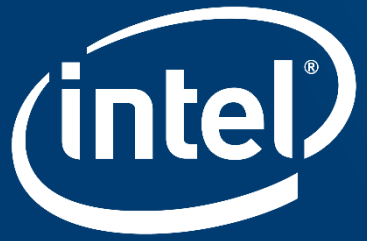

PERFORMANCE ANALYSIS OF PYTHON* APPLICATIONS WITH INTEL® VTUNE™ AMPLIFIER

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Agenda

Why do we need Python optimization?

How one finds the code to tune?

Short overview of existing tools

Intel® VTune™ Amplifier capabilities and comparison

An example

Q & A

Why do we need Python optimization?

- Python is used to power wide range of software, including those where application performance matters
- Some Python code may not scale well, but you won't know it unless you give it enough workload to chew on
- Sometimes you are just not happy with the speed of your code

All in all, there are times when you want to make your code run faster, be more responsive, *(insert your favorite buzzword here)*.

So, you need to **optimize** (or tune) your code.

How one finds the code to tune – measuring vs guessing

- **Hard stare** = Often wrong

- **Logging** = Analysis is tedious

- **Profile** = Accurate, Easy

Not All Profilers Are Equal

There are different profiling techniques, for example:

- **Event-based**
  - Example: built-in Python cProfile profiler

- **Instrumentation-based**
  - Usually requires modifying the target application (source code, compiler support, etc.)
  - Example: line_profiler

- **Statistical**
  - Accurate enough & less intrusive
  - Example: vmstat, statprof

Short profilers overview

Tool	Description	Platforms	Profile level	Avg. overhead *
Intel® VTune™ Amplifier	• Rich GUI viewer • Mixed C/C++/Python code	Windows Linux	Line	~1.1-1.6x
cProfile (built-in)	• Text interactive mode: “pstats” (built-in) • GUI viewer: RunSnakeRun (Open Source) • PyCharm	Any	Function	1.3x-5x
Python Tools	• Visual Studio (2010+) • Open Source	Windows	Function	~2x
line_profiler	• Pure Python • Open Source • Text-only viewer	Any	Line	Up to 10x or more

* Measured against Grand Unified Python Benchmark

Machine specs: HP EliteBook 850 G1; Intel® Core™ i5-4300U @1.90 Ghz (4 cores with HT on) CPU; 16 GB RAM; Windows 8.1 x86_64

Mixed C/Python example to profile: **core.pyx** (Cython-based)

```
import math
cdef class SlowpokeCore:
    cdef public object N
    def __init__(self, N):
        self.N = N

    cdef double doWork(self, int N) except *:
        cdef int i, j, k
        cdef double res
        res = 0
        for j in range(N):
            k = 0
            for i in range(N):
                k += 1
            res += k
        return math.log(res)

    def __str__(self):
        return 'SlowpokeCore: %f' % self.doWork(self.N)
```

Mixed C/Python example to profile: **main.py** (Cython-based)

```
from slowpoke import SlowpokeCore
import logging
import time

def makeParams():
    objects = tuple(SlowpokeCore(50000) for _ in xrange(50))
    template = ''.join('{%d}' % i for i in xrange(len(objects)))
    return template, objects

def doLog():
    template, objects = makeParams()
    for _ in xrange(1000):
        logging.info(template.format(*objects))

def main():
    logging.basicConfig()
    start = time.time()
    doLog()
    stop = time.time()
    print('run took: %.3f' % (stop - start))

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

cProfile + pstats UI example

```
> python -m cProfile -o run.prof main.py
> python -m pstats run.prof

run.prof% sort cumulative
run.prof% stats 10
Wed May 18 13:15:23 2016    run.prof

         6160 function calls in 3.043 seconds

   Ordered by: cumulative time
   List reduced from 40 to 10 due to restriction <10>

   ncalls  tottime  percall  cumtime  percall filename:lineno(function)
        1    0.000    0.000    3.043    3.043 <string>:1(<module>)
        1    0.000    0.000    3.043    3.043 C:\Vass\Work\pytrace_tpss\video\main.py:15(main)
        1    0.005    0.005    3.042    3.042 C:\Vass\Work\pytrace_tpss\video\main.py:10(doLog)
     1000    3.029    0.003    3.029    0.003 {method 'format' of 'str' objects}
     1000    0.004    0.000    0.008    0.000 C:\Python27\lib\logging\__init__.py:1586(info)
     1000    0.001    0.000    0.004    0.000 C:\Python27\lib\logging\__init__.py:1122(info)
     1000    0.001    0.000    0.003    0.000 C:\Python27\lib\logging\__init__.py:1324(isEnabledFor)
     1000    0.001    0.000    0.001    0.000 C:\Python27\lib\logging\__init__.py:1310(getEffectiveLevel)
     1002    0.000    0.000    0.000    0.000 {len}
        1    0.000    0.000    0.000    0.000 C:\Vass\Work\pytrace_tpss\video\main.py:5(makeParams)
```


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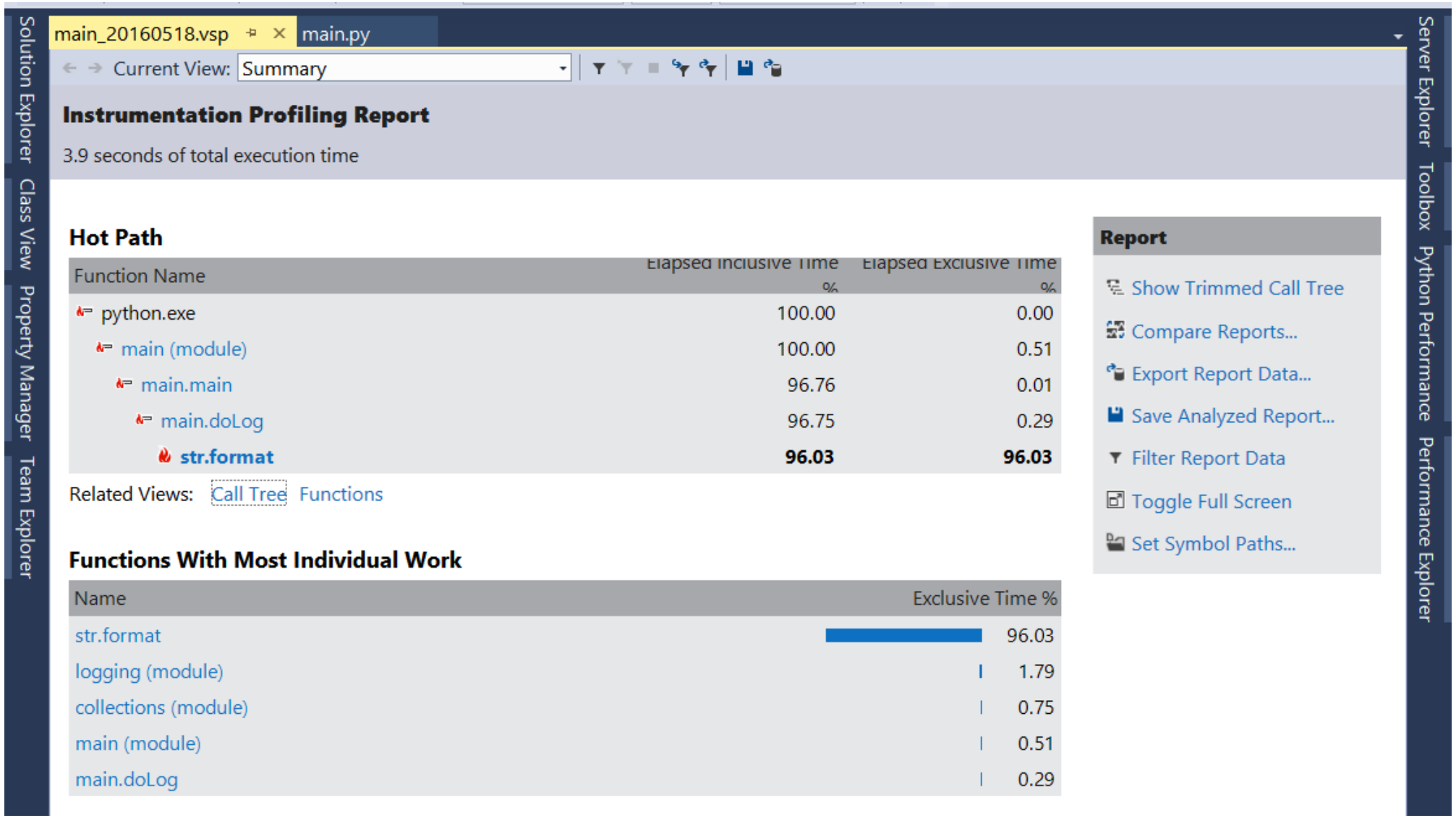
Python Tools GUI example



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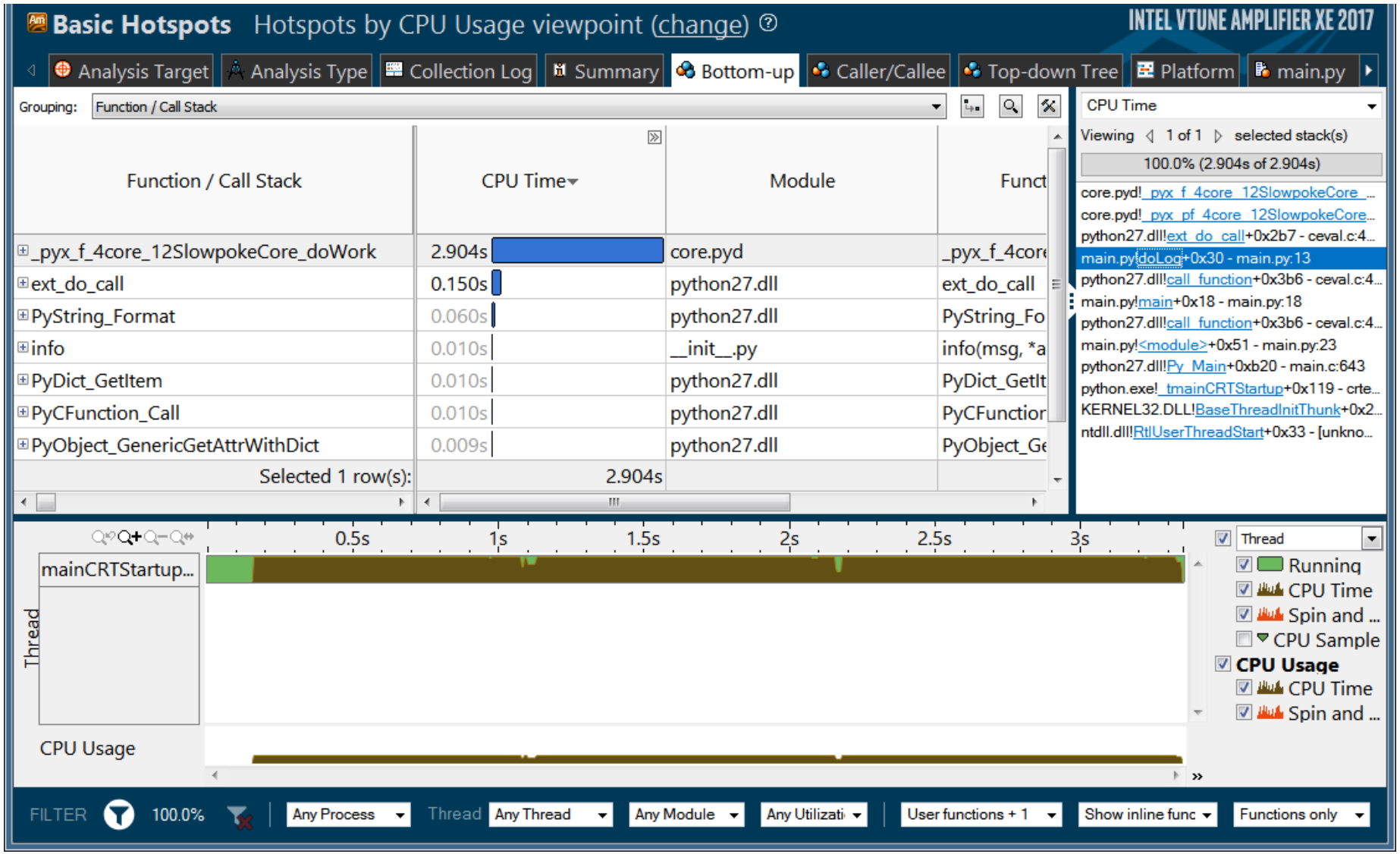
Intel® VTune™ Amplifier example



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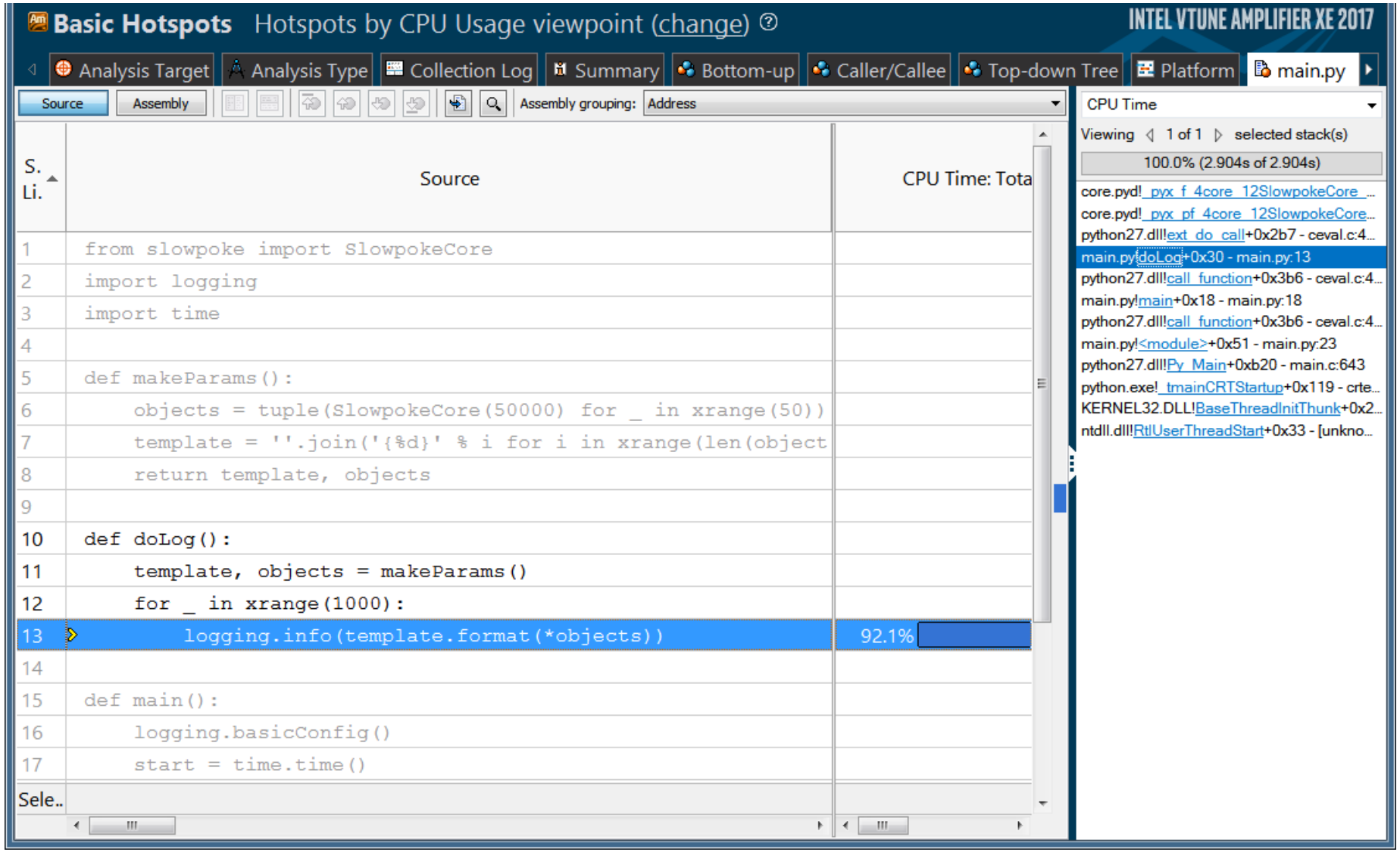
Intel® VTune™ Amplifier – source view (main.py)



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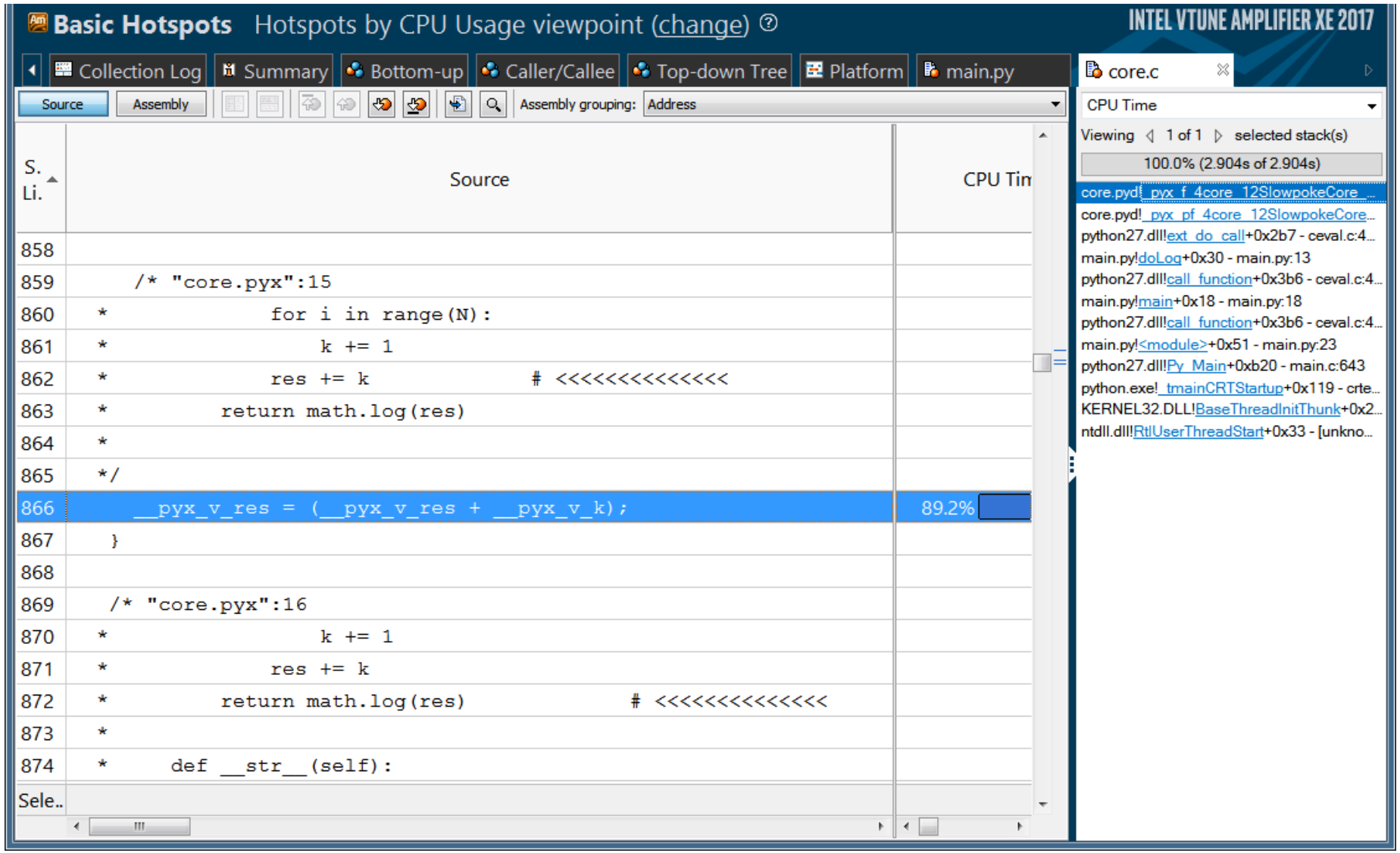
Intel® VTune™ Amplifier – source view (core.c)



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Intel® VTune™ Amplifier: Accurate & Easy

Line-level profiling details:

- Uses sampling profiling technique
- Average overhead ~1.1x-1.6x (on certain benchmarks *)

Cross-platform:

- Windows and Linux
- Python 32- and 64-bit; 2.7.x, 3.4.x, 3.5.0 versions

Rich Graphical UI

Supported workflows:

- Start application, wait for it to finish
- Attach to application, profile for a bit, detach

* Measured against Grand Unified Python Benchmark

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Resources

- Get access to Intel® VTune™ Amplifier 2017 Beta:
  - Visit https://software.intel.com/en-us/python-profiling for registration, download and support
  - Documentation available when installed
- Get Intel® Distribution for Python*:
  - Visit https://software.intel.com/en-us/python-distribution for download, documentation and support
  - Also available at Intel channel at Anaconda (you can use "`conda install`"!): https://anaconda.org/intel
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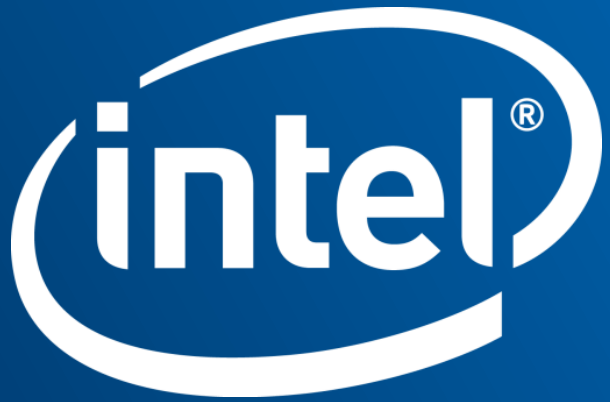
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