Project 4 [6 FP "Fluency Points"]:

Explain the effect of r (frequency ratio) on the vibration response of a wine glass subject to a harmonic excitation, for 0 ≤ r ≤ 1

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Description:

An opera singer is singing near a wine glass while varying the pitch of their voice, from very low pitch ("bassy") to a pitch when resonance occurs which results in the glass shattering. In this project, you are tasked with educating the reader about the effect of the singer's pitch (i.e., the driving frequency) on the vibration response of the glass.

- In a typed document (PDF), begin your work by modeling the wine glass as a 1-DOF, undamped vibration system
  - Present this theoretical modeling with assumptions, sketches, and math
  - It's completely up to you to assume the physical properties of the glass
  - Assume initial conditions of zero displacement and zero velocity at $t = 0$
  - Write down two solutions for the vibration response x, one for r < 1 and another for r = 1
- Create a short animation (movie), in either MP4, AVI, or GIF format, containing a series of plots showing the vibration response for 0 ≤ r ≤ 1, starting with r = 0.
- Explain how you generated the plots and created the animation.
- Finally, reflect on your learning and journey of working on this project.

Deliverable:

Present your written work (except for the animation) in a PDF, and the animation in a single MP4, AVI or GIF file.

Rules and Format:
- File requirements
  - Your PDF must contain the entirety of your work for this project except the animated plot.
  - The animation file must be readily playable on any computer.
- Animation requirements
  - Your animation plot must display the same axis range, for both x and t axes, for all frames of the file
  - Your animation plot must contain an annotation (text box) showing your name and other identifiers
  - Your animation plot must dynamically display the r value for each frame of the file (either as an annotation, title, or some other plot element)
  - Your animation plot must contain a title and axis labels
  - Your animation plot must display a plot background color different from the default white
- This is an individual project

<u>Tips:</u>
- Feel free to use the derived complete solutions for r ≠ 1 *and* r = 1 for plotting, <u>or</u> an ODE solver in Matlab (or any language) to solve the ODE and plot

<u>Submission:</u>

Submit your PDF and animation in Gradescope only. Submissions by email or other means will be disregarded.

Due on Oct 18, 2021 (Monday), at 11:59 pm CST.

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

<u>Grading Rubric:</u>

	Fluency			Scaling	Max Possible
	2	**1**	**0**		
Technical Rigor	Vibration theoretical modeling is convincing; explanation of the animation creation is detailed and clear	Some obvious details missing	Farfetched, or missing most details	1	2
Professionalism	Written work is easy to read; format is well-structured; free from grammatical or typographical errors; animation plot is well formatted and annotated	Some issues with legibility, formatting, or grammar	Barely legible, major issues with grammar and typos	1	2
Rationale, Justification, Reflection	Thoughtful and authentic; accuracy of assumptions are evaluated; acknowledges any limitations and/or sources of errors; and suggests future (self-)improvements	Insubstantial or vague	Missing altogether	1	2
				Max Possible:	6