

Physics 165: Intro to Programming for the Physical Sciences, Fall 2013

Tu Th 9:30 – 10:45 am, PLS 1129

INSTRUCTOR: Professor Michelle Girvan

Email: girvan@umd.edu (Please include ‘phys165’ in the subject of all emails)

Phone: x5-1610

Office Hours: Mondays 1:30 – 2:30 pm, or by appointment, A.V. Williams 3327

Course website:

Our course website is accessible through <http://www.elms.umd.edu>

COURSE DESCRIPTION:

Introduction to programming using examples in the physical sciences.

COURSE SOFTWARE:

MATLAB: We will be using Matlab for this class. Problem sets will require that you have access to a computer with Matlab installed. You can use the computer labs on campus or download a copy of Matlab for free for your personal computer at:

<http://terpware.umd.edu/Windows/Package/2053>

REQUIRED TEXTBOOK:

Matlab: A Practical Introduction to Programming and Problem Solving, S. Attaway, second edition. Note: While many of the topics covered in class are also presented in the textbook, some topics addressed in the lectures are not included in the textbook. You are responsible for all material covered in class and all assigned textbook readings.

ADDITIONAL REFERENCES:

- *Essential Matlab for Engineers and Scientists*, Hahn and Valentine, Third Edition
- *An Introduction to Computer Simulation Methods*, H. Gould and J. Tobochnik
- *Physical Modeling in Matlab*, A. Downey. Can be purchased online or downloaded for free at: <http://www.greentepress.com/matlab/>

COURSE FORMAT:

The course will be taught using a combined lecture/laboratory approach. About half the class sessions will be dedicated to lectures. During the remaining “laboratory” sessions, students will work on homework programming exercises in teams of two or three. In order to allow more hands-on experience in class, students will be required to complete assigned reading (both from the textbook and from course notes) and assigned introductory exercises before class. A schedule assigning rotating teams for the laboratory sessions will be posted during the second week of class. In the event that your only other team member is absent from class, you will be reassigned to another team. Note that classes may contain both lecture and laboratory components.

A NOTE ABOUT CLICKERS:

Because the class has been restructured for this semester to include more hands-on programming, clickers are no longer required. If you have purchased a clicker for use just for this class, you can return it.

EVALUATIONS:

1. **Attendance, preparation, and participation:** You are expected to attend class and complete assigned reading and assigned introductory exercises before the laboratory sessions. You are also encouraged to ask questions during both lecture and laboratory sessions.
2. **Problem sets:** 8 total
3. **In class exams:** Tuesday, October 8th (tentative), and Thursday, November 21st (tentative)
4. **Programming Project:** Due Tuesday, Dec. 10th. In class presentations Tuesday, Dec. 10th and Thursday, Dec. 12th. Your final programming project will require you to choose a programming problem that involves either multiple interacting elements or stochastic processes. You will write a computer program (about 75-100 lines of code without comments) to calculate the system behavior. Your submission will include a written description of your problem and your approach, as well as your code. You will also describe and demonstrate your program in a 5-10 minute presentation for the class. Additional details to follow.
5. **Final Exam:** Tuesday, December 17th, 8-10am.

GRADING:

Attendance, preparation, and participation: 5%

Problem sets: 25%

In class exams (2): 15% each

Programming project: 20%

Final Exam: 20%

POLICY FOR LATE HOMEWORK SUBMISSIONS:

- Submissions received on time will be scored at the 100% level.
- Submissions received after the deadline, but with 24 hours thereof, will be scored at the 75% level. (*i.e.* you can receive at most 75% of the total possible points.)
- Between 1 & 2 days late: 60%
- Between 2 & 3 days late: 45%
- Between 3 & 4 days late: 30%
- Between 4 & 5 days late: 15%
- No submissions accepted after 5 days.
- Exceptions can be granted for serious situations, documentation necessary.
- The entire problem set will be scored at a single level as indicated above. *i.e.*, you can't submit part of it to be scored at the 100% level and the rest at the 75% level.

ABSENCES AND MAKEUPS:

Your attendance in class is expected, however, you will not be penalized for missing up to three classes. If illness, family emergency, or other serious extenuating circumstances require you to miss more than this, you should provide the instructor with appropriate documentation. Similarly, if a serious documented circumstance requires you to miss an exam or prevents you from turning in a homework assignment on time, you should contact the instructor to arrange for a makeup or extension.

ACADEMIC HONESTY:

Working together on assignments is encouraged. However, each student is expected to write his or her own version of the assigned programs. If you work with other students on a problem set,

you must list their names on the first sheet of your submitted solutions. Examinations are to be worked completely independently.

MATERIAL (*Approximate dates indicated in italics*):

Basic concepts for scientific programming (~4 weeks)

- Intro to Matlab, variables: scalars and arrays (Chapter 1) – *Tu 9/3, Th 9/5*
- Simple Matlab scripts and functions (Chapter 2) – *Th 9/5, Tu 9/10*
- If statements, for and while loops (Chapters 3 and 4) – *Tu 9/10, Th 9/12, Tu 9/17, Th 9/19*
- Logical variables and masks – *Tu 9/24, Th 9/26*
- Errors, pitfalls, and debugging (Chapter 5) – *Tu 10/1*

Application: Dynamical systems, chaos and fractals (~1 week)

Th 10/3, Th 10/10

Numerical methods for the physical sciences: Part I (~1 week)

- Root finding – *Tu 10/15, Th 10/17*
- Curve fitting (Chapter 14) – *Th 10/17*

More advanced programming concepts (~2 weeks)

- Strings (Chapter 6) – *Tu 10/22, Th 10/24*
- Recursion (Chapter 9) – *Th 10/24, Tu 10/29*
- Advanced data structures (Chapter 7) – *Tu 10/29*
- Basic statistics, searching and sorting (Chapter 12) – *Th 10/31*

Monte Carlo simulations (~2 weeks)

- Computational studies of error propagation – *Tu 11/5*
- Simple stochastic simulations: random walks, levy flights, physically inspired cellular automata

Th 11/7, Tu 11/12, Th 11/14, Tu 11/19

Numerical methods, Part II: Integration and ODEs (Chapter 14) (~2 weeks)

Tu 11/26, Tu 12/3, Th 12/5

IMPORTANT DATES (*The dates listed below are tentative. Any changes will be announced in class and via the course website. Problem sets to be submitted online via ELMS.*):

Thursday, 9/12: Problem Set #1 due

Tuesday, 9/24: Problem Set #2 due

Tuesday, 10/1: Problem Set #3 due

Tuesday, 10/8: Exam #1 in class

Tuesday, 10/15: One paragraph description of your final project problem choice due.

Thursday, 10/17: Problem Set #4 due

Thursday, 10/24: Problem Set #5 due

Thursday, 10/31: One half to one page description of your programming approach for your final project due

Tuesday, 11/5: Problem Set #6 due

Thursday, 11/14: Problem Set #7 due

Thursday, 11/21: Exam #2 in class

Thursday, 12/5: Problem Set #8 due

Tuesday, 12/10: Final projects due, in class presentations begin

Thursday, 12/12: Final project presentations conclude

Tuesday, 12/17: Final Exam 8-10am, PLS 1129