AOSC 652: Analysis Methods in Atmospheric & Oceanic Science: Fall 2016

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MWF, 12:45 pm to 1:50pm, CSS Bldg, Room 3426

Class website: http://www.atmos.umd.edu/~rjs/class/fall2016

Text (primary):
FORTRAN 77 Programming (2nd edition, 1990) by T.M.R. Ellis
Numerical Recipes in FORTRAN: The Art of Scientific Computing (1992) by William Press et al.
Numerical Analysis by Richard L. Burden and J. Douglas Faires

Text (secondary):
An Introduction to Programming with IDL: Interactive Data Language by Kenneth Bowman
Numerical Computing with MATLAB by Cleve Moler

Course Descriptions/Objectives. The objective of the course is to provide students experience in the development of code to solve a variety of numerical problems they are likely to encounter during their dissertation research and subsequent careers in atmospheric and oceanic science. This course is composed of hands on lessons in the development of code to solve a variety of numerical problems and to visualize data in manners common to these fields. Numerical method theory will be taught through the analysis of actual atmospheric and oceanic data records. For instance, the lesson plan on Multiple Linear Regression will be based on analysis of the global mean temperature record, from 1900 to present, tabulated by the Climate Research Unit of the University of East Anglia. The lesson plan focused on Fourier Analysis will be based on the proxy for temperature preserved in the Vostok ice core.

Typically, the first meeting of each week will be devoted to white board lecture of the weekly topic. The second meeting of each week will be conducted using projection of an active computer monitor, showing interactive examples related to the weekly topic. An assignment will be handed out at the end of the second meeting of each week (on Wed). The third meeting of each week will be devoted to in class work on the assigned problem (typically due at the start of the first lecture of the following week) with the instructors present for consultation and encouragement. Assigned problems will be drawn from real world examples of the various topics in atmospheric and oceanic science.

The class is taught in a Computer Instructional Laboratory setting. Students will be exposed to FORTRAN, plus either MATLAB, IDL, or Python in a Linux environment. We will work with data from NASA satellites written in modern file formats such as HDF5 and NetCDF and students will be exposed to advanced graphical capabilities of MATLAB, IDL, or Python.

Requirements: Successful completion of freshman physics (PHYS 141) and Calculus III (MATH 241) or their equivalents is required. The course is geared to students with a physical sciences background (i.e., understand differentiation & integration). No prior programming experience is required.

Grades: Grades will be determined based on attendance and participation (10%), the weekly assigned projects (70%), and a final project (20%) that will be chosen either by each student or from a list of suggested final projects. The last week of class will be devoted to the final project. The final project will emphasize application of the tools of the class to a problem of current interest in the geophysical sciences.

Weekly Syllabus

Week	Topic
01	Intro to Linux & Text Editing
02	Intro to FORTRAN, Simple Computation & Graphics, and IDL
03	Intro to Graphics & Analysis of Satellite Measurements of Atmos. Comp.
04	Getting to know FORTRAN: Data Sorting, Input/Output, and Simple Statistics
05	Least Squares Analysis, Statistical Regression, and Spline Fitting
06	Numerical Integration
07	Root Finding & Newton Raphson Minimization
08	Introduction to MATLAB, IDL, and Python (Students choose one track)
09	Fourier Analysis
10	Satellite Data Visualization
11	HDF & NetCDF File Formats; Multiple Linear Regression; File Management
12	Ordinary & Partial Differential Equations
13	Short week due to Thanksgiving: review of past assignments
14	Work on computational project
15	Continue work on computational project (Mon) and present projects (Wed, Fri)