

Python 4 - Iteration

Question 4: Weight converter Chart

After so many years in England I still have trouble with imperial measurements. Write a program to print a table where the column header contains the number of pounds and the row header contains the number of stones. At the intersection of the column and row is the weight in Kilos, rounded to one decimal (see example below). Unit conversion: 1 pound = 0.45 kg, 1 stone = 6.35 kg, 1 stone = 14 pounds

stone\pound	0	1	2	...
0	0	0.4	0.9	...
1	6.3	6.8	7.3	...

>>>

Question 5: Matrices

In question 3 we have been working on vector, in this exercise we will be working with matrices. A 3×2 matrix A has the following form:

$$A = \begin{bmatrix} a_{1,1} & a_{1,2} \\ a_{2,1} & a_{2,2} \\ a_{3,1} & a_{3,2} \end{bmatrix}$$

The basic

How could you represent a matrix in Python. Write a program to perform the following operations and print the result (inputs taken from user):

Scalar product: $\lambda \cdot A = \begin{bmatrix} \lambda \cdot a_{1,1} & \lambda \cdot a_{1,2} \\ \lambda \cdot a_{2,1} & \lambda \cdot a_{2,2} \\ \lambda \cdot a_{3,1} & \lambda \cdot a_{3,2} \end{bmatrix}$

Addition: $A + B = \begin{bmatrix} a_{1,1} & a_{1,2} \\ a_{2,1} & a_{2,2} \\ a_{3,1} & a_{3,2} \end{bmatrix} + \begin{bmatrix} b_{1,1} & b_{1,2} \\ b_{2,1} & b_{2,2} \\ b_{3,1} & b_{3,2} \end{bmatrix} = \begin{bmatrix} a_{1,1} + b_{1,1} & a_{1,2} + b_{1,2} \\ a_{2,1} + b_{2,1} & a_{2,2} + b_{2,2} \\ a_{3,1} + b_{3,1} & a_{3,2} + b_{3,2} \end{bmatrix}$

Note: A and B must have the same dimension. Depending on your representation of a matrix, how could you check they have the same dimension?

The advanced bit

Transpose: the transpose of a $m \times n$ matrix is a $n \times m$ matrix. For A , its transpose A^T is a 2×3 matrix.

$$A^t = \begin{bmatrix} a_{1,1} & a_{2,1} & a_{3,1} \\ a_{1,2} & a_{2,2} & a_{3,2} \end{bmatrix}$$

Write a program to perform the transpose operations and print the result (inputs taken from user).

The difficult one

Write a program to do the multiplication of two matrices. If you don't know how to perform matrix multiplication, you should search the web.

Question 6: *The King and the Wise man*

When the creator of the game of chess showed his invention to the ruler of the country, the ruler was so pleased that he gave the inventor the right to name his prize for the invention. The man, who was very wise, asked the king this: that for the first square of the chess board, he would receive one grain of wheat (in some telling, rice), two for the second one, four on the third one, and so forth, doubling the amount each time. The ruler, arithmetically unaware, quickly accepted the inventor's offer, even getting offended by his perceived notion that the inventor was asking for such a low price, and ordered the treasurer to count and hand over the wheat to the inventor. Given that the chessboard is a 8×8 board, and given the weight of a single grain of rice is about 30 mg, calculate the total weight of rice the king must give to the wise man. The program should print the weight of rice for each chessboard square.

Problem I: ...continued.

The basic

Last week we were able to calculate the cost of renting only one item. Modify your code in order to rent more than one item.

The advanced bit

Modify your code so a user can remove an item from his current bill. How would you represent an item? How would you store it? Discuss your choices.

Note: this is a difficult problem, and it may take more than a week to find a solution. We will go back to this problem later during the year and see an alternative way of representing the data.

Problem II:

In computing, a regular expression provides a concise and flexible means to "match" (specify and recognize) strings of text, such as particular characters, words, or patterns of characters. Common abbreviations for "regular expression" include **regex** and **regexp**.

We are going to implement some aspect of regular expressions. In this problem each small program takes two inputs from the user. The first input is a text to be searched; the second is a regular expression that we are going to match against the text. Both inputs are strings. You must not use predefined methods from the string type to find matches.

The basic

The regular expression is composed only of letters and numbers, no special characters. Write a script to print the position of the first character for each match in the text.

Example: Text: "The cat has a hat.", regex: 'at', result: prints 5, 15

The advanced bit

The regular expression can contain the question mark '?', representing a quantifier. The question mark indicates there is zero or one of the preceding element. For example, `colou?r` matches both `color` and `colour`. Write a program to print all sub-strings that match the regular expression, you may find duplicates.

The difficult one

We can define two more quantifiers:

1. The asterisk (*) indicates there is *zero or more* of the preceding element.
For example, `ab*c` matches "ac", "abc", "abbc", "abbbc", and so on.
2. The plus sign (+) indicates there is *one or more* of the preceding element.
For example, `ab+c` matches "abc", "abbc", "abbbc", and so on, but not "ac".

Write a program to print all sub-strings that match a regular expression that may contain the quantifiers "+, *, ?". Note you may find duplicates, try to improve your program in order to remove the duplicates.

Hints:

To transform an string containing an expression, use `eval(my_expression)` as shown below for a list.

```
>>> my_list = eval('[1, 2, 3]')
>>> type(my_list)
<type 'list'>
>>> my_list
[1, 2, 3]
```

To format a number in a print statement use % as shown below:

```
>>> my_number = 125.65
>>> print "formatted number: %6.2f" %my_number
formatted number: 125.65
>>> print "formatted number: %6.1f" %my_number
formatted number: 125.7
>>> print "formatted number: %6.0f" %my_number
formatted number: 126
>>>
```

Note that there is no comma between the string and the %variable. In this case 6 character spaces are used to print the number. The number behind the decimal indicate of many spaces should be used for the decimal part. Notice the rounding of the result.