San José State University, Department of Physics and Astronomy
PHYS 140, Computational Methods in Physics, Fall 2013

Contact Information

Instructor:	Aaron Romanowsky
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Office Hours:	Thursdays 2:20–4:00pm, Clark Hall 111, and by email or appointment
Class Days/Time:	Tuesdays, Thursdays 1:30–2:20pm (seminar), Tuesdays 2:30–5:20pm (laboratory)
Classroom:	Clark Hall 111 (Incubator Classroom (IC) for seminar and lab)
Prerequisites:	PHYS 50–52 or PHYS 70–71

Faculty Web Page and MYSJSU Messaging

The Canvas online course management system will be an integral part of this course. This will include announcements, distribution of handouts, submission and grading of assignments, online quizzes, etc. Your enrollment in the course gives you access to the site – please check there for further information and updates, including to the syllabus. Canvas is accessed via http://sjsu.instructure.com, and more information and help can be found at http://www.sjsu.edu/at/ec/canvas/student_resources/index.html.
Note that besides using a web browser to access Canvas, there is also an App for iOS.

You are responsible for regularly checking for course news sent to your email address. You may also want to make use of the Canvas Notifications system to receive updates about upcoming deadlines, etc. Feedback on assignments will be posted on Canvas, but please do not use the Canvas messaging system for any urgent matters: **use direct email instead**.

Course Description

This course provides an introduction to traditional numerical analysis techniques in the context of a modern computational environment for physicists. The primary emphasis is on learning to program with Python, and on computer-driven communication and problem solving in general, including use of Unix and LaTeX.

This semester the course meets in the Incubator Classroom, which provides a state-of-the-art technology-assisted, flexible learning environment, with facilities such as screen-sharing, multiple projectors, smart boards, and lecture capture. For further information, see http://www.sjsu.edu/at/asc/classroom_resources/.

Prerequisites include the calculus-based introductory physics sequence. Linear algebra and ordinary differential equations are strongly recommended.

Course Goals and Learning Outcomes

Course Learning Outcomes (CLO)

The critical goals of this course are to (1) gain basic competency with a widely used computer language, Python, for both general and scientific programming, (2) understand and apply fundamental numerical analysis methods used by physicists, (3) become familiar with other standard scientific software tools, and (4) improve skills in scientific communication.

After this course, the students will (1) be capable of writing a Python program to solve a research problem, (2) be able to recognize basic numerical problems and program solutions for them, (3) be able to navigate basic Unix commands, and (4) produce scientific reports with LaTeX.

Required Texts/Readings

Textbook (*available free and online!)*

The following is our main textbook:
A Primer on Scientific Programming with Python, Hans Petter Langtangen. Springer: 3rd edition (2012). ISBN 978-3-642-30292-3. Hardcover version available for sale or rent at campus bookstore. Free e-Book available via the SJSU library via the following address: http://discover.sjlibrary.org/iii/encore_sjsu/record/C__Rb4450148

This textbook will be used for select material:
A Survey of Computational Physics: Introductory Computational Science / Python Multimodal eTextBook. Rubin H. Landau, Manuel Jose Paez, & Cristian C. Bordeianu. Princeton Univ. Press. (2012). ISBN 978-0-691-13137-5. Free e-Book available via the following address: http://discover.sjlibrary.org/iii/encore_sjsu/record/C__Rb4394602

Other Readings

Links to other readings will be posted on Canvas later in the semester.

Other equipment / material requirements

Computer usage outside of class hours will be required for some assignments. Students should identify early a lab or personal computer that will be suitable for programming. The IC will be available right after class on Thursdays for this purpose, with the instructor present for general office hours. The SCI 242 computer lab will also be available during certain hours, which are anticipated to be Mon/Wed 1:30–3:00pm and 4:30–5:30pm, Fri 9:00–10:30am and 11:30am–5pm (see schedule on classroom door).

Library Liaison

Physics & Astronomy library liaison: Christine Mune, christina.mune@sjsu.edu
See also Physics & Astronomy LibGuide at http://libguides.sjsu.edu/physics_astronomy.

Course Requirements and Assignments

SJSU classes are designed such that in order to be successful, it is expected that students will spend a minimum of forty-five hours for each unit of credit (normally three hours per unit per week), including preparing for class, participating in course activities, completing assignments, and so on. More details about student workload can be found in University Policy S12-3 at http://www.sjsu.edu/senate/docs/S12-3.pdf.
As PHYS 140 incorporates a substantial lab component, the workload outside of class will be lower than in a standard 3-unit class.

The main component of this course is the lab experience, which will provide you with the opportunity for hands-on learning of programming and computational methods. There will be occasional in-class quizzes to motivate reading and studying on your own, and also a midterm exam on programming. Regular homework assignments will geared to cultivating scientific writing skills, and each student will take a turn during the semester to share results with the class. The culminating experience for the course will be final class projects.

Grading Policy

The overall grading scheme is as follows:

Weekly lab work:	50%
Homework:	15%
In-class reports:	5%
Quizzes:	10%
Midterm exam:	5%
Final project:	15%

The letter-grade assignment is:

A+	97–100	A	93–96	A–	90–92
B+	87–89	B	83–86	B–	80–82
C+	77–79	C	73–76	C–	70–72
D+	67–69	D	63–66	D–	60–62
F	0–59				

Late submissions will be accepted for some assignments, but with diminishing credit equivalent to an exponential decay rate. Occasional extra-credit opportunities will be available.

Classroom Protocol

Attendance and participation are crucial for success in this course. Cell phones on 'silent', please. Student help may be appreciated in regular shifting of the customizable classroom furniture. Additional classroom- and computer-specific guidelines will be provided in class.

University Policies

Dropping and Adding

Students are responsible for understanding the policies and procedures about add/drop, grade forgiveness, etc. Refer to the current semester's Catalog Policies section at http://info.sjsu.edu/static/catalog/policies.html. Add/drop deadlines can be found on the current academic year calendars document on the Academic Calendars webpage at http://www.sjsu.edu/provost/services/academic_calendars/. The Late Drop Policy is available at http://www.sjsu.edu/aars/policies/latedrops/policy/. Students should be aware of the current deadlines and penalties for dropping classes.

Information about the latest changes and news is available at the Advising Hub at http://www.sjsu.edu/advising/.

Consent for Recording of Class and Public Sharing of Instructor Material

University Policy S12-7, http://www.sjsu.edu/senate/docs/S12-7.pdf, requires students to obtain instructor's permission to record the course.

- "Common courtesy and professional behavior dictate that you notify someone when you are recording him/her. You must obtain the instructor's permission to make audio or video recordings in this class. Such permission allows the recordings to be used for your private, study purposes only. The recordings are the intellectual property of the instructor; you have not been given any rights to reproduce or distribute the material."
    - It is suggested that the greensheet include the instructor's process for granting permission, whether in writing or orally and whether for the whole semester or on a class by class basis.
    - In classes where active participation of students or guests may be on the recording, permission of those students or guests should be obtained as well.
- "Course material developed by the instructor is the intellectual property of the instructor and cannot be shared publicly without his/her approval. You may not publicly share or upload instructor generated material for this course such as exam questions, lecture notes, or homework solutions without instructor consent."

Academic integrity

Your commitment as a student to learning is evidenced by your enrollment at San Jose State University. The University Academic Integrity Policy S07-2 at http://www.sjsu.edu/senate/docs/S07-2.pdf requires you to be honest in all your academic course work. Faculty members are required to report all infractions to the office of

Student Conduct and Ethical Development. The Student Conduct and Ethical Development website is available at http://www.sjsu.edu/studentconduct/.

Instances of academic dishonesty will not be tolerated. Cheating on exams or plagiarism (presenting the work of another as your own, or the use of another person's ideas without giving proper credit) will result in a failing grade and sanctions by the University. For this class, all assignments are to be completed by the individual student unless otherwise specified. If you would like to include your assignment or any material you have submitted, or plan to submit for another class, please note that SJSU's Academic Integrity Policy S07-2 requires approval of instructors.

Campus Policy in Compliance with the American Disabilities Act

If you need course adaptations or accommodations because of a disability, or if you need to make special arrangements in case the building must be evacuated, please make an appointment with me as soon as possible, or see me during office hours. Presidential Directive 97-03 at http://www.sjsu.edu/president/docs/directives/PD_1997-03.pdf requires that students with disabilities requesting accommodations must register with the Accessible Education Center at http://www.sjsu.edu/aec/ to establish a record of their disability.

Student Technology Resources

Recommendations for computer access for this course are discussed above under "other equipment". Other computers for student use (which may support *some* of the software needed for this course) are available in the Academic Success Center at http://www.sjsu.edu/at/asc/ located on the 1st floor of Clark Hall and in the Associated Students Lab on the 2nd floor of the Student Union. Additional computer labs may be available in certain departments/colleges. Computers are also available in the Martin Luther King Library.

SJSU Peer Connections

For brief information about Peer Connections, see Canvas page here: https://sjsu.instructure.com/courses/1012117/assignments/syllabus#peer, or the Peer Connections website at http://peerconnections.sjsu.edu.

SJSU Writing Center

For brief information about the Writing Center, see Canvas page here: https://sjsu.instructure.com/courses/1012117/assignments/syllabus#writing, or the Writing Center website at http://www.sjsu.edu/writingcenter.

SJSU Counseling Services

For brief information about the Counseling Center, see Canvas page here:https://sjsu.instructure.com/courses/1012117/assignments/syllabus#counsel, or the Counseling Services website at http://www.sjsu.edu/counseling.

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Course Schedule

Topics are provisional, and the midterm date is tentative, to be decided by consensus.
The general schedule is:

Seminar Tuesdays and Thursdays.
Lab Tuesdays.
Homework assignment given out each Tuesday, due the following Tuesday.
Homework segues to project preparation toward end of course.

Course Schedule

Week	Date	Topics, Readings, Assignments, Deadlines
Week 1	August 22	Seminar 1: course details, what is computation (Downey Ch. 1)
Week 2	August 27, 29	Seminar 2: numbers, errors, variables (Landau Ch. 1.7; Langtangen Ch. 1.2–1.4; Downey Ch. 2) Lab: Python start-up, arithmetic, variables (Ch. 1) Seminar 3: precision, IPython, Python lists (Langtangen Ch. 1.5, 2.2.1, 2.4.3)
Week 3	September 3, 5	Seminar 4: Python arrays, scripts, plots (Langtangen Ch. 5.1–5.3, 5.6.1, 5.7.1–5.7.3, App. H.1) Lab: Python lists, arrays, plots (Ch. 2) Seminar 5: algorithms, Python input (Langtangen Ch. 1.2, 4.1.1)
Week 4	September 10, 12	Seminar 6: Python output, functions (Langtangen Ch. 4.1.1, 1.1.11, 3.1.1) Lab: Python input/output, functions (Ch. 3) Seminar 7: Python file I/O, relational expressions, logical operators (Langtangen Ch. 6.1.1., 6.5.1, 2.1.3)
Week 5	September 17, 19	Seminar 8: Python if–else branching (Langtangen Ch. 3.2.1, 4.3.0, 5.5.2) Lab: logic and conditions (Ch. 4) Seminar 9: Python nested if–else; '`for`' loops (Langtangen Ch. 2.2.2)
Week 6	September 24, 26	Seminar 10: Python '`for`' and '`while`' loops (Langtangen Ch. 2.1.2, 2.2.2) Lab: multiple slit interference and diffraction (Ch. 5) Seminar 11: Python nested loops and array products (Langtangen Ch. 5.7.2, 5.7.3)
Week 7	October 1, 3	Seminar 12: Python nested loops, namespaces, review (Landau Ch. 3.3) Lab: Fourier series with nested loops (Ch. 6)

Week	Date	Topics, Readings, Assignments, Deadlines
		Seminar 13: MIDTERM EXAM
Week 8	October 8, 10	Seminar 14: Unix Lab: Unix (Ch. 7) Seminar 15: Unix/Python interface, and debugging (Langtangen App. F.1, F.2.1)
Week 9	October 15, 17	Seminar 16: debugging, journals, and LaTeX Lab: LaTeX (Ch. 8) Seminar 17: data fitting – linear regression (Press, Ch. 15.0–15.2; Landau Ch. 8.7, 8.7.1)
Week 10	October 22, 24	Seminar 18: data fitting – χ^2 and curves (Press, Ch. 15.0–15.2, 15.4; Landau Ch. 8.7, 8.7.1) Lab: data fitting (Ch. 9) Seminar 19: curve fitting and class projects (Press, Ch. 15.4)
Week 11	October 29, 31	Seminar 20: statistics (Press, Ch. 14.0–14.1, pp. 658–659; Downey, Ch. 2) Lab: statistics (Ch. 10) Seminar 21: random numbers, mock data sets, root finding (Landau, Ch. 8.1; Press, Ch. 7.0, 9.0)
Week 12	November 5, 7	Seminar 22: root finding: bisection method (Landau, Ch. 7.9; Press, Ch. 9.1) Lab: root finding (Ch. 11) Seminar 23: root finding: Newton's method (Landau, Ch. 7.10; Langtangen, App. A.1.10; Press, Ch. 9.4)
Week 13	November 12, 14	Seminar 24: systems of linear equations (Landau, Ch. 8.4.2; Press, Ch. 2.0) Lab: linear systems of equations (Ch. 12) Seminar 25: linear systems of equations, numerical integration (Landau, Ch. 8.4.2, 6.1–6.2.1; Press, Ch. 2.0, 4.0–4.1)
Week 14	November 19, 21	Seminar 26: numerical integration (Landau, Ch. 6.1–6.2.1; Press, Ch. 4.0–4.1, 4.4) Lab: numerical integration (Ch. 13) Seminar 27: ordinary differential equations (Landau Ch. 9.3,9.5.1; Langtangen App. E.1.2; Press Ch. 16.0–16.1)
Week 15	November 26	Seminar 28: ordinary differential equations Lab: ordinary differential equations (Ch. 14)
Week 16	December 3, 5	Seminar 29: Monte Carlo integration and simulation (Langtangen Ch. 8.3, 8.5; Press Ch. 7.6, 15.6; Landau Ch. 5.4, 5.5, 6.5, 6.6) Lab: Monte Carlo methods (Ch. 15)

Week	Date	Topics, Readings, Assignments, Deadlines
		Seminar 30: course review; project reports and presentations
Final Exam	Thursday, December 12	FINAL EXAM / PRESENTATIONS, Clark 111, 12:15–2:30pm