Name: _____

Date: _____

Collaborators: _____

(If applicable, the collaborators submit their individually written assignments together)

Question:	1	2	3	4	5	6	Total
Points:	10	10	5	20	20	10	75
Score:							

Instructor/grader comments:

For the purpose of this assignment a *continuing student* is a student who took MATH 3510 Section 2 class in the Fall 2020. Everybody else is a *new student*.

1. (10 points)

   For **continuing** students only: I deleted my Fall 2020 homework assignment projects from my gitlab account

   For **new** students only: I signed up for a gitlab account at https://gitlab.phys.uconn.edu/. I used my UConn email address for the registration. I created the account with the 'name' part of my UConn email as my user name. (For the reference, the 'name' part of the email address albert.2.einstein@uconn.edu is albert.2.einstein; it is **not** AlbertEinstein, Einstein, Albert, Einstein1905, or even albert.einstein.)

   Sign and date here: _____

2. (10 points) I read and understood the homework guidelines that are posted on the course website https://www.phys.uconn.edu/~rozman/Courses/m3511_21s/homework.html#guidelines

   Sign and date here: _____

3. (5 points) I watched the video Eigenvalues and eigenvector which is a part of Homework 1 assignment.

   Sign and date here: _____

Rayleigh quotient

4. The set of all possible values of Rayleigh quotient $R_A(\vec{\mathbf{x}})$ of a matrix A is known as the *field of values* of the matrix A.

   (a) (10 points) Write a matlab script (call it **hw01p4.m**) that generates 1000 random complex vectors $\vec{\mathbf{z}}$, calculates $R_A(\vec{\mathbf{z}})$, and plots points in the field of values of the following matrix:

   $$A = \begin{pmatrix} 1 & 0 & -2 \\ 0 & 2 & 0 \\ -2 & 0 & 1 \end{pmatrix}.$$

   Notice the values of $\mathrm{Im}(R_A(\vec{\mathbf{x}}))$ and compare it to machine epsilon.

   Provide axes labels and title for your graph.

   Place the commands `clear`, `clf` at the top of your script.

   (b) (5 points) continue developing your script by calculating (and printing) the eigenvalues of A. Use matlab function `eig`.

   (c) (5 points) Guess (and describe in your README.md file) what is the exact field of values for A.

   Hint: To generate a three dimensional random vector with the uniform angular distribution, you can use the following matlab code:

   ```
   x = randn(3, 1);
   ```

   Hint: Seed the random generator to have a reproducible result.

   Hint: to generate a random complex vector, first generate two real vectors and next combine them as following:

   ```
   z = x + 1i*y;
   ```

Similarity transformation

5. (20 points) Find

   $$B(t) = \sin(A\,t),$$

   where

   $$A = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix},$$

   and t is a real parameter.

Hint: Recall that

$$A\begin{pmatrix} \frac{1}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} \end{pmatrix} = \begin{pmatrix} \frac{1}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} \end{pmatrix}$$

and

$$A\begin{pmatrix} \frac{1}{\sqrt{2}} \\ -\frac{1}{\sqrt{2}} \end{pmatrix} = -\begin{pmatrix} \frac{1}{\sqrt{2}} \\ -\frac{1}{\sqrt{2}} \end{pmatrix}.$$

Show all your work.

Gitlab

6. (10 points) Create a gitlab project called **hw01** (name it exactly as shown). Upload **all** Matlab files that are needed to run your code.

   create README.md file and write in there your answer to Problem 1(c).

   Scan your answers/solutions of Problems 1–3, and 5, combine all scans into a single pdf file (call it **hw01.pdf**) and upload it to gitlab. **Do not** upload other types of files (e.g. no graphics files).

   Share the project with the instructor and the grader and grant them **Reporter** privileges.