Week 5: Functions

Unit 1: Why Are Functions Necessary?

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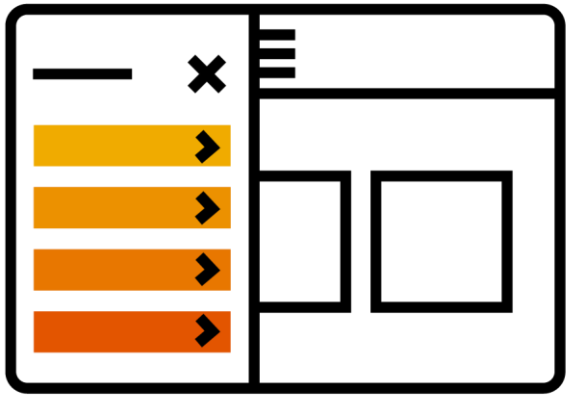
Why are functions necessary?

Functions are essential to structure programs

- Functions are already known from mathematics
  - Each element *x* is mapped to another element *y*
- The structure of functions in programming is similar
  - Functions have a name
  - Usually, functions have input parameters
  - Functions process the input
  - Usually, functions have a return value
- What advantage is achieved using functions?
  - Programs tend to become huge; functions support the structuring of programs
  - Functions enable the reusability of functionality
- `print()` is a function already known and used in this course



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Why are functions necessary?
Showtime

Now it’s time to get hands on and start programming!

If you like, you can open the Jupyter Notebook instructions in parallel to the demo.

If you haven’t done so yet:

- Download the Notebook
- Start the Jupyter Server
- Open the Notebook

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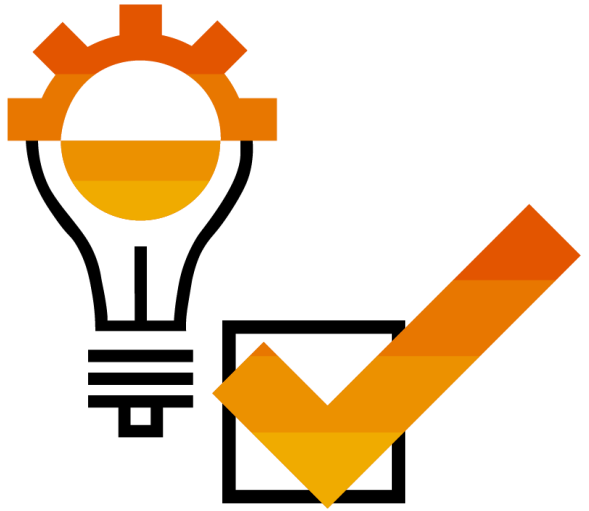
Summary / key takeaways

In this unit you learned ...

- … why functions are required in programming
- … the basic structure of functions in Python
- … how to define and call your own function



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Week 5: Functions

Unit 2: Returning Results from Functions

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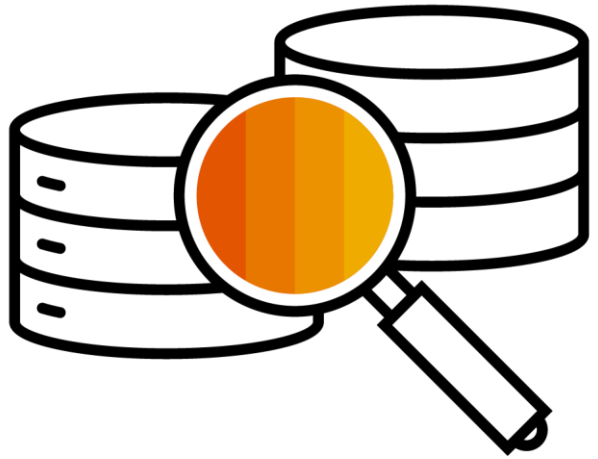
Returning results from functions

Many functions have a return value

- Functions often yield results, which should be returned to the calling program code
- The result of a function is called the *return value*
  - Returning the result is actually done using the keyword `return`
- Return values can have different data types
- Functions can have none, one, or several return values
  - If there is no `return` within a function, then the value `None` is returned
  - If several values should be returned, they have to be packed into a complex data structure like a list or a tuple



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Returning results from functions
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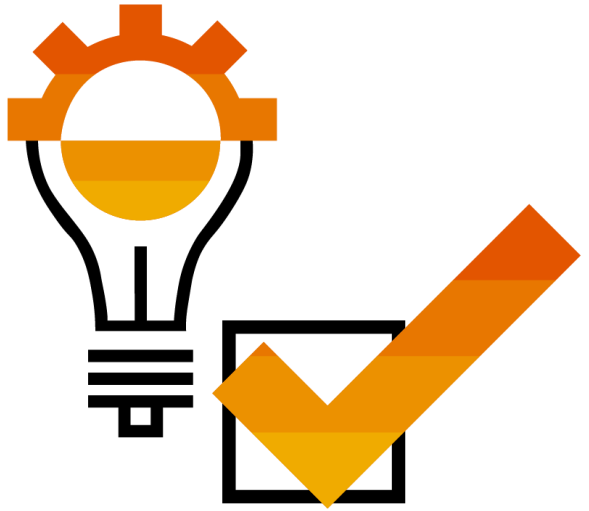
Summary / key takeaways

In this unit you learned ...

- … the possible return options of functions
- … how to return different values out of functions



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Week 5: Functions

Unit 3: Adding Parameters to Functions

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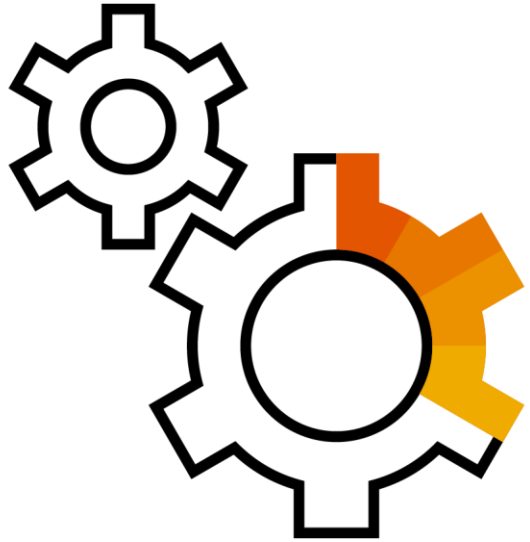
Adding parameters to functions

Using input parameters makes functions more flexible

- Parameters enhance the possibilities of functions
  - Adapt functions to different scenarios
  - Reuse functions with different inputs
- No/one/multiple parameters possible for functions
- Possibility to define default values for parameters
  - If a function is called without the parameter, the default value is used



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Adding parameters to functions
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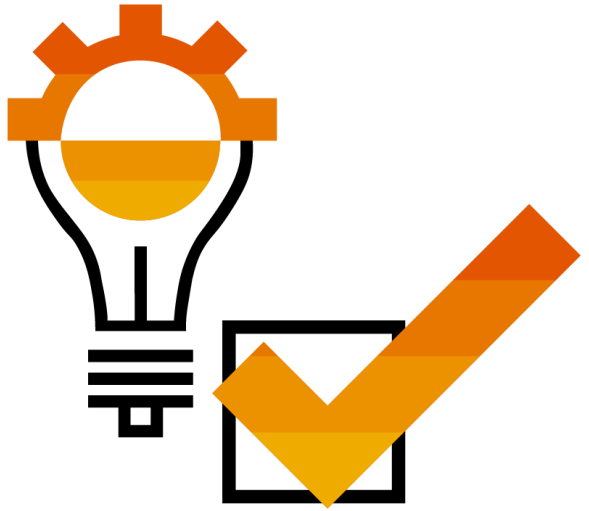
Summary / key takeaways

In this unit you learned ...

- … why using parameters can be useful
- … how many parameters can be used for a function
- … how to set default values for parameters



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Week 5: Functions

Unit 4: Visibility of Variables

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Visibility of variables

Global vs. local variable scopes

- Up to now we only used global variables
- **Global** variables are accessible everywhere in the program
- **Local** variables are only visible inside their scope, e.g., inside a function
  - Multiple *local* variables with the same name in different functions are possible
- Local variables can hide global variables
  - A local variable inside a function will hide a global variable with the same name
- We recommend not to use global variables within functions

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Visibility of variables
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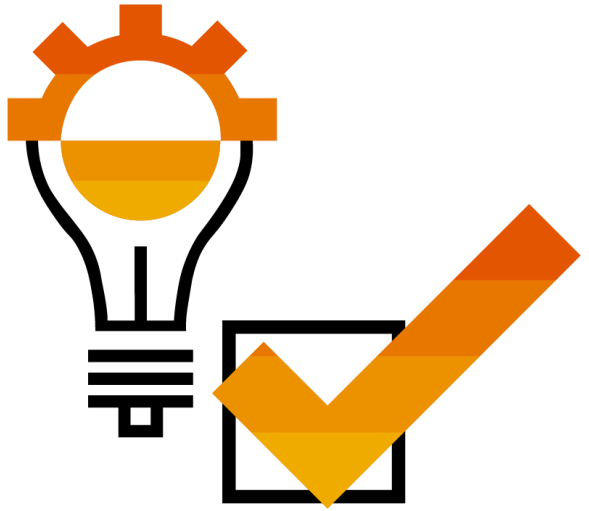
Summary / key takeaways

In this unit you learned ...

- … how to differentiate between local and global variables
- … that local variables hide global ones with the same name
- … the recommendation for the use of local and global variables



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Week 5: Functions

Unit 5: Combining Functions

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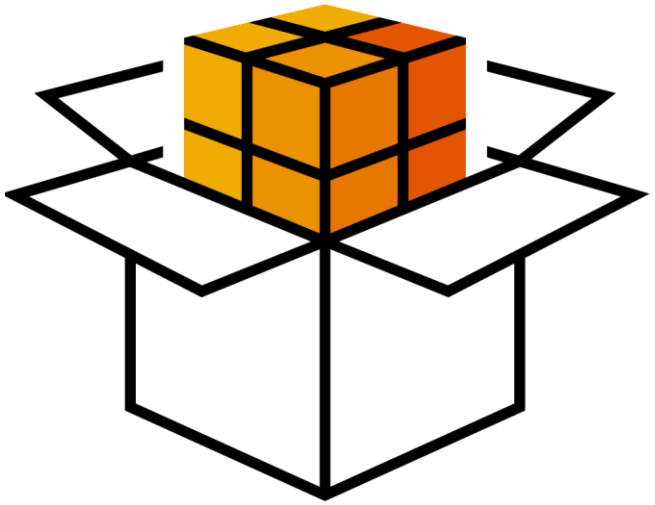
Combining functions

To make code more compact, functions can be nested

- Nesting functions is a common pattern
  - Already used example: `length = int(input())`
- Nested functions are evaluated from the innermost to the outermost function
  - First, get input with `input()`
  - Use the return value of `input()` as the input parameter for `int()`
  - Be careful with nesting functions though: too many → confusing code
- Functions can be combined by invoking other functions



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Combining functions
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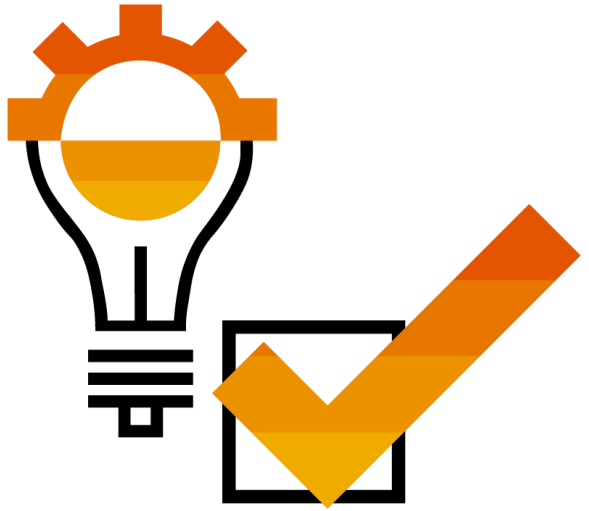
Combining functions
Summary / key takeaways

In this unit you learned ...

- … how to combine functions
- … the caveats of combining multiple functions



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Week 5: Functions

Unit 6: Methods vs. Functions

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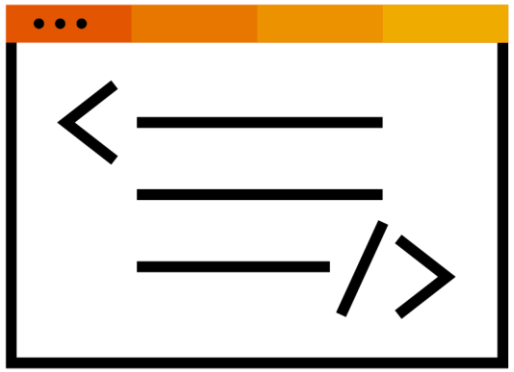
Methods vs. functions

Methods and functions are not the same

- To handle complexity in programming, several programming paradigms have been introduced. Two examples are:
  - Procedural programming
  - Object-oriented programming
- Both paradigms are supported by Python
- Procedural programming:
  - Program is structured into different procedures.
  - These procedures are called functions in Python
- Object-oriented programming:
  - Objects contain data and methods.
  - Methods are invoked by calling the object together with the method

```
object_name.method_name
```



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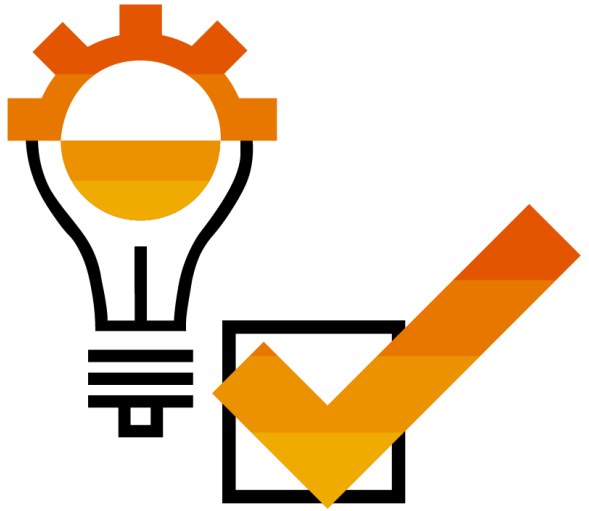
Summary / key takeaways

In this unit you learned ...

- … the differences between functions and methods



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Week 5: Functions

Unit 7: Destructuring Assignment

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Destructuring assignment

Destructuring simplifies access to lists and tuples

- It is possible to return more than one value from a function by using a tuple
- Destructuring assignment splits tuples into individual variables
- Use of * to assign all remaining values to a variable

```
primes = [2, 3, 5, 7, 11, 13, 17, 19]
smallest_prime, *_, largest_prime = primes

print(
    "The smallest prime number in the list is",
    smallest_prime,
    ", the largest",
    largest_prime,
)
```

```
The smallest prime number in the list is 2 , the largest 19
```

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Destructuring assignment
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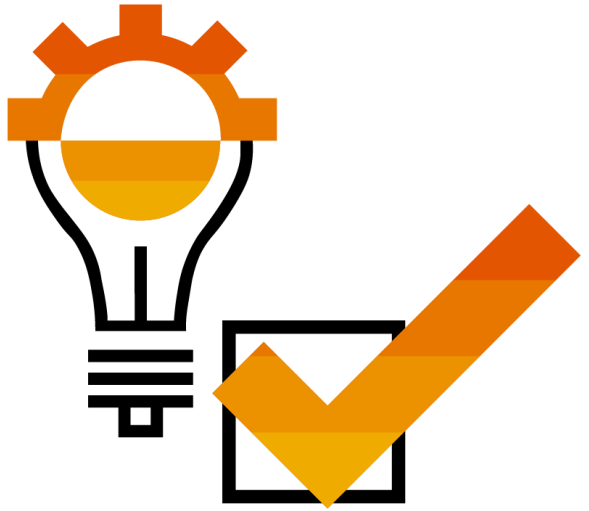
Destructuring assignment
Summary / key takeaways

In this unit you learned ...

- … how to assign multiple return values to single variables
- … how to assign left-over return values to a list



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