The Practice of Computing Using

PYTHON

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Chapter 5

Functions-QuickStart

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What is a Function?

Functions

- From mathematics we know that functions perform some operation and return <u>one</u> value.
- They “encapsulate” the performance of some particular operation, so it can be used by others (for example, the sqrt() function).

Why Have Them?

- Support divide-and-conquer strategy
- Abstraction of an operation
- Reuse: once written, use again
- Sharing: if tested, others can use
- Security: if well tested, then secure for reuse
- Simplify code: more readable

Mathematical Notation

- Consider a function which converts temperatures in Celsius to temperatures in Fahrenheit:
  - Formula: f = c*1.8 + 32.0
  - Functional notation: f = celsisus2Fahrenheit(c) where

    celsius2Fahrenheit(f) = c*1.8 + 32.0

Function Invocation

- Math: f = celsius2Fahrenheit(c)
- Python, the invocation is much the same

  f = celsius2Fahrenheit(c)

  Terminology: argument “c”

Function Definition

- Math: celsius2Fahrenheit(c) =

  c*1.8 + 32.0
- Python

```
def celsius2Fahrenheit(c):
    return c*1.8 + 32.0
```

- Terminology: parameter “c”

Return Statement

- The return statement indicates the value that is returned by the function.
- The statement is optional (the function can return nothing). If no return, the function is often called a procedure.

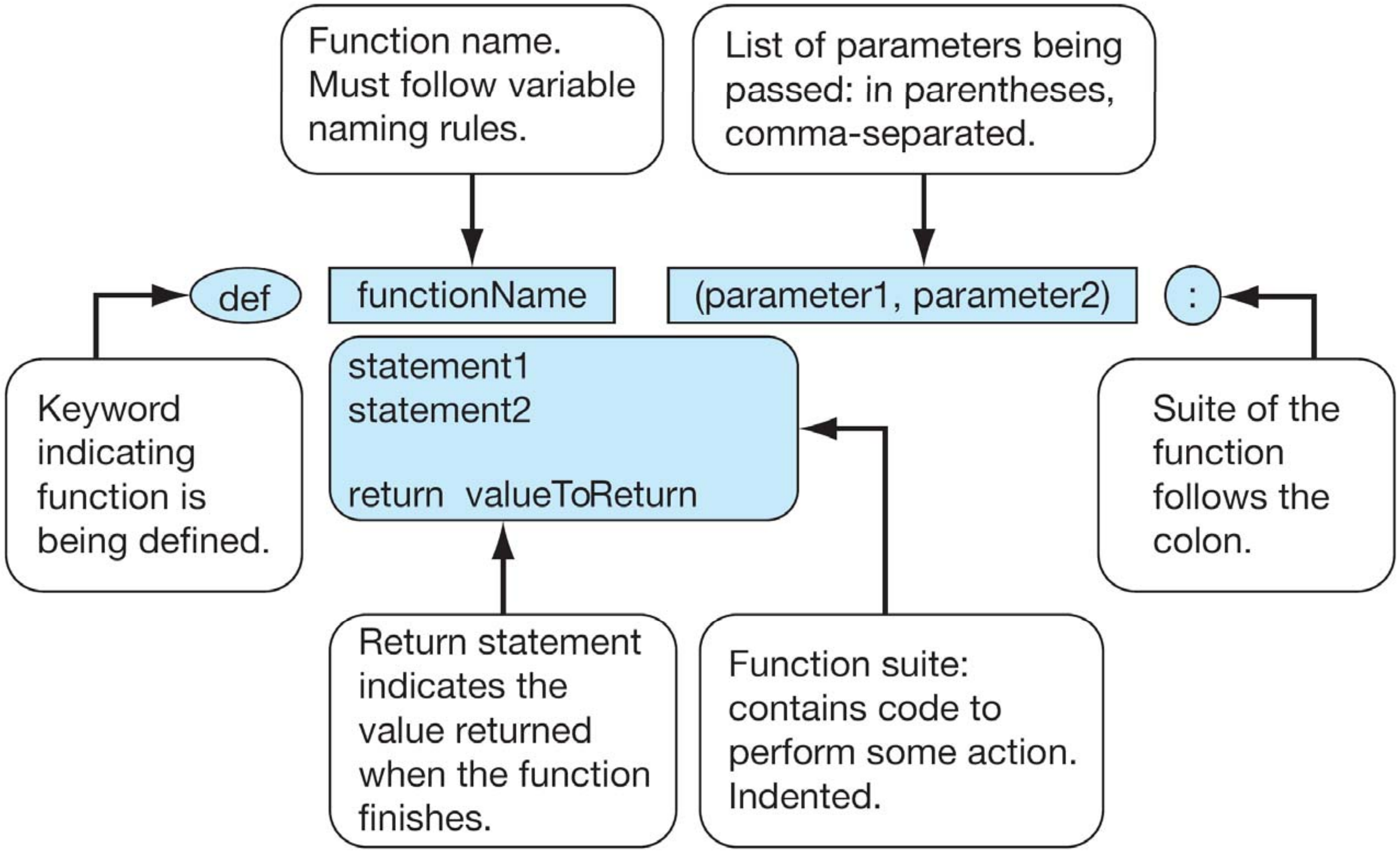
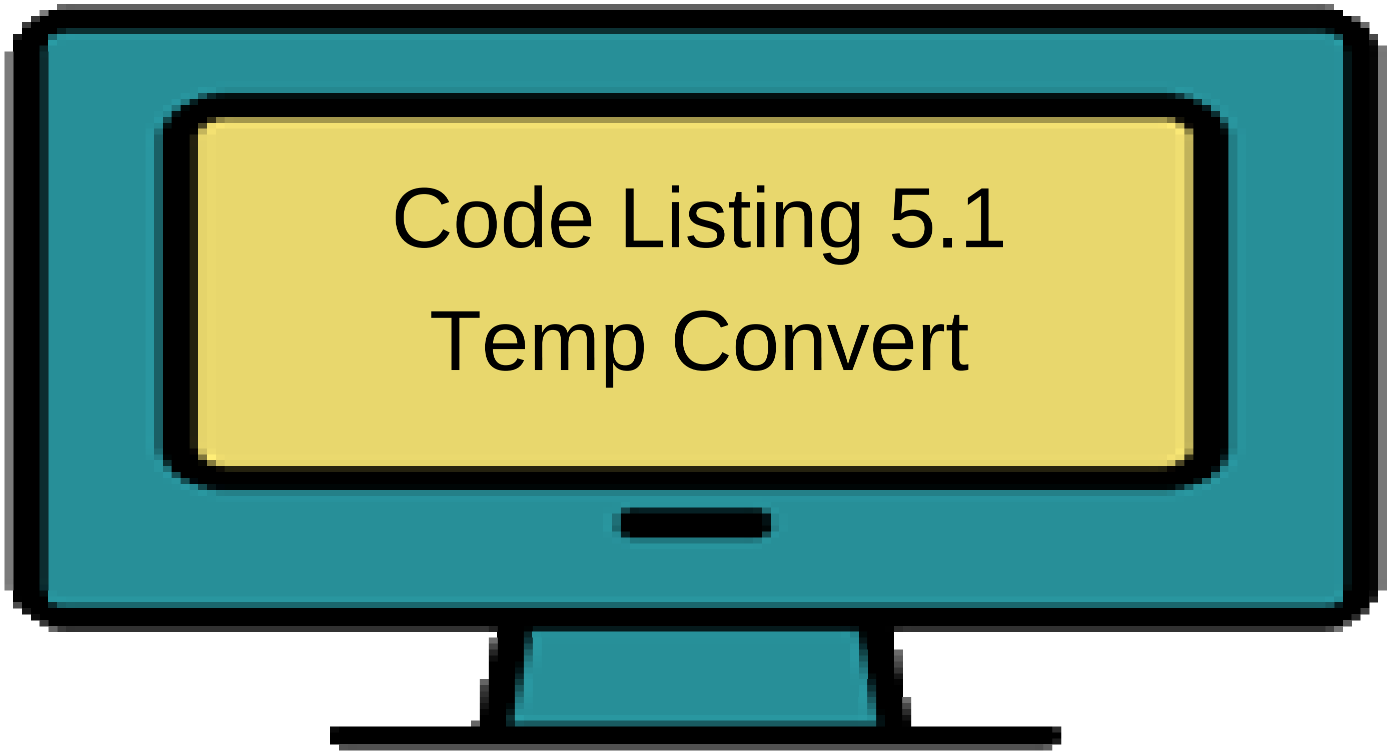

Function name. Must follow variable naming rules.
List of parameters being passed: in parentheses, comma-separated.
def
functionName
(parameter1, parameter2)
:
statement1
statement2
return valueToReturn
Keyword indicating function is being defined.
Suite of the function follows the colon.
Return statement indicates the value returned when the function finishes.
Function suite: contains code to perform some action. Indented.

FIGURE 5.1 Function parts.



Code Listing 5.1
Temp Convert

```
# Temperature conversion

def celsius2fahrenheit(celsius):
    """ Convert Celsius to Fahrenheit."""
    return celsius*1.8 + 32
```

Triple Quoted String in Function

- A triple quoted string just after the def is called a docstring
- docstring is documentation of the function’s purpose, to be used by other tools to tell the user what the function is used for.

Operation

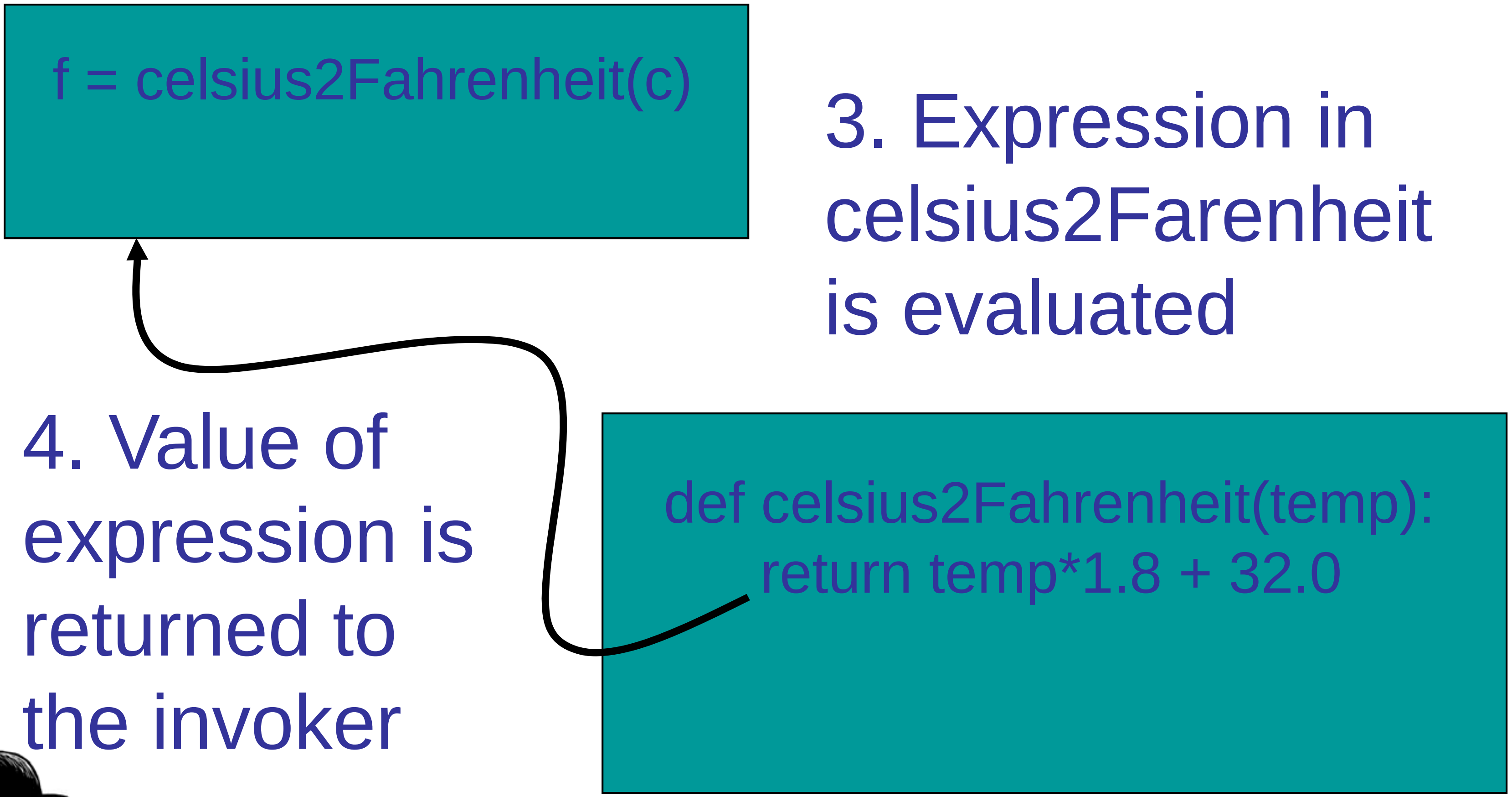
```
f = celsius2Fahrenheit(c)
```

1. Call copies argument c to parameter temp

```
def celsius2Fahrenheit(temp):
    return temp*1.8 + 32.0
```

2. Control transfers to function “celsius2Farenheit”

Operation (con’t)



```
f = celsius2Fahrenheit(c)
```

3. Expression in celsius2Farenheit is evaluated

4. Value of expression is returned to the invoker

```
def celsius2Fahrenheit(temp):
    return temp*1.8 + 32.0
```

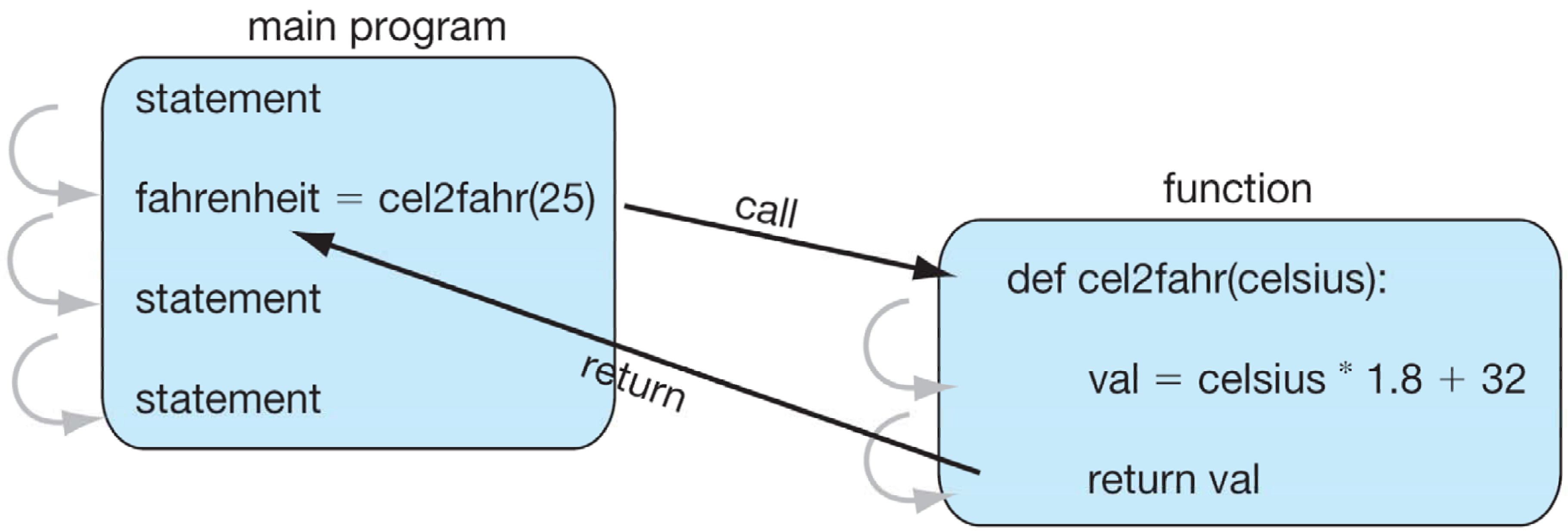


FIGURE 5.2 Function flow of control.

Implement len()

- How might we count the number of characters in a string without using len()?

```
def length(s):
    """Return the length of s."""
    count = 0
    for c in s:
        count += 1
    return count
```

Count lowercase characters

- How might we count the number of lowercase characters in a string?

Count lowercase characters

- import string
- use string.lowercase, string of lowercase
  - ‘abcdefghijklmnopqrstuvwxyz’
- check if each letter is a member (using the in operator) of string.lowercase

```
import string

def lowercaseCount(s):
    """Return the lowercase count in s."""
    count = 0
    for c in s:
        if c in string.lowercase:
            count += 1
    return count
```

Example: Word Puzzle

- Find an English language word that has the vowels ‘a’, ‘e’, ‘i’, ‘o’, and ‘u’ in sequence

Example: Word Puzzle

- Clean the text (i.e., covert to lowercase and remove whitespace and punctuation characters.
- Create a string containing the sequence of vowels in the word
- Check to see if that string contains ‘aeiou’

```
def cleanWord(word):
“““Return word in lower case stripped of whitespace
and punctuation characters”””
    word = word.strip().lower()
    badChars = string.whitespace + string.punctuation
    for char in badChars :
        word = word.replace(char, '')
    return word
```

```
def getVowelsInWord(word):
    “““ Return vowels in string, include repeats”””
    vowelStr = ‘aeiou’
    vowelsInWord = ‘’
    for char in word:
        if char in vowelStr:
            vowelsInWord += char
    return vowelsInWord
```

Yet another function

- Let’s add a function which determines if a word contains the vowels ‘aeiou’ in order:

```
def hasVowelsInOrder(word):
    """" Return true if the word contains vowels in order,
false otherwise""""
    vowels = getVowelsInWord(cleanWord(word))
    index = vowels.find('aeiou')
    return index != -1
```

Now automate the process

- Can read a file using the open() function:
  - data = open(“filename.txt”)
- Then we can do something like:
  - Then we can search the words in the file using:

```
for line in data:
        print line
```

- Let’s find and download a dictionary file.

```
data = open(“dictionary.txt”)
for line in data:
    if hasVowelsInOrder(line):
        print(line)
```

Example: Palindromes

- Remember palindromes?

```
import string

inputString      = raw_input("Enter input: ")
lowerString      = inputString.lower()
removeCharacters = string.whitespace +
string.punctuation
for char in removeCharacters:
    lowerString = lowerString.replace(char, '')
```

```
if lowerString == lowerString[::-1]:
    print "PALINDROME! "
else:
    print "NOT A PALIDOME!"
print lowerString + " " + lowerString[::-1]
```

Example: Palindromes

- How might we simplify this code by defining functions?

Example: Palindromes

- Define two helpter functions:
  - clearText(text)
    - Returns a lowercase version of the text stripped of whitespace and punctuation characters.
  - reverseText(text)
    - Returns a reverse version of the text.
- Makes defining isPalindrome(text) easy!

```
def cleanText(text):
"""“Return text in lower case stripped of whitespace and
punctuation characters”"""
    text = text.strip().lower()
    badChars = string.whitespace + string.punctuation
    for char in badChars :
        text = text.replace(char, '')
    return text
```

```
def reverseText(text):
“““Return text in reverse order”””
    return text[::-1]
```

```
def isPalindrome(text):
""""Return True if the text is a palindrome, False
otherwise""""
    text = cleanText(text)
    return text == reverseText(text)
```

How to Write a Function

- Does one thing. If it does too many things, it should be broken down into multiple functions (refactored).
- Readable. How often should we say this? If you write it, it should be readable.
- Reusable. If it does one thing well, then when a similar situation (in another program) occurs, use it there as well.

More on Functions

- Complete. A function should check for all the cases where it might be invoked. Check for potential errors.
- Not too long. Kind of synonymous with “does one thing”. Use it as a measure of doing too much.

Procedures

- Functions that have no return statements are often called *procedures*.
- Procedures are used to perform some duty (print output, store a file, etc.)
- Remember, return is not required.

Multiple Returns in a Function

- A function can have multiple return statements.
- Remember, the first return statement executed ends the function.
- Multiple returns can be confusing to the reader and should be used judiciously.

Example: Classify a Number

- Write a function which returns “positive” if the number is positive, “negative” if the number is negative, or “zero” if the number is zero.

```
def classifyNumber(number):
“““Return “positive” if the number is positive, “negative”
if the number is negative, “zero” if the number is
zero”””
    if number > 0:
        return “positive”
    elif number < 0:
        return “negative”
    else:
        return “zero”
```

Example: Palindromes (cont)

- If text has less than 2 characters, it must be a palindrome.
  - Modify isPalindrome() accordingly.

```
def isPalindrome(text):
“““Return True if the text is a palindrome, False
otherwise”””
    if len(text) < 2:
        return True

    text = cleanText(text)
    return text == reverseText(text)
```