Proposal for a new
Common Curriculum computing course
"Practical computing for engineers"

A 1-credit supplement to CS 1112

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Prepared by: Andy Ruina

Course Name: ENGRG 1112, 1 credit
Practical computing for engineers

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Course description:

An introduction to Engineering problem solving using Matlab, supplementing CS 1112. The course uses CS 1112 concepts in the service of basic numerical computation for engineering. At course completion, a student will be able to comfortably use Matlab to solve or check homework problems or project issues, in almost all other math and engineering courses, using various numerical and symbolic methods.

Throughout the semester, students will solve 'word problems'. The overarching theme, sitting above the list of topics in the applied text and in the CS 1112 syllabus, is the nature of problem solving: How to turn a question into a solvable problem, and then solving, debugging and making sense of the solution. The final project and demonstration will show competence in all of this.

Prerequisites: No specific pre-requisites

Corequisites: Math 191or equivalent, and CS 1112 or equivalent

Student Preparation Summary: **Math.** Students should be comfortable with topics up to calculus including algebra, geometry and trigonometry.

Required materials: - **Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers, 7th Edition**

-Strongly recommended. A laptop computer, with MATLAB installed (student or Cornell license).
-i-clicker, or cell phone app that interfaces with i-clicker.

Class and lab schedule:	**-1 Lectures per week.** **-Office hours.** Many. Students are expected to come, at least briefly, every week.
Assignments, exams, and projects:	- Daily in-class i-clicker quizzes - Video and/or reading prep for every lecture. - Using-the-computer assignment(s) associated with every lecture - No prelims or exams - Final "design" project, and individual presentation of project including query of student's mastery of material - Nominal workload. is 3 hours/wk (in class and out of class). $\Rightarrow$ 50 hours total for the semester
Grading:	Letter grade or pass/fail. Based on a weighted average of all course components. **Pass/fail:** A student who credibly documents an investment of 50 hours total, passes. **Letter:** 50 hours guarantees a B. The median grade will be somewhere in the B+ range, depending on overall class performance.
Typical topics covered:	**Detailed skills and knowledge** The course will reinforce most of the content in CS 1112. Additional emphasis will be on such things as he MATLAB user interface (managing windows, help, directories, etc); reading and writing files; Symbolic calculations; useful math functions (ode45, interpolation, curve fitting, backslash, etc); accuracy, convergence, roundoff and method errors; advanced Plotting, animation. Sample numerical problems will include finding areas and volumes, integration, differentiation, limits, series, monte-carlo population dynamics simulations, Euler's method for ODEs, etc.

Student outcomes

a. Working knowledge of most of the above topics, including both programming skills and special MATLAB shortcuts.
b. Comfort and ability to setup, solve engineering and math problems using the tools above.
c. Ability to and habits of doing well documented, organized and checked-for-reasonableness computer work.
d. Student should be comfortably able to solve, illustrate, plot, or animate some features of most homework problems in most later courses using Matlab, including projects involving multiple files and user-created functions.
e. Examples of detailed skills to be obtained by students.
   (a) Go from a word problem to system of linear equations to matrix form to computer solution to interpretation of solution.

(b) Be able to code up in MATLAB , without special MATLAB commands: Euler's method; numerical differentiation; numerical integration in 1-3 dimensions.

(c) Do algebra with the Symbolic toolbox

(d) Convert symbolic expressions into expressions for numerical evaluation

(e) print using disp and fprintf.

(f) Use the debugger

(g) Use the plot command with some sophistication in 2D and 3D

(h) Make simple animations.

(i) Use various forms of online Help (help, doc, google, etc)

(j) Use the computer iteratively to estimate method and roundoff errors.

Design
The primary focus of the class is "problem solving". This is distinct from 'solving homework problems'. Here, 'problem solving' is the iterative development of a question, an approach, candidate solutions, development of solutions, checks and debugging of solutions, and communication of solutions. Although a student might need to learn and use a prescribed algorithm, the focus here is, instead, on this more general, iterative, problem solving. This course should be a great place for developing the generalized common sense encapsulated in the design process, in debugging previously poorly solved problems, and in the scientific method.

Academic integrity

1. Defined away. *All forms of help*, up to and including direct copying, are allowed if clearly acknowledged at the top of the given assignment. A student doing A+ copying, with full citation, will not be violating academic integrity, but also will not get a great grade. A great grade depends on top performance in prelims, the exam, and defending the final project.
2. There is some assumed honesty in reporting of degree of help and amount of personal effort.

Assessment course success

An experiment needs results. Ideally we would like to know if a student taking this course is better off various ways, say, 5 years after graduation. Instead, with a small self-selected group of students, we have to use various crude proxies.
Here are some.

1. Andy Ruina will attend most CS 1112 lectures to compare, in detail, how that course fits with this new course.

2. Put 2 questions on the CS 1112 final course evaluation.

   - Did you take CS AEW workshop or ENGRG 1112?
     1=neither, 2 = AEW, 3 = ENGER 1112, 4 = both.
   - How well prepared do you feel your CS classes so far have made you for using computers in non-CS classes? 1= not prepared, can't use; 5 = very prepared, already use often

3. Pull out all comments from the CS1112 evaluation that mention "ENGRG" or "Ruina".

4. Require course evaluation of all students taking ENGRG 1112, and encourage comments.

5. In the middle of the Spring 2018 find ex-ENGRG 1112 students and ask open-ended questions about how useful they have found their Matlab skills.

6. In the middle of the Spring 2018 poll all ENGRD 2020 students and see if correlations can be found, or not, between taking ENGRG 1112 and feeling comfortable using computers in ENGRD 202. To the extent that staff has time and money, do comparisons of outcomes for students in other later courses, such as CS 2110 and MAE 2020 & 2030. Correcting for, say, performance in Math classes.

7. Study and summarize all of the results above.

8. To the extent that staff has time and money, do comparisons of outcomes for students in later courses, such as CS 2110 and MAE 2020 & 2030. Correcting for, say performance in Math classes.

9. Look at outcomes from students taking BEE 1510 (a course much like the proposed course) in CS 2110.

10. Prepare a small presentation about these results for any interested groups (*e.g.,* CCGB or CS or MAE).