Exercise 1 *(Reading - Getting started with Octave/Matlab)***.** In order to solve programming exercises it is necessary to download (the non-comercial) **GNU OCTAVE** or (the commercial variant) **MATLAB**. The programming languages are (almost) identical. The easiest way is probably to download Octave from the website

https://octave.org/download

If you nevertheless want to download matlab you should visit

https://www.th-rosenheim.de/intranet/einrichtungen/rechenzentrum/it-services/software/allgemeine-software/

In order to be able to take first steps in octave/matlab you can download the book by Ferreira and Fantuzzi: "MATLAB Codes for Finite Element Analysis" free of charge as an e-book in the university library.

https://touchpoint.th-rosenheim.de/TouchPoint/perma.do?q=+1035%3D%22BV046791856%22+IN+%5B2%5D&v=fro&l=de

In the first chapter of this book you will find a short introduction to octave/matlab, which will enable you to solve simple programming tasks (e.g. in Exercise 2).

Exercise 2 *(Programming)***.** It is (without proof)

$$\sum_{j=1}^{\infty} \frac{1}{j^2} = \frac{\pi^2}{6}.$$

How large must N be chosen in

$$\sum_{j=1}^{N} \frac{1}{j^2} \tag{1}$$

in order to calculate π with an error of less than 10^{-6}? To determine such a number N, write a Matlab/Octave script that can calculate the sum in (1) above. Find the solution by trying.

Exercise 3 *(Math)***.** A symmetric matrix $A \in \mathbb{R}^{n\times n}$ is called positive definite if

$$\langle x, Ax\rangle = x^T Ax > 0 \quad \forall x \in \mathbb{R}^n,\ x \neq 0$$

holds. Prove the following

(a) For symmetric $A \in \mathbb{R}^{n\times n}$ we have

$$A \text{ is positive definite} \Leftrightarrow \text{all eigenvalues of } A \text{ are strictly positive}$$

Hint: For the reverse direction, use that the symmetric matrix A has an orthonormal basis of eigenvectors, and then represent x in Ax with respect to this particular basis.

(b) If $A = (a_{ij}) \in \mathbb{R}^{n\times n}$ is symmetric and positive definite, then all the diagonal elements of A are strictly positive, i.e.

$$a_{ii} > 0 \quad i = 1, \dots, n.$$

The exercises can be discussed in the Tuesday lecture next week.