Organization & Introduction to Matlab

Data Mining Practical Course

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Practical Course Organization

- Meeting in room D-114, D-118 every two weeks
  - 3 hours (=4SWS)
- Procedure:
  - Tasks consist of theoretical & practical parts
  - Data and sheets available in the CommSy room
    - If not happened yet: **apply now**
    - Group of 2 students/computer
  - No corrections, no points
  - Create your own course documents
  - Discussions with tutor
    - Tutor decides whether sheet is passed (like in SE1)

Practical Course Organization

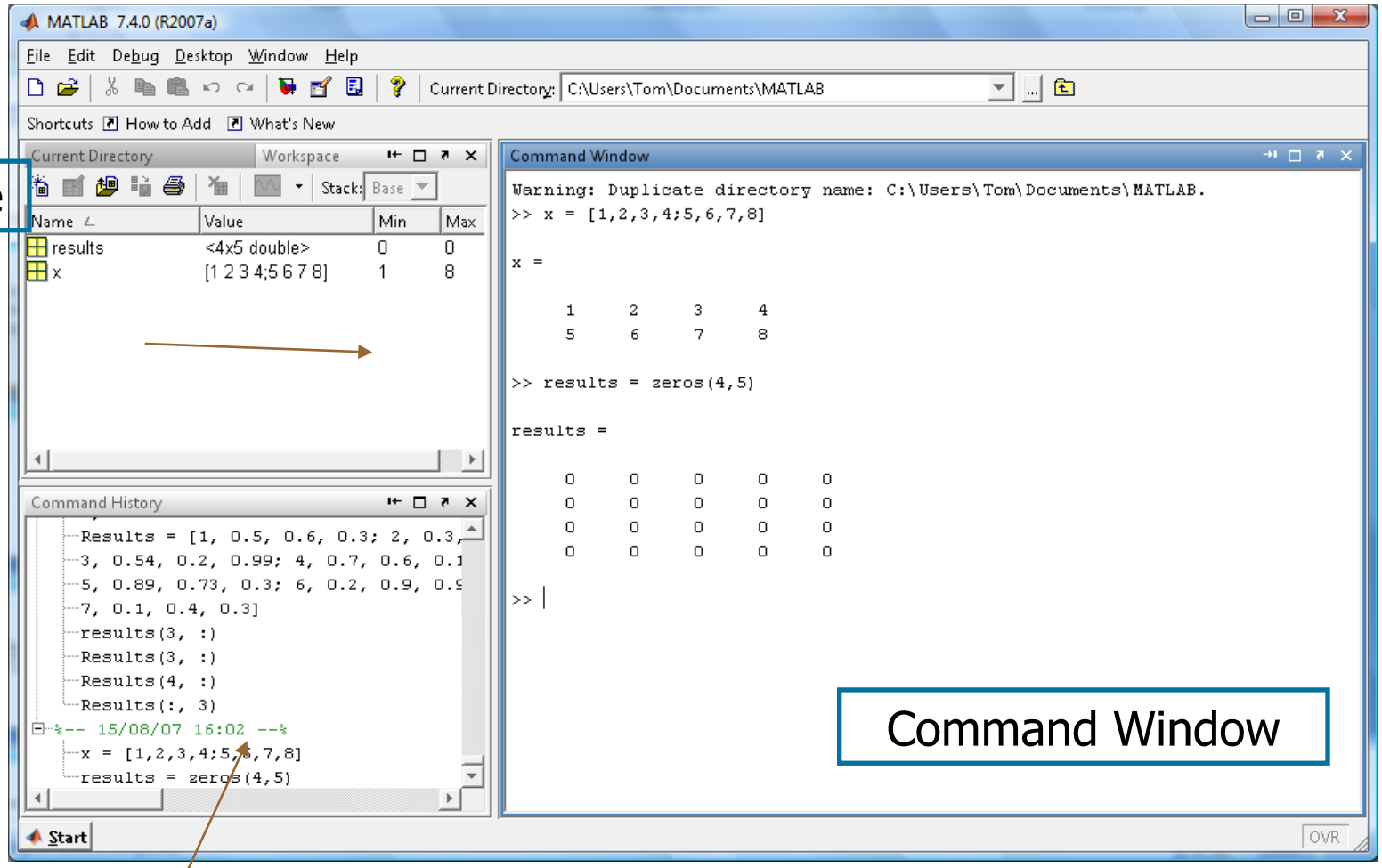
- Attendance!
  - Case of illness: Inform your tutor
- Every sheet has to be finalized in course time
  - You get a joker to finalize **one** sheet in the beginning of the next tutorial's course time
- Every sheet has to be passed
- Activity in discussions and practical work
  - Every student should be prepared to explain the group work

Questions???

What is Matlab

- **Mat**rix **Lab**oratories, The Mathworks Inc. software product
- High-level, interpreted language
- GUI-based, but also terminal
- Contains a lot of specialized function packages
  - Toolbox: e.g. image processing, optimization, etc.
- Needs licenses ☹
  - Solution: vpn-connection to UHH or **Octave** (free)
- Linux: just type *matlab* (without GUI: -nodesktop)
- Book recommendation: Wolfgang Schweizer, *Matlab Kompakt*, Oldenbourg Verlag, 4. Auflage

Matlab GUI



Workspace

Command Window

Command History

Variables

- No need for types. i.e.,

```
int a;
double b;
float c;
```

- All variables are created with double precision unless specified and they are matrices

```
Example:
>>x=5;
>>x1=2;
```

- After these statements, the variables are 1x1 matrices with double precision
- Also: char, string, float, logical, integer, …

Further Representation

- Matlab operations rely on linear algebra
  - Data can be scalar, vector or matrix
- Variable assignment: any string of upper and lower case letters along with numbers and underscores but it must begin with a letter
- Examples:
  - a=5;
  - b=[1 2 3]; %row vector
  - c=[1;2;3]; %column vector
  - d=[1 2 3 4; 5 6 7 8]; %2x4 matrix

Data generation with : operator

- `a =1:10`

```
a =
    1    2    3    4   5   6    7   8    9    10
```

- `b =2:-0.5:-1`

```
b =
    2   1.5   1   0.5   0   -0.5   -1
```

- `c = [1:4; 5:8]`

```
c =
    1      2      3     4
    5      6      7     8
```

Access to data

```
c =
        1       2       3      4
        5       6       7      8

c(1,:) =
        1       2       3      4

c(1,[1:3])=
        1       2       3

c(:,[1:3]) =
        1       2       3
        5       6       7
c(2,[2:end])=
        6       7      8
```

Operations

- **Simple arithmetic:** +, - , /, *
- **Logical Operators:**
  - Greater Than: >
  - Less Than: <
  - Greater Than or Equal To: >=
  - Less Than or Equal To: <=
  - Is Equal: ==
  - Not Equal To: ~=
- **Boolean:** &, ~, |
- **Transpose**: ‘

Functions

- Signature for writing your own functions

```
output=func_name(input)
[output1, output2]=fun_name(in1,in2,in3)
output=fun_name(in1, in2, varargin)
[output, varargin]=fun_name(in1, in2, varargin)
```

- File name should match function name

- Usage of **built-in** functions

```
result=mean(data);
[sort_out]=sort(data);
[sort_out, index]=sort(data, dim);
```

Useful Functions today

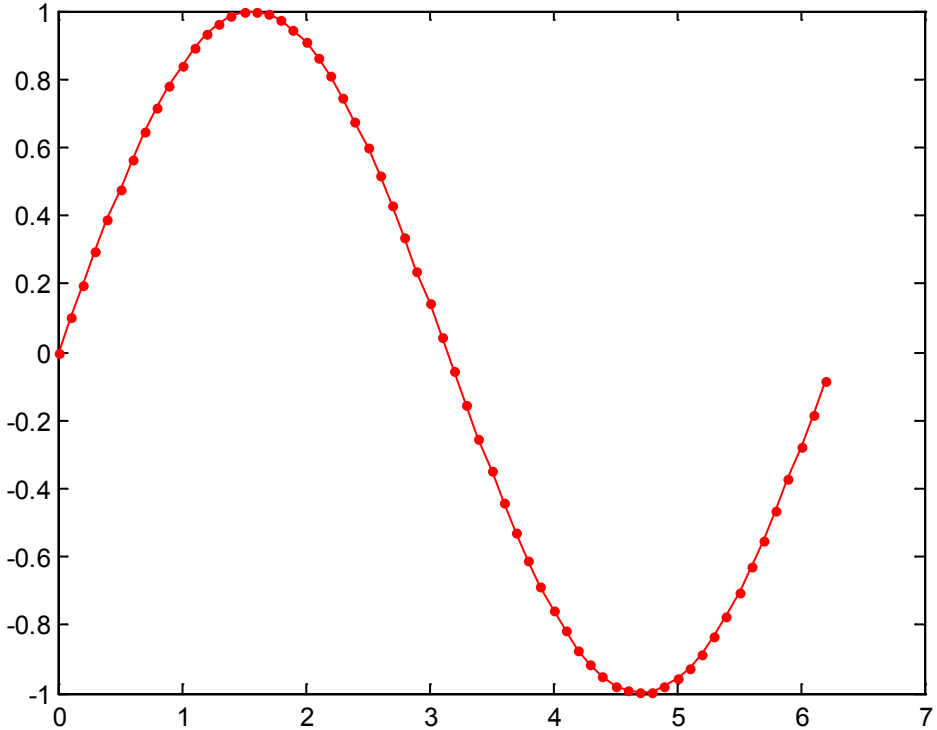
- MATLAB built-in functions
  - sum – Sums the content of the variable passed
  - prod – Multiplies the content of the variable passed
  - mean – Calculates the mean of the variable passed
  - median – Calculates the median of the variable passed
  - mode – Calculates the Mode of the variable passed
  - std – Calculates the standard deviation of the variable passed
  - sqrt – Calculates the square root of the variable passed
  - max – Finds the maximum of the data
  - min – Finds the minimum of the data
  - size – Gives the size of the variable passed

- Special:
  - pi, i or j (sqrt(-1)), inf

Plotting in Matlab

- A basic plot

```
>> x = [0:0.1:2*pi]
>> y = sin(x)
>> plot(x, y, 'r.-')
```



Here: commands are typed in command window

But: sequence of Matlab commands can be saved as a ***.m-file**

Task today: Explore Matlab & Visualization

- Hints and useful command for today:
  - Data is stored in ***.mat-files** → Download from Commsy
    - Open data in workspace by double-click or import
  - Make sure your the data is in the right path
  - Matlab treats columns as individual data (e.g. data file *min_salary*)
  - Type e.g. `help median` to get help directly on your command window
    - Else: Refer to Matlab documentation (press F1)
  - Type `help help` for further advice how to get help

Today: Explore Matlab & Visualization (cont'd)

- Hints and useful command for today:
  - Matlab opens only one figure panel to plot your results
    - Use hold for multiple plots in one panel, e.g. for time-series
    - Use command again to release
  - For multiple figures use figure(n), n=1,2,3,…
  - Use close all to close all currently opened figures
  - For labeling data (etc), figure editor comprises nice features
    - You can also generate code like in sin-plot example automatically
      - Figure→File →Generate code (save as *.m-file)
  - Delete <u>all</u> variables in workspace: clear
  - Clear the command window: clc