Python (3/3)

PU Deep Learning

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Recap

- List Comprehension
  - Define lists by specifying a pattern
    - `[x*2 for x in l1 if x < 10]`
- Functions
  - Weakly typed arguments
  - Named arguments, default values
  - Return values, `None` and `NoneType`

Today

Input/Output

Exception Handling

Python Packages

Exercise

Section 1

Input/Output

Introduction

- IO: Input/Output
- Standard model: Streams of bytes/characters: Most programming languages

Introduction

- IO: Input/Output
- Standard model: Streams of bytes/characters: Most programming languages
- Regular workflow
  1. Open a file
     - Configure: Mode, encoding, file type, ...
  2. Read from file or write to file
  3. Close file

IO in Python

Listing: File Reading

```
1  # open file and create a file
2  # object
3  fh = open(FILENAME)
4
5  # call a method on file object
6  for line in fh.readlines():
7    # process each line
8
9  # close object
10 # (important, because open files
11 # consume resources)
12 fh.close()
```

Listing: File Writing

```
1  # open file and create a file
2  # object
3  fh = open(FILENAME, mode="w")
4
5  # write list content into file
6  for line in listOfResults:
7    fh.write(line)
8
9  # close object
10 # (important, because open files
11 # consume resources)
12 fh.close()
```

IO in Python

open()

```
open(file, mode='r', buffering=-1, encoding=None, errors=None, newline=None, closefd=True, opener=None)
```

- https://docs.python.org/3/library/functions.html#open
- mode: Reading or writing
- buffering: Controls when and in which chunks data is actually written to the disk
- encoding: Specify encoding (hint: Make sure that UTF-8 is used)
- errors: How to handle encoding errors
- newline: Which characters are used to indicate a new line?
- ...

IO in Python

Methods of the File Object

- `https://docs.python.org/3/library/io.html#module-io`
- `close()`: Flush and close the stream
  - In Java, `close()` only closes without flushing
- `flush()`: Flush the stream
- `readline(size=-1)`: Read and return one line from the stream
- `readlines(hint=-1)`: Read and return a list of lines from the stream.
- `write(s)`: Write the string s to the stream and return the number of characters written.
- ...

Section 2

Exception Handling

Introduction

- Program errors
  - Variables have the wrong type (i.e., we try to multiply two strings)
  - IO issues: Disk full, file/directory doesn't exist
  - Parse errors: Input isn't how we expect it to be
  - Users errors: A user enters something unexpected
  - ...

Introduction

- Program errors
  - Variables have the wrong type (i.e., we try to multiply two strings)
  - IO issues: Disk full, file/directory doesn't exist
  - Parse errors: Input isn't how we expect it to be
  - Users errors: A user enters something unexpected
  - ...
- Error prevention: Verify before doing
  - Some errors cannot be anticipated
- Exception handling: Do, and specify behavior if error occurs

Exception Handling

- Anytime, code can ›throw an exception‹ (Python: `raise`)
- The exception can be caught by other code
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Example

```
1  l1 = [1,2,3,4,5,6]
2
3  try:
4    userInput = input()
5    intInput = int(userInput) # may raise a TypeError
6    print(l1[intInput])       # may raise an IndexError
7  except TypeError:
8    print("Please enter an integer number!")
9  except IndexError:
10   print("Doesn't exist")
```

Example

```
1  def myFunc(a1):
2    if type(a1) == str:
3      print(a1)
4    else:
5      raise TypeError
6
7  try:
8    myFunc("bla")
9  except TypeError:
10   print("An error occurred")
11
12 try:
13   myFunc(15)
14 except TypeError:
15   print("An error occurred")
```

Built-In Errors

- A number of error types are built into the standard library
- They are also used by library functions
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Error type misuse

- Nothing prevents you to use a `TypeError` for something unrelated to types
- But: Code becomes more difficult to maintain
- Don't do it

Define Your Own Exceptions

- Exceptions are classes that inherit from `BaseException`
- Own exceptions should be derived from `Exception`

```
1 class MyException(Exception):
2   pass
3
4 if a > len(l):
5   raise MyException
```

Exception Payload

It's possible to pass information through exceptions (e.g., the file name that doesn't exist)

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```
1  def openAndRead(filename):
2    fo = open(filename)
3    content = ""
4    for l in fo.readlines():
5      content.append(l)
6    fo.close()
7    return content
8
9  try:
10   content = openAndRead("filename.txt")
11 except OSError as err:
12   print("File " + err.filename + " does not exist.")
```

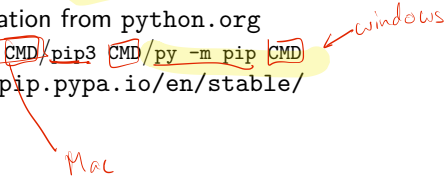
Section 3

Python Packages

Java: Maven, Gradle

Python Packages

- Central repository for python libraries: `https://pypi.org`
- Installation and local management: `pip`
  - Contained in python installation from `python.org`
  - Run on command line: `pip CMD` / `pip3 CMD` / `py -m pip CMD`
  - Documentation: `https://pip.pypa.io/en/stable/`



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Example

```
1 pip install numpy
```

Section 4

Exercise

Exercise 04

https://github.com/idh-cologne-deep-learning/exercise-04