
**PHZ3150: INTRODUCTION TO NUMERICAL COMPUTING
FALL 2021 SYLLABUS**

1. Course Vitals

Where:	BA1 O126 & Zoom		
When:	TR 12:00-1:20 pm		
Dates:	8/23-12/10		
Grading:	ABCDF w+/-		
Credits:	3		
Final:	Project due: December 2		
Textbook:	Downey, A. B. 2006. Think Python, 2nd edition. http://greenteapress.com/thinkpython2/thinkpython2.pdf free ebook		
HW Git URL:	https://classroom.github.com/classrooms/76880121-phz3150-classroom-fall2021		
	Instructor	Teaching Assistant	Learning Assistant
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Office hours:	TBD	TBD	TBD

2. Course Objectives

Those who successfully complete this course will be able to:

1. Conceptualize problems as calculations
 2. Write simple programs to carry out those calculations
 3. Visualize data using graphs and simple animations
 4. Understand basic numerical techniques
 5. Use current software development tools
 6. Make good and ready to share code
 7. Manage project files, plan a workflow, keep a work log
 8. Be self-sufficient in learning new numerical and computing skills.
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3. Class Requirements

Students must bring a computer to class that runs a recent version of Linux, MacOS, or Windows, has 20 GB of free space, and has sufficient power to last the full class period. A keyboard and pointer (mouse, trackpad, trackball), a full-sized screen, and access to the UCF wireless network are required (no phones, pure tablets, netbooks, or Chromebooks). The student must have administrator/root access to install the class's software environment. All software in the class is free, free of charge, and typically also open-source.

4. Approach

In modern physics, whether we are analyzing experimental data, simulating a system, designing equipment, or planning a research budget, nearly all of our work involves numerical computing. This class will teach you to do numerical calculations on your own computer – not one stuck in a lab classroom somewhere, but one you'll have access to forever. Rather than teaching a long list of different numerical techniques, it focuses on conceptualizing physics problems as calculations; planning and writing good programs; forming good habits; using modern coding methods; organizing, logging, and automating your work; and learning how to find, research, and use the right algorithms and packages for the problem at hand. Our goal is for you to embrace numerical computing, competently using your own computer and continuing to learn throughout your career.

While anyone may register, the course is geared toward computing in the physics curriculum, both in classes and in research, and as a go-to tool for solving ordinary problems. It is the first methods course in physics, using tools common to the discipline. Its content will evolve with the needs of the physics undergraduate program and practice in physics and astronomy. We teach enough principles to do the work, but focus on practical coding, rather than depth in computing topics, which is taught in other courses. This course will prepare you for the computing requirements of any physics or astronomy course without a specific computing-class prerequisite.

We cover the following topics in roughly this order:

1. Logging your work, reproducible research
2. Basic command-line (shell) use
3. Basic programming, numerics, and plotting in Python, NumPy, and Matplotlib. Using Jupyter.
4. Visualization in 2D and 3D
5. Planning and doing work on a computer
6. Software development tools (debuggers, test-driven development, version control)
7. Numerical techniques
8. Databases

In addition, about half of each week is devoted to the practice of reducing problems to code. These include:

1. Unit conversions
2. Calculating and plotting equations in one variable resulting from physics problems
3. Calculating and visualizing scalar and vector fields resulting from physics problems
4. Simulating probability (statistical mechanics, quantum mechanics, error analysis)
5. Fitting linear and arbitrary models to data
6. Integrating and animating non-analytic 1D and field problems (chaotic orbits, fluids, etc.)

5. Class Participation

No prior knowledge of the physics topics listed is expected.

The aim of this course is for you to learn how to program. Therefore there will be approximately weekly homework assignments and project work. The interactive discussion of in-class coding exercises and homework is one of the central learning elements of the class. It is critical that you do the homework and readings **before** the beginning of class on the due date, as we discuss answers in class. Your personal understanding is what counts in the discussions, and discussions count toward your final grade. Since answers will be discussed in class, **no late homework will be accepted**.

The demos and homework solutions are a critical teaching element. You must read them, including all comments in code, each week. They

contain discussion of how and why to do important things, knowledge you will need for later assignments. If you do not understand them well, work through them until you do, and seek help from course staff to get caught up.

6. Grading

Lecture attendance is mandatory. You must bring a laptop to class and be an active learner by doing the demos and exercises along with the instructor; don't just watch. Preparation for and participation in class discussion counts toward the final grade. We will use peer evaluation (not grading) of homework assignments, this assists us somewhat in grading, but is mostly useful as a learning element for you. Your attendance and participation in the peer evaluation count toward your grade. Because this is a “doing” class, homework and discussions are heavily weighted:

GRADE WEIGHTING			
Homework		25%	
Quizzes		20%	
Mid term project		15%	
Final project		25%	
Discussion participation		5%	
Attendance		5%	
Peer evaluation		5%	

GRADING			
	-	Straight	+
A	90 - 93.33	93 1/3 - 100	
B	80 - 83.33	83.33 - 86.66	86.66 - 89.99
C	70 - 73.33	73.33-76.66	76.66-79.99
D	60 - 63.33	63.33-66.66	66.66-69.99
F		Below 60%	

Numerical coding is among the most difficult to do correctly, because there are myriad “moving parts” to track, and because wrong code often does not look much different from correct code. Sometimes wrong code will even give you the right results for some test cases! Learning what to do from lists presented in lecture is ineffective; we learn coding experientially. We learn nearly as fast from the experience of others (both positive and negative) as from our own, and with much less effort (we didn’t have to write that code).

Therefore, we use peer evaluation as a primary learning tool. As we discuss the solutions to each assignment, students will evaluate three others’ work, filling in a rubric in WebCourses. We will discuss multiple ways it could have been coded and the benefits and disadvantages of each. Going through the rubric, solutions, and another’s code in detail leads to a much deeper understanding and a longer retention of the material. Participation in the peer evaluation is graded. The final homework grades are given by the course staff and frequently differ from the peer evaluation rubrics.

7. Homework

Hand in all homework on WebCourses as a single zip file per assignment, unless otherwise stated, including prose and math. To make the peer evaluation and grading easier and to promote good coding habits, there are strictly enforced homework format and style rules. See the handout on that topic. Specific instructions on the assignments supersede those instructions.

The comments in homework feedback are often about coding style or homework format, so a close reading is important to avoid losing points for the same errors on multiple assignments.

8. Academic Honesty, Sharing and Information Resources

We will follow the letter and spirit of the UCF Golden Rule. Research relies on taking advantage of resources developed elsewhere: software libraries, descriptions of methods, etc. Unless we state otherwise, please use such external sources in your work. However, there are several conditions:

1. All math, code, and text answers must be your original work. You may (and should) discuss the relevant general topics with each other, but you may neither give nor receive specific help on, nor share, assigned work. Sharing code, even to the extent of making it visible on-screen or reading it from someone else's screen, is not allowed, regardless of whether the

other party gives permission. This includes help from others not in the class.

2. For coding problems, the portion of the answer relevant to the problem must be your original work. For example, if the question asks you to subtract two images, you must write the code to do the subtraction but you may use third-party code to read the images from files.

3. You must have legal permission to use an external source (assumed if publicly posted).

4. You **MUST** give credit to all external sources on a problem-by-problem basis. Credits must include the name of the item, a sentence fragment describing it if it is not obvious from the name, its author(s), year of authorship, and location (e.g., the name, volume, and pages of a journal article, or the URL of a software package distributed online).

5. As with any scientific research project, you alone are responsible for the output: if you download a package that claims to do something and it has a bug that gives the wrong answer, the answer is wrong and you will be marked accordingly.

6. Work you did prior to the start of the course may not be handed in for grade (talk to the instructor for exceptions).

9. Course Schedule

Date		Day	#	Topic	HW
Aug	24	T	1	Introduction, keeping logs 101	
	26	R	2	Introduction to programming, Software installation	1
	31	T	3	Command-line, revision control, keeping logs with Git and GitHub	
Sep	2	R	4	Organizing your work in files/directories with command line	2
	7	T	5	'Hello World!', print, Variables, expressions, statements	
	9	R	6	Functions, tuples, lists, modules – Practicum	3
	14	T	7	numpy: numerical arrays, implicit math, and broadcasting	
	16	R	8	numpy– Practicum	4
	21	T	9	Quiz 1 - matplotlib: Visualizing data in 2D	
	23	R	10	Strings, dictionaries, formatting	5
	28	T	11	Conditionals and logic part 2: IF, FOR, WHILE	
	30	R	12	Conditionals and logic part 1: IF, FOR, WHILE – Practicum	6
Oct	5	T	13	Midterm Due	
	7	R	14	I/O, storing data, pickling, pandas, reading data	7
	12	T	15	Quiz 2- Objects: Classes and Attributes	
	14	R	16	Objects: Methods and Inheritance - Practicum	8
	19	T	17	Software development: revision control, debugging	
	21	R	18	Errors, exceptions and logging in Python – Practicum	9
	26	T	19	Advanced 2D plotting, colorblind and printer friendly	
	28	R	20	Visualizing data in 3D, Reporting your work - Practicum	10
Nov	2	T	21	Quiz 3 - Dimensionality of a problem and its reduction	
	4	R	22	Algorithmic efficiency & Practicum	11
	9	T	23	Least squares fitting, Interpolation, extrapolation	
	11	R	24	Least squares fitting, Interpolation, extrapolation - Practicum	12
	16	T	25	Integration, differentiation	
	18	R	26	Problems with fitting data: over and underfitting - Practicum	13
	23	T	--	Probabilities and Monte Carlo	
	25	R	--	Thanksgiving	
	30	T	27	Databases, Machine Learning	14

Dec	2	R	28	Final Project Due
	9	T	29	Project solution – Open topic

10. Disclaimer

This syllabus is a guideline, not a contract. The instructor may alter it at any time.

11. Departmental Policies

Missed Work Policy

It is Physics Department policy that making up missed work will only be permitted for University sanctioned activities and bona fide medical or family reasons. Authentic justifying documentation must be provided in every case (in advance for University-sanctioned activities). At the discretion of the instructor, the make-up may take any reasonable and appropriate form including, but not limited to, the following: a replacement exam, replacing the missed work with the same score as a later exam, allowing a “dropped” exam, replacing the missed work with the homework or quiz average.

NOTE: Those unable to attend class in person on a particular day may, by arrangement with the instructor, attend via the internet. This is intended mainly to handle mild flu cases and should not be used when it is physically possible for the student to attend class.

Disabilities Policy

The University of Central Florida is committed to providing reasonable accommodations for all persons with disabilities. This syllabus is available in alternate formats upon request. Students with disabilities who need accommodations in this course must contact the professor at the beginning of the semester to discuss needed accommodations. No accommodations will be provided until the student has met with the professor to request accommodations. Students who need accommodations must be registered with Student Accessibility Services, Student Resource Center Room 132, phone (407) 823-2371, TTY/TDD only phone (407) 823-2116, before requesting accommodations from the professor.

Establishing Academic Activity For Financial Aid

All instructors/faculty are required to document students' academic activity at the beginning of each course. In order to document that you began this course, please be present in class, where attendance will be taken, and/or complete the first homework assignment, by the end of the first week of classes or as soon as possible after adding the course.

Failure to do so may result in a delay in the disbursement of your financial aid.

12. Required UCF Policies and Statements

The following material is required to be included in all UCF syllabi. It is important information that all students should know and follow. It comes from: <https://ctl.ucf.edu/teaching-resources/course-design/syllabus-statements/#core>

UCF Core Syllabus Statements

See section 8 of UCF Policy 4-403.1, “Required Elements of the Course Syllabus”

Academic Integrity

Students should familiarize themselves with UCF’s Rules of Conduct at <http://osc.sdes.ucf.edu/process/roc>. According to Section 1, “Academic Misconduct,” students are prohibited from engaging in

1. Unauthorized assistance: Using or attempting to use unauthorized materials, information or study aids in any academic exercise unless specifically authorized by the instructor of record. The unauthorized possession of examination or course-related material also constitutes cheating.
 2. Communication to another through written, visual, electronic, or oral means: The presentation of material which has not been studied or learned, but rather was obtained through someone else’s efforts and used as part of an examination, course assignment, or project.
 3. Commercial Use of Academic Material: Selling of course material to another person, student, and/or uploading course material to a third-party vendor without authorization or without the express written permission of the university and the instructor. Course materials include but are not limited to class notes, Instructor’s PowerPoints, course syllabi, tests, quizzes, labs, instruction sheets, homework, study guides, handouts, etc.
 4. Falsifying or misrepresenting the student’s own academic work.
 5. Plagiarism: Using or appropriating another’s work without any indication of the source, thereby attempting to convey the impression that such work is the student’s own.
 6. Multiple Submissions: Submitting the same academic work for credit more than once without the express written permission of the instructor.
 7. Helping another violate academic behavior standards.
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For more information about Academic Integrity, consult the International Center for Academic Integrity <http://academicintegrity.org> .

For more information about plagiarism and misuse of sources, see “Defining and Avoiding Plagiarism: The WPA Statement on Best Practices” <http://wpacouncil.org/node/9> .

Responses to Academic Dishonesty, Plagiarism, or Cheating
Students should also familiarize themselves with the procedures for academic misconduct in UCF’s student handbook, The Golden Rule <http://goldenrule.sdes.ucf.edu/docs/goldenrule.pdf> . UCF faculty members have a responsibility for students’ education and the value of a UCF degree, and so seek to prevent unethical behavior and when necessary respond to academic misconduct. Penalties can include a failing grade in an assignment or in the course, suspension or expulsion from the university, and/or a “Z Designation” on a student’s official transcript indicating academic dishonesty, where the final grade for this course will be preceded by the letter Z. For more information about the Z Designation, see <http://goldenrule.sdes.ucf.edu/zgrade> .

Course Accessibility Statement

The University of Central Florida is committed to providing access and inclusion for all persons with disabilities. Students with disabilities who need disability-related access in this course should contact the professor as soon as possible. Students should also connect with Student Accessibility Services (SAS) <http://sas.sdes.ucf.edu/> (Ferrell Commons 185, sas@ucf.edu, phone 407-823-2371). Through Student Accessibility Services, a Course Accessibility Letter may be created and sent to professors, which informs faculty of potential access and accommodations that might be reasonable. Determining reasonable access and accommodations requires consideration of the course design, course learning objectives and the individual academic and course barriers experienced by the student.

Campus Safety Statement

Emergencies on campus are rare, but if one should arise during class, everyone needs to work together. Students should be aware of their surroundings and familiar with some basic safety and security concepts.

- In case of an emergency, dial 911 for assistance.
 - Every UCF classroom contains an emergency procedure guide posted on a wall near the door. Students should make a note of the guide’s
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physical location and review the online version at http://emergency.ucf.edu/emergency_guide.html .

- Students should know the evacuation routes from each of their classrooms and have a plan for finding safety in case of an emergency.
- If there is a medical emergency during class, students may need to access a first-aid kit or AED (Automated External Defibrillator). To learn where those are located, see <http://www.ehs.ucf.edu/AEDlocations-UCF> (click on link from menu on left).
- To stay informed about emergency situations, students can sign up to receive UCF text alerts by going to <https://my.ucf.edu> and logging in. Click on “Student Self Service” located on the left side of the screen in the toolbar, scroll down to the blue “Personal Information” heading on the Student Center screen, click on “UCF Alert”, fill out the information, including e-mail address, cell phone number, and cell phone provider, click “Apply” to save the changes, and then click “OK.”
- Students with special needs related to emergency situations should speak with their instructors outside of class.
- To learn about how to manage an active-shooter situation on campus or elsewhere, consider viewing this video (<https://youtu.be/NIKYajEx4pk>).

Campus Safety Statement for Students in Online-Only Courses

Though most emergency situations are primarily relevant to courses that meet in person, such incidents can also impact online students, either when they are on or near campus to participate in other courses or activities or when their course work is affected by off-campus emergencies. The following policies apply to courses in online modalities.

- To stay informed about emergency situations, students can sign up to receive UCF text alerts by going to <https://my.ucf.edu> and logging in. Click on “Student Self Service” located on the left side of the screen in the toolbar, scroll down to the blue “Personal Information” heading on the Student Center screen, click on “UCF Alert”, fill out the information, including e-mail address, cell phone number, and cell phone provider, click “Apply” to save the changes, and then click “OK.”
 - Students with special needs related to emergency situations should speak with their instructors outside of class.
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Make-Up Assignments for Authorized University Events or Co-curricular Activities

Students who represent the university in an authorized event or activity (for example, student athletes) and who are unable to meet a course deadline due to a conflict with that event must provide the instructor with documentation in advance to arrange a make-up. No penalty will be applied. For more information, see the UCF policy at

<https://policies.ucf.edu/documents/4-401.2MakeUpAssignmentsorAuthUnivEventsorCocurricularActivities.pdf>

Religious Observances

Students must notify their instructor in advance if they intend to miss class for a religious observance. For more information, see the UCF policy at <https://regulations.ucf.edu/chapter5/documents/5.020ReligiousObservancesFINALJan19.pdf>

Deployed Active Duty Military Students

Students who are deployed active duty military and/or National Guard personnel and require accommodation should contact their instructors as soon as possible after the semester begins and/or after they receive notification of deployment to make related arrangements.

In-Class Recording Statement

Students may, without prior notice, record video or audio of a class lecture for a class in which the student is enrolled for their own personal educational use. A class lecture is defined as a formal or methodical oral presentation as part of a university course intended to present information or teach students about a particular subject. Recording classroom activities other than class lectures, including but not limited to lab sessions, student presentations (whether individually or part of a group), class discussion (except when incidental to and incorporated within a class lecture), clinical presentations such as patient history, academic exercises involving student participation, test or examination administrations, field trips, and private conversations is prohibited. Recordings may not be used as a substitute for class participation and class attendance, and may not be published or shared without the written consent of the faculty member. Failure to adhere to these requirements

may constitute a violation of the University's Student Code of Conduct as described in the Golden Rule.

Required Statement Regarding COVID-19

To protect members of our community, everyone is required to wear a facial covering inside all common spaces including classrooms (<https://policies.ucf.edu/documents/PolicyEmergencyCOVIDReturnPolicy.pdf>). Students who choose not to wear facial coverings will be asked to leave the classroom by the instructor. If they refuse to leave the classroom or put on a facial covering, they may be considered disruptive (please see the [Golden Rule](#) for student behavior expectations). Faculty have the right to cancel class if the safety and well-being of class members are in jeopardy. Students will be responsible for the material that would have been covered in class as provided by the instructor.

Depending on the course of the pandemic during the semester, the university may make changes to the way classes are offered. If that happens, please look for announcements or messages in Webcourses@UCF or Knights email about changes specific to this course.

COVID-19 and Illness Notification – Students who believe they may have a COVID-19 diagnosis should contact UCF Student Health Services (407-823-2509) so proper contact tracing procedures can take place.

Students should not come to campus if they are ill, are experiencing any symptoms of COVID-19, have tested positive for COVID, or if anyone living in their residence has tested positive or is sick with COVID-19 symptoms. CDC guidance for COVID-19 symptoms is located here: (<https://www.cdc.gov/coronavirus/2019-ncov/symptoms-testing/symptoms.html>)

Students should contact their instructor(s) as soon as possible if they miss class for any illness reason to discuss reasonable adjustments that might need to be made. When possible, students should contact their instructor(s) before missing class.

In Case of Faculty Illness – If the instructor falls ill during the semester, there may be changes to this course, including having a backup instructor take over the course. Please look for announcements

or mail in Webcourses@UCF or Knights email for any alterations to this course.

Course Accessibility and Disability COVID-19

Supplemental Statement – Accommodations may need to be added or adjusted should this course shift from an on-campus to a remote format. Students with disabilities should speak with their instructor and should contact sas@ucf.edu to discuss specific accommodations for this or other courses.
