Course meets: Monday & Wednesday 12:30–1:20, Thursday 1:30–4:20 in POST 733.

Prerequisites: Math 241 (Calculus I) (or concurrent) or department approval. In other words, students must have a good command of trigonometry and algebra and a basic understanding of differentiation and integration.

Textbook: Matlab: An introduction with applications, second edition, by Amos Gilat. Please be sure to get the second edition; it is often available on Amazon for a few cents.

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Overview: In order to do science, or nearly any other type of technical work, one must be able to program computers. The good news is that once you have learned one computer language, you will have little trouble learning others. We will use Matlab because it is the language of choice for many earth scientists, engineers and physicists. They like it because it is a powerful, easy-to-understand language with a limited instruction set. In this course you will use Matlab to solve problems of increasing difficulty. There is a freeware version of Matlab (called – surprise! – FreeMat), which you can read about at http://freemat.sourceforge.net

Philosophy: Just as the most effective way of learning a second language is immersion, so the most effective way of learning how to program is to program. I teach this course as a series of programming exercises in which you proceed at your own pace and I help you as needed. I lecture as little as possible.

Assessment and Grading: There is no ‘curve’ for this course, so everyone can get A. Grades are based on weekly assignments, 15-minute, closed-book quizzes, attendance and a notebook used for diagrams, flowcharting and pseudo-code. In each weekly assignment you create a Matlab computer script, which you email to me for grading.

Course Contents: Variable names, arithmetic operations, display formats, built-in functions, arrays (matrices), the transpose and other array operators, addressing array contents, string arrays, random numbers, scripts, plotting (in 2D and 3D), functions, relational and logical operators, if-end structures and other structures such as if-else-end, if-elseif-else-end, for-end, while-end, and switch-case. Curve fitting and interpolation, solving systems of linear equations, cost functions, optimization (finding the minima and maxima of a cost function), histograms, mean, variance, and standard deviation. For more details, see the Table of Contents of our textbook.

GG Student Learning Objectives (SLOs): The GG department has defined 5 learning objectives for the undergraduate degree program related to Relevance of Geology and Geophysics, Technical knowledge, Scientific method, Oral and written skills, and Evaluating Phenomena. This course incorporates content relevant to 3 of those:

- SLO2: Students can apply technical knowledge of relevant computer applications,
laboratory methods, field methods, and the supporting disciplines (math, physics, chemistry, biology) to solve real-world problems in geology and geophysics.

- **SLO3**: Students use the scientific method to define, critically analyze, and solve a problem in earth science.
- **SLO4**: Students can reconstruct, clearly and ethically, geological knowledge in both oral presentations and written reports.

While SLO2 enters particularly strongly via the development of programming and applying their math and physics skills, SLO3 enters in how we break down a problem into multiple steps and test how each part works. SLO4 mostly enters via the written documentation you will put into your programming assignments.

**Course Goals:** Enable you to solve practical problems using the Matlab computer language. In particular you will:

- Review your basic mathematical skills.
- Learn matrix addition and multiplication.
- Review some basic statistics.
- Learn the concepts of programming, i.e., variables, control flow, input/output, functions, etc.
- Gain experience in developing solutions to multi-step problems.
- Build solutions using basic math, physics and statistics.
- Practice translating such solutions into working code.
- Experience how to test new code and find bugs.
- Appreciate the importance of documentation and clarity of code comments.

You will reach the SLOs by completing programming assignments and will be tested for factual knowledge during closed-book quizzes.

**Use of alternate computer language:** Certain students (Global Environmental Sciences students, biology graduate students, engineering students) who already have considerable experience in coding may do the weekly assignments using ‘R’ instead of Matlab if they wish. Such students should use their own laptop computers and consider using Rstudio. For biologists and statisticians there are almost too many introductory books on ‘R’, but for physical scientists I have found only two so far:


Students who elect to use ‘R’ should still purchase the Matlab text by Gilat, because many assignments will consist of problems from that book.