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

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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

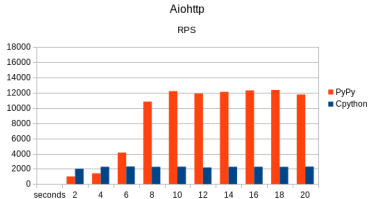
PyPy 3.5

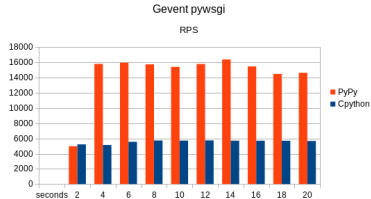
PyPy 3.5

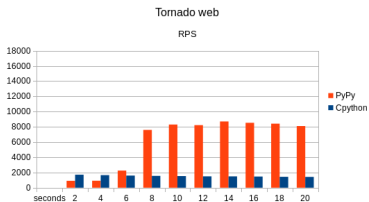
- Python 3.5 support released in *gamma*
  - as stable (and mostly as fast) as PyPy 2.7, same JIT/GC/etc.
  - what could be wrong is a few details everywhere
  - please try it and *report issues!*
- Thanks to Mozilla for funding this work!

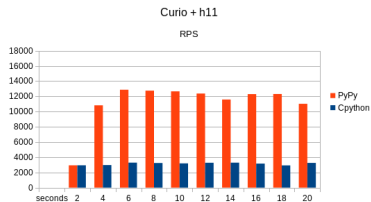
PyPy 3.5

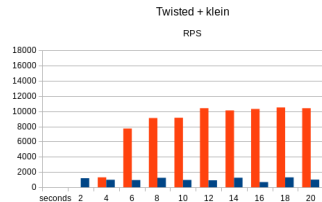
- Async HTTP benchmarks:











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 very soon
- Python 3.6 to follow

Scientific stack

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Numpy or Numpypy?

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- 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?

- Another possibility: a GIL-free but non-STM PyPy
- Large amount of work, not looking forward to do it
- Would require serious funding first

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?

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- Polish PyPy 3.5 / 3.6
- Polish Numpy and the scientific stack
- Port RevDB to PyPy 3.5
- Better memory profiling

Question & answers

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- Polish Numpy and the scientific stack
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Thank you! `http://pypy.org/`