	(6/2) x (2/3) = (2)
-41,5,28,-40	(-41/5) x (-28/40) = (287/50)
6,19,45,-14	(6/19) x (-45/14) = (-135/133)

6,1,6,-3
-6,-2,-2,-3
-41,5,28,-40
6,19,45,-14

Greatest Common Divisor (GCD) GCD (or HCF)

- Factors of 36: 1, 2, 3, 4, 6, 9, 12, 18, 36.
- Factors of 56: 1, 2, 4, 7, 8, 14, 28, 56
- So what is GCD?
- According to the table below, how can we write GCD algorithm in Python?

dividend	=	divisor	x	quotient	+	remainder
56		36		1		20
36		20		1		16
20		16		1		4
16		4		4		0

Least Common Multiple (LCM)

What is the LCM 36 and 56?

Method 1: use GCD to find LCM

$$LCM = \frac{a \times b}{GCD} = \frac{36 \times 56}{4} = 504$$

Method 2:

4	36	56
	9	14

$$4 \times 9 \times 14 = 504$$

You may explore more methods to find LCM.

END