Functions

Lecture 2

Department of Computer Science and Engineering, ITER
Siksha 'O' Anusandhan (Deemed to be University),
Bhubaneswar, Odisha, India.

Contents

Introduction

- Simple statements can be put together in the form of functions to do useful tasks.
- To solve a problem, divide it into simpler sub-problems.
- The solutions of the sub-programs are then integrated to form the final program.
- This approach to problem solving is called step-wise refinement method or **modular approach**.
- Functions are generally of two types. Such as:
  1. Built-in functions
  2. User-defined functions

Built-in Functions

- Built-in Functions are predefined functions that are already available in Python.
- The function **input** enables us to accept an input string from the user without evaluating its value.
- The function *input* continues to read input text from the user until it encounters a newline. For Example:

  $>>>$ name = input('Enter a Name:')

  Enter a Name: Alok

  $>>>$ name

  'Alok'

  Here, the string 'Enter a Name:' specified within the parentheses is called an argument.
- The function eval is used to evaluate the value of a string. For Example:

  | $>>>$ eval('15') |

  | 15 |

  | $>>>$ eval('15 + 10') |

  | 25 |

Built-in Functions (Cont.)

- The value returned by a function may be used as an argument for another function in a nested manner. This is called **composition**. For Example:

> $>>>$ n1 = eval(input('Enter a Number:'))

> Enter a Name: 234

> $>>>$ n1

> 234

- We can print multiple values in asingle call to print function, where expressions are separated by comma. For Example:

> $>>>$ print(2, 567, 234)

> 2 567 234

> $>>>$ name = 'Raman'

> $>>>$ print('hello',name, '2+2 =', 2+2)

> hello Raman 2+2 = 4

Built-in Functions (Cont.)

- We can use python escape sequences such as \n (newline), \t (tab), \a (bell), \b (backspace), \f (form feed), and \r (carriage return). For Example:

  > >>> print('hello',name, '\n 2+2 =', 2+2)

  > hello Raman

  > 2+2 = 4

- Python function type tells us the type of a value. For Example:

  > >>> print(type(12), type(12.5), type('hello'), type(int))

  > $\langle class'int'\rangle$, $\langle class'float'\rangle$, $\langle class'str'\rangle$, $\langle class'type'\rangle$

- The round function rounds a number up to specific number of decimal places. For Example:

  > >>> print(round(89.625,2), round(89.625), round(89.625,0))

  > 89.62 90 90.0

Built-in Functions (Cont.)

- The input function considers all inputs as strings. Hence, type conversion is required. For Example:

```
>>> str(123)
'123'
>>> float(123)
123.0
>>> int(123.0)
123
>>> str(123.45)
'123.45'
>>> float('123.45')
123.45
>>> int('123.45') //String incompatible for conversion
Traceback (most recent call last):
File "⟨pyshell#3⟩", line 1, in ⟨module⟩
int('123.45')
ValueError: invalid literal for int() with base 10: '123.45'
```

Built-in Functions (Cont.)

- The functions *max* and *min* are used to find maximum and minimum values respectively; can also operate on string values.
- The integer and floating point values are compatible for comparison; whereas numeric values cannot be compared with string values.
- For Example:

> $>>>$ max(59,80,95.6,95.2)
>
> 95.6
>
> $>>>$ min(59,80,95.6,95.2)
>
> 59
>
> $>>>$ max('hello', 'how', 'are', 'you')
>
> 'you'
>
> $>>>$ min('hello', 'how', 'are', 'you', 'Sir')
>
> 'Sir'

- The function pow(a,b) computes a to the power b.

$$>>> a = pow(2,3)$$
$$>>> a$$
$$8$$

Built-in Functions (Cont.)

- The function random is used to generate a random number in the range [0,1). Python module random contains this function and needs to be imported for using it.

- Let us agree that player A will play the first turn if the generated falls in the range [0,0.5), otherwise player B will play as:
  ```
  if random.random() ⟨ 0.5:
      print('Player A plays the first turn.')
  else:

      print('Player B plays the first turn.')
  ```

- The math module provides some functions for mathematical computations.

- In order to obtain these functions available for use in script, we need to import the math module as:
  import math

- Name of the module, followed by the separator dot, should precede function name. The math module also defines a constant math.pi having value 3.141592653589793.

Built-in Functions (Cont.)

- Functions of math module are:

Function	Description
ceil(x)	Returns the smallest integer greater than or equal to x.
floor(x)	Returns the largest integer less than or equal to x.
fabs(x)	Returns the absolute value of x.
exp(x)	Returns the value of expression e**x.
log(x,b)	Returns the log(x) to the base b.In the case of absence of the second argument,the logarithmic value of x to the base e is returned.
log10(x)	Returns log(x) to the base 10.This is equivalent to specifying math.log(x,10).
pow(x,y)	Returns x raised to the power of y,i.e.,x**y.
sqrt(x)	Returns the square root of x.
cos(x)	Returns the cosine of x radians.
sin(x)	Returns the sine of x radians.
tan(x)	Returns the tangent of x radians.

Built-in Functions (Cont.)

- Functions of math module are (Cont.:

Function	Description
acos(x)	Returns the inverse cosine of x iin radians.
asin(x)	Returns the inverse sine of x in radians.
atan(x)	Returns the inverse tangent of x radians.
degrees(x)	Returns a value in degree equivalent of input value x(in radians).
radians(x)	Returns a value in radiant equivalent of input value x(in degrees).

- For Example:

> > > import math

> > > math.ceil(3.4)

> > > 4

> > > math.floor(3.7)

> > > 3

Built-in Functions (Cont.)

- If we want to see the complete list the complete list of built-in functions, we can use the built-in function dir as dir(__builtins__)

- We can get the help on a function as:

  > $>>>$ import math

  > $>>>$ help(math.cos)

  Help on built-in function cos in module math:

  cos(...)

  cos(x)

  Return the cosine of x (measured in radians).

Function Definition and Call

- The syntax for function definition as:

  def *function_name*(comma_separated_list_of_parameters):
      statement_1
      statement_2
      statement_3
      ....
      statement_n

- "*function_name*" should not be a python keyword.
- Python code following colon must be intended, i.e., shifted right.

Function Definition and Call

- Example: Program to print a triangle, a blank line and a square:
  (**picture.py**)

```python
def main():
    # To print a triangle
    print('   *')
    print('  ***')
    print(' *****')
    print('*******')

    # To print a blank line
    print()

    # To print a square
    print('* * * *')
    print('* * * *')
    print('* * * *')
    print('* * * *')
```

Function Definition and Call (Cont.)

- Executing a python file, for e.g., **picture.py**
- To do this, we need to invoke the function main() in the following two steps.
    1. In **Run** menu, click on the option Run Module.
    2. Using Python shell, invoke (call) the function main() by executing the following command:

        $>>>$ main()

- We can eliminate the need to call function main() explicitly from the shell, by including in the script **picture.py**, the following call to function main:

    if __**name**__ == '__main__':

        main()

- Python module has a built-in variable called __**name**__ containing the name of the module.
- When the module itself is being run as the script, this variable __**name**__ is assigned the string '__main__' designating it to be a __main__ module.

Function Definition and Call (Cont.)

- Program to print a triangle followed by a square as:

```python
def main():
    # To print a triangle
    print('   *')
    print('  ***')
    print(' *****')
    print('*******')

    # To print a blank line
    print()

    # To print a square
    print('* * * *')
    print('* * * *')
    print('* * * *')
    print('* * * *')

if __name__ == '__main__':
    main()
```

Function Definition and Call (Cont.)

- Invoking a function from main() function.

```python
def triangle():
    # To print a triangle
    print(' *')
    print(' ***')
    print(' *****')
    print('*******')

def main():
    # To print a triangle
    triangle()

if __name__ == '__main__':
    main()
```

- Function main serves as a caller function for the callee or called function triangle.

- A function definition has no effect unless it is invoked.

  ```
  def triangle():
      # To print a triangle
      print(' *')
      print(' ***')
      print(' *****')
      print('*******')

  def main():
      # To print a triangle
      print('Triangle')

  if __name__ == '__main__':
      main()
  ```

- The script shows that function triangle is not being invoked.

Function Definition and Call (Cont.)

- **return** statement returns the value of expression following the return keyword. In the absence of the return statement, default value None is returned.
- Arguments: Variables or Expressions whose values are passed to called function.
- Parameters: Variables or Expressions in function definition which receives value when the function is invoked.
- Arguments must appear in the same order as that of parameters.

Function Definition and Call (Cont.)

- Example: Program to compute area of a rectangle:

  def areaRectangle(length, breadth):

        """

        Objective: To compute the area of rectangle

        Input Parameters: length, breadth- numerical value

        Return Value: area - numerical value

        """

        area = length * breadth

        return area

Function Definition and Call (Cont.)

Fruitful Functions vs void Functions

- A function that returns a value is often called a fruitful function.
- A function that does not return a value is often called a void function.

Function Help

- Recall that function help can be used to provide a description of built-in functions.
- Function help can also be used to provide description of the function defined by user.
- Function help retrieves first multi-line comment from the function definition

Function Definition and Call (Cont.)

Default Parameter Values

- The function parameters may be assigned initial values also called **default values**.
- Function call uses default value, if value for a parameter is not provided.
- Non-default arguments should not follow default arguments in a function definition.

- Default Parameter Values: Example

```
def areaRectangle(length, breadth=1):
    '''
    Purpose : To compute area of rectangle
    Input Parameters :
        length - int
        breadth (default = 1) - int
    Return Value: area - int
    '''
    area = length * breadth
    return area
```

>>> areaRectangle(5)

>>> 5

>>> areaRectangle(5,2)

>>> 10

Function Definition and Call (Cont.)

Keyword Arguments

- Python allows us to specify arguments in an arbitrary order in a function call, by including the parameter names along with arguments.
- The syntax for keyword arguments is:
  parameter_name = value
- indeed, in situations involving a large number of parameters, several of which may have default values, keyword arguments can be of great help.
- For Example:

  >>> **def** f(a=2, b=3, c=4, d=5, e=6, f=7, g=8, h=9):
          return a+b+c+d+e+f+g+h
  >>> f(c=10, g=20)
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Importing User-Defined Module

- To access a function from a user-defined module (also known as program or script that may comprise functions, classes, and variables), we need to import it from that module.
- To ensure that the module is accessible to the script, we are currently working on, we append to the system's path, the path to the the folder containing the module.
- The syntax for importing a module:
  import *name-of-the-module*

Assert Statement

- The assert statement is used for error checking.
- For Example, When we are going for the calculation of average of marks, be sure that inputs provided by the user are in the correct range.
- For this purpose, we make use of an assert statement that has the following form:
  assert *condition*
- If the condition specified in an assert statement fails to hold, Python responds with an assertion error.

Command Line Arguments

- Steps to execute the python script from the command line interface.
    1. Open the directory (say F:\PythonCode \Ch02) containing the file "**area.py**".
    2. Open the command prompt window using an option in context menu.
    3. Execute the command : **python area.py**

        F:\PythonCode \Ch02>python area.py
        Enter the following values for rectangle:
        Length : integer value : 20
        Breadth : integer value : 10
        Area of rectangle is 200
        End of program

Command Line Arguments

- Command line arguments can be used to accept the input from the user.

  *F:\PythonCode\Ch02>python area.py **20 10***
  Area of rectangle is 200
  End of program

- When the above command is executed, the arguments including the name of python program ("**area.py**") and the following inputs (**20** and **10**) gets stored in the list "**sys.argv**".

- Name of the script is the first argument and accesses as **argv[0]**.

- Similarly, **20** and **10** can be accessed as **argv[1]** and **argv[2]**, respectively

References

[1]   Python Programming: A modular approach by Taneja Sheetal, and Kumar Naveen, *Pearson Education India, Inc.*, 2017.