E7: Introduction to Computer Programming for Scientists and Engineers
University of California at Berkeley, Spring 2017
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Course Syllabus
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Acknowledgments:
Many thanks to a number of previous E7 instructors for providing past E7 syllabi

Contact Information

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Overview and Course Objectives

Engineers and scientists need to have strong computing skills so they can acquire and analyze data from laboratory experiments and field studies, simulate and gain insight into how natural and engineered systems behave, and design and test new products and processes. Effective use of computer graphics to help visualize and communicate results of these analyses is also important.

Computing skills can help you to develop your own applications, follow the professional path of your choice, and/or become an eminent researcher in your field of interest. I therefore encourage you to think of programming knowledge as critical to your future. Additionally, computer programming can be a most enjoyable skill to develop and master, as it can be applied to virtually any kind of subject matter, scientific or not.

Goals for this semester are to (1) introduce you to computer programming – including general concepts and theory as well as practical aspects, (2) learn about important numerical methods that are widely used in scientific computing, and (3) become comfortable as a programmer, not just this semester, but also for future classes and in the next stages of your

career.

In this class, you will learn fundamental concepts of computer programming and a number of numerical methods that are often useful for engineering and science applications. The programming language used here is Matlab, but the knowledge discussed in this class should be readily transferable to a number of other programming languages. In other words, you will be learning "computer programming and numerical methods, using Matlab as a tool", rather than just learning "Matlab". One of the goals of this class is to give you the knowledge and tools that will allow you to quickly learn the fundamentals of many other programming languages. Other skills that you should develop throughout this course include:

- Working comfortably with data and functions in the Matlab environment.
- Implementing iterative and recursive methods to solve engineering problems.
- Deriving and applying numerical methods for least squares regression, interpolation, root finding, differentiation, and integration.
- Implementing algorithms to approximate solutions to ordinary differential equations that describe a physical process.
- Creating clear and informative data visualizations.
- Applying algorithmic thinking to decompose problems into smaller components that can be programmed on computers.
- Turning mathematical models into computer code to solve engineering problems.
- Working as a team to design and code programs made of multiple components.
- Estimating how the computational cost of a computer algorithm grows with the size of the problem to solve.
- Applying computer programming to your life, to make your life easier.

Course Logistics

Prerequisites

Both Math 1A and Math 1B are required prerequisites if you are taking E7. Math 1B may be taken concurrently. The class does not require or assume any prior experience with computer programming; it is truly an introductory class.

Course Site

bCourses (http://bcourses.berkeley.edu) will be used as a central source of information and course material. The different uses of bCourses for this class are detailed in the relevant sections below.

Communications

Important E7-related information will be communicated using one or a combination of the following three methods:

1. bCourses announcements.
2. bCourses messages (see section "Inbox" in bCourses).
3. email. For security reasons, all E7-related email communications that you will receive from any member of the E7 teaching team (me: the instructor, GSIs, Readers) should come from our respective @berkeley.edu email addresses. If in doubt, contact me, the head GSI, and/or your GSI by emailing us on our @berkeley.edu email addresses. I also ask you to always use your @berkeley.edu email address when communicating with members of the E7 teaching team. Questions regarding online and information security can be addressed to security@berkeley.edu.

You are responsible for keeping up with E7-related communications made through these three communication channels. To facilitate this task, you may wish to consider configuring bCourses such that bCourses announcements and messages are also sent automatically to your @berkeley.edu email address. Note that these automatic notifications may be sent from an email address other than a @berkeley.edu email address. If in doubt, look for the original message or announcement on bCourses.

Installing Matlab on Your Personal Device(s)

Installing Matlab on your personal device(s) is optional, but may give you flexibility as to where and when you work on E7 material. It is not, however, a requirement to do so, since Matlab is available in computer labs that are reserved for E7 this semester. Matlab is also available in various other campus labs (check with computer support staff in your department to find out more). As a UC Berkeley student, you can obtain a Matlab license to install Matlab for free on your personal devices, and that is valid for the current year, by following instructions that can be found at http://software-central.berkeley.edu. If you do so, please note that it can take a week or more to receive your Matlab license after you request it.

Reading

Reading will be assigned from the following textbook:

An Introduction to MATLAB Programming and Numerical Methods for Engineers by Timmy Siauw and Alexandre M. Bayen, Elsevier Inc, 2015.

Additionally, a number of bCourses "Pages" on specific topics will be written and maintained by the teaching team throughout the semester. Some of these Pages will contain material that you will be required to know, while the others will contain optional material aimed at enriching your E7 experience. All material on these Pages will be labeled as either required or optional.

You are responsible to keep up to date with the content of these Pages. Major changes and additions will be announced by bCourses announcements, but minor changes (*e.g.,* re-wording, fixing typos, adding more examples) may not.

Lectures and Discussions

Lectures and discussions are Mondays, Wednesdays, and Fridays from 2 pm to 3 pm in 155 Dwinelle Hall. These three hours will be dedicated to learning, understanding, and discussing concepts of computer programming and numerical methods. Please be ready to take notes and work on drills during these lectures and discussions.

Use of laptop computers will be restricted to people sitting in the rows closest to the front of the class. We will start the semester by authorizing the use of laptop computers in the 10 front rows only. This number may be adjusted throughout the semester at my discretion. These rows are not reserved for students who wish to use their laptop computers. In other words, students who are not using laptop computers during lecture and discussion are also welcome to sit in the front rows.

In addition to the three hours of lecture and discussion, you will have 4 hours of scheduled lab sections per week, where you will be given the opportunity to apply the concepts seen in lecture, and practice programming on a computer. Logistics regarding lab sections are discussed below.

Laboratory Sections (or simply "Lab Sections")

In lab section, you will spend time programming on a computer, and you will overcome challenges so you build confidence and improve your skills. You must be enrolled in a specific lab section. Each lab section meets for a total of 4 hours per week, either Monday/Wednesday or Tuesday/Thursday. In each lab section, two GSIs will be there to help you understand and apply the course material, and to answer your questions. One of these GSIs will be your primary GSI (or simply "your GSI"), who should be your primary point of contact for all E7-related questions. Your GSI will also help you with your lab assignments, with the final project, and with studying for E7 exams. The other ("secondary") GSI in your lab section will assist the primary GSI in answering your questions. A schedule of all the E7 lab sections offered this semester, along with the names of the GSIs assigned to each of these sections, will be posted and maintained on bCourses.

We ask you to not attend E7 lab sections into which you are not enrolled. We want to provide a high-quality laboratory experience for all students, which is why we limit the number of students present during each lab section.

We strongly encourage you to bring a removable storage device (*e.g.,* flash drive) to lab sections to save the work that you do there. **All data saved to the lab computers will be erased upon logging out**, so it is critical that you either back up your work on a removable storage device or email your work to yourself. Alternatively, you can submit your complete or partially complete work to bCourses, and re-submit an updated version later if necessary. Yet another approach is to work on your laptop computer during lab section. In either case, we recommend you to back up your work regularly.

Lab Assignments (or simply "Labs")

Lab assignments will be posted on Thursdays, and must be completed during the following week. You will be expected to develop, test, and document Matlab code, and to submit your code electronically via bCourses by 12 pm on the Friday of the week following the assignment date. To account for possible bCourses upload traffic jams, there will be a 2-hour grace period for submitting your work. Work will therefore be accepted if submitted by 2 pm on the due day. There will be **no exceptions** in accepting late lab assignment submissions after 2 pm, so push the limits of the grace period at your own risk. You can re-submit your work on bCourses, so you are encouraged to always submit partial work early during the week, in case you are unable to submit your final work on time.

We will proof-read and test lab assignments for scope, clarity, errors, and time demands before they are posted on bCourses. Despite these efforts, errors may still slip through, and wording may remain ambiguous in some cases. Corrections and clarifications to lab assignments, and/or updated lab assignment instructions will be posted on bCourses as necessary. bCourses announcements will be made every time modifications are made to lab assignment instructions. Solutions to lab assignments will be posted on bCourses the week after the due date.

Lab Grading Procedure

Your lab assignment submissions will be graded by an automatic grading system which has been designed for E7. In the lab assignment instructions, you will be provided with some test cases (*i.e.* sample input data) and associated answers (*i.e.* expected outputs) that you can use to help test your code. The provided test cases are not exhaustive, and it is your responsibility to ensure that your code works in general, not just for a few supplied test cases. We will use additional undisclosed test cases in grading your lab assignments. You will receive feedback for each lab assignment showing your score on each question and where you lost points. You may wish to compare your output with the output in the solutions to understand what is going on in cases where you lost points.

Regrade Requests

Any lab assignment grading disputes must be registered no later than one week after your lab assignment score is posted on bCourses, rounded up to 11:59 pm of the last day of this period. For example, if grades for Lab 01 are released on Friday February 3$^{\text{rd}}$, you will have until Friday February 10$^{\text{th}}$ at 11:59 pm to submit re-grade requests for Lab 01. Instructions for submitting re-grade requests will be written up and maintained as a bCourses Page. You are responsible for being familiar with the latest re-grade request instructions before submitting any re-grade request.

Lab Collaboration Policy

We encourage you to get to know the GSIs and other students in your lab section, and to discuss lab assignments with them. It is fine to ask for and offer advice, and to answer ques-

tions from other students during lab sections. **You must not email, post, or otherwise share your code with others, and you may not copy the computer code of another student. More generally, you may not submit the work of someone else, or work together in teams and claim jointly authored or copied work to be your own.** We will use special software to check submitted computer code for plagiarism. In situations such as a function header at the beginning of a file where everyone's code is similar, similarities do not matter and will be ignored. In areas where most codes are dissimilar, any remaining ones that show strong similarities will be flagged. The penalty for copying will be a score of –100 (negative one hundred) on that lab assignment for all involved (original author and any copiers). A repeat offense earns a final grade of F and referral to the Center for Student Conduct. A negative score on a lab assignment means you will lose points earned from completing other lab assignments. A score of -100 obtained as a result of plagiarism will not be dropped for the purpose of calculating final course grades (see Section "Course Grading" below). In other words, a score of -100 is undroppable. Your lowest 2 lab scores among the other lab assignments can still be dropped.

Programming Project (or simply "Project")

In the second part of the semester, you will work in teams of two or three on a programming project. All team members must be enrolled in the same lab section. The project is designed to be a fun and comprehensive synthesis of the programming concepts you will learn throughout the semester. When working on the project, **you will have the opportunity to explore and try many different algorithms and programming techniques, as well as design your own**. Further details about the project, including instructions, guidelines, and important dates, will be given later.

The project is the only assignment for which you are allowed to work together on writing code, but only with the members of your team. We will still control for plagiarism between different teams. The penalty for plagiarism between programming project teams will be explained when the instructions for the project are released to you.

Exams

There will be one in-class midterm (Wednesday March 1$^{\text{st}}$, in class) and a final exam (Tuesday May 9$^{\text{th}}$, from 11:30 am to 2:30 pm) covering material discussed in class and in lab sections. The final exam will be cumulative: it will cover topics discussed in the class throughout the entire semester, including topics discussed before the midterm exam. You **must** bring your Cal Student ID to all exams. Please check the final exam schedule now so you can make changes to your course enrollments in case you have schedule conflicts or too many final exams on the same day.

Accomodations

Students with disabilities should contact the Disabled Students Program (DSP) office first, and then me, as soon as possible, but in any event at least a month in advance of any exam

for which special accommodations are requested.

Getting Help

This section describes the various ways for you to get help within the course.

Lab Sections

The best way to get help for understanding the course material and completing assignments (lab assignments and project) is to ask questions in person to GSIs during your scheduled lab sections. We encourage you to be present from the very beginning of your lab sections, and to come prepared with questions. Guidelines for communicating with your GSI via email or bCourses messages will be explained to you by your GSI during your first lab section.

Frequently Asked Questions (FAQs)

For each assignment (lab assignment and project) and before each exam, one or more GSIs will compile a list of frequently asked questions (FAQs) and write up answers to these questions in a bCourses Page. There will be one such Page for each assignment and for each exam. FAQs will be gathered from lab sections and from the bCourses Discussions platform (see below). You should consult the relevant lists of FAQs (and their answers) every time before you:

- come to lab section.
- ask a question on the bCourses Discussions platform.

bCourses Discussions platform

Discussions will be set up on bCourses ("Discussions" section in bCourses) so that students can discuss assignments and exams, ask questions, and answer each other's questions. This platform will be used as a student-to-student help platform only, and the teaching team will not answer any question, nor modify or comment on any answer posted there. The teaching team will, however, be monitoring the platform for appropriateness of discussion. This platform is made available to you to encourage you to help each other in your studies. Discussions on this platform are restricted to E7-related material. One discussion thread will be created by the teaching team for each lab assignment question, for the project, for discussion related to preparing for the midterm exam, and for discussion related to preparing for the final exam. Please post to the relevant discussion thread.

When posting on this platform, keep in mind the rules regarding plagiarism. In particular, do not post code that can be submitted to complete parts or the entirety of an assignment. You will not be able to modify or edit your posts once posted, so please proof-read your messages carefully before publishing them. If you publish a post by mistake and want it to be removed from the discussion, contact your GSI.

Drop-in Hours

The computer lab in 1109 Etcheverry Hall will be open for "drop-in" (*i.e.* it will be open for you to use outside of any scheduled lab section) during the following times:

- Mondays and Wednesdays from 3 pm to 4 pm.
- Fridays from 8 am to 5 pm.

One or more GSIs will be available in this room to answer your E7-related questions on Fridays from 9 am to 12 pm, but not during the remainder of the drop-in hours.

Office Hours

You are also welcome and encouraged to ask me questions about the concepts taught and discussed in lectures and discussions during my office hours. Due to the large class size, however, I will not be able to provide assistance with lab or project assignments during office hours or by email. Similarly, the head GSI will not be able to provide assistance with lab or project assignments by email.

Summary

To summarize, you can obtain help on course material but not on assignments by asking me questions during my office hours. You can obtain help on both course material and on assignments by:

- Asking questions in person to GSIs during your lab section.
- Asking questions in person to GSIs in 1109 Etcheverry Hall on Fridays between 9 am and 12 pm.
- Consulting the lists of frequently asked questions (FAQs) in the bCourses Pages.
- Asking your fellow students in person or in the relevant bCourses discussion threads.

Please be courteous and respectful of others in all interactions, whether online or in person.

We want everyone to succeed, enjoy the class, and learn a lot about computer programming and numerical methods. If you are having issues that you cannot resolve by talking with your GSI, please do not hesitate to contact the head GSI and/or me. We are here to help you succeed and have a good experience in this class.

You should be aware that **the material covered during the first few weeks of class will be used throughout the rest of the semester**, so we encourage you to stay up to date with the material from the very beginning, and to **not hesitate to seek all the help you need early on in the semester**.

Course Grading

Your final course grade will be determined based on your participation to scheduled lab sections, your evaluated work on the lab assignments, evaluation of your programming project,

and your scores on the midterm and final exams. Your final course grade will be evaluated using both grading options listed in the table below, and we will use the option that results in the higher score, separately for each student. A minimum overall score of 60% is needed to pass the class.

		Relative contribution to overall course grade
Option 1	Participation to lab sections	15%
	Lab assignments	35%
	Programming project	10%
	Midterm exam	10%
	Final exam	30%
Option 2	Lab assignments	35%
	Programming project	10%
	Midterm exam	15%
	Final exam	40%

You will score one participation (to lab sections) point during a given week if you attend at least one of your scheduled E7 lab sections that week and ask at least one question about E7-related material. You cannot score more than one participation point per week. The maximum participation score is 10 points, but there will be 13 weeks where lab sections are scheduled, so you do not need to ask a question every week in order to get full participation credit. Participation points will be used in the calculation of your final course grade only if they help to increase your grade. These points are being offered to encourage you to (a) actively participate in lab sections, and (b) to get an early start on assignments each week. You can earn participation points only by attending the lab section into which you are actually enrolled. Your final letter grade will be computed on a straight scale unless upward adjustments are necessary. Your grade will not be curved down.

Lab Assignment Weighting and Two Lowest Lab Assignment Scores Drop Policy

For both grading options, your two lowest lab assignment scores will be dropped from the calculation of your course grade. This approach will give everyone some maneuvering room in case of illness, personal/family issues, travel plans, crunch times in other classes, and so on. This drop policy is intended to give you flexibility to handle these situations without needing to email us to request deadline extensions or other special consideration. The remaining lab assignment scores that will actually be used in the calculation of your final course grade will be weighted equally in that calculation.

Concluding Thoughts

Computer programming is a powerful tool that all engineers and scientists should know about. We will work hard to present E7 course material to you in a way that is clear and compelling, and you will work hard learning valuable new skills in this class. We hope you have a great semester!

Tentative Lecture Schedule

The table below shows a tentative lecture and assignment schedule.

Week of	Topics	Textbook Chapters	Exams and Assignments
	Part 1: Fundamental Concepts of Programming		
Jan. 16	Course overview; Matlab as a calculator; Fundamental data types; Variables, assignment, and workspace	1 and 2	
Jan. 23	Scripts; Functions; Arrays	2 and 3	Lab 01 (due Friday)
Jan. 30	More on arrays; Matrices; Branching	2 and 4	Lab 02 (due Friday)
Feb. 6	Iteration; Recursion	5 and 6	Lab 03 (due Friday)
Feb. 13	Debugging; Error handling; More data structures; Binary representation of data	2, 8, and 9	Lab 04 (due Friday)
Feb. 20	Complexity of algorithms; data visualization and plotting	7 and 11	Lab 05 (due Friday)
Feb. 27	Review (Monday); Midterm (Wednesday); Reading and writing text files (Friday)	10	Lab 06 (due Friday) Midterm Exam (Wednesday)
	Part 2: Numerical Methods for Scientists and Engineers		
Mar. 6	Root finding; Systems of linear algebraic equations	12 and 16	Lab 07 (due Friday)
Mar. 13	Least squares regression	13	Lab 08 (due Friday)
Mar. 20	Interpolation; Series	14 and 15	Lab 09 (due Friday)
Mar. 27	Spring break		
Apr. 3	Numerical differentiation; Numerical integration	17 and 18	Lab 10 (due Friday)
Apr. 10	Ordinary differential equations	19	Lab 11 (due Friday)
Apr. 17	Searching and sorting		Lab 12 (due Friday)
Apr. 24	Special topics		Project (due Friday)
May 1	RRR week; Review of course material		
May 8	Week of finals. The E7 Final exam will be on Tuesday May 9^{th}, from 11:30 am to 2:30 pm		Final Exam (Tuesday)