

Python DeCal

Week 7

Announcements

- Final Projects
 - Thank you for completing the quiz and we will be assigning groups by Wednesday.
 - Let us know ASAP if you changed your mind.
 - Final Project Proposal due: **March 15th**
- Attendance: <https://forms.gle/z2YzpH7zccen4FVm7>

Recap

- What is the difference between `import scipy.integrate as integrate` and `from scipy.integrate import ...`
- What do you do when you are stuck with debugging or having a problem/question while coding?

Library for Astronomers: ASTROPY!

- A library designed to make astronomy research easier .
- Lots of packages within:

```
import astropy.blah_blah as ...
```

```
from astropy.blah_blah import ...
```

- You may have to install it by running `pip install astropy` in terminal



astropy

A Community Python Library for Astronomy

Units with Astropy!

```
import astropy.units as u
```

- You can assign units to variables and astropy will just keep track of them.

```
- E.g. >>> length1 = 1*u.m  
  
      >>> length2 = 2*u.cm  
  
      >>> L = length1 + length2  
  
      >>> L
```

```
<Quantity 1.02m>
```

<https://docs.astropy.org/en/stable/units/>

earthMass	Earth mass	5.9721679×10^{24} kg	M_earth , Mearth	No
earthRad	Earth radius	6378100 m	R_earth , Rearth	No
electron	Number of electrons			No
jupiterMass	Jupiter mass	1.8981246×10^{27} kg	M_jup , Mjup , M_jupiter , Mjupiter	No
jupiterRad	Jupiter radius	71492000 m	R_jup , Rjup , R_jupiter , Rjupiter	No
Jy	Jansky: spectral flux density	$1 \times 10^{-26} \frac{\text{W}}{\text{Hz m}^2}$	Jansky , jansky	Yes
littleh	Reduced/"dimensionless" Hubble constant			No
lyr	Light year	9.4607305×10^{15} m	lightyear	Yes
M_e	Electron mass	$9.1093837 \times 10^{-31}$ kg		No
M_p	Proton mass	$1.6726219 \times 10^{-27}$ kg		No
pc	parsec: approximately 3.26 light-years.	3.0856776×10^{16} m	parsec	Yes
ph	photon (ph)		photon	Yes
pix	pixel (pix)		pixel	Yes
R	Rayleigh: photon flux	$7.9577472 \times 10^8 \frac{\text{ph}}{\text{s sr m}^2}$	Rayleigh , rayleigh	Yes
Ry	Rydberg: Energy of a photon whose wavenumber is the Rydberg constant	13.605693 eV	rydberg	Yes
solLum	Solar luminance	3.828×10^{26} W	L_sun , Lsun	No
solMass	Solar mass	1.9884099×10^{30} kg	M_sun , Msun	No
solRad	Solar radius	6.957×10^8 m	R_sun , Rsun	No

Units with Astropy!

- You may also assign units to an entire numpy array

```
arr = np.array([1,2,3])*u.m
```

- You can get extract the magnitudes by doing

```
arr.value
```

- You can do unit conversion by doing

```
arr.to(u.nm)
```



New units

<https://docs.astropy.org/en/stable/units/>

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Fundamental Constants with Astropy!

```
import astropy.constants as con
```

$$G = 6.67430(15) \times 10^{-11} \text{ m}^3 \cdot \text{kg}^{-1} \cdot \text{s}^{-2}$$

$$\sigma = 5.670\,374\,419\dots \times 10^{-8} \text{ W} \cdot \text{m}^{-2} \cdot \text{K}^{-4}$$

- They come with units!!!!

- E.g.

```
>>> G = con.G
```

```
>>> c = con.c
```

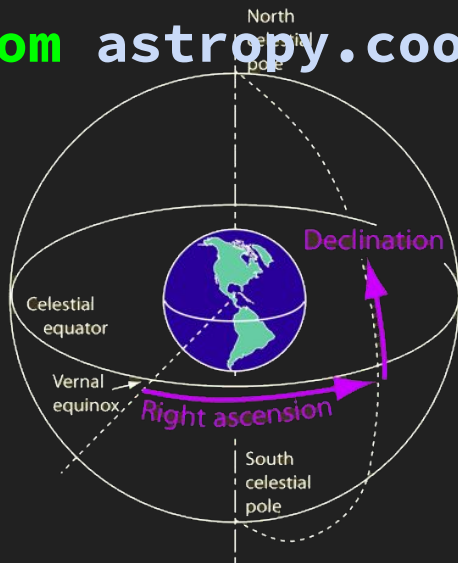
```
>>> sigma = con.sigma_sb
```

<https://docs.astropy.org/en/stable/constants/>

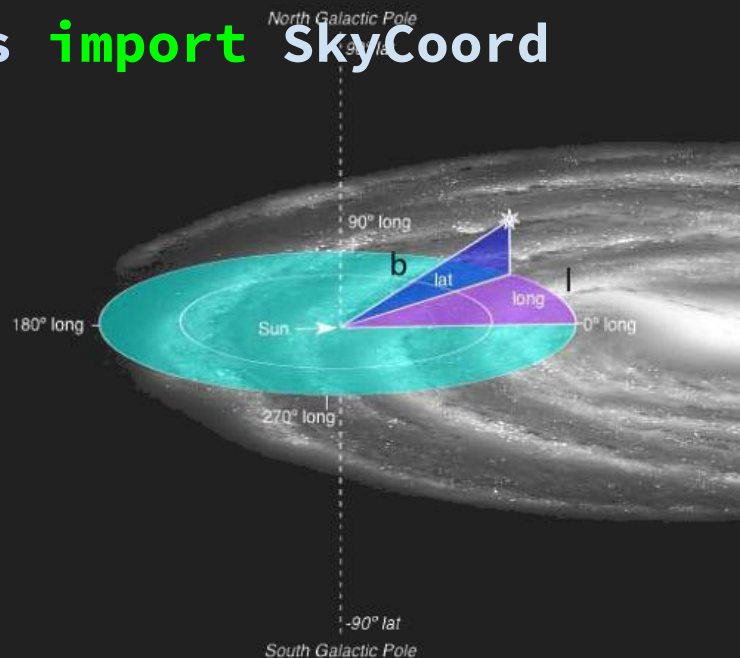
Name	Value	Unit	Description
G	6.6743e-11	m ³ / (kg s ²)	Gravitational constant
N_A	6.02214076e+23	1 / (mol)	Avogadro's number
R	8.31446262	J / (K mol)	Gas constant
Ryd	10973731.6	1 / (m)	Rydberg constant
a0	5.29177211e-11	m	Bohr radius
alpha	0.00729735257		Fine-structure constant
atm	101325	Pa	Standard atmosphere
b_wien	0.00289777196	m K	Wien wavelength displacement law constant
c	299792458	m / (s)	Speed of light in vacuum
e	1.60217663e-19	C	Electron charge
eps0	8.85418781e-12	F/m	Vacuum electric permittivity
g0	9.80665	m / s ²	Standard acceleration of gravity
h	6.62607015e-34	J s	Planck constant
hbar	1.05457182e-34	J s	Reduced Planck constant
k_B	1.380649e-23	J / (K)	Boltzmann constant
m_e	9.1093837e-31	kg	Electron mass
m_n	1.6749275e-27	kg	Neutron mass
m_p	1.67262192e-27	kg	Proton mass
mu0	1.25663706e-06	N/A ²	Vacuum magnetic permeability
muB	9.27401008e-24	J/T	Bohr magneton
sigma_T	6.65245873e-29	m ²	Thomson scattering cross-section
sigma_sb	5.67037442e-08	W / (K ⁴ m ²)	Stefan-Boltzmann constant

Coordinate Transformation!

from astropy.coordinates **import** SkyCoord



ICRS (RA-DEC)
International Celestial
Reference System



Galactic Coordinates (l-b)

Coordinate Transformation!

```
from astropy.coordinates import SkyCoord
```

```
icrs = SkyCoord(ra, dec, distance)
```

Call each component by doing:

```
icrs.ra, icrs.dec, icrs.distance
```

You have to include units here:

Coordinate Transformation

```
ra = RA_arr*u.deg
```

```
gal = icrs.transform_to('Galactic')
```

<https://docs.astropy.org/en/stable/coordinates/>

<https://docs.astropy.org/en/stable/api/astropy.coordinates.SkyCoord.html>

Astropy Tables...

```
from astropy.table import Table
```

```
data = Table.read(your_file_or_array)
```

Call a column (columns acts like arrays):

```
data[ 'column_header' ]
```

Call the n-th row:

```
data[n]
```

```
data[m:n]
```

idx	a	b	c	d
				m / s
0	1	2.0	x	10.0
1	4	5.0	y	20.0
2	5	8.5	z	30.0

Wednesday



Attendance: <https://forms.gle/2v4CUSsTQRvHo4kSA>

Announcements

Final Projects!

Groups	Unknowns
Rav Kaur & Michaelangelo Dominguez	Ish Malik
Megan Joseph	Alondra Martinez Najera
Raselle Chetwynd	Melissa Gross
Carlin Will & Asher Welsh	
Faby Hernandez Martinez & Derek Kaplan	

Attendance Poll: <https://forms.gle/2v4CUSsTORvHo4kSA>

Announcements

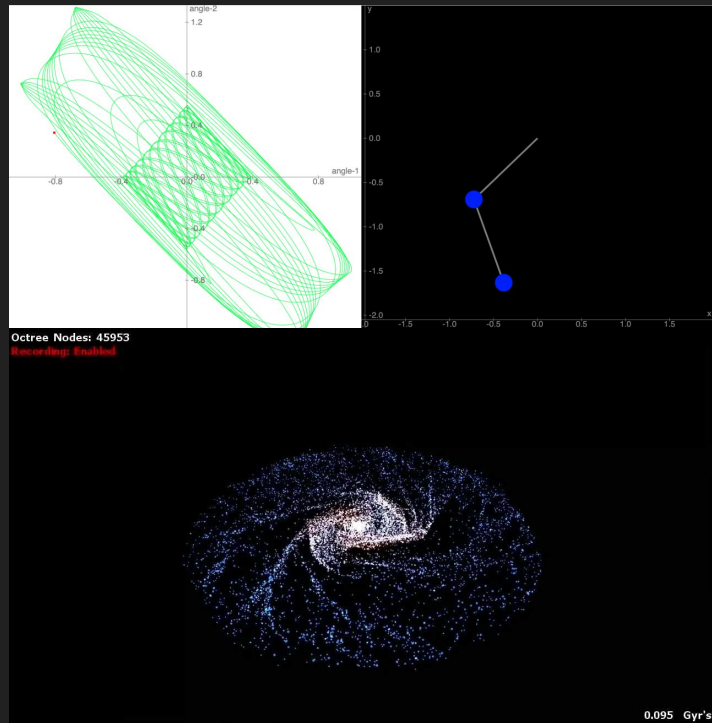
- HW 5 Just due
- HW 6 will be pushed back to next FRIDAY(March 19th)
- Your project proposal will ALSO be pushed back to next Wednesday (March 17th)

Attendance Poll: <https://forms.gle/2v4CUSsTORvHo4kSA>

Final Projects

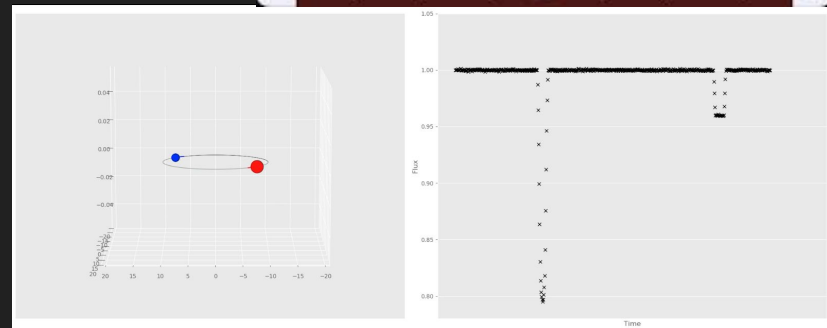
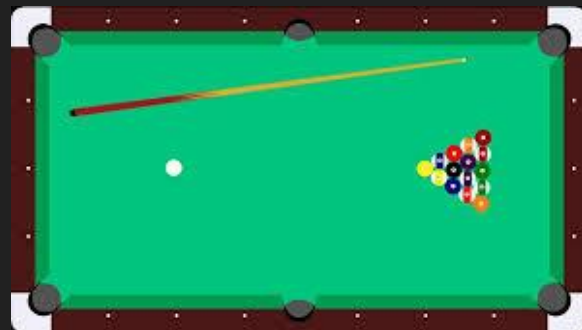
- You need to do the final project to pass this class! (If you're **auditing** don't worry but we still recommend doing a project)
- Here are some potential ideas for inspiration:
 - N - Body Simulations
 - Collision Simulations (pool game?)
 - Analyze some astronomical object(s) (make a lightcurve for a supernova?)
 - Construct an HR Diagram with GAIA data, and analyze it
 - Plot the trajectory of a pendulum (or double pendulum?)
 - Simulate Transit Method between exoplanets and stars
 - Ask us for more ideas if you want another type of project!
 - Animate some fractals

Cool Stuff



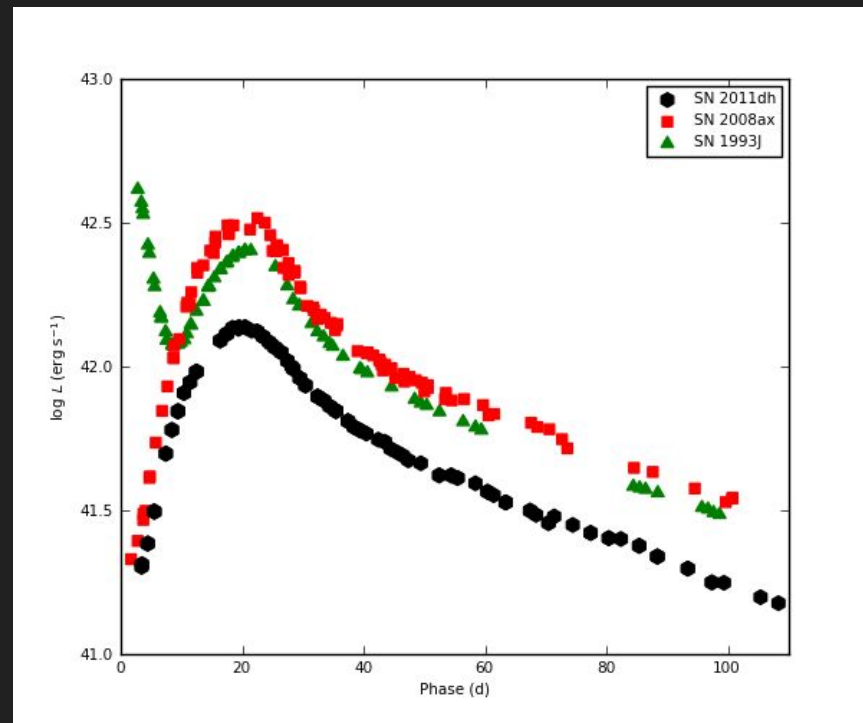
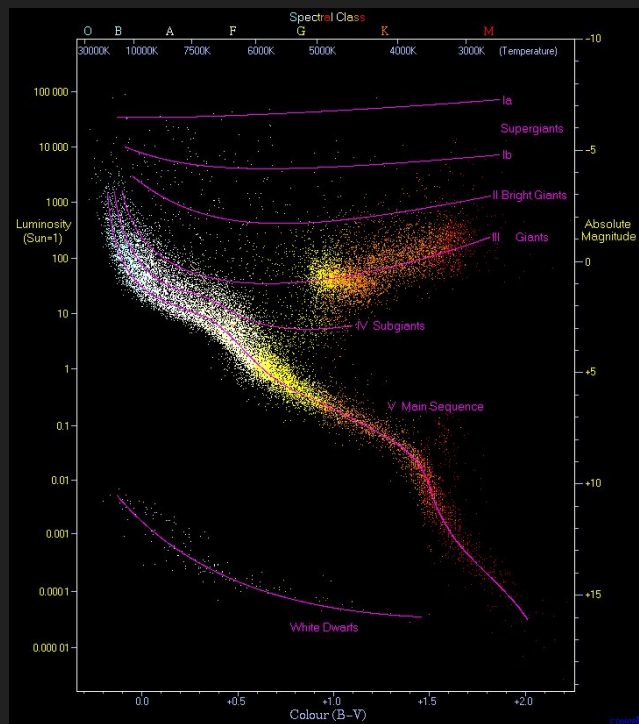
Some really cool stuff!!!

We encourage you to do some cool stuff too :)

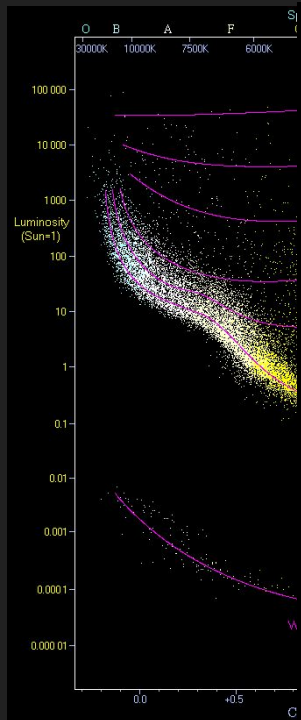


Simulation produced by
Elliot Cantor in EPS 109

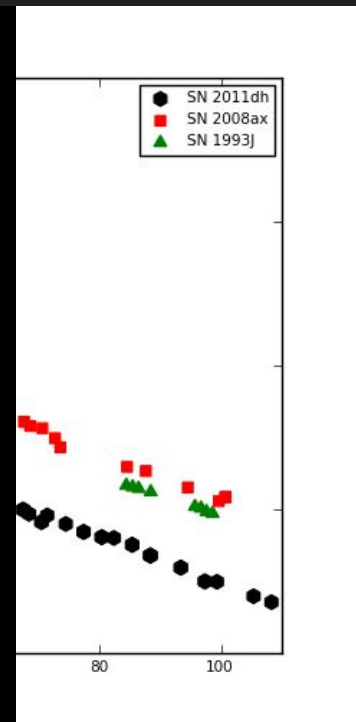
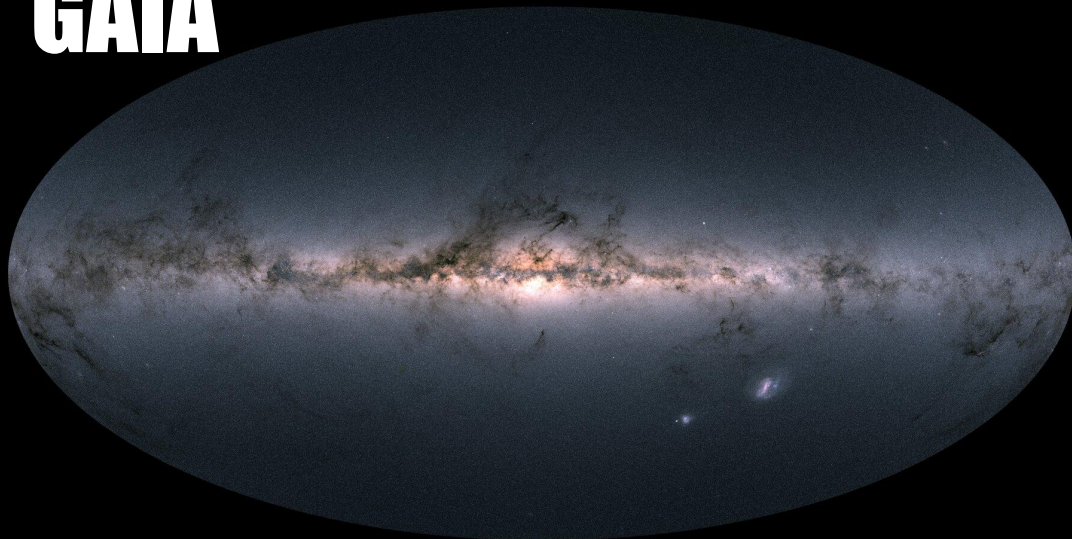
More Cool Stuff



More Cool Stuff



GAIA



Final Project Proposal

- Needs to be in LaTeX
(we will teach you how today)
- DUE March 17th



Final Project Proposal

It Needs:

- Title
- Introduction + Objective
- Proposed Methods (how will you try to simulate a solar system?)
- Expected Outcome/Deliverable
- References

We want roughly 2 pages

Breakout Rooms

- If your partner is here discuss what y'all would be interested in doing!
 - If they aren't here send them an email and start discussing what y'all want to do.
-
- If time permits, what is the 3 Most important features of the Astropy Library discussed on Wednesday?

What is the tool we use for Scientific Writing?

- L^AT_EX
 - Typesetting system
 - Code-like, but definitely easier than Python
 - You don't see the output while you are writing it

-  Overleaf
 - Online LaTeX editor
 - Easy for collaborative work
 - www.overleaf.com

Useful Packages and links

- Packages

- amsmath
- amssymb
- physics
- enumitem
- GOOGLE AS
YOU NEED
MORE!

Links

- <https://www.overleaf.com/learn>
 - Overleaf documentation
- <http://detexify.kirelabs.org/classify.html>
 - Searching for command by drawing the symbols
- www.google.com
 - We all know what this is for
- <https://texnique.xyz/>
 - If you are bored and want practice in LaTeX

Overleaf Demo

What is a CV

- Curriculum Vitae (CV) is an academic resume
- Can be more than 1 page
- A bit more focused than a standard resume
- Focused primarily on college experience
- A good CV contains
 - GPA
 - Research Interests
 - Research Experiences (this is probably nothing yet)
 - Relevant coursework/programs you've done (Python DeCal Final Project is an awesome example)
 - Skills: PYTHON, LaTeX, Unix (terminal),
 - Outreach/Teaching (probably nothing yet)

CV Examples

CV Writing Workshop

- We will go into breakout rooms. Each instructor will be there for assistance on how to use overleaf.
- We want you to find a nice CV template on Overleaf and start filling it in for yourself.
- Don't worry if you get stuck, or feel like there is nothing you can put on it yet. That's okay, ask us and we can help you brainstorm.