SITARE University

Module 26

Advanced Error Handling

Acknowledgement

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Describe Error Types

- Error messages contain a lot of information
  - Stack trace is the complete call stack at crash
  - Final thing is the error message
  - But something right before the message…
- **Examples**
  - **ZeroDivisionError:** division by zero
  - **ValueError:** invalid literal for int() with base 10
  - **TypeError:** 'int' object is not iterable
- This value is the **error type**

Error Types in Python

```
def foo():
    assert 1 == 2, 'My error'
```

```
>>> foo()
AssertionError: My error
```

```
def foo():
    x = 5 / 0
```

```
>>> foo()
ZeroDivisionError:
integer division or
modulo by zero
```

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Class Names

Error Types in Python

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```
>>> foo()
AssertionError: My error
```

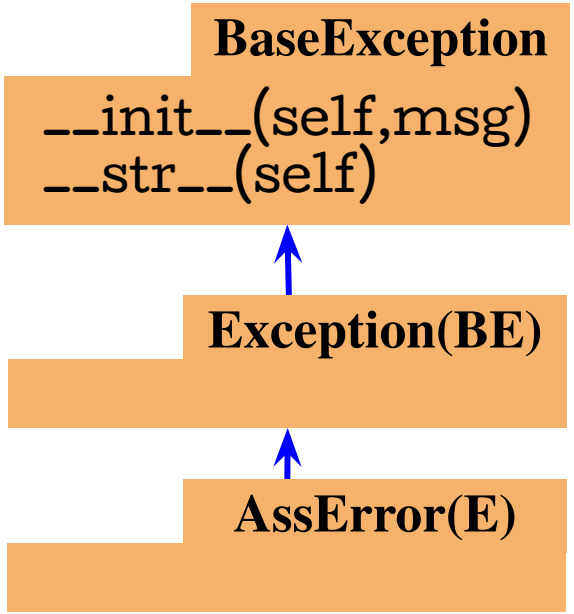
Information about an error is stored inside an **object**. The error type is the **class** of the error object.

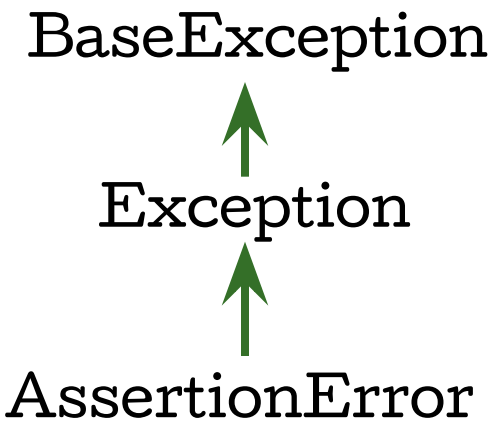
Class Names

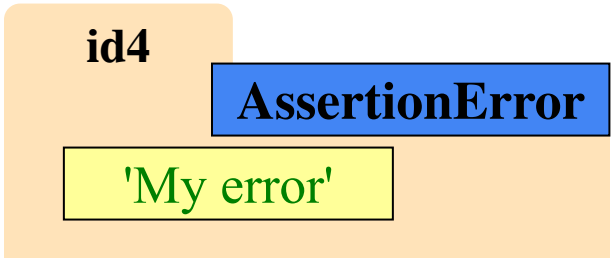
ZeroDivisionError: integer division or modulo by zero

Error Types in Python

- All errors are instances of class BaseException
- This allows us to organize them in a hierarchy







→ means "extends"
or "is an instance of"

Error Types in Python

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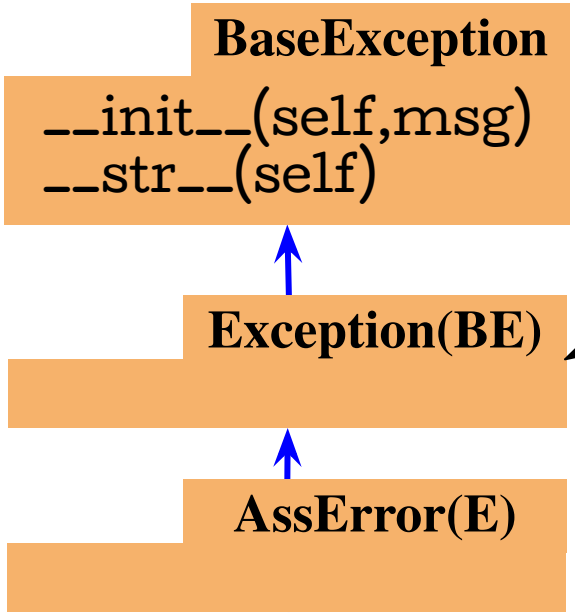


BaseException

All of these are actually empty! **Why?**

AssertionError

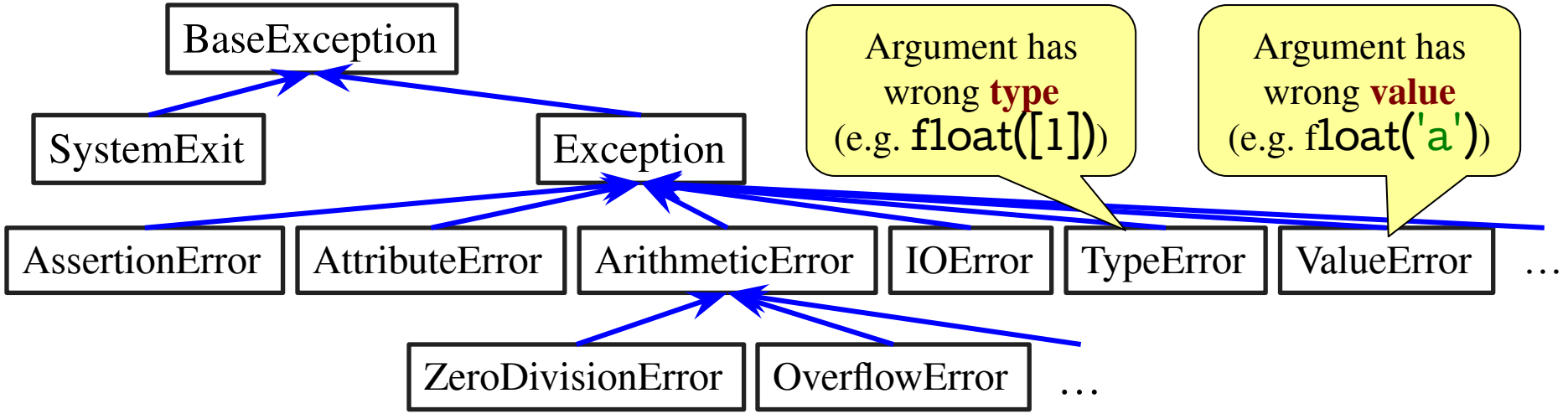
id4

AssertionError

'My error'

→ means "extends" or "is an instance of"

Python Error Type Hierarchy



http://docs.python.org/library/exceptions.html

Why so many error types?

Recall: Recovering from Errors

- try-except blocks allow us to recover from errors
  - Do the code that is in the try-block
  - Once an error occurs, jump to the catch
- **Example**:

```
try:
    val = input()      # get number from user
    x = float(val)     # convert string to float
    print('The next number is '+str(x+1))
except:
    print('Hey! That is not a number!')
```

might have an error

executes if have an error

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```
try:
    val = input()      # get number from user
    x = float(val)     # convert string to float
    print('The next number is '+str(x+1))
    assert x<10, 'Out of range'
except:
    print('Hey! That is not a number!')
```

might have an error

executes if have an error

Handling Errors by Type

- try-except blocks can be restricted to **specific** errors
  - Does except if error is **an instance** of that type
  - If error not an instance, do not recover
- **Example**:

```
try:
    val = input()      # get number from user
    x = float(val)     # convert string to float
    print('The next number is '+str(x+1))
    assert x<10, 'Out of range'
except ValueError:
    print('Hey! That is not a number!')
```

May have ValueError

May have AssertionError

Only recovers ValueError.
Other errors ignored.

This Allows for Multiple Excepts

```
try:
    val = input()      # get number from user
    x = float(val)     # convert string to float
    print('The next number is '+str(x+1))
    assert x<10, 'Out of range'
except ValueError:
    print('Hey! That is not a number!')
except AssertionError:
    print('Out of Bounds!')
```

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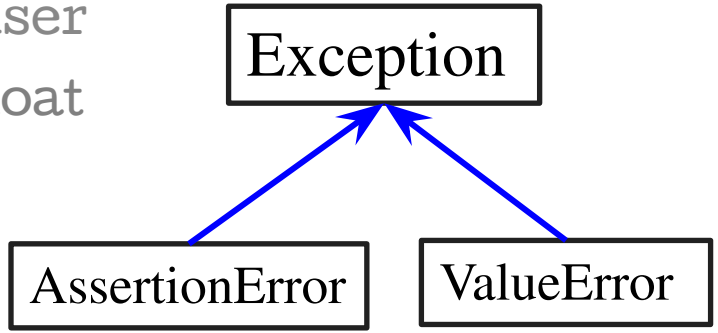
```
try:
    val = input()      # get number from user
    x = float(val)     # convert string to float
    print('The next number is '+str(x+1))
    assert x<10, 'Out of range'
except ValueError:
    print('Hey! That is not a number!')
except AssertionError:
    print('Out of Bounds!')
```

This works just like elif!

Except Matches with isinstance

```
try:
    val = input()       # get number from user
    x = float(val)      # convert string to float
    print('The next number is '+str(x+1))
except Exception:
    print('Something bad just happened')
```



This recovers from **all** errors

Recall: Try-Except and the Call Stack

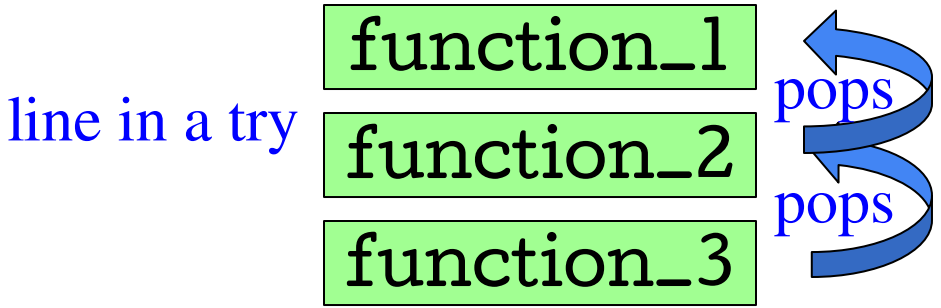
```
# recover.py

def function_1(x,y):
    try:
        return function_2(x,y)
    except:
        return float('inf')

def function_2(x,y):
    return function_3(x,y)

def function_3(x,y):
    return x/y # crash here
```

- Error "pops" frames off stack
  - Starts from the stack bottom
  - Continues until it sees that current line is in a `try`-block
  - Jumps to `except`, and then proceeds as if no error



Tracing Control Flow

```
def first(x):
    print('Starting first.')
    try:
        second(x)
    except AssertionError:
        print('Caught at first')
    print('Ending first')

def second(x):
    print('Starting second.')
    try:
        third(x)
    except ArithmeticError:
        print('Caught at second')
    print('Ending second')
```

```
def third(i):
    print('Starting third.')
    if i == 1:
        pass
    if i == 2:
        y = 5/0
    if i == 3:
        assert False, 'Intentional Error'
    print('Ending third.')
```

What is the output of `first(2)`?

Tracing Control Flow

```
def first(x):
    print('Starting first.')
    try:
        second(x)
    except AssertionError:
        print('Caught at first')
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def second(x):
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        third(x)
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```

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    if i == 1:
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    if i == 2:
        y = 5/0
    if i == 3:
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    print('Ending third.')
```

'Starting first.'
'Starting second.'
'Starting third.'
'Caught at second'
'Ending second'
'Ending first'

Tracing Control Flow

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def first(x):
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What is the output of `first(3)`?

Tracing Control Flow

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def first(x):
    print('Starting first.')
    try:
        second(x)
    except AssertionError:
        print('Caught at first')
    print('Ending first')

def second(x):
    print('Starting second.')
    try:
        third(x)
    except ArithmeticError:
        print('Caught at second')
    print('Ending second')
```

```
def third(x):
    print('Starting third.')
    if i == 1:
        pass
    if i == 2:
        y = 5/0
    if i == 3:
        assert False, 'Intentional Error'
    print('Ending third.')
```

'Starting first.'
'Starting second.'
'Starting third.'
'Caught at first'
'Ending first'

Creating Errors in Python

- Create errors with `raise`
  - **Usage**: raise <exp>
  - exp evaluates to an object
  - An instance of Exception
- Tailor your error types
  - **ValueError**: Bad value
  - **TypeError**: Bad type
- Still prefer **asserts** for preconditions, however
  - Compact and easy to read

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```
def foo(x):
    assert type(x) == int, 'Not int'
    assert x < 2, 'My error'
```

Identical

```
def foo(x):
    if x >= 2:
        m = 'My error'
        err = AssertionError(m)
        raise err
```

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```
def foo(x):
  assert type(x) == int, 'Not int'
  assert x < 2, 'My error'
```

Identical

```
def foo(x):
  if type(x) != int :
    m = 'My error'
    err = TypeError(m)
    raise err
```

Creating Your Own Exceptions

```
class CustomError(Exception):
    """An instance is a custom exception"""
    pass
```

This is all you need

- No extra fields
- No extra methods
- No constructors

Inherit everything

Only issue is choice of parent error class. Use **Exception** if you are unsure what.

Accessing Error Attributes

- try-except can put the error in a variable
- **Example**:

```
try:
    val = input()      # get number from user
    x = float(val)     # convert string to float
    print('The next number is '+str(x+1))
except ValueError as e:
    print(e.args[0])
    print('Hey! That is not a number!')
```

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    val = input()      # get number from user
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except ValueError as e:
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```

Some Error subclasses have more attributes