More Python for Videogames

Videogames Technology
Asignatura transversal

Departamento de Automática

Objectives

1. Being able to manipulate files in Python.
2. Being able to understand the usefulness of Python serialization (*pickles* and JSON).
3. Being able to handle exceptions.

Bibliography

- The Python Tutorial. *Section 7.2: Reading and writing files.* (Link)
- The Python Tutorial. *Chapter 8: Errors and Exceptions.* (Link)

Table of Contents

1. Reading and writing files
   - Path
   - Opening files
   - Reading files
   - Writing files
   - Useful methods
   - Examples
2. Serialization
   - The pickle module
   - The JSON module
3. Exceptions
   - Motivation
   - Definition
   - Handling exceptions
   - Clean-up actions

Reading and writing files

Path

Path: A string that identifies a file in a file system

- On Linux, the path is denoted by:

```
path = '/tmp/prueba.txt'
```

- On Windows, the path is denoted by:

```
path = 'C:\Windows\Temp'
```

And it is represented in Python by:

```
path = 'C:\\Windows\\Temp'
```

But by also using *raw string*:

```
path = r'C:\Windows\Temp'
```

Reading and writing files

Opening files

All file operations are made through a *file object*

- First of all: Call the `open()` function

The `open()` function

`open(filename[, mode])`

Description: The function returns an object file

- *filename*: String with the file name
- *mode*: Characters describing how the file will be used
  - r: Reading mode, *w*: Writing mode, +: Reading/Writing mode.
  - *b*: Binary mode, *a*: Appending mode

Always, always, always close the file: `f.close()`

Reading files (I)

The `read()` function

`f.read([size])`

- *size*: The number of bytes to be read from the file.
- Return value: The bytes read in string.

Option 1: Read the entire file (`f.read()`)

```
>>> f = open("/tmp/file", 'r+')
>>> f.read()
'This is the entire file.\\n'
>>> f.read()
''
>>> f.close()
```

Reading files (II)

Option 2: Read a single line (`f.readline()`)

```
>>> f = open("/tmp/file2", 'r+')
>>> f.readline()
'This is the first line of the file.\n'
>>> f.readline()
'This is the second line of the file\n'
>>> f.readline()
''
>>> f.close()
```

Reading files (III)

Option 3: Read lines as list (`f.readlines()`)

```
>>> f = open("/tmp/file2", 'r+')
>>> f.readlines()
['This is the first line of the file.\n',
'This is the second line of the file\n']
>>> f.close()
```

Option 4: Read in a loop

```
f = open("/tmp/file2", 'r+')
for line in f:
    print(line, end='')
f.close()
```

Writing files (I)

The `write()` function

`f.write(string)`

- *string*: String to write in file.
- Return value: The number of written bytes.

Example 1: Write a line

```
>>> f = open("/tmp/file", 'w+')
>>> f.write('This is a test\n')
15
>>> f.read()
''
>>> f.close()
```

Writing files (II)

Example 2: Write a number

```
>>> f = open("/tmp/file", 'w+')
>>> f.write(str(42))
2
>>> f.close()
```

Useful methods

Method	Description
`f.tell()`	Returns the pointer's position
`f.seek(n)`	Moves the pointer `n` bytes
`f.close()`	Closes a file. Use it always!

```
>>> f = open("/tmp/file", 'rb+')
>>> f.write(b'0123456789abcdef')
16
>>> f.seek(5)
5
>>> f.read(1)
b'5'
```

Example 1

Calculating the average of characters per line of file `example.txt`

```
1 file_ex = open('example.txt', 'r')
2 num_total_char = 0
3 count_line= 0
4
5 for line in file_ex:
6   count_line += 1
7   num_total_char += len(line)
8 file_ex.close()
9 print('average', float(num_total_char) / float(count_line))
```

Example 2

Reading a line each time

```
1 count_line = 0
2 with open('/Users/julia/code/names.txt') as arch_names:
3     for line in arch_names:
4         count_line += 1
5         print('{:<10}{}'.format(count_line, line.rstrip()))
```

names.txt

```
1 Juan
2 Laura
3 Pablo
4 Enrique
5 Javier
```

Output

```
1         Juan
2         Laura
3         Pablo
4         Enrique
5         Javier
```

Serialization

The `pickle` module: Introduction

- What happens if we need to store complex data structures?
  - Think about lists, dictionaries or even objects ...
  - The `pickle` module comes to help.
- *Pickling*: Transform an object to string representation.
- *Unpickling*: Reconstruct an object from its string representation.
- Given an object `x` and a file object `f` ...

```
>>> pickle.dump(x, f)
>>> x = pickle.load(f)
```

Serialization

The `pickle` module: Examples

Save a list to a file

```
1 import pickle
2
3 list_number = [2, 5, 7, 8]
4
5 f = open('list.pickle', 'wb')
6
7 pickle.dump(list_number, f)
8
9 f.close()
```

Load a list from a file

```
1 import pickle
2
3 f = open('list.pickle', 'rb')
4
5 list_number = pickle.load(f)
6
7 print(list_number)
```

Serialization

The JSON module: Introduction

JSON: *JavaScript Object Notation*

- Data format for hierarchical data
- Created in 2001 for stateless client-server communication
- Text-based
- Interoperable (pickles only for Python)
- Complex data structures

filename.json

```
{
  "firstName": "John",
  "isAlive": true,
  "age": 27,
  "address": {
    "streetAddress": "21 2nd Street",
    "city": "New York",
    "state": "NY",
  },
  "phoneNumbers": [ "111", "333" ]
}
```

Serialization

The JSON module: Examples

Save a list to a file

```
1 import json
2
3 mylist = ["John", 42, "Smith"]
4
5 myfile = open("myfile.json", "w")
6
7 json.dump(mylist, myfile, indent = 4)
```

Load a list from a file

```
1 import json
2
3 mylist = json.load(open('myfile.json'))
4 print(mylist)
```

Exceptions

Motivation

Errors happen

- We need a mechanism to handle errors
- Some errors happen before execution (*syntax errors*)
- Others are only detected in execution (*runtime errors*)
  - We need tools to handle errors: Exceptions

```
>>> while True print('Hello world')
  File "<stdin>", line 1
    while True print('Hello world')
                    ^
  SyntaxError: invalid syntax

>>> int("hola")
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
ValueError: invalid literal for int() with base 10: 'hola'
```

Exceptions

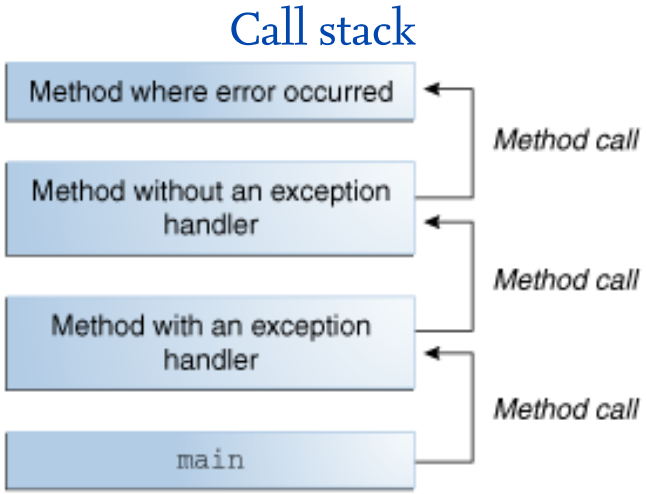
Exception definition (I)

Exception: An error that disrupts the normal execution flow

- File not found, division by zero, invalid argument, etc
- Code cannot be executed
- Elegant solution to handle errors

Exceptions

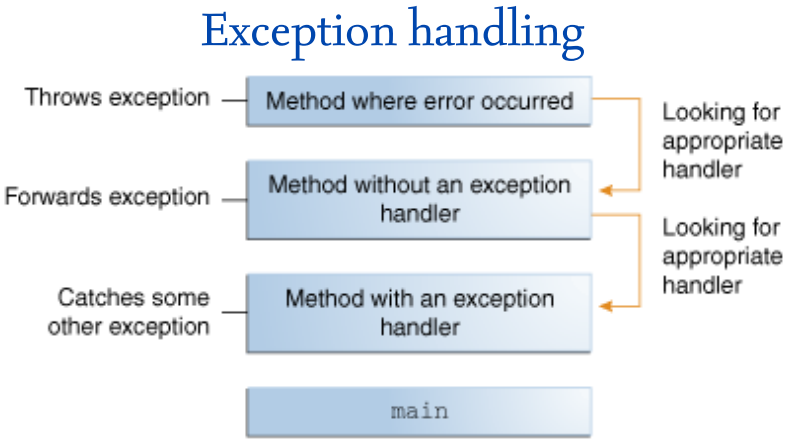
Exception definition (II)



Call stack: Sequence of invoked methods

Exceptions

Exception definition (III)



When an error happens ...

1. Code execution is stopped
2. An exception is thrown
3. The interpreter goes back in the call stack
4. When the interpreter finds an exception handler, it is executed

The exception handler catches the exception, the program finishes otherwise

Exceptions

Exception definition (IV)

```
Traceback (most recent call last):
  File "r2p2.py", line 57, in <module>
    start_simulation(args.scenario)
  File "r2p2.py", line 41, in start_simulation
    u.load_simulation(config)
  File "/home/david/repositorios/r2p2/r2p2/utils.py", line 175,
      in load_simulation
    with open(json_file, 'r') as fp:
FileNotFoundError: [Errno 2] No such file or directory: 'foo.
    json'
```

Exceptions

Handling exceptions (I)

Handling an exception requires a try-except statement

- `try`: Encloses the vulnerable code
- `catch`: Code that handles the exception

try-catch statement

```
try:
    # Risky code
except ExceptionType1:
    # Handle error
except ExceptionType2:
    # Handle error
except:
    # Handle errors
```

Exceptions

Handling exceptions (II)

try-catch example

```
try:
    x = int(input("Please enter a number: "))
except ValueError:
    print("Oop!, that was not a number!")
except KeyboardInterrupt:
    print("Got Ctrl-C, good bye!")
```

The exception type contains the error

Exceptions

Handling exceptions (III)

try-catch example

```
try:
    f = open('file.txt')
    s = f.readline()
    i = int(s.strip())
except IOError as err:
    print("I/O error: " + err)
except ValueError:
    print("Could not convert data to integer")
except:
    print("Unexpected exception")
    raise
```

New Python elements

- Raise
- Exception as object

Exceptions

Clean-up actions

Sometimes we need to execute code under all circumstances

- Typically clean-up actions: Close files, database connections, sockets, etc
- The **finally** clause solves this problem

Example

```
1 try:
2     raise KeyboardInterrupt
3 finally:
4     print("Goodbye, world!")
```