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## Python list comprehension complex examples

When you're learning of a new programming language, it's challenging to figure out how to keep your code clear. One of the best ways to make Python code more accessible to your colleagues comes from collapsing multiple lines of code into a single line. In a recent article I showed you how to do this using list comprehensions. This article builds off that one, so you should definitely check it out before continuing here. As it turns out, you can nest list comprehensions within another list comprehension to further reduce your code and make it easier to read still. As a matter of fact, there's no limit to the number of comprehensions you can nest within each other, which makes it possible to write very complex code in a single line. Since this is such a powerful function, let's take a deeper look. List comprehensions create a new list by scanning all items in a list, checking to see if they meet a condition, passing the values that do and applying a function to them. You can place one list comprehensions within another list comprehension. This creates a nested list comprehension and further simplifies your code. Back to Basics: Increase the Readability of Your Python Script With 1 Simple Tool Quick Refresher: What Is a List Comprehension? As a quick refresher, a list comprehension is a way to create a new list by filtering elements in a list that meet a condition, transforming the elements as desired and storing the new values in a list. All we need is a single line of code. The code is as follows: `Result = [Function for Value in DataSet if Condition]` That code sorts through each value in your data set, checks to see if it meets the condition, applies the stated function and stores it in a list named Result. It applies a for loop, if statement and a function all in a single line. Here's an example showing how list comprehensions work: `Numbers = [1,2,3,4,5,6,7,8,9,10]` `Result_ForLoop = []` for Number in Numbers: if Number > sum(Numbers)/len(Numbers): `Result.append(Number)` `Result_ListComprehension = []` `Result_ListComprehension = [Number for Number in Numbers if Number > sum(Numbers)/len(Numbers)]` `print(Result_ForLoop)` `print(Result_ListComprehension)` Those two print statements will show the exact same result: `[6,7,8,9,10]`. For a more detailed discussion of how those two pieces of code return the same result see my guide to list comprehensions. Now let's dive in to nested list comprehensions. What Is a Nested List Comprehension? A nested list comprehension doubles down on the concept of list comprehensions. It's a way to combine not only one, but multiple for loops, if statements and functions into a single line of code. This becomes useful when you have a list of lists (instead of merely a single list). Let's consider an example. Say you have two lists of numbers and you want to return the square of all of the even numbers. You could write the following code using a single list comprehension: `Numbers = [[1,2,3,4,5,6,7,8,9,10], [11,12,13,14,15,16,17,18,19,20]]` `Result = []` for list in Numbers: `Squares = [Number ** 2 for Number in list if Number % 2 == 0]` `Result.extend(Squares)` The above code: Creates the input data set and stores it in Numbers. The input data consists of two lists. The first list runs from one to 10, and the second list runs from 11 to 20. Then the code creates an empty list called Result. We will use Result to store the output from our function. The code will then create a for loop and iterate through each list in Number. Within the for loop it uses a list comprehension to search through the provided list, check if each number in the list is divisible by two (i.e. Is it even?), squares the result and stores it in a list. This list is then stored in the variable Squares. The final line then adds Squares to Result giving us a list of the squares of the values that are divisible by two. Since there are two lists in Numbers it executes the for loop twice. Now, since you're familiar with list comprehensions you probably understand it's fully possible to remove the for loop and if statement with a list comprehension. Doing so creates a nested list comprehension. To do this we write a single list comprehension with two for loops. It's key to remember three things when doing this: The function is always the first term. The for loops are always written in the order of the nesting. The condition is always placed at the end. So, to construct a nested for loop in our example we need to: Write the function to square the numbers that have passed the filter. Write a for loop iterating through all of the lists in Numbers. Write a for loop iterating through each number in the passed list. Write a condition passing the numbers that are even. And we need to do it in that order. Fortunately, once we've created that structure in our minds it's easy to do. The code appears as follows: `Result = [Number ** 2 for list in Numbers for Number in list if Number % 2 == 0]` If you replace the previous code you'll find this nested list comprehension returns the same result. This is a powerful way to reduce several lines of code into a single line and can significantly increase the readability of your code. Since it's in a single line, anybody who understands list comprehensions will be able to quickly deduce what is happening and follow your logic. Learn More With Peter Grant: Need to Automate Your Data Analysis? Here's How. Before You Start Nesting... While nested list comprehensions are a useful way to improve your code's readability, there is a downside. List comprehensions can get very complex very quickly. What if you have a hundred for loops? Or what if you have very complex function and condition descriptions? I could envision a complex nested for loop spanning several lines of code, and becoming nearly impossible to read or understand. While there's Python has no technical limit to understanding complex a nested for loops, there is a human limit. If you have a complex piece of code with many for loops, or complex functions and conditions, using a nested for loop may actually make your code more difficult to understand. Take care to ensure your efforts are making your collaborators' lives easier instead of harder. Generally speaking, if you have more than three levels of nesting it may be easier for everybody if you just write out the for loops. Learning to make code easy for other people to understand is a critical task in the modern workplace—especially as more and more teams work remotely. List comprehensions and nested list comprehensions are a useful Python tool to help your collaborators quickly understand how your code works. This article was published as a part of the Data Science Blogathon Introduction. In this article, we'll study Python list comprehensions, and the way to use them. The topics which we'll be discussing in this article are as follows: What's the difference between List Comprehension and For loop in Python? Syntax of List Comprehensions in python Difference between Lambda functions and List Comprehensions Conditionals within the List Comprehension Nested loops within the List Comprehensions in python Key points on List Comprehension More Examples of List Comprehension Image Source: Google Images What's the Difference between List Comprehension and For Loop in Python? Suppose, we wish to separate the letters of the word "analytics" and add the letters as items of a list. The primary thing that comes to mind would be using for loop. Example 1: Using For loop to Iterate through a String `separated_letters = []` for letter in 'analytics': `separated_letters.append(letter)` `print(separated_letters)` Output: `['a', 'n', 'a', 'l', 'y', 't', 'i', 'c', 's']` Code Explanation: In this example, we will split the string based on characters and store all those characters in a new list. However, Python has a better way to solve this issue using List Comprehension. List comprehension is a sublime way to define and make lists based on existing lists. Let's see how the above program may be written using list comprehensions. Example 2: Using List Comprehension to Iterate through a String `separated_letters = [ letter for letter in 'analytics' ]` `print( separated_letters )` Output: `['a', 'n', 'a', 'l', 'y', 't', 'i', 'c', 's']` Code Explanation: In the above example, a brand new list is assigned to variable `separated_letters`, and the list contains the things of the iterable string "analytics". Finally, to receive the output, we call the `print()` function of Python. Syntax of List Comprehension `[expression for item in list]` Now, we are able to identify where list comprehensions are used. If you noticed, "analytics" could be a string, not a list. This is often the facility of list comprehension. It can identify when it receives a string or a tuple and works on that as a list. You can try this using loops. However, not every loop may be rewritten as a list comprehension. But as you learn and acquire comfortable with list comprehensions, you'll end up replacing more and more loops with this elegant syntax. List Comprehensions vs Lambda functions To work or operations with the lists, List comprehensions aren't the only way but various built-in functions and lambda functions can create and modify lists in fewer lines of code. Example 3: Using Lambda functions inside List `letters = list(map(lambda y: y, 'analytics'))` `print(letters)` Output: `['a', 'n', 'a', 'l', 'y', 't', 'i', 'c', 's']` Code Explanation: In this code, we will separate the characters of the string using lambda functions. However, in general list comprehensions are more human-readable than lambda functions. It's easier to grasp what the programmer was trying to accomplish when list comprehensions are used. Conditionals in List Comprehension List comprehensions can utilize conditional statements to change the existing lists (or other tuples). we are going to create a list that uses mathematical operators, integers, and `range()`. Example 4: Using if with List Comprehension `even_list = [ i for i in range(10) if i % 2 == 0]` `print(even_list)` Output: `[0, 2, 4, 6, 8]` Code Explanation: The list, `even_list`, is going to be populated by the things in the range from 0 - 9 if the item's value is divisible by 2. Example 5: Nested if with List Comprehension `filtered_list = [ x for x in range(50) if x % 2 == 0 if x % 5 == 0]` `print(filtered_list)` Output: `[0, 10, 20, 30, 40]` Code Explanation: Here, list comprehension checks: Is x divisible by 2 or not? Is x divisible by 5 or not? If x satisfies both conditions, x is appended to filtered list. Example 6: if...else With List Comprehension `list = ["even" if y%2==0 else "odd" for y in range(5)]` `print(list)` Output: `['even', 'odd', 'even', 'odd', 'even']` Code Explanation: Here, list comprehension will check the five numbers from 0 to 4. If y is divisible by 2, then even is appended to the obj list. If not, odd is appended. Nested Loops in List Comprehension Suppose, we'd like to compute the transpose of a matrix that needs nested for loop. Let's see how it's done using normal for loop first. Example 7: Finding Transpose of Matrix using Nested Loops `transposed_matrix = []` `matrix = [[1, 2, 3, 4], [4, 5, 6, 8]]` for i in range(len(matrix[0])): `transposed_row = []` for row in matrix: `transposed_row.append(row[i])` `transposed_matrix.append(transposed_row)` `print(transposed_matrix)` Output: `[[1, 4], [2, 5], [3, 6], [4, 8]]` Code Explanation: The above code uses two for loops to search out the transpose of the matrix. Also, We can perform nested iterations inside a list comprehension. In this section, we are going to find the transpose of a matrix using a nested loop inside a list comprehension. Example 8: Finding Transpose of a Matrix using List Comprehension `matrix = [[1, 2], [3,4], [5,6], [7,8]]` `transpose_matrix = [row[i] for row in matrix] for i in range(2)]` `print( transpose_matrix )` Output: `[[1, 3, 5, 7], [2, 4, 6, 8]]` Code Explanation: In the above program, we've got a variable matrix that has 4 rows and a couple of columns. We need to seek out the transpose of the matrix. For that, we used list comprehension. Key Points on List Comprehension The key points which we have to keep in mind while working with list comprehension are as follows: List comprehension is a sublime way to define and build lists with the help of existing lists. In comparison to normal functions and loops, List comprehension is usually more compact and faster for creating lists. However, we should always avoid writing very long list comprehensions in one line to confirm that code is user-friendly. Remember, every list comprehension is rewritten in for loop, but every for loop can't be rewritten within the kind of list comprehension. More Examples of List Comprehensions Let's see some more examples related to List Comprehension so that you have a better understanding of List Comprehensions in Python. Example 9: Finding the elements in a list in which elements are ended with the letter 'b' and the length of that element is greater than 2 `names = ['Ch', 'Dh', 'Eh', 'cb', 'Tb', 'Td', 'Chb', 'Tdb']` `final_names = [name for name in names if name.lower().endswith('b') and len(name) > 2]` `final_names` Output: `['Chb', 'Tdb']` Code Explanation: In the above code, we use list comprehension with some conditions associated with it. The functions involved in the conditions are as follows: `name.lower().endswith('b')`: This function filter out all the strings from the list that are ended with the letters 'b' or 'B'. `len(name)`: This function finds the length of all the elements in a specified tuple. List = `[string[::-1] for string in ('Hello', 'Analytics', 'Vidhya)]` # Display the list `print(List)` Output: `['olleH', 'scitylanA', 'ydhiv']` Code Explanation: In the above code, we use the concept of slicing in a string, therefore by using the `str[::-1]` function, we can reverse the elements of a string, and we apply this function to every element in the tuple by using list comprehension. This ends our discussion! End Notes I hope you enjoyed the article. If you want to connect with me, please feel free to contact me by Email. Your suggestions and doubts are welcomed here in the comment section. Thank you for reading my article! The media shown in this article are not owned by Analytics Vidhya and are used at the Author's discretion. Related





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