ASTR 28500/41200: Course Syllabus

General Information

- **Classes**: Tue/Th 9:30-10:50 in KPTC 309
- **Instructor**: Alex Drlica-Wagner
- **Office hours**: After class on Tuesday or by appointment in ERC457
- **Website and repository**: http://github.com/kadrlica/ASTR412s19

Course Description

The last several years have seen a veritable explosion of novel astronomical survey programs covering large areas of sky with unprecedented sensitivity. This course will explore the wide variety of science that can be done with surveys like the Sloan Digital Sky Survey, the Dark Energy Survey, the Gaia satellite, and the upcoming Large Synoptic Survey Telescope. Science topics will include our solar system, our Galaxy, the Local Group, distant galaxies, and cosmological measurements of our Universe. We will familiarize ourselves with the hardware and software components of astronomical surveys, before diving into hands-on analysis of public data sets. Students will learn computational and statistical techniques for analyzing large astronomical data sets.

Course Objectives

This course will give you hands-on experience extracting science from large astronomical surveys. The specific goals are:

- To give a high-level introduction to the wide range of science that can be done with astronomical surveys.
- To provide exposure to the tools and techniques for extracting science from large astronomical surveys.
- To give hands-on experience with modern practices in astronomical computing and data analysis.
- To provide an introduction to modern scientific software development techniques.

Course Content

This course seeks to provide the scientific background, tools, and techniques to analyze large astronomical data sets. The main components of the course are:

- **Lectures:** Lectures will provide an overview of the science driving astronomical surveys. They will consist of presentations and interactive exercises. There will be one lecture session per week.

- **Tutorials:** Tutorials will consist of guided analyses in IPython Notebooks. Students will work together to complete these notebooks in class with guidance from the instructor. There will be one tutorial session per week.
- **Homework:** Homework assignments will be similar to tutorials, but with less guidance. They can be completed individually or in groups, but each student must submit a separate assignment.
- **Final Project:** The final project will be a student-directed extension of the analyses done in tutorials and homework. You will be expected to present your work and prepare a written report at the end of the quarter.

Course Requirements

Evaluation in this course will be broken into three components, as described in more detail in the course requirements document.

1. **Participation (40%):** A significant amount of class time will be devoted to hands-on, participatory activities. Regular attendance and active participation are expected and required. Tutorials must be completed and submitted to GitHub for full credit.
2. **Homework (30%):** There will be several homework assignments, mostly in the first half of the quarter. Homework must be completed and submitted to GitHub for full credit.
3. **Final Project (30%):** Final projects will extend the data analysis techniques learned in class. Final projects will consist of an abstract, an outline, an oral presentation, and a written report.

Feel free to discuss and work collaboratively on tutorials, homework assignments, and the final project. However, each student is expected to submit their own instance of each assignment. Collaborators should be properly acknowledged.

There will be **no exams** in this course.

Course Resources

This course relies on the lectures and notebooks available on the GitHub repository. Links to reference material will be provided, usually in the form of scientific papers. The best way to find a specific piece of course material is Schedule.md.

There is no required textbook; however, a few general references are listed below:

- "Statistics, Data Mining, and Machine Learning in Astronomy" by Ivezic
- "Python Data Science Handbook" by VanderPlas
- The Astropy Project - http://www.astropy.org/