# Python for Astronomy

ASTR 302

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# Today

- Why Python for Astronomers?
- Administrivia
- Getting set up (JupyterHub & Slack)

# About Me

- Mario Juric (mar-ee-oh you-rich)
  - Astronomy Prof & DiRAC Institute Director
  - Office: C320, mjuric@astro.washington.edu
- What I do:
  - Rubin Observatory / LSST
  - Astronomical algorithms and software research
  - Science derived from large surveys: Understanding the Solar System, Milky Way Structure

Artist's impression: 👇

Learns by trial and error: 👈

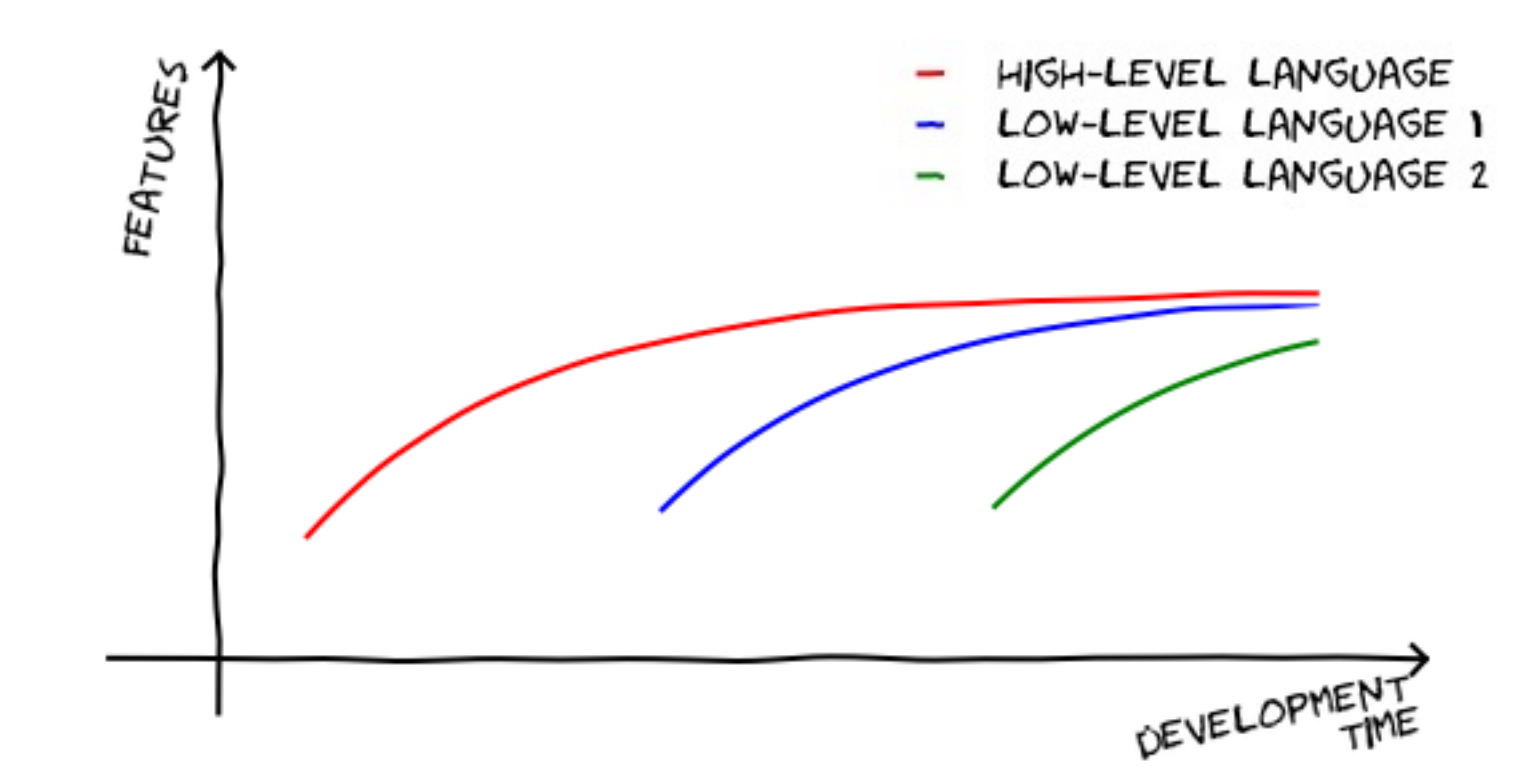
# Why Python for Astronomers?

- ***Python has recently become the common language of astronomy (specifically, astronomical data analysis).***

- The goal of this course is to teach how to effectively use the tools available in the Python ecosystem (the language, the libraries, and *the concepts underpinning both*) for your research. Think of it as a part of a series: ASTR 300 -> 302 -> 324 -> 497 (Astro Surveys & Big Data).

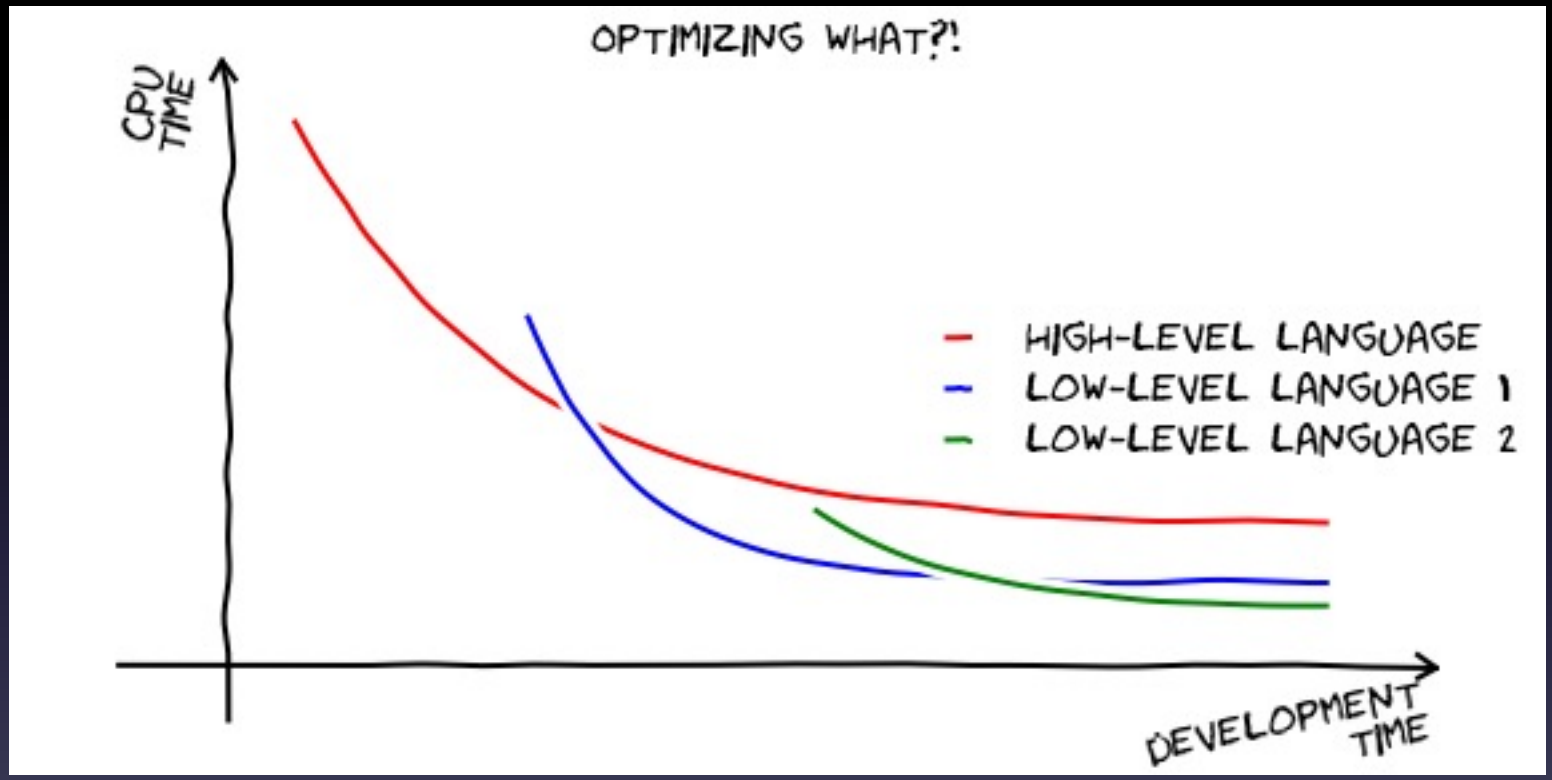
- While motivated by astronomy, the skills learned here should be broadly useful. It should easily transfer to more general data-science work.

# Why Python?




Higher-level languages, in general, shorten your time to research results. Python is one such language that is easy to learn, freely available, similar to legacy languages (IDL, FORTRAN, C/C++), and was mature enough at just the right time to spur adoption.

# As usual, lunches don't come free




Computational efficiency is the price you pay for speed of development. But that is typically a good trade to make.

# How Many of you are comfortable with…

Writing a command-line Python script (.py)

Using Python lists()

Using Python dicts()

Using tuples

Writing Python functions

Writing Python classes

Writing a Python module

Working with numpy arrays

Making a mpl scatter plot

Plotting an image w. mpl

Exception handling

Writing a list comprehension

Writing a lambda function

Using decorators

Writing a decorator

Utilizing ABC classes

*"Hey, look, a survey!"*

# "The Only Thing That Is Constant Is Change"

*- typically misattributed to Heraclitus*

- In astronomical data analysis (and related computing disciplines), things change too quickly to be learned only once. Learning is a process that never ends.

- I will try to teach you what is currently the best (IMNSHO!) set of tools and techniques to have in your toolbox.

- But know this will change. So the major emphasis of this course will be on *understanding the concepts*, and learning how to continuously keep your knowledge up-to-date.



*Languages may change,*
*but concepts transfer!*

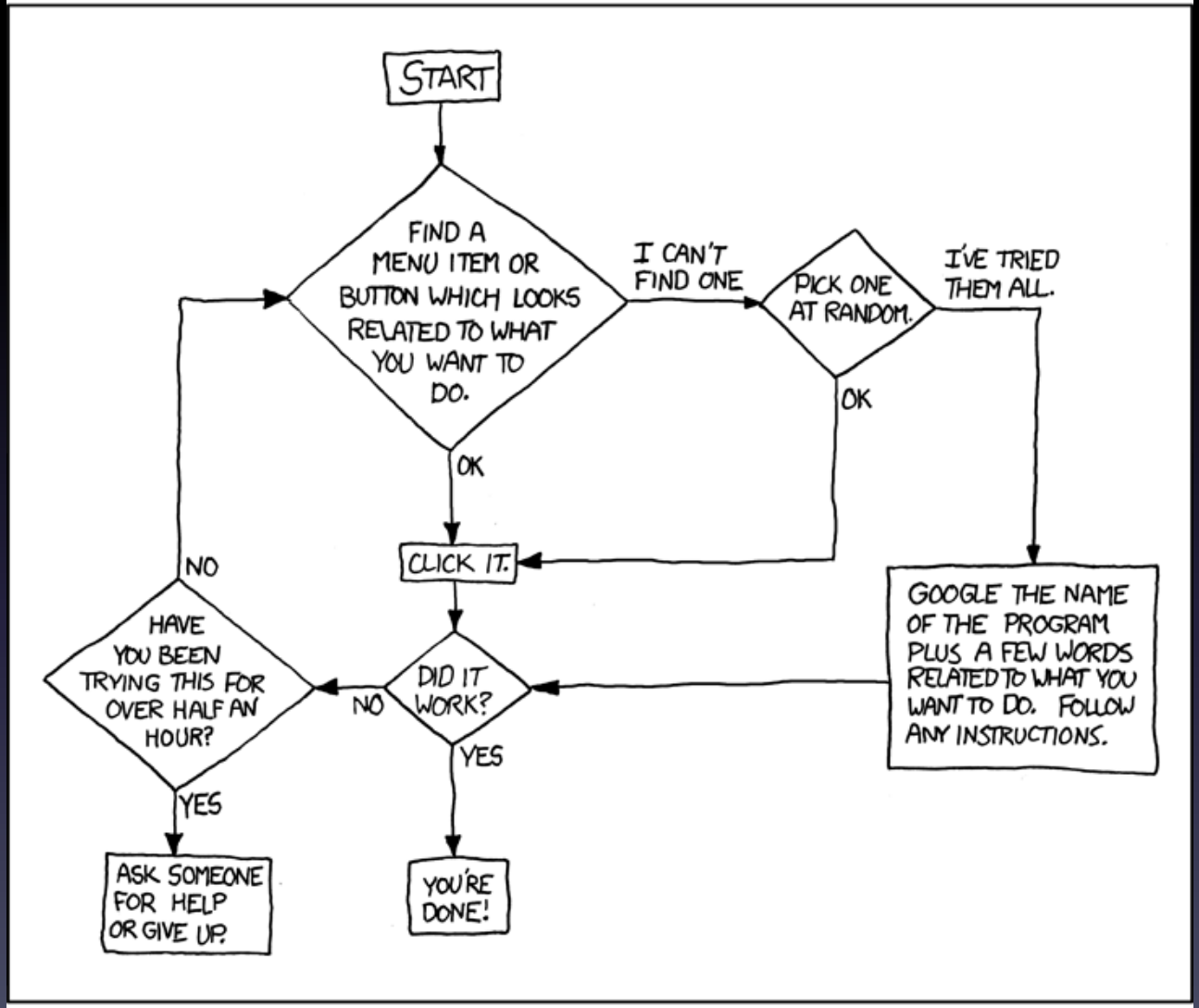
# Learning how to Learn

- We'll also learn ***how*** to learn: how to discover information, keep your knowledge up-to-date, find leads that help you solve problems, evaluate their worthiness.

- This may be the most valuable piece to take away from this class.

DEAR VARIOUS PARENTS, GRANDPARENTS, CO-WORKERS, AND OTHER "NOT COMPUTER PEOPLE."

WE DON'T MAGICALLY KNOW HOW TO DO EVERYTHING IN EVERY PROGRAM. WHEN WE HELP YOU, WE'RE USUALLY JUST DOING THIS:




PLEASE PRINT THIS FLOWCHART OUT AND TAPE IT NEAR YOUR SCREEN. CONGRATULATIONS; YOU'RE NOW THE LOCAL COMPUTER EXPERT!

# The Fun Part: Projects!

- ~April: a short (re)introduction to the basics (Python, git, how to find information, teamwork & software dev. methodology).

- Form a few "startups", each with an (ambitious) product in mind.
  - 3-4 people each. Work in teams, using github and agile sprints.
  - Example: Build a 3D n-body visualization widget for Jupyter
  - Example: Build a website to tell whether Rubin could find a newly discovered NEO

- May-June: work towards that goal in weekly sprints

# Lectures

- When: TTh, 10:00am-11:20am
- Were & how: PAA 210
  - Please bring your laptops

- Lecture structure (may change from week to week):
  - About an ~hour for introducing new material. **!!! WILL BE HANDS-ON !!!**
  - Leave ~20 minutes to work on homeworks, questions, open-ended discussion
  - Interrupt and ask questions at any time!

# Course Materials

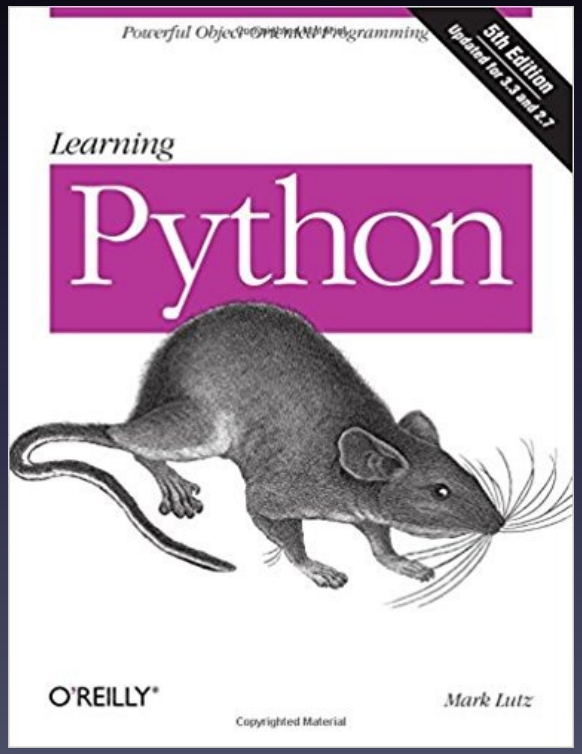
- I'll be adding most of what we need to the following repository on GitHub:

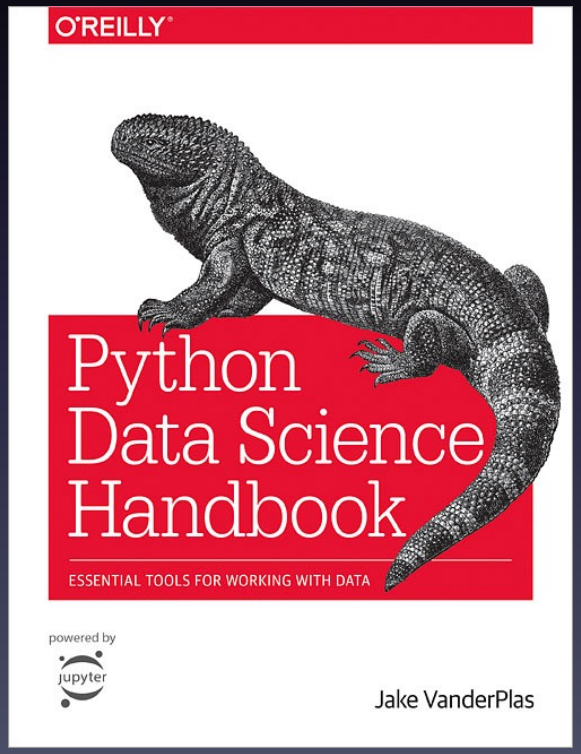
`https://dirac.us/git302`

*Action: Let's make sure everyone can access this repository.*

# Textbooks & Reference Material

- There is a wealth of material available online and as eBooks (for UW students, via UW Libraries & Seattle Public Library). The two I'd recommend to begin with:




+ many (many) online writeups / blog posts that I will point you to over the next few weeks.

# Syllabus

- Available at: https://dirac.us/syllabus302
  - (this will take you to the class github repository).

- Things to note:
  - The syllabus *will* change as we go through the quarter. Your feedback will be invaluable!

# Grading, Homeworks, Etc.

**Homeworks (30% of the grade):**

- Designed to exercise what we've learned recently.

**Projects (70% of the grade):**

- The projects you will build.

*Advice: Turn in your homeworks on time!*

# Communication: Slack

- In this class, we won't be using a mailing list but an instant messaging (-like) tool called Slack (http://slack.com). Slack is heavily used today by many research & technology companies and projects.
- Request to join our department Slack at:
  - `https://uw-astronomy.slack.com`
  - `Then join the #astr-302 channel`
- What to use it for:
  - Asking questions, discussing the class, exchanging snippets of code, collaborating on projects (when appropriate).
  - Please prefer Slack to sending me e-mails. Two reasons:
    - Everyone can benefit from the question and answer.
    - Your colleagues may be able to help!

*Action: Let's make sure everyone's on Slack.*

# Our working environment: class JupyterHub

https://dirac.us/hub302

- A UW-managed Jupyter
- Allows you to run Jupyter on a remote computer w/o having to have anything installed locally (like Google Docs, but for Jupyter)
- Everything "Just works" ™

*Action: Let's try it out*

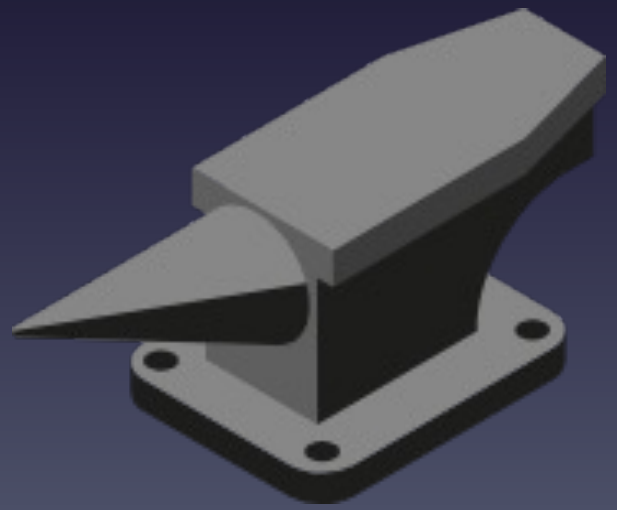
# Getting Python: Miniconda

- Locally, you can install the Miniforge Python Distribution.

*https://github.com/conda-forge/miniforge*

Note: we don't need it for this class, but it'll be useful for you to learn how to set up a Python environment from scratch.

a) it's easy, and b) you won't always have sysadmins available to do it for you.



# Next time

- A Walk Through Python!

*Note: Please refresh your ASTR 300 memory by working through the notebooks at*

https://github.com/UWashington-Astro300

*(the ASTR 300 github repository)*