## Contents

### Plac: Parsing the Command Line the Easy Way
- The importance of scaling down 3
- Scripts with required arguments 3
- Scripts with default arguments 5
- Scripts with options (and smart options) 7
- Scripts with flags 9
- plac for Python 2.X users 9
- More features 10
- A realistic example 12
- Keyword arguments 13
- plac vs argparse 14
- Final example: a shelve interface 15
- plac vs the rest of the world 18
- The future 18
- Trivia: the story behind the name 18

### Advanced usages of plac
- Introduction 19
- From scripts to interactive applications 19
- Testing a plac application 21
- Plac easy tests 22
- Plac batch scripts 23
- Implementing subcommands 24
- plac.Interpreter.call 27
- Readline support 28
- The plac runner 30
- A non class-based example 32
- Writing your own plac runner 34
- Long running commands 35
- Threaded commands 36
- Running commands as external processes 38
- Managing the output of concurrent commands 39
- Parallel computing with plac 39
- The plac server 42
- Summary 42
- Appendix: custom annotation objects 43
The importance of scaling down

There is no want of command-line arguments parsers in the Python world. The standard library alone contains three different modules: getopt (from the stone age), optparse (from Python 2.3) and argparse (from Python 2.7). All of them are quite powerful and especially argparse is an industrial strength solution; unfortunately, all of them feature a non-negligible learning curve and a certain verbosity. They do not scale down well enough, at least in my opinion.

It should not be necessary to stress the importance of scaling down; nevertheless, a lot of people are obsessed with features and concerned with the possibility of scaling up, forgetting the equally important issue of scaling down. This is an old meme in the computing world: programs should address the common cases simply and simple things should be kept simple, while at the same time keeping difficult things possible. plac adhere as much as possible to this philosophy and it is designed to handle well the simple cases, while retaining the ability to handle complex cases by relying on the underlying power of argparse.

Technically plac is just a simple wrapper over argparse which hides most of its complexity by using a declarative interface: the argument parser is inferred rather than written down by imperatively. Still, plac is surprisingly scalable upwards, even without using the underlying argparse. I have been using Python for 9 years and in my experience it is extremely unlikely that you will ever need to go beyond the features provided by the declarative interface of plac: they should be more than enough for 99.9% of the use cases.

plac is targeting especially unsophisticated users, programmers, sys-admins, scientists and in general people writing throw-away scripts for themselves, choosing the command-line interface because it is quick and simple. Such users are not interested in features, they are interested in a small learning curve: they just want to be able to write a simple command line tool from a simple specification, not to build a command-line parser by hand. Unfortunately, the modules in the standard library forces them to go the hard way. They are designed to implement power user tools and they have a non-trivial learning curve. On the contrary, plac is designed to be simple to use and extremely concise, as the examples below will show.

Scripts with required arguments

Let me start with the simplest possible thing: a script that takes a single argument and does something to it. It cannot get simpler than that, unless you consider the case of a script without command-line arguments, where there is nothing to parse. Still, it is a use case extremely common: I need to write scripts like that nearly every day, I wrote hundreds of them in the last few years and I have never been happy. Here is a typical example of code I have been writing by hand for years:

```python
# example1.py

def main(dsn):
    "Do something with the database"
    print("ok")

if __name__ == '__main__':
    import sys
    n = len(sys.argv[1:])
    if n == 0:
        sys.exit('usage: python %s dsn' % sys.argv[0])
    elif n == 1:
        main(sys.argv[1])
    else:
        sys.exit('Unrecognized arguments: %s' % ' '.join(sys.argv[2:])))
```

As you see the whole if __name__ == '__main__' block (nine lines) is essentially boilerplate that should not exist. Actually I think the language should recognize the main function and pass the command-line arguments automatically; unfortunately this is unlikely to happen. I have been writing
boilerplate like this in hundreds of scripts for years, and every time I hate it. The purpose of using a scripting language is convenience and trivial things should be trivial. Unfortunately the standard library does not help for this incredibly common use case. Using getopt and optparse does not help, since they are intended to manage options and not positional arguments; the argparse module helps a bit and it is able to reduce the boilerplate from nine lines to six lines:

```python
# example2.py
def main(dsn):
    """Do something on the database"
    print(dsn)
    # ...

if __name__ == '__main__':
    import argparse
    p = argparse.ArgumentParser()
    p.add_argument('dsn')
    arg = p.parse_args()
    main(arg.dsn)
```

However, it just feels too complex to instantiate a class and to define a parser by hand for such a trivial task.

The plac module is designed to manage well such use cases, and it is able to reduce the original nine lines of boiler plate to two lines. With the plac module all you need to write is

```python
# example3.py
def main(dsn):
    """Do something with the database"
    print(dsn)
    # ...

if __name__ == '__main__':
    import plac; plac.call(main)
```

The plac module provides for free (actually the work is done by the underlying argparse module) a nice usage message:

```
$ python example3.py -h
usage: example3.py [-h] dsn
Do something with the database
positional arguments:
  dsn
optional arguments:
  -h, --help    show this help message and exit
```

Moreover plac manages the case of missing arguments and of too many arguments. This is only the tip of the iceberg: plac is able to do much more than that.
Scripts with default arguments

The need to have suitable defaults for command-line scripts is quite common. For instance I have encountered this use case at work hundreds of times:

```python
# example4.py
from datetime import datetime

def main(dsn, table='product', today=datetime.today()):
    "Do something on the database"
    print(dsn, table, today)

if __name__ == '__main__':  # manual management before argparse
    import sys
    args = sys.argv[1:]
    if not args:
        sys.exit('usage: python %s dsn' % sys.argv[0])
    elif len(args) > 2:
        sys.exit('Unrecognized arguments: %s' % ' '.join(args[2:]))
    main(*args)
```

Here I want to perform a query on a database table, by extracting the most recent data: it makes sense for `today` to be a default argument. If there is a most used table (in this example a table called `product`) it also makes sense to make it a default argument. Performing the parsing of the command-line arguments by hand takes 8 ugly lines of boilerplate (using argparse would require about the same number of lines). With plac the entire `__main__` block reduces to the usual two lines:

```python
if __name__ == '__main__':
    import plac; plac.call(main)
```

In other words, six lines of boilerplate have been removed, and we get the usage message for free:

```
usage: example5.py [-h] dsn [table] [today]
Do something on the database

positional arguments:
  dsn
  table       [product]
  today       [YYYY-MM-DD]

optional arguments:
  -h, --help  show this help message and exit
```

Notice that by default plac prints the string representation of the default values (with square brackets) in the usage message. plac manages transparently even the case when you want to pass a variable number of arguments. Here is an example, a script running on a database a series of SQL scripts:

```python
# example7.py
from datetime import datetime

def main(dsn, *scripts):
    "Run the given scripts on the database"
    for script in scripts:
```
Here is the help message:

usage: example7_.py [-h] dsn [scripts [scripts ...]]

Run the given scripts on the database

positional arguments:
  dsn
  scripts

optional arguments:
  -h, --help    show this help message and exit

The examples here should have made clear that plac is able to figure out the command-line arguments parser to use from the signature of the main function. This is the whole idea behind plac: if the intent is clear, let's the machine take care of the details.

plac is inspired to an old Python Cookbook recipe of mine (optionparse), in the sense that it delivers the programmer from the burden of writing the parser, but is less of a hack: instead of extracting the parser from the docstring of the module, it extracts it from the signature of the main function.

The idea comes from the function annotations concept, a new feature of Python 3. An example is worth a thousand words, so here it is:

```python
# example7_.py
from datetime import datetime

def main(dsn: "Database dsn", *scripts: "SQL scripts"):
    "Run the given scripts on the database"
    for script in scripts:
        print('executing %s' % script)
    # ...
    if __name__ == '__main__':
        import plac; plac.call(main)
```

Here the arguments of the main function have been annotated with strings which are intended to be used in the help message:

usage: example7_.py [-h] dsn [scripts [scripts ...]]

Run the given scripts on the database

positional arguments:
  dsn       Database dsn
  scripts   SQL scripts

optional arguments:
plac is able to recognize much more complex annotations, as I will show in the next paragraphs.

## Scripts with options (and smart options)

It is surprising how few command-line scripts with options I have written over the years (probably less than a hundred), compared to the number of scripts with positional arguments I wrote (certainly more than a thousand of them). Still, this use case cannot be neglected. The standard library modules (all of them) are quite verbose when it comes to specifying the options and frankly I have never used them directly. Instead, I have always relied on the `optionparse` recipe, which provides a convenient wrapper over `optionparse`. Alternatively, in the simplest cases, I have just performed the parsing by hand. In plac the parser is inferred by the function annotations. Here is an example:

```python
# example8.py
def main(command: ("SQL query", 'option', 'q'), dsn):
    if command:
        print('executing %s on %s' % (command, dsn))
    # ...

if __name__ == '__main__':
    import plac; plac.call(main)
```

Here the argument `command` has been annotated with the tuple ("SQL query", 'option', 'c'):
the first string is the help string which will appear in the usage message, the second string tells plac that `command` is an option and the third string that there is also a short form of the option `-c`, the long form being `--command`. The usage message is the following:

```
usage: example8.py [-h] [-q COMMAND] dsn

positional arguments:
    dsn

optional arguments:
    -h, --help            show this help message and exit
    -q COMMAND, --command COMMAND
                         SQL query
```

Here are two examples of usage:

```
$ python3 example8.py -c"select * from table" dsn
executing select * from table on dsn

$ python3 example8.py --command="select * from table" dsn
executing select * from table on dsn
```

The third argument in the function annotation can be omitted: in such case it will be assumed to be None. The consequence is that the usual dichotomy between long and short options (GNU-style options) disappears: we get smart options, which have the single character prefix of short options and behave like both long and short options, since they can be abbreviated. Here is an example featuring smart options:

```python
# example6.py
def main(dsn, command: ("SQL query", 'option')='select * from table'):
```

7
print('executing %r on %s' % (command, dsn))

if __name__ == '__main__':
    import plac; plac.call(main)

usage: example6.py [-h] [-command select * from table] dsn

positional arguments:
   dsn

optional arguments:
   -h, --help            show this help message and exit
   -command select * from table
   SQL query

The following are all valid invocations ot the script:

$ python3 example6.py -c "select" dsn
executing 'select' on dsn
$ python3 example6.py -com "select" dsn
executing 'select' on dsn
$ python3 example6.py -command="select" dsn
executing 'select' on dsn

Notice that the form -command=SQL is recognized only for the full option, not for its abbreviations:

$ python3 example6.py -com="select" dsn
usage: example6.py [-h] [-command COMMAND] dsn
example6.py: error: unrecognized arguments: -com=select

If the option is not passed, the variable command will get the value None. However, it is possible to specify a non-trivial default. Here is an example:

# example8_.py
def main(dsn, command: ('SQL query', 'option', 'q')='select * from table'):
    print('executing %r on %s' % (command, dsn))

if __name__ == '__main__':
    import plac; plac.call(main)

Notice that the default value appears in the help message:

usage: example8_.py [-h] [-q select * from table] dsn

positional arguments:
   dsn

optional arguments:
   -h, --help            show this help message and exit
   -q select * from table, --command select * from table
   SQL query

When you run the script and you do not pass the -command option, the default query will be executed:
Scripts with flags

plac is able to recognize flags, i.e. boolean options which are True if they are passed to the command line and False if they are absent. Here is an example:

```python
# example9.py
def main(verb: ('prints more info', 'flag', 'v'), dsn: 'connection string'):
    if verb:
        print('connecting to %s' % dsn)
    # ...
if __name__ == '__main__':
    import plac; plac.call(main)
```

Usage: example9.py [-h] [-v] dsn

Positional arguments:
  dsn            connection string

Optional arguments:
  -h, --help     show this help message and exit
  -v, --verbose  prints more info

Notice that it is an error trying to specify a default for flags: the default value for a flag is always False. If you feel the need to implement non-boolean flags, you should use an option with two choices, as explained in the "more features" section.

For consistency with the way the usage message is printed, I suggest you to follow the Flag-Option-Required-Default (FORD) convention: in the main function write first the flag arguments, then the option arguments, then the required arguments and finally the default arguments. This is just a convention and you are not forced to use it, except for the default arguments (including the varargs) which must stay at the end as it is required by the Python syntax.

I also suggests to specify a one-character abbreviation for flags: in this way you can use the GNU-style composition of flags (i.e. -zxvf is an abbreviation of -z -x -v -f). I usually do not provide the one-character abbreviation for options, since it does not make sense to compose them.

plac for Python 2.X users

I do not use Python 3. At work we just migrated to Python 2.7. It will take years before we think to migrate to Python 3. I am pretty much sure most Pythonistas are in the same situation. Therefore plac provides a way to work with function annotations even in Python 2.X (including Python 2.3). There is no magic involved; you just need to add the annotations by hand. For instance the annotated function declaration

```python
def main(dsn: "Database dsn", *scripts: "SQL scripts"):
    ...
```
is equivalent to the following code:

```python
def main(dsn, *scripts):
    ...
main.__annotations__ = dict(
    dsn="Database dsn",
    scripts="SQL scripts")
```

One should be careful to match the keys of the annotation dictionary with the names of the arguments in the annotated function; for lazy people with Python 2.4 available the simplest way is to use the `plac.annotations` decorator that performs the check for you:

```python
@plac.annotations(
    dsn="Database dsn",
    scripts="SQL scripts")
def main(dsn, *scripts):
    ...
```

In the rest of this article I will assume that you are using Python 2.X with X >= 4 and I will use the `plac.annotations` decorator. Notice however that the core features of `plac` run even on Python 2.3.

### More features

One of the goals of `plac` is to have a learning curve of minutes for its core features, compared to the learning curve of hours of `argparse`. In order to reach this goal, I have not sacrificed all the features of `argparse`. Actually a lot of the `argparse` power persists in `plac`. Until now, I have only showed simple annotations, but in general an annotation is a 6-tuple of the form

```
(help, kind, abbrev, type, choices, metavar)
```

where `help` is the help message, `kind` is a string in the set {"flag", "option", "positional"}, `abbrev` is a one-character string or `None`, `type` is a callable taking a string in input, `choices` is a discrete sequence of values and `metavar` is a string.

`type` is used to automagically convert the command line arguments from the string type to any Python type; by default there is no conversion and `type=None`.

`choices` is used to restrict the number of the valid options; by default there is no restriction i.e. `choices=None`.

`metavar` has two meanings. For a positional argument it is used to change the argument name in the usage message (and only there). By default the `metavar` is `None` and the name in the usage message is the same as the argument name. For an option the `metavar` is used differently in the usage message, which has now the form `--option-name METAVAR`. If the `metavar` is `None`, then it is equal to the uppercased name of the argument, unless the argument has a default: then it is equal to the stringified form of the default.

Here is an example showing many of the features (copied from the `argparse` documentation):

```python
# example10.py
import plac

@plac.annotations(
    operator=("The name of an operator", 'positional', None, str, ['add', 'mul']),
    numbers=("A number", 'positional', None, float, None, "n"))
def main(operator, *numbers):
    """A script to add and multiply numbers"""
```
if operator == 'mul':
    op = float.__mul__
    result = 0.0
else:  # operator == 'add'
    op = float.__add__
    result = 0.0
for n in numbers:
    result = op(result, n)
return result

if __name__ == '__main__':
    print(plac.call(main))

Here is the usage:

usage: example10.py [-h] {add,mul} [n [n ...]]
A script to add and multiply numbers

positional arguments:
  {add,mul}   The name of an operator
  n           A number

optional arguments:
  -h, --help  show this help message and exit

Notice that the docstring of the main function has been automatically added to the usage message. Here are a couple of examples of usage:

$ python example10.py add 1 2 3 4
10.0
$ python example10.py mul 1 2 3 4
24.0
$ python example10.py ad 1 2 3 4 # a mispelling error
usage: example10.py [-h] {add,mul} [n [n ...]]
example10.py: error: argument operator: invalid choice: 'ad' (choose from 'add', 'mul')

plac.call can also be used in doctests like this:

>>> import plac, example10
>>> plac.call(example10.main, ['add', '1', '2'])
3.0

plac.call works for generators too:

>>> def main(n):
...     for i in range(int(n)):
...         yield i
... >>> plac.call(main, ['3'])
[0, 1, 2]

Internally plac.call tries to convert the output of the main function into a list, if possible. If the output is not iterable or it is a string, it is left unchanged, but if it is iterable it is converted. In particular, generator objects are exhausted by plac.call.
This behavior avoids mistakes like forgetting of applying `list(result)` to the result of `plac.call`; moreover it makes errors visible early, and avoids mistakes in code like the following:

```
try:
    result = plac.call(main, args)
except:
    # do something
```

Without eagerness, a main function returning a generator object would not raise any exception until the generator is iterated over. If you are a fan of lazyness, you can still have it by setting the `eager` flag to `False`, as in the following example:

```
for line in plac.call(main, args, eager=False):
    print(line)
```

If `main` returns a generator object this example will print each line as soon as available, whereas the default behaviour is to print all the lines together and the end of the computation.

**A realistic example**

Here is a more realistic script using most of the features of `plac` to run SQL queries on a database by relying on SQLAlchemy. Notice the usage of the `type` feature to automagically convert a SQLAlchemy connection string into a `SqlSoup` object:

```
# dbcli.py
import plac
from sqlalchemy.ext.sqlsoup import SqlSoup

@plac.annotations(
    db=plac.Annotation("Connection string", type=SqlSoup),
    header=plac.Annotation("Header", 'flag', 'H'),
    sqlcmd=plac.Annotation("SQL command", 'option', 'c', str, metavar="SQL"),
    delimiter=plac.Annotation("Column separator", 'option', 'd'),
    scripts=plac.Annotation("SQL scripts"),
)
def main(db, header, sqlcmd, delimiter='|', *scripts):
    "A script to run queries and SQL scripts on a database"
    yield 'Working on %s' % db.bind.url
    if sqlcmd:
        result = db.bind.execute(sqlcmd)
        if header:  # print the header
            yield delimiter.join(result.keys())
        for row in result:  # print the rows
            yield delimiter.join(map(str, row))
    for script in scripts:
        db.bind.execute(file(script).read())
        yield 'executed %s' % script

if __name__ == '__main__':
    for output in plac.call(main):
        print(output)
```
You can see the *yield-is-print* pattern here: instead of using `print` in the main function, I use `yield`, and I perform the print in the `__main__` block. The advantage of the pattern is that tests invoking `plac.call` and checking the result become trivial: had I performed the printing in the main function, the test would have involved an ugly hack like redirecting `sys.stdout` to a `StringIO` object.

Here is the usage message:

```
A script to run queries and SQL scripts on a database

positional arguments:
  db                    Connection string
  scripts               SQL scripts

optional arguments:
  -h, --help            show this help message and exit
  -H, --header          Header
  -c SQL, --sqlcmd SQL  SQL command
  -d |, --delimiter |    Column separator
```

You can check for yourself that the script works.

**Keyword arguments**

Starting from release 0.4, `plac` supports keyword arguments. In practice that means that if your main function has keyword arguments, `plac` treats specially arguments of the form "name=value" in the command line. Here is an example:

```
# example12.py
import plac

@plac.annotations(
    opt=('some option', 'option'),
    args='default arguments',
    kw='keyword arguments')
def main(opt, *args, **kw):
    if opt:
        yield 'opt=%s' % opt
    if args:
        yield 'args=%s' % str(args)
    if kw:
        yield 'kw=%s' % kw

if __name__ == '__main__':
    for output in plac.call(main):
        print(output)
```

Here is the generated usage message:

```
usage: example12.py [-h] [-opt OPT] [args [args ...]] [kw [kw ...]]

positional arguments:
  args        default arguments
  kw          keyword arguments
```
optional arguments:
- h, --help show this help message and exit
- opt OPT some option

Here is how you call the script:

```bash
$ python example12.py -o X a1 a2 name=value
opt=X
args=('a1', 'a2')
kw={'name': 'value'}
```

When using keyword arguments, one must be careful to use names which are not already taken; for instance in this examples the name `opt` is taken:

```bash
$ python example12.py 1 2 kw1=1 kw2=2 opt=0
usage: example12.py [-h] [-o OPT] [args [args ...]] [kw [kw ...]]
example12.py: error: colliding keyword arguments: opt
```

The names taken are the names of the flags, of the options, and of the positional arguments, excepted varargs and keywords. This limitation is a consequence of the way the argument names are managed in function calls by the Python language.

**plac vs argparse**

*plac* is opinionated and by design it does not try to make available all of the features of *argparse* in an easy way. In particular you should be aware of the following limitations/differences (the following assumes knowledge of *argparse*):

- *plac* does not support the destination concept: the destination coincides with the name of the argument, always. This restriction has some drawbacks. For instance, suppose you want to define a long option called `--yield`. In this case the destination would be `yield`, which is a Python keyword, and since you cannot introduce an argument with that name in a function definition, it is impossible to implement it. Your choices are to change the name of the long option, or to use *argparse* with a suitable destination.

- *plac* does not support "required options". As the *argparse* documentation puts it: *Required options are generally considered bad form - normal users expect options to be optional*. You should avoid the use of required options whenever possible. Notice that since *argparse* supports them, *plac* can manage them too, but not directly.

- *plac* supports only regular boolean flags. *argparse* has the ability to define generalized two-value flags with values different from `True` and `False`. An earlier version of *plac* had this feature too, but since you can use options with two choices instead, and in any case the conversion from `{True, False}` to any couple of values can be trivially implemented with a ternary operator (`value1 if flag else value2`), I have removed it (KISS rules!).

- *plac* does not support `nargs` options directly (it uses them internally, though, to implement flag recognition). The reason it that all the use cases of interest to me are covered by *plac* and I did not feel the need to increase the learning curve by adding direct support for `nargs`.

- *plac* does support subparsers, but you must read the advanced usage document to see how it works.

- *plac* does not support actions directly. This also looks like a feature too advanced for the goals of *plac*. Notice however that the ability to define your own annotation objects (again, see the advanced usage document) may mitigate the need for custom actions.
On the plus side, plac can leverage directly on a number of argparse features.

For instance, you can use argparse.FileType directly. Moreover, it is possible to pass options to the underlying argparse.ArgumentParser object (currently it accepts the default arguments description, epilog, prog, usage, add_help, argument_default, parents, prefix_chars, fromfile_prefix_chars, conflict_handler, formatter_class). It is enough to set such attributes on the main function. For instance writing

```python
def main(...):
    pass
main.add_help = False
```

disables the recognition of the help flag -h, --help. This mechanism does not look particularly elegant, but it works well enough. I assume that the typical user of plac will be happy with the defaults and would not want to change them; still it is possible if she wants to.

For instance, by setting the description attribute, it is possible to add a comment to the usage message (by default the docstring of the main function is used as description).

It is also possible to change the option prefix; for instance if your script must run under Windows and you want to use "/" as option prefix you can add the line:

```python
main.prefix_chars='/-'
```

The first prefix char (/) is used as the default for the recognition of options and flags; the second prefix char (-) is kept to keep the -h/--help option working; however you can disable it and reimplement it, if you like.

It is possible to access directly the underlying ArgumentParser object, by invoking the plac.parser_from utility function:

```python
>>> import plac
>>> def main(arg):
...     pass
...
>>> print(plac.parser_from(main)) #doctest: +ELLIPSIS
ArgumentParser(prog=...)
```

Internally plac.call uses plac.parser_from. Notice that when plac.call(func) is invoked multiple time, the parser is re-used and not rebuilt from scratch again.

I use plac.parser_from in the unit tests of the module, but regular users should not need to use it, unless they want to access all of the features of argparse directly without calling the main function.

Interested readers should read the documentation of argparse to understand the meaning of the other options. If there is a set of options that you use very often, you may consider writing a decorator adding such options to the main function for you. For simplicity, plac does not perform any magic.

**Final example: a shelf interface**

Here is a nontrivial example showing off many plac feature, including keyword arguments recognition. The use case is the following: suppose we have stored the configuration parameters of a given application into a Python shelve and we need a command-line tool to edit the shelve. A possible implementation using plac could be the following:
# ishelve.py
import os, shelve, plac

DEFAULT_SHELVE = os.path.expanduser('~/conf.shelve')

@plac.annotations(
    help=('show help', 'flag'),
    showall=('show all parameters in the shelve', 'flag'),
    clear=('clear the shelve', 'flag'),
    delete=('delete an element', 'option'),
    filename=('filename of the shelve', 'option'),
    params='names of the parameters in the shelve',
    setters='setters param=value')
def main(help, showall, clear, delete, filename=DEFAULT_SHELVE, *params, **setters):
    "A simple interface to a shelve. Use .help to see the available commands."    
    sh = shelve.open(filename)
    try:
        if not any([help, showall, clear, delete, params, setters]):
            yield 'no arguments passed, use .help to see the available commands'
        elif help: # custom help
            yield 'Commands: .help, .showall, .clear, .delete'
            yield '<param> ...'
            yield '<param=value> ...'
        elif showall:
            for param, name in sh.items():
                yield '%s=%s' % (param, name)
        elif clear:
            sh.clear()
            yield 'cleared the shelve'
        elif delete:
            try:
                del sh[delete]
            except KeyError:
                yield '%s: not found' % delete
            else:
                yield 'deleted %s' % delete
            for param in params:
                try:
                    yield sh[param]
                except KeyError:
                    yield '%s: not found' % param
                for param, value in setters.items():
                    sh[param] = value
                    yield 'setting %s=%s' % (param, value)
    finally:
        sh.close()
    main.add_help = False # there is a custom help, remove the default one
    main.prefix_chars = '.' # use dot-prefixed commands

if __name__ == '__main__':
    for output in plac.call(main):
        print(output)

A few notes are in order:
1. I have disabled the ordinary help provided by argparse and I have implemented a custom help command.

2. I have changed the prefix character used to recognize the options to a dot.

3. Keyword arguments recognition (in the **setters**) is used to make it possible to store a value in the shelve with the syntax `param_name=param_value`.

4. *params are used to retrieve parameters from the shelve and some error checking is performed in the case of missing parameters.

5. A command to clear the shelve is implemented as a flag (.clear).

6. A command to delete a given parameter is implemented as an option (.delete).

7. There is an option with default (.filename=conf.shelve) to store the filename of the shelve.

8. All things considered, the code looks like a poor man object oriented interface implemented with a chain of elifs instead of methods. Of course, plac can do better than that, but let me start from a low-level approach first.

If you run `ishelve.py` without arguments you get the following message:

```
$ python ishelve.py
no arguments passed, use .help to see the available commands
```

If you run `ishelve.py` with the option `.h` (or any abbreviation of `.help`) you get:

```
$ python ishelve.py .h
Commands: .help, .showall, .clear, .delete
<param> ...
<param=value> ...
```

You can check by hand that the tool work:

```
$ python ishelve.py .clear # start from an empty shelve
cleared the shelve
$ python ishelve.py a=1 b=2
setting a=1
setting b=2
$ python ishelve.py .showall
b=2
a=1
$ python ishelve.py .del b # abbreviation for .delete
deleted b
$ python ishelve.py a
1
$ python ishelve.py b
b: not found
$ python ishelve.py .cler # mispelled command
       [.filename /home/micheles/conf.shelve]
       [params [params ...]] [setters [setters ...]]
ishelve.py: error: unrecognized arguments: .cler
```
plac vs the rest of the world

Originally plac boasted about being “the easiest command-line arguments parser in the world”. Since then, people started pointing out to me various projects which are based on the same idea (extracting the parser from the main function signature) and are arguably even easier than plac:

- operator by Dusty Phillips
- CLIArgs by Pavel Panchekha
- commandline by David Laban

Luckily for me none of such projects had the idea of using function annotations and argparse; as a consequence, they are no match for the capabilities of plac.

Of course, there are tons of other libraries to parse the command line. For instance Clap by Matthew Frazier which appeared on PyPI just the day before plac; Clap is fine but it is certainly not easier than plac.

plac can also be used as a replacement of the cmd module in the standard library and as such it shares many features with the module cmd2 by Catherine Devlin. However, this is completely coincidental, since I became aware of the cmd2 module only after writing plac.

Command-line argument parsers keep coming out; between the newcomers I will notice marrow.script by Alice Bevan-McGregor, which is quite similar to plac in spirit, but does not rely on argparse at all. Argh by Andrey Mikhaylenko is also worth mentioning; it is based on argparse, it came after plac and I must give credit to the author for the choice of the name, much funnier than plac!

The future

Currently the core of plac is around 200 lines of code, not counting blanks, comments and docstrings. I do not plan to extend the core much in the future. The idea is to keep the module short: it is and it should remain a little wrapper over argparse. Actually I have thought about contributing the core back to argparse if plac becomes successfull and gains a reasonable number of users. For the moment it should be considered in a frozen status.

Notice that even if plac has been designed to be simple to use for simple stuff, its power should not be underestimated; it is actually a quite advanced tool with a domain of applicability which far exceeds the realm of command-line arguments parsers.

Version 0.5 of plac doubled the code base and the documentation: it is based on the idea of using plac to implement command-line interpreters, i.e. something akin to the cmd module in the standard library, only better. The new features of plac are described in the advanced usage document. They are implemented in a separated module (plac_ext.py), since they require Python 2.5 to work, whereas plac_core.py only requires Python 2.3.

Trivia: the story behind the name

The plac project started very humbly: I just wanted to make easy_installable my old optionparse recipe, and to publish it on PyPI. The original name of plac was optionparser and the idea behind it was to build an OptionParser object from the docstring of the module. However, before doing that, I decided to check out the argparse module, since I knew it was going into Python 2.7 and Python 2.7 was coming out. Soon enough I realized two things:

1. the single greatest idea of argparse was unifying the positional arguments and the options in a single namespace object;
2. parsing the docstring was so old-fashioned, considering the existence of functions annotations in Python 3.
Putting together these two observations with the original idea of inferring the parser I decided to build an `ArgumentParser` object from function annotations. The `optionparser` name was ruled out, since I was now using `argparse`; a name like `argparse_plus` was also ruled out, since the typical usage was completely different from the `argparse` usage.

I made a research on PyPI and the name `clap` (Command Line Arguments Parser) was not taken, so I renamed everything to clap. After two days a Clap module appeared on PyPI <expletives deleted>!

Having little imagination, I decided to rename everything again to plac, an anagram of clap: since it is a non-existing English name, I hope nobody will steal it from me!

That concludes the section about the basic usage of `plac`. You are now ready to read about the advanced usage.

**Advanced usages of plac**

**Introduction**

One of the design goals of `plac` is to make it dead easy to write a scriptable and testable interface for an application. You can use `plac` whenever you have an API with strings in input and strings in output, and that includes a huge domain of applications.

A string-oriented interface is a scriptable interface by construction. That means that you can define a command language for your application and that it is possible to write scripts which are interpretable by `plac` and can be run as batch scripts.

Actually, at the most general level, you can see `plac` as a generic tool to write domain specific languages (DSL). With `plac` you can test your application interactively as well as with batch scripts, and even with the analogous of Python doctests for your defined language.

You can easily replace the `cmd` module of the standard library and you could easily write an application like `twill` with `plac`. Or you could use it to script your building procedure. `plac` also supports parallel execution of multiple commands and can be used as task manager. It is also quite easy to build a GUI or a Web application on top of `plac`. When speaking of things you can do with `plac`, your imagination is the only limit!

**From scripts to interactive applications**

Command-line scripts have many advantages, but they are no substitute for interactive applications. In particular, if you have a script with a large startup time which must be run multiple times, it is best to turn it into an interactive application, so that the startup is performed only once. `plac` provides an `Interpreter` class just for this purpose.

The `Interpreter` class wraps the main function of a script and provides an `.interact` method to start an interactive interpreter reading commands from the console.

For instance, you can define an interactive interpreter on top of the `ishelve` script introduced in the basic documentation as follows:

```python
# shelve_interpreter.py
import plac, ishelve

@plac.annotations(
    interactive=('start interactive interface', 'flag'),
    subcommands='the commands of the underlying ishelve interpreter')
def main(interactive, *subcommands):
    """
    This script works both interactively and non-interactively.
    """
```
Use .help to see the internal commands.

```python
if interactive:
    plac.Interpreter(ishelve.main).interact()
else:
    for out in plac.call(ishelve.main, subcommands):
        print(out)

if __name__ == '__main__':
    plac.call(main)
```

A trick has been used here: the ishelve command-line interface has been hidden inside an external interface. They are distinct: for instance the external interface recognizes the -h/--help flag whereas the internal interface only recognizes the .help command:

```bash
$ python shelve_interpreter.py -h
```

```
usage: shelve_interpreter.py [-h] [-interactive] [subcommands [subcommands ...]]

This script works both interactively and non-interactively.
Use .help to see the internal commands.

positional arguments:
  subcommands   the commands of the underlying ishelve interpreter

optional arguments:
  -h, --help    show this help message and exit
  -interactive  start interactive interface
```

Thanks to this ingenuous trick, the script can be run both interactively and non-interactively:

```bash
$ python shelve_interpreter.py .clear # non-interactive use
cleared the shelve
```

Here is an usage session:

```
$ python shelve_interpreter.py -i # interactive use
A simple interface to a shelve. Use .help to see the available commands.
i> .help
Commands: .help, .showall, .clear, .delete
<i param> ...
<i param=value> ...
i> a=1
setting a=1
i> a
1
i> b=2
setting b=2
i> a b
1
2
```
The `.interact` method reads commands from the console and send them to the underlying interpreter, until the user send a CTRL-D command (CTRL-Z in Windows). There is a default argument `prompt='i> '` which can be used to change the prompt. The text displayed at the beginning of the interactive session is the docstring of the main function. `plac` also understands command abbreviations: in this example `del` is an abbreviation for `delete`. In case of ambiguous abbreviations `plac` raises a `NameError`.

Finally I must notice that `plac.Interpreter` is available only if you are using a recent version of Python (>= 2.5), because it is a context manager object which uses extended generators internally.

**Testing a plac application**

You can conveniently test your application in interactive mode. However manual testing is a poor substitute for automatic testing.

In principle, one could write automatic tests for the `ishelve` application by using `plac.call` directly:

```python
# test_ishelve.py
import plac, ishelve

def test():
    assert plac.call(ishelve.main, ['.clear']) == ['cleared the shelve']
    assert plac.call(ishelve.main, ['a=1']) == ['setting a=1']
    assert plac.call(ishelve.main, ['a']) == ['1']
    assert plac.call(ishelve.main, ['.delete=a']) == ['deleted a']
    assert plac.call(ishelve.main, ['a']) == ['a: not found']

if __name__ == '__main__':
    test()
```

However, using `plac.call` is not especially nice. The big issue is that `plac.call` responds to invalid input by printing an error message on stderr and by raising a `SystemExit`: this is certainly not a nice thing to do in a test.

As a consequence of this behavior it is impossible to test for invalid commands, unless you wrap the `SystemExit` exception by hand each time (a possibly you do something with the error message in stderr too). Luckily, `plac` offers a better testing support through the `check` method of `Interpreter` objects:

```python
# test_ishelve_more.py
from __future__ import with_statement
import plac, ishelve

def test():
    with plac.Interpreter(ishelve.main) as i:
        i.check('.clear', 'cleared the shelve')
        i.check('a=1', 'setting a=1')
        i.check('a', '1')
        i.check('.delete=a', 'deleted a')
```

21
The method `.check(given_input, expected_output)` works on strings and raises an `AssertionError` if the output produced by the interpreter is different from the expected output for the given input. Notice that `AssertionError` is caught by tools like `py.test` and `nose` tests and actually `plac` tests are intended to be run with such tools.

Interpreters offer a minor syntactic advantage with respect to calling `plac.call` directly, but they offer a major semantic advantage when things go wrong (read exceptions): an Interpreter object internally invokes something like `plac.call`, but it wraps all exceptions, so that `.check` is guaranteed not to raise any exception except `AssertionError`.

Even the `SystemExit` exception is captured and you can write your test as

```python
i.check('-cler', 'SystemExit: unrecognized arguments: -cler')
```

without risk of exiting from the Python interpreter.

There is a second advantage of interpreters: if the main function contains some initialization code and finalization code (`__enter__` and `__exit__` functions) they will be run at the beginning and at the end of the interpreter loop, whereas `plac.call` ignores the initialization/finalization code.

**Plac easy tests**

Writing your tests in terms of `Interpreter.check` is certainly an improvement over writing them in terms of `plac.call`, but they are still too low-level for my taste. The `Interpreter` class provides support for doctest-style tests, a.k.a. plac easy tests.

By using plac easy tests you can cut and paste your interactive session and turn it into a runnable automatics test. Consider for instance the following file `ishelve.placet` (the `.placet` extension is a mnemonic for plac easy tests):

```python
#!/ishelve.py
i> .clear # start from a clean state
  cleared the shelve
i> a=1
  setting a=1
i> a
  1
i> .del a
  deleted a
i> a
  a: not found
i> .cler # spelling error
  .cler: not found
```

Notice the presence of the shebang line containing the name of the `plac` tool to test (a `plac` tool is just a Python module with a function called `main`). The shebang is ignored by the interpreter (it looks like a comment to it) but it is there so that external tools (say a test runner) can infer the plac interpreter to use to test the file.

You can run the `ishelve.placet` file by calling the `.doctest` method of the interpreter, as in this example:

```bash
$ python -c "import plac, ishelve
plac.Interpreter(ishelve.main).doctest(open('ishelve.placet'), verbose=True)"
```

22
Internally `Interpreter.doctests` invokes something like `Interpreter.check` multiple times inside the same context and compare the output with the expected output: if even a check fails, the whole test fail.

You should realize that the easy tests supported by `plac` are not unitests; they are functional tests. They model the user interaction and the order of the operations generally matters. The single subtests in a `.placet` file are not independent and it makes sense to exit immediately at the first failure.

The support for doctests in `plac` comes nearly for free, thanks to the `shlex` module in the standard library, which is able to parse simple languages as the ones you can implement with `plac`. In particular, thanks to `shlex`, `plac` is able to recognize comments (the default comment character is `#`), escape sequences and more. Look at the `shlex` documentation if you need to customize how the language is interpreted. For more flexibility, it is even possible to pass to the interpreter a custom split function with signature `split(line, commentchar)`.

In addition, I have implemented some support for line number recognition, so that if a test fail you get the line number of the failing command. This is especially useful if your tests are stored in external files, even if they do not need to be in a file: you can just pass to the `.doctest` method a list of strings corresponding to the lines of the file.

At the present `plac` does not use any code from the doctest module, but the situation may change in the future (it would be nice if `plac` could reuse doctests directives like ELLIPSIS).

It is straightforward to integrate your `.placet` tests with standard testing tools. For instance, you can integrate your doctests with `nose` or `py.test` as follow:

```python
import os, shlex, plac

def test_doct():
   
   Find all the doctests in the current directory and run them with the corresponding plac interpreter (the shebang rules!)
   
   placets = [f for f in os.listdir('.') if f.endswith('.placet')]
   for placet in placets:
       lines = list(open(placet))
       assert lines[0].startswith('#'), 'Missing or incorrect shebang line!'
       firstline = lines[0][2:] # strip the shebang
       main = plac.import_main(*shlex.split(firstline))
       yield plac.Interpreter(main).doctest, lines[1:]
```

Here you should notice that usage of `plac.import_main`, an utility which is able to import the main function of the script specified in the shebang line. You can use both the full path name of the tool, or a relative path name. In this case the runner look at the environment variable `PLACPATH` and it searches the plac tool in the directories specified there (`PLACPATH` is just a string containing directory names separated by colons). If the variable `PLACPATH` is not defined, it just looks in the current directory. If the plac tool is not found, an `ImportError` is raised.

**Plac batch scripts**

It is pretty easy to realize that an interactive interpreter can also be used to run batch scripts: instead of reading the commands from the console, it is enough to read the commands from a file. `plac` interpreters provide an `.execute` method to perform just that.

There is just a subtle point to notice: whereas in an interactive loop one wants to manage all exceptions, a batch script should not continue in the background in case of unexpected errors. The implementation of `Interpreter.execute` makes sure that any error raised by `plac.call` internally is re-raised. In other words, `plac` interpreters wrap the errors, but does not eat them: the errors are always accessible and can be re-raised on demand.
The exception is the case of invalid commands, which are skipped. Consider for instance the following batch file, which contains a mispelled command (.dl instead of .del):

```bash
#!/ishelve.py
.clear
a=1 b=2
.show
.del a
.dl b
.show
```

If you execute the batch file, the interpreter will print a .dl: not found at the .dl line and will continue:

```
$ python -c "import plac, ishelve
plac.Interpreter(ishelve.main).execute(open('ishelve.plac'), verbose=True)"

i> .clear
cleared the shelve
i> a=1 b=2
setting a=1
setting b=2
i> .show
b=2
a=1
i> .del a
deleted a
i> .dl b
2
.dl: not found
i> .show
b=2
```

The `verbose` flag is there to show the lines which are being interpreted (prefixed by `i>`). This is done on purpose, so that you can cut and paste the output of the batch script and turn it into a `.placet` test (cool, isn't it?).

### Implementing subcommands

When I discussed the `ishelve` implementation in the basic documentation, I said that it looked like the poor man implementation of an object system as a chain of elifs; I also said that `plac` was able to do much better than that. Here I will substantiate my claim.

`plac` is actually able to infer a set of subparsers from a generic container of commands. This is useful if you want to implement subcommands (a familiar example of a command-line application featuring subcommands is version control system). Technically a container of commands is any object with a `.commands` attribute listing a set of functions or methods which are valid commands. A command container may have initialization/finalization hooks (`__enter__/__exit__`) and dispatch hooks (`__missing__`, invoked for invalid command names). Moreover, only when using command containers `plac` is able to provide automatic autocompletion of commands.

The shelve interface can be rewritten in an object-oriented way as follows:

```bash
#!/ishelve2.py
import shelve, os, plac
```
class ShelveInterface(object):
    "A minimal interface over a shelve object."
    commands = 'set', 'show', 'showall', 'delete'
    @plac.annotations(
        configfile=('path name of the shelve', 'option'))
def __init__(self, configfile):
    self.configfile = configfile or '~/conf.shelve'
    self.fname = os.path.expanduser(self.configfile)
    self.__doc__ += '
Operating on %s. Use help to see '
    'the available commands. %s' % (self.fname
    def __enter__(self):
        self.sh = shelve.open(self.fname)
        return self
    def __exit__(self, etype, exc, tb):
        self.sh.close()
def set(self, name, value):
    "set name value"
    yield 'setting %s=%s' % (name, value)
    self.sh[name] = value
def show(self, *names):
    "show given parameters"
    for name in names:
        yield '%s = %s' % (name, self.sh[name]) # no error checking
    def showall(self):
    "show all parameters"
    for name in self.sh:
        yield '%s = %s' % (name, self.sh[name])
def delete(self, name=None):
    "delete given parameter (or everything)"
    if name is None:
        yield 'deleting everything'
        self.sh.clear()
    else:
        yield 'deleting %s' % name
        del self.sh[name] # no error checking
if __name__ == '__main__':
    plac.Interpreter(plac.call(ShelveInterface)).interact()

plac.Interpreter objects wrap context manager objects consistently. In other words, if you wrap
an object with __enter__ and __exit__ methods, they are invoked in the right order (__enter__
before the interpreter loop starts and __exit__ after the interpreter loop ends, both in the regular and in
the exceptional case). In our example, the methods __enter__ and __exit__ make sure the the
shelve is opened and closed correctly even in the case of exceptions. Notice that I have not implemented
any error checking in the show and delete methods on purpose, to verify that plac works correctly in
the presence of exceptions.

When working with command containers, plac automatically adds two special commands to the set of
provided commands: help and .last_tb. The help command is the easier to understand: when
invoked without arguments it displays the list of available commands with the same formatting of the cmd
module; when invoked with the name of a command it displays the usage message for that command.
The .last_tb command is useful when debugging: in case of errors, it allows you to display the
traceback of the last executed command.

Here is the usage message:
usage: ishelve2.py [-h] [-configfile CONFIGFILE]

A minimal interface over a shelve object.

optional arguments:
  -h, --help            show this help message and exit
  -configfile CONFIGFILE path name of the shelve

Here is a session of usage on an Unix-like operating system:

$ python ishelve2.py -c ~/test.shelve
A minimal interface over a shelve object.
Operating on /home/micheles/test.shelve.
Use help to see the available commands.
i> help

special commands
-----------------
.last_tb

custom commands
---------------
delete  set  show  showall

i> delete
deleting everything
i> set a pippo
setting a=pippo
i> set b lippo
setting b=lippo
i> showall
b = lippo
a = pippo
i> show a b
a = pippo
b = lippo
i> del a
deleting a
i> showall
b = lippo
i> delete a
deleing a
KeyError: 'a'
i> .last_tb
File "/usr/local/lib/python2.6/dist-packages/plac-0.6.0-py2.6.egg/plac_ext.py", line 190, in _wrap
for value in genobj:
File "/ishelve2.py", line 37, in delete
del self.sh[name] # no error checking
File "/usr/lib/python2.6/shelve.py", line 136, in __delitem__
del self.dict[key]
i>

Notice that in interactive mode the traceback is hidden, unless you pass the verbose flag to the Interpreter.interact method.

CHANGED IN VERSION 0.9: if you have an old version of plac the help command must be prefixed with a dot, i.e. you must write .help. The old behavior was more consistent in my opinion, since it made it clear that the help command was special and treated differently from the regular commands. Notice that if you implement a custom help command in the commander class the default help will not be added, as you would expect.

In version 0.9 an exception `plac.Interpreter.Exit` was added. Its purpose it to make it easy to define commands to exit from the command loop. Just define something like:
def quit(self):
    raise plac.Interpreter.Exit

and the interpreter will be closed properly when the quit command is entered.

**plac.Interpreter.call**

At the core of plac there is the call function which invokes a callable with the list of arguments passed at the command-line (sys.argv[1:]). Thanks to plac.call you can launch your module by simply adding the lines:

```python
if __name__ == '__main__':
    plac.call(main)
```

Everything works fine if main is a simple callable performing some action; however, in many cases, one has a main "function" which is actually a factory returning a command container object. For instance, in my second shelve example the main function is the class ShelveInterface, and the two lines needed to run the module are a bit ugly:

```python
if __name__ == '__main__':
    plac.Interpreter(plac.call(ShelveInterface)).interact()
```

Moreover, now the program runs, but only in interactive mode, i.e. it is not possible to run it as a script. Instead, it would be nice to be able to specify the command to execute on the command-line and have the interpreter start, execute the command and finish properly (I mean by calling __enter__ and __exit__) without needing user input. Then the script could be called from a batch shell script working in the background. In order to provide such functionality plac.Interpreter provides a classmethod named .call which takes the factory, instantiates it with the arguments read from the command line, wraps the resulting container object as an interpreter and runs it with the rest arguments found in the command line. Here is the code to turn the ShelveInterface into a script

```bash
# ishelve3.py
from ishelve2 import ShelveInterface

if __name__ == '__main__':
    import plac; plac.Interpreter.call(ShelveInterface)
```

## try the following:

- $ python ishelve3.py delete
- $ python ishelve3.py set a 1
- $ python ishelve3.py showall

and here are a few examples of usage:

```bash
$ python ishelve3.py help

special commands
================
.last_tb

custom commands
===============
delete set show showall
```
$ python ishelve3.py set a 1
setting a=1
$ python ishelve3.py show a
a = 1

If you pass the -i flag in the command line, then the script will enter in interactive mode and ask the user for the commands to execute:

$ python ishelve3.py -i
A minimal interface over a shelve object.
Operating on /home/micheles/conf.shelve.
Use help to see the available commands.

i>

In a sense, I have closed the circle: at the beginning of this document I discussed how to turn a script into an interactive application (the shelf_interpreter.py example), whereas here I have show how to turn an interactive application into a script.

The complete signature of plac.Interpreter.call is the following:

```python
call(factory, arglist=sys.argv[1:],
     commentchar='#', split=shlex.split,
     stdin=sys.stdin, prompt='i> ', verbose=False)
```

The factory must have a fixed number of positional arguments (no default arguments, no varargs, no kwargs), otherwise a TypeError is raised: the reason is that we want to be able to distinguish the command-line arguments needed to instantiate the factory from the rest arguments that must be sent to the corresponding interpreter object. It is also possible to specify a list of arguments different from sys.argv[1:] (useful in tests), the character to be recognized as a comment, the splitting function, the input source and the prompt to use while in interactive mode, and a verbose flag.

**Readline support**

Starting from release 0.6 plac offers full readline support. That means that if your Python was compiled with readline support you get autocompletion and persistent command history for free. By default all commands are autocomplete in a case sensitive way. If you want to add new words to the autocompletion set, or you want to change the location of the .history file, or to change the case sensitivity, the way to go is to pass a plac.ReadlineInput object to the interpreter. Here is an example, assuming you want to build a database interface understanding SQL commands:

```python
import os, plac
from sqlalchemy.ext.sqlsoup import SqlSoup

SQLKEYWORDS = set(['help', 'select', 'from', 'inner', 'join', 'outer', 'left', 'right'])
# and many others
DBTABLES = set(['table1', 'table2'])
# you can read them from the db schema

COMPLETIONS = SQLKEYWORDS | DBTABLES

class SqlInterface(object):
    commands = ['SELECT']
```
```python
def __init__(self, dsn):
    self.soup = SqlSoup(dsn)
def SELECT(self, argstring):
    sql = 'SELECT ' + argstring
    for row in self.soup.bind.execute(sql):
        yield str(row)  # the formatting can be much improved

rl_input = plac.ReadlineInput(
    COMPLETIONS, histfile=os.path.expanduser('~/sql_interface.history'),
    case_sensitive=False)

def split_on_first_space(line, commentchar):
    return line.strip().split(' ', 1)  # ignoring comments

if __name__ == '__main__':
    plac.Interpreter.call(SqlInterface, split=split_on_first_space,
                          stdin=rl_input, prompt='sql> ')
```

Here is an example of usage:

```
$ python sql_interface.py <some dsn>
sql> SELECT a.* FROM TABLE1 AS a INNER JOIN TABLE2 AS b ON a.id = b.id
...
```

You can check that entering just `sel` and pressing TAB the readline library completes the `SELECT` keyword for you and makes it upper case; idem for `FROM`, `INNER`, `JOIN` and even for the names of the tables. An obvious improvement is to read the names of the tables by introspecting the database: actually you can even read the names of the views and of the columns, and have full autocompletion. All the entered commands and recorded and saved in the file `~/.sql_interface.history` when exiting from the command-line interface.

If the readline library is not available, my suggestion is to use the `rlwrap` tool which provides similar features, at least on Unix-like platforms. `plac` should also work fine on Windows with the `pyreadline` library (I do not use Windows, so this part is very little tested: I tried it only once and it worked, but your mileage may vary). For people worried about licenses, I will notice that `plac` uses the readline library only if available, it does not include it and it does not rely on it in any fundamental way, so that the `plac` licence does not need to be the GPL (actually it is a BSD do-whatever-you-want-with-it licence).

The interactive mode of `plac` can be used as a replacement of the `cmd` module in the standard library. It is actually better than `cmd`: for instance, the `help` command is more powerful, since it provides information about the arguments accepted by the given command:

```
i> help set
usage:  set name value

  set name value

  positional arguments:
    name
    value

i> help delete
usage:  delete [name]

delete given parameter (or everything)
```
As you can imagine, the help message is provided by the underlying argparse subparser: there is a subparser for each command. plac commands accept options, flags, varargs, keyword arguments, arguments with defaults, arguments with a fixed number of choices, type conversion and all the features provided of argparse.

Moreover at the moment plac also understands command abbreviations. However, this feature may disappear in future releases. It was meaningful in the past, when plac did not support readline.

Notice that if an abbreviation is ambiguous, plac warns you:

```
i> sh
NameError: Ambiguous command 'sh': matching ['showall', 'show']
```

## The plac runner

The distribution of plac includes a runner script named plac_runner.py, which will be installed in a suitable directory in your system by distutils (say in /usr/local/bin/plac_runner.py in a Unix-like operative system). The runner provides many facilities to run .plac scripts and .placet files, as well as Python modules containing a main object, which can be a function, a command container object or even a command container class.

For instance, suppose you want to execute a script containing commands defined in the ishelve2 module like the following one:

```
#!/ishelve2.py:ShelveInterface -c ~/conf.shelve
set a 1
del a
del a # intentional error
```

The first line of the .plac script contains the name of the python module containing the plac interpreter and the arguments which must be passed to its main function in order to be able to instantiate an interpreter object. In this case I appended :ShelveInterface to the name of the module to specify the object that must be imported: if not specified, by default the object named 'main' is imported. The other lines contains commands. You can run the script as follows:

```
$ plac_runner.py --batch ishelve2.plac
setting a=1
deleting a
Traceback (most recent call last):
  ...
.bsddb.DBNotFoundError: (-30988, 'DB_NOTFOUND: No matching key/data pair found')
```
The last command intentionally contained an error, to show that the plac runner does not eat the traceback.

The runner can also be used to run Python modules in interactive mode and non-interactive mode. If you put this alias in your bashrc

```
alias plac="plac_runner.py"
```

(or you define a suitable `plac.bat` script in Windows) you can run the `ishelve2.py` script in interactive mode as follows:

```
$ plac -i ishelve2.py:ShelveInterface
A minimal interface over a shelf object.
Operating on /home/michele/conf.shelve.
.help to see the available commands.

i> del
deleting everything
i> set a 1
setting a=1
i> set b 2
setting b=2
i> show b
b = 2
```

Now you can cut and paste the interactive session and turns into into a `.placet` file like the following:

```
#!/ishelve2.py:ShelveInterface -configfile=~/.test.shelve
# an example of .placet file for the ShelveInterface
i> del
deleting everything
i> set a 1
setting a=1
i> set b 2
setting b=2
i> show a
a = 1
```

Notice that the first line specifies a test database `~/.test.shelve`, to avoid clobbering your default shelf. If you mispell the arguments in the first line plac will give you an `argparse` error message (just try).

You can run placets following the shebang convention directly with the plac runner:

```
$ plac --test ishelve2.placet
run 1 plac test(s)
```

If you want to see the output of the tests, pass the `-v/--verbose` flag. Notice that the runner ignores the extension, so you can actually use any extension you like, but it relies on the first line of the file to invoke the corresponding plac tool with the given arguments.

The plac runner does not provide any test discovery facility, but you can use standard Unix tools to help. For instance, you can run all the `.placet` files into a directory and its subdirectories as follows:

```
$ find . -name ".*placet" | xargs plac_runner.py -t
```

The plac runner expects the main function of your script to return a plac tool, i.e. a function or an object with a `.commands` attribute. It this is not the case the runner gracefully exits.
It also works in non-interactive mode, if you call it as

$ plac module.py args ...

Here is an example:

$ plac ishelve.py a=1
setting a=1
$ plac ishelve.py .show
a=1

Notice that in non-interactive mode the runner just invokes `plac.call` on the `main` object of the Python module.

**A non class-based example**

`plac` does not force you to use classes to define command containers. Even a simple function can be a valid command container, it is enough to add to it a `.commands` attribute and possibly `__enter__` and/or `__exit__` attributes.

In particular, a Python module is a perfect container of commands. As an example, consider the following module implementing a fake Version Control System:

"A Fake Version Control System"

import plac

commands = 'checkout', 'commit', 'status'

@plac.annotations(url='url of the source code')
def checkout(url):
    """A fake checkout command"
    return ('checkout ', url)

@plac.annotations(message=('commit message', 'option'))
def commit(message):
    """A fake commit command"
    return ('commit ', message)

@plac.annotations(quiet=('summary information', 'flag', 'q'))
def status(quiet):
    """A fake status command"
    return ('status ', quiet)

def __missing__(name):
    return ('Command %r does not exist' % name,)

def __exit__(etype, exc, tb):
    """Will be called automatically at the end of the interpreter loop"
    if etype in (None, GeneratorExit):  # success
        print('ok')

main = __import__(__name__)  # the module imports itself!

if __name__ == '__main__':
    import plac
for out in plac.call(main): print(out)

Notice that I have defined both an __exit__ hook and a __missing__ hook, invoked for non-existing commands. The real trick here is the line main = __import__(__name__), which define main to be an alias for the current module.

The vcs module can be run through the plac runner (try plac vcs.py -h):

```plaintext
usage: plac_runner.py vcs.py [-h] {status,commit,checkout} ...

A Fake Version Control System

optional arguments:
  -h, --help            show this help message and exit

subcommands:
  {status,commit,checkout}
    checkout           A fake checkout command
    commit             A fake commit command
    status             A fake status command
```

You can get help for the subcommands by inserting an -h close the name of the command:

```plaintext
$ plac vcs.py status -h
usage: plac_runner.py vcs.py status [-h] [-q]

A fake status command

optional arguments:
  -h, --help   show this help message and exit
  -q, --quiet  summary information
```

Notice how the docstring of the command is automatically shown in usage message, as well as the documentation for the sub flag -q.

Here is an example of a non-interactive session:

```plaintext
$ plac vcs.py check url
checkout
url
$ plac vcs.py st -q
status
True
$ plac vcs.py co
commit
None
```

and here is an interactive session:

```plaintext
$ plac -i vcs.py
usage: plac_runner.py vcs.py [-h] {status,commit,checkout} ...
  i> check url
  checkout
  url
```
Notice the invocation of the __missing__ hook for non-existing commands. Notice also that the __exit__ hook gets called only in interactive mode.

If the commands are completely independent, a module is a good fit for a method container. In other situations, it is best to use a custom class.

**Writing your own plac runner**

The runner included in the plac distribution is intentionally kept small (around 50 lines of code) so that you can study it and write your own runner if want to. If you need to go to such level of detail, you should know that the most important method of the Interpreter class is the .send method, which takes strings in input and returns a four-tuple with attributes .str, .etype, .exc and .tb:

- .str is the output of the command, if successful (a string);
- .etype is the class of the exception, if the command fail;
- .exc is the exception instance;
- .tb is the traceback.

Moreover the __str__ representation of the output object is redefined to return the output string if the command was successful or the error message if the command failed (actually it returns the error message preceded by the name of the exception class).

For instance, if you send a mispelled option to the interpreter a SystemExit will be trapped:

```python
>>> import plac
>>> from ishelve import ishelve
>>> with plac.Interpreter(ishelve) as i:
...     print(i.send('.cler'))
... SystemExit: unrecognized arguments: .cler
```

It is important to invoke the .send method inside the context manager, otherwise you will get a RuntimeError.

For instance, suppose you want to implement a graphical runner for a plac-based interpreter with two text widgets: one to enter the commands and one to display the results. Suppose you want to display the errors with tracebacks in red. You will need to code something like that (pseudocode follows):

```python
input_widget = WidgetReadingInput()
output_widget = WidgetDisplayingOutput()

def send(interpreter, line):
    out = interpreter.send(line)
```
if out.tb: # there was an error
    output_widget.display(out.tb, color='red')
else:
    output_widget.display(out.str)

main = plac.import_main(tool_path) # get the main object

with plac.Interpreter(main) as i:
    def callback(event):
        if event.user_pressed_ENTER():
            send(i, input_widget.last_line)
    input_widget.addcallback(callback)
    gui_mainloop.start()
If you run the `import_file` command, you will have to wait for 200 seconds before entering a new command:

```
$ python importer1.py dsn -i
A fake importer with an import_file command
i> import_file file1
... <wait 3+ minutes>
Imported 100 lines
Imported 200 lines
Imported 300 lines
...
Imported 10000 lines
closing the file
```

Being unable to enter any other command is quite annoying: in such situation one would like to run the long running commands in the background, to keep the interface responsive. `plac` provides two ways to reach this goal: threads and processes.

**Threaded commands**

The most familiar way to execute a task in the background (even if not necessarily the best way) is to run it into a separated thread. In our example it is sufficient to replace the line

```python
commands = ['import_file']
```

with

```python
thcommands = ['import_file']
```

to tell to the `plac` interpreter that the command `import_file` should be run into a separated thread. Here is an example session:

```
i> import_file file1
<ThreadedTask 1 [import_file file1] RUNNING>
```

The import task started in a separated thread. You can see the progress of the task by using the special command `.output`:

```
i> .output 1
<ThreadedTask 1 [import_file file1] RUNNING>
Imported 100 lines
Imported 200 lines
```

If you look after a while, you will get more lines of output:

```
i> .output 1
<ThreadedTask 1 [import_file file1] RUNNING>
Imported 100 lines
Imported 200 lines
Imported 300 lines
Imported 400 lines
```

```python
if __name__ == '__main__':
    plac.Interpreter.call(FakeImporter)
```
If you look after a time long enough, the task will be finished:

```
\> .output 1
<ThreadedTask 1 [import_file file1] FINISHED>
```

It is possible to store the output of a task into a file, to be read later (this is useful for tasks with a large output):

```
\> .output 1 /tmp/out.txt
saved output of 1 into /tmp/out.txt
```

You can even skip the number argument: then `.output` will return the output of the last launched command (the special commands like `.output` do not count).

You can launch many tasks one after the other:

```
\> import_file file2
<ThreadedTask 5 [import_file file2] RUNNING>
\> import_file file3
<ThreadedTask 6 [import_file file3] RUNNING>
```

The `.list` command displays all the running tasks:

```
\> .list
<ThreadedTask 5 [import_file file2] RUNNING>
<ThreadedTask 6 [import_file file3] RUNNING>
```

It is even possible to kill a task:

```
\> .kill 5
<ThreadedTask 5 [import_file file2] TOBEKILLED>
# wait a bit ...
closing the file
\> .output 5
<ThreadedTask 5 [import_file file2] KILLED>
```

You should notice that since at the Python level it is impossible to kill a thread, the `.kill` commands works by setting the status of the task to `TOBEKILLED`. Internally the generator corresponding to the command is executed in the thread and the status is checked at each iteration: when the status become `TOBEKILLED` a `GeneratorExit` exception is raised and the thread terminates (softly, so that the `finally` clause is honored). In our example the generator is yielding back control once every 100 iterations, i.e. every two seconds (not much). In order to get a responsive interface it is a good idea to yield more often, for instance every 10 iterations (i.e. 5 times per second), as in the following code:

```python
import time
import plac

class FakeImporter(object):
    """A fake importer with an import_file command"
    thcommands = ['import_file']
    def __init__(self, dsn):
        self.dsn = dsn
    def import_file(self, fname):
        # 'here' is any callable that yields back control
        # after 100 iterations
        for i in range(100):
            ... # some long running code
        return 'done'
```

```
```
"Import a file into the database"
try:
    for n in range(10000):
        time.sleep(.02)
        if n % 100 == 99: # every two seconds
            yield 'Imported %d lines' % (n+1)
        if n % 10 == 9: # every 0.2 seconds
            yield # go back and check the TOBEKILLED status
finally:
    print('closing the file')
if __name__ == '__main__':
    plac.Interpreter.call(FakeImporter)

Running commands as external processes

Threads are not loved much in the Python world and actually most people prefer to use processes instead. For this reason plac provides the option to execute long running commands as external processes. Unfortunately the current implementation only works in Unix-like operating systems (including Mac OS X) because it relies on fork via the multiprocessing module.

In our example, to enable the feature it is sufficient to replace the line

    thcommands = ['import_file']

with

    mpcommands = ['import_file'].

The user experience is exactly the same as with threads and you will not see any difference at the user interface level:

```
i> import_file file3
<MPTask 1 [import_file file3] SUBMITTED>
i> .kill 1
<MPTask 1 [import_file file3] RUNNING>
closing the file
i> .output 1
<MPTask 1 [import_file file3] KILLED>
Imported 100 lines
Imported 200 lines
i>
```

Still, using processes is quite different than using threads: in particular, when using processes you can only yield pickleable values and you cannot re-raise an exception first raised in a different process, because traceback objects are not pickleable. Moreover, you cannot rely on automatic sharing of your objects.

On the plus side, when using processes you do not need to worry about killing a command: they are killed immediately using a SIGTERM signal, and there is not a TOBEKILLED mechanism. Moreover, the killing is guaranteed to be soft: internally a command receiving a SIGTERM raises a TerminatedProcess exception which is trapped in the generator loop, so that the command is closed properly.

Using processes allows to take full advantage of multicore machines and it is safer than using threads, so it is the recommended approach unless you are working on Windows.
Managing the output of concurrent commands

plac acts as a command-line task launcher and can be used as the base to build a GUI-based task launcher and task monitor. To this aim the interpreter class provides a .submit method which returns a task object and a .tasks method returning the list of all the tasks submitted to the interpreter. The submit method does not start the task and thus it is nonblocking. Each task has an .outlist attribute which is a list storing the value yielded by the generator underlying the task (the None values are skipped though): the .outlist grows as the task runs and more values are yielded. Accessing the .outlist is nonblocking and can be done freely. Finally there is a .result property which waits for the task to finish and returns the last yielded value or raises an exception. The code below provides an example of how you could implement a GUI over the import example:

```python
from __future__ import with_statement
from Tkinter import *
from importer3 import FakeImporter

def taskwidget(root, task, tick=500):
    """A Label widget showing the output of a task every 500 ms""
    sv = StringVar(root)
    lb = Label(root, textvariable=sv)
    def show_outlist():
        try:
            out = task.outlist[-1]
        except IndexError: # no output yet
            out = ''
        sv.set('%s %s' % (task, out))
        root.after(tick, show_outlist)
    root.after(0, show_outlist)
    return lb

def monitor(tasks):
    root = Tk()
    for task in tasks:
        task.run()
        taskwidget(root, task).pack()
    root.mainloop()

if __name__ == '__main__':
    import plac
    with plac.Interpreter(plac.call(FakeImporter)) as i:
        tasks = [i.submit('import_file f1'), i.submit('import_file f2')]
    monitor(tasks)
```

Parallel computing with plac

plac is certainly not intended as a tool for parallel computing, but still you can use it to launch a set of commands and to collect the results, similarly to the MapReduce pattern popularized by Google. In order to give an example, I will consider the "Hello World" of parallel computing, i.e. the computation of pi with independent processes. There is a huge number of algorithms to compute pi; here I will describe a trivial one chosen for simplicity, not per efficiency. The trick is to consider the first quadrant of a circle with radius 1 and to extract a number of points \((x, y)\) with \(x\) and \(y\) random variables in the interval \([0,1]\). The probability of extracting a number inside the quadrant (i.e. with \(x^2 + y^2 < 1\)) is proportional to the area of the quadrant (i.e. \(\pi/4\)). The value of \(\pi\) therefore can be extracted by multiplying by 4 the ratio between the number of points in the quadrant versus the total number of points \(N\), for \(N\) large:
The algorithm is trivially parallelizable: if you have n CPUs, you can compute \( \pi \) n times with \( N/n \) iterations, sum the results and divide the total by n. I have a Macbook with two cores, therefore I would expect a speedup factor of 2 with respect to a sequential computation. Moreover, I would expect a threaded computation to be even slower than a sequential computation, due to the GIL and the scheduling overhead.

Here is a script implementing the algorithm and working in three different modes (parallel mode, threaded mode and sequential mode) depending on a \texttt{mode} option:

```python
def calc_pi(N):
    inside = 0
    for j in xrange(N):
        x, y = random(), random()
        if x*x + y*y < 1:
            inside += 1
    return (4.0 * inside) / N

from __future__ import with_statement
from random import random
import multiprocessing
import plac

class PiCalculator(object):
    """Compute pi in parallel with threads or processes"""

    @plac.annotations(
        npoints=('number of integration points', 'positional', None, int),
        mode=('sequential|parallel|threaded', 'option', 'm', str, 'SPT'))
    def __init__(self, npoints, mode='S'):
        self.npoints = npoints
        if mode == 'P':
            self.mpcommands = ['calc_pi']
        elif mode == 'T':
            self.thcommands = ['calc_pi']
        elif mode == 'S':
            self.commands = ['calc_pi']
        self.n_cpu = multiprocessing.cpu_count()

    def submit_tasks(self):
        self.i = plac.Interpreter(self).__enter__()
        return [self.i.submit('calc_pi %d' % (self.npoints / self.n_cpu))
                for _ in range(self.n_cpu)]

    def close(self):
        self.i.close()

    @plac.annotations(
        npoints=('npoints', 'positional', None, int))
    def calc_pi(self, npoints):
        counts = 0
        for j in xrange(npoints):
            n, r = divmod(j, 1000000)
            if r == 0:
                yield '%dM iterations' % n
            x, y = random(), random()
```

40
Notice the submit_tasks method, which instantiates and initializes a plac.Interpreter object and submits a number of commands corresponding to the number of available CPUs. The calc_pi command yield a log message every million of interactions, just to monitor the progress of the computation. The run method starts all the submitted commands in parallel and sums the results. It returns the average value of pi after the slowest CPU has finished its job (if the CPUs are equal and equally busy they should finish more or less at the same time).

Here are the results on my old Macbook with Ubuntu 10.04 and Python 2.6, for 10 million of iterations:

```bash
$ python picalculator.py -mP 10000000 # two processes
3.141904 in 5.744545 seconds
$ python picalculator.py -mT 10000000 # two threads
3.141272 in 13.875645 seconds
$ python picalculator.py -mS 10000000 # sequential
3.141586 in 11.353841 seconds
```

As you see using processes one gets a 2x speedup indeed, where the threaded mode is some 20% slower than the sequential mode.

Since the pattern submit a bunch of tasks, starts them and collect the results is so common, plac provides an utility function runp(genseq, mode='p', start=True) to start a bunch a generators and return a list of task objects. By default runp use processes, but you can use threads by passing mode='t'. If you do not wont to start the tasks, you can say so (start=False). With runp the parallel pi calculation becomes a one-liner:

```python
sum(task.result for task in plac.runp(calc_pi(N) for i in range(ncpus)))/ncpus
```

The file test_runp in the doc directory of the plac distribution shows another example of usage.
The plac server

A command-line oriented interface can be easily converted into a socket-based interface. Starting from release 0.7 plac features a built-in server which is able to accept commands from multiple clients and to execute them. The server works by instantiating a separate interpreter for each client, so that if a client interpreter dies for any reason the other interpreters keep working. To avoid external dependencies the server is based on the `asynchat` module in the standard library, but it would not be difficult to replace the server with a different one (for instance, a Twisted server). Notice that at the moment the `plac` server does not work with Python 3.2 due to changes to `asynchat`. In time I will fix this and other known issues. You should consider the server functionality still experimental and subject to changes. Also, notice that since `asynchat`-based servers are asynchronous, any blocking command in the interpreter should be run in a separated process or thread. The default port for the `plac` server is 2199, and the command to signal end-of-connection is EOF. For instance, here is how you could manage remote import on a database (say a SQLite db):

```python
import plac
from importer2 import FakeImporter

def main(port=2199):
    main = FakeImporter('dsn')
    plac.Interpreter(main).start_server(port)

if __name__ == '__main__':
    plac.call(main)
```

You can connect to the server with `telnet` on port 2199, as follows:

```
$ telnet localhost 2199
Trying ::1...
Trying 127.0.0.1...
Connected to localhost.
Escape character is '^]'.
i> import_file f1
i> .list
<ThreadedTask 1 [import_file f1] RUNNING>
i> .out
Imported 100 lines
Imported 200 lines
i> EOF
Connection closed by foreign host.
```

Summary

Once `plac` claimed to be the easiest command-line arguments parser in the world. Having read this document you may think that it is not so easy after all. But it is a false impression. Actually the rules are quite simple:

1. if you want to implement a command-line script, use `plac.call`;
2. if you want to implement a command interpreter, use `plac.Interpreter`:
   - for an interactive interpreter, call the `interact` method;
   - for a batch interpreter, call the `execute` method;
3. for testing call the `Interpreter.check` method in the appropriate context or use the `Interpreter.doctest` feature;
4. if you need to go at a lower level, you may need to call the `Interpreter.send` method which returns a (finished) `Task` object.
5. long running command can be executed in the background as threads or processes: just declare them in the lists `thcommands` and `mpcommands` respectively.
6. the `.start_server` method starts an asynchronous server on the given port number (default 2199)

Moreover, remember that `plac_runner.py` is your friend.

---

**Appendix: custom annotation objects**

Internally `plac` uses an `Annotation` class to convert the tuples in the function signature into annotation objects, i.e. objects with six attributes `help`, `kind`, `short`, `type`, `choices`, `metavar`.

Advanced users can implement their own annotation objects. For instance, here is an example of how you could implement annotations for positional arguments:

```python
# annotations.py
class Positional(object):
    def __init__(self, help='', type=None, choices=None, metavar=None):
        self.help = help
        self.kind = 'positional'
        self.abbrev = None
        self.type = type
        self.choices = choices
        self.metavar = metavar
```

You can use such annotations objects as follows:

```python
# example11.py
import plac
from annotations import Positional

@plac.annotations(
    i=Positional("This is an int", int),
    n=Positional("This is a float", float),
    rest=Positional("Other arguments"))
def main(i, n, *rest):
    print(i, n, rest)

if __name__ == '__main__':
    import plac; plac.call(main)
```

Here is the usage message you get:

```
usage: example11.py [-h] i n [rest [rest ...]]

positional arguments:
  i       This is an int
```
<table>
<thead>
<tr>
<th>n</th>
<th>This is a float</th>
</tr>
</thead>
<tbody>
<tr>
<td>rest</td>
<td>Other arguments</td>
</tr>
</tbody>
</table>

optional arguments:
-h, --help  show this help message and exit

You can go on and define Option and Flag classes, if you like. Using custom annotation objects you could do advanced things like extracting the annotations from a configuration file or from a database, but I expect such use cases to be quite rare: the default mechanism should work pretty well for most users.