ENG EK 125 Introduction to Programming for Engineers Fall 2022

SYLLABUS
(Classes and discussions listed; labs always follow classes)

Date	Topics
	Week # 1
9/5	*Holiday; No class*
9/7	Class 1: Introduction to EK 125; Introduction to MATLAB, Characters, Relational expressions (M Chapter 1)
9/9	Discussion 1: Problem solving techniques; Quiz Formats; Practice Quiz
	Week # 2
9/12	Class 2: Vectors, Matrices (M Chapter 2A: Sec 2.1-2.4)
9/14	Class 3: Matrix Ops, Intro to Programming, Scripts, I/O (M 2B: Sec 2.5, 3A: Sec 3.1-3.4)
9/16	Discussion 2: Quiz 1
	Week # 3
9/19	Class 4: Plots, File I/O Functions, Programs, Commands (M 3B: Sec 3.5-3.10)
9/19	*Last day to add a course*
9/21	Class 5: If statements, Relational expressions; switch statements; "is" functions (M Chap 4)
9/23	Discussion 3: Quiz 2
	Week # 4
9/26	Class 6: Loops: for, nested (M5A: Sec 5.1-5.2); **HW 1 Due**
9/28	Class 7: Exam Review
9/30	Discussion 4: Exam Review
9/30	***** EXAM # 1 4:30 – 6:00 pm**

Week # 5

10/3 Class 8: Loops: while, error-checking; Vectorizing, Timing Code (M 5B: Sec 5.3 - 5.5);

10/5 Class 9: User-defined functions, MATLAB program organization, Scope, Persistent variables, Debugging, Live scripts (M Chapter 6)

10/7 Discussion 5: Quiz 3

Week # 6

10/10 *Holiday; No Classes*

10/11 *Monday Schedule at BU;* Class 10: Text Manipulation (M Chapter 7); **HW 2 Due**

10/11 *Last day to drop a course (without a "W")*

10/12 Class 11: Advanced data structures (M Chap 8A: Sec 8.1-8.3, also DS/ML Supplement)

10/14 Discussion 6: Quiz 4

Week # 7

10/17 Class 12: Data Transfer (M Chap 9)

10/19 Class 13: Advanced functions: variable # of arguments, Validating Function arguments, anonymous functions (M Chap 10A: Sec 10.1-10.3 also DS/ML Supplement)

10/21 Discussion 7: Quiz 5

Week # 8

10/24 Class 14: Sets, Intro to Machine Learning (M 14A: Sec 14.1, Chapter 15 including all DS/ML supplements; **HW 3 Due**

10/26 Class 15: Exam Review

10/28 Discussion 8: Exam Review

10/28 ***** EXAM # 2 4:30 – 6:15 pm**

Week # 9

10/31 Class 16: Command Line Interfaces; Intro to C (C Chapter 1)

11/2 Class 17: Selection Statements and Loops (C Chapter2)

11/4 Discussion 9: Quiz 6

Week # 10

11/7 Class 18: Data Structures: Arrays, Strings, and Structures (C Chapter 3); **HW 4 Due**

11/9 Class 19: Introduction to Functions and Program Organization in C (C 4A: Sec 4.1-4.6)

11/11 Discussion 10: Quiz 7

Week # 11

11/14 Class 20: Pointers, Call-by-reference (C 4B: Sec 4.7); **Project Proposal Due**

11/14 *Last day to drop a course (with a "W")*

11/16 Class 21: Dynamic Memory Allocation (C 5A: Sec 5.1)

11/18 Discussion 11: Quiz 8

Week # 12

11/21 Class 22: Introduction to Linked Lists (C 5B: Sec 5.2.1-5.2.3)

11/23-11/27 Holiday; Thanksgiving Recess

Week # 13

11/28 Class 23: Common Operations on Linked Lists (C 5C: Sec 5.2.4 – 5.2.5)

11/30 Class 24: Exam Review

12/2 Discussion 12: Exam Review

12/2 * EXAM # 3 4:30 – 6:15pm**

Week # 14

12/5 Class/Lab 25: Project Presentations

12/7 Class 26: What's Next; Course Evaluations

12/9 No Discussions

Week # 15

12/12 *Last Day of Classes; No EK 125;* **Project Due**

ENG EK 125 Introduction to Programming for Engineers
Fall 2022

COURSE INFORMATION

Cast of Characters

Professor: Stormy Attaway
Department of Mechanical Engineering
110 Cummington Mall, Room 112
Office phone: (617) 353-5224 Office FAX: (617) 353-5866
Home phone: (603) 878-2760
email: sa@bu.edu
Office Hours: Vary weekly; posted on the board outside of my office every week

Co-Instructor: Leah Gaeta

Graduate Student Teachers (GST): are in charge of their lab sections, and will grade homework assignments and the final project for their lab section

Teaching Assistants (TA's):

- The TA's are undergraduates and LEAP students. Their duties are to help in the class, lab and the discussion sections, and grade the weekly quizzes. Some experienced TA's are designated as "Senior TA's"; they may lead discussion sections.
- TA Open Hours will be held the evenings before class days. Check the course web site on BlackBoard for details.

Course Material

The goal of this course is to introduce first-year engineering students to modern computational environments used to solve engineering problems. In the context of engineering applications, basic procedural programming concepts will be covered including input/output, branching, looping, functions, file input/output, data structures (arrays, strings, and structures), pointers, and memory management. Emphasis will be on programming style, debugging, top-down design and modular code. Supplemental material will also introduce topics related to data science and machine learning. Specific topics are listed in the course syllabus.

Course Outcomes

As an outcome of completing this course, students will:

- Gain knowledge of basic procedural programming concepts and computational thinking
- Become proficient in the use of modern computational tools
- Develop basic problem solving skills
- Develop experience in designing a solution to engineering problems using software
- Be able to document solutions to engineering problems and communicate the results
- Work in teams to design a solution to a societal problem

BU Hub

This course covers Hub units in:

- Quantitative Reasoning I
- Creativity/Innovation
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Hub Learning Outcomes:

Quantitative Reasoning I

1. Students will demonstrate their understanding of core conceptual and theoretical tools used in quantitative reasoning, such as statistics, computing, and mathematics.

In EK 125, students will demonstrate their knowledge of computational thinking by creating algorithms to solve engineering problems and implementing these algorithms in modern computational environments utilizing basic procedural programming paradigms. Students must understand the underlying mathematics in order to write the codes to solve the problems.

2. Students will interpret quantitative models and understand a variety of methods of communicating them, such as graphs, tables, formulae, and schematics.

In EK 125, students will take engineering problem statements that are posed using mathematical formulae, and will translate these into executable computer codes to solve the problems. Output from these codes will include graphs and tables. In many assignments, students will have to decide the most appropriate form for the output.

3. Students will communicate quantitative information symbolically, visually, numerically, or verbally.

In EK 125, students use a variety of plot types to communicate trends in data sets. Every day in class, students write their own problem statements and solution codes, and then explain them verbally to the instructor and teaching assistants.

4. Students will recognize and articulate the capacity and limitations of quantitative methods and the risks of using them improperly.

In EK 125, debugging code is an important part of the course. Students will learn debugging techniques, and techniques to minimize mistakes such as top-down design and the use of function stubs. Students are shown common mistakes and how to avoid them. Students will also learn to fit curves through data sets, and will learn the risks of interpolation and extrapolation.

Creativity/Innovation:

1. Students will demonstrate understanding of creativity as a learnable, iterative process of imagining new possibilities that involves risk-taking, use of multiple strategies, and reconceiving in response to feedback, and will be able to identify individual and institutional factors that promote and inhibit creativity.

The entire class is about coding concepts. Coding is inherently creative. When writing code, one first comes up with an initial algorithm; this is then translated into code that is executed. Most code fails initially; it either has errors such as syntax errors (or “bugs”), or does not produce the desired results. The art of “debugging”, finding and fixing the

mistakes, is an integral part of the course. In many cases the algorithm must also be revised. So, coding is an iterative process that involves constantly modifying the code in response to a variety of feedback mechanisms. This is a learnable process. Students are shown common mistakes and how to avoid them, and they also learn techniques such as top-down design, and the use of modular code and function stubs in order to minimize mistakes.

2. Students will be able to exercise their own potential for engaging in creative activity by conceiving and executing original work either alone or as part of a team.

Students work in teams to write their own problems and solutions every day in class. Additionally, students work in teams to design their own final project description and its solution, subject to constraints. The project must utilize a large data set and must solve a problem that will benefit society. Students must first write a project proposal; they get course staff feedback on the proposal before continuing with the project. The final project is done over the last six weeks of the course, and it builds on tools learned from homework assignments that are given throughout the semester. The coding for the final project is an iterative process.

Course Format

EK 125 has been a fully flipped course for several years, so the class is entirely active learning. What that means is that instead of a traditional lecture followed by you trying to do homework, we flip or reverse that: you watch online lecture videos and answer assessment questions online before coming to class, and then class time is entirely active learning; working on problem sets in small groups. All education research shows that students learn much more (and more deeply) from active learning environments and therefore Prof. Attaway spent hundreds of hours flipping the course, creating the lecture videos for you to watch and all of supporting documents that you will see online.

All students must be registered for one Lecture section, one Lab section, and one Discussion section. The lecture/class sections are Mon/Wed. These are taught in PHO 117 and LSE B03. The two instructors will alternate between the two rooms. The labs in all cases follow the lectures; they are held Mon/Wed afternoons, in PHO 117 and LSE B03. The discussion sections are all on Friday. (Note that the Fri 4:30-6:15 time listed under “Lecture” is actually the exam time; see syllabus for those dates.) Many sections become full quickly, so it is imperative that you only attend those sections for which you are officially registered.

The specific topics that will be covered in the classes are listed in the course syllabus. Students are expected to do the reading, view the lecture videos, and to complete all online assessment problems before coming to class. The class period will consist of an active learning environment. During a majority of the class time, students will be actively working on problems first as individuals and then in groups, either on paper or on the white board walls, or on the BB discussion forum.

During the lab, there will be worksheet problems to work on, based on the material covered in the lecture earlier that day. All worksheet solutions must be tested, either in MATLAB or in C. It is expected that students will bring their own laptops to lab. As a continuation of the lab, problems to be done on MATLAB Grader during the MATLAB portion of the course will be posted in the evenings after the lab sections have ended. Extra problem sets will also be available for students who wish to have more programming experience; these are optional.

In the discussion sections on Fridays, the Senior TAs in charge of the section will review the week's material, and answer any questions that students may have. In some cases, extensions of the material will be covered also. In most of the discussions, there will then be a short (15 minute) quiz on the material covered that week (the exact dates are listed in the syllabus).

Please note that what is detailed in this entire document is the current plan. Everything is subject to change, however.

Covid Protocols

Currently, there are no protocols in place, but this could of course change. Both instructors will be wearing masks, and we encourage you to do the same. We ask that you distance to the extent that you can in order to keep everyone safe.

Course Websites

The course materials will be on the course website on BlackBoard Ultra. This can be accessed from learn.bu.edu. All questions should be posted on the Discussion Forum on this site, not by email. A separate document, "EK 125 Course Accounts," details other accounts that you will need, for MATLAB, and MATLAB Grader.

Textbook

The text is "MATLAB: A Practical Introduction to Programming and Problem Solving, Sixth Edition" by Stormy Attaway, © 2023 Elsevier, Inc. ISBN: 978-0-323-91750-6. For the last part of the course, a pdf of a manuscript "C Programming for MATLAB Programmers" will be available for students to use online. The sections to be read before each lecture are listed in the syllabus next to the topic. For best comprehension, it is very important to read through everything including the Quick Questions, and to work on the Practice problems. Note we are using the Sixth Edition of the MATLAB book, which is organized in a slightly different way and contains much more material than the first five editions (including introducing material on data science and machine learning). Either hard copy or e-book is fine.

Grading

Letter grades are given only for the entire course, not for individual assignments or tests. Numerical grades will be calculated for every student, based on the following percentages:

Class (including online pre-class & in-class Practice Problems)	15%
Lab (including Worksheets and MATLAB Grader Problems)	15%
Homeworks and Final Project	15%
Discussions (including Quiz Average)	15%
Exam 1	10%
Exam 2	15%
Exam 3	15%

Class, Lab, and Discussion grades include attendance. Some, but not all, grades will be posted on BlackBoard. In order to calculate your average mid-semester, you must keep track of all of your own grades. The cut-offs for the different letter grades will depend on the distribution of numerical grades at the end of the semester. Usually, the ranges are: 90 and above is an A (A- or A), 80 + is a B, 70+ is a C, 60+ is a D and below 60 is an F. (There may be a curve, but if so it would be in the favor of the students, e.g. an A- might

go as far down as 89, but it would not be raised to 91.) The cutoffs between the letter grades for a given range (e.g., B+, B, B-) will depend on the actual numerical grades and will not be determined until the end of the semester. All grades become final one week after posting. In addition to the numerical average, students **must demonstrate a mastery of the material by having a passing average on the last two exams and on the Homeworks/Final Project** in order to earn a passing grade in the course.

Class Grade

Students are expected to be on time for every class, and are expected to be prepared for every class by doing the reading and completing all online material. Please note that the reading covers all of the material; the online slides do not necessarily cover everything. Therefore, the online materials supplement the reading; they do not replace the reading. During the class period, students will be given sets of Practice Problems. Individual Practice Problems (IPP) are to be completed in the very beginning (first five minutes) of the class period, without using any reference materials. These will be followed by Group Practice Problems (GPP) to be done in small groups; reference materials may be used for these problem sets. Students may NOT work alone on the GPP. Students are requested to NOT use software (MATLAB or C) during class. Points will be deducted from the class grade if a student (a) arrives late; (b) is not prepared; (c) leaves early; or (d) does not answer Practice Problems. The class grade will be a combination of attendance, online, and in-class Practice Problem solutions, including the 5-minute IPP that will be graded. The IPP will be used for the attendance. If a student arrives late to class, after the IPPs have been collected, it is up to them to contact the TA's on arrival to be counted as present. One class attendance grade and one IPP grade will be dropped.

Lab Attendance

For the lab, students will be given worksheet problems to work on during the lab period. Students will receive full credit for every lab for arriving on time and either completing all of the **current** worksheet problems in MATLAB or C, or spending the full amount of time diligently working on these problems. Points will be deducted from the lab attendance score if a student (a) arrives late; (b) is not prepared for lab; (c) leaves early without completing all of the worksheet problems in MATLAB or C; (d) does not spend the time diligently working on the current problems; or (e) spends time working on other worksheets (e.g. old ones not yet completed) or homeworks (or doing anything online) instead of the current worksheet. Missed labs must be made up as soon as possible. All worksheet problems must be completed and submitted on BlackBoard. For the lab attendance grade, students must only work diligently on the problems during the lab, and may not use computers for any other purpose until the problem set has been completed. If the worksheet problems are not completed during the lab period, students must complete the problems on their own time. One lab attendance grade will be dropped.

Worksheets and MATLAB Grader Problems

For full credit on the worksheet, the solutions for the worksheet problems must be completed. For the MATLAB part of the course, MATLAB Grader Problems must also be completed. The solutions to these problems must be submitted on the MATLAB Grader site. For these problems, test scripts have been written by the course staff to test whether your solution not only works in MATLAB, but does exactly what the problem specifies. The solutions to all problems (worksheet and Grader) must be completed by 8am on Wednesdays for Monday labs, and by 9am Fridays for Wednesday labs. All Worksheets must be submitted to BB. Sometimes the problems will be simply checked

off, and sometimes particular solutions will be graded. The grading will be on both the correctness of the solution and style. One worksheet grade will be dropped.

Homework Assignments

Homeworks will be assigned throughout the semester. The due dates are listed on the Syllabus. Rules for working in groups (which will be within your lab section) will be specified on each homework description. Homework assignments will be announced on the course web site on BB, and will be submitted to Gradescope.

Final Project

The final project will be due on the last EK 125 class day of the semester. This is a programming problem, which is larger in scope than the problems that can be done during the scheduled lab periods. It will also be an open-ended problem, for which there is no set answer. Specific guidelines will be provided at least six weeks before the project due date. The project is to be completed during the open lab hours. Late projects will NOT be accepted, for any reason. The final project will be a group project. PROGRAMS THAT DO NOT RUN WILL NOT NORMALLY BE ACCEPTED.

Quizzes

There will be 8 quizzes this semester, given during the discussion sections. The exact dates are listed in the syllabus. Each quiz will be on the material covered that week. There will be NO make-ups for quizzes for any reason; however, one of the grades will be dropped before the quiz average is calculated. All of the quizzes will be closed book. All quizzes must be taken in the discussion section for which the student is officially enrolled; otherwise, the grade will not count. No electronic devices (calculators, cell phones, etc.) will be allowed during quizzes.

Exams

There will be three exams, given on Friday afternoons. These are common exams, given to all sections of this class at once. Since they will not be during the regularly scheduled class time, mark the dates on your calendar! The first exam will be given on Friday September 30 from 4:30 – 6pm. The second exam will be given on Friday, October 28 from 4:30 – 6:15pm. The third exam will be given on Friday, December 2 from 4:30 – 6:15pm. Exam locations will be announced in class. All exams are closed book. However, student will be allowed to bring one 8.5x11" piece of paper with notes, double sided (Note: no staples or tape, just one sheet of paper). No electronic devices (calculators, cell phones, ear buds, etc.) will be allowed during exams.

Exam study sessions will be held on the evenings before the exams.

Make-ups

As explained in previous sections, there are no make-ups for homeworks, projects or quizzes. Since most students will have a valid reason for missing a class during the semester (for example, due to illness), one class attendance grade will be dropped, one IPP grade will be dropped, one lab attendance grade will be dropped, one worksheet check grade will be dropped, one discussion attendance grade will be dropped, and one quiz grade will be dropped. Missed lab attendance must be made up during the open lab

hours by completing the worksheet problems (for full credit if the lab was missed for a valid reason, otherwise half credit).

Make-up Exams

Make-up exams will be more difficult than the regularly scheduled exams. The only valid reasons for missing an exam are: death in the immediate family, serious illness (documented by a physician), or a conflict with a scheduled Boston University event. If you feel that you have a valid reason for missing an exam, you must petition to Prof. Attaway for permission to take the make-up. This petition must be received BEFORE the regularly scheduled exam (except in cases of extreme emergency). Petitions should be submitted as soon as possible. Petitions are not always granted! If the petition is granted, a mutually convenient time for the make-up exam will be arranged.

Incompletes

Incompletes will ONLY be given for those students who miss the third exam and whose petitions for the make-up have been granted, and for whom the make-up has been scheduled for a time after the final grades for the semester have been determined. An incomplete contract must be filed in that case before the end of the semester.

Grievance Procedure

If you disagree with any grade received in this course, you must write a short note explaining your reasons on a separate sheet of paper, attach it to the paper in question (exam, quiz, etc.) and give it to one of your lab or your discussion TAs. It will be reviewed, and returned to you.

Collaboration Policy

Students are allowed (in fact, encouraged) to work together on the Practice problems and on the lab worksheets, and in groups on the project. Working together means truly working together, exchanging ideas, NOT copying. Copying another's work is cheating, as is allowing someone else to copy your work. All quizzes and exams must be done by each student individually. Falsifying information on a group project cover sheet will also be considered to be cheating. Anyone caught cheating may be subject to disciplinary action by the Committee on Student Conduct of the College of Engineering. Also, anyone found guilty of cheating will receive a 0 for that particular grade. Please note that these are policies for ENG EK 125; other courses may have different policies. When in doubt, ask before you collaborate! Please remember the University's Academic Conduct Code, which can be found at: *https://www.bu.edu/academics/policies/academic-conduct-code/*

Cell Phone Abuse

It is not appropriate to have a cell phone on during any class (lecture, lab, discussion), exam, or while in the lab. Therefore, **cell phones must always be turned off**. Any violation of this will result in a 0. For example, if a cell phone is used during class time, the student will receive a 0 for that day's attendance. If a cell phone is used during a discussion section, the student will receive a 0 on that day's quiz. If a cell phone is used during an exam, the student will receive a 0 on the exam. **Leaving a class/discussion/exam to use a cell phone elsewhere (e.g., in the hallway) will be**

considered to be the same as using it in the class. The exception to this policy is any legitimate use of MATLAB Mobile.

Inclusion:

All members of this class, as well as the course team, are expected to contribute to a respectful, welcoming and inclusive environment for every other member of the class.

Accommodations:

- Accommodations for Students with Documented Disabilities If you are a student with a disability or believe you might have a disability that requires accommodations, requests for accommodations must be made in a timely fashion to Disability & Access Services, 25 Buick St, Suite 300, Boston, MA 02215; 617-353-3658 (Voice/TTY). Students seeking academic accommodations must submit appropriate medical documentation and comply with the established policies and procedures *http://www.bu.edu/disability/accommodations/*
- For students who receive extra time on quizzes and exams, please let Professor Attaway know (even if you do not yet have the official documentation) and email your schedule so that alternate times may be determined.