astropy with undergrads

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Acknowledgements

My context

- Undergraduate-only department
- Up to half are astro emphasis, but almost none go to graduate school to study astro
  - 0.5/year
- Too much to do, not enough time
- Primarily evaluated on teaching

astropy + undergraduates

- code contributions
- better homework
- enthusiastic, patient beta-testers
- science

code contributions

- Start small, with code (not documentation) contribution
- Actively mentor
- Introduce concept of unit testing
- good example: github.com/walkerna22

Better homework with astropy

(notebook illustrating use of IPython widget in notebooks)

astropy + undergraduates

- **science**
  - measure timing of exoplanet transits

    Exoplanet Transit Database (http://var2.astro.cz/ETD/predictions.php)
  - look for variables in exoplanet fields

    AAVSO (http://www.aavso.org/vsx/)
  - HR diagram of open cluster
  - RR Lyrae without measured periods
  - long term study of RR Lyrae with Blazhko effect

The science needs

images with metadata (msumastro)

reduction

source extraction/instrumental mags

differential ensemble photometry

light curve modeling

   in some cases, Fourier transform

The software must:

- support Windows
- have short learning curve
- be widely used/validated and/or open source
- leave behind a record

Practical advice

- Start with a little bit of terminal practice http://cli.learncodethehardway.org/book/ (includes windows!)
- On windows, use PowerShell
- Use anaconda python distribution windows! environments! packaging!

Options

IRAF? No: Windows, learning curve

Commercial?

    GUI (good)

    $$ (bad)

    closed source/limited documentation (ugly)

One very good option

AstroImageJ

http://www.astro.louisville.edu/software/astroimagej/ and
http://www.astro.louisville.edu/software/index.html

Shout out and thanks to:

Karen Collins, U Kentucky, Louisville

- GUI (good)
- lots of features (good)

AstroImageJ (too good for one slide)

- active development (good)
- open source (good), but one dev (wow!)
- source is Java (hard (for me))
- no log (bad)
- relies on file names (error-prone)
- some features missing (sigma clipping in stacks, CR removal)

solution: <u>reducer</u>

<u>ccdproc</u> behind the scenes

IPython widget-based notebooks

- Widgets are NOT preserved in IPython2!

install: `$ pip install --pre reducer`

run: `$ reducer`

creates, in working directory: reduction.ipynb

start notebook server: `$ ipython notebook`

The science needs

images with metadata (msumastro)

reduction (reducer)

source extraction/instrumental mags

differential ensemble photometry

light curve modeling

Fourier transform of nonuniform data

Future

- reducer improvements
  - Add missing ccdproc steps
  - Use MVC
  - generate scripts
- photometry (from image and differential)
- light curve analysis

repo links

ccdproc: https://github.com/astropy/ccdproc

reducer: https://github.com/mwcraig/reducer

msumastro: https://github.com/mwcraig/msumastro