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Computer Praktikum 1
SS 2003, 14.04.2003

# Computational Neuroscience II: Foundations of Neural Coding

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## 1. First Steps

- Turn on the computer. Wait until Windows has loaded.
- Double-click with the right mouse button on the Xwin32 icon on your "desktop" (i.e., your Windows screen). The most immediate effect of double-clicking is that a cursive X is added to the panel *either* on the bottom right of the screen or next to the Start button on the lower left. Do a *single* right mouse click on this symbol, and open a session (to pool#). And then wait. This might take a few seconds.
- A terminal window appears, connecting you to the Linux environment. O brave new world, this ain't Windows anymore, and you'll have to get used to some typing. Some common commands under Linux are
  1. **pwd** print the name of the current directory.
  2. **ls** list the contents of the current directory.
  3. **cd** ⟨dir_name⟩ change into directory "dir_name".
  4. **mkdir** ⟨dir_name⟩ create a *new* directory "dir_name".
  5. **cp** ⟨file1⟩ ⟨file2⟩ copy contents of file1 into file2.
  6. **mv** ⟨file1⟩ ⟨file2⟩ rename file1, assigning it the name file2 (and overwriting any prior version of file2).
  7. **rm** ⟨file_name⟩ removes file with name "file_name" (use with caution!)

  A common editor (to create text files) within a Unix/Linux environment is emacs, or xemacs which can be invoked by typing

  emacs ⟨file_name⟩

  for instance. You may also use a more "Windows"-like editor kedit. Don't start the editor for the moment, though. Now create a new directory (using your first or last name) and change into it (e.g., move into the terminal window with the mouse, and then type `mkdir mathilde`, followed by `cd mathilde`).
- Type `matlab` to start Matlab. You can start the demo within Matlab by typing `demo`. Have a look at the 2- and 3-dimensional plotting functions and check out the corresponding Matlab codes.

## 2. Introduction to Matlab

If Matlab starts up correctly, you'll see a prompt of the form >>.

a) Type $54211 + 2733$ at the prompt and hit return.

b) Enter $a = [1 \quad 2 \quad 3 \quad 4]$. What do you get (and what does it mean)?

c) Add a second vector $b = [5 \quad 6 \quad 7 \quad 8]$.

d) What happens when you use $a'$ and/or $b'$ instead of $a, b$? What is the mathematical term for the operation denoted by the prime symbol "′"?

e) Try manipulating these two vectors. For instance, enter

$$a + b, a * b', a - b, a/b, a. * b \text{ and } a./b \qquad .$$

(Don't enter the commas when typing these items at the Matlab prompt. Just hit return.) Examine Matlab's operator preferences, by combining several arithmetic operations and setting parentheses. Is $a. * b - b = a. * (b - b)$?

f) What is the difference between

$$a1 = [1 \quad 2 \quad 3 \quad 4] \quad \text{and} \quad a2 = [1; 2; 3; 4]?$$

How could you convert $a1$ into $a2$?

g) What does the entry $0 : 0.5 : 10$ create? Try a few different values for the entries in this sequence.

h) Matrices are entered by using semicolons to denote different rows. For instance, $M = [1 \quad 2; \quad 3 \quad 4], N = [4 \quad 5; \quad 6 \quad 7], Q = [1 \quad 0; 0 \quad 1; 0 \quad 1]$; Try different algebraic manipulations using these matrices.

i) Replacing elements in a matrix is straightforward. So, suppose you want to change the last entry in $Q$ from 1 to 2. Then type $Q(3, 2) = 2$.
In general, you can refer to the i-throw, and j-th column of a matrix by $Q(i, j)$. A vector is nothing more than a single column or single row matrix, so you can refer to the i-th vector element by either typing $a(i, 1)$ or $a(1, i)$ (why?), or simply $a(i)$.

j) Accordingly, what does $Q(:, 1 : 2)$ or $Q(1 : 3, :)$ mean?

k) Now, let's look at a system of linear equations

$$a * x + b * y = p$$
$$c * x + d * y = q$$

Transform this set of equations into a matrix equation. What is the solution of this problem? Calculate the solution for the specific values of $p = 1, q = 0$ and

$$\begin{pmatrix} a & b \\ c & d \end{pmatrix} = \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}.$$

*Hint: $N = inv(M)$ calculates the inverse of the matrix $M$.*

l) Is there a solution for

$$\begin{pmatrix} a & b \\ c & d \end{pmatrix} = \begin{pmatrix} 1 & 1 \\ 1 & 1 \end{pmatrix}?$$

*Hint: use the command* `lookfor` ⟨`search term`⟩ *to list all commands related to a specific search term. To find the proper syntax for a command, enter* `help` ⟨*command*⟩*. And, if this is not sufficient, the entire help system within Matlab can be called up via* `helpdesk`*.*

m) How do you compute the matrix inverse of a $2 \times 2$ matrix without using the Matlab command `inv()`? *(Hint: use the Matlab help tools.)*

n) Explore Matlab tutorials on the Web. Use a WWW browser such as Netscape or Internet Explorer to go to one of the following sites:

1. www.engin.umich.edu/group/ctm/basic/basic.html
2. www.math.ufl.edu/help/matlab-tutorial
3. www.math.utah.edu/lab/ms/matlab/matlab.html

o) (*for specialists*) You will find two files figure1.ps and figure2.ps in the directory /home/tutor/CompNeuroII/Assignment1. Copy them in your home directory with "`cp /home/tutor/CompNeuroII/Assignment1/figure?.ps .`" and open both figures with the programme ghostview (`gv`). Try to reproduce them. You may consult Matlab online help (Matlab commands `>> helpdesk` or `>> helpwin`). The relevant function is $f(x, y) = x\, e^{-x^2-y^2}$. Play around with the `shading` and `colormap` commands (`>> help shading`).

p) Type `quit` to exit matlab.

## 3. A small list of emacs commands

Now it's time to have a first look at very few vital commands of the most beloved text editor in the Unix world — *emacs*.

- Start the editor by typing `emacs` and move your mouse pointer into the new window.
- Open a new file with `Ctrl x + Ctrl f`. In the bottom line of the window you are asked for a file name. Choose any you like.
- If everything has worked out right, you have obtained a blank screen with a cursor at the top left position. Type a few senseless words and erase them again until you get bored.
- Apply the following commands and try to memorize them

| shortcut | command |
|---|---|
| `Ctrl x+ Ctrl f` | open file |
| `Ctrl x+ Ctrl s` | save current buffer |
| `Ctrl x+ Crtl w` | save current buffer as |
| `Ctrl x+ Ctrl c` | quit |
| `Ctrl x + k` | kill (=quit) current buffer |
| `Ctrl g` | escape from command line (important!) |
| `Ctrl k` | delete line |
| `Ctrl Alt k` | delete word |
| `Ctrl y` | insert marked text (Windowsly know as `Ctrl v`) |
| `Ctrl SPACE` | begin mark |
| `Alt w` | end mark |
| `Ctrl w` | end mark and delete region |
| `Alt x + undo` | Undo |
| `Alt q` | format text |
| `Ctrl s` | incremental search (most important in large files!) |
| `Alt x + help-with-tutorial` | an interactive tutorial (browse with `Ctrl s`) |
| `Alt x + TAB` | many many more commands such as spell checking, replacement macros, etc. |

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Besprechung der Aufgaben am 17.04.2003 um $8^{15}$