

# PyPy meets Python 3 and Numpy (and other What's New topics)

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EuroPython 2017

July 2017

# What's New In PyPy

1. Python 3.5
2. Numpy, Cython, Pandas, ...
3. pypy-stm?
4. RevDB: reverse debugging
5. Others...

# What is PyPy

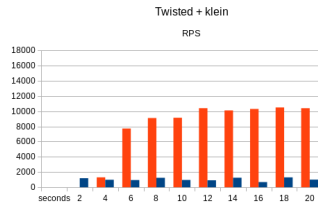
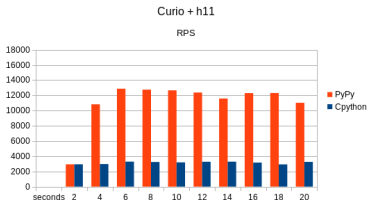
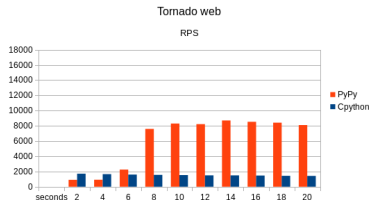
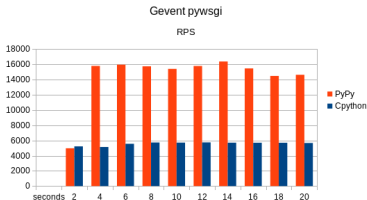
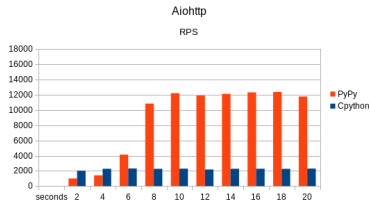
- ▶ PyPy is another implementation of Python
- ▶ Mostly, drop-in replacement
- ▶ Supports Python 2.7, and almost Python 3.5
- ▶ Comes with a JIT, good performance



# PyPy 3.5

- ▶ Python 3.5 support released in *gamma*
  - ▶ as stable (and mostly as fast) as PyPy 2.7, same JIT/GC/etc.
  - ▶ what could be wrong is a few details everywhere
  - ▶ please try it and *report issues!*
- ▶ Thanks to Mozilla for funding this work!

## ► Async HTTP benchmarks:



## PyPy 3.5 status

- ▶ Roughly complete 3.5 support (plus f-strings!)
- ▶ Reasonably good performance
- ▶ Tested mostly on Linux so far
- ▶ First "final" to be released soon (i.e. some time in 2017 I guess)
- ▶ Python 3.6 to follow

# Scientific stack



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- ▶ Numpy = the standard numpy library
- ▶ Numpypy = our own partial reimplementation

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Numpy or Numpypy?

- ▶ Numpy = the standard numpy library (*use this*)
- ▶ Numpypy = our own partial reimplementation (*deprecated*)

# Scientific stack

- ▶ Numpy works (99.9%)
- ▶ On both PyPy 2.7 and PyPy 3.5
- ▶ The rest of the scientific stack mostly works too (Jupyter, Matplotlib, Pandas, etc.)

# Cython, cpyext

- ▶ Cython mostly works
- ▶ Actually, any CPython C extension module mostly works
- ▶ Thanks to `cpyext`, our CPython C API emulation layer

# Performance?

- ▶ Numpy/Pandas/etc. are all slow-ish at the Python-C boundary
- ▶ Less so than last year but still
- ▶ Complex algorithms written inside Numpy in C or Fortran have the same speed, of course
  - ▶ lots of `ndarray[index]`: slow
  - ▶ one call to `numpy.linalg.eig()`: fast
  - ▶ speed hack: `p = ffi.cast("double *", ffi.from_buffer(ndarray))`

# Performance?

- ▶ We have plans to improve
- ▶ Funding help welcome
- ▶ For now: try it out on your own code and see

# Software Transactional Memory

# Software Transactional Memory

- ▶ `pypy-stm`: getting rid of the Global Interpreter Lock



# Software Transactional Memory

- ▶ ...unfortunately, this approach does not seem to work :-)

# Software Transactional Memory

Unstable performance:

- ▶ "Conflicts" between threads are hard to find
- ▶ Fix one conflict, usually only to uncover the next one
- ▶ As long as there is one, performance is bad
- ▶ You may fix enough to get good performance... but:
- ▶ Continue developing the program, and you'll often reintroduce conflicts
- ▶ (Also, hard to test for, reliably)

# PyPy-nogil?

- ▶ Thinking instead about a GIL-free but non-STM PyPy
- ▶ See lightning talk later

# Reverse Debugger

# Reverse Debugger

- ▶ RevDB: The essential tool you need once a year

# Reverse Debugger

- ▶ Debugger with the ability to go forward *and backward in time*
- ▶ Watchpoints to know when a value changes, while going in either direction
- ▶ <http://bitbucket.org/pypy/revdb>

# Others

# JIT improvements

- ▶ Reductions in the warm-up time
- ▶ Consumes less memory, too



# VMProf

- ▶ A good high-performance profiler for Python code
- ▶ `pip install vmprof`
- ▶ Works on CPython and on PyPy
- ▶ The PyPy version shows the machine code generated by the JIT

# CFFI improvements

- ▶ CFFI: calling C from Python or the other way around
- ▶ Works identically on CPython and on PyPy
- ▶ Biggest improvement of last year is *embedding*
- ▶ Use CFFI to embed Python inside another program---much easier than with the CPython C API, and works identically on CPython or PyPy too

Next year?

## Next year?

- ▶ Polish PyPy 3.5 / 3.6
- ▶ Polish Numpy and the scientific stack
- ▶ Play with PyPy-nogil
- ▶ Port RevDB to PyPy 3.5

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## Question & answers

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Thank you! PyPy main site: <http://pypy.org/>