

COMP1730/COMP6730

Programming for Scientists

Modules and programs



Lecture outline

- * python modules & import
- * Commandline interface and scripting
- * User interaction



Modules

Modules

- * Every python file is a module.
 - A module is a sequence of statements.
 - Every module has a name.
- * When the python shell runs in “script mode”, the file it’s executing becomes the “main module”.
 - Its name becomes `'__main__'`.
 - Its namespace is the global namespace.
- * The first time a module is imported, that module is loaded (executed); it may later be re-loaded.
- * Every loaded module creates a separate (permanent) namespace.

- ★ When executing `import modname`, the python interpreter:
 - checks if `modname` is already loaded;
 - if not (or if reloading), it:
 - finds the module file (normally `modname.py`)
 - executes the file in a new namespace;
 - and stores the module object (roughly, namespace) in the system dictionary of loaded modules;
 - and then associates `modname` with the module object in the current namespace.
- ★ Note: the Spyder IDE reloads all user-defined modules on (first) import when running a file.

- * The global variable `__name__` in every module namespace stores the module name.
- * `sys.modules` is a dictionary of all loaded modules.
- * `dir(module)` returns a list of names defined in *module*'s namespace
- * `dir()` lists the current (global) namespace.



```
>>> __name__
'__main__'
>>> import sys
>>> len(sys.modules)
...
>>> sys.modules['math'].__name__
'math'
>>> dir()
[ ..., sys ]
>>> import math
>>> dir()
[ ..., sys, math ]
```

```
def some_useful_function(x):  
    ...  
  
if __name__ == '__main__':  
    # this part will not execute when  
    # the module is imported  
    print(some_useful_function(0))  
    ...
```

- * Code within the `if` statement will execute when the module is run, but not when it's imported ("guarded main").
- * For example, test cases.



The commandline

- * A commandline (“terminal” or “shell”) is a text I/O interface to the computer’s operating system (OS).
- * The shell is an *interpreter* for a command (programming) language.
- * The languages of shells are (more or less) different, but some aspects are fairly common.
- * Some concepts from the commandline interface explain how programs interact with the OS.



(Image from wikipedia)

- * To run a (executable) program, type its name.
 - Where the OS searches for programs is usually configurable.
 - Alternatively, enter the full path.
- * To run a python program (file):

```
$ python3 my_prog.py
```

 - Runs the python shell in “script mode”.
- * Can pass arguments (strings) to the program:

```
$ python3 my_prog.py arg1 "arg two"
```

- * Inputs that the OS provides to the program:
 - A list of commandline arguments (strings).
 - A set of *environment variables* (key–value pairs, both (byte) strings).
 - Open files (or file-like objects) for “standard input” and “standard output”.
- * You can access these within python:
 - `sys.argv`
 - `os.environ` **and** `os.getenv(var)`
 - `sys.stdin` **and** `sys.stdout`
- * By default, `input(..)` **reads** `sys.stdin` **and** `print(...)` **writes to** `sys.stdout`.



User interaction



- * A general-purpose program (not solving a single instance of a single problem) will need some user input. For example:
 - which data file? computation parameters;
 - options (e.g., more or less output).
- * Main goal: *don't make the user's life harder than it has to be.*
 - Know the use case; follow conventions.
 - Reduce work, avoid repetition.
 - Offer flexibility, but not at the cost of simplicity.
- * If you're writing a library (module), the “user” is the programmer that will use its functions.

Example: Asking for a filename

- * Make it a commandline argument.
 - Use `argparse` or `getopt` module for commandline processing.
- * Typed input (`input(...)`)
 - Can use, and also customise, the `readline` facility, or use the `prompt_toolkit` module (system-dependent).
 - Can provide defaults or shortcuts.
- * Open a “Select File” dialog box, using `tkinter` (system-dependent).



- * Example: the homework testing program.
- * Needs an input (the file to test).
 - Fixed name (edit program to change).
 - Typed input?
 - Dialog box?
- * Who are the users, and what are their use cases?
 - Student: testing one file, many times.
 - Marker: testing many files, once.