Mod 02 - Python Lists and Advanced Flow Control

SCRIPTING ESSENTIALS

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Learning Objectives

Understanding Python lists

indexes

slices

length

changing values

concatenating and replicating lists

deleting values

looping through lists

Checking if a value is in (or not in) a list

list methods

index

append

insert

remove

sorting a list

mutability

tuples

converting tuples and lists

list references

copying a list (deepcopy)

Learning Objectives

Functions

Variable Scope

Exception Handling

Lists

Basics:

- A list contains multiple values in an ordered sequence.
- Items are the things inside a list
- Lists are inside square brackets [ ]
- Item are comma delimited

Examples:

- [1, 2, 3]
- [‘cat’, ‘rat’, ‘bat’]
- [1, ‘Bob’, 3.14]

List Indexes

Items in a list are access by integer position, left to right, starting with zero

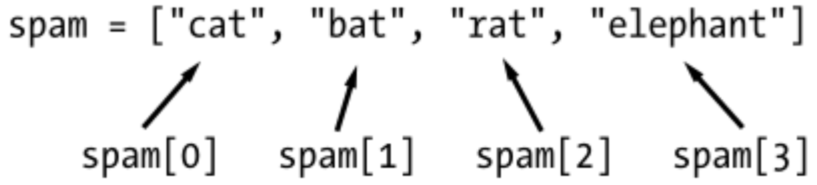
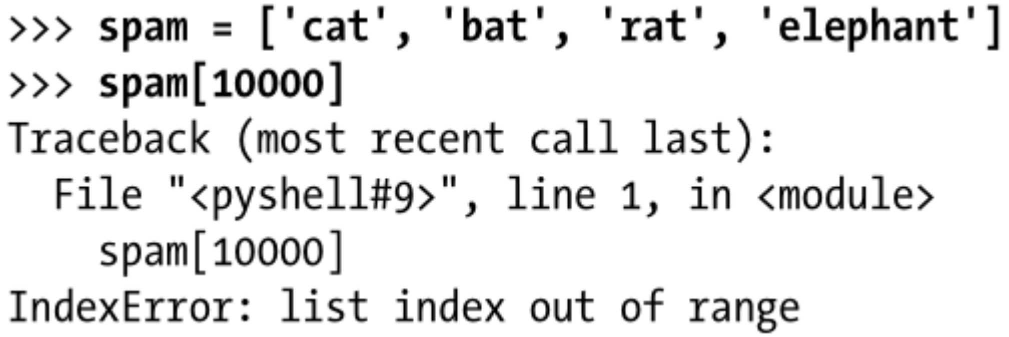


Figure 4-1: A list value stored in the variable spam, showing which value each index refers to

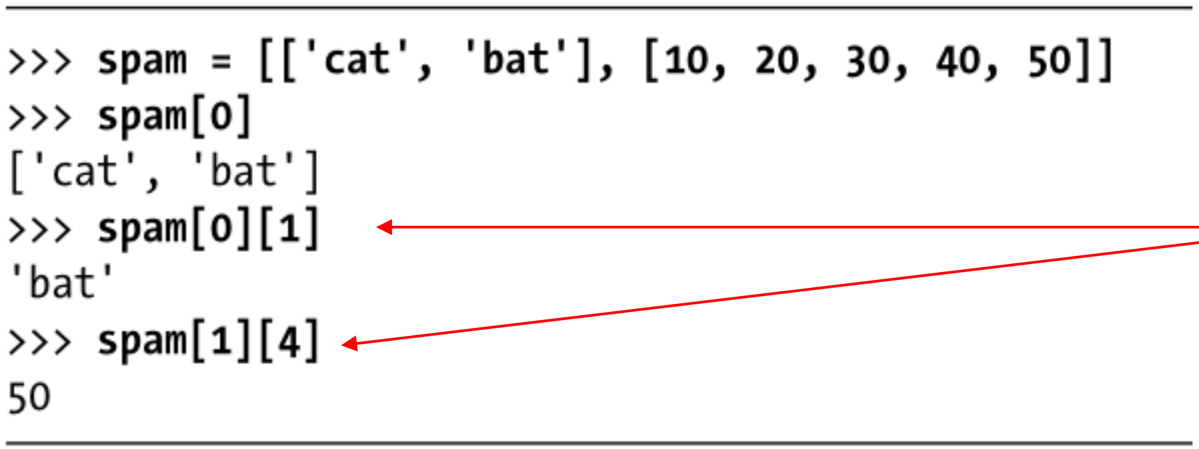
Index out of range error:



```
>>> spam = ['cat', 'bat', 'rat', 'elephant']
>>> spam[10000]
Traceback (most recent call last):
  File "<pyshell#9>", line 1, in <module>
    spam[10000]
IndexError: list index out of range
```

List Indexes

Lists can contain lists:



```
>>> spam = [['cat', 'bat'], [10, 20, 30, 40, 50]]
>>> spam[0]
['cat', 'bat']
>>> spam[0][1]
'bat'
>>> spam[1][4]
50
```

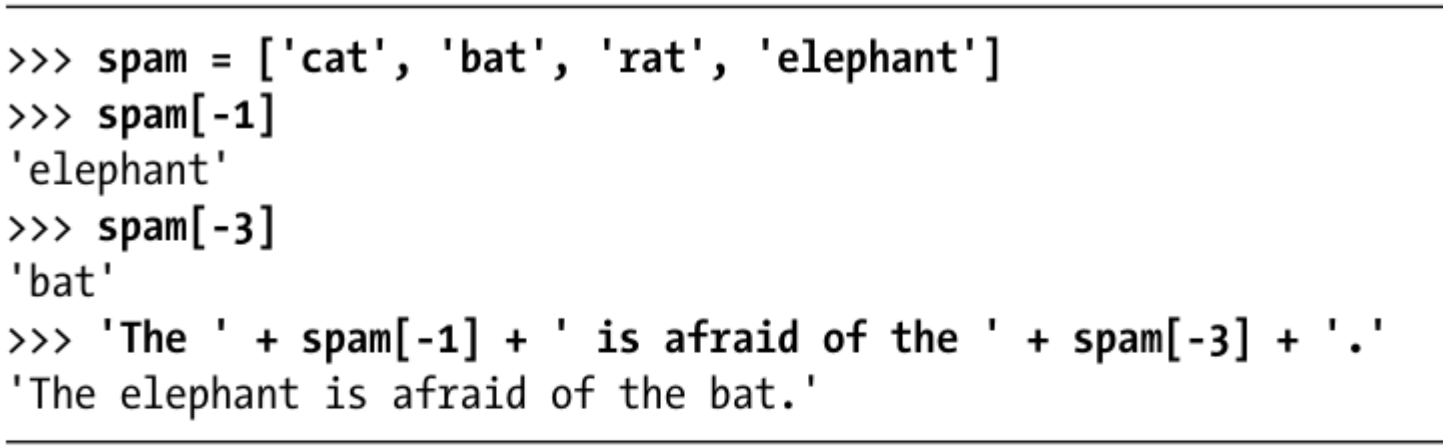
Note how you access items in a list, in a list

```
spam = [['cat', 'bat'], [10, 20, 30, 40, 50]]
print (spam[0])
print (spam[0][1])
print (spam[1][4])
```

List Indexes

You can use negative indexes

- They reference right to left



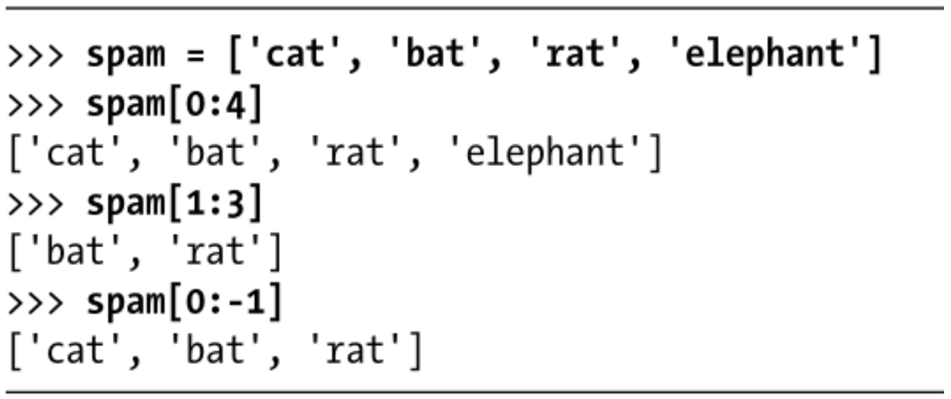
```
>>> spam = ['cat', 'bat', 'rat', 'elephant']
>>> spam[-1]
'elephant'
>>> spam[-3]
'bat'
>>> 'The ' + spam[-1] + ' is afraid of the ' + spam[-3] + '.'
'The elephant is afraid of the bat.'
```

```
spam = ['cat', 'bat', 'rat', 'elephant']
print (spam[-1])
print (spam[-3])
print ('The ' + spam[-1] + ' is afraid of the ' + spam[-3] + '.')
```

List Indexes

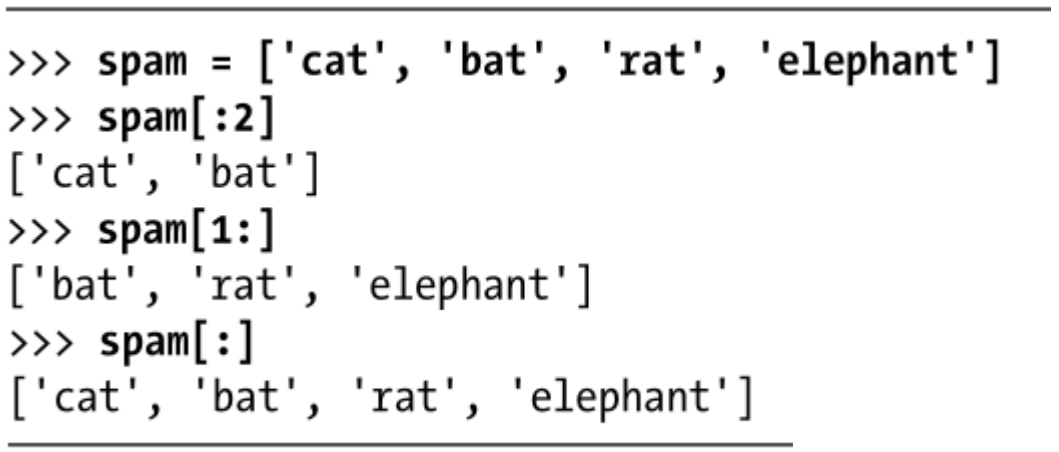
Slices get several values from a list

- List[start:end]
  - The end value is never included



```
>>> spam = ['cat', 'bat', 'rat', 'elephant']
>>> spam[0:4]
['cat', 'bat', 'rat', 'elephant']
>>> spam[1:3]
['bat', 'rat']
>>> spam[0:-1]
['cat', 'bat', 'rat']
```

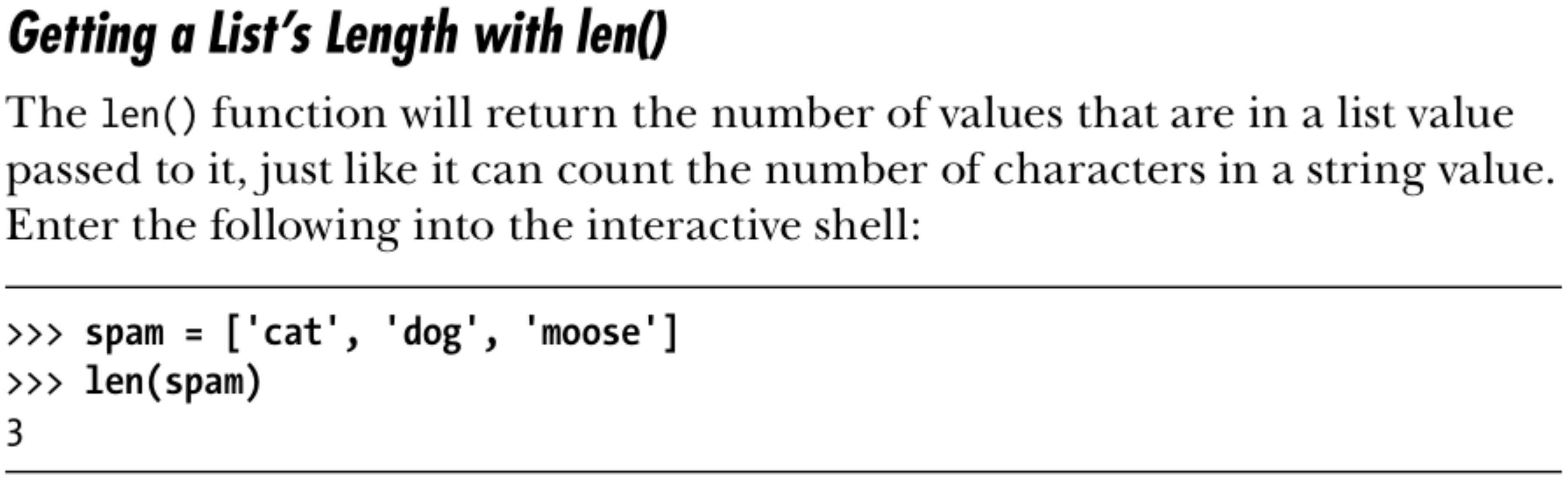
Or you can leave out one end:



```
>>> spam = ['cat', 'bat', 'rat', 'elephant']
>>> spam[:2]
['cat', 'bat']
>>> spam[1:]
['bat', 'rat', 'elephant']
>>> spam[:]
['cat', 'bat', 'rat', 'elephant']
```

```
spam = ['cat', 'bat', 'rat', 'elephant']
print (spam[0:4])
print (spam[1:3])
print (spam[0:-1])
print (spam[:2])
print (spam[1:])
print (spam[:])
```

List Length



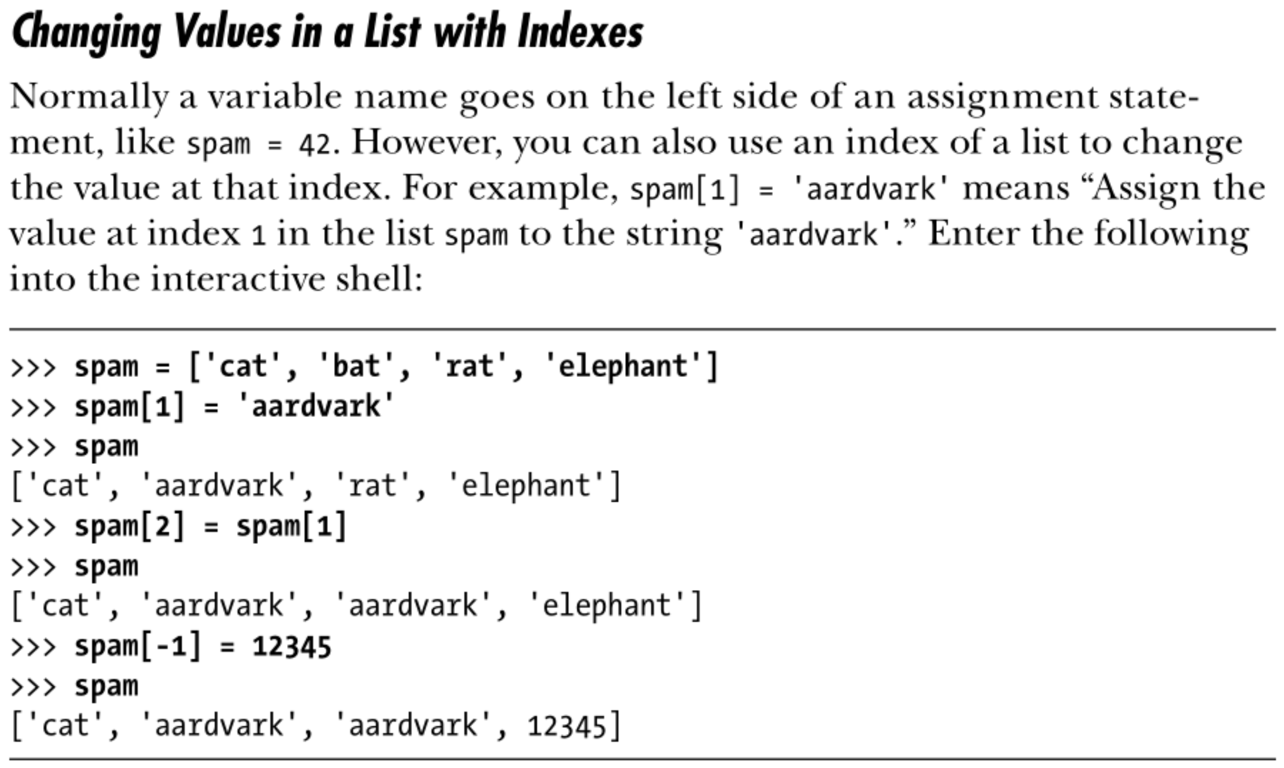
Getting a List's Length with len()

The `len()` function will return the number of values that are in a list value passed to it, just like it can count the number of characters in a string value. Enter the following into the interactive shell:

```
>>> spam = ['cat', 'dog', 'moose']
>>> len(spam)
3
```

spam = ['cat', 'dog', 'moose']
print (len(spam))

Changing List Values



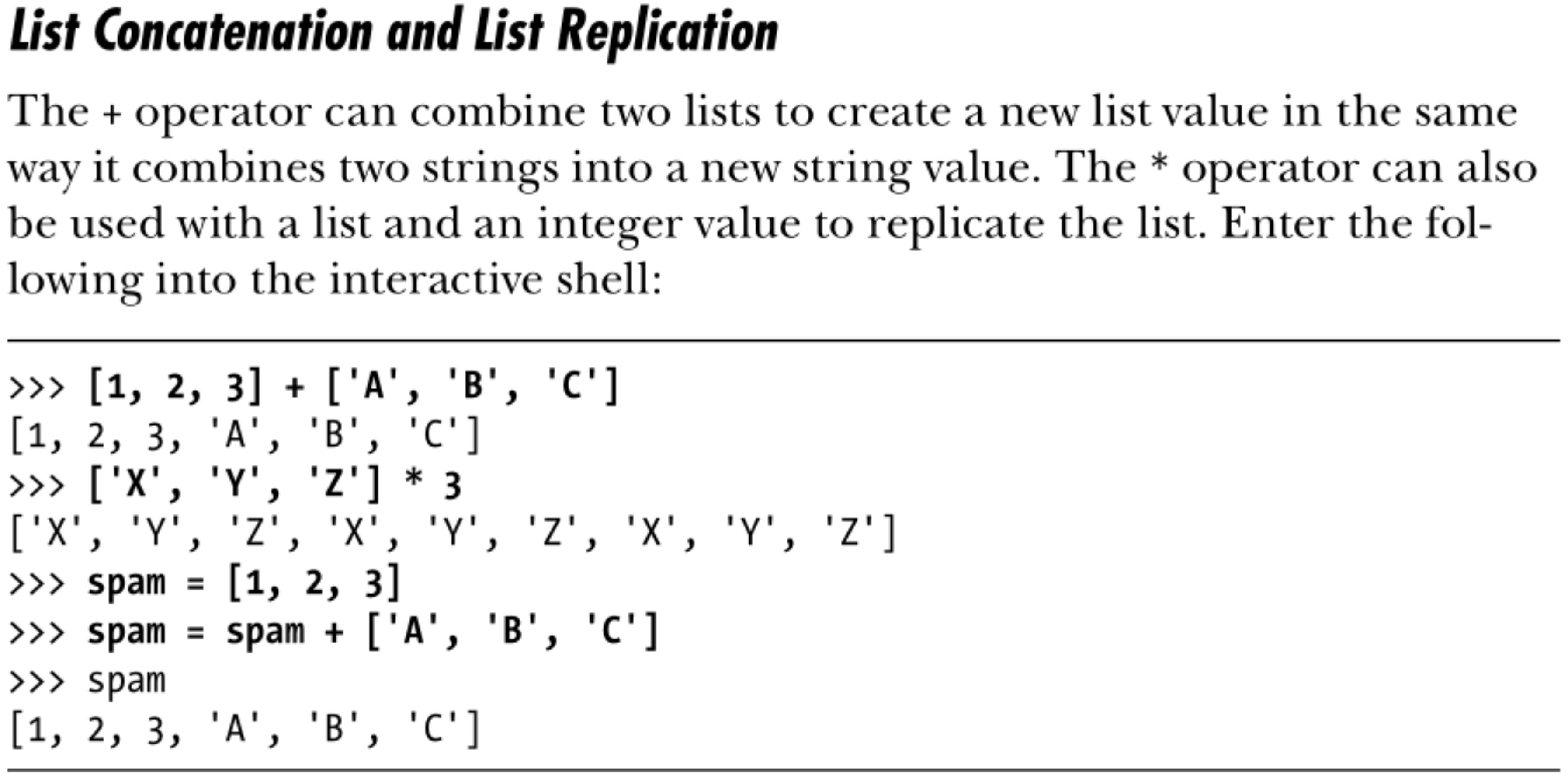
Changing Values in a List with Indexes

Normally a variable name goes on the left side of an assignment statement, like `spam = 42`. However, you can also use an index of a list to change the value at that index. For example, `spam[1] = 'aardvark'` means "Assign the value at index `1` in the list `spam` to the string `'aardvark'`." Enter the following into the interactive shell:

```
>>> spam = ['cat', 'bat', 'rat', 'elephant']
>>> spam[1] = 'aardvark'
>>> spam
['cat', 'aardvark', 'rat', 'elephant']
>>> spam[2] = spam[1]
>>> spam
['cat', 'aardvark', 'aardvark', 'elephant']
>>> spam[-1] = 12345
>>> spam
['cat', 'aardvark', 'aardvark', 12345]
```

```
spam = ['cat', 'bat', 'rat', 'elephant']
spam[1] = 'aardvark'
print(spam)
spam[2] = spam[1]
print (spam)
spam[-1] = 12345
print (spam)
```

List Concatenation and Replication

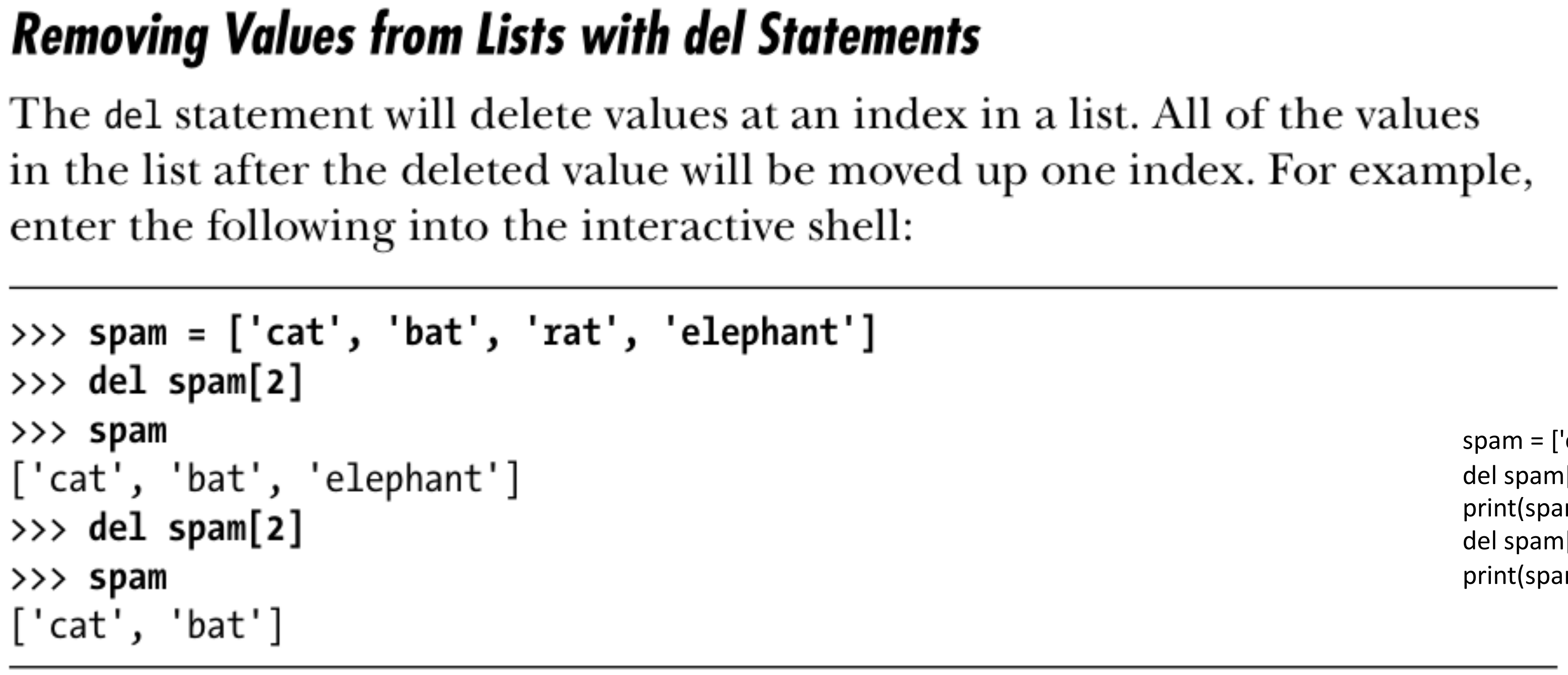


List Concatenation and List Replication

The + operator can combine two lists to create a new list value in the same way it combines two strings into a new string value. The * operator can also be used with a list and an integer value to replicate the list. Enter the following into the interactive shell:

```
>>> [1, 2, 3] + ['A', 'B', 'C']
[1, 2, 3, 'A', 'B', 'C']
>>> ['X', 'Y', 'Z'] * 3
['X', 'Y', 'Z', 'X', 'Y', 'Z', 'X', 'Y', 'Z']
>>> spam = [1, 2, 3]
>>> spam = spam + ['A', 'B', 'C']
>>> spam
[1, 2, 3, 'A', 'B', 'C']
```

Removing Values with del



Removing Values from Lists with del Statements

The `del` statement will delete values at an index in a list. All of the values in the list after the deleted value will be moved up one index. For example, enter the following into the interactive shell:

```
>>> spam = ['cat', 'bat', 'rat', 'elephant']
>>> del spam[2]
>>> spam
['cat', 'bat', 'elephant']
>>> del spam[2]
>>> spam
['cat', 'bat']
```

```
spam = ['cat', 'bat', 'rat', 'elephant']
del spam[2]
print(spam)
del spam[2]
print(spam)
```

Example Usage (Try this)

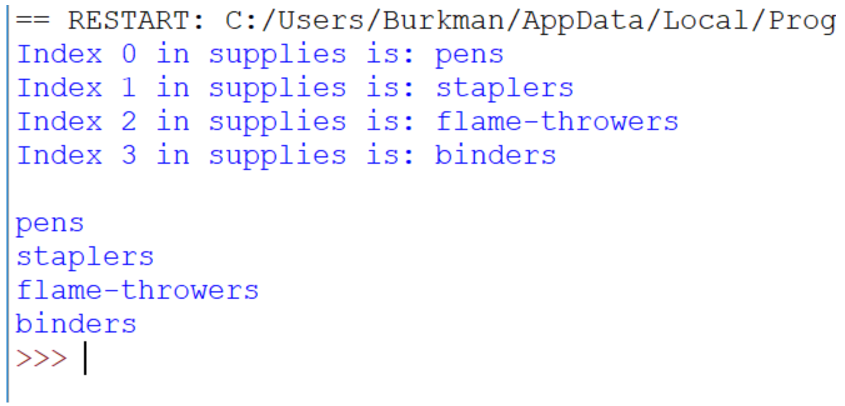
```
cat_names = [] #I am initializing an empty list
while True:
    print('Enter the name of cat ' + str(len(cat_names) +1) +
          ' (Or enter nothing to stop.):')
    name = input()
    if name == '':
        break
    cat_names = cat_names + [name] #list concatenation
print('The cat names are:')
for name in cat_names:
    print('  ' + name)
```

Looping Lists

```
supplies = ['pens', 'staplers', 'flame-throwers', 'binders']
for i in range(len(supplies)):
    print('Index ' + str(i) + ' in supplies is: ' + supplies[i])

print()

for j in supplies:
    print(j)
```

Note: len(supplies) = 4

Instead of using For to iterate through a range, we are iterating through a collection.



```
== RESTART: C:/Users/Burkman/AppData/Local/Prog
Index 0 in supplies is: pens
Index 1 in supplies is: staplers
Index 2 in supplies is: flame-throwers
Index 3 in supplies is: binders

pens
staplers
flame-throwers
binders
>>> |
```

Is X in my list?

In and Not in yield a Boolean evaluation:

```
>>> 'howdy' in ['hello', 'hi', 'howdy', 'heyas']
True
>>> spam = ['hello', 'hi', 'howdy', 'heyas']
>>> 'cat' in spam
False
>>> 'howdy' not in spam
False
>>> 'cat' not in spam
True
```

```
myPets = ['Zophie', 'Pooka', 'Fat-tail']
print('Enter a pet name:')
name = input()
if name not in myPets:
    print('I do not have a pet named ' + name)
else:
    print(name + ' is my pet.')
```

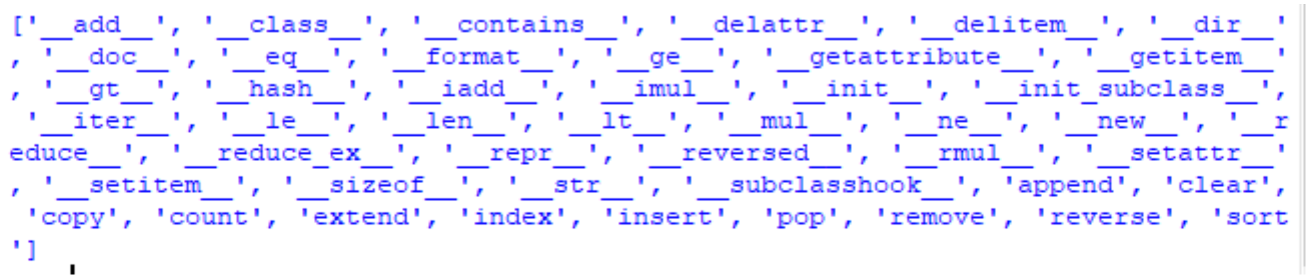
Methods

Same as a function but it is called on a value. Data types have methods.

- Method comes after value, separated by a period.

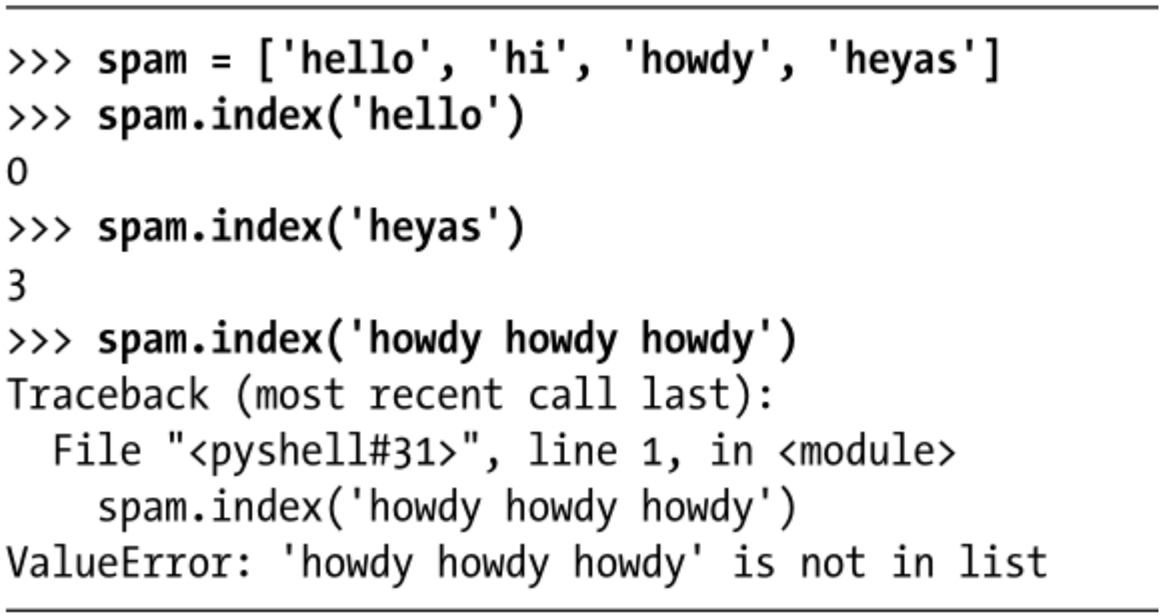
Remember, we can find the methods with dir

- dir(list)



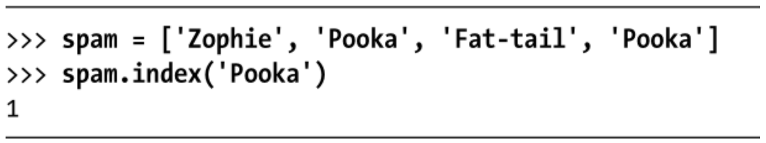
```
['__add__', '__class__', '__contains__', '__delattr__', '__delitem__', '__dir__'
, '__doc__', '__eq__', '__format__', '__ge__', '__getattribute__', '__getitem__'
, '__gt__', '__hash__', '__iadd__', '__imul__', '__init__', '__init_subclass__',
 '__iter__', '__le__', '__len__', '__lt__', '__mul__', '__ne__', '__new__', '__r
educe__', '__reduce_ex__', '__repr__', '__reversed__', '__rmul__', '__setattr__'
, '__setitem__', '__sizeof__', '__str__', '__subclasshook__', 'append', 'clear',
 'copy', 'count', 'extend', 'index', 'insert', 'pop', 'remove', 'reverse', 'sort
']
```

list.index



```
>>> spam = ['hello', 'hi', 'howdy', 'heyas']
>>> spam.index('hello')
0
>>> spam.index('heyas')
3
>>> spam.index('howdy howdy howdy')
Traceback (most recent call last):
  File "<pyshell#31>", line 1, in <module>
    spam.index('howdy howdy howdy')
ValueError: 'howdy howdy howdy' is not in list
```

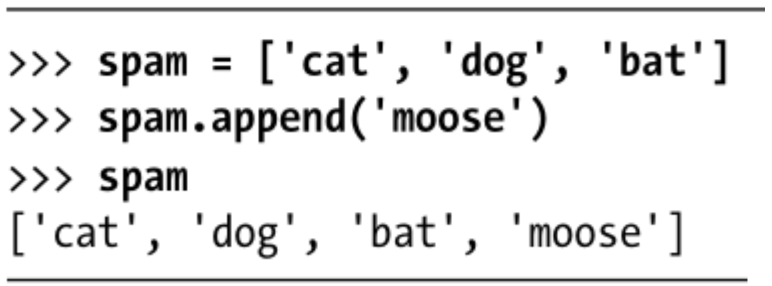
Note: If duplicates are in a list, index only finds the first instance



```
>>> spam = ['Zophie', 'Pooka', 'Fat-tail', 'Pooka']
>>> spam.index('Pooka')
1
```

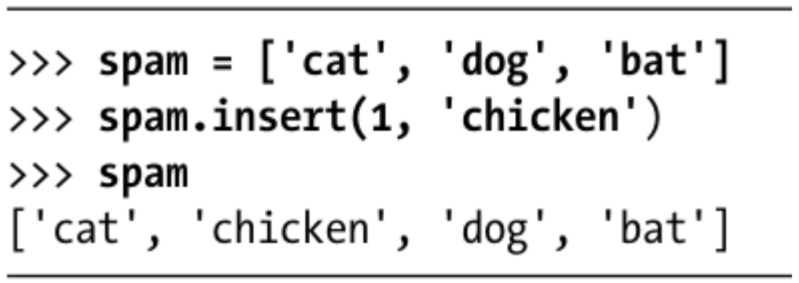
list.append and list.insert

list.append



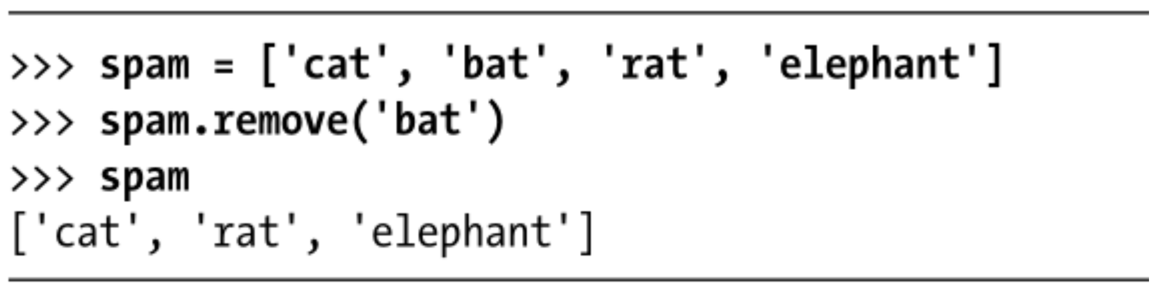
```
>>> spam = ['cat', 'dog', 'bat']
>>> spam.append('moose')
>>> spam
['cat', 'dog', 'bat', 'moose']
```

list.insert



```
>>> spam = ['cat', 'dog', 'bat']
>>> spam.insert(1, 'chicken')
>>> spam
['cat', 'chicken', 'dog', 'bat']
```

list.remove

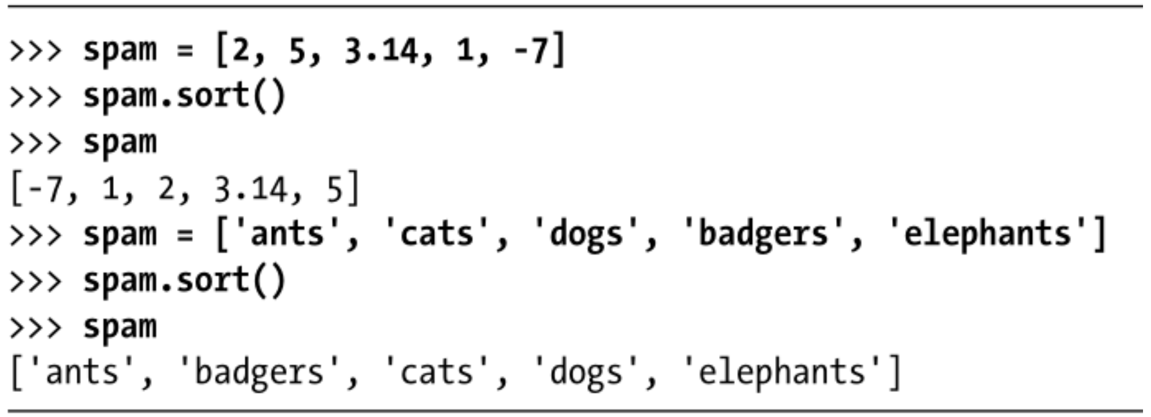


```
>>> spam = ['cat', 'bat', 'rat', 'elephant']
>>> spam.remove('bat')
>>> spam
['cat', 'rat', 'elephant']
```

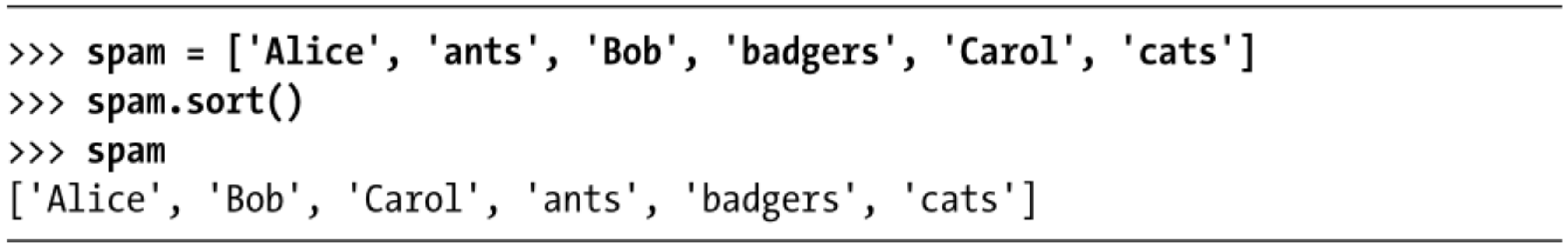
Sorting a list

The sort method can only sort:

- like things (no mixing numbers and strings)
- ASCII style
  - A a B b

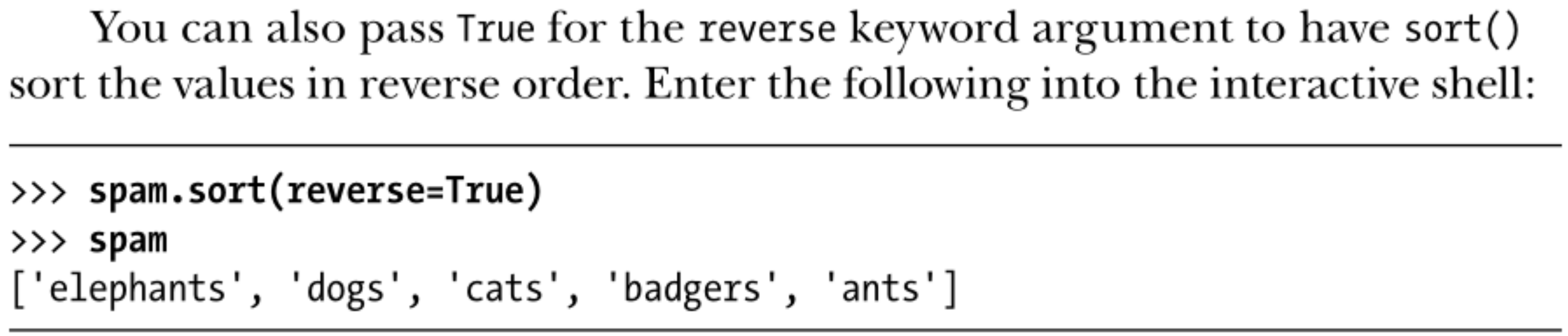


```
>>> spam = [2, 5, 3.14, 1, -7]
>>> spam.sort()
>>> spam
[-7, 1, 2, 3.14, 5]
>>> spam = ['ants', 'cats', 'dogs', 'badgers', 'elephants']
>>> spam.sort()
>>> spam
['ants', 'badgers', 'cats', 'dogs', 'elephants']
```



```
>>> spam = ['Alice', 'ants', 'Bob', 'badgers', 'Carol', 'cats']
>>> spam.sort()
>>> spam
['Alice', 'Bob', 'Carol', 'ants', 'badgers', 'cats']
```

Sorting a list

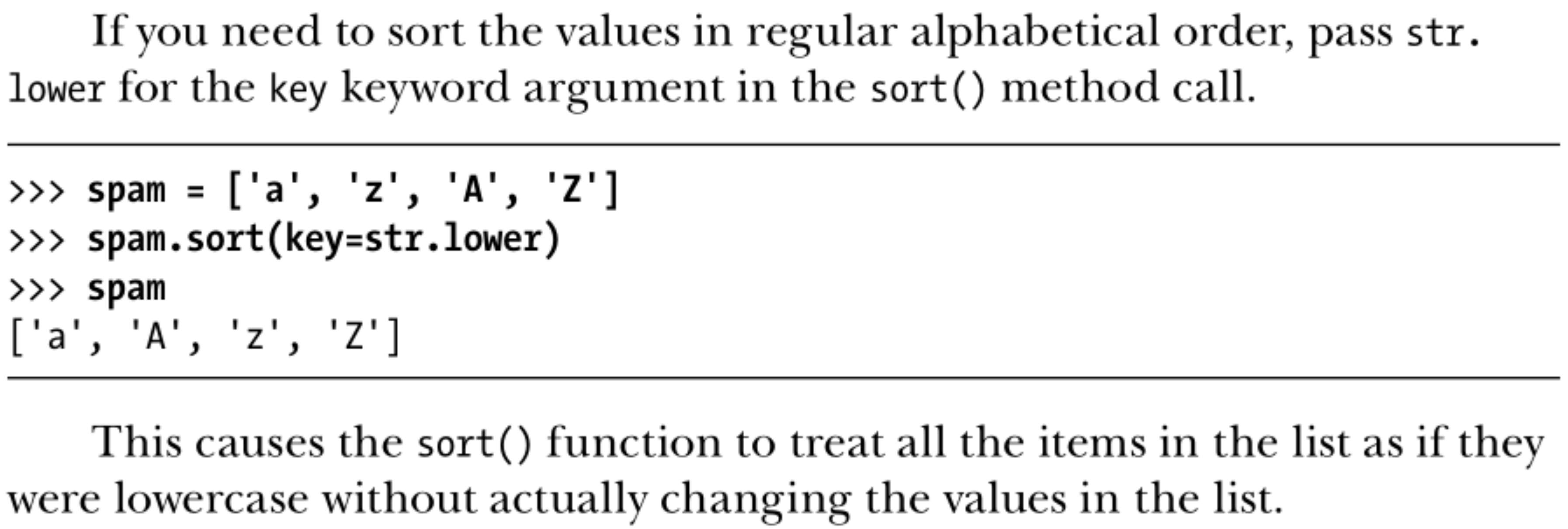


You can also pass True for the reverse keyword argument to have sort() sort the values in reverse order. Enter the following into the interactive shell:

```
>>> spam.sort(reverse=True)
>>> spam
['elephants', 'dogs', 'cats', 'badgers', 'ants']
```

Sorting a list

You can also sort using the key keyword argument:



If you need to sort the values in regular alphabetical order, pass `str.lower` for the `key` keyword argument in the `sort()` method call.

```
>>> spam = ['a', 'z', 'A', 'Z']
>>> spam.sort(key=str.lower)
>>> spam
['a', 'A', 'z', 'Z']
```

This causes the `sort()` function to treat all the items in the list as if they were lowercase without actually changing the values in the list.

Try This

```
import random

messages = ['It is certain',
'It is decidedly so',
'Yes definitely',
'Reply hazy try again',
'Ask again later',
'Concentrate and ask again',
'My reply is no',
'Outlook not so good',
'Very doubtful']

print(messages[random.randint(0, len(messages) - 1)])
```

A Slight Change

```
import random

a=0

while a<5:
    messages = ['It is certain',
    'It is decidedly so',
    'Yes definitely',
    'Reply hazy try again',
    'Ask again later',
    'Concentrate and ask again',
    'My reply is no',
    'Outlook not so good',
    'Very doubtful']

    print(messages[random.randint(0, len(messages) - 1)])
    a = a +1
```

Mutability

Mutable

- Can have values added, removed or changed
- Lists are mutable

Immutable

- Cannot be changed
- Strings and tuples are immutable

Tuple

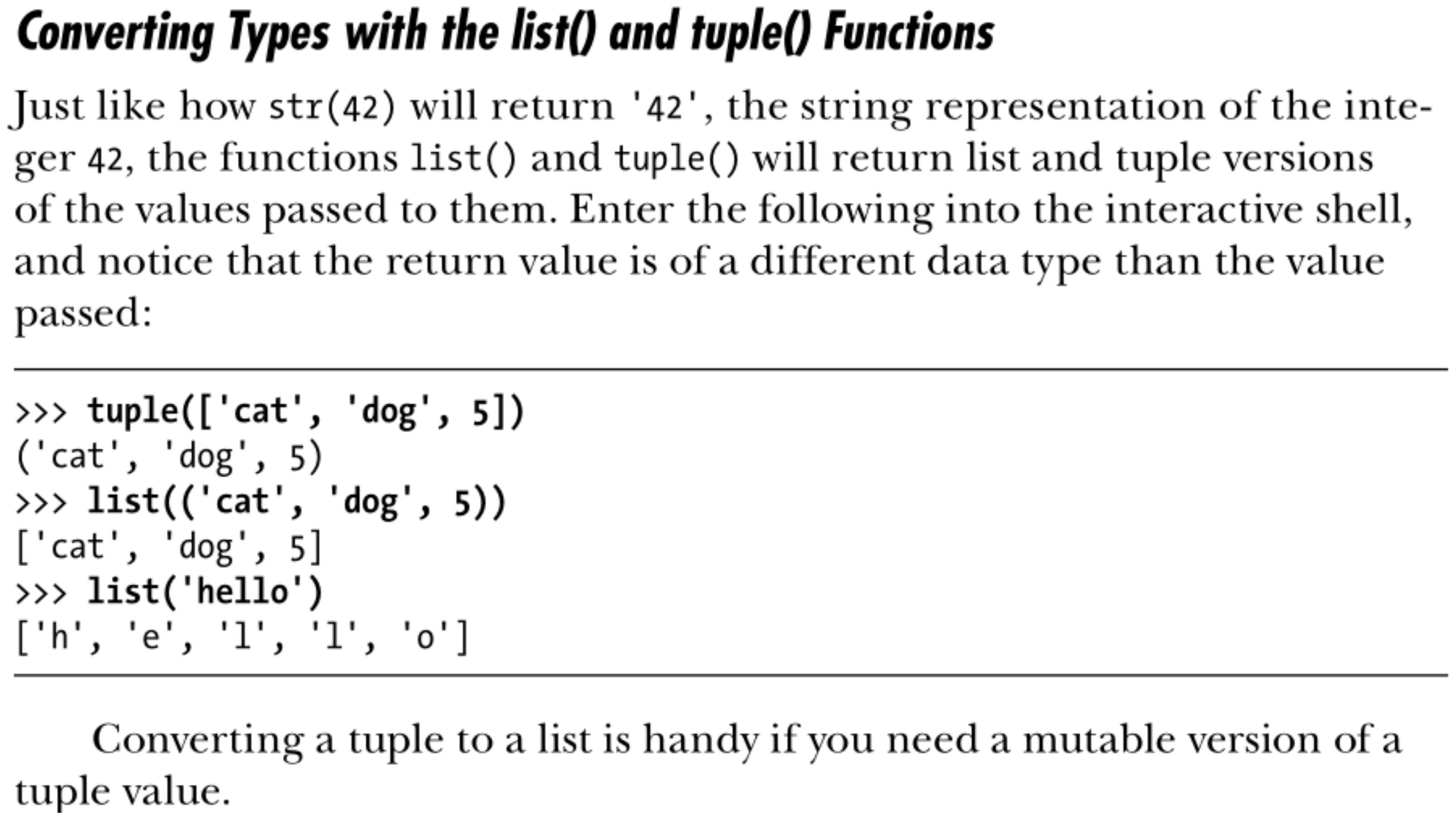
A tuple acts like an immutable list

- Has parentheses instead of square brackets.

```
>>> eggs = ('hello', 42, 0.5)
>>> eggs[0]
'hello'
>>> eggs[1:3]
(42, 0.5)
>>> len(eggs)
3
```

```
>>> eggs = ('hello', 42, 0.5)
>>> eggs[1] = 99
Traceback (most recent call last):
  File "<pyshell#5>", line 1, in <module>
    eggs[1] = 99
TypeError: 'tuple' object does not support item assignment
```

Converting Types



Converting Types with the list() and tuple() Functions

Just like how `str(42)` will return `'42'`, the string representation of the integer `42`, the functions `list()` and `tuple()` will return list and tuple versions of the values passed to them. Enter the following into the interactive shell, and notice that the return value is of a different data type than the value passed:

```
>>> tuple(['cat', 'dog', 5])
('cat', 'dog', 5)
>>> list(('cat', 'dog', 5))
['cat', 'dog', 5]
>>> list('hello')
['h', 'e', 'l', 'l', 'o']
```

Converting a tuple to a list is handy if you need a mutable version of a tuple value.

Populating a List with a Range

In Python 3 range is an iterator so you have to convert it to a list.

- Note that the upper value isn’t included

```
my_list = list(range(1, 1001))
print(my_list)
```

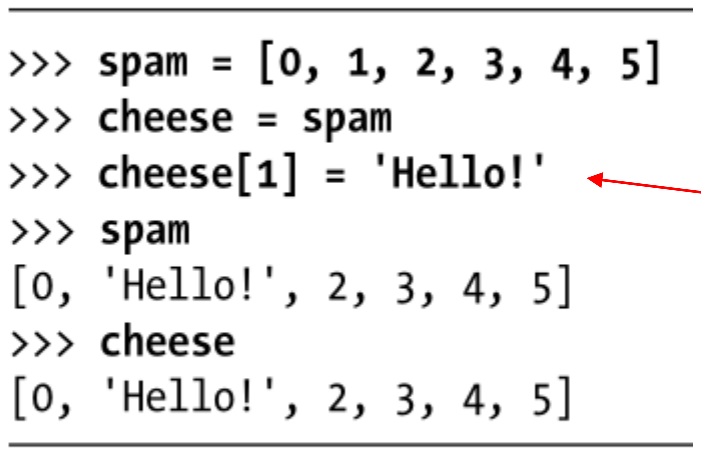
Understanding List References

Variables work like we’d expect. Each variable is its own “container”, even if it gets “filled” by another variable.

```
>>> spam = 42
>>> cheese = spam
>>> spam = 100
>>> spam
100
>>> cheese
42
```

Understanding List References

Lists don’t work this way. When you assign a list to a variable, the variable is only storing a reference (like a pointer) to that list. There are never multiple instances of one particular list.



```
>>> spam = [0, 1, 2, 3, 4, 5]
>>> cheese = spam
>>> cheese[1] = 'Hello!'
>>> spam
[0, 'Hello!', 2, 3, 4, 5]
>>> cheese
[0, 'Hello!', 2, 3, 4, 5]
```

Here, cheese is just pointing to the original spam list. Changes made to cheese actually go right over to the original spam list.

Copying a list with copy()

```
import copy

spam = ['A', 'B', 'C', 'D']

cheese = copy.copy(spam) #This does make a new list

cheese[1] = 42

print(spam)
print(cheese)
```

Copy.deepcopy

```
#Use deepcopy() if your list contains lists

import copy

spam = [[1,2,3],['a', 'b', 'c']]

cheese = copy.deepcopy(spam) #This does make a new list

cheese[0][1] = 42

print(spam)
print(cheese)
```

Functions

A named chunk of code that may, or may not, accept parameters. The parameter value only exists while the function runs (“name”, in the second example).

```
def hello():
    print('Hello World')


hello()
```

```
def hello(name):
    print('Hello ' + name)


hello('Jim')
hello('Nita')
```

Functions

Return does just that, it returns a value from a function

Here r is assigned a random value, then that value is passed to the getAnswer function. The return value gets assigned to "fortune", which is then printed.

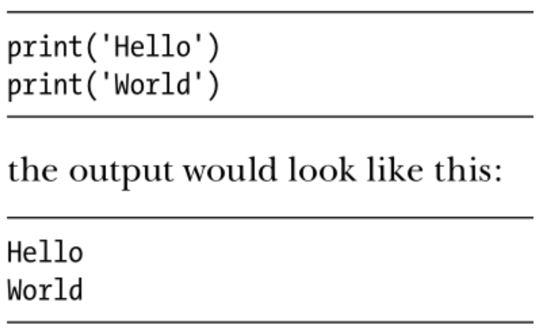
```
import random
def getAnswer(answerNumber):
    if answerNumber == 1:
        return 'It is certain'
    elif answerNumber == 2:
        return 'It is decidedly so'
    elif answerNumber == 3:
        return 'Yes'
    elif answerNumber == 4:
        return 'Reply hazy try again'
    elif answerNumber == 5:
        return 'Ask again later'
    elif answerNumber == 6:
        return 'Concentrate and ask again'
    elif answerNumber == 7:
        return 'My reply is no'
    elif answerNumber == 8:
        return 'Outlook not so good'
    elif answerNumber == 9:
        return 'Very doubtful'

r = random.randint(1, 9)
fortune = getAnswer(r)
print(fortune)
```

Keyword Arguments in Built-in Functions

Generally the order of function inputs matters

- random.randint(1, 10) take the lower and upper bounds. It is not the same as random.randint(10, 1)

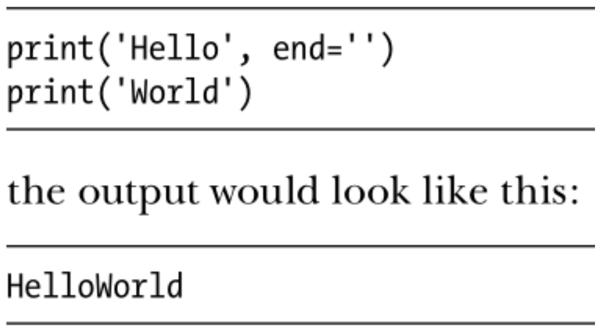
Keyword arguments are used for optional parameters



```
print('Hello')
print('World')
```

the output would look like this:

```
Hello
World
```



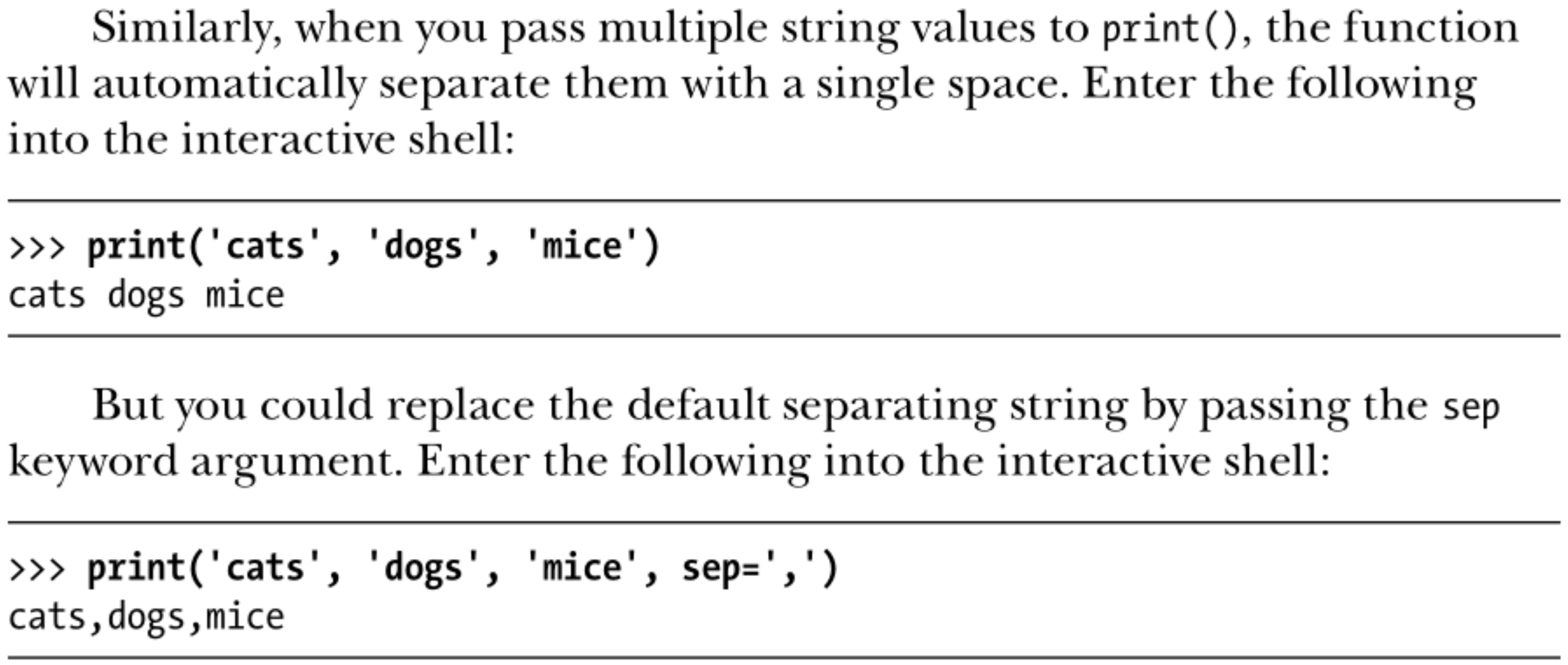
```
print('Hello', end='')
print('World')
```

the output would look like this:

```
HelloWorld
```

Here the “end” parameter changes the newline to the specified delimiter ‘’.

Keyword Arguments in Built-in Functions



Similarly, when you pass multiple string values to `print()`, the function will automatically separate them with a single space. Enter the following into the interactive shell:

```
>>> print('cats', 'dogs', 'mice')
cats dogs mice
```

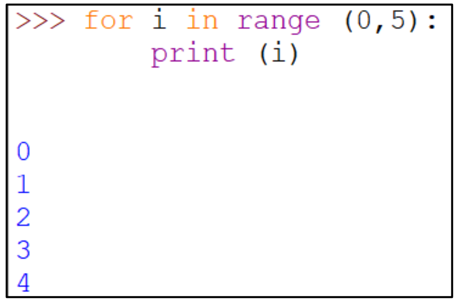
But you could replace the default separating string by passing the `sep` keyword argument. Enter the following into the interactive shell:

```
>>> print('cats', 'dogs', 'mice', sep=',')
cats,dogs,mice
```

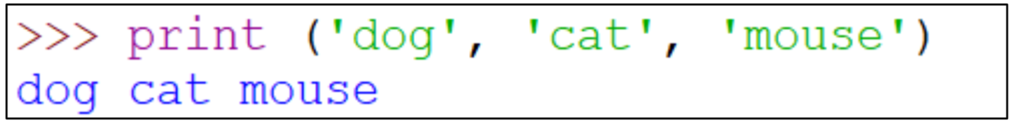
Sep vs End

By default the end parameter in Print is a new line. End changes that, so if you have multiple print statements (or a print statement that runs multiple times in a loop) you can get the output items together with something like end = ' '

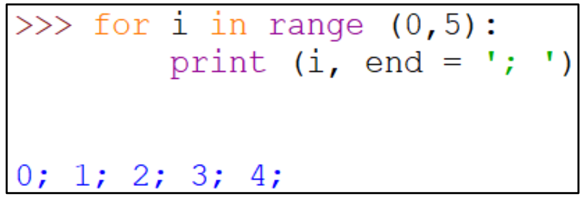
Sep provides the character(s) between items being printed. The default is a space (technically a soft space)



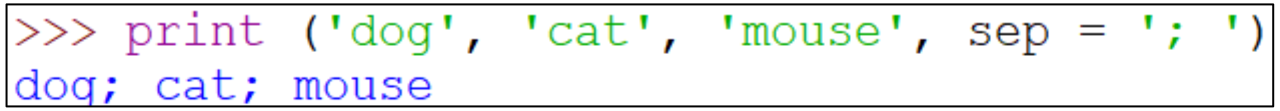
```
>>> for i in range (0,5):
        print (i)


0
1
2
3
4
```



```
>>> print ('dog', 'cat', 'mouse')
dog cat mouse
```



```
>>> for i in range (0,5):
        print (i, end = '; ')


0; 1; 2; 3; 4;
```



```
>>> print ('dog', 'cat', 'mouse', sep = '; ')
dog; cat; mouse
```

Scope

Scope is like a container for all your variables

- Global scope is created when your program begins, and destroyed when the program ends
  - There’s only one global scope
- Local scope is created whenever a function is called, and destroyed when the function ends.
  - There can be many local scopes

Access rights:

- Global cannot access local
- Local cannot access other local
- Local can access Global

Variable names are unique within the scope. Global spam != local spam

- But be sane and use unique variable names everywhere

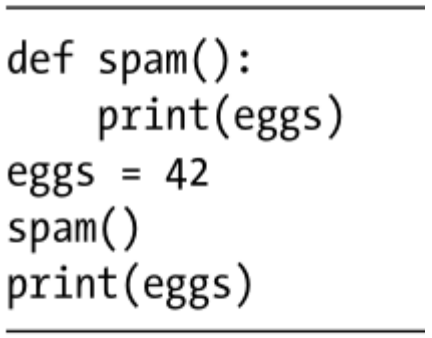
Scope

```
def spam():
    eggs = 31337
spam()
print(eggs)
```

```
Traceback (most recent call last):
  File "<pyshell#4>", line 1, in <module>
    print(eggs)
NameError: name 'eggs' is not defined
```

```
def spam():
    eggs = 99
    bacon()
    print(eggs)

def bacon():
    ham = 101
    eggs = 0

spam()
```

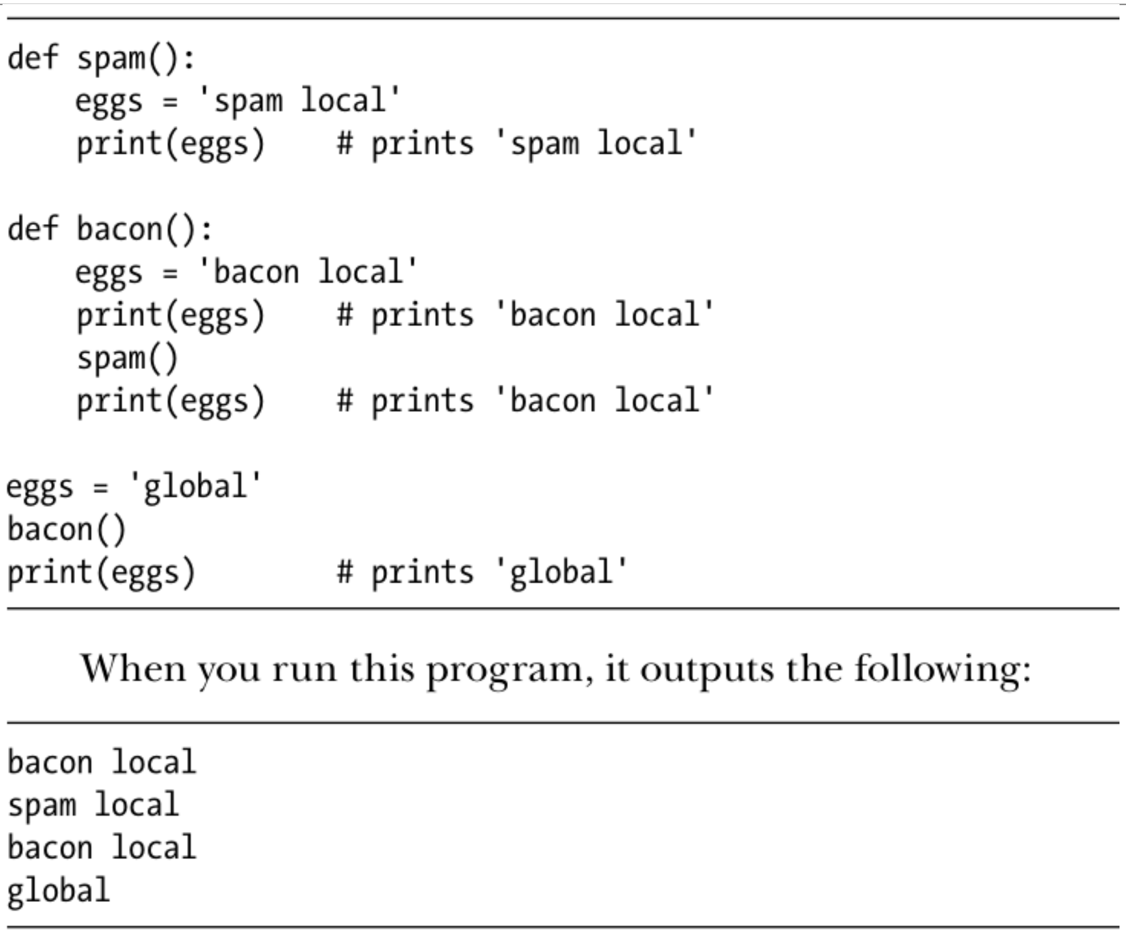
```
99
```



```
def spam():
    print(eggs)
eggs = 42
spam()
print(eggs)
```

```
42
42
```

Scope



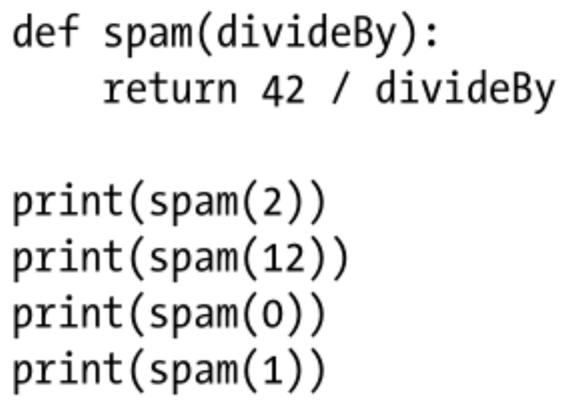
```
def spam():
    eggs = 'spam local'
    print(eggs)    # prints 'spam local'

def bacon():
    eggs = 'bacon local'
    print(eggs)    # prints 'bacon local'
    spam()
    print(eggs)    # prints 'bacon local'

eggs = 'global'
bacon()
print(eggs)        # prints 'global'
```

When you run this program, it outputs the following:

```
bacon local
spam local
bacon local
global
```

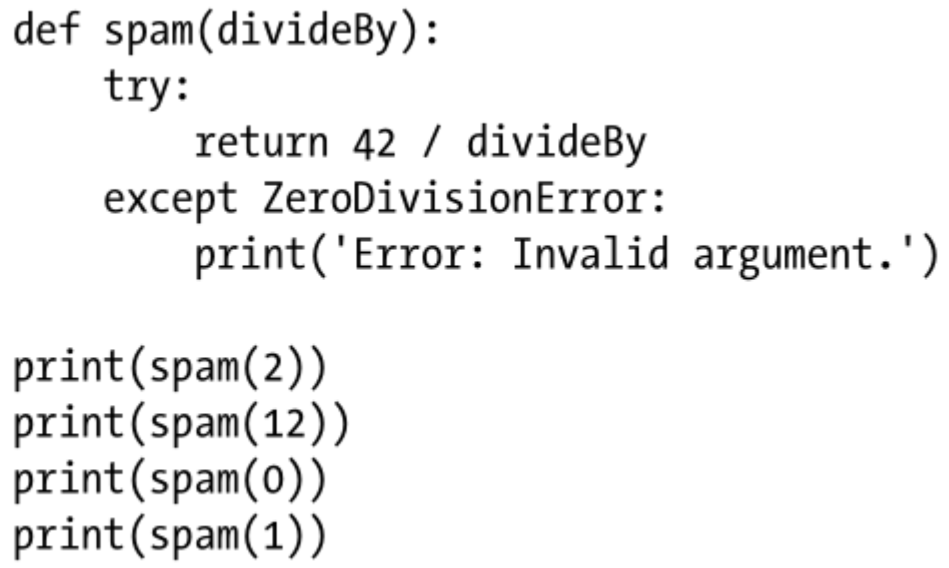
Exception Handling (Try/Except)

Make and run this program:



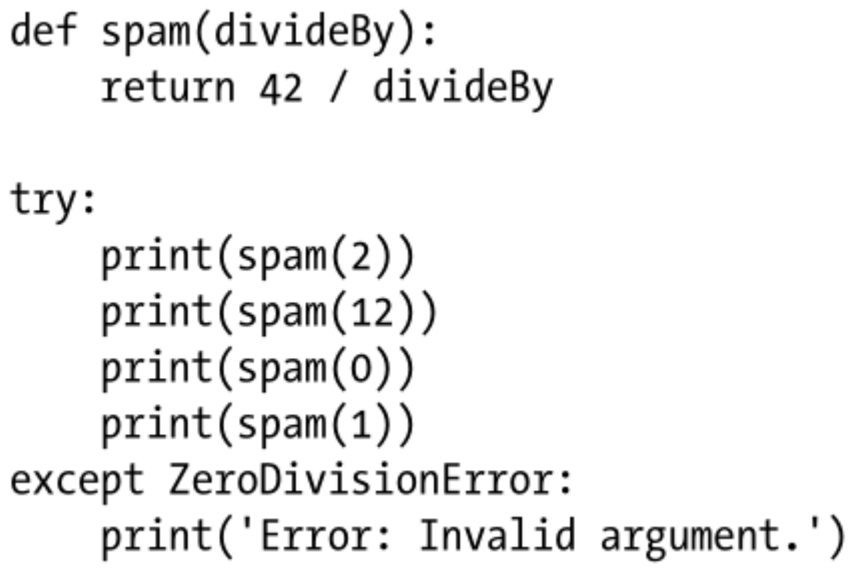
```
def spam(divideBy):
    return 42 / divideBy

print(spam(2))
print(spam(12))
print(spam(0))
print(spam(1))
```

Then this program:

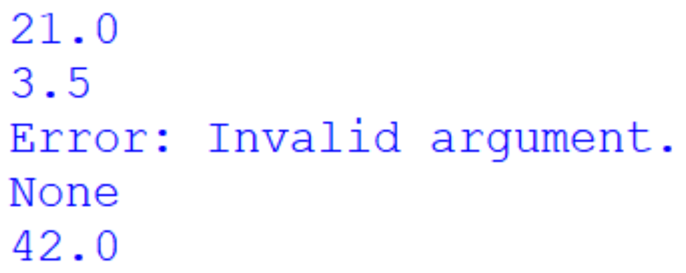


```
def spam(divideBy):
    try:
        return 42 / divideBy
    except ZeroDivisionError:
        print('Error: Invalid argument.')

print(spam(2))
print(spam(12))
print(spam(0))
print(spam(1))
```

Try/Except



```
def spam(divideBy):
    return 42 / divideBy

try:
    print(spam(2))
    print(spam(12))
    print(spam(0))
    print(spam(1))
except ZeroDivisionError:
    print('Error: Invalid argument.')
```



```
21.0
3.5
Error: Invalid argument.
None
42.0
```

```
dog = input('Enter a number: ')
try:
   dog_check = int(dog)
except:
   print('That is not an integer')
```

Try/Except

If you don’t specify the kind of exception it will just catch all exceptions.

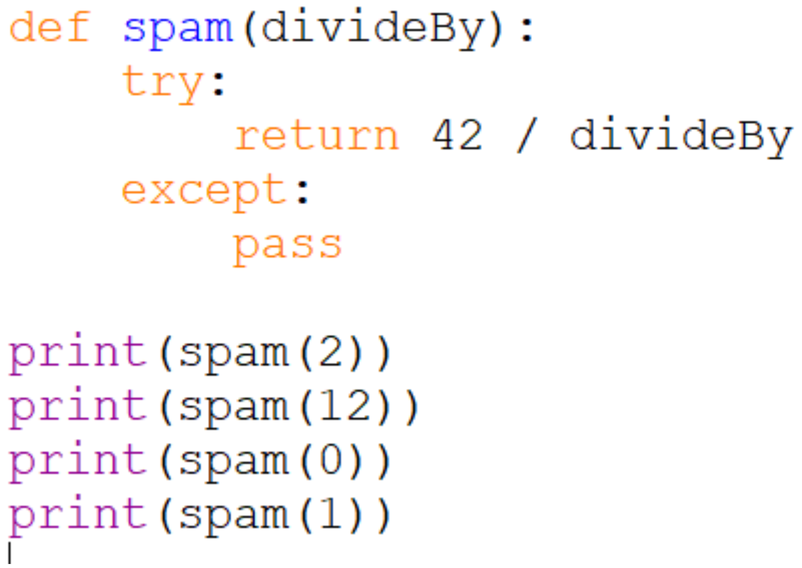
```
try:
    something
except:
    message
```

<- These are equivalent ->

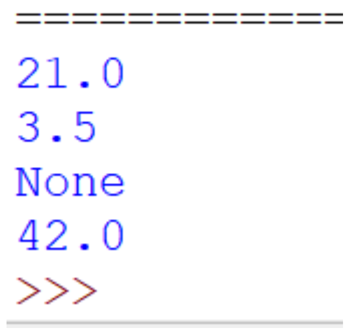
```
try:
    something
except Exception:
    message
```

Try/Except

You have to do something with the exception but you can just say pass



```python
def spam(divideBy):
    try:
        return 42 / divideBy
    except:
        pass

print(spam(2))
print(spam(12))
print(spam(0))
print(spam(1))
```



```
=============
21.0
3.5
None
42.0
>>>
```

Error Exceptions

https://docs.python.org/3/library/exceptions.html#bltin-exceptions