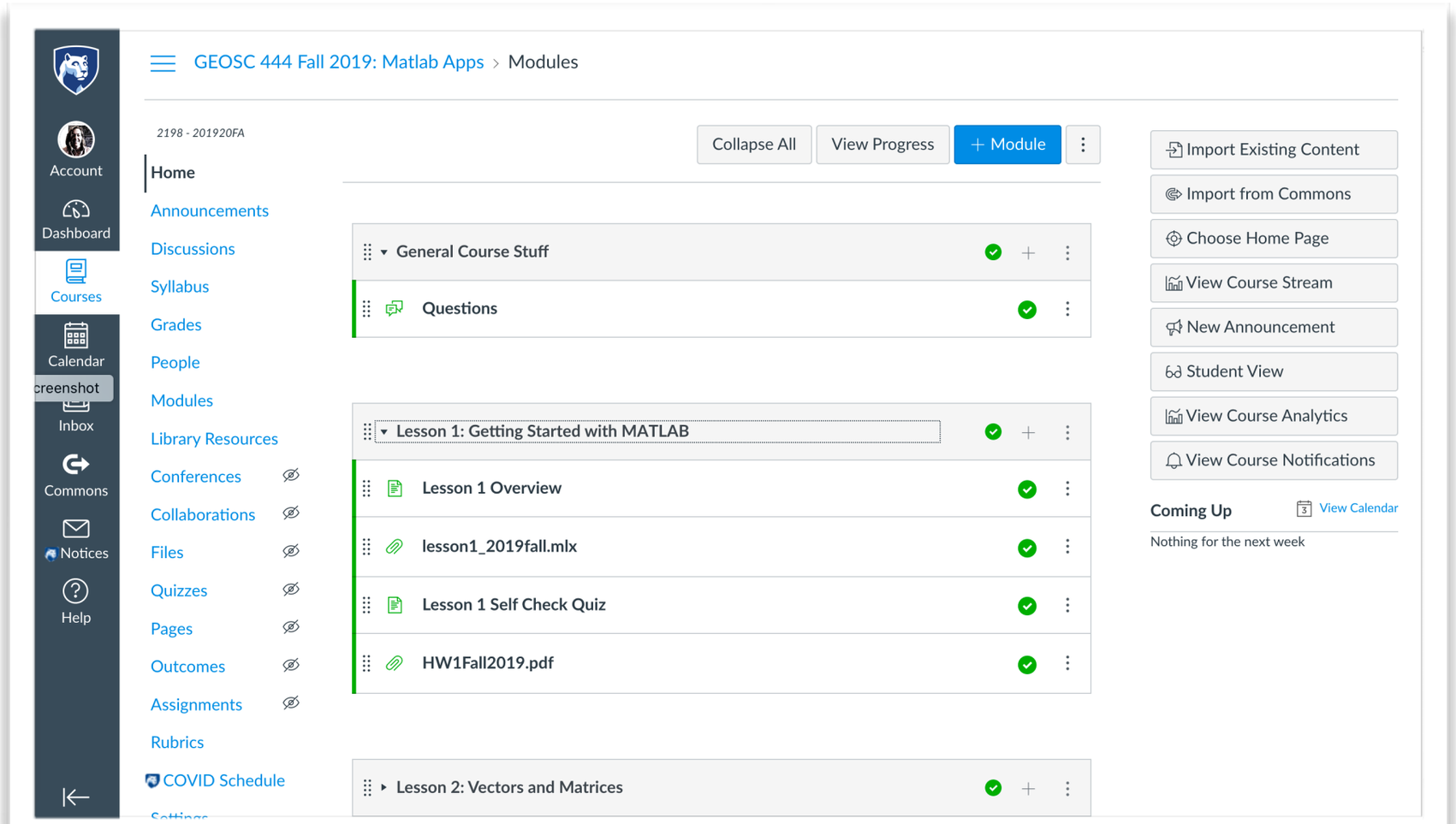
Introducing Geoscience students to coding in MATLAB



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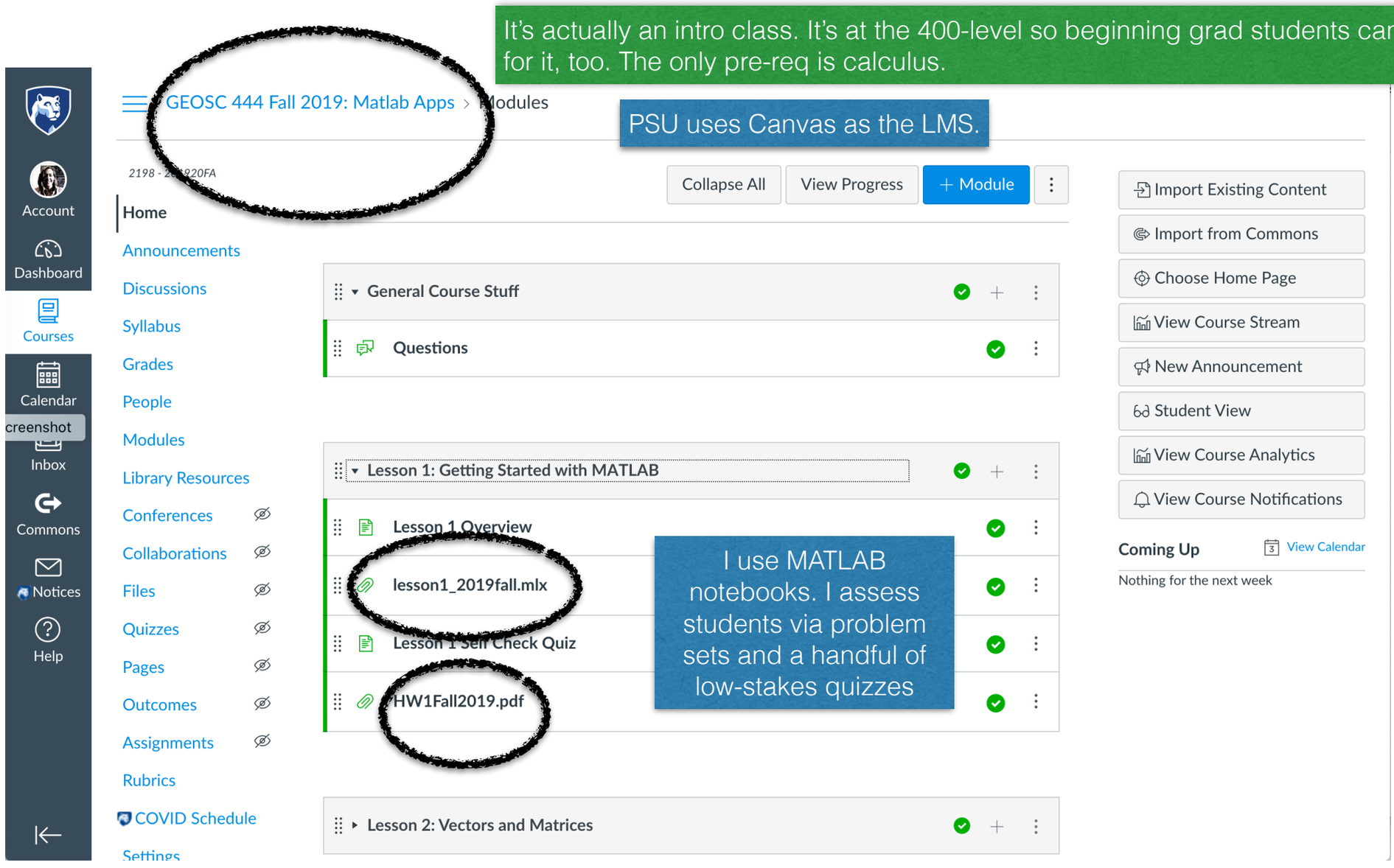
My course is a 400-level course called “MATLAB Applications in the Geosciences”



What I assume they can do at the beginning:

1. Find the MATLAB icon on the computer lab’s desktop
2. Snapchat their friends during class :)

Screenshot of the first half of problem set 1.
At the beginning students struggle with

- assignment right to left
- radians vs. degrees
- log vs. log10
- non updates of past calculations
- other things that aren't wysiwyg as in a dumb spreadsheet program

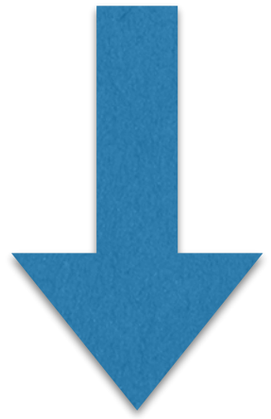
Part 0: [Optional] Back story about you

Who are you? What do you spend time on when you are not taking this class? Undergrad? Grad? Major? Experience with MATLAB or other programming/scripting languages? Specific goal for this class? Other cool things about you that I should know?

Part 1: MATLAB as calculator

1. Jake deGrom of the New York Mets won the National League's 2018 Cy Young award, given to the league's best pitcher. His season "earned run average" (ERA) was 1.70. He gave up a total of 41 earned runs during the 2018 season. How many innings did he pitch during the 2018 season? (ERA = 9*runs/innings)
2. Find the area and perimeter of a rectangle whose length is 11 meters and whose width is 6 meters.
3. Verify the identity tan(x) = sin(x)/cos(x) by substituting x = $\pi/4$ and calculating both sides of the equation.
4. The empirical formula for the energy released by an earthquake is: $\log_{10} E = 5.24 + 1.44M$ in which M is magnitude and the units of energy are joules. How many times more energy is released in a M = 8 earthquake compared to a M = 7 earthquake?
5. Triangle ABC is a right triangle, not drawn to scale. A=12 and B=9. Define A and B as variables, and
   a. Use the Pythagorean theorem to calculate C
   b. Use the Law of Cosines to calculate α. (The Law of Cosines: $B^2 = A^2 + C^2 - 2AC\cos\alpha$)

The way to get them past these beginning struggles is to make them practice a lot.



.....students admit this is true :)

University Open Ended Items

Open 1	What helped you learn in this course?
being taught how to use resources	
The problem set.	
A lot of practice in MATLAB.	
Open 2	What changes would improve your learning?
none	
It is already very good.	

University Open Ended Items

Open 1	What helped you learn in this course?
Problem set	
The homework assignments created the best atmosphere for application of the concepts.	
Asking the professor for help.	
Definitely the example problems we did in class, as well as the problems from the tutorials posted on Canvas. Also, office hours were a godsend	
Open 2	What changes would improve your learning?
Nothing regarding the class- I would just start my problem sets earlier	
Maybe a group assignment to allow students to see how others in the class code and expand upon the thinking style required for coding.	
More time to work through problem sets in class.	

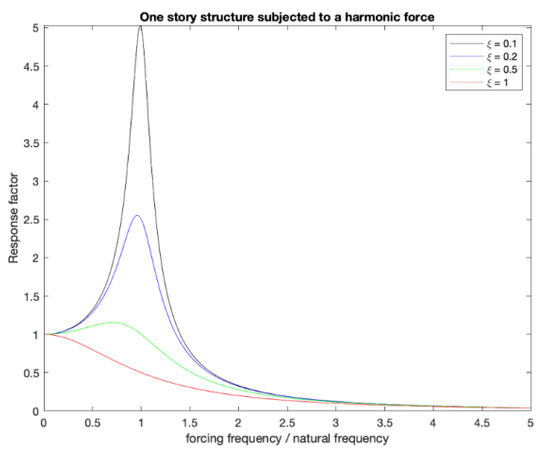
Overall course goal:

Students think through approaches to unfamiliar problems without panic. Anecdotal success according to colleagues and the students themselves

2. The response for a one-story structure subjected to a harmonic force may be written as

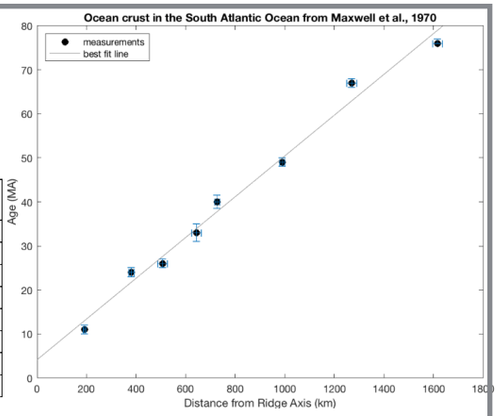
$$D = \frac{1}{\sqrt{(1-\beta^2)^2 + (2\xi\beta)^2}}$$

in which D is the response factor, β is the ratio of the forcing frequency to the structure's natural frequency, and ξ is the damping ratio. Plot a family of curves for ξ = 0.1, 0.2, 0.5, and 1 over the interval 0 < β < 5. (When I say "family of curves" that means I want them all on the same plot, with a legend that says which one is which.) For each ξ, find the maximum response factor D and the value of β at which the maximum response factor occurs.



6. The table below gives paleontological ages and distances from the ridge axis of the sediments just above the basalt basement rock from some drilling sites in the South Atlantic Ocean. Plot this data with error bars and make a best fit line with whatever functional form you feel is appropriate. Use this best fit to estimate the age of sediments that are 1200 km from the ridge axis. This data comes from Maxwell et al., 1970, Deep Sea Drilling in the South Atlantic, *Science* **168**, 1047-1059.

Site number	Age (million years)	Distance from ridge (km)
16	11 ± 1	191 ± 5
15	24 ± 1	380 ± 10
18	26 ± 1	506 ± 20
17	33 ± 2	643 ± 20
14	40 ± 1.5	727 ± 10
19	49 ± 1	990 ± 10
20	67 ± 1	1270 ± 20
21	>76	1617 ± 20



So far ….

I've taught this class face to face in the past, so we used class time for coding practice with me right there immediately to help.

Also the class is only ~20 students.

But in the spirit of *always* messing with what works, folks up the line want me to put it online, and make it bigger:**

Maybe MATLAB Grader?

(And why oh why do deans and department heads think you can just "put it online" and "double the enrollment" without any more work involved??? This is a perpetual mystery to me)

**OK I admit coronavirus gets some of the blame here, but still…