***Read all of the following information before starting the project:***

*Permitted on project*:

* Open book, open notes, open Python documentation, open internet (Google, etc.).
* You are **encouraged** to copy/modify your existing code from homework 1-10, exams 1-3, and Dr. Smay’s solutions as necessary. All new additions to the code should be your own work.
* You are permitted to work in teams of two or three.
* You must first *fork* the github repository  and then work with your partner(s) as collaborators to commit the changes you’ve made. Finally, you should submit a link to your repository through Canvas.

*Not permitted on project*:

* You **MAY NOT** use any form of technology to communicate with, send to, or receive information from another person (other than the instructor, TA or partners), during the project.

*Project submission*:

* Your repository should be a private github repository called **Project\_2025** that houses all your files and has a record of all commits and perhaps pull requests. Submit a link to your repository in Canvas and invite the professor and TA as collaborators.
* You may include scans/pictures of your hand-written notes to augment your work on the problems. This is especially helpful when deciding partial credit on programs that don’t work fully.

*Grading*:

* A working program that satisfies all the requirements of the problem is easy to grade and receives full credit.
* A partially working program or non-functioning program likely deserves much partial credit, but this depends on your commenting in the code and/or submitting hand-written notes about your work.

1. (75 points) This is a collective class effort and depends on all of you to participate. On CANVAS, there is a link for Course Evaluations (SSI). If 90% of the class completes the SSI prior to the due date, you will all receive 75% of the credit on the project. If less than 90% complete the SSI, I will prorate the score.
2. (25 points) A working four-bar linkage program has been uploaded to github as a starting point. This linkage has a parallel arrangement of a spring and dashpot attached between the output and coupler links. This schematic is purely kinematic (i.e., represents the relative motion and connection of the links) with a simple computation of the spring force. Also, the angular range of the input link is unconstrained and there is no error checking for input angles that cause the linkage to lock.

For this project you should accomplish the following tasks:

1. (10pts) Create widgets (numeric up/down controls) that allow the user to set a maximum and minimum angle for the input link and then impose those limits when the user interacts with the input link graphically.
2. (10pts) Compute the force generated in the dashpot as the user moves the linkage. Recall, the force generated by a dashpot is proportional to the rate of change of the length of the dashpot. Display this force similar to the way the spring force is displayed on the graphic view.
3. (5pts) Assuming the equilibrium position of the linkage is when the input link is at 90 degrees, create a simulation that animates the motion of the linkage when the user releases the mechanism from an angle (say 180 degrees) until it returns back to the equilibrium position. You should allow the user to select the mass of each linkage and the values for the spring constant and damping coefficient. To create this simulation, you should solve the equations of motion for the linkage using the state equation approach and initial conditions imposed by the user releasing the mouse button with the assumption of zero angular velocity at that initial condition.