Lambda functions

INTERMEDIATE PYTHON FOR DEVELOPERS

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Simple functions

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

Lambda functions

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

```
lambda
```

Lambda functions

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

```
lambda argument(s)
```

Lambda functions

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

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

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

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

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

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

average
```

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

Using lambda functions

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

Using lambda functions

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

```
6.0
```

Storing and calling a lambda function

```python
# 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

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

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

```python
# 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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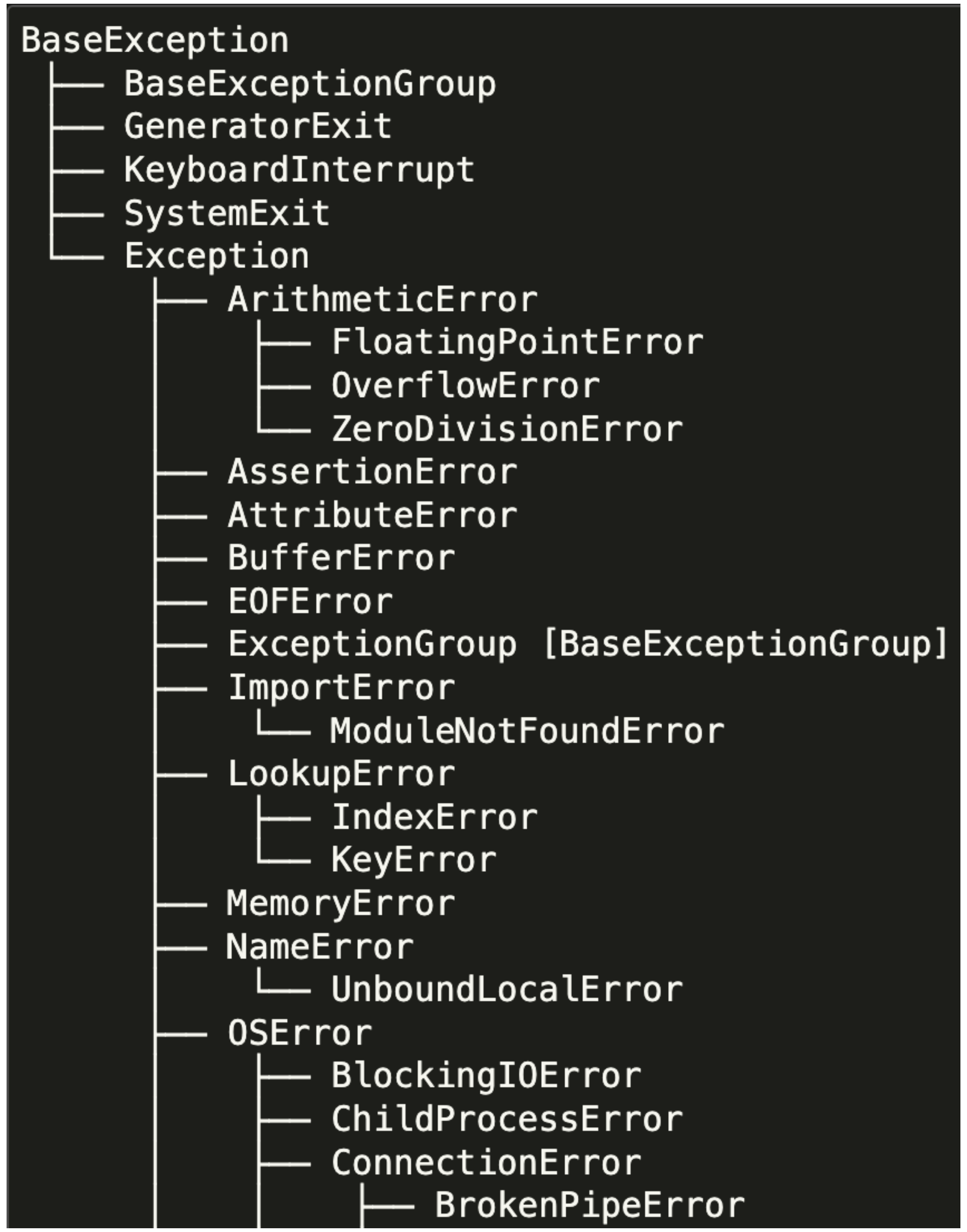
What is an error?

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



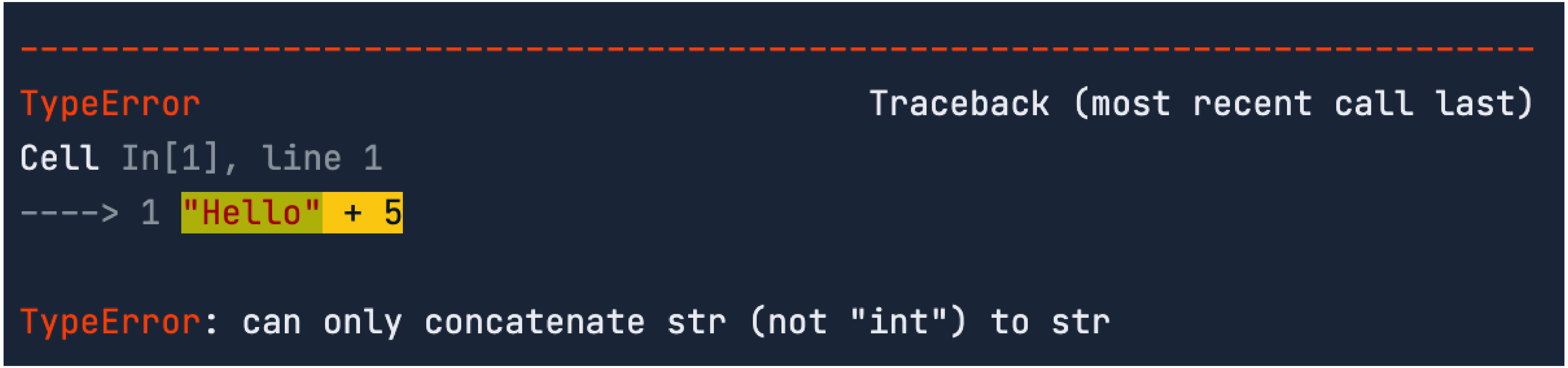
```
BaseException
 ├── BaseExceptionGroup
 ├── GeneratorExit
 ├── KeyboardInterrupt
 ├── SystemExit
 └── Exception
      ├── ArithmeticError
      │    ├── FloatingPointError
      │    ├── OverflowError
      │    └── ZeroDivisionError
      ├── AssertionError
      ├── AttributeError
      ├── BufferError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

[1] https://docs.python.org/3/library/exceptions.html#exception-hierarchy

TypeError

- Incorrect data type

```python
"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")
```

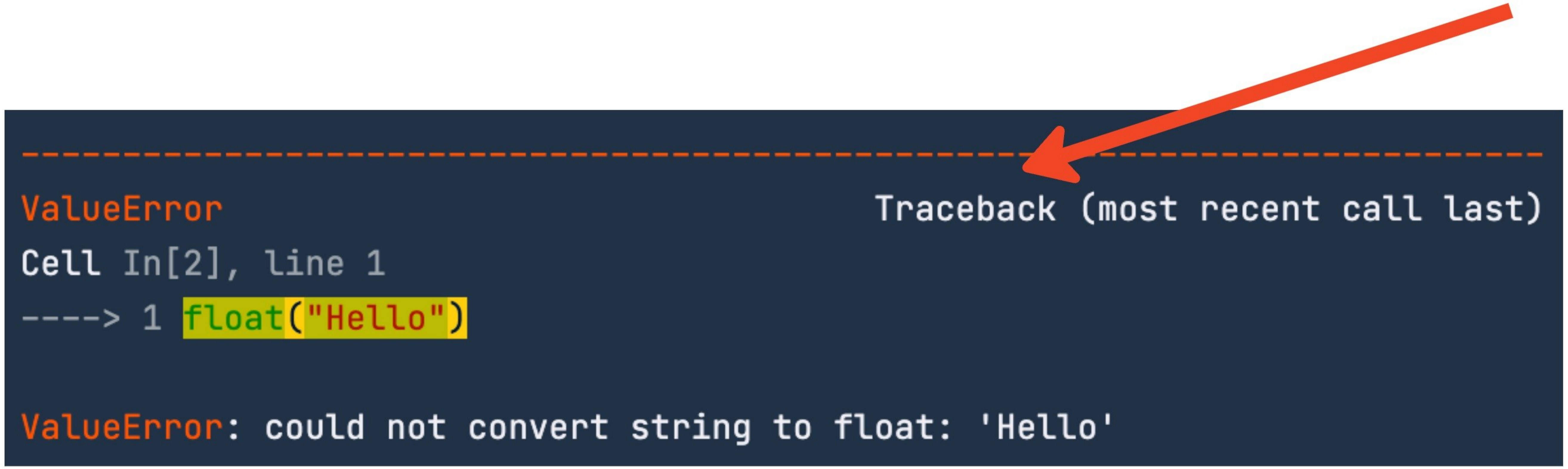
```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Cell In[2], line 1
----> 1 float("Hello")

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

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

```
2.0
```

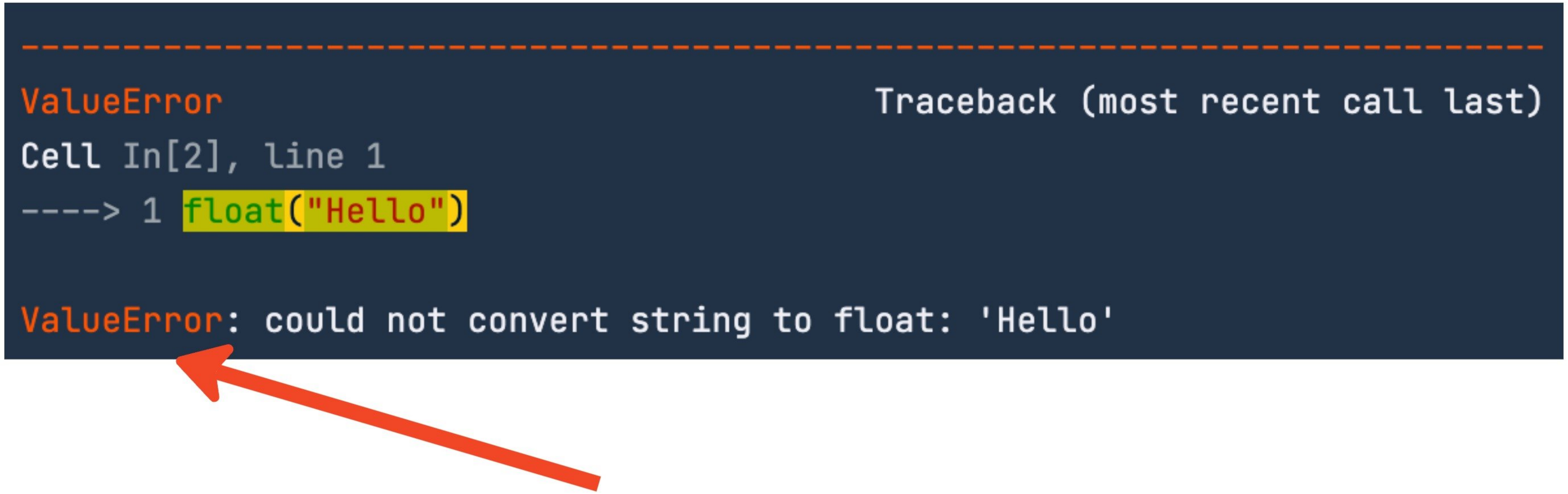
- The value is not acceptable in an acceptable range

Tracebacks



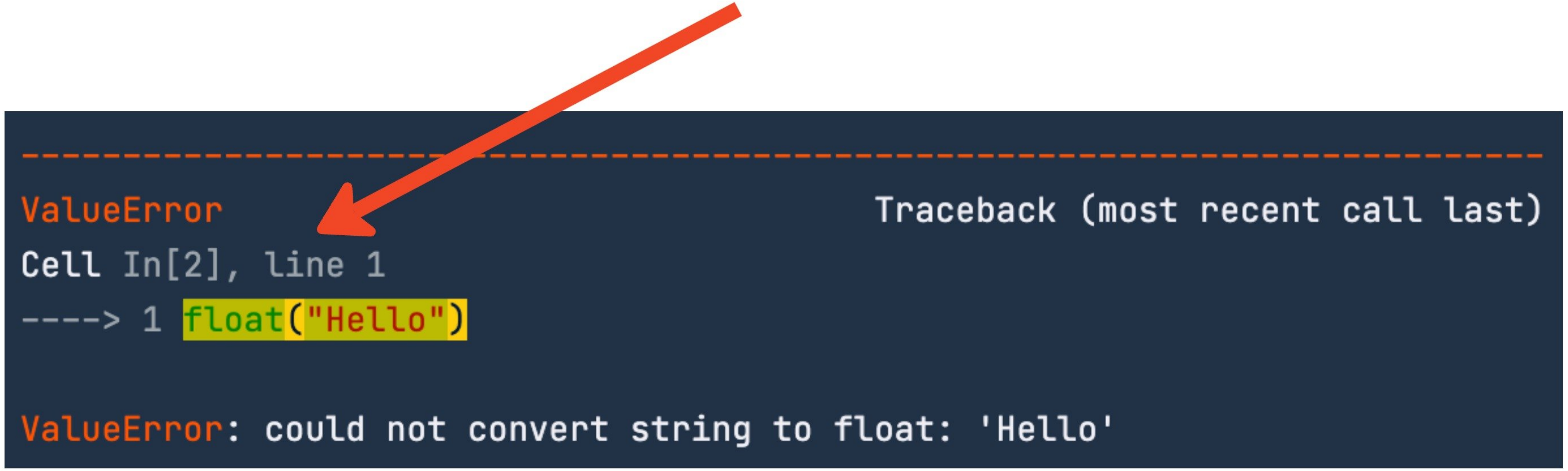
```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Cell In[2], line 1
----> 1 float("Hello")

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'
```

Tracebacks



```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Cell In[2], line 1
----> 1 float("Hello")

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

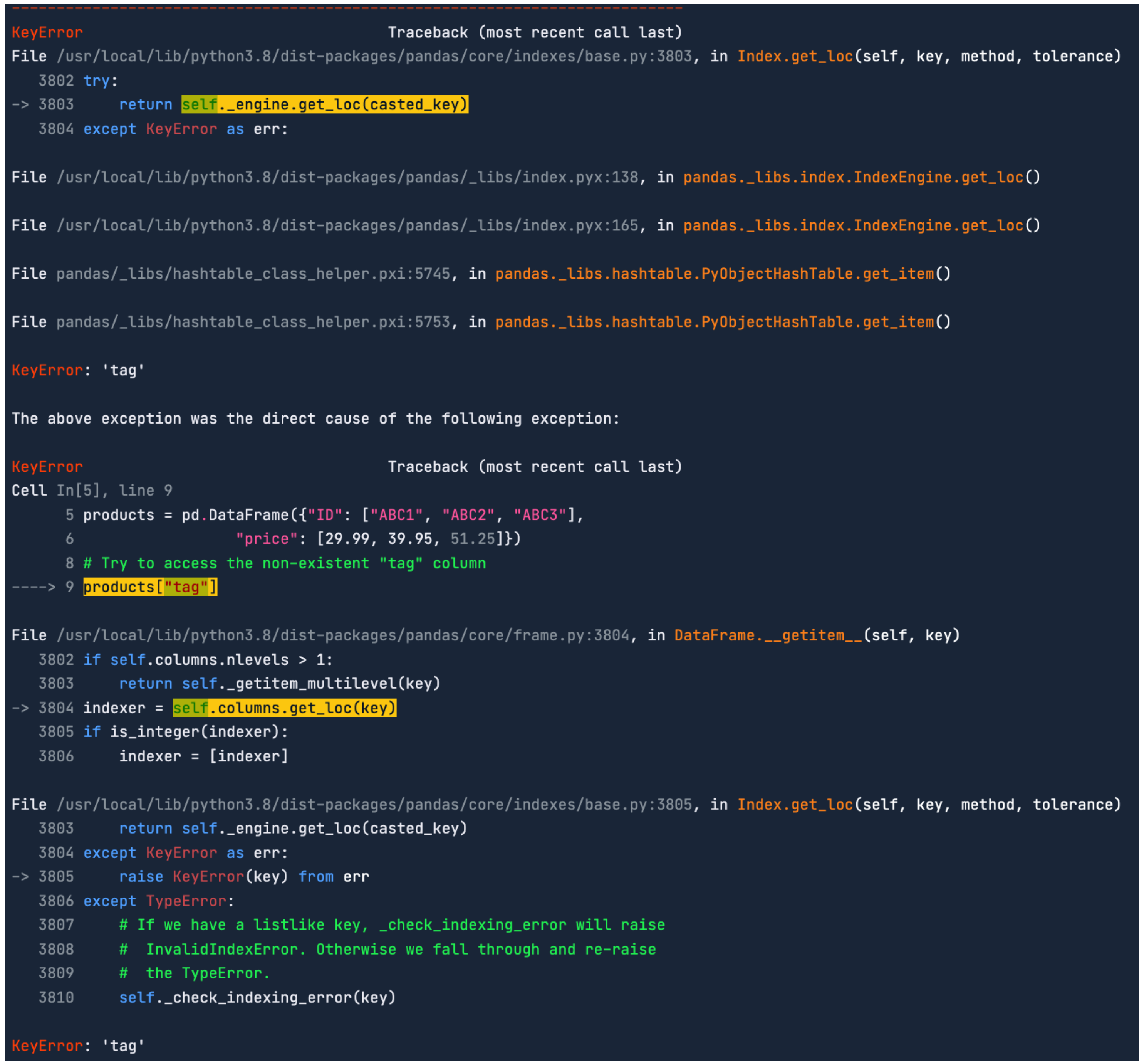
Code in packages

- 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

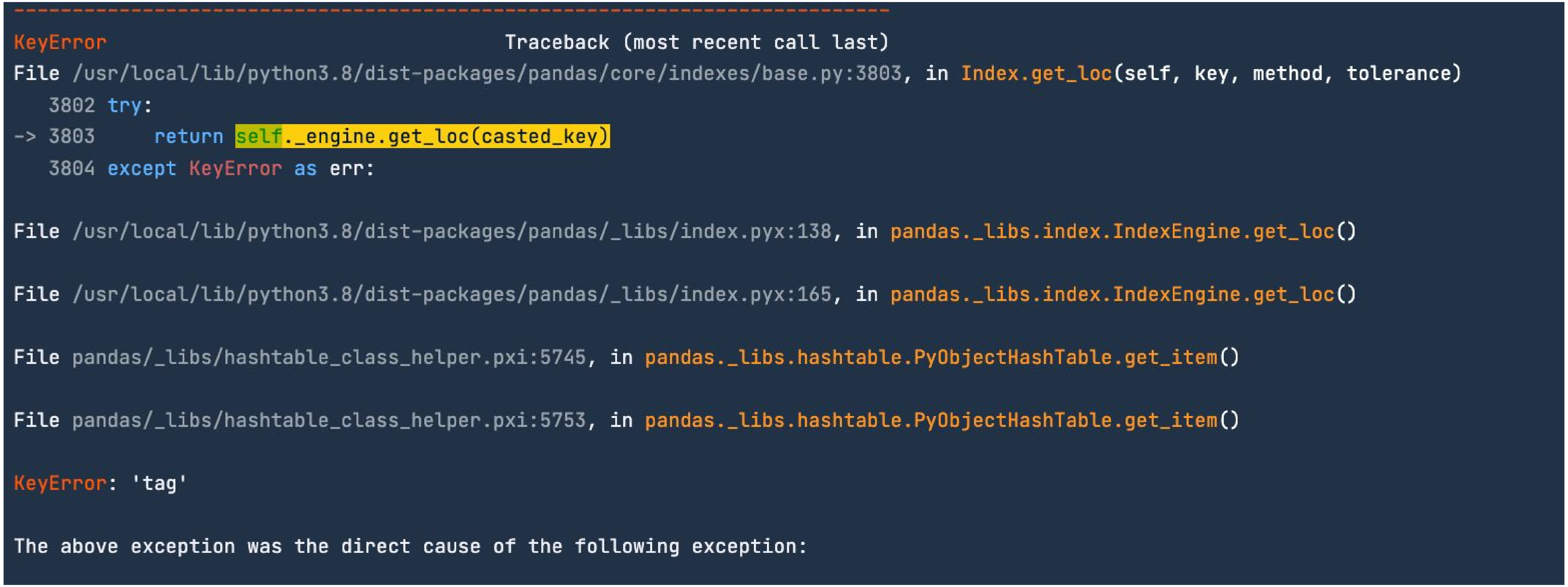
```
# Import pandas package
import pandas as pd

# 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:
```
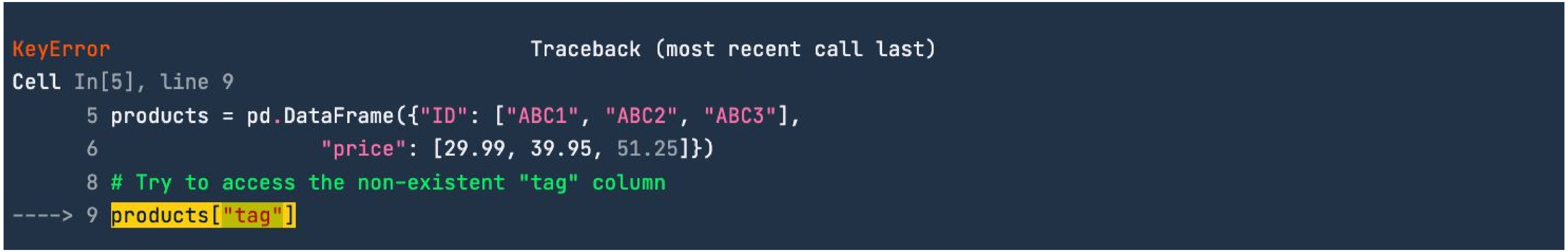
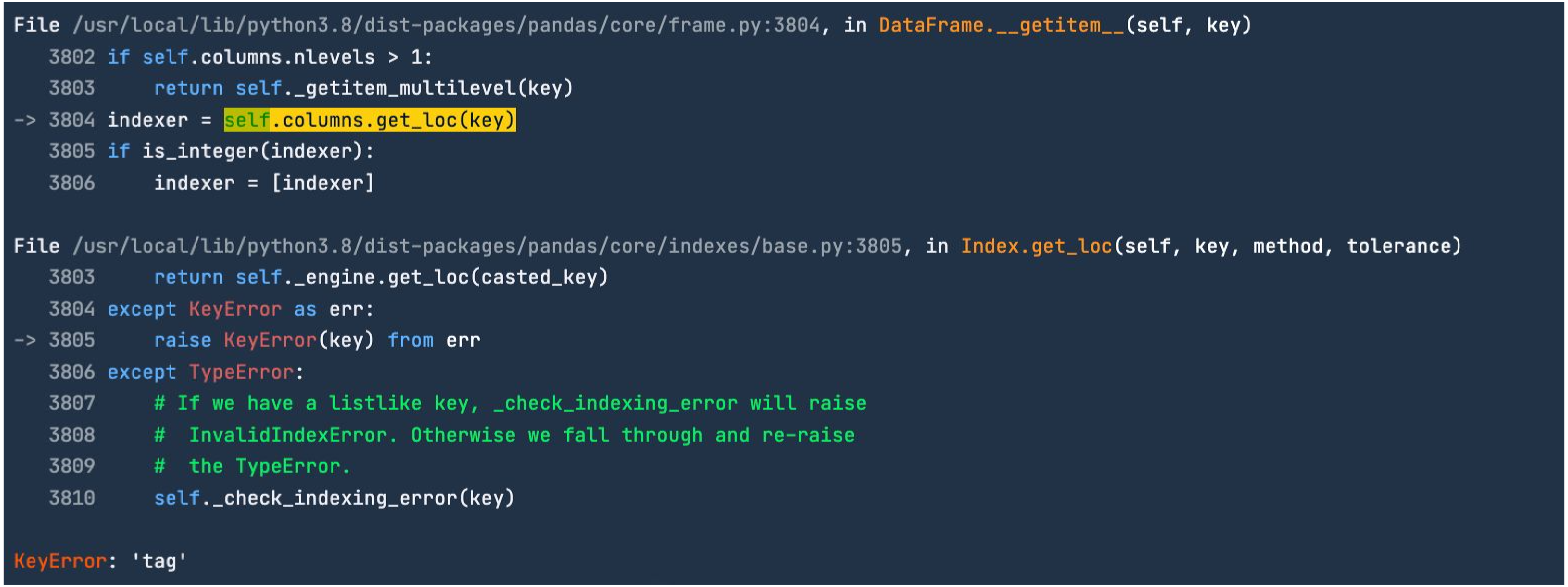

Tracebacks from packages



```
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)
   3802 if self.columns.nlevels > 1:
   3803     return self._getitem_multilevel(key)
-> 3804 indexer = self.columns.get_loc(key)
   3805 if is_integer(indexer):
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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'
```

Let's practice!

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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   3808     #  InvalidIndexError. Otherwise we fall through and re-raise
   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

[1] Image credit: https://www.flickr.com/photos/140641142@N05/

Error handling in custom functions

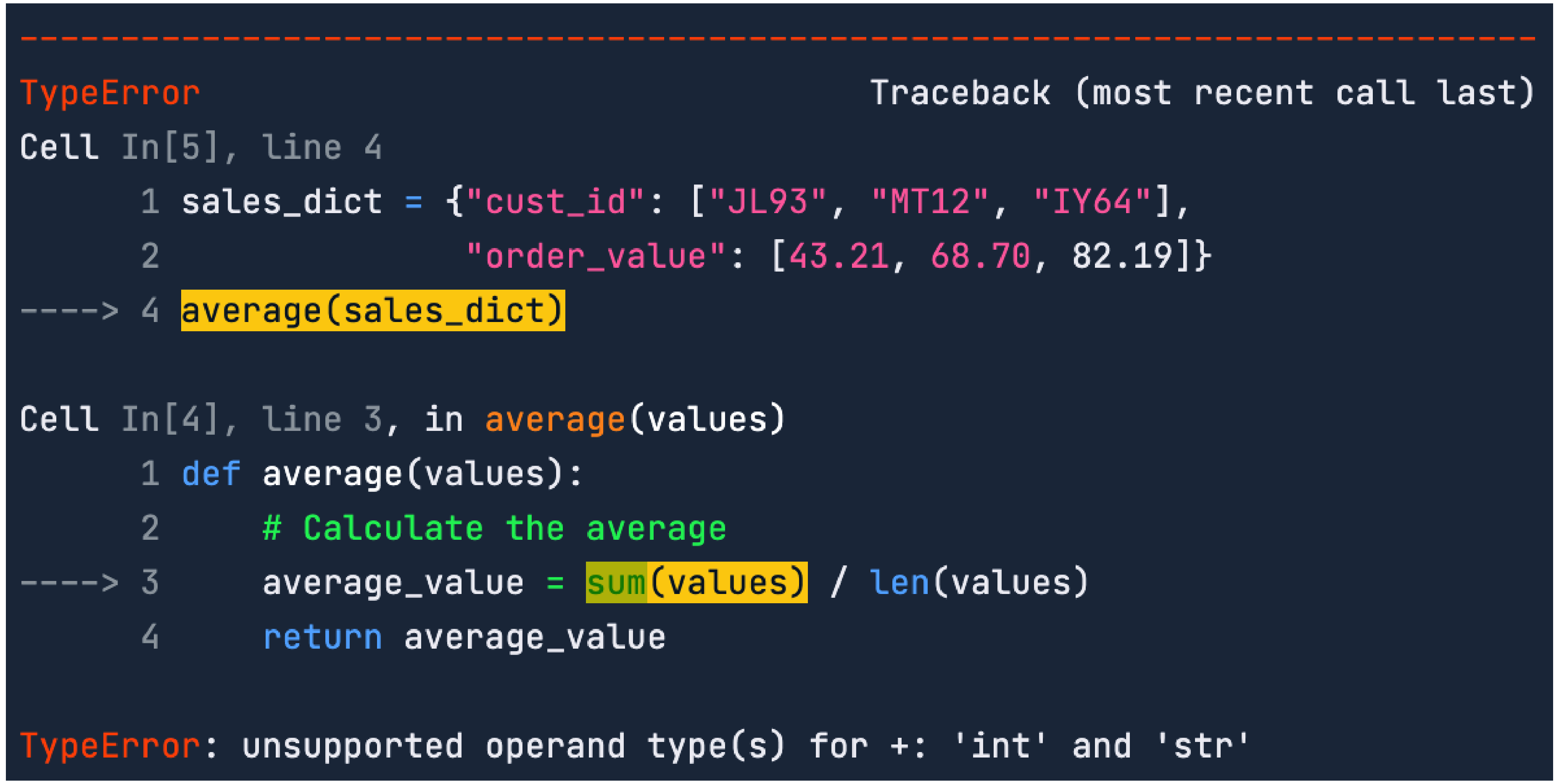
```python
def average(values):
    # Calculate the average
    average_value = sum(values) / len(values)
    return average_value
```

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

```python
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

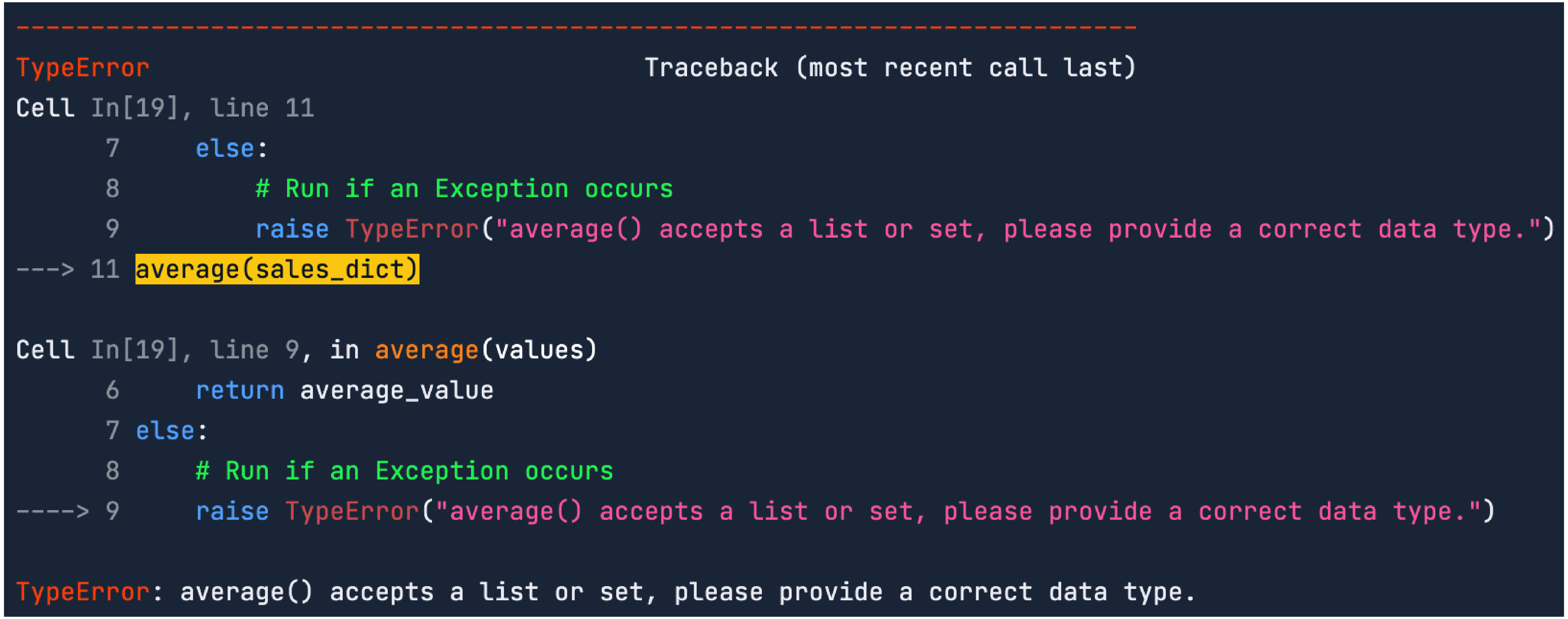
```python
def average(values):
    # Check data type
    if type(values) in ["list", "set"]:
        # Run if appropriate data type was used
        average_value = sum(values) / len(values)
        return average_value
    else:
        # Run if an Exception occurs
        raise
```

raise TypeError

```python
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

```python
# 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

```python
# 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`

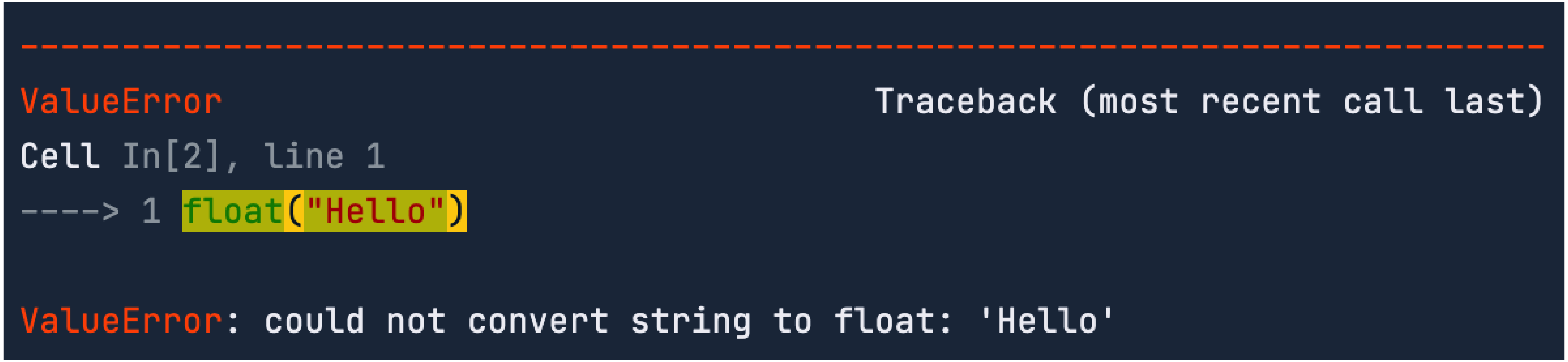
```
names = ["john", "sally", "leah"]

# 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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