IAM 550 Introduction to Engineering Computing
Computer Lab 1
Math and MATLAB Warmup
J. Raeder, September 3/5 2019

Objectives:
- Be able to start up MATLAB and use it as a simple calculator
- Be able to convert somewhat xomplicated math into MATLAB
- An introduction to variable assignments, built-in functions
- Learn and practice how to write a proper report

Deliverables **due at the beginning of your next lab session:**
- A MATLAB diary for your entire laboratory session (25% of your laboratory grade). This should be submitted via canvas as an assignment before your next laboratory session.
- Note that for this laboratory you will have **two** diary sessions – please submit both..
- A lab report summarizing your results *from section II only* and answering any questions asked in the lab instructions for section II, and including any MATLAB files that have been requested. Make sure your name is on *all* pages of your lab report.

I.   **A first MATLAB session**
- a. Start MATLAB: either double click on the desktop icon or find it in the start menu.
- b. Identify the COMMAND WINDOW
- c. At the command prompt (either >> or EDU>, depending on whether you have the educational version or not) initialize a MATLAB diary using the following format:

   > LastnameFirstinitial_Diary_LabX_a.txt
   > Example:
   > >> diary RaederJ_Diary_Lab1_a.txt

   This puts creates a text file in the location MATLAB is currently working. You will submit this diary as part of your laboratory grade, so don't forget to do this!

- d. Figure out where your text file is! (you'll need to find this again at the end of the lab in order to submit your MATLAB diary)

   > See what directory you are in:
   > >> pwd
   > See what files you have in this directory
   > >> ls
   > >> ls -al

- e. Do some simple MATLAB calculations.
   - i. Divide 10 by 2.
   - ii. Divide 2 by 10.
   - iii. Multiply 2 by 5.
   - iv. Add 3 + 5.

      v.   Raise 2 to the 16th power.

     vi.   Raise 27 to the 1/3rd power.

f.   Quit MATLAB. Type 'quit' at the command prompt, select file→exit MATLAB, or click the Close box in the MATLB desktop.

g.   Find and open your MATLAB diary. Verify that it contains all of your commands and results from steps d-f and submit your result to canvas. TAs will explain how to submit.

II.   Engine/Compression I

Before you begin: Initialize a MATLAB diary: LastnameFirstinitial_Diary_LabX_b.txt

Refer to Figure 1.

(a) Derive an expression for the distance *d* as a function of the angle ω. You only need some basic trigonometry for right triangles.

(b) For the numerical values of L_1=12 cm, L_2=30 cm, height of the piston *h*=12 cm, and *L*=50 cm, use MATLAB to calculate *d* for the angles ω of 0, 12, 45, 60, 90, 135, and 180 degrees and make a table.

(c) At Bottom Dead Center (BDT, explain what that is), the combustion chamber is filled with air at temperature T_B=283 K and pressure p_B=10^5 Pa. During the next half cycle the air is adiabatically compressed. Calculate the temperature T_T and pressure p_T at TDC (explain what that is). Use the ideal gas law $pV=nkT$ and the adiabatic relation $p_T/p_B=(V_B/V_T)^\gamma$. Here, V is the volume of the combustion chamber, γ is the adiabatic constant (5/3 for air), n is the number of air molecules and k is the Boltzmann constant, but you don't need to know them because they both fall out.

You need to understand the following concepts at a basic level:

- Scalar variables and scalar arithmetic operations
- Variable names and the assignment ('=') operator
- Use of built-in function and how to find them.
- The MATLAB help system (for example, try typing >> help asin function in the MATLAB COMMAND WINDOW).
- Use cut-paste or arrow keys to avoid retyping long expressions.

When you finish: Don't forget to retrieve your diary file and submit them via canvas. Note that you should be submitting a separate diary for part I and II.
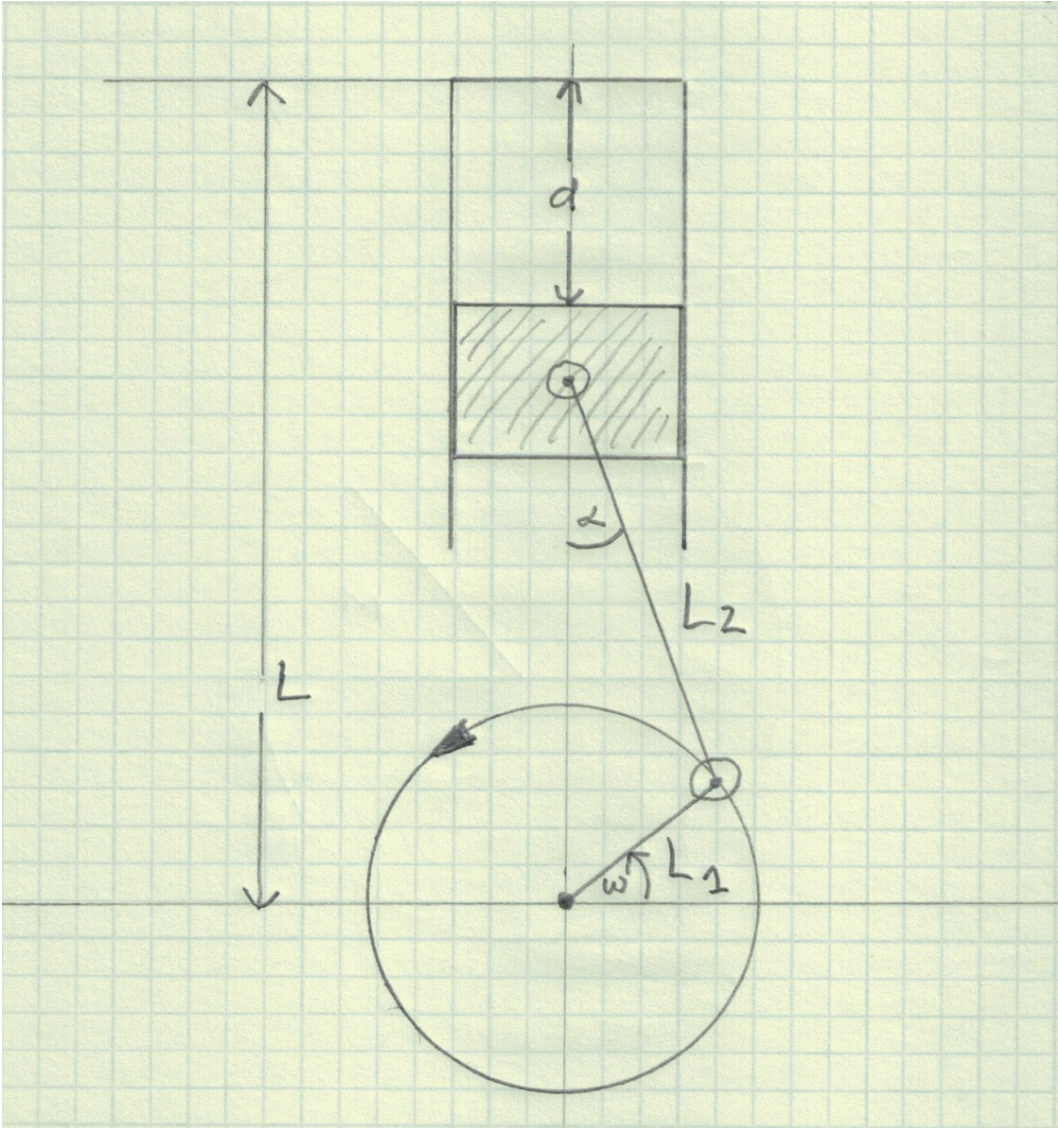
Figure 1: Cross section of a combustion engine with crankshaft, pushrod, piston (shaded), cylinder, and combustion chamber.