

# Lambda functions

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# Simple functions

```
def average(values):  
    average_value = sum(values) / len(values)  
    return average_value
```

# Lambda functions

- `lambda` keyword
  - Represents an *anonymous function*

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# Lambda functions

- `lambda` keyword
  - Represents an *anonymous function*
  - **Can** store as a variable and call it

```
lambda argument(s): expression
```

- Convention is to use `x` for a single argument
- The `expression` is the equivalent of the function body
- No `return` statement is required

# Creating a lambda function

```
# Lambda average function  
lambda x: sum(x) / len(x)
```

```
<function __main__.<lambda>(x)>
```

```
# Custom average function  
def average(x):  
    return sum(x) / len(x)
```

```
average
```

```
<function __main__.average(x)>
```

# Using lambda functions

```
# Get the average  
(lambda x: sum(x) / len(x))
```



# Using lambda functions

```
# Get the average  
(lambda x: sum(x) / len(x))([3, 6, 9])
```

```
6.0
```

# Storing and calling a lambda function

```
# Store lambda function as a variable
average = lambda x: sum(x) / len(x)

# Call the average function
average([3, 6, 9])
```

```
6.0
```

# Multiple parameters

```
# Lambda function with two arguments  
(lambda x, y: x**y)(2, 3)
```

8

# Lambda functions with iterables

- `map()` applies a function to **all** elements in an iterable

```
names = ["john", "sally", "leah"]  
# Apply a lambda function inside map()  
capitalize = map(lambda x: x.capitalize(), names)  
print(capitalize)
```

```
<map object at 0x7fb200529c10>
```

```
# Convert to a list  
list(capitalize)
```

```
['John', 'Sally', 'Leah']
```

# Custom vs. lambda functions

Scenario	Function Type
Complex task	Custom
Same task several times	Custom
Simple task	Lambda
Performed once	Lambda

# Let's practice!

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# Introduction to errors

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# What is an error?

- Code that violates one or more rules
- Error = Exception
- Cause our code to terminate!

```
BaseException
├── BaseExceptionGroup
├── GeneratorExit
├── KeyboardInterrupt
├── SystemExit
├── Exception
│   ├── ArithmeticError
│   │   ├── FloatingPointError
│   │   ├── OverflowError
│   │   └── ZeroDivisionError
│   ├── AssertionError
│   ├── AttributeError
│   ├── BufferError
│   ├── EOFError
│   ├── ExceptionGroup [BaseExceptionGroup]
│   ├── ImportError
│   │   └── ModuleNotFoundError
│   ├── LookupError
│   │   ├── IndexError
│   │   └── KeyError
│   ├── MemoryError
│   ├── NameError
│   │   └── UnboundLocalError
│   └── OSError
│       ├── BlockingIOError
│       ├── ChildProcessError
│       ├── ConnectionError
│       │   └── BrokenPipeError
```

<sup>1</sup> <https://docs.python.org/3/library/exceptions.html#exception-hierarchy>



# TypeError

- Incorrect data type

```
"Hello" + 5
```

```
-----  
TypeError
```

```
Traceback (most recent call last)
```

```
Cell In[1], line 1
```

```
----> 1 "Hello" + 5
```

```
TypeError: can only concatenate str (not "int") to str
```

# ValueError

```
float("Hello")
```

```
-----  
ValueError                                Traceback (most recent call last)  
Cell In[2], line 1  
----> 1 float("Hello")  
  
ValueError: could not convert string to float: 'Hello'
```

- The value is not acceptable in an acceptable range

```
float("2")
```

```
2.0
```

# Tracebacks

-----  
**ValueError**

Cell In[2], line 1

----> 1 float("Hello")


**ValueError:** could not convert string to float: 'Hello'

Traceback (most recent call last)



# Tracebacks

```
-----  
ValueError                                Traceback (most recent call last)  
Cell In[2], line 1  
----> 1 float("Hello")  
  
ValueError: could not convert string to float: 'Hello'
```



# Tracebacks

-----  
**ValueError**

Traceback (most recent call last)

Cell In[2], line 1

----> 1 float("Hello")

**ValueError:** could not convert string to float: 'Hello'

# Code in packages

- Packages contain other people's code e.g., custom functions
- Known as source code
- `pip install <package>` downloads source code to our local environment
- The pandas' `pd.read_csv()` function executes the code written for that custom function behind the scenes

# Tracebacks from packages

```
# Import pandas package
import pandas as pd

# Create pandas DataFrame
products = pd.DataFrame({"ID": "ABC1",
                        "price": 29.99})

# Try to access the non-existent "tag" column
products["tag"]
```

# Tracebacks from packages

```

KeyError                                Traceback (most recent call last)
File /usr/local/lib/python3.8/dist-packages/pandas/core/indexes/base.py:3803, in Index.get_loc(self, key, method, tolerance)
    3802 try:
-> 3803     return self._engine.get_loc(casted_key)
    3804 except KeyError as err:

File /usr/local/lib/python3.8/dist-packages/pandas/_libs/index.pyx:138, in pandas._libs.index.IndexEngine.get_loc()

File /usr/local/lib/python3.8/dist-packages/pandas/_libs/index.pyx:165, in pandas._libs.index.IndexEngine.get_loc()

File pandas/_libs/hashtable_class_helper.pxi:5745, in pandas._libs.hashtable.PyObjectHashTable.get_item()

File pandas/_libs/hashtable_class_helper.pxi:5753, in pandas._libs.hashtable.PyObjectHashTable.get_item()

KeyError: 'tag'

The above exception was the direct cause of the following exception:

KeyError                                Traceback (most recent call last)
Cell In[5], line 9
      5 products = pd.DataFrame({"ID": ["ABC1", "ABC2", "ABC3"],
      6                        "price": [29.99, 39.95, 51.25]})
      8 # Try to access the non-existent "tag" column
----> 9 products["tag"]

File /usr/local/lib/python3.8/dist-packages/pandas/core/frame.py:3804, in DataFrame.__getitem__(self, key)
    3802 if self.columns.nlevels > 1:
    3803     return self._getitem_multilevel(key)
-> 3804 indexer = self.columns.get_loc(key)
    3805 if is_integer(indexer):
    3806     indexer = [indexer]

File /usr/local/lib/python3.8/dist-packages/pandas/core/indexes/base.py:3805, in Index.get_loc(self, key, method, tolerance)
    3803     return self._engine.get_loc(casted_key)
    3804 except KeyError as err:
-> 3805     raise KeyError(key) from err
    3806 except TypeError:
    3807     # If we have a listlike key, _check_indexing_error will raise
    3808     # InvalidIndexError. Otherwise we fall through and re-raise
    3809     # the TypeError.
    3810     self._check_indexing_error(key)

KeyError: 'tag'
```



# Tracebacks from packages

```
-----
KeyError                                Traceback (most recent call last)
File /usr/local/lib/python3.8/dist-packages/pandas/core/indexes/base.py:3803, in Index.get_loc(self, key, method, tolerance)
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KeyError: 'tag'

The above exception was the direct cause of the following exception:
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# Tracebacks from packages

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KeyError                                Traceback (most recent call last)
Cell In[5], line 9
      5 products = pd.DataFrame({"ID": ["ABC1", "ABC2", "ABC3"],
      6                          "price": [29.99, 39.95, 51.25]})
      8 # Try to access the non-existent "tag" column
----> 9 products["tag"]
```

# Tracebacks from packages

```
File /usr/local/lib/python3.8/dist-packages/pandas/core/frame.py:3804, in DataFrame.__getitem__(self, key)
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    3809     # the TypeError.
    3810     self._check_indexing_error(key)

KeyError: 'tag'
```

# Let's practice!

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# Error handling

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# Pandas traceback

```
File /usr/local/lib/python3.8/dist-packages/pandas/core/indexes/base.py:3805, in Index.get_loc(self, key, method, tolerance)
    3803     return self._engine.get_loc(casted_key)
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    3809     # the TypeError.
    3810     self._check_indexing_error(key)

KeyError: 'tag'
```

- `except` , `raise`
- Try to anticipate how errors might occur

# Design-thinking

- How might people use our custom function?
- Test these different approaches
- Find what errors occur



<sup>1</sup> Image credit: <https://www.flickr.com/photos/140641142@N05/>

# Error handling in custom functions

```
def average(values):  
    # Calculate the average  
    average_value = sum(values) / len(values)  
    return average_value
```



# Where might they go wrong?

- Provide more than one argument
- Use the wrong data type

# Where might they go wrong?

```
sales_dict = {"cust_id": ["JL93", "MT12", "IY64"],  
              "order_value": [43.21, 68.70, 82.19]}  
  
average(sales_dict)
```

```
-----  
TypeError                                Traceback (most recent call last)  
Cell In[5], line 4  
      1 sales_dict = {"cust_id": ["JL93", "MT12", "IY64"],  
      2               "order_value": [43.21, 68.70, 82.19]}  
----> 4 average(sales_dict)  
  
Cell In[4], line 3, in average(values)  
      1 def average(values):  
      2     # Calculate the average  
----> 3     average_value = sum(values) / len(values)  
      4     return average_value  
  
TypeError: unsupported operand type(s) for +: 'int' and 'str'
```

# Error-handling techniques

- Control flow `if` , `elif` , `else`
- Docstrings

# try-except

```
def average(values):  
    try:  
        # Code that might cause an error  
        average_value = sum(values) / len(values)  
        return average_value  
    except:  
        # Code to run if an error occurs  
        print("average() accepts a list or set. Please provide a correct data type.")  
  
average(sales_dict)
```

```
average() accepts a list or set. Please provide a correct data type.
```

# raise

```
def average(values):  
    # Check data type  
    if type(values) in ["list", "set"]:  
        # Run if appropriate data type was used  
        average_value = sum(values) / len(values)  
        return average_value
```

# raise

```
def average(values):  
    # Check data type  
    if type(values) in ["list", "set"]:  
        # Run if appropriate data type was used  
        average_value = sum(values) / len(values)  
        return average_value  
    else:  
        # Run if an Exception occurs  
        raise
```

# raise TypeError

```
def average(values):  
    # Check data type  
    if type(values) in ["list", "set"]:  
        # Run if appropriate data type was used  
        average_value = sum(values) / len(values)  
        return average_value  
    else:  
        # Run if an Exception occurs  
        raise TypeError("average() accepts a list or set, please provide a correct data type.")
```

# raise TypeError output

```
average(sales_dict)
```

```
-----  
TypeError                                Traceback (most recent call last)  
Cell In[19], line 11  
      7     else:  
      8         # Run if an Exception occurs  
      9         raise TypeError("average() accepts a list or set, please provide a correct data type.")  
----> 11 average(sales_dict)  
  
Cell In[19], line 9, in average(values)  
      6     return average_value  
      7 else:  
      8     # Run if an Exception occurs  
----> 9     raise TypeError("average() accepts a list or set, please provide a correct data type.")  
  
TypeError: average() accepts a list or set, please provide a correct data type.
```



# try-except vs. raise

## try - except

- Avoid errors being produced
- Still execute subsequent code

## raise

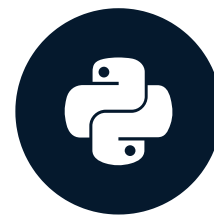
- Will produce an error
- Avoid executing subsequent code

# Let's practice!

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# Congratulations

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# Chapter 1 recap

- Built-in functions
  - `print()` , `help()` , `type()`
  - `max()` , `min()` , `sum()`
  - `len()` , `round()` , `sorted()`
- Modules
  - `collections` , `string` ,
  - `os` , `logging` , `subprocess`
- Packages
  - `pandas`

# Chapter 2 recap

```
# Create a custom function
def average(values):
    # Calculate the average
    average_value = sum(values) / len(values)

    # Round the results
    rounded_average = round(average_value, 2)

    # Return rounded_average as an output
    return rounded_average
```

# Chapter 2 recap

```
# Create a custom function
def average(values, rounded=False):
    # Round average to two decimal places if rounded is True
    if rounded == True:
        average_value = sum(values) / len(values)
        rounded_average = round(average_value, 2)
        return rounded_average
    # Otherwise, don't round
    else:
        average_value = sum(values) / len(values)
        return average_value
```

# Chapter 2 recap

```
def average(values):  
    """  
    Find the mean in a sequence of values and round to two decimal places.  
  
    Args:  
        values (list): A list of numeric values.  
  
    Returns:  
        rounded_average (float): The mean of values, rounded to two decimal places.  
    """  
    average_value = sum(values) / len(values)  
    rounded_average = round(average_value, 2)  
    return rounded_average
```

# Chapter 2 recap

```
# Use arbitrary positional arguments
```

```
def average(*args):  
    average_value = sum(values) / len(values)  
    rounded_average = round(average_value, 2)  
    return rounded_average
```

```
# Use arbitrary keyword arguments
```

```
def average(**kwargs):  
    average_value = sum(kwargs.values()) / len(kwargs.values())  
    rounded_average = round(average_value, 2)  
    return rounded_average
```



# Chapter 3 recap

- `lambda argument(s): expression`

```
names = ["john", "sally", "leah"]

# Apply a lambda function inside map()
capitalize = map(lambda x: x.capitalize(), names)

# Convert to a list
list(capitalize)
```

```
['John', 'Sally', 'Leah']
```

# Chapter 3 recap

```
-----  
ValueError                                Traceback (most recent call last)  
Cell In[2], line 1  
----> 1 float("Hello")  
  
ValueError: could not convert string to float: 'Hello'
```

# Chapter 3 recap

- `try`
- `except`
- `raise`

# Next steps

- Additional built-in functions
  - `zip()`
  - `input()`
  - `reduce()`
  - `filter()`
- More packages and modules
  - `time`
  - `venv`
  - `requests`
  - `fastapi`
- Object-oriented programming

# Congratulations!

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