Basics of Programming (Thurs. / Fri.; Springer)

- Reading a line of code
- Variables – x=2
  - Entering
  - Retrieving
  - Mathematical Operations + - * / ^
  - Order of Operations
- Arrays
  - Loading
  - Visualizing
  - Retrieving Values
  - Altering Values
- Basic Functions – Analyzing a dataset
  - Length, size
  - Mean, median, standard deviation
  - Sort
- Functions of 2D arrays
- Entering Arrays
  - Bracket operator
  - Colon operator
  - Comma semicolon
- Conditional Retrieval
  - >
  - find
- Ploting
  - 2D: colors, lines, labels
  - 3D
- Scripts
- Conditional States and Control Flow
  - For loops
  - If, Elself, Else
  - !, ==, >, <, >=
  - Or and And (| || & &&)
  - While
  - Counters
- Cell Arrays
  - Entering
  - Retrieving
  - fieldnames
- Function
  - Simple functions
  - Scope
- Data Structures
- Strings – dealing with text and mixed data
- Parsing data

Statistics with MATLAB (Monday, AM; Born)

- Rattus binomialis: When is he guessing?
  - all you need is 'rand'
  - simulations and probability
  - 'for' loops
  - tricky indexing into arrays
  - 'tic' and 'toc' to time code execution
  - binomial distribution
  - pdf's and cdf's

- Bootstrap Bill: Statistics for the common man
  - operations along columns of 2D matrix
  - use of 'repmat'
  - simple descriptive statistics: mean, median, standard error
  - plotting functions: 'plot', 'errorbar', 'polar'
  - handle graphics
  - bootstrapping: null hypothesis; permutation test; confidence intervals

- Sorting spikes: The joys of dimensionality reduction
  - thresholding to find peaks in data
  - using 'diff' to find events in continuous data
  - PCA/SVD to reduce dimensionality of data
  - 3D plotting
  - ISI histograms

Image Processing I: Computer Processing (Monday, PM; Springer)

- Visualizing an image in MATLAB
  - loading images – imread and dragging
  - displaying images –imshow, imagesc, surf
  - data types – double, mat2gray

- Manipulating Pixels
  - Background Subtraction
  - Rescaling
  - Transform – e.g. log
• Manipulating Field of pixels – Filters
  o Intensity Preserving
    • Smoothing Filters
  o Non-Intensity Preserving
    • Contrast
    • Vertical Lines
    • Horizontal Lines
    • Edges
    • Contrast – Laplacian
    • Laplacian of Gaussian (LoG)

**Image Processing II: Images and Your Brain**
(Tuesday, AM; Born)

• Horace Barlow: Image Statistics and "Suspicious Coincidences"
  o loading and displaying images
  o histograms and probability density functions
  o nearby pixels are similar: correlation with 'corcoef'
  o center-surround: LoG and 'imfilter'
  o orientation selectivity: finding "suspicious coincidences with 'colfilt'

• David Marr: Where's Abe?
  o image manipulation: blkproc
  o edge detection: LoG and thresholding
  o image filtering in the frequency domain: 'fft2', 'ifft2'
  o band-rejection filters
  o zero-crossings and the "raw primal sketch"
  o better recognition through subtraction

**Modeling with SIMBIOLOGY**
(Tuesday, PM; Springer)

• Launching simulink
  o The hydrogen model – mRNA synthesis and decay
    • Drawing a model
    • Setting the rate equations
    • Running a simulation
    • Running a parameter scan
    • Extract the data into MATLAB to manipulate

• Models
  o Enzymatic reactions
  o Binding unbinding reaction
  o Ligand Receptor with Sink/Drug pharmacology with Sink
  o Competitive Inhibition
  o Multisite Phosphorylation

**Image Processing III: Segmentation**

• Finding cells or features
  o Thresholding
  o Bwlabel
  o Cleaning up the features – imopen, imclose, imerode imdialate

• Quantititating Cell
  o Regionprops
  o Extracting values from pixels