This assignment has ?? tasks.

**Exercises**

For these tasks you need knowledge about vectors and arrays, i.e. the basics from Chapter IV.2 and the first sections of Ch. V

**Task 1**

Write a function, which takes a matrix as parameter. It should check if this matrix is symmetric. The function should return $1$ for a symmetric matrix, $-1$ for a skew-symmetric matrix and $0$ otherwise.

Test your function.

**Task 2**

Write a function, which takes two vectors as parameters. It should check if these vectors are orthogonal. If they are orthogonal it should return $\text{True}$, otherwise $\text{False}$.

Don’t forget to provide your function with a docstring.

Test your function.

**Task 3**

Write a function, which takes a vector as parameter and which returns the corresponding normalized vector, i.e. $\frac{\vec{v}}{\|\vec{v}\|}$. Write two variants of this program: one in which you compute the norm (use the 2-norm) of the vector by yourself and another, which uses the function $\text{norm}$ from the module $\text{scipy.linalg}$.

Recall that to be able to use Scipy’s norm-function you must have the line

```python
from scipy.linalg import norm
```

at the start of your program. Note that (of course) you cannot then call your own function $\text{norm}$ too. If this is inconvenient, one can use
to give Scipy’s \texttt{norm}-function the new name \texttt{scnorm}.

\textbf{Task 4}

Show experimentally that the inverse of a rotation matrix is its transpose.
\textit{Hint:} $B$ is the inverse of $A$ if $AB = BA = I$, the identity matrix.

Note, in 2D a rotation matrix has the form

\[
\begin{pmatrix}
\cos \alpha & \sin \alpha \\
-\sin \alpha & \cos \alpha
\end{pmatrix}
\]

where $\alpha$ can be any angle.

\textbf{Task 5}

\textit{(If you don’t know eigenvalues (yet) skip this task)} Construct a $20 \times 20$ matrix with the value 4 on its diagonal and the value 1 on its sub- and super-diagonal. The rest of the matrix is zero. Compute its eigenvalues. (Use the function \texttt{eig} from the module \texttt{scipy.linalg}). You might also want to check the function \texttt{diag} for this task

\textbf{Task 6}

\textit{(If you don’t know eigenvalues (yet) skip this task)} Change in the above task the matrix in such a way that all the elements of its subdiagonal instead have the value $-1$. How are the eigenvalues affected by this change?