Python Profiling

Amjith Ramanujam

Utah Python User Group

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Profiling a Python Script

What

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Why?

- Optimize intelligently.
- Know the bottle-necks.

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How?

Python comes with a few profilers.

- cProfile
- Profile (older pure python implementation)
- hotshot (deprecated)

Let's use cProfile

```
>>> import cProfile
>>> import lcm
>>> cProfile.run('lcm.ver_1(2, 3)')
6 function calls in 0.000 seconds

Ordered by: standard name
ncalls  tottime  percall  cumtime  percall filename
     1    0.000    0.000    0.000    0.000 <string>
     1    0.000    0.000    0.000    0.000 lcm.py:1
     2    0.000    0.000    0.000    0.000 {max}
     1    0.000    0.000    0.000    0.000 {'_lspro
     1    0.000    0.000    0.000    0.000 {min}
```

Lowest Common Multiplier

Problem

Given two numbers a,b find the lowest number c that is divisible by both a and b.

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Given two numbers a,b find the lowest number c that is divisible by both a and b.

Algorithm:

1. Start i from the max(a,b)
2. If i is perfectly divisible by a and b
   i is the answer
3. Increment i by max(a,b). Goto Step 1.

Lowest Common Multiplier (ver 1)

```
# lcm.py
def ver_1(arg1, arg2):
    i = max(arg1, arg2)
    while i < (arg1 * arg2):
        if i % min(arg1,arg2) == 0:
            return i
        i += max(arg1,arg2)
    return(arg1 * arg2)
```

Let's Profile (ver 1)

```
>>> cProfile.run('lcm.ver_1(21498497, 38901201)')
         42996996 function calls in 25.478 seconds

   Ordered by: standard name

   ncalls  tottime  percall  cumtime  percall filena
        1    0.000    0.000   25.478   25.478 <strin
        1   16.358   16.358   25.478   25.478 lcm.py
 21498497    4.583    0.000    4.583    0.000 {max}
        1    0.000    0.000    0.000    0.000 {'_lsp
 21498496    4.537    0.000    4.537    0.000 {min}
```

Lowest Common Multiplier (ver 2)

```
# lcm.py
def ver_2(arg1, arg2):
    mx = max(arg1, arg2)
    mn = min(arg1, arg2)
    i = mx
    while i < (arg1 * arg2):
        if i % mn == 0:
            return i
        i += mx
    return(arg1 * arg2)
```

Let's Profile (ver 2)

```
>>> cProfile.run('lcm.ver_2(21498497, 38901201)')
         5 function calls in 5.889 seconds

Ordered by: standard name

ncalls  tottime  percall  cumtime  percall filename
     1    0.000    0.000    5.889    5.889 <string>
     1    5.889    5.889    5.889    5.889 lcm.py:9
     1    0.000    0.000    0.000    0.000 {max}
     1    0.000    0.000    0.000    0.000 {'_lspro
     1    0.000    0.000    0.000    0.000 {min}
```

Lowest Common Multiplier (ver 3)

```
# lcm.py
def ver_3(arg1, arg2):
    mx = max(arg1, arg2)
    mn = min(arg1, arg2)
    i = mx
    mx_limit = arg1*arg2
    while i < mx_limit:
        if i % mn == 0:
            return i
        i += mx
    return mx_limit
```

Let's Profile (ver 3)

```
>>> cProfile.run('lcm.ver_3(21498497, 38901201)')
         5 function calls in 5.232 seconds

Ordered by: standard name

ncalls  tottime  percall  cumtime  percall filename
     1    0.000    0.000    5.232    5.232 <string>
     1    5.232    5.232    5.232    5.232 lcm.py:1
     1    0.000    0.000    0.000    0.000 {max}
     1    0.000    0.000    0.000    0.000 {'_lspro
     1    0.000    0.000    0.000    0.000 {min}
```

Profile from Command Line

Profiling a whole script.

```
$ python -m cProfile script.py

291502 function calls (291393 primitive calls) in 4

Ordered by: standard name

ncalls  tottime  percall  cumtime  percall filename
     1    0.000    0.000    0.000    0.000 UserDict
     1    0.000    0.000    0.000    0.000 __init__
     1    0.000    0.000    0.000    0.000 __init__
     1    0.000    0.000    0.000    0.000 __init__
     ...
     ...
```

Save and Analyze Profiles

Problem:

- Small functions are easy to profile in the repl.
- Profiles of bigger programs are messy.
- Sorting by function name is useless.

Solution:

- Save the profile to a file.
- Reload the profile and analyze the stats on the profile.

Save the Profile

Let's save the profile to a file.

Interpreter:

```
>>> cProfile.run('lcm.ver_3(21498497, 38901201)',
    'lcm.prof')
```

Command Line:

```
$ python -m cProfile -o script.prof script.py
```

Analyze the Profile

```
>>> import pstats
>>> p  = pstats.Stats('script.prof')
>>> p.sort_stats('cumulative')
>>> p.print_stats(5)

402649 function calls (402540 primitive calls) in 4
Ordered by: cumulative time
List reduced from 72 to 5 due to restriction <5>

ncalls  tottime  percall  cumtime  percall filename
     1    0.009    0.009    4.173    4.173 log_prof
     1    0.000    0.000    4.161    4.161 log_prof
     1    3.596    3.596    3.716    3.716 log_prof
249139    0.334    0.000    0.334    0.000 {built-i
     1    0.114    0.114    0.281    0.281 log_prof
```

GUI Profile Viewer

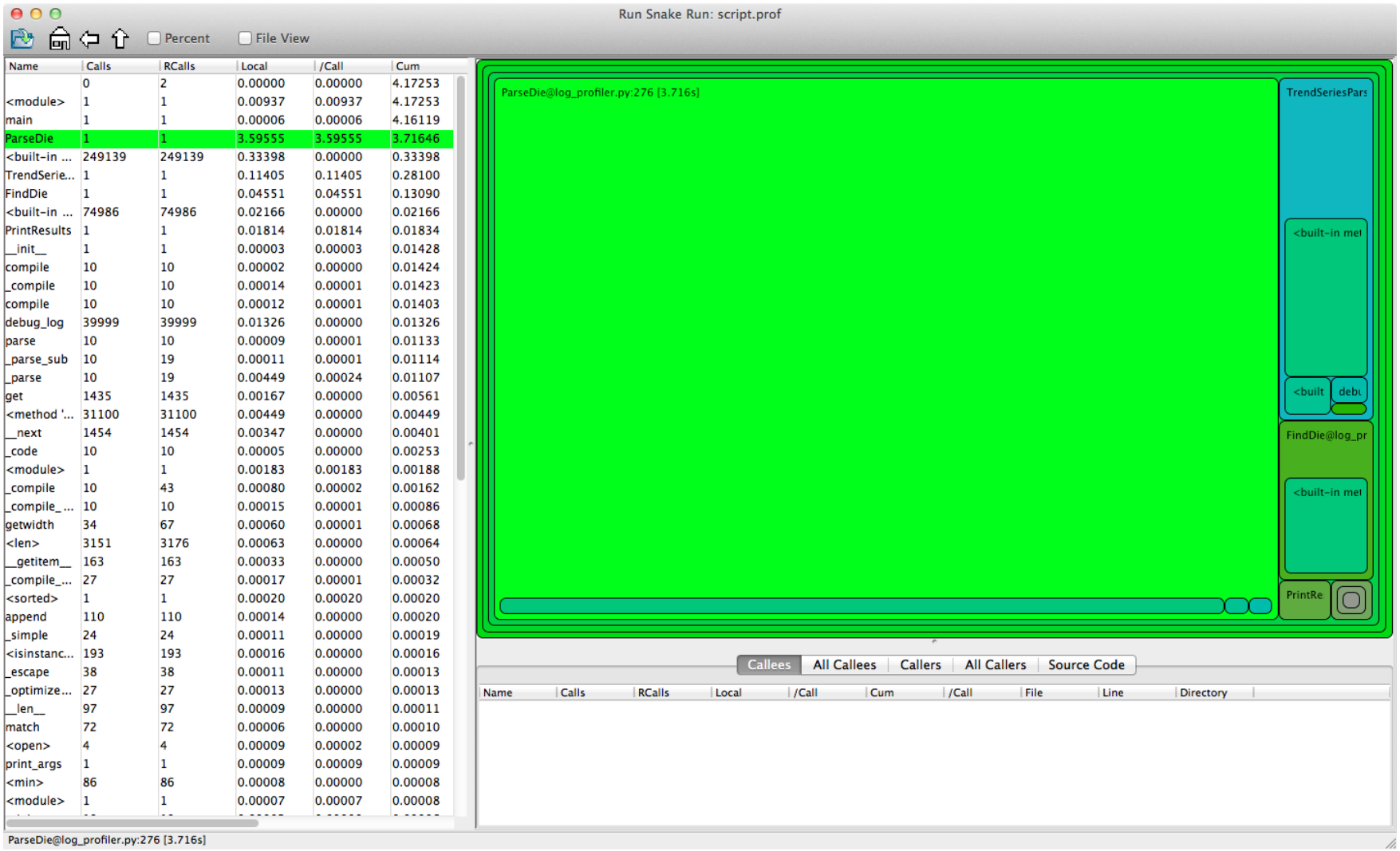
runsnakerun

- A GUI viewer for python profiles
- Shows the bigger picture
- Requires wxPython

```
$ pip install  SquareMap RunSnakeRun
```

```
$ runsnake script.prof
```

Smart Optimization



Clearly shows which parts are worth optimizing.

Profiling Decorator

- Hide the profiling in a decorator.
- Useful for profiling a single function in a module.

https://gist.github.com/1283366

Using Profiling Decorator

```
from profile_func import profile_func

@profile_func()
def ParseDie(self, inpFile, XY = None):
    if not XY:
        XY = self.DieXY
    else:
        self.DieXY = XY
....

$ ls \*.profile
ParseDie_func.profile
```

Micro Benchmarks with timeit

- *timeit* module is used to profile individual statements or blocks in the code.
- Runs the code multiple times to collect more data points.
- Resilient to OS noise.

```
>>> import timeit
>>> t = timeit.Timer('4000*234')
>>> t.timeit(1000)/1000
6.198883056640625e-08
>>> t = timeit.Timer('lcm.ver_1(2000,3000)',
    'import lcm')
>>> t.timeit(10000)/10000
2.1011111412048339 7e-06
```

Micro Benchmark

Let's say we'd like to time a http request.

```
conn = httplib.HTTPConnection('google.com')
conn.request('GET', '/')
```

We want to do it in code instead of REPL.

Micro Benchmark using Context Manager

```
with Timer() as t:
    conn = httplib.HTTPConnection('google.com')
    conn.request('GET', '/')
print('Request took %.03f sec.' % t.interval)

import timeit
class Timer:
    def __enter__(self):
        self.start = timeit.default_timer()
        return self

    def __exit__(self, *args):
        self.end = timeit.default_timer()
        self.interval = self.end - self.start
```

Acknowledgements

- Stephen Mcquay
  - Introducing runsnakerun
- Seth House
  - rst2beamer help
- Decorator Idea: `https://translate.svn.sourceforge.net/svnroot/translate/src/trunk/virtaal/devsupport/profiling.py`
- Context Manager Code: `http://code.activestate.com/recipes/577896/`

Questions?