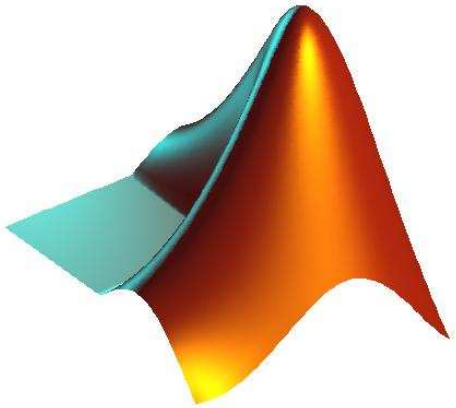
Matlab Tutorial - Practical Part

15.10.2008



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Roadmap of the Tutorial

- **Practical part (14.00-17.00):**
  - learning by doing
- go into the directoy /usr/local/matlab/bin,
- start matlab

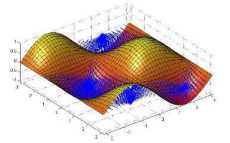
Generation and manipulation of vectors

- generate a row and column vector using
  - direction definition `>> x=[1 3 8];`
  - using `ones,zeros,rand,randn` or the colon operator `:`
    in case of error or unknown commands use `>> help function`
- check the workspace content with `>> whos`
- check the size with `>> size(your_array)`
- transform your row vector into a column vector and then concatenate both.

Generation and manipulation of matrices

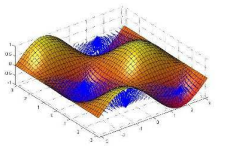
- generate a square matrix of the same size as your column vector
  - use either `rand,randn`
- check the workspace content with `>> whos`
- check the size with `>> size(your_array)`
- multiply the column vector with the matrix and assign the result to a new variable
- take the inner product of the result and your original column vector (there are at least three ways to do that - how many do you find ?)

Indexing matrices



- generate a random 3×4- matrix A
- access the elements $A(3,1)$, $A(1,4)$ and assign zero to them
- what are the corresponding linear indices ? (try it !)
- display the third column and the second row
- display all elements which are larger than 0.5
- generate a zero array of size $2 \times 3 \times 4$
  assign the matrix A such that $B_{2kl} = A_{kl}$ with $1 \leq k \leq 3$ and $1 \leq l \leq 4$.
- display row and column indices of A which are between 0.2 and 0.5.

Linear Equations and first functions



- use `>> x=rand(30,2); y=0.5*x(:,1)+0.2*x(:,2);`
- define `>> H=x'*x` and `>> b=x'*y`
- solve the linear system $Hw = b$,
- what are the coefficients w ?
- (add a little bit of Gaussian noise to y and repeat)
- write a function `LeastSquares` with input x, y which has as output w.
- what will happen if y has more than one column ?
- add a comment to the function - and check what is shown when you use `help LeastSquares`

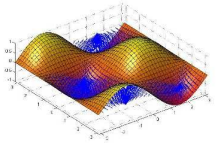
For the fast ones:

- write a function `MatrixPower` with a symmetric matrix A and a real number c as input - compute A^c using the eigenvalues and eigenvectors of A.

JIT compilation versus vectorization

- implement functions `PNorm1` and `PNorm2` and repeat the experiment of the lecture
- check runtimes for the growing arrays once when you preallocate memory and once without
- use `clear` to free memory of variables

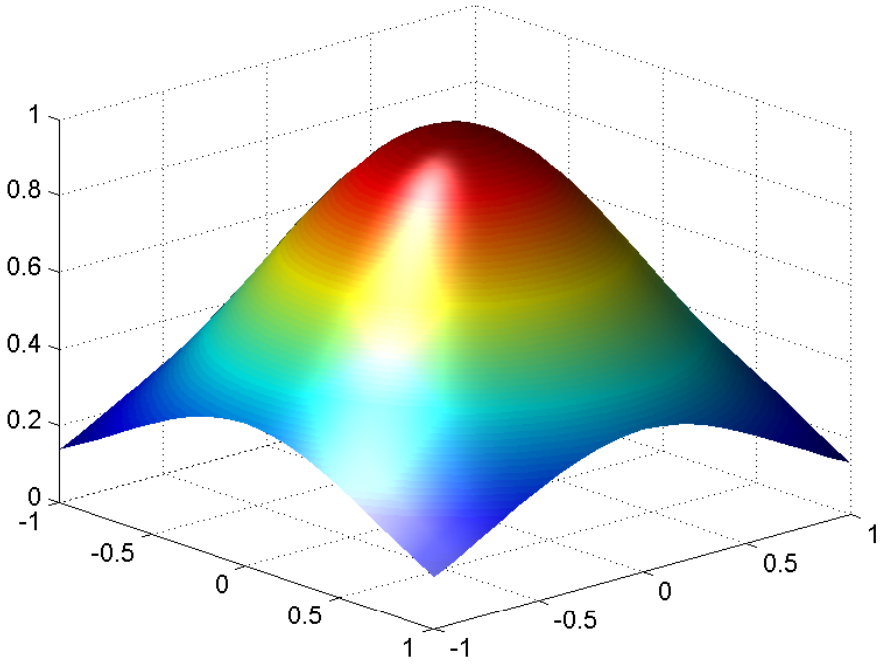
Debugging



- download the file `dist_euclideanBUG.m` from the Matlab-Tutorial homepage
- it is supposed to define the distances between two set of points X and Y e.g. with `X=rand(30,6); Y=rand(20,6); D=dist_euclideanBUG(X,Y)` computes the 30×20 distances between the 6-dimensional vectors.
- use the debugger to find the bug in `dist_euclideanBUG.m`

Plotting

- reproduce the plots from the lecture
- play around with the parameters - different colors, plotting styles etc.
- generate other functions and plot them



Profiler

- generate data with

  ```
  >> x=randn(500,2); x=[x ; randn(500,2)+3]
  ```

- run

  ```
  Ind=SpectralClustering(x)
  ```

  in the profiler