

Programming with Python

EOAS Software Carpentry Workshop

September 21st, 2016

Creating Functions - Defining a Function

Learning Goals

1. Explain why we should divide programs into small, single-purpose functions.
2. Define a function that takes parameters.
3. Return a value from a function.

Example Code

- ```
def fahr_to_kelvin(temp):
 return ((temp - 32) * (5/9)) + 273.15
```
- ```
def kelvin_to_celsius(temp):  
    return temp - 273.15
```
- ```
def fahr_to_celsius(temp):
 temp_k = fahr_to_kelvin(temp)
 result = kelvin_to_celsius(temp_k)
 return result
```

## Exercise

Write a function called `analyze` that takes a filename as a parameter and displays the three graphs produced in the previous lesson, i.e., `analyze('inflammation-01.csv')` should produce the graphs already shown, while `analyze('inflammation-02.csv')` should produce corresponding graphs for the second data set. Hint: a function can just “do” something. It doesn’t necessarily need to return anything.

## Solution

```
def analyze(filename):
 data = np.loadtxt(fname=filename, delimiter=',')
 fig = plt.figure(figsize=(10.0, 3.0))

 axes1 = fig.add_subplot(1, 3, 1)
 axes2 = fig.add_subplot(1, 3, 2)
 axes3 = fig.add_subplot(1, 3, 3)

 axes1.set_ylabel('average')
 axes1.plot(data.mean(axis=0))

 axes2.set_ylabel('max')
 axes2.plot(data.max(axis=0))

 axes3.set_ylabel('min')
 axes3.plot(data.min(axis=0))

 fig.tight_layout()
 plt.show(fig)
```

## Defining a Function

```
def detect_problems(filename):

 data = np.loadtxt(fname=filename, delimiter=',')

 if data.max(axis=0)[0] == 0 and data.max(axis=0)[20] == 0:
 print('Suspicious looking maxima!')
 elif data.min(axis=0).sum() == 0:
 print('Minima add up to zero!')
 else:
 print('Seems OK!')
```

# Testing and Documentation

## Learning Goal

3. Test and debug a function.

## Example Code

- ```
def centre(data, desired):  
    return (data - data.mean()) + desired
```
- ```
z = numpy.zeros((2,2))
```
- ```
print centre(z, 3)
```
- ```
print data.std() - centred.std()
```
- ```
def center(data, desired):  
    '''Return a new array containing the original data  
    centered around the desired value.'''  
    return (data - data.mean()) + desired
```
- ```
help(centre)
```

# Defining Defaults

## Learning Goals

6. Set default values for function parameters.

## Example Code

- `def center(data, desired = 0):`
- `def display(a=1, b=2, c=3):`  
    `print 'a:', a, 'b:', b, 'c:', c`  
    `print 'no parameters:'`  
    `display()`  
    `print 'one parameter:'`  
    `display(55)`  
    `print 'two parameters:'`  
    `display(55, 66)`
- `help(numpy.loadtxt)`

## Exercise

“Adding” two strings produces their concatenation: `'a' + 'b'` is `'ab'`. Write a function called `fence` that takes two parameters called `original` and `wrapper` and returns a new string that has the wrapper character at the beginning and end of the original. A call to your function should look like this:

```
print(fence('name', '*'))
name
```



## Exercise

“Adding” two strings produces their concatenation: `'a' + 'b'` is `'ab'`. Write a function called `fence` that takes two parameters called `original` and `wrapper` and returns a new string that has the wrapper character at the beginning and end of the original. A call to your function should look like this:

```
print(fence('name', '*'))
name
```

## Solution

```
def fence(original, wrapper):
 """Returns a string with charcter wrapper added to the
 beginning and end of string original."""

 return wrapper + original + wrapper
```

# Tracebacks and Exceptions

## Learning Goals

1. Read a traceback, and determine the following relevant pieces of information:
  - ▶ The file, function, and line number on which the error occurred
  - ▶ The type of the error
  - ▶ The error message
2. Describe the types of situations in which the following errors occur:
  - ▶ `SyntaxError` and `IndentationError`
  - ▶ `NameError`
  - ▶ `IndexError`
  - ▶ `FileNotFoundError`

## Exercise

Does this code raise an exception? If so, what is the name of the exception?

```
for x in range(10, -10, -1):
 print('inverse of', x, 'is', 1/x)
```

Can you modify the code so that it does what is intended, but avoids the exception?

# Try/Except Blocks

## Learning Goals

1. Write error handling Python code using try and except statements.

## Lesson Commands

```
try:
 # something that might go wrong
except SomeError:
 # handle the error
```

# Command-line programs

## Learning goals

1. Use the values of command-line arguments in a program.
2. Handle flags and files separately in a command-line program.
3. Read data from standard input in a program so that it can be used in a pipeline.

## Commands and functions

`sys.version`

`sys.argv`

`sys.stdin`

# Switching to shell commands

\$ in front of a command that tells you to run that command in the shell rather than the Python interpreter

- Rewrite `readings.py` so that it uses `-n`, `-m`, and `-x` instead of `--min`, `--mean`, and `--max` respectively. Is the code easier to read? Is the program easier to understand?
- Separately, modify `readings.py` so that if no action is given it displays the means of the data.