Astronomy 3310

Lecture 1:
Introduction and Course Overview

Overall Objective of this Course

• Gain an understanding of and experience with the basic data reduction and analysis techniques used in modern solar system imaging studies
• Develop general data handling and processing skills and experience that could be relevant and useful in future research projects

Our Secret Agenda

• To help you all get proficient enough in MATLAB and astronomical/planetary data analysis to propose for and get great summer REU (or other) jobs!

(Grad Students: Hit the ground running on your first research projects)
How will you do that?

• You will learn to use the (substantial) resources available to you in both MATLAB and ArcGIS, which we will provide, using your own computer.

• But to do that, you’ll need access to the software and an account on our server
  – (let’s start that process right now...)

Detailed Course Objectives

• Gain familiarity with a matrix-oriented computer language (MATLAB)
• Learn characteristics of detectors including Charge-Coupled Device (CCD) and Complementary Metal-Oxide Semiconductor (CMOS) technologies.
• Learn the basics of Geographic Information Systems (GIS) and gain familiarity with the most common platform for planetary mapping/cartography: ArcGIS.
• Exposure to various spacecraft data and to diverse planetary images
• Learn how to do some basic image display and manipulation
• Practice the derivation and plotting of image statistics
• Learn “standard” image data reduction procedures and calibrations
• Work with a variety of different types of measurements (imaging, astrometry, photometry, spectroscopy, etc.)
• Learn basic coregistration and other geometric processing methods
• Learn some basic multispectral image analysis techniques
• Learn some basic hyperspectral “image cube” analysis techniques

NOTE: This course will NOT teach you how to program (try CS 11XX) or cover everything about MATLAB

Approach

• The course will begin with a quick introduction to basic remote sensing and image processing concepts
• Subsequent lectures and weekly labs will focus on applications of these concepts to solar system imaging studies, and will cover:
  – data reduction, calibration, photometry, photogrammetry, photogeology, multispectral imaging, and spectroscopy.
• Labs will begin with introductory exercises designed to familiarize students with MATLAB, and then subsequent labs will involve accompanying development of students’ own MATLAB programs.
Approach (continued)

- Generally, Tuesdays will be "Lecture" days and Thursdays will be "Lab" days
- However, the vagaries of Prof. Hayes' and Prof. Lloyd's travel and research schedule may result in switching that around some weeks
  - Keep current via the course web site:
    - http://www.astro.cornell.edu/courses/astro3310
- And remember that the Labs and other work are accessible to you at all times, as you will be using your own computer.

Contacts

- Professor: Alex Hayes
  - 412 Space Sciences; phone x5-1712
  - http://www.alexanderghayes.com
  - Office Hours: TR 3:00 to 4:00 pm
  - hayes@astro.cornell.edu (usually ~1 day turnaround)
- Professor: James Lloyd
  - 230 Space Sciences; phone x5-4083
  - http://www.astro.cornell.edu/~jpl/
  - Office Hours: TBD
  - jl554@cornell.edu
- Assistant: Paul Corlies
  - 406 Space Sciences; phone x5-4709
  - pmc232@cornell.edu

Requirements and Grading

- Attendance at "Lecture" classes is part of your grade
  - Class starts promptly at 1:25 pm, ends no later than 2:40 pm
- Students are expected to have completed the assigned reading before the listed lecture begins (today is the only exception...)
- Grading:
  - 8 laboratory exercises x 20 = 160 points
  - final project proposal 30 points
  - final project 50 points
  - attendance/participation 60 points
  - TOTAL COURSE GRADE 300 points

NOTE: Two extra lab exercises will also be offered for EXTRA CREDIT of up to 10 points each.
Makeups and Extensions

- There are no makeup labs but there are 2 extra credit labs
- All labs must be turned in sequentially (1, 2, 3, ...)
- Lab due dates are already listed on the course schedule
- ANY requests for extensions must be:
  - Medically/officially justified (Gannett, etc.)
  - Made prior to the day the lab is due
  - Approved in advance by Prof. Hayes or Prof. Lloyd
- **No extensions** will be granted for the final project abstract, due Oct. 15, or the final project proposal, due Nov. 3
- **No extensions** will be granted for the final project presentations on Dec. 1 and Dec. 3

Academic Integrity

- You may discuss the labs with Prof. Hayes, Prof. Lloyd, or Paul, or your fellow classmates, but the work that you turn in must represent your own, original work.
- There is a thin boundary between collaboration, allowed and encouraged in this class, and plagiarism. Even if you have discussed your work with others, you should not have copied it or let others copy your work.
- Any breach of the academic integrity code listed in the college handbook will be considered grounds for failure in the course. A primary hearing will be held, and a letter will be put in your record in Student Services. [http://cuinfo.cornell.edu/Academic/AIC.html](http://cuinfo.cornell.edu/Academic/AIC.html)

Those are the Rules

Read Them
Learn Them
Live Them

You read it, You bought it.
Course Syllabus and Outline

- The current version of the Astro 3310 syllabus and/schedule can always be found at:
  
  http://www.astro.cornell.edu/courses/astro3310/schedule.html

- Let’s go through the syllabus now...

Datafarm Access

- We will use Prof. Hayes’ server to turn in lab write ups and code (DO NOT upload provided data files): datafarm.astro.cornell.edu
  
  - Mac Users: Log in and transfer data using SSH/SCP
  - Windows Users: Download and install WinSCP and Putty (see Syllabus)

- Hopefully by this point today your account has been established... log in and change your password!
  
  - To change your password, use the "passwd" command from an SSH terminal

- After you finish each lab, upload an archive file of the REPORT subdirectory that includes your write up as well as all the code you use to used to perform any analysis and make graphs.
  
  - Important: Keep a log all of the commands you type to complete each lab using the MATLAB editor. Each assignment should have a master script that runs all commands, calls all required functions, and makes the necessary plots. We will run the master script after you turn in the lab and the results will be part of your grade.
  
  - Hint: Become familiar with the MATLAB editor window ASAP!
MATLAB Tutorials

• CS1132 is a 1-credit (S/U) 5-week class that provides an introduction to programming using Matlab. It cover the Matlab environment, conditionals, scripts, functions, iterations, arrays, and graphics.
  – CS1132 is being taught this fall (MWF). If you do not have any programming experience, you should consider taking it.
  – For those of you who cannot accommodate the course in your schedule, the Spring semester version is an Auto-Tutorial Course and the lecture material is available online: [http://www.cs.cornell.edu/courses/cs1132/2015sp/](http://www.cs.cornell.edu/courses/cs1132/2015sp/)
• The short online lectures from CS1132 will be assigned as required reading during the first two weeks of class.
• Readings will also be assigned in the Matlab e-books listed on the course website.
• After the first two weeks, you are free to make use of any of the Matlab Tutorials and Guides we have made available to you, but the class will be shifting focus to data reduction and processing.
  – Remember, this is NOT a programming class.