



Writing your own functions

Lesson 6 – 9/23/16

Today's schedule

1. Defining your own functions
 - basics
 - importing from a separate file
 - variable "scope"

Defining your own functions

Why do it?

- Allows you to re-use a certain piece of code without re-writing it
- Organizes your code into functional pieces
- Makes your code easier to read and understand

Defining a function

Syntax:

```
def function_name(parameters) :  
    statements  
    var = something  
return var
```

Example:

```
def strAdd(num1, num2) :  
    result = int(num1) + int(num2)  
return result
```

Defining a function

Syntax:

```
def function_name(parameters) :  
    statements  
    var = something  
return var
```

This is the value that the function returns when we use it. To give a familiar example, the `int()` function's return value is the string converted to an integer.

Which value we return must be considered carefully, since no other information inside the function will be accessible when we call it. All we can do is capture the return value.

Example:

```
def strAdd(num1, num2) :  
    result = int(num1) + int(num2)  
return result
```

Using a custom function

```
def strAdd(num1, num2):  
    result = int(num1) + int(num2)  
    return result
```

Using a custom function

```
def strAdd(num1, num2):  
    result = int(num1) + int(num2)  
    return result  
  
first = raw_input("First number? ")  
second = raw_input("Second number? ")  
added = strAdd(first, second)  
print added
```

Using a custom function

```
def strAdd(num1, num2):  
    result = int(num1) + int(num2)  
    return result
```



Function must be defined before it can be used (usually we define all our definitions at the very top of the script or in a separate script)

```
first = raw_input("First number? ")  
second = raw_input("Second number? ")  
added = strAdd(first, second)  
print added
```



Here is where execution actually starts (the first un-indented line)




Here is where we "call" our function

Using a custom function

```
4  def strAdd(num1, num2):  
5      result = int(num1) + int(num2)  
6      return result  
  
1  first = raw_input("First number? ")  
2  second = raw_input("Second number? ")  
3/7 added = strAdd(first, second)  
8  print added
```

Using a custom function

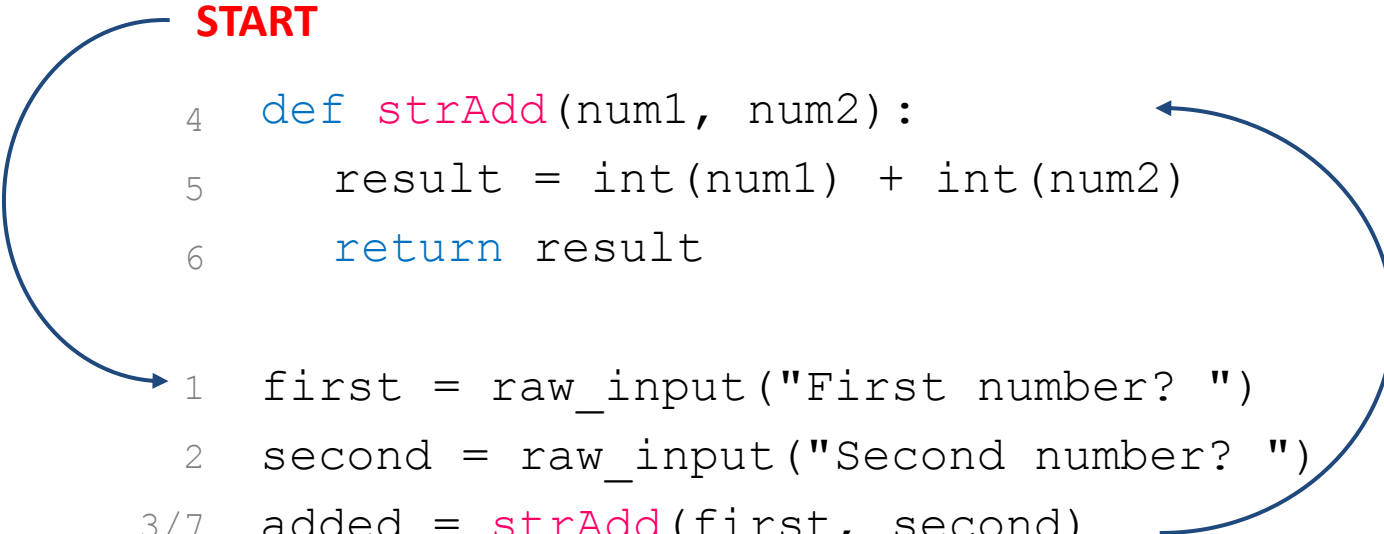
START



```
4  def strAdd(num1, num2):  
5      result = int(num1) + int(num2)  
6      return result  
  
1  first = raw_input("First number? ")  
2  second = raw_input("Second number? ")  
3/7 added = strAdd(first, second)  
8  print added
```

Using a custom function

START

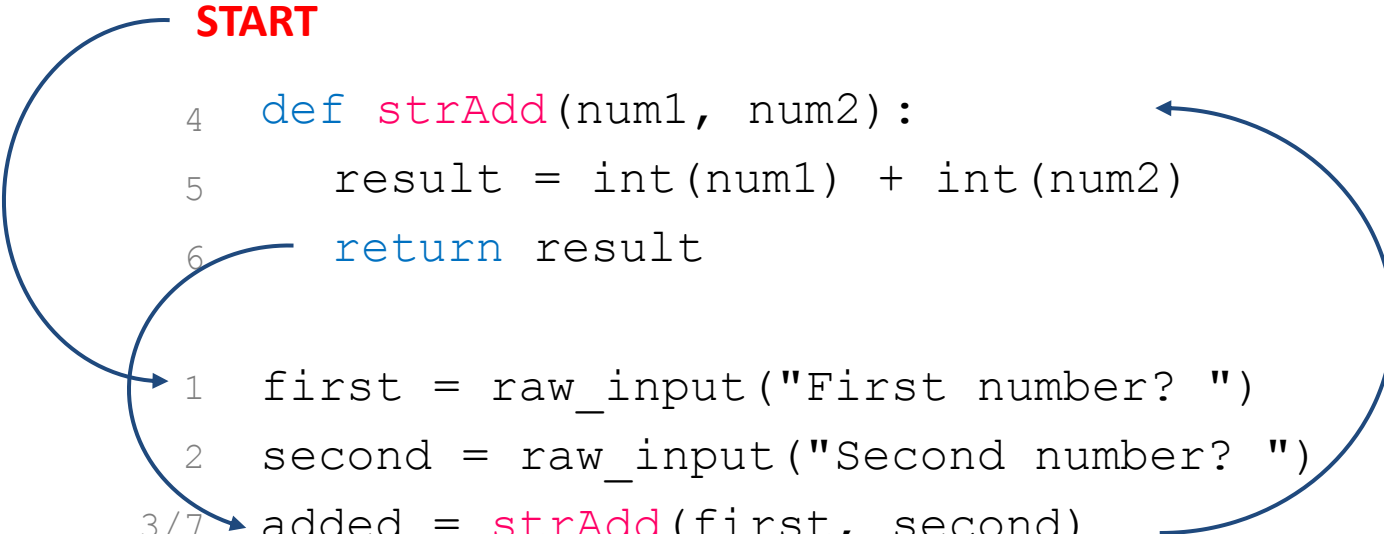


The diagram illustrates the execution flow of the code. A blue curved arrow originates from the word 'START' and points to line 1 of the main code block. Another blue curved arrow originates from the 'strAdd' function call on line 3/7 and points back to the function definition on lines 4-6, indicating a recursive call or function invocation.

```
4  def strAdd(num1, num2):  
5      result = int(num1) + int(num2)  
6      return result  
  
1  first = raw_input("First number? ")  
2  second = raw_input("Second number? ")  
3/7 added = strAdd(first, second)  
8  print added
```

Using a custom function

START



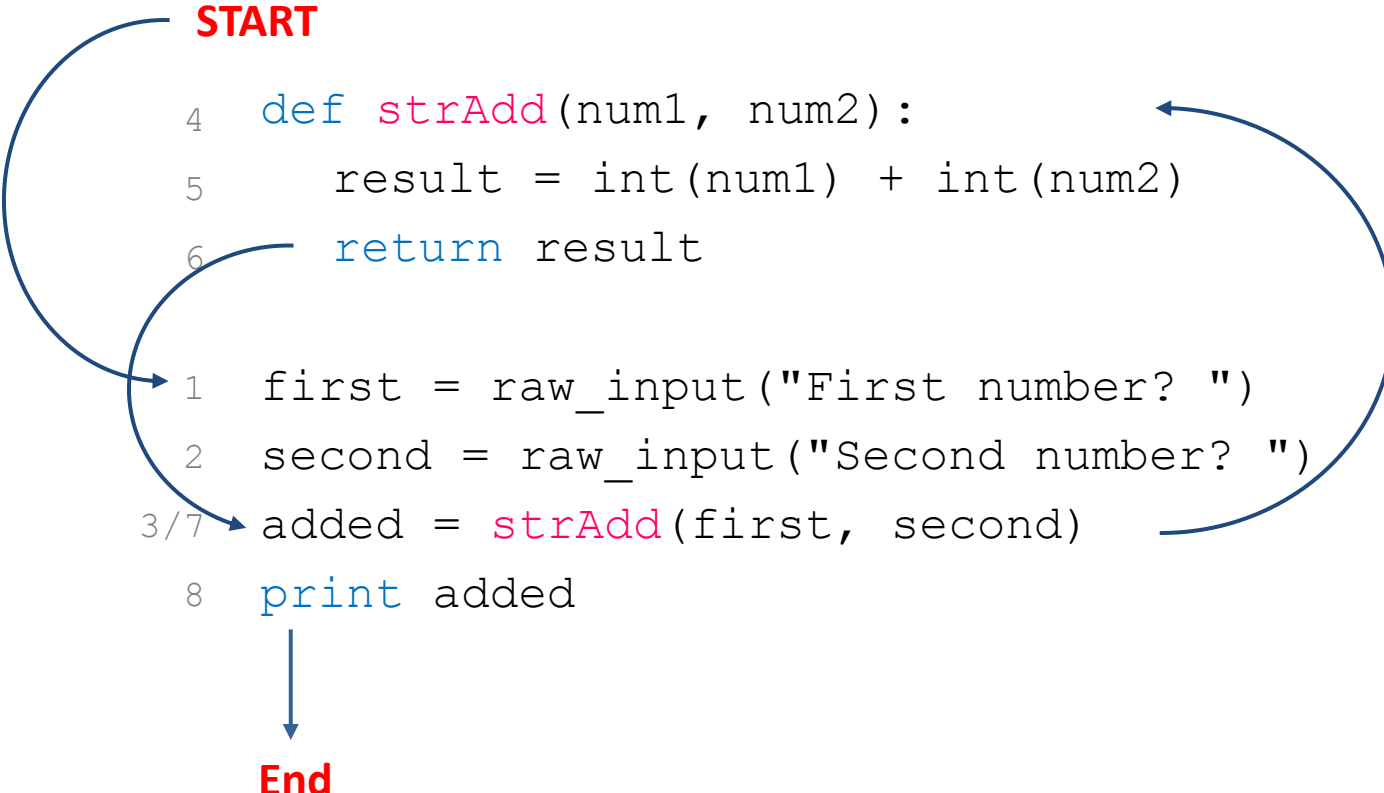
```
4  def strAdd(num1, num2):  
5      result = int(num1) + int(num2)  
6  return result  
  
1  first = raw_input("First number? ")  
2  second = raw_input("Second number? ")  
3/7 added = strAdd(first, second)  
8  print added
```

The diagram illustrates the execution flow of the code. A blue arrow originates from the 'START' label and points to line 1. Another blue arrow points from line 6 to line 3, indicating a function call. A third blue arrow points from line 3 back to line 6, representing the return of the function's result.

Using a custom function

START

```
4  def strAdd(num1, num2):  
5      result = int(num1) + int(num2)  
6      return result  
  
1  first = raw_input("First number? ")  
2  second = raw_input("Second number? ")  
3/7 added = strAdd(first, second)  
8  print added
```




End

What will this code print?

```
def strAdd(num1, num2):  
    result = int(num1) + int(num2)  
    return result  
  
first = raw_input("First number? ")  
second = raw_input("Second number? ")  
added = strAdd(first, second)  
print added
```

Result:

First number? *<input>* 5
Second number? *<input>* 4



Assuming we input these
values for first and second

What will this code print?

```
def strAdd(num1, num2):  
    result = int(num1) + int(num2)  
    return result  
  
first = raw_input("First number? ")  
second = raw_input("Second number? ")  
added = strAdd(first, second)  
print added
```

Result:

```
First number? <input> 5  
Second number? <input> 4  
9
```

A more useful example: counting

Result of using `.count()`:

```
>>> seq = "CGCACGCACGCGC"
```

```
>>> seq.count("CGC")
```

```
3
```

Notice that there are actually 4 possible instances of "CGC" in this sequence – the "CGCGC" at the end can be counted as having two instances.

The `.count()` only counts non overlapping instances. What if that's not what we want?

A more useful example: counting

Count (potentially overlapping) instances of a subsequence in a string

```
def count_occurrences(seq, subseq):  
    seq = seq.upper()  
    subseq = subseq.upper()  
    count = 0  
    index = 0  
    done = False  
    while not done:  
        index = seq.find(subseq, index)  
        if (index == -1):  
            done = True  
        else:  
            count += 1  
            index += 1 # add one so this pos won't be found again  
    return count
```

main script

```
seq = raw_input("Full sequence: ")  
subseq = raw_input("Subseq to search for: ")  
result = count_occurrences(seq, subseq)  
print "The subseq occurs", result, "times in the full seq"
```

A more useful example: counting

Result of using `.count()`:

```
>>> seq = "CGCACGCACGCGC"  
>>> seq.count("CGC")  
3
```

Result:

Full sequence: CGCACGCACGCGC

Subseq to search for: CGC

The subseq occurs 4 times in the full seq

Keep your functions in a separate file

If you have a set of functions you want to use in various different scripts (e.g. a function to read in a fasta file), you can save these functions in a separate file and then *import* them into other scripts. Example:

useful_fns.py:

```
# Count (potentially overlapping) instances of a  
subsequence in a string
```

```
def count_occurrences(seq, subseq):  
    seq = seq.upper()  
    subseq = subseq.upper()  
    count = 0  
    index = 0  
    done = False  
    while not done:  
        index = seq.find(subseq, index)  
        if (index == -1):  
            done = True  
        else:  
            count += 1  
            index += 1  
    return count
```

test.py:

```
import useful_fns  
  
seq = raw_input("Full sequence: ")  
subseq = raw_input("Subseq to search for: ")  
result = useful_fns.count_occurrences(seq, subseq)  
print "The subseq occurs", result, "times"
```

Result:

```
> python test.py  
Full sequence: CGCACGCACGCGC  
Subseq to search for: CGC  
The subseq occurs 4 times
```

Keep your functions in a separate file

If you have a set of functions you want to use in various different scripts (e.g. a function to read in a fasta file), you can save these functions in a separate file and then *import* them into other scripts. Example:

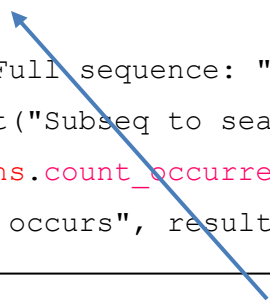
useful_fns.py:

Count (potentially overlapping) instances of a subsequence in a string

```
def count_occurrences(seq, subseq):  
    seq = seq.upper()  
    subseq = subseq.upper()  
    count = 0  
    index = 0  
    done = False  
    while not done:  
        index = seq.find(subseq, index)  
        if (index == -1):  
            done = True  
        else:  
            count += 1  
            index += 1  
    return count
```

test.py:

```
import useful_fns  
  
seq = raw_input("Full sequence: ")  
subseq = raw_input("Subseq to search for: ")  
result = useful_fns.count_occurrences(seq, subseq)  
print "The subseq occurs", result, "times"
```



Result:

```
> python test.py
```

```
Full sequence: CGCAGCAGCGCG
```

```
Subseq to search for: CGC
```

```
The subseq occurs 4 times
```

we save the file of functions as `useful_fns.py`, but then import it using just the file name (no `.py`). Then we can access the functions in this file by saying `useful_fns.functionName()`

A note on "scope"

- Variables you *create* within a function are considered to be in a different "scope" than the rest of your code
- This means that those variables are inaccessible outside of the function definition block
- Reusing a variable name within a function definition block will not overwrite any variable defined outside the block.
- Somewhat confusingly, functions *can* sometimes use variables defined within the main body (as long as it has been created before the function is called). However, doing this generally considered bad practice, since it makes the effects of a function harder to predict (especially if you plan to use it in many different scripts).
- The best practice is to only allow functions to use the external variables that are supplied directly as parameters.

Example of scope

```
>>> def someFn(val):  
...     c = val * 10  
...     z = c * c  
...     return z  
...  
>>> x = 5  
>>> z = 1  
>>> result = someFn(x)
```

Example of scope

```
>>> def someFn(val):  
...     c = val * 10  
...     z = c * c  
...     return z  
...  
>>> x = 5  
>>> z = 1  
>>> result = someFn(x)
```

} function scope

} main scope

Example of scope

```
>>> def someFn(val):  
...     c = val * 10  
...     z = c * c  
...     return z  
...
```

} function scope

```
>>> x = 5  
>>> z = 1  
>>> result = someFn(x)
```

} main scope

```
>>> print result
```


Example of scope

```
>>> def someFn(val):  
...     c = val * 10  
...     z = c * c  
...     return z  
...  
>>> x = 5  
>>> z = 1  
>>> result = someFn(x)
```

} function scope

} main scope

```
>>> print result  
2500
```

Example of scope

```
>>> def someFn(val):  
...     c = val * 10  
...     z = c * c  
...     return z  
...  
>>> x = 5  
>>> z = 1  
>>> result = someFn(x)
```

} function scope

} main scope

```
>>> print result  
2500  
>>> print z
```

Example of scope

```
>>> def someFn(val):  
...     c = val * 10  
...     z = c * c  
...     return z  
...  
>>> x = 5  
>>> z = 1  
>>> result = someFn(x)
```

} function scope

} main scope

```
>>> print result  
2500  
>>> print z  
1
```

← The `z` defined in the main scope was not overwritten
by the `z` defined in the function scope

Example of scope

```
>>> def someFn(val):  
...     c = val * 10  
...     z = c * c  
...     return z  
...  
>>> x = 5  
>>> z = 1  
>>> result = someFn(x)
```

} function scope

} main scope

```
>>> print result  
2500  
>>> print z  
1  
>>> print c
```

Example of scope

```
>>> def someFn(val):  
...     c = val * 10  
...     z = c * c  
...     return z  
...  
>>> x = 5  
>>> z = 1  
>>> result = someFn(x)
```

} function scope

} main scope

```
>>> print result  
2500  
>>> print z  
1  
>>> print c
```

```
Traceback (most recent call last):  
  File "<stdin>", line 1, in <module>  
NameError: name 'c' is not defined
```

There is no `c` defined in the main scope, and we cannot access the `c` defined in the function scope, so this creates a `NameError`