

LIST COMPREHENSIONS

Quick Recap

You should already know what list comprehensions are, but let's quickly recap their syntax and how they work:

goal → generate a list by **transforming**, and optionally **filtering**, another **iterable**

- start with some iterable
- create empty new list
- iterate over the original iterable
- skip over certain values (filter)
- transform value and append to new list

```
other_list = ['this', 'is', 'a', 'parrot']  
new_list = []  
for item in other_list:  
    if len(item) > 2:  
        new_list.append(item[::-1])
```

List comprehension:

```
new_list = [item[::-1] for item in other_list if len(item) > 2]
```

transformation

iteration

filter

Formatting the Comprehension Expression

If the comprehension expression gets too long, it can be split over multiple lines

For example, let's say we want to create a list of squares of all the integers between 1 and 100 that are not divisible by 2, 3 or 5

```
sq = [i**2 for i in range(1, 101) if i%2 and i%3 and i%5]
```

We could write this over multiple lines:

```
sq = [i**2  
      for i in range(1, 101)  
      if i%2 and i%3 and i%5]
```


Comprehension Internals

Comprehensions have their own **local scope** – just like a function

We should think of a list comprehension as being **wrapped** in a function that is created by Python that will return the new list when executed

```
sq = [i**2 for i in range(10)]
```

RHS

When the RHS is compiled: Python creates a temporary function that will be used to evaluate the comprehension

```
def temp():  
    new_list = []  
    for i in range(10):  
        new_list.append(i**2)  
    return new_list
```

When the line is executed: Executes `temp()`
Stores the returned object (the list) in memory
Points `sq` to that object

We'll disassemble some Python code in the coding video to actually see this

Comprehension Scopes

So comprehensions are basically functions

They have their own local scope: `[item ** 2 for item in range(100)]`

local symbol

But they can access **global** variables:

```
# module1.py
```

```
num = 100
```

global symbol

```
sq = [item**2 for item in range(num)]
```

local symbol

As well as **nonlocal** variables:

```
def my_func(num):
```

```
    sq = [item**2 for item in range(num)]
```

nonlocal symbol

Closures!!

Nested Comprehensions

Comprehensions can be nested within each other

And since they are functions, a nested comprehension can access (nonlocal) variables from the enclosing comprehension!

```
[ [i * j for j in range(5)] for i in range(5)]
```

nested comprehension

outer comprehension

local variable: *i*

closure

local variable: *j*

free variable: *i*

Nested Loops in Comprehensions

We can have nested loops (as many levels as we want) in comprehensions.

This is not the same as nested comprehensions

```
l = []
for i in range(5):
    for j in range(5):
        for k in range(5):
            l.append((i, j, k))
```

```
l = [(i, j, k) for i in range(5) for j in range(5) for k in range(5)]
```

Note that the **order** in which the for loops are specified in the comprehension correspond to the order of the nested loops

Nested Loops in Comprehensions

Nested loops in comprehensions can also contain `if` statements

Again the order of the `for` and `if` statements does matter, just like a normal set of `for` loops and `if` statements

```
l = []
for i in range(5):
    for j in range(5):
        if i==j:
            l.append((i, j))
```

```
l = []
for i in range(5):
    if i==j:
        for j in range(5):
            l.append((i, j))
```

won't work!

```
l = [(i, j) for i in range(5) for j in range(5) if i == j]
```

`j` is created here

`j` is referenced after
it has been created

```
l = [(i, j) for i in range(5) if i == j for j in range(5)]
```

won't work!

Nested Loops in Comprehensions

```
l = []
for i in range(1, 6):
    if i%2 == 0:
        for j in range(1, 6):
            if j%3 == 0:
                l.append((i,j))
```

```
[(i, j)
 for i in range(1, 6) if i%2==0
 for j in range(1, 6) if j%3==0]
```



```
l = []
for i in range(1, 6):
    for j in range(1, 6):
        if i%2==0:
            if j%3 == 0:
                l.append((i,j))
```

```
[(i, j)
 for i in range(1, 6)
 for j in range(1, 6)
 if i%2==0
 if j%3==0]
```



```
l = []
for i in range(1, 6):
    for j in range(1, 6):
        if i%2==0 and j%3==0:
            l.append((i,j))
```

```
[(i, j)
 for i in range(1, 6)
 for j in range(1, 6)
 if i%2==0 and j%3==0]
```



Code Exercises

© 2018 Matplotlib Academy