This assignment has 3 tasks.

Exercises

For these tasks you need knowledge about vectors and arrays, Chapter 4/5 in the course book.

Task 1

A central theorem in linear algebra says that the eigenvalues of real symmetric matrices are real and that their eigenvectors are orthogonal. Try to verify this theorem by using square random matrices of dimensions not less then 5.
Test your function.

Task 2

Given a vector $u \in \mathbb{R}n$. Construct a $n \times n$matrix A with the properties

$$
\begin{aligned}
A_{i,i} &= -2u_i, \;\; i = 1, \ldots, n \\
A_{i+1,i} &= u_i \;\; i = 1, \ldots, n-1 \\
A_{i,i+1} &= u_{i+1} \;\; i = 1, \ldots, n-1
\end{aligned}
$$

and all other elements being zero.
Do this task by using the numpy command `diag` and alternatively, by using for-loops. Write a function, that takes a vector and returns such a matrix.

Task 3

Call the function you created in the last task with `u=linspace(0,2*pi,500)` as input to get a matrix D. Compute the matrix $\sin(D)$. Multiply this matrix with the one-vector (a vector filled with 1's.) and plot the result versus u.