# NPRG065: Programming in Python *Lecture 4*

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Department of Distributed and Dependable Systems

*Tomas Bures*

*Petr Hnetynka*

{bures,hnetynka}@d3s.mff.cuni.cz

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faculty of mathematics and physics

## Modules

- Module ~ a file with Python definitions
  - extension .py
- To use elements from a module in another module – **`import`**

All the files with examples till now have been modules

fibo.py

```
def fib(n):
  print "computing and printing Fibonacci numbers"
```

program.py

```
import fibo

fibo.fib(5)
```

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## Import

- Objects in different modules **must be always imported**
  - unlike in Java, cannot be used directly
- Can be placed anywhere in code
- Multiple options of usage

```
import sys
print(sys.argv[0])   # usage with module name

from sys import argv
print(argv[0])       # imported to local namespace

from sys import argv as sysargv
print(sysargv[0])    # imported to local namespace and
                     # renamed

from sys import *    # everything from the sys module
print(argv[0])       # imported to local namespace
```

## Modules

- `from sys import *`
  - imports all names except those beginning with an underscore
    - reminder – a name beginning with underscore ~ a special name
- Module search path
  - three locations
    - current directory +
    - PYTHONPATH +
    - installation defaults
  - available through in `sys.path`

Environment variable

# Modules

- Module name

```
import fibo
print(fibo.__name__)
```

- When module executed as script
  - i.e., python my_module.py
  - the name set to "__main__"

fibo.py

```
def fib(n):
  print "computing and printing Fibonacci numbers"

if __name__ == "__main__":
    import sys
    fib(int(sys.argv[1]))
```

Importable and executable module

# dir()

- Built-in function
- Returns names in a module

```
import fibo
print(dir(fibo))   # -> [ fib ]
```

The list will be longer but other names will be special

- Without argument – names in local namespace

```
a = [1, 2, 3, 4, 5]
import fibo
fib = fibo.fib
dir() # ['__annotations__', '__builtins__',
         '__doc__', '__loader__', '__name__',
         '__package__', '__spec__', 'a', 'fib',
         'fibo']
```

## Packages

package package module

```
import sound.effects.echo
```

- Package ~ directory with the `__init__.py` file
  - __init__.py is mandatory

```
sound/                          Top-level package
      __init__.py               Initialize the sound package
      formats/                  Subpackage for file format
              __init__.py
              wavread.py
              wavwrite.py
              ...
      effects/                  Subpackage for sound effects
              __init__.py
              echo.py
              ...
      filters/                  Subpackage for filters
              __init__.py
              equalizer.py
              ...
```

## Packages

- Importing

```
import sound.effects.echo
sound.effects.echo.echofilter(4)     # full name required

from sound.effects import echo
echo.echofilter(4)                   # module name only

from sound.effects.echo import echofilter
echofilter(4)                        # function name only
```

- Importing * from a package
  - only those declared in the variable `__all__` in __init__.py

```
sound/effects/__init__.py
```

```
__all__ = ["echo", "surround", "reverse"]
```

## Packages

- Naming
  - no conventions as in Java (i.e., like reversed internet name)
  - “pick memorable, meaningful names that aren’t already used on PyPI”
- Conflicting names – no big deal
  - we have renaming

    ```
    from abc import xyz as mno
    ```
  - we can import anywhere in the code

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## Basic I/O and Exceptions

# print

- `print(*objects, sep=' ', end='\n', file=sys.stdout, flush=False)`
  - all *objects* printed separated by *sep* and followed by *end*
  - file – an object where to print
- `sys.stdout, sys.stderr`
- `input([prompt])`
  - reads a line from input (stripping a trailing newline)
- `getpass.getpass(prompt='Password: ')`
  - like input() but without echoing
- `repr(object)`
  - a printable representation of an object
    - like in the interactive Python shell

## Reading and Writing Files

- `open(file, mode='r')`
  - returns a file object
    - the actual type may differ based on mode, etc.
    - and thus not all the methods below may be always available
- file object methods/fields
  - `read(size=-1)`
  - `write(str_or_bytes)`
  - `close()`
  - `readline()`
  - `readlines()`
  - `seek(offset)`
  - `readable(), writable(), seekable()`
  - `closed`
  - …

Here are more named parameters but commonly unused

Path-like object (str, bytes, an object implementing the os.PathLike protocol)

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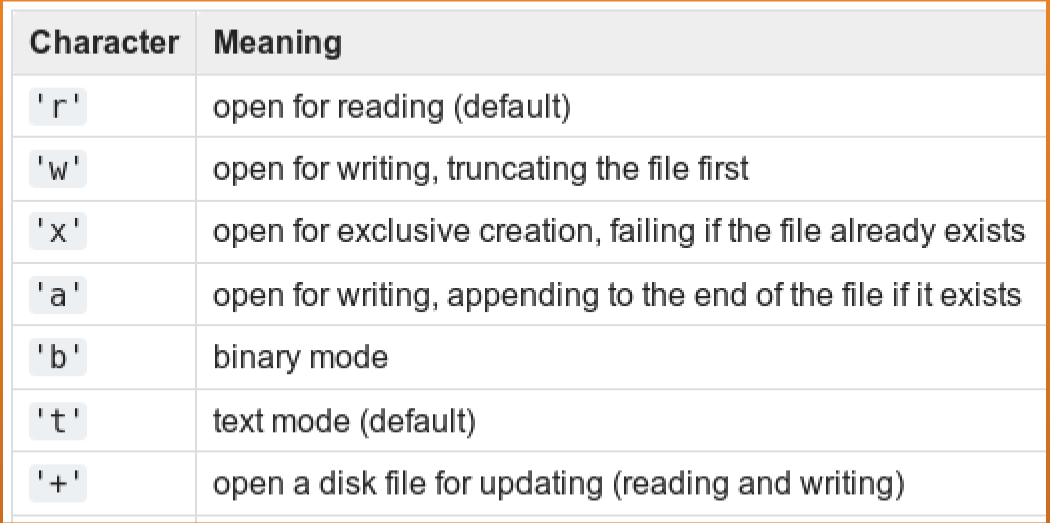

| Character | Meaning |
|---|---|
| `'r'` | open for reading (default) |
| `'w'` | open for writing, truncating the file first |
| `'x'` | open for exclusive creation, failing if the file already exists |
| `'a'` | open for writing, appending to the end of the file if it exists |
| `'b'` | binary mode |
| `'t'` | text mode (default) |
| `'+'` | open a disk file for updating (reading and writing) |

# Exception

- Represents errors
  - any

```
while True print('Hello world')
    # results in the SyntaxError exception

10 * (1/0)
    # results in the ZeroDivisionError exception

4 + spam*3
    # results in the NameError exception

'2' + 2
    # results in the TypeError exception
```

Try these in the interactive shell

## Exceptions

See not_caught.py

- Exceptions are either caught or terminates program execution
  - if the exception is not caught in a block where it occurs, it propagates to the upper block
  - if the exception is not caught in a function, it propagates to the calling function
  - if the exception reaches “main” and it not caught, it terminates the program
    - information about the exception is printed
- No need to explicitly declare or catch exceptions
  - like in Java

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## Handling exceptions

- try/except/else/finally command

```
while True:
    try:
        x = int(input("Please enter a number: "))
        break
    except ValueError:
        print('Not a number. Try again...')
```

- except can caught multiple exceptions

```
except (RuntimeError, TypeError, NameError):
    print('An exception occurred:')
```

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## Handling exceptions

- `else` clause
  - executed if no exception occurs
  - must follow all `except` clauses

```
import sys

try:
    f = open(sys.argv[1], 'r')
except OSError:
    print('cannot open', sys.argv[1])
else:
    print('File has', len(f.readlines()), 'lines')
    f.close()
```

## Handling exceptions

- using the exception object

```
import sys

try:
    f = open(sys.argv[1], 'r')
except OSError as ex:
    print('cannot open', sys.argv[1])
    print(ex)
else:
    print('File has', len(f.readlines()), 'lines')
    f.close()
```

See exception_info.py

# Exception handling

- multiple **except** clauses

```
try:
    # code here
except RuntimeError:
    print('RuntimeError exception occurred')
except TypeError:
    print('TypeError exception occurred')
```

- **finally** clause
  - always executed

```
def divide(x, y):
    try:
        result = x / y
    except ZeroDivisionError:
        print("division by zero!")
    else:
        print("result is", result)
    finally:
        print("executing finally clause")
```

Try division.py with different arguments

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