Functions: Create

CPSC 217: Introduction to Computer Science for Multidisciplinary Studies I
Winter 2023

Jonathan Hudson, Ph.D.
Instructor
Department of Computer Science
University of Calgary

January 9, 2023

UNIVERSITY OF CALGARY

Functions

- A function is a block of code that accomplishes a single purpose, such as calculating an average from a list of values, or printing a message to console.
  - A function (optionally) takes some inputs (also named arguments), performs some operations, and (optionally) gives back a result.

- Proper design and use of functions can save time and make a program easy to read, maintain, organized, and efficient.

Great job!

You've already been using functions

You've already been using functions

- Built-in functions are provided by the language
- Library functions are similar but provided by another programmer
- User-defined functions are created by programmers
- All function operate the same

You've already been using functions

All function operate the same

Functions might receive some arguments to work with. This is handled as *parameters* in the function definition

When calling the function, we supply the actual data to the function as *arguments* in the function call

Functions **may** *return* results

UNIVERSITY OF CALGARY

Functions Overview

Functions are useful because they:

1. Facilitate code reuse
   - Write once, use many times
2. Reduce code complexity
   - Allow programmers to break problems into smaller sub problems
   - Details relevant to solving a specific sub problem are placed in the function
   - Programmer can concentrate on higher level problems
3. Ease Maintenance
   - Bugs only need to be corrected once
   - Functions can be tested separately

Python built-in functions

Built-in Functions				
abs()	dict()	help()	min()	setattr()
all()	dir()	hex()	next()	slice()
any()	divmod()	id()	object()	sorted()
ascii()	enumerate()	input()	oct()	staticmethod()
bin()	eval()	int()	open()	str()
bool()	exec()	isinstance()	ord()	sum()
bytearray()	filter()	issubclass()	pow()	super()
bytes()	float()	iter()	print()	tuple()
callable()	format()	len()	property()	type()
chr()	frozenset()	list()	range()	vars()
classmethod()	getattr()	locals()	repr()	zip()
compile()	globals()	map()	reversed()	__import__()
complex()	hasattr()	max()	round()	
delattr()	hash()	memoryview()	set()	

Good style function

- Functions are like tools:
  - They need to have a self descriptive name
    - **indicating a clear description of the task**
  - One function serves one purpose, code with different purposes should not be combined into one function.
    - **You do not design a fridge that is also a stove!**
  - Functions can use (call) each other
  - There could be multiple correct solution
    - It depends on your design

Your functions

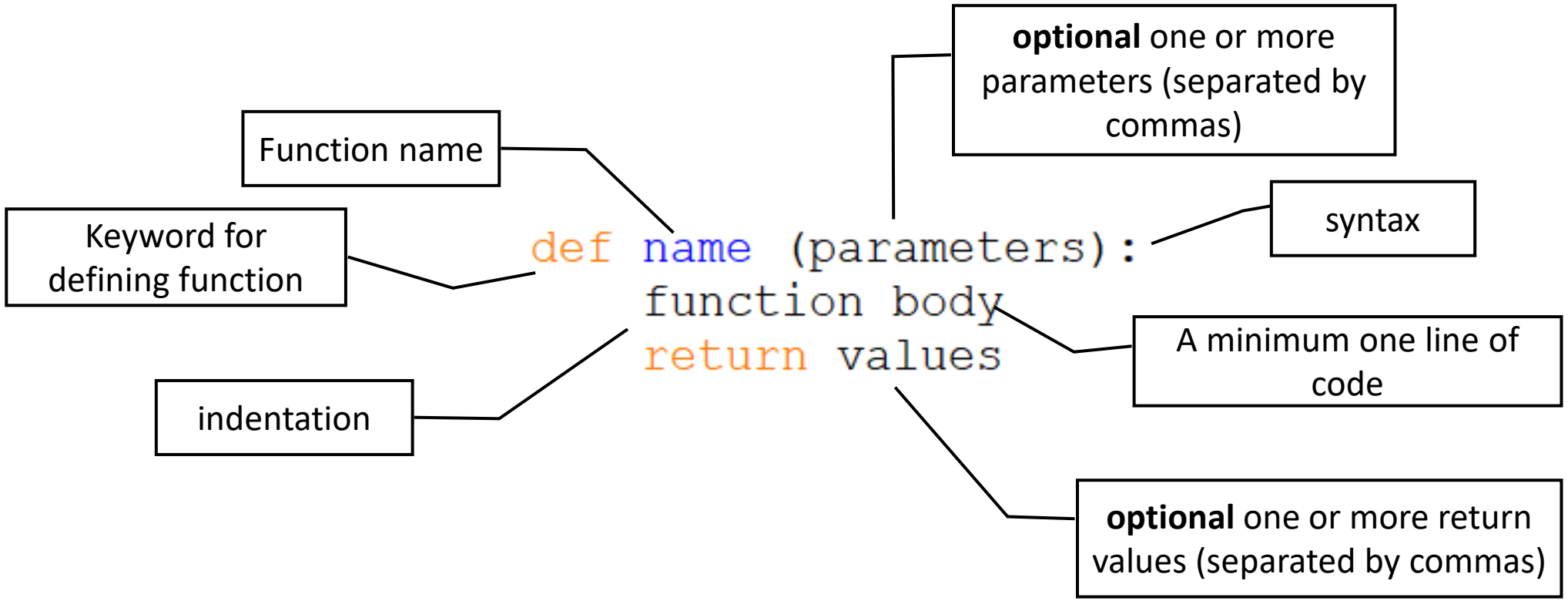
User-Defined Functions

- Programmers can define their own functions.
- A function consists of the following components:
  - (Required) **Function name**
  - (Optional) **Function parameters**
  - (Required) **Function body** (code), including a return statement: The function's body must contain at least one line of code.
- The following is a minimal function that does nothing:

```
def foo():
    pass
```

User-Defined Functions

- You can define your own function using the following syntax:



Storing functions

Think of what “import math” did

Accessing functions in other libraries

```
def fun():
        print ('Hello World!')
```

fun.py

```
def foo():
        print ('Goodbye World!')
```

foo.py

```
from fun import *
import foo
def main():
        fun ()
        foo.foo()

# Main body
main()
```

main.py

Design

User-Defined Functions - Well Designed Functions

- A Function should:
  - Have a **descriptive name** that indicates the tasks the function performs.
  - **Serve one purpose**; code with different purposes should not be combined into one function.
  - **Reduce code redundancy**
    - A function that has one line of code is generally not a good function
    - A function is that used only once in code is generally not a good function
  - Start with **comments** that describe the function's purpose, the parameter(s), and any value(s) that will be returned.
- Functions can call other functions, which further helps in minimizing code redundancy.

Parameters

Parameters

- A parameter acts like a variable and holds the value we give to the function when we call it.

A parameter provides the needed data passed by the caller

```
def pay (amount):
        print ("Direct bank deposit: $%d." % (amount))

def payroll ():
        salary = 40 * 15
        pay (salary)

payroll ()
```

Parameters

- A parameter acts like a variable and holds the value we give to the function when we call it.

```
def pay (amount):
        print ("Direct bank deposit: $%d." % (amount))

def payroll ():
        salary = 40 * 15
        pay (salary)

payroll ()
```

A parameter provides the needed data passed by the caller

The parameter name and argument name can be different.

The variable **salary** is a pointer to a place in memory

The parameter **amount** is a new variable created each time pay is called which is pointed to same information in memory

User-Defined Functions - Multiple Parameters

- You can define a function that accepts multiple parameters
- The function call must match the number of parameters
  - It must also match the expected data type (not enforced by python)

```
def printbar(char, num):
    bar = ''
    for i in range(1, num + 1, 1)
        bar = bar + char
    print(bar)

printbar('-', 3)
length = 10
printbar('=',length)
```

Do these work?

- **printbar ('-')**
- **printbar (3)**
- **printbar (length)**
- **printbar (3, '-')**

User-Defined Functions - Multiple Parameters

- The following function takes two points (x1, y1) and (x2, y2) in Cartesian plane and return the Euclidean distance between them.

```
def CalcDistance(x1,y1,x2,y2):
    dx = x1-x2
    dy = y1-y2
    dSquared = (dx**2) + (dy**2)
    result = dSquared **(1/2)
    return(result)

print(CalcDistance(1, 2, 4, 6))
```

User-Defined Functions - Multiple Parameters

```
#CONSTANTS
WIDTH = 800
HEIGHT = 600

def drawStar(pointer, length):
        for i in range(5):
                pointer.forward(length)
                pointer.right(144)

#Setup turtle
pointer = turtle.Turtle()
screen = turtle.getscreen()
screen.setup(WIDTH, HEIGHT, 0, 0)
screen.setworldcoordinates(0, 0, WIDTH, HEIGHT)
pointer.hideturtle()
screen.delay(delay=0)

pointer.up()
pointer.goto(400,300)
pointer.down()
drawStar(pointer, 100)
pointer.up()

screen.exitonclick()
```

main() function

```
#CONSTANTS
WIDTH = 800
HEIGHT = 600

def drawStar(pointer, length):
        for i in range(5):
                pointer.forward(length)
                pointer.right(144)
def main():
        #Setup turtle
        pointer = turtle.Turtle()
        screen = turtle.getscreen()
        screen.setup(WIDTH, HEIGHT, 0, 0)
        screen.setworldcoordinates(0, 0, WIDTH, HEIGHT)
        pointer.hideturtle()
        screen.delay(delay=0)

        pointer.up()
        pointer.goto(400,300)
        pointer.down()
        drawStar(pointer, 100)
        pointer.up()

        screen.exitonclick()
main()
```

Optional Parameters

User-Defined Functions - Optional Parameters

- Optional parameters are parameters that programmers do not have to pass to the function during function call.
- They have default values that will be used if none were provided.
- Optional parameters should appear at the end of the parameter list in the function definition:

```
def printbar(char, num = 10):
    bar = ''
    for i in range(num + 1):
        bar = bar + char
    print(bar)

printbar('-')
printbar('=', 20)
```

User-Defined Functions - Optional Parameters

- You can define default parameter values
  - The function will always use these values unless new ones are declared

```
def foo(x=1,y=2):
    print("x=",x,"y=",y)

foo()
foo(3)
foo(3,4)
```

User-Defined Functions - Optional Parameters

- You can define default parameter values
  - The function will always use these values unless new ones are declared

```
def foo(x=1,y=2):
    print("x=",x,"y=",y)

foo()                    x= 1 y= 2
foo(3)                   x= 3 y= 2
foo(3,4)                 x= 3 y= 4
```

User-Defined Functions - Variadic Functions

- Variadic functions are functions that accept a variable number of parameters.
- Useful when you do not know *a priori* how many parameters the user may pass to the function:
- Commonly used for functions that perform some operation on a series of inputs, such as summing numbers, concatenating strings, or formatting output.
  - Ex. `print("My name is", name, ". I am from", country)`

User-Defined Functions - Variadic Functions

- You can define a variadic function in python as follows:

```
def variadicFunction(*args):
    for i in args:
        print(i)
```

- *args* is a conventional name. You can use any name you like.
- You can pass any number of arguments when calling the function:

```
variadicFunction("a")          →    a
variadicFunction("a","b","c") →    a
                                   b
                                   c
```

User-Defined Functions - Variadic Functions

- You can include defined parameters at the beginning as follows:

```
def variadicFunction(param1,*args):
      print("Named param is:", param1)
      for i in args:
         print(i)
```

- Start with any named parameters you may have followed by the variable-length parameter list. You can have none.
- You must pass the named params followed by any number of arguments when calling the function:

```
variadicFunction("a")      →    Named param is: a
variadicFunction("a","b")→    Named param is: a
                                b
```

Onward to … using functions.

Jonathan Hudson
jwhudson@ucalgary.ca
https://pages.cpsc.ucalgary.ca/~jwhudson/

UNIVERSITY OF CALGARY