Introduction to Computer Programming for Scientists and Engineers

**Lecture Times:** Monday and Wednesday, 2-3 pm, Pimentel 1

**Instructor:** Raja Sengupta, Civil and Environmental Engineering
Email: rajasengupta@berkeley.edu
Office Hours: Monday & Wednesday 3-4pm at 112 McLaughlin Hall (after lecture) or by appointment

**Head GSIs:** Morgan Wilder and Xin Peng
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Office Hours: By appointment – weekly hours TBA
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**GSI Staff:**

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**Course Material:**
Recommended Text: An Introduction to MATLAB Programming and Numerical Methods for Engineers, Siauw & Bayen. The textbook is available in the campus bookstore.

Recommended Software: You will have access to the latest version of MATLAB in the lab sections (see lab information below for information). You may also install your own copy if you wish to be able to work on your personal computer. The latest version of MATLAB (2019b or 2019a) is provided free of cost to you by the university. For installation instructions, please see this link: https://software.berkeley.edu/matlab.

## I. Course Objectives

E7 is an introductory course on computer programming for lower-division students in science and engineering. The principal goal of the course is to teach basic computer programming concepts and apply them to computer-based problem-solving methods. The course stresses hands-on computer programming using MATLAB, a powerful high-level programming environment.

The prerequisite for this course is Math 1B, which may be taken concurrently.

## II. Course Format

Each E7 student will attend two hours of lecture, four hours of computer laboratory, and one hour of discussion per week. Professor Sengupta will teach the lectures, while the GSI staff lead labs and discussions.

Lab sections will begin in the first week of instruction (Wednesday, January 22) to help with MATLAB downloads and basic syntax. Discussion sections will begin in the first week of instruction (Friday, January 24). **You should only attend the lab and discussion section in which you are officially enrolled.** If you have a conflict with your lab section schedule, please email Morgan to discuss a solution (Subject line – E7 Lab Schedule Conflict)

## III. Course Website

The course website is hosted at bcourses.berkeley.edu. The E7 bcourses site is where you can access course announcements, homework assignments, grades, and other documents pertaining to course material. You will also be required to upload your homework assignments only via bcourses. Additionally, you will have access to a discussion forum (Piazza) where you can communicate with the instructor, GSI's, and fellow classmates about technical questions in the coursework. While you may post questions about the course material, **under no circumstances may you post code or copy another student's work.**

Violations of the honor code will be severely punished. It is your responsibility to check the website frequently, as important information about the course will be routinely posted without being announced in lecture.

We also have Piazza. This is intended for any student to ask questions regarding course material and difficulties in doing the assignments. The GSI team will be online 9am-9pm, Monday to Friday. The signup can be done through this link:
piazza.com/berkeley/spring2020/engineering7

## IV. Grading and Examinations

The course grade will be assigned based on the following percentages:

| | |
|---|---|
| 50% | Homework Assignments |
| 12.5% | Midterm 1 (Wednesday, March 4, 2-3 PM – Lecture Time) Room: TBD |
| 12.5% | Midterm 2 (Wednesday, April 15, 2-3 PM – Lecture Time) Room: TBD |
| 25% | Final Examination (Exam Group 6: 11:30-2:30 PM, Tuesday, May 12) Room: TBD |

Homework will be returned to you typically via bcourses. If you feel that a problem was graded incorrectly, you may submit a re-grade request within one week of receiving the graded assignment. To do this, you must first consult with your Lab GSI and if approved, the Lab GSI will write a short paragraph on the grading error and submit it to the class email for evaluation. **Please note that your entire assignment may be re-graded, not only the sections you question.**

Midterms will be held during lecture times, with rooms to be announced as the midterm draws nearer. If you are a DSP student and require accommodations for the exam, please notify the instructor and Head GSI within the first two weeks of class so that we can provide the necessary accommodations for you. Attendance at all examinations is mandatory unless cleared in advance with the professor and Head GSI.

## V. Assignments

There will be 10 assignments, posted on Fridays of each week. Your lowest score on any individual assignment will be dropped. Assignments must be turned in on bcourses no later than 11.59 pm (slightly before midnight) on Friday of the week they are due. **No late assignments will be accepted.**

We recognize the possibility of a student doing badly on two or more assignments due to circumstances beyond their control or extraordinary commitments to the university. We will consider such situations when assigning the final grade. To receive this consideration:

- submit documentation establishing that the absence or late submission is due to an unfortunate circumstance or extraordinary commitment to the university, and
- submit the late work as soon as possible by email before its solution is posted, to the class email e7.berkeley@gmail.com, with heading: "Late Submission – Assignment XX".

Your case will be put on our record and considered when assigning your final grade. Note to receive this consideration for a late assignment you must submit your work before its solution is posted. Solutions will be posted one week after the assignment is due.

Assignments are to be worked on both during lab sections and outside of class. There are precise formatting requirements for submitting assignments that will be explained in the first assignment and in lab section.

You can discuss the assignments with anyone of your choice. **All material submitted must be your own original work. Copying someone else's work or allowing your work to be copied constitutes cheating. Cheating will result in zero credit for the entire assignment, and will result in further disciplinary action as appropriate under university policy.** For further reference, see the Berkeley Campus Code of Student Conduct at: https://sa.berkeley.edu/conduct.

## VI. MATLAB

MATLAB, like many languages, has an extensive list of additional functions that have been packaged into sets, called toolboxes (other languages usually call them libraries). Toolboxes are a great resource, since someone has often already made a function that does the task you are trying to do. However, for this class your lab functions will all be tested on an identical environment to the ones provided in Etchevery 1109 and 1111. As such, the autograder will only have access to the toolboxes installed on this system. If your code attempts to use a function in another toolboxes, it will throw an error in the autograder and receive 0 points. A full list of the Matlab system and toolboxes installed on the Etcheverry systems can be found below. You can generate a similar list for your Matlab system by typing "ver" into the command window. We recommend that you either check your code on a lab section computer before submission, or that you remove any additional toolboxes on your system manually going to Home -> Environment -> Manage Add-Ons).

The list of the default toolboxes are as follow:

```
MATLAB                                                Version 9.5
Simulink                                              Version 9.2
Aerospace Blockset                                    Version 4.0
Aerospace Toolbox                                     Version 3.0
Antenna Toolbox                                       Version 3.2
Audio System Toolbox                                  Version 1.5
Automated Driving System Toolbox                      Version 1.3
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|---|---|
| Bioinformatics Toolbox | Version 4.11 |
| | |
| Communications Toolbox | Version 7.0 |
| Computer Vision System Toolbox | Version 8.2 |
| Control System Toolbox | Version 10.5 |
| Curve Fitting Toolbox | Version 3.5.8 |
| DSP System Toolbox | Version 9.7 |
| Database Toolbox | Version 9.0 |
| Datafeed Toolbox | Version 5.8 |
| Deep Learning Toolbox | Version 12.0 |
| Econometrics Toolbox | Version 5.1 |
| Embedded Coder | Version 7.1 |
| Filter Design HDL Coder | Version 3.1.4 |
| Financial Instruments Toolbox | Version 2.8 |
| Financial Toolbox | Version 5.12 |
| Fixed-Point Designer | Version 6.2 |
| Fuzzy Logic Toolbox | Version 2.4 |
| GPU Coder | Version 1.2 |
| Global Optimization Toolbox | Version 4.0 |
| HDL Coder | Version 3.13 |
| HDL Verifier | Version 5.5 |
| Image Acquisition Toolbox | Version 5.5 |
| Image Processing Toolbox | Version 10.3 |
| Instrument Control Toolbox | Version 3.14 |
| LTE HDL Toolbox | Version 1.2 |
| LTE Toolbox | Version 3.0 |
| MATLAB Coder | Version 4.1 |
| MATLAB Compiler | Version 7.0 |
| MATLAB Compiler SDK | Version 6.6 |
| MATLAB Report Generator | Version 5.5 |
| Mapping Toolbox | Version 4.7 |
| Model Predictive Control Toolbox | Version 6.2 |
| Optimization Toolbox | Version 8.2 |
| Parallel Computing Toolbox | Version 6.13 |
| Partial Differential Equation Toolbox | Version 3.1 |
| Phased Array System Toolbox | Version 4.0 |
| Polyspace Bug Finder | Version 2.6 |
| Polyspace Code Prover | Version 9.10 |
| Powertrain Blockset | Version 1.4 |
| Predictive Maintenance Toolbox | Version 1.1 |
| RF Blockset | Version 7.1 |
| RF Toolbox | Version 3.5 |
| Risk Management Toolbox | Version 1.4 |
| Robotics System Toolbox | Version 2.1 |
| Robust Control Toolbox | Version 6.5 |
| Signal Processing Toolbox | Version 8.1 |
| SimBiology | Version 5.8.1 |
| SimEvents | Version 5.5 |
| Simscape | Version 4.5 |
| Simscape Driveline | Version 2.15 |
| Simscape Electrical | Version 7.0 |
| Simscape Fluids | Version 2.5 |
| Simscape Multibody | Version 6.0 |
| Simulink 3D Animation | Version 8.1 |
| Simulink Check | Version 4.2 |
| Simulink Code Inspector | Version 3.3 |
| Simulink Coder | Version 9.0 |
| Simulink Control Design | Version 5.2 |
| Simulink Coverage | Version 4.2 |
| Simulink Design Optimization | Version 3.5 |
| Simulink Design Verifier | Version 4.0 |
| Simulink Report Generator | Version 5.5 |
| Simulink Requirements | Version 1.2 |
| Simulink Test | Version 2.5 |
| Stateflow | Version 9.2 |
| Statistics and Machine Learning Toolbox | Version 11.4 |
| Symbolic Math Toolbox | Version 8.2 |
| System Identification Toolbox | Version 9.9 |

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Text Analytics Toolbox                          Version 1.2
Trading Toolbox                                 Version 3.5
Vehicle Dynamics Blockset                       Version 1.1
Vehicle Network Toolbox                         Version 4.1
Vision HDL Toolbox                              Version 1.7
WLAN Toolbox                                    Version 2.0
Wavelet Toolbox                                 Version 5.1
```

## VII. Lab and Course Policies

All students are required to attend only the lab they are officially enrolled in. You can attend a lab different from the one enrolled in only under certain circumstances which have to be discussed with the Head GSI.

No food, drink, or cell phones are permitted in lab. If you choose to receive a call or wish to eat, you should step outside of the lab to do so. We strongly encourage that you bring a removable storage device/flash drive to lab sections to save your work. 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 flash drive or email your work to yourself. We will give you login information on the first day of E7 lab, which will also be used to keep track of the course printing allocation. **Login information is confidential and should not be shared with students outside E7. If the printing allocation is exceeded, you will be charged to refill it.**

**Contact your Lab/Discussion GSIs and the Professor for all questions regarding the course material (lectures, assignments and so on). Contact the Head GSI only for administrative matters that include course conduct, enrollment, grading concerns, examinations and other special accommodations. Please do not expect to get course material or assignment related questions answered by the Head GSI.**

## VIII. Lab Schedule

Lab sessions will commence on Wednesday, January 22, 2020.

| Section | Times | Location | Instructors |
|---|---|---|---|
| Lab 011 | MW 8-10 am | Etcheverry 1109 | Guillaume Goujard<br>Kieran Janin |
| Lab 012 | MW 10 am - noon | Etcheverry 1109 | Onur Bayindir<br>Guillaume Gourjard |
| Lab 013 | MW noon - 2 pm | Etcheverry 1109 | Onur Bayindir<br>Guillaume Gourjard |
| Lab 014 | MW 4-6 pm | Etcheverry 1109 | Tiansong Cheng<br>Onur Bayindir |
| Lab 016 | TuTh 10 am - noon | Etcheverry 1109 | Tiansong Cheng<br>Charlie Zhang |
| Lab 017 | TuTh noon - 2 pm | Etcheverry 1109 | Charlie Zhang<br>Millard Mcelwee |
| Lab 018 | TuTh 2-4 pm | Etcheverry 1109 | Yuxi Xie<br>Kieran Janin |
| Lab 019 | TuTh 4-6 pm | Etcheverry 1109 | Charlie Zhang<br>Gurjot Kohli |
| Lab 020 | TuTh 6-8 pm | Etcheverry 1109 | Alice Hsu<br>Gurjot Kohli |
| Lab 021 | MW 6-8 pm | Etcheverry 1109 | Kieran Janin<br>Tiansong Cheng |
| Lab 022 | TuTh 9 am - 11 am | Etcheverry 1111 | Gurjot Kohli<br>Alice Hsu |

## VIII. Discussion Schedule

Discussion sessions will commence on Friday, January 24, 2020.

| Section | Times | Location | Instructor |
|---|---|---|---|
| Dis 101 | F 8-9 am | Cory 241 | Millard Mcelwee |
| Dis 102 | F 9-10 am | Cory 241 | Millard Mcelwee |
| Dis 103 | F 10-11 am | Haviland 12 | Millard Mcelwee |
| Dis 104 | F 11 am - noon | Cory 247 | Caglar Tamur |
| Dis 105 | F 1-2 pm | Dwinelle 219 | Caglar Tamur |
| Dis 106 | F 2-3 pm | Lewis 9 | Millard Mcelwee |
| Dis 108 | F 10-11 am | Wheeler 204 | Caglar Tamur |
| Dis 110 | F 2-3 pm | Cory 247 | Caglar Tamur |

## IX. Lecture Schedule

Content subject to change.
Labs are posted on Fridays.

| Lecture | Date | Day | Subject | Lecture Slides | Lab |
|---|---|---|---|---|---|
| | Mon | 20-Jan | *No Class - Martin Luther King Day* | | |
| 1 | Wed | 22-Jan | Course Introduction: how to use computer for engineering problem | Lecture01 | |
| | Fri | 24-Jan | Discussion/Lab Intro | | Lab 1 assigned |
| 2 | Mon | 27-Jan | Funtions, programing languages, encoders, turing machine | Lecture02 | |
| 3 | Wed | 29-Jan | Von Neumann architecture and programs, using memory, data types | Lecture03 | |
| | Fri | 31-Jan | Discussion/Lab Intro | | Lab 1 due, Lab 2 assigned |
| 4 | Mon | 3-Feb | Data types, memory, type checking, function composition | Lecture04 | |
| 5 | Wed | 5-Feb | Function calls, scope, I/O, iteration | Lecture05 | |
| | Fri | 7-Feb | Discussion/Lab Intro | | Lab 2 due, Lab 3 assigned |
| 6 | Mon | 10-Feb | Turing completeness, halting problem, for vs while, recursive functions | Lecture06 | |
| 7 | Wed | 12-Feb | Recursive programs, sets, program tracing, order of recurrence | Lecture07 | |
| | Fri | 14-Feb | Discussion/Lab Intro | | Lab 3 due, Lab 4 assigned |
| | Mon | 17-Feb | *No Class - President's Day* | | |
| 8 | Wed | 19-Feb | Program specification, functional and imperative programing, induction | Lecture08 | |
| | Fri | 21-Feb | Discussion/Lab Intro | | Lab 4 due, Lab 5 assigned |
| 9 | Mon | 24-Feb | Floating point numbers | Lecture09 | |
| 10 | Wed | 26-Feb | Computational complexity, Big O notation | Lecture10 | |
| | Fri | 28-Feb | Discussion - Midterm Review | | Lab 5 due |
| 11 | Mon | 2-Mar | Midterm 1 Review | Midterm1_Review | |
| 12 | Wed | 4-Mar | **Midterm 1 (Material up to Lecture 9)** | | |
| | Fri | 6-Mar | Discussion? | | |
| 13 | Mon | 9-Mar | Linear equations | Lecture13 | |
| 14 | Wed | 11-Mar | Least squares regression | Lecture14 | |
| | Fri | 13-Mar | Discussion/Lab Intro | | Lab 6 assigned |
| 15 | Mon | 16-Mar | Curve fitting, interpolation | Lecture15 | |
| 16 | Wed | 18-Mar | Numerical root finding | Lecture16 | |
| | Fri | 20-Mar | Discussion/Lab Intro | | Lab 6 due, Lab 7 assigned |
| | Mon | 23-Mar | *Spring Break* | | |
| | Wed | 25-Mar | *Spring Break* | | |
| | Fri | 27-Mar | *Spring Break* | | |
| 17 | Mon | 30-Mar | Numerical differentiation | Lecture17 | |
| 18 | Wed | 1-Apr | Numerical integration | Lecture18 | |
| | Fri | 3-Apr | Discussion/Lab Intro | | Lab 7 due, Lab 8 assigned |
| 19 | Mon | 6-Apr | ODE | Lecture19 | |
| 20 | Wed | 8-Apr | Data storage and retrieval, keys and values | Lecture20 | |
| | Fri | 10-Apr | Discussion - Midterm Review | | Lab 8 due |
| 21 | Mon | 13-Apr | Midterm 2 Review | Midterm2_Review | |
| 22 | Wed | 15-Apr | **Midterm 2 (material up to Lecture 18)** | | |
| | Fri | 19-Apr | Discussion/Lab Intro | | Lab 9 assigned |
| 23 | Mon | 20-Apr | Memory basics, handlers/pointers, call by value/reference | Lecture23 | |
| 24 | Wed | 22-Apr | Memory deallocation, pointer arithmetic, memory safety | Lecture24 | |
| | Fri | 24-Apr | Discussion/Lab Intro | | Lab 9 due, Lab 10 assigned |
| 25 | Mon | 27-Apr | Data retrival, memory fragmentation, lists, queues, tree | Lecture25 | |
| 26 | Wed | 29-Apr | Hash tables and functions | M-file (lecture26.m) | |
| | Fri | 1-May | Discussion - Final Review | | Lab 10 due |
| Week of 4-May to 8-May – Review | | | | | |