Turning the image processing wheel *faster* with *Cython* and *Numba*.

Nathan Faggian, PhD.

PyConAU, Hobart, 2013.

Contents

- Cython? Numba?
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  - *Cython, Numba (Nathan)*
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Cython

- **www.cython.org** : “Combined power of Python and C”

- Superset of the python language that allows calls to C functions and declarations of C types, leading to efficient C code from cython code.

Numba

- **numba.pydata.org:** “Just-In-Time specializing compiler”

- A compiler for python code with minimal markup that leverages off the low level virtual machine toolchain (LLVM).

Image Segmentation

Partitioning of an image into regions of interest.

IP[y]: IPython

Interactive Computing

Cython

- Transform your python code into something more like C.
- Little understanding is required to obtain huge speed gains simply by statically typing.
- Nice integration with Numpy.

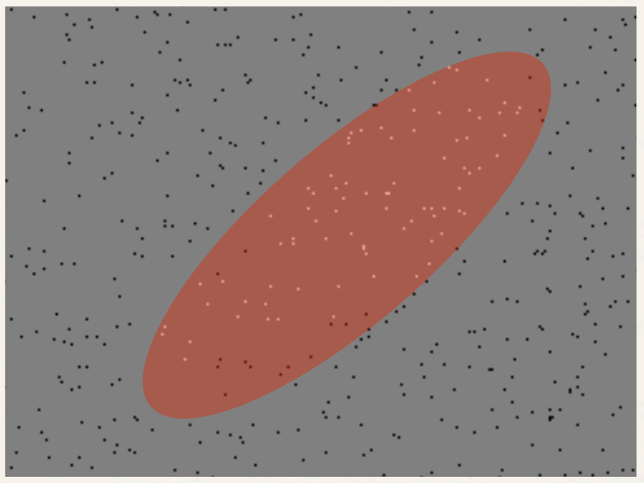
Numba

- Similar level of unfolding as Cython with less understanding required.
- Extreme simplicity, requires the LLVM toolchain to be installed.

GrowCut

V. Vezhnevets, V. Konouchine. ***"Grow-Cut" - Interactive Multi-Label N-D Image Segmentation".*** *In Proceedings of the 2005 Conference, Graphicon. Pages 150 – 156.*

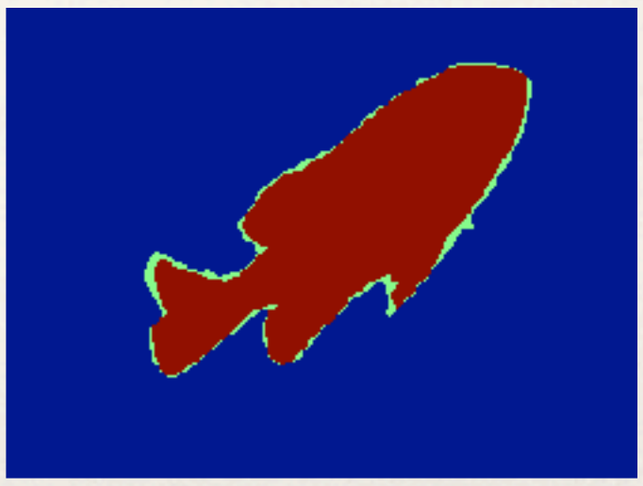
Bacteria



GrowCut

Human Segmentation

Overlap

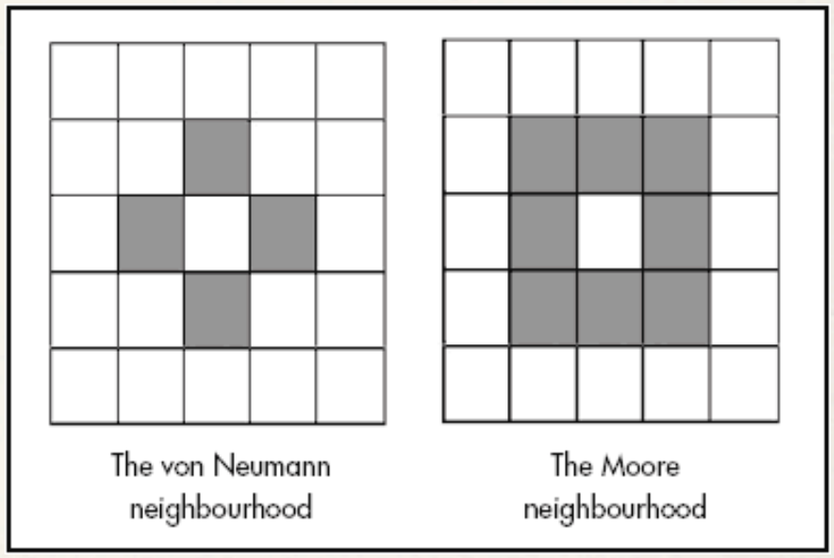


Algorithm

Code 1 Automata evolution rule

```
// For each cell...
for ∀p ∈ P
    // Copy previous state
    l_p^{t+1} = l_p^t;
    θ_p^{t+1} = θ_p^t;
    // neighbors try to attack current cell
    for ∀q ∈ N(p)
        if g(‖C⃗_p − C⃗_q‖_2) · θ_q^t > θ_p^t
            l_p^{t+1} = l_q^t
            θ_p^{t+1} = g(‖C⃗_p − C⃗_q‖_2) · θ_q^t
        end if
    end for
end for
```

kernel



$$g(x) = 1 - \frac{x}{\max \|\vec{C}\|_2};$$

IP[y]: IPython

Interactive Computing

Conclusions

- Easier than ever before to make use of tools to speed-up slow python code.
- IPython notebook is a great platform for tinkering with “cython magic”
- Speed gap between Cython and Numba is almost negligible:

  Jake Vanderplas: *http://jakevdp.github.io*

- Numba is **fantastic** but is still less mature than Cython.
  - Exponential growth in the last couple of months.
  - Success of Continuum IO and development grants.

Thanks

- **Stefan Van Der Walt**
    - Scikit-image : *http://scikit-image.org*
- **Aron Ahmadia**
    - Numba development team : *http://continuum.io/blog/numba_growcut*
- **Ed Schofield**
    - Melbourne python users group: *http://wiki.python.org/moin/MelbournePUG*

Questions?

https://github.com/nfaggian

https://github.com/stefanv 

https://github.com/ahmadia