MkPy Python Tutorial

8:30 - 9:00	Coffee and Tea
9:00 - 10:15	Intro to Python I
10:15 - 10:30	Break
10:30 - 12:00	Intro to Python II
12:00 - 1:00	Lunch (provided)
1:00 - 1:45	Astropy 1
1:45 - 2:45	Plotting
2:45 - 3:00	Break
3:00 - 4:30	Astropy 2 & 3
4:30 - 5:00	Wrap Up & Advice

Times are **very** approximate

- The goal today is to give you a brief introduction to python and to show you some of the powerful tools that are available in python.

- We want to help you find useful tools to get your work done, not teach you formal programming skills.

A Brief Introduction to Git and Github

Git

- Git is a “version control system”
- Git is a tool which facilitates collaboration
    - branching and merging
    - remote repository tools

Git: Version Control

```
[trapezium] ~ > mkdir MyProject
[trapezium] ~ > cd MyProject/
[trapezium] ~/MyProject > git init
Initialized empty Git repository in /Users/joshw/MyProject/.git/
[trapezium] ~/MyProject > touch readme.txt
[trapezium] ~/MyProject > edit readme.txt
[trapezium] ~/MyProject > more readme.txt
This is my readme.txt file.
[trapezium] ~/MyProject > git add readme.txt
[trapezium] ~/MyProject > git commit -m "Initial commit.  Created a readme file for
this project."
[master (root-commit) 5946c92] Initial commit.  Created a readme file for this
project.
 1 file changed, 1 insertion(+)
 create mode 100644 readme.txt
```

Git: Version Control

```
[trapezium](master) ~/MyProject > git log
commit 5946c92a938406f4ca155a1d8375dd10043963a7
Author: Josh Walawender <jmwalawender@gmail.com>
Date:   Wed Nov 20 14:05:46 2013 -1000

    Initial commit.  Created a readme file for this project.
```

Git: Version Control

```
[trapezium](master) ~/MyProject > touch FileWhichIsImportant.txt
[trapezium](master) ~/MyProject > edit FileWhichIsImportant.txt
[trapezium](master) ~/MyProject > more FileWhichIsImportant.txt
This file contains an important part of my project.
[trapezium](master) ~/MyProject > git add FileWhichIsImportant.txt
[trapezium](master) ~/MyProject > git commit -a -m "Added FileWhichIsImportant.txt and
added important content to it."
[master a6d94ef] Added FileWhichIsImportant.txt and added important content to it.
 1 file changed, 1 insertion(+)
 create mode 100644 FileWhichIsImportant.txt
```

Git: Version Control

```
[trapezium](master) ~/MyProject > edit FileWhichIsImportant.txt
[trapezium](master) ~/MyProject > more FileWhichIsImportant.txt
This file contains an important part of my project.

This is some important information.
[trapezium](master) ~/MyProject > git commit -a -m "Added additional content."
[master bd6e5b3] Added additional content.
 1 file changed, 2 insertions(+)
```

Git: Version Control

```
[trapezium](master) ~/MyProject > git log
commit bd6e5b3190d532b0825459928bd2727e91122c05
Author: Josh Walawender <jmwalawender@gmail.com>
Date:   Thu Nov 21 10:31:05 2013 -1000

    Added additional content.

commit a6d94ef605fcdb3fac466f3c4203c2490d807855
Author: Josh Walawender <jmwalawender@gmail.com>
Date:   Wed Nov 20 14:14:11 2013 -1000

    Added FileWhichIsImportant.txt and added important content to it.

commit 5946c92a938406f4ca155a1d8375dd10043963a7
Author: Josh Walawender <jmwalawender@gmail.com>
Date:   Wed Nov 20 14:05:46 2013 -1000

    Initial commit.  Created a readme file for this project.
```

Git: Branching & Merging

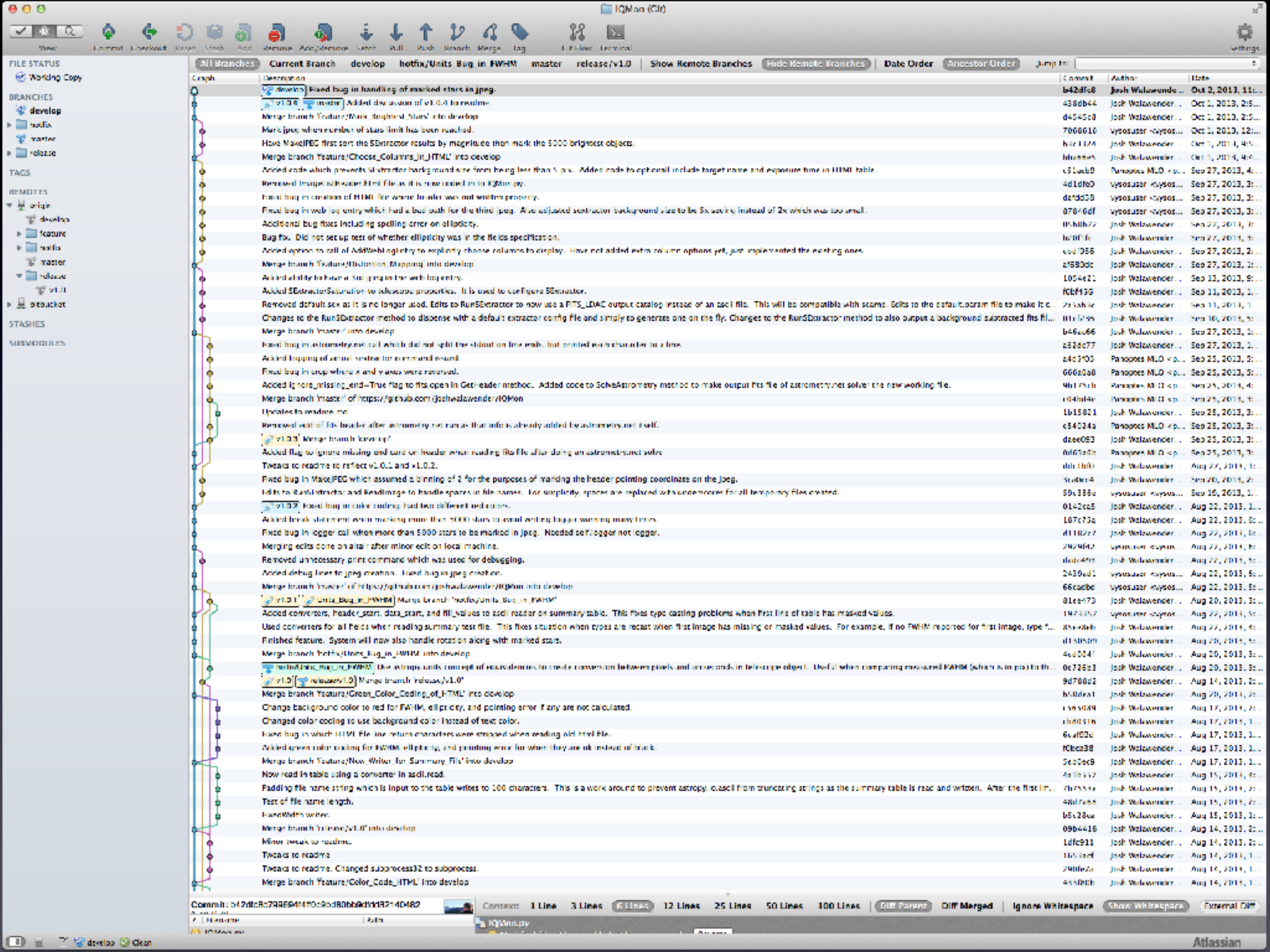
- a git repository can be “branched”
    - allows you to switch between multiple branches of a project
    - can branch a project to experiment with an idea, but always have the “master” branch to return to
- git branch

Git: Branching & Merging

```
[trapezium](master) ~/MyProject > git branch crazy_idea
[trapezium](master) ~/MyProject > git branch -v
  crazy_idea f7ea0e7 Initial commit.  Created a readme file
* master     f7ea0e7 Initial commit.  Created a readme file
[trapezium](master) ~/MyProject > git checkout crazy_idea
Switched to branch 'crazy_idea'
[trapezium](crazy_idea) ~/MyProject > edit new_file.txt
[trapezium](crazy_idea) ~/MyProject > more new_file.txt
hmmm ... I wonder if this will work.
[trapezium](crazy_idea) ~/MyProject > git add new_file.txt
[trapezium](crazy_idea) ~/MyProject > git commit -m ‘Just playing around.’
[crazy_idea 5b64b33] Just playing around.
 1 file changed, 1 insertion(+)
 create mode 100644 new_file.txt
[trapezium](crazy_idea) ~/MyProject > git checkout master
[trapezium](master) ~/MyProject > git branch -v
  crazy_idea 5b64b33 Just playing around.
* master     f7ea0e7 Initial commit.  Created a readme file
```

Git: Branching & Merging

- a branch can be merged back in to another branch
- If your crazy idea works out, you can merge back in to master.
    - Very easy if master has not changed in the meantime
    - Still possible (though more complex) if master has changed. This is the utility of git for collaboration.


IQMon (Git)
FILE STATUS
Working Copy
BRANCHES
develop
hotfix
master
release
TAGS
REMOTES
origin
bitbucket
STASHES
All Branches
Current Branch
develop
hotfix/Units Bug in FWHM
master
release/v1.0
Show Remote Branches
Hide Remote Branches
Date Order
Ancestor Order
Graph
Description
Commit
Author
Date
develop Fixed bug in handling of marked stars in jpeg.
Merge branch 'feature/Mark_Brightest_Stars' into develop
Merge branch 'feature/Choose_Columns_in_HTML' into develop
Accidental bug fixes including spelling error on ellipticity.
Bug fix. Did not set up test of whether ellipticity was in the fields specification.
Added SExtractorSaturation to telescope properties. It is used to configure SExtractor.
Merging edits done on altair after minor edit on local machine.
Removed unnecessary print command which was used for debugging.
Finished feature. System will now also handle rotation along with marked stars.
Merge branch 'feature/Green_Color_Coding_of_HTML' into develop
Change background color to red for FWHM, ellipticity, and pointing error if any are not calculated.
Changed color coding to use background color instead of text color.
Merge branch 'feature/New_Writer_for_Summary_File' into develop
Now read in table using a converter in ascii.read.
Test of file name length.
Minor tweaks to readme.
Tweaks to readme
Tweaks to readme. Changed subprocess32 to subprocess.
Merge branch 'feature/Color_Code_HTML' into develop
b42dfc8
438db44
d4545c8
7068616
c31ae69
4d1dfe0
daddd38
8784ddf
1054e21
fcbf156
b46ac66
a52dc77
666a0a8
1b15821
daee093
0142ca5
107c75a
66cadbe
81ee473
0c726e3
9d788d2
fcbca38
5e00ec9
b5c28aa
09b4416
1dfe911
Josh Walawender
vysosuser
Panoptes MLO
Oct 2, 2013, 11:...
Oct 1, 2013, 2:5...
Sep 27, 2013
Sep 25, 2013
Aug 22, 2013
Aug 20, 2013
Aug 17, 2013
Aug 15, 2013
Aug 14, 2013
Context:
1 Line
3 Lines
6 Lines
12 Lines
25 Lines
50 Lines
100 Lines
Diff Parent
Diff Merged
Ignore Whitespace
Show Whitespace
External Diff
develop
Clean
Atlassian

Git: Collaboration

- git handles decentralized remote repositories
    - you can clone a repository from another source (i.e. another machine on the network)
    - you can then make edits (commits) and push your changes (commits) to the remote repository or pull someone else's changes (commits) to your machine

Why Is This Important?

- I can start working on a project (code or scientific paper) others can see what I'm doing and keep up by using git pull.

- No more emailing versions of files around with increasingly complex names:

A STORY TOLD IN FILE NAMES:

Location: C:\user\research\data

Filename	Date Modified	Size	Type
data_2010.05.28_test.dat	3:37 PM 5/28/2010	420 KB	DAT file
data_2010.05.28_re-test.dat	4:29 PM 5/28/2010	421 KB	DAT file
data_2010.05.28_re-re-test.dat	5:43 PM 5/28/2010	420 KB	DAT file
data_2010.05.28_calibrate.dat	7:17 PM 5/28/2010	1,256 KB	DAT file
data_2010.05.28_huh??.dat	7:20 PM 5/28/2010	30 KB	DAT file
data_2010.05.28_WTF.dat	9:58 PM 5/28/2010	30 KB	DAT file
data_2010.05.29_aaarrrgh.dat	12:37 AM 5/29/2010	30 KB	DAT file
data_2010.05.29_#$@*&!!.dat	2:40 AM 5/29/2010	0 KB	DAT file
data_2010.05.29_crap.dat	3:22 AM 5/29/2010	437 KB	DAT file
data_2010.05.29_notbad.dat	4:16 AM 5/29/2010	670 KB	DAT file
data_2010.05.29_woohoo!!.dat	4:47 AM 5/29/2010	1,349 KB	DAT file
data_2010.05.29_USETHISONE.dat	5:08 AM 5/29/2010	2,894 KB	DAT file
analysis_graphs.xls	7:13 AM 5/29/2010	455 KB	XLS file
ThesisOutline!.doc	7:26 AM 5/29/2010	38 KB	DOC file
Notes_Meeting_with_ProfSmith.txt	11:38 AM 5/29/2010	1,673 KB	TXT file
JUNK...	2:45 PM 5/29/2010		Folder
data_2010.05.30_startingover.dat	8:37 AM 5/30/2010	420 KB	DAT file

Type: Ph.D Thesis Modified: too many times

Copyright: Jorge Cham

www.phdcomics.com

Why Is This Important?

- Others can make changes and make a “pull request”. You then “merge” their edits in to your code (if you want to).

- Git (especially combined with GitHub) is a powerful sharing and collaboration tool

Github.com

- github.com is a hosting service for git repositories
- repositories hosted on github are public: anyone can clone, you control who can edit
- private repositories on github cost money
- other hosting services (i.e. bitbucket.org) are the opposite (private = free, public = paid)

https://github.com/astropy/astropy

Now use git to get today's material

In a terminal on your machine type:

```
git clone https://github.com/MkPy/python-tutorial.git
```

Now you have a directory called python-tutorial.

If you had already cloned that yesterday, you should cd in to that directory and pull the very latest version by typing:

```
git pull
```

Python

How to Run Python Code

- From the command line: `python mycode.py`
- Type lines of code in an interpreter
    - python

ipython

- Great for exploration and testing (use this instead of the python interpreter)
- Code highlighting
- Tab completion
- Help: `numpy.mean?`
- Special functions: `%paste, %timeit`

Jupyter Notebooks

- Web based (run locally) interactive python sessions with markup and inline graphics.
- Great for exploration and testing
- Great for documentation and teaching
- And since notebooks are good for teaching …

Other Topics

Other Topics

- Things we couldn't cover, but you should look at:
- Other python concepts
    - OrderedDict
    - Building your own Exceptions
    - Testing (e.g. pytest)

Other Topics

- Things we couldn't cover, but you should look at:
- Other astropy packages
  - astropy.modeling (models and fitting)
  - astropy.stats (statistics)
  - astropy.cosmology (cosmology calculations)
  - astropy.convolution (convolution & filtering)

Other Topics

- Things we couldn't cover, but you should look at:
- Astropy affiliated packages
    - astroquery (query online databases)
    - astroplan (planning observations)
    - ccdproc (CCD reductions)
    - ginga (FITS display)
    - photutils (photometry)
    - specutils (spectroscopy)

Advice

This is my soap box,
your mileage may vary :)

Text Editors

- Don’t use ancient editors like vi or emacs (both originally written in 1976) unless you have a particular reason to do so (i.e. you’re already a ninja).
    - Yes, they are over 40 years old.
- Try out modern editors such as: TextWrangler (free), BBEdit ($), Sublime ($), or Atom (free)
- Some people prefer to use integrated development environments (IDEs)
    - I use Coda on iOS

Text Editors

- Most editors have a way to open up a remote file using SFTP, so when you ssh to a remote machine you don't have to use whatever crappy editor is on there.
- My workflow is almost always BBEdit + a terminal (remote or local)
- Also most editors have a feature which will do syntax highlighting to make it easier to read code.

CSU_initializer.py

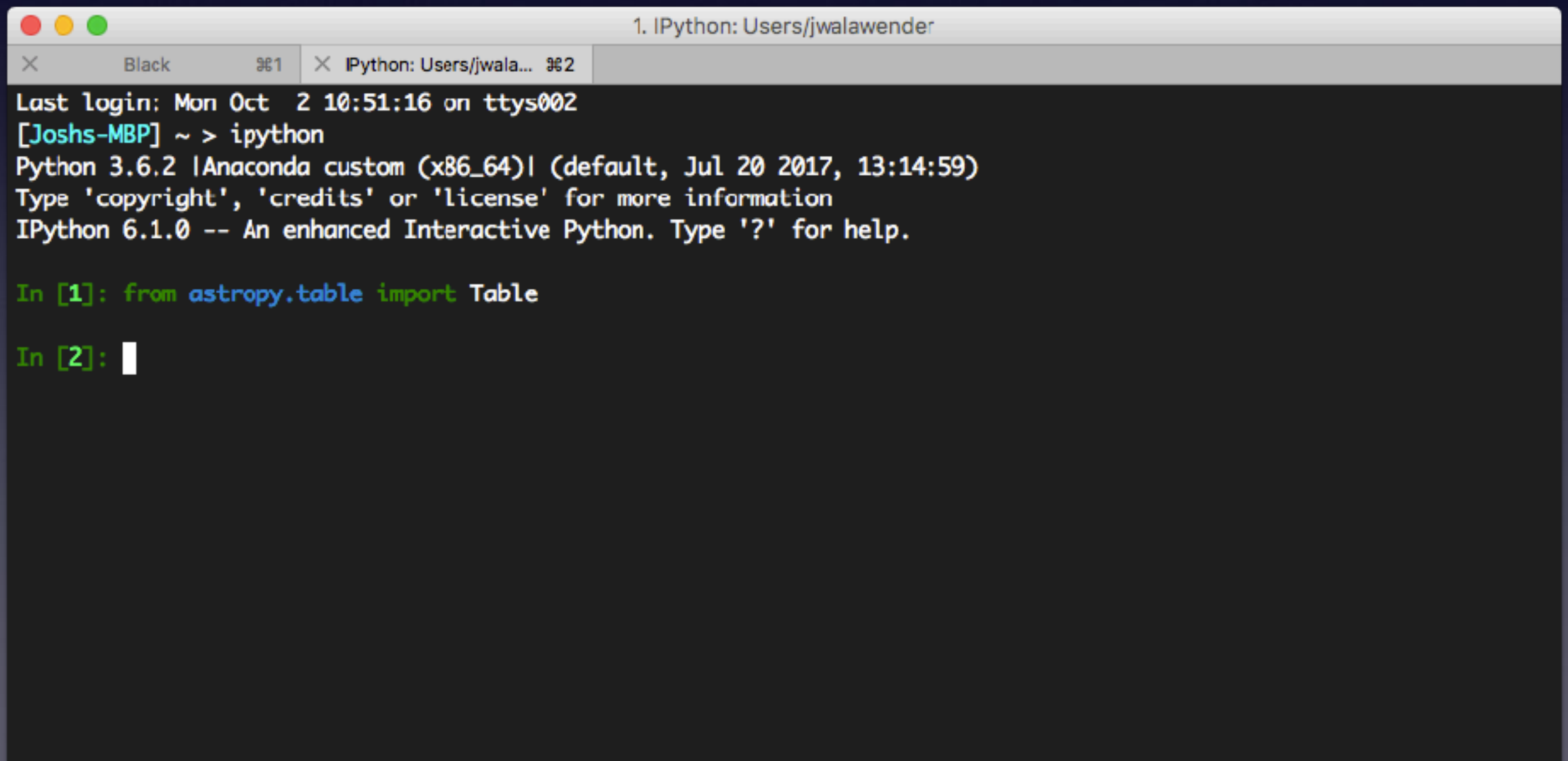
~/git/ginga-plugins/plugins/CSU_initializer.py — move_bar_to_open

```
10
11  from ginga import GingaPlugin
12  from ginga.gw import Widgets
13
14  # import any other modules you want here--it's a python world!
15  import os
16  from datetime import datetime as dt
17  import numpy as np
18  from ginga import GingaPlugin, RGBImage, colors
19  from ginga.gw import Widgets
20  from ginga.misc import ParamSet, Bunch
21  from ginga.util import dp
22  from ginga.gw.GwHelp import FileSelection
23  from astropy.io import fits
24  from astropy.modeling import models, fitting
25  from scipy import ndimage
26  import socket
27
28  class CSU_initializer(GingaPlugin.LocalPlugin):
29
30      def __init__(self, fv, fitsimage):
31          """
32          This method is called when the plugin is loaded for the  first
33          time.  ``fv`` is a reference to the Ginga (reference viewer) shell
34          and ``fitsimage`` is a reference to the specific ImageViewCanvas
35          object associated with the channel on which the plugin is being
36          invoked.
37          You need to call the superclass initializer and then do any local
38          initialization.
39          """
40          super(CSU_initializer, self).__init__(fv, fitsimage)
41
42          # Load plugin preferences
43          prefs = self.fv.get_preferences()
44          self.settings = prefs.createCategory('plugin_CSU_initializer')
```

L: 724 C: 9 — Python — Unicode (UTF-8) — Unix (LF) — Saved: 7/6/17, 10:24:29 PM — 16 / 1 / 0 — 100%

The Terminal

- You don’t have to use a standard terminal either. On macOS, I use iTerm2



Git Can be Confusing

- There are third party solution for that too!
- Check out SourceTree (free) or Git Tower ($)

MkPy – Working Copy (master – 1 Changed Files)

Open | Fetch | Pull | Push | Apply Stash | Save Stash | Merge | Rebase | Git-Flow | Refresh | Search

Repositories > MkPy (master) | Clone

Workspace
- Working Copy 1
- History
- Stashes
- Settings

Branches
- master HEAD

Tags

Remotes
- upstream
  - master

Submodules

Remote Activity

master > upstream/master

Commit Subject

Stage All | Commit

Status	Filename
N	...y 2 - Units & Coordinates.ipynb

Astropy 2 - Units & Coordinates.ipynb — Staged | Unstaged

13 chunks, 124 insertions, 74 deletions

@@ -1,37 +1,14 @@ — Discard Chunk | Stage Chunk

```
 1  1  {
 2  2   "cells": [
 3  3    {
 4  4     "cell_type": "markdown",
 5  5     "metadata": {},
 6  6     "source": [
-7        "# Astropy\n",
-8        "\n",
         "\"The Astropy Project is a community effort to develop a single core package for
-9       Astronomy\"\n",
-10       "\n",
-11       "Astropy includes many different tools which may be of use to you including (but not
         limited to):\n",
-12       "* units and constants\n",
-13       "* time\n",
-14       "* tables\n",
-15       "* coordinates\n",
-16       "* FITS files and WCS\n",
-17       "* models and fitting\n",
-18       "\n",
         "In addition Astropy includes the concept of affiliated packages:  \"An affiliated
         package is an astronomy-related Python package that is not part of the astropy core
         package, but has requested to be included as part of the Astropy project's community.\"
-19       Some highlights include:\n",
-20       "\n",
-21       "* ginga FITS viewer\n",
-22       "* montage image mosaicing engine\n",
-23       "* APLpy (Astronomical Plotting Library in Python)"
-24      ]
-25     },
-26     {
-27      "cell_type": "markdown",
-28      "metadata": {},
-29      "source": [
-30       "# Units"
+7        "# Astropy Units"
```

Don’t Struggle

- If some common task seems annoying, there’s a good chance someone else thinks so too and has a fix.

- Good tools make you more efficient. It is worth a bit of time (& money) to find good workflow tools.

Don’t Struggle

- Take advantage of online training tools.
- www.CodeFights.com is an online coding “arcade” with practice programming problems.

Don’t Struggle

- Take advantage of online training tools.
- For example: some conferences post videos
  - SciPy is a scientific python (SciPy, get it?) conference held every year.
  - It consists of multiple half day tutorial sessions (which are posted to YouTube) and talks (which are also posted to YouTube).

"SCRIPT ALL THE THINGS!"

–James Reed
(at SciPy 2017 Lightning Talks)
https://youtu.be/Ujc1TmzzORg?t=5m30s