Introduction to Computational Methods
Physics 3750
Fall 2017

Lecture/Labs
> 1 credit hour, 2 in-class hours/week
> Mondays, 1:00 pm to 2:50 pm
> Room: Physics 377

Final Exam Time
> Wednesday, December 13, 12:30pm to 2:30pm

Instructors
> Professor Christopher V. Kelly
> Office: 283 Physics Building
> Email: cvkelly@wayne.edu
> Phone: 313-577-8471
> Office Hours: Mondays and Wednesdays, Noon to 1:00 pm
> > or by appointment.

Recommended Texts
> A Student's Guide to Python for Physical Modeling (PPM)
> by Jesse M. Kinder & Philip Nelson
> http://press.princeton.edu/titles/10644.html

Online Resources
> Blackboard
> > blackboard.wayne.edu
> Online tutorials
> > www.learnpython.org/ ; www.datacamp.com ; www.tutorialspoint.com/python/ ; etc.
> Software
> > https://www.anaconda.com/download/ with Python version 3.6

Pre-requisites: PHY 2130/2140 or PHY 2170/2180, MAT 2020, or consent of the instructor.
Recommended Co-registered with: PHY 3700

Software and Computers
> We will be primarily working with Python this semester and also gaining a little exposure to MATLAB (The MathWorks, Inc.). All software is available to you in the Physics Computer Lab (377 Physics) from 8:30am to 5pm on work days via a key from the Physics Department office. Python is free. A basic, student version of MATLAB costs $50, but is not required for this course.

Add/Drop Dates
> Please refer to WSU's Academic and Registration Calendar (http://reg.wayne.edu/students) for the University's add and drop dates. Note: failing to drop a class by a deadline may hurt your GPA, financial aid status, and/or your tuition bill.

How to be successful in this course

The key to being successful in this course is to engage at all levels. Read the relevant sections of the text before lectures/labs, be attentive during lectures, be a leader during labs, ask questions, learn from your mistakes on homework, quizzes, and exams, and follow up during office hours. Students who display a strong desire to thrive will display their efforts via detailed questions from the readings or assignments that reflect their individual effort to understand the subject matter. Utilize the numerous resources available to you and recognize that success in this course will not be achieved solely through passive observation of the lectures and labs.

Course Content

This course will introduce the principles of computer programming. We will roughly follow the content in PPM but there will be opportunities for independent projects of topics that interest you individually.

Much of this course content has been assembled by Professor Peter Hoffmann and modified by your instructor. Thanks to Prop. Hoffmann, for all of his hard work!

Overarching Learning Objectives

1) Demonstrate a conceptual understanding of computer programming.
2) Demonstrate competence in Python programming.
3) Demonstrate the capability to learn new programming skills through independent use of help menus and online resources.

Final Grades

Final grades will be calculated from 50% participation and in-class exercises, 30% homework, and 20% final project and presentation. Final grades may be rescaled to increase the average student's grade, however the minimum letter grade to be awarded based on final percentages are shown in this chart:

Final Cumulative Work	Minimum Letter Grade
90%	A-
80%	B-
70%	C-
60%	D-

Exams

There will be no exams in this course. However, large projects and presentations represent the large fraction of the final grade. Presentation of the final projects may occur during the final exam time.

Homework

Homework will be assigned and submitted every week. Usually, homework will require the writing and submission of working Python code. Code should be submitted as an easy-to-read HTML or PDF file that shows all your computations completed successfully.

Students are encouraged to work together on the homework via small study groups. However, each student is required to write their own code and answers without copying or plagiarizing others. Your homework is expected to be a reflection of your effort and your understanding. Any copying or plagiarizing will be considered cheating, result in no credit, and possibly university-level disciplinary actions (http://www.otl.wayne.edu/wsu_integrity.php). Your homework and project submissions may be checked for plagiarism with SafeAssign.

Participation

Your participation in all activities of the course will help you and other students learn the material. Participation points will be given for pre-class surveys, in-class activities, and out-of-class

study-group participation. Frequently in this course, students will be offered the chance to explain how they achieved a programming feat. Participation points will count for up to 50% of your final grade. Repeated absences will decrease your in-class participation grade. Should your participation in class prove to be distracting or disruptive, you may be asked to leave for the day and come to the lecturer's office hours to discuss the situation.

Projects and Presentations

A final presentation will be required by each student on an individual topic. Topics may come from your out-of-class research projects and/or your personal interest. Each project will require a use of Python to achieve something that would be near-impossible to do without computer programming.

Class time has been set aside to allow for each student to present their project to the rest of the class. Each presentation should describe the big picture and purpose of the project, the psuedo-code outline followed, a few of the particularly advanced concepts used in your code, and the working code.

Missed Deadlines

It is important to turn in all assignments in a timely manner and your grade will suffer if you fail to do so. However, I want to support your learning while recognizing that life can be complex. For this reason, homework and project grades will be decreased depending on how late the assignments are turned in, as shown in this

Days Late	Reduction in Homework Grade	Reduction in Project Grade
1	15%	30%
≤7	30%	At least 50%
>7	At least 50%	At least 50%

table. Exceptions can be made on a case-by-case basis, but only with pre-approval from the instructor.

Incompletes

The mark of I for Incomplete is given to either an undergraduate or a graduate student when he/she has not completed all of the course work as planned for the term and when there is, in the judgment of the instructor, a reasonable probability that the student can complete the course successfully without again attending regular class sessions. The student should be passing at the time the grade of 'I' is given. A written contract specifying the work to be completed should be signed by the student and instructor. Responsibility for completing all course work rests with the student (*2011-2013 WSU Undergraduate Bulletin*, 41).

Students with Disabilities

If you have a documented disability that requires accommodations, you will need to register with Student Disability Services for coordination of your academic accommodations. The Student Disability Services (SDS) office is located in the Adamany Undergraduate Library. SDS telephone number is 313-577-1851 or 313-577-3365 (TTD only). Once you have your accommodations in place, I will be glad to meet with you privately during my office hours or at another agreed upon time to discuss your needs. Student Disability Services' mission is to assist the university in creating an accessible community where students with disabilities have an equal opportunity to fully participate in their educational experience at Wayne State University. Also see: http://studentdisability.wayne.edu.

Syllabus Modifications

I will be trying a number of teaching techniques throughout this semester, some of which are described in this syllabus. As I learn what is working and what is not, I will be modifying the policies of this course. And so, this syllabus is a dynamic document that may be updated as the semester progresses.

Academic Misconduct

Academic misbehavior means any activity that tends to compromise the academic integrity of the institution or subvert the education process. All forms of academic misbehavior are prohibited at Wayne State University, as outlined in the Student Code of Conduct (http://doso.wayne.edu/codeofconduct.pdf). Students who commit or assist in committing dishonest acts are subject to downgrading (to a failing grade for the test, paper, or other course-related activity in question, or for the entire course) and/or additional sanctions as described in the Student Code of Conduct. Cheating: Intentionally using or attempting to use, or intentionally providing or attempting to provide, unauthorized materials, information or assistance in any academic exercise. Examples include: (a) copying from another student's test paper; (b) allowing another student to copy from a test paper; (c) using unauthorized material such as a "cheat sheet" during an exam. (d) unauthorized access to a test from a previous semester also constitutes cheating. Fabrication: Intentional and unauthorized falsification of any information or citation. Examples include: (a) citation of information not taken from the source indicated; (b) listing sources in a bibliography not used in a research paper. Plagiarism: To take and use another's words or ideas as one's own. Examples include: (a) failure to use appropriate referencing when using the words or ideas of other persons. (b) altering the language, paraphrasing, omitting, rearranging, or forming new combinations of words in an attempt to make the thoughts of another appear as your own. Other forms of academic misbehavior include, but are not limited to: (a) unauthorized use of resources, or any attempt to limit another student's access to educational resources, or any attempt to alter equipment so as to lead to an incorrect answer for subsequent users; (b) enlisting the assistance of a substitute in the taking of examinations; (c) violating course rules as defined in the course syllabus or other written information provided to the student; (d) selling, buying or stealing all or part of an un-administered test or answers to the test; (e) changing or altering a grade on a test or other academic grade records.

WSU Resources for Students
- Student Disability Services (SDS) http://studentdisability.wayne.edu/
- Academic Success Center http://www.success.wayne.edu/
- Counseling and Psychological Services (CAPS) http://www.caps.wayne.edu
- Dean of Students' Office http://www.doso.wayne.edu
- College of Liberal Arts & Sciences: http://clasweb.clas.wayne.edu/CurrentStudents
- Departmental Website: http://physics.clas.wayne.edu//

Schedule and Learning Outcomes

<u>Week 1</u> - Sections 1.1 – 1.2
- Explain the concept of algorithms and discuss the importance of correct sequencing
- Explain the concept of states in a computer
- Explain the difference between a variable assignment and variable equalities
- Use the Python Console to perform simple commands and calculations

<u>Week2</u> – Sections 1.3 – 1.4
- Write and run simple scripts.
- Search for help on using Python
- Recognize error messages and use them to correct errors
- Import python modules, especially numpy and pyplot
- Write simple Python expressions
- Perform simple calculations on the command line
- Use simple functions
- Define what objects, variables, functions, methods and attributes are

<u>Week 3</u> - Sections 2.1 - 2.3
- Define different data types: Integers, floating point numbers, characters, Booleans
- Use the dir command to explore objects
- Distinguish mutable and immutable objects
- Create and distinguish lists, tuples and arrays
- Modify arrays in various ways
- Use slicing to obtain parts of arrays
- Create and manipulate string objects

<u>Week 4</u> - Sections 2.4 – 2.6
- Program loop structures
- Use and distinguish for and while loops
- Apply vectorization to calculations over arrays
- Create multidimensional arrays and matrices, and manipulate them
- Reduce arrays and flatten them
- Write simple scripts using the Spyder editor
- Properly comment scripts
- Use descriptive variable and function names
- Calculate various properties of arrays, such as sums, products, means, maxima and minima
- Distinguish between element-wise and matrix multiplication

<u>Week 5</u> - Sections 2.7-2.8
- Apply branching to program contingency into scripts
- Use the if, elif, else structure correctly
- Program nested structures in loops and branching

- Write simple programs with loops, branching and nesting

Week 6 - Sections 3.1-3.2
- Import and export data into a program
- Write simple data analysis programs

Week 7 - Section 3.3
- Plot data
- Use attributes to control the appearance of a data plot
- Create linear, log, multiple and sub-plots

Week 8 - Chapter 4
- Write programs that import, manipulate, export and plot data

Week 9 – Section 5.1
- Write functions

Week 10 - Sections 5.2-5.4
- Use random numbers
- Create histograms, bar graphs, contour plots and surfaces

Week 11 - Sections 5.5-5.6
- Solve nonlinear equations by finding roots
- Solve systems of linear equations

Week 12 - Sections 5.7
- Integrate functions numerically

Week 13/14
- Present a project plan
- Work in a team to complete a modestly complex, multipart project

Week 15/Final exam time
- Present project results both orally and in written form