Charming the Snake
Using Python Programming in High School Astronomy Research Programs

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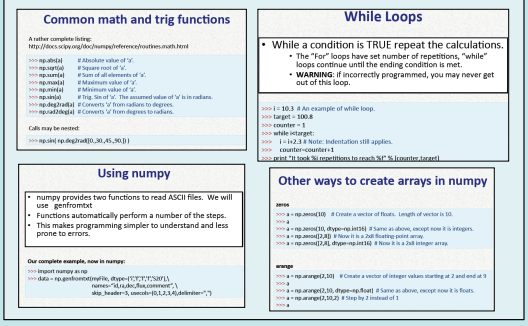
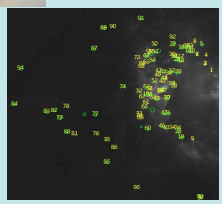
Getting Started

- Want more than "barebones" Python.
- Download packaged Python (Anaconda) with SciPy, NumPy, MatPlotLib, and several other libraries already installed.
- All members of group use same platform.
- Teach Basics of Programming: "Hello, World", basic math operations, variables, data types, scalars, arrays, loops, reading and writing files, etc.
- Weekly tutorials for teachers on basics of Python programming.
- Teachers then teach students.
- Students create video tutorials for each other.

Tutorial Topics

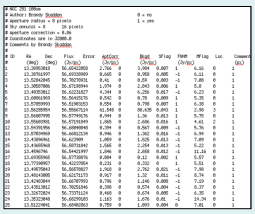


Teachers work on creating Python programs such as programs that write regions files of possible sources in NGC 281 created for DS9 (FITS viewer).

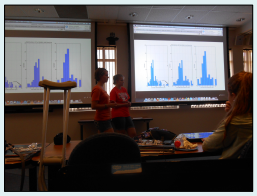


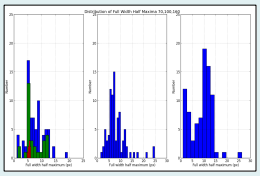
How was Python Used During Research?

- Read an APT output table file into memory.
- Write a DS9 region file using a table of either (x,y) or (ra,dec) positions and ID.
- Read SHIPs ASCII format data table.
- Write SHIPs ASCII format data table.
- Merge photometry tables.
- Create 2-dimensional plots of various types: scatter plots, line plots, histograms. These plots may have multiple data sets on them.
- Save plots to a JPG, PNG or similar graphic format file.



An example of an ASCII file of formatted data culled and processed from photometry software (APT).

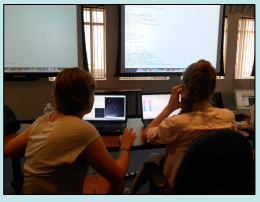




Students present histograms produced using Python programming of the photometry full-width half maxima during a session discussing source selection at Caltech.

Student Responses to Learning Python

Maddie: "The best part about programming is the result. Knowing that you have created something that now can perform functions that you instructed it to do. It's so rewarding!"
Casey: "I was flustered because Python programming was difficult at first. But, when I pressed "run" and it functioned properly, the feeling was undeniably satisfying."
Alex: "Learning more of the language, the code flowed more easily from my fingers. I am not a meticulous person, but Python makes me very picky and strict. Now when I do things, I pay more attention to detail."
Brandy: "I really actually had a lot of fun with Python. Creating something new was quite exciting, frustrating, tiring, and hard. It was hard to sit there and have it not work and trying again and again, but after finally getting it to work it was a very satisfying feeling."



Students work on writing Python programs and perform photometry during their visit to Caltech.

Thoughts for Future Implementation

- Need to not only devote significant upfront time to learning Python, but must devote time to sustaining learned skills.
- While teachers spent on average 4-6 hours a week on the research and Python programming, students spent only 2 hours a week during after school weekly meetings. This was not enough to develop deep mastery with Python programming.
- Teachers developed deeper learning through having to teach students the new skills they had acquired with programming.
- Teachers found it difficult to turn around and teach a newly learned skill to students. However, on a positive note, this created more of a collaborative learning environment between students and forced student independence of the teacher.
- Students appreciated how the need to learn Python arose organically from needing to perform certain tasks for data analysis during the research process; however, the specific tasks in which programming was used were only slightly varied in their nature and the programming skills required to complete them. The addition of a few contrived tasks may have created more varied skill development.

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