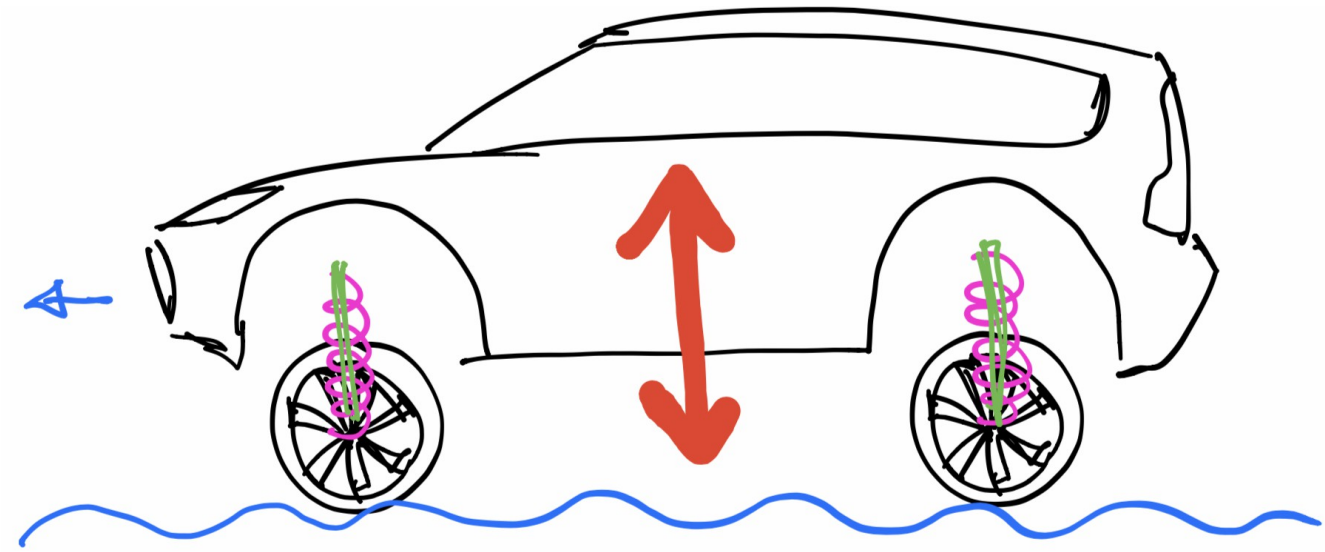
Project 5 [14 FP “Fluency Points”]:

Car Suspension Tuning and Design

Description:



You work for a major automotive company as an NVH (Noise, Vibration and Harshness) engineer. Your boss asked you to do some preliminary analysis of a new suspension system for a super secret passenger vehicle prototype.

The vehicle design is still in the highly conceptual phase, so “anything goes” at the moment. Your boss did tell you that this is a 5-seater with an EV drivetrain, so it's slightly heavy.

The goal here, according to your boss, is to get a sense of the selection and tuning of the suspension system (spring + damper) in order to ensure passsenger comfort when the vehicle is traveling on a bumpy road at various speeds.

Specifically, you have been tasked with:

- Building a spreadsheet that
  - allows the user to easily specify vehicle and suspension system parameters, including vehicle mass, spring constant, damping ratio, road bump (roughness) height, and the vehicle speed range to be considered
  - generates a plot of *max amplitude of vehicle bounce* vs. *vehicle speed*; this plot must automatically update with changes in any of the user-specified parameters
- Proposing a damping ratio value that will limit the max amplitude of bounce, at any speed, to 10 cm (about 4 in.), if the road roughness height is 5 cm
- Concluding your analysis, noting any limitations, sources of errors and areas of improvement
- Reflecting on your learning and journey of working on this project

Deliverable:

Present your work in a Google Doc and a Google Sheet; the Sheet must be embedded (clickable hyperlink) in the Doc; submit the Google Doc link to Gradescope.

Rules and Format:

- File requirements
  - Your Google Doc must contain the entirety of your work for this project, including vibration modeling and mathematical formulation, a plot from your Google Sheet, an embedded link to your Google Sheet, conclusion, and reflection
  - Your entire Google Doc must be in portrait orientation and has a vertical page flow
  - Your Google Doc and Sheet must be publicly accessible, i.e., no permission required (see Appendix A below for how to set up and share your Google Doc)
  - Your Google Doc and Sheet must not be edited after you have submitted it to Gradescope (your Google Doc and Sheet will show the last edit date to any viewer)
- Theory/analysis requirements
  - Your theory presentation (sketches, assumptions, equations), if handwritten and then digitized, must be signed and dated on each page
- Plot requirements
  - Your plot must display a plot title, axis title, and labels (numbers)
- Spreadsheet requirements
  - Your spreadsheet must include instructions for the user
  - It must allow the user to quickly change values of the parameters described above
  - It must contain a plot that dynamically updates whenever an input value changes
  - It must have only one tab; all input parameters (constants), data, and plot must be shown in the same tab
- This is an individual project
- Violation of *any* of these rules will invalidate your submission altogether – read this document carefully (srsly)!

Submission:

Submit your Google Doc link (URL) on Gradescope only. Submissions by email or other means will be disregarded.

Due March 29, 2021 (Monday) 11:59 pm.

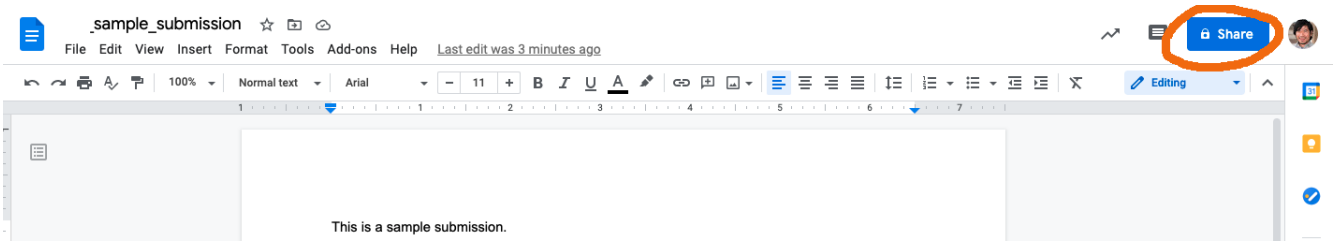
Late submissions will be subject to the “half-life” reduction policy according to the syllabus.

Grading Rubric:

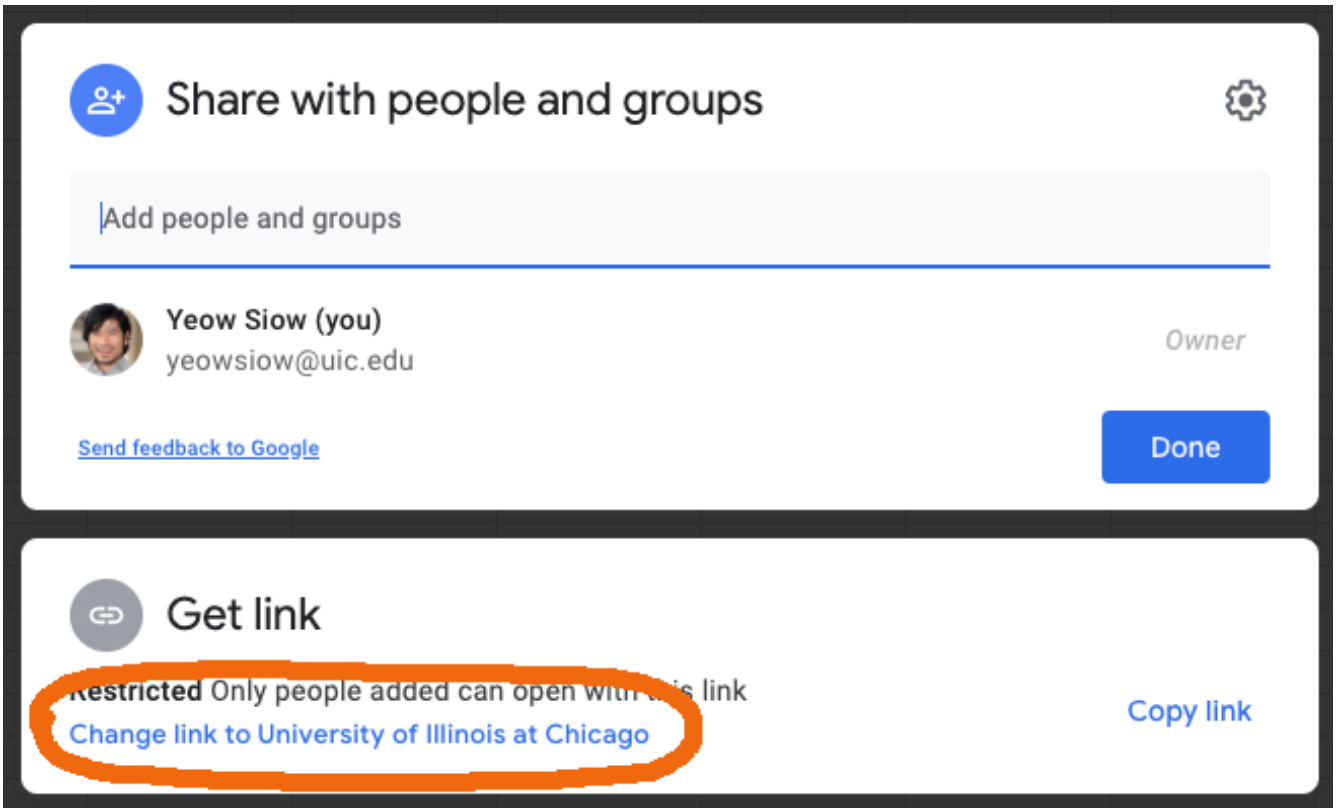
	Fluency			Scaling	Max Possible
	2	**1**	**0**		
Theoretical Rigor	Assumptions are reasonable and not oversimplified; sketches are clear and consistent with assumptions; physics and math are accurate and convincing	Some obvious details missing	Incorrect physics, or missing most details	2	4
Spreadsheet Usability	Clear instructions for the user; changing parameters is easy; data are generated using spreadsheet formulas; plot is professional and accurate	Has obvious issues with ease of use, accuracy, and/or formatting	Missing; or violates any of the rules	3	6
Conclusion	Insightful, thoughtful and transparent; goes beyond "pointing out the obvious"	Rash	Missing	1	2
Reflection	Thoughtful and authentic	Insubstantial or vague	Missing	1	2
				Total	14

Appendix A: How to Share and Submit Your Google Doc

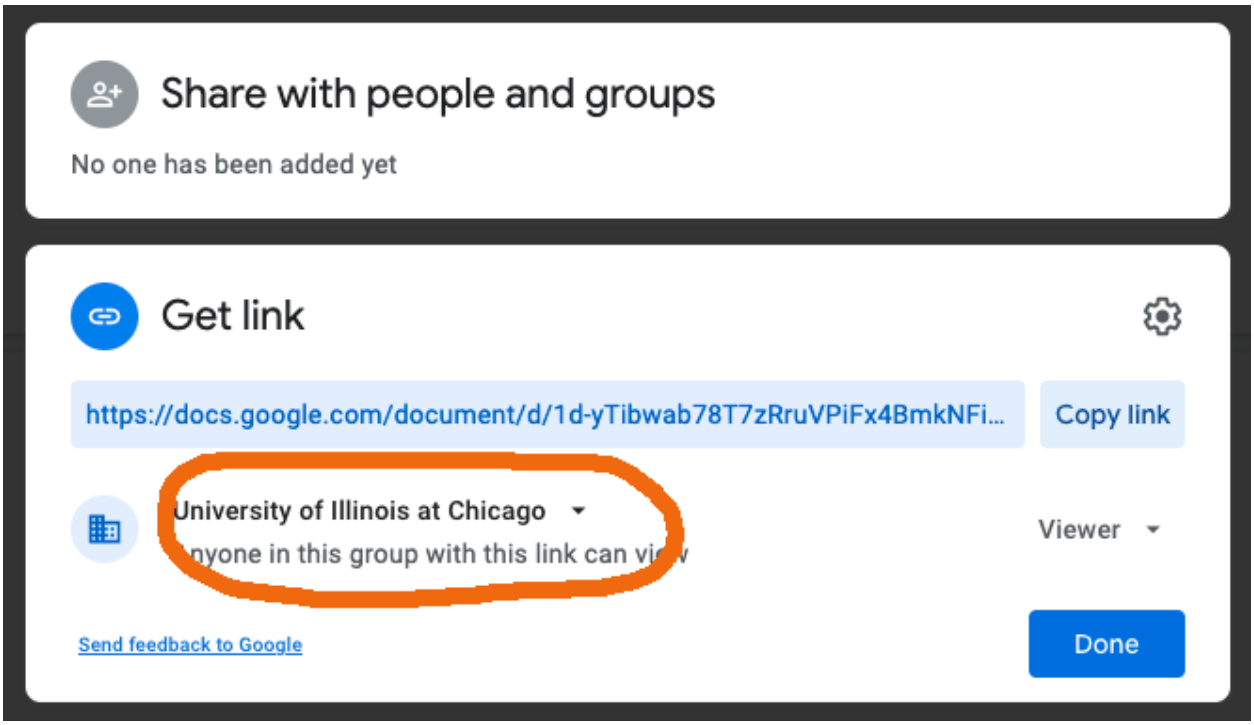
1. Sign in to your UIC account on Google. On your Google Doc, click “Share”:



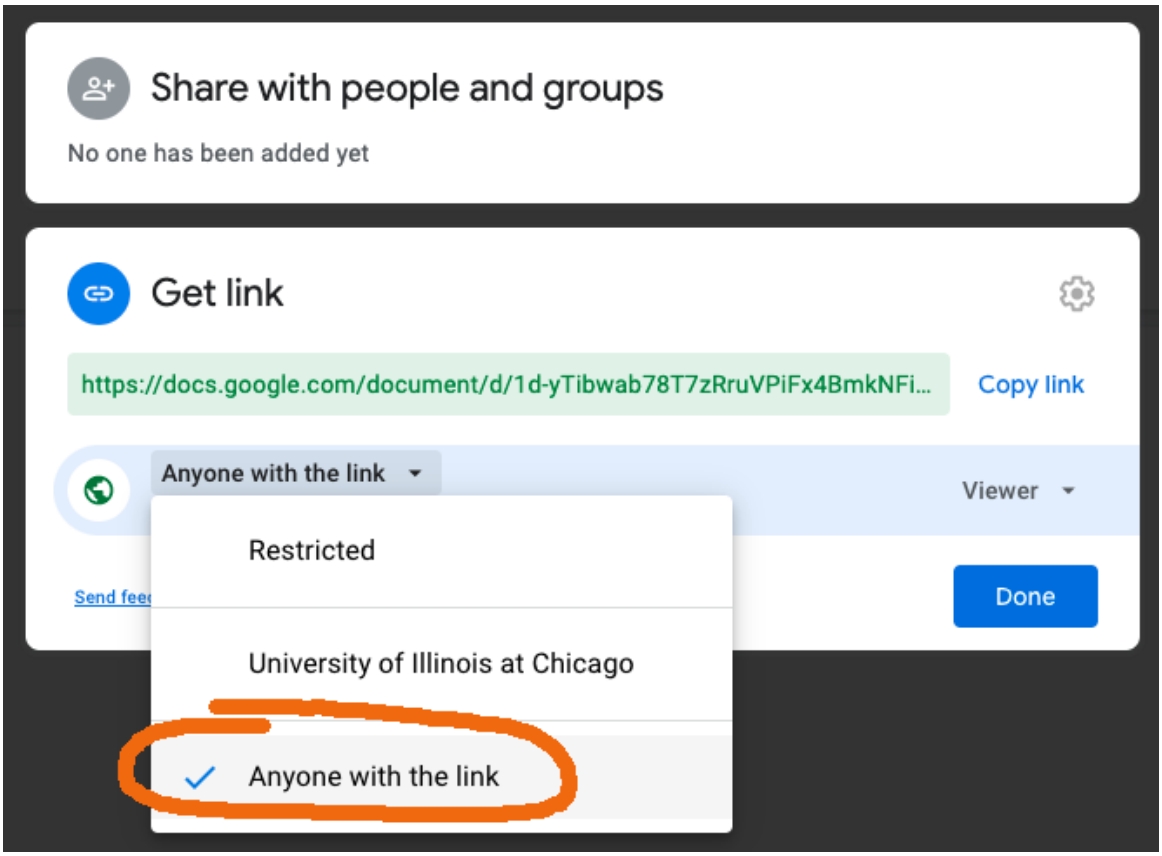
2. Under “Get link,” click “Change link to University of Illinois at Chicago”:



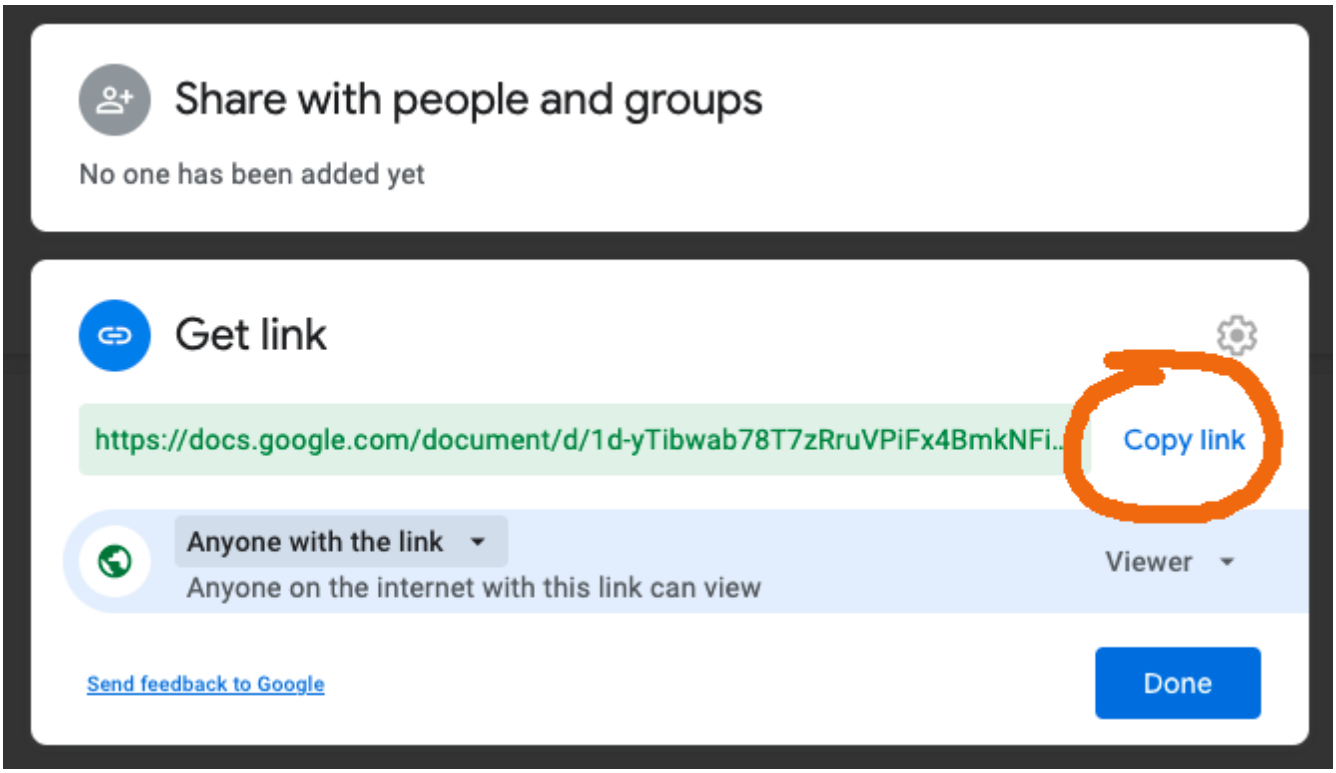
3. Click “University of Illinois at Chicago”:



4. Select “Anyone with the link”:



5. Click “Copy link” then “Done”:



6. Paste the link in Gradescope.