Lecture:
- Einführung in Matlab zur Auswertung von MRT-Bilddaten in der Hirnforschung -

- Introduction to Matlab for analyzing MRI Data in Brain Research -

Summary:
This lecture series is a comprehensive introduction to the programming languages Matlab and Octave (Octave is a free software which is largely compatible with Matlab). It covers the most important Matlab/Octave features and functions, with a particular focus on the display and analysis of MR images and measurement data.

Target audience and prerequisites:
The lecture series is open to everybody who wants to learn about Matlab and Octave. Importantly, there are no prerequisites.

Language:
English or German, as requested by the audience.

Place and Time:
In presence: Seminar area of the Cooperative Brain Imaging Center (CoBIC), Heinrich-Hoffmann-Str. 9, Building 88, Campus Niederrad; Time: will be announced.
Online (if requested or if lectures in presence are not possible): Links will be sent to registered participants.

Script:
The lecture material can be made available to registered participants.

Registration:
Via E-Mail to Prof. Dr. Ralf Deichmann <Deichmann@med.uni-frankfurt.de>

(see next pages for an overview of the lecture series)

Overview of the different parts:

Part 1
1. Introduction: Matlab and Octave
2. The Command Window
3. Predefined variables and naming of own variables
4. Creating lists of values
5. Vectors and Matrices

Part 2
1. Types of Matrices
2. Mathematical Matrix Operations:
   2a: Overview
   2b: Matrix and Vector Algebra
   2c: Element-wise Operations
3. "find" and Logical Operators: Motivation
4. The find function
5. Logical Operators
6. "find" and Logical Operators: Application

Part 3
1. Data Types
2. Input Functions
3. Output Functions
4. if-Statements
5. switch-case-Statements

Part 4
1. Random Numbers
2. Histograms
3. Basic Statistical Functions
4. Defining Own Functions

Part 5
0. Summary: Plot Types
1. Line Plots
2. Scatter Plots
3. Bar Charts
4. Pie Charts
5. Define Image Position and Size
6. Export Plots
7. Handles

Part 6

1. Operations on 2D image data
   1a: Display via "imagesc"
   1b: Mirror image
   1c: Rotate and transpose image
   1d: Circular Shifts
2. Operations on 3D image data
   2a: Extract slices in different orientations, command "squeeze"
   2b: Display via "montage", command "reshape"
   2c: Permute dimensions (1): command "permute"
   2d: Permute dimensions (2): command "shiftdim"
3. A WARNING about image operations

Part 7

1. for-Loops
2. while-Loops
3. Interrupting loops
4. Concatenating loops
5. Cell Arrays
6. The "system" command

Part 8

1. The "sort" command:
   1a: Default
   1b: Specify order of sorting
   1c: Calculate percentiles
   1d: Sort with indexing
2. Working with text files:
   2a: General
   2b: Writing to text files
   2c: Reading from text files
3. Strings:
   3a: General commands
   3b: Composing strings: "sprintf"
   3c: Decomposing strings

Part 9

1. Linear Regressions:
   1a: Motivation and basic principles
   1b: The function "polyfit"
   1c: Linearizations
   1d: polyfit at higher orders
2. Nonlinear Regressions:
   2a: Motivation and basic principles
   2b: Function handles

2c: The function "fminsearch"
2d: Performing nonlinear regressions

Part 10

1. Interpolations - 1D
   1a: Motivation and basic principles
   1b: Linear interpolation
   1c: Spline interpolation
2. Interpolations - 2D
   2a: 2D functions
   2b: Basics of 2D interpolation
   2c: Resampling 2D images
3. Interpolations - 3D
   3a: Resampling 3D images
   3b: meshgrid and ndgrid
4. 3D-Plots of scalar fields
   4a: mesh
   4b: surf
   4c: contour and surfc
   4d: imagesc
5. 3D-Plots of vector fields
   5a: quiver

Part 11

1. Regression: Quick Repetition
2. The Coefficient of Determination
3. Systematic and Statistical Deviations
4. Confidence Intervals
   4a: Background
   4b: Monte Carlo Simulations
5. Confidence Bands