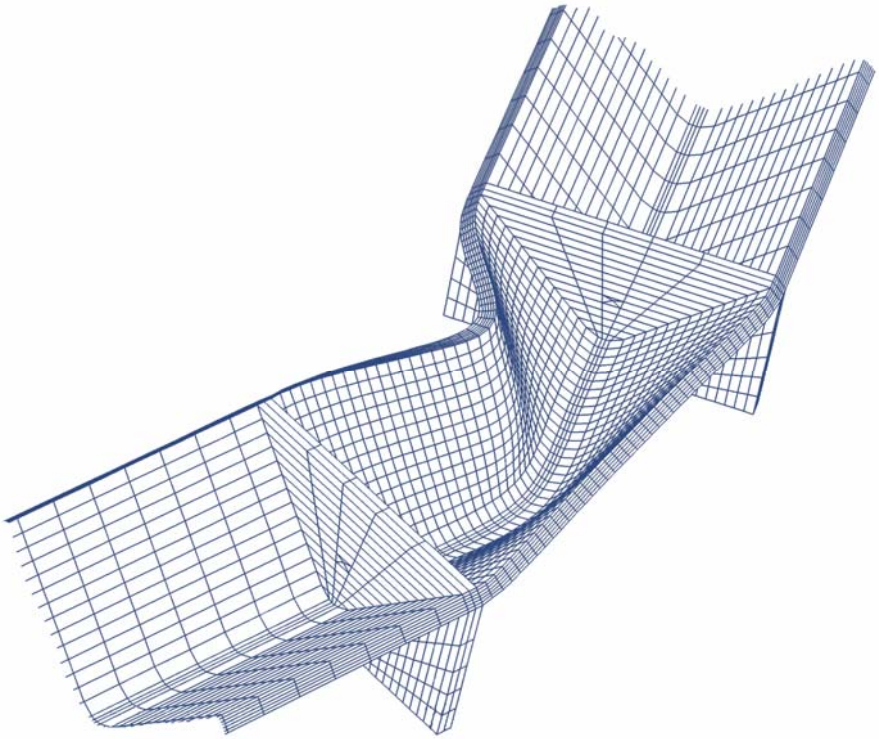
Short introduction to Matlab



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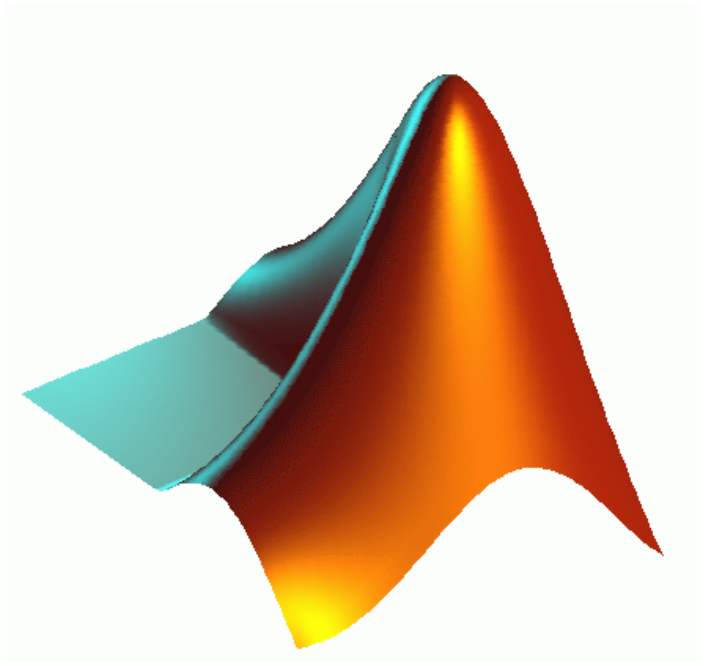
ETH Zurich, Switzerland

Short introduction to Matlab

Overview

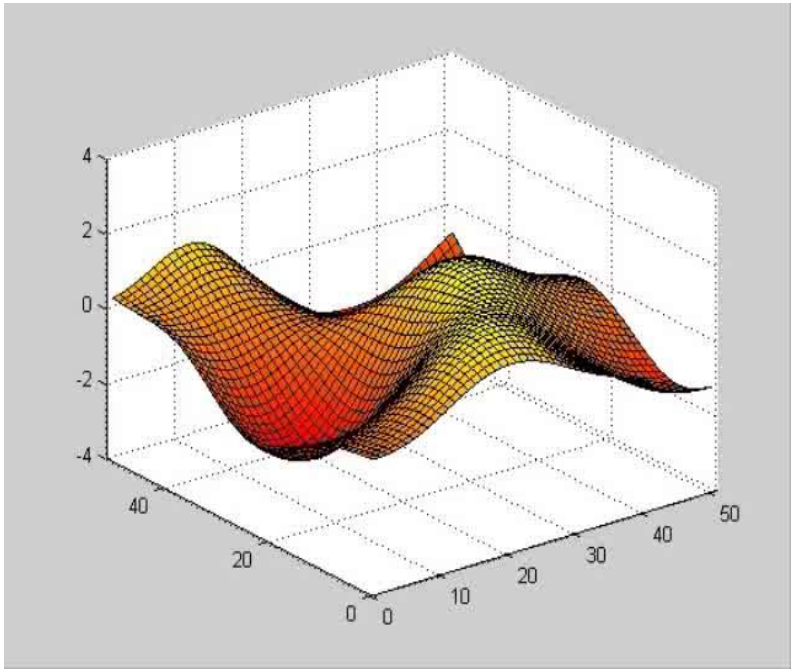


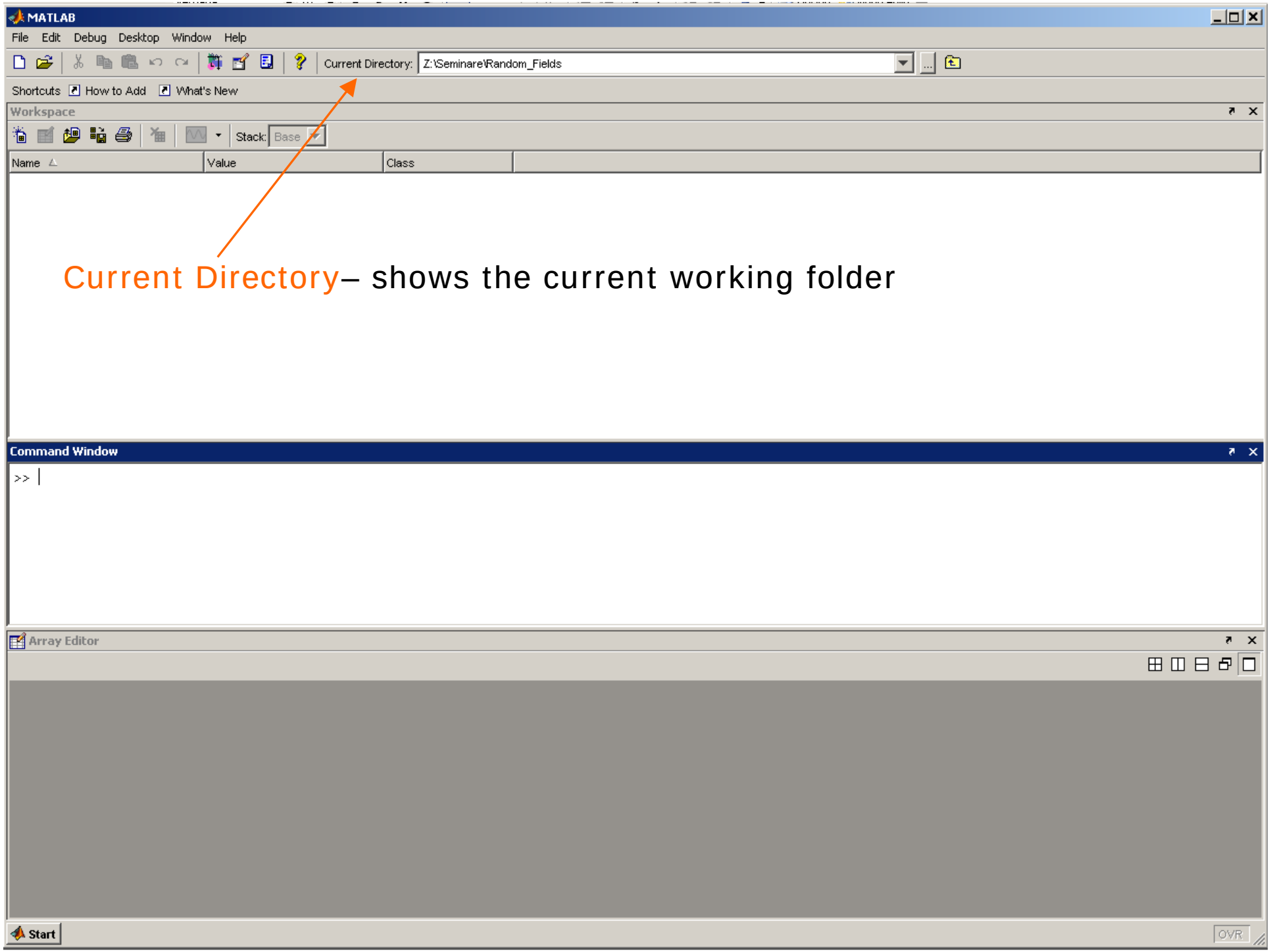
- Introduction
- Matlab user interface
- Creating Variables
- Working with matrices
- The help function
- The m-file
- Plots

Short introduction into Matlab©

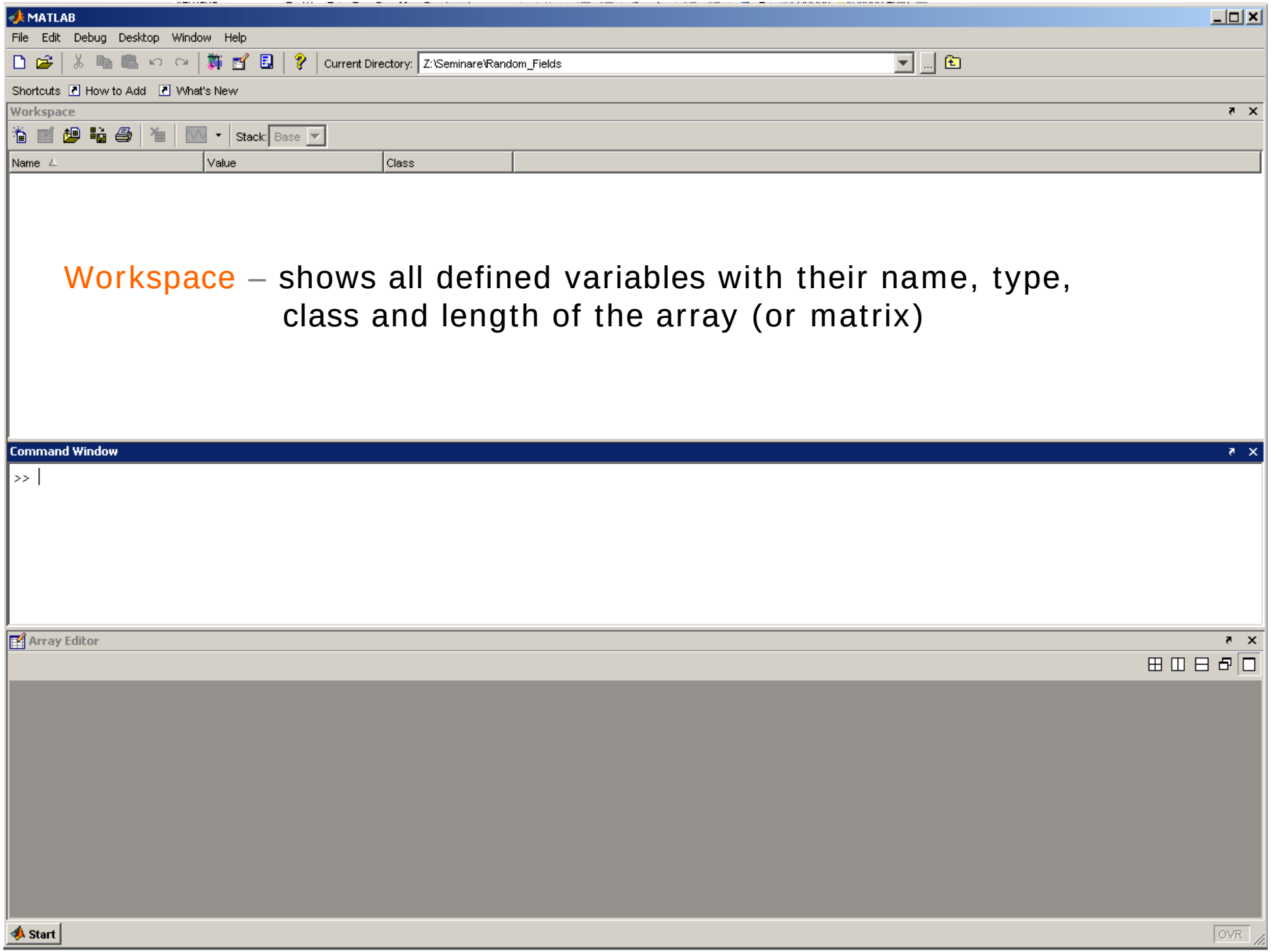
Why will we use Matlab in this course?

- It is useful for numerical calculations
- Symbolic calculations can be performed
- Easy visualization of data
- Interactive use
- Use as a programming language (easy programming)

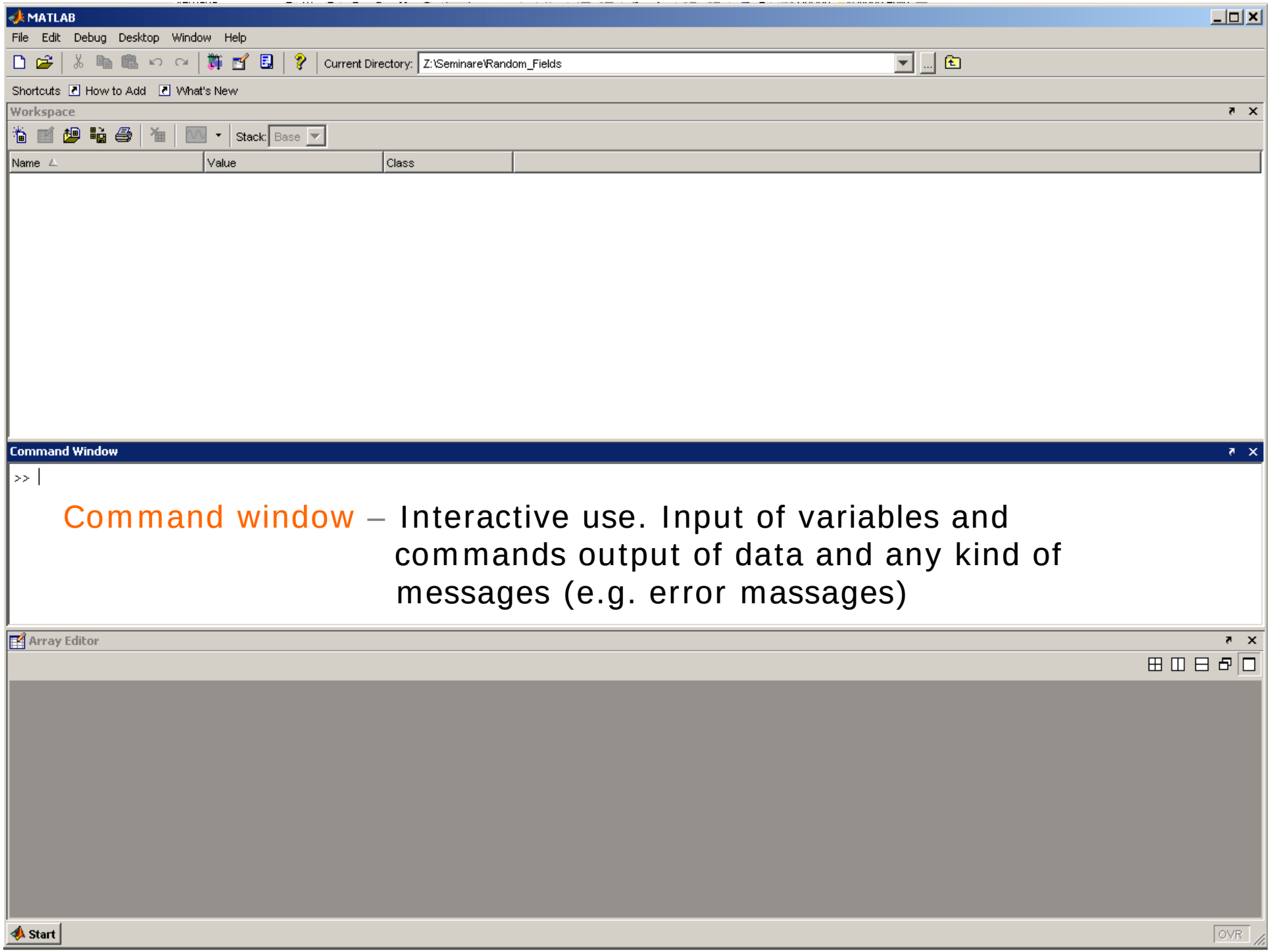




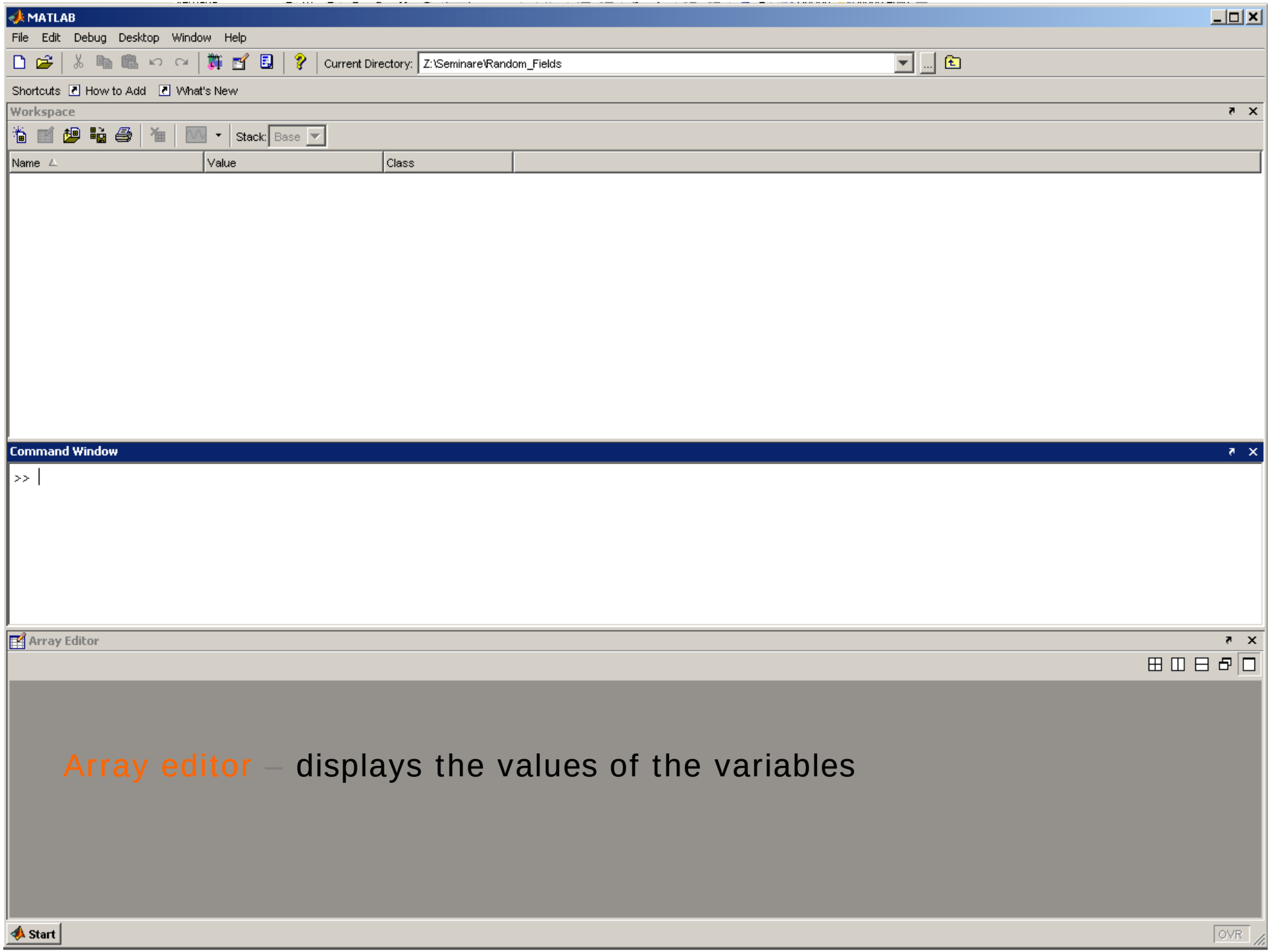
Current Directory– shows the current working folder



Workspace – shows all defined variables with their name, type, class and length of the array (or matrix)



Command window – Interactive use. Input of variables and commands output of data and any kind of messages (e.g. error massages)


MATLAB
File Edit Debug Desktop Window Help
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Value
Class
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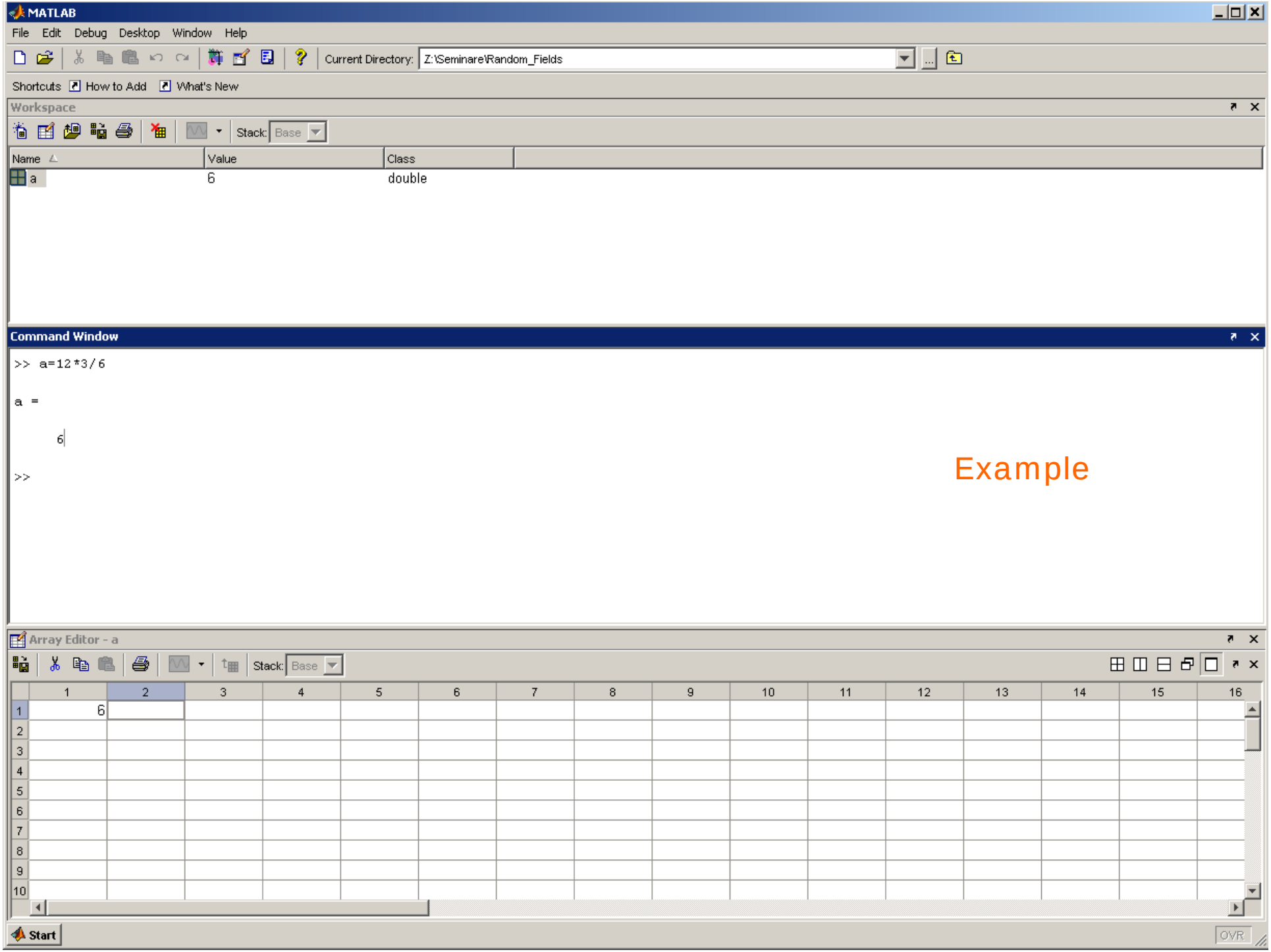
>>
Array Editor
Array editor – displays the values of the variables
Start
OVR


MATLAB
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Name Value Class
a 6 double
Command Window
>> a=12*3/6
a =
6
>>
Array Editor - a
Stack: Base
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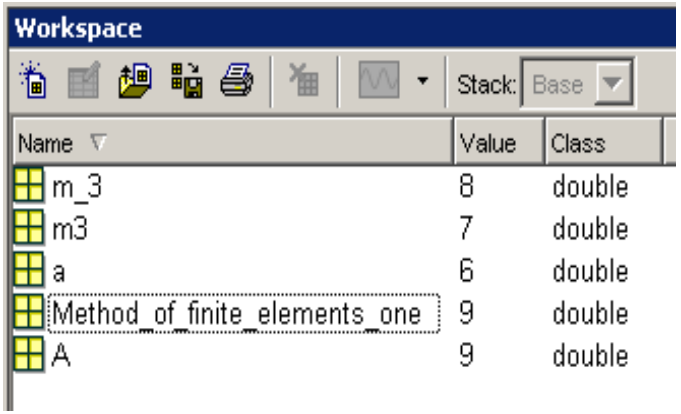
OVR

Example

Variables

Rules for defining variables:

- The name of the variables must not include special characters (%,&,*,...) exception: underscore (_)
- The first character has to be a alphabetic character (m3: ok. – 3m: not ok.)
- Matlab distinguishes between capitals and lower case letters
- With `clear'name'` you can delete variables



Short introduction to Matlab

Defining matrices and vectors

Defining vectors and matrixes:

```
>>x=[0 2 4 6 8]

              x= 0 2 4 6 8
```

x ~ matrix with 1 row and 5 columns

By using a comma the input may be easier to read:

```
>>x=[0,2,4,6,8]

              x= 0 2 4 6 8
```

Short introduction to Matlab

Defining matrices and vectors

Sometimes vectors can be created easier:

```
>>x=0:2:8

            x= 0 2 4 6 8
```

linspace(x,y,n) generates n points between x and y.

```
>>x=linspace(0,8,5)

            x= 0 2 4 6 8
```

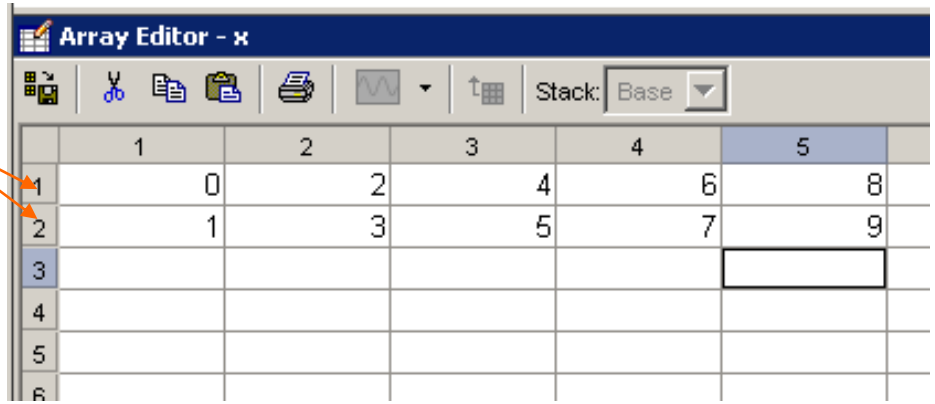
Short introduction to Matlab

Defining matrices and vectors

Matrix

```
>>x=[0 2 4 6 8; 1 3 5 7 9]

x = 0 2 4 6 8
    1 3 5 7 9
```



Or:

```
>>x=[0,2,4,6,8; 1,3,5,7,9]

x = 0 2 4 6 8
    1 3 5 7 9
```

Working with matrices

1) Element wise operations

Multiplication of a matrix with a scalar

```
>>x=[0 2 4 6 8; 1 3 5 7 9]*2
       X=
              0 4 8 12 16
              2 6 10 14 18
```

Element wise multiplication of two matrices

```
>>x=[0 2 4 6 8; 1 3 5 7 9].*[0 2 4 6 8; 1 3 5 7 9]

              X=
                     0 4 16 36 64
                     1 9 25 49 81

>>x=[0 2 4 6 8; 1 3 5 7 9].^2
```

Working with matrices

1) Element wise operations

Element wise division of two matrices

```
>>x=[0 2 4 6 8; 1 3 5 7 9]./[0 2 4 6 8; 1 3 5 7 9]

                X=
                      NaN 1 1 1 1
                      1   1 1 1 1
```

Addition of two matrices

```
>>x=[0 2 4 6 8; 1 3 5 7 9]+[0 2 4 6 8; 1 3 5 7 9]

                X=
                       0 4  8 12 16
                       2 6 10 14 18
```

Short introduction to Matlab

Working with matrices

1) Matrix operations

Transpose a matrix

```
>>x=[3 4 -2; -1 2 8; 2 0 5];
>>y=transpose(x)

        y=      3 -1  2
                4  2  0
               -2  8  5
```

Or:

```
>>y=x'
```

Short introduction to Matlab

Working with matrices

1) Matrix operations

Invert a matrix

```
>>x=[3 4 -2; -1 2 8; 2 0 5];
>>y=inv(x)
```

```
y=      -0.4545    0.9091    1.6364
         0.5000   -0.5000   -1.0000
        -0.1818    0.3636    0.4545
```

Working with matrices

1) Matrix operations

Eigenvalue of a matrix

```
>>x=[1 2 3; 4 5 6; 7 8 9];
>>y=eig(x)

        y=      16.1168
                -1.1168
                -0.0000
```

Sometimes a specific cell of a matrix is needed for the calculation.
If you want to get the 3rd value of the vector, write:

```
>>z=y(3,1)

        z=-1.304e-15
```

Working with matrices

1) Matrix operations

Or you are interested in the first column of matrix x:

```
x=[1 2 3; 4 5 6; 7 8 9]

        x= 1 2 3
           4 5 6
           7 8 9
```

then you can select the whole row or column by using the colon

```
>>x(1,:)

        ans=   1
               4
               7
```

Working with matrices

1) Matrix operations

Other helpful comands

```
det(x)      -  is the  determinant of the matrix x
eye(n,m)    -  creates a n x m identity matrix
zeros(n,m)  -  creates a n x m zero matrix (helpful to allocate memory)
ones(n,m)   -  creates a n x m matrix filled with ones
size(x)     -  gives the dimension of the matrix x
```

If you perform matrix operation,
the dimensions of the matrix must agree

e.g. `y=ones(4,3)` and `x=ones(1,4)`

```
>>z=y*x
??? Error using ==> mtimes
Inner matrix dimensions must agree.
```

Short introduction to Matlab

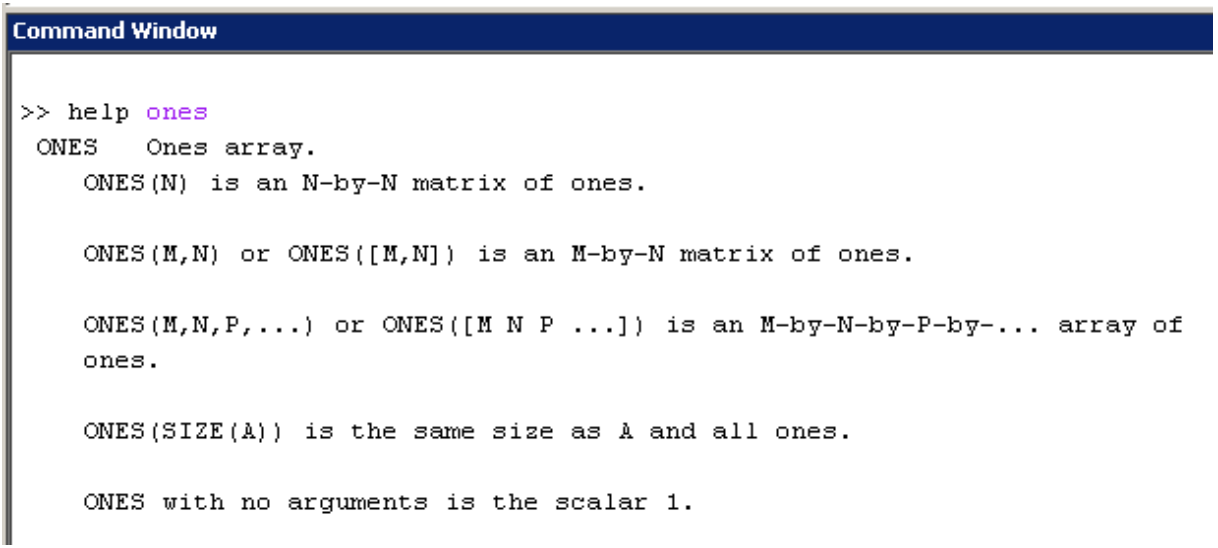
The help function

Here you find everything you need!

```
>>help 'function'
```

Helps you to find the exact notation for all functions, e.g:

```
>>help ones
```



Help

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Help Navigator

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multiplication with zero bias and misma	Simulink Fixed Point
multiplication with zero biases and mat	Simulink Fixed Point
signals	Simulink Fixed Point
online conversions with and fixed-point dat	Stateflow
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online help	Communications ...
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online help	Instrument Control...
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loading	
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server relationship	
OPC Toolbox Objects Toolbar	OPC Toolbox
OPC Write block	OPC Toolbox
opccallback function	OPC Toolbox
read operations	

Title: ones (MATLAB Functions)

MATLAB Function Reference

ones

Create array of all ones

Syntax

```
Y = ones(n)
Y = ones(m,n)
Y = ones([m n])
Y = ones(m,n,p,...)
Y = ones([m n p ...])
Y = ones(size(A))
ones(m, n,...,classname)
ones([m,n,...],classname)
```

Description

`Y = ones(n)` returns an `n`-by-`n` matrix of `1`s. An error message appears if `n` is not a scalar.

`Y = ones(m,n)` or `Y = ones([m n])` returns an `m`-by-`n` matrix of ones.

`Y = ones(m,n,p,...)` or `Y = ones([m n p ...])` returns an `m`-by-`n`-by-`p`-by-`...` array of `1`s.

> **Note** The size inputs `m`, `n`, `p`, `...` should be nonnegative integers. Negative integers are treated as 0.

`Y = ones(size(A))` returns an array of `1`s that is the same size as `A`.

`ones(m, n,...,classname)` or `ones([m,n,...],classname)` is an `m`-by-`n`-by-`...` array of ones of data type `classname`. `classname` is a string specifying the data type of the output. `classname` can have the following values: `'double'`, `'single'`, `'int8'`, `'uint8'`, `'int16'`, `'uint16'`, `'int32'`, `'uint32'`, `'int64'`, or `'uint64'`.

Example

```
x = ones(2,3,'int8');
```

See Also

`eye`, `zeros`, `complex`

odextend open

Programming with matlab – the m.files

Two different types of m.files are distinguished by matlab

- script files: all variables are global

- function files: all variables are local;
input and output parameters are passed

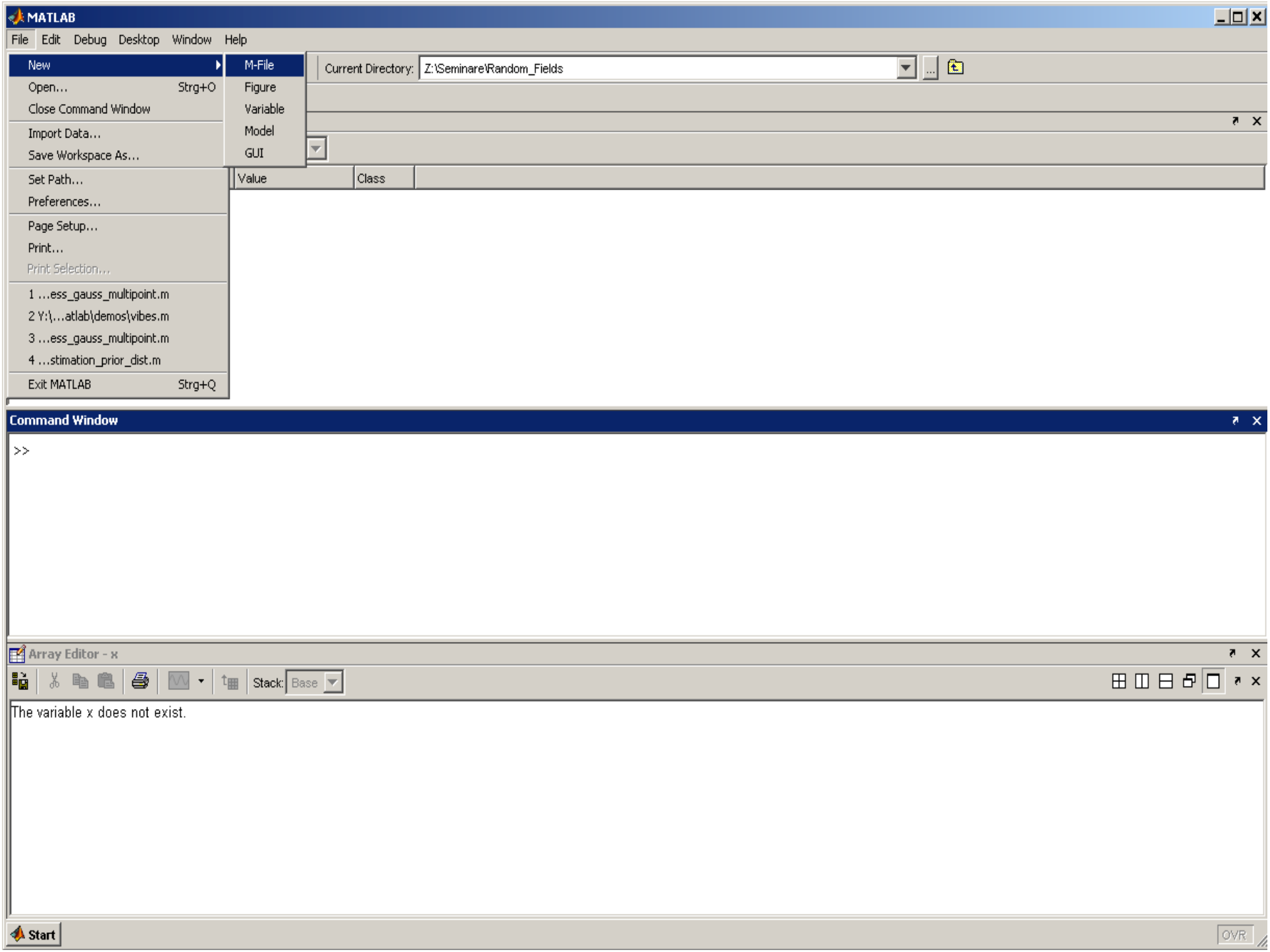
m.files

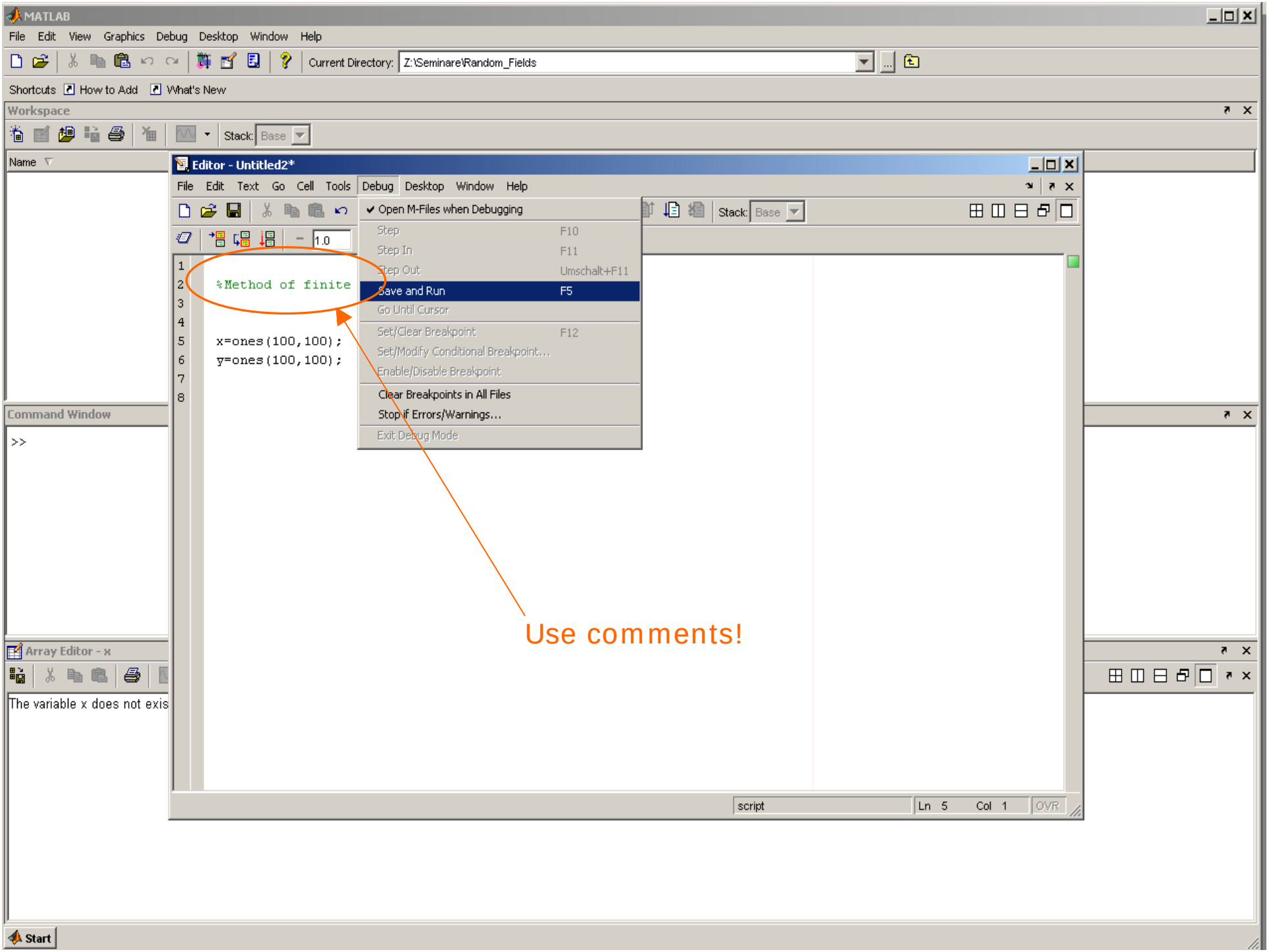
The commands are written in a text editor and saved with the ending .m

The commands are written like in the command line

All commands available in the command line can be used
(*for* loops – *if else*, etc.. + self programmed functions)

All commands are processed line by line


MATLAB
File Edit Debug Desktop Window Help
New
Open... Strg+O
Close Command Window
Import Data...
Save Workspace As...
Set Path...
Preferences...
Page Setup...
Print...
Print Selection...
1 ...ess_gauss_multipoint.m
2 Y:\...atlab\demos\vibes.m
3 ...ess_gauss_multipoint.m
4 ...stimation_prior_dist.m
Exit MATLAB Strg+Q
M-File
Figure
Variable
Model
GUI
Current Directory: Z:\Seminare\Random_Fields
Value
Class
Command Window
>>
Array Editor - x
Stack: Base
The variable x does not exist.
Start
OVR


MATLAB
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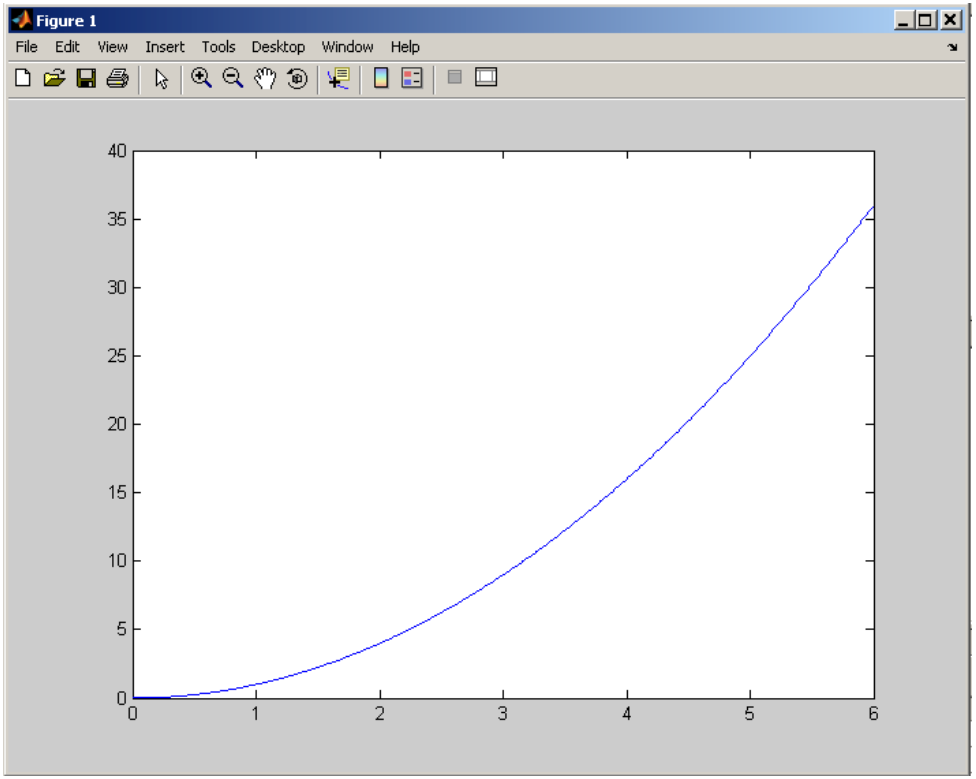
Open M-Files when Debugging
Step F10
Step In F11
Step Out Umschalt+F11
Save and Run F5
Go Until Cursor
Set/Clear Breakpoint F12
Set/Modify Conditional Breakpoint...
Enable/Disable Breakpoint
Clear Breakpoints in All Files
Stop if Errors/Warnings...
Exit Debug Mode
1.0
1 %Method of finite
2
3 x=ones(100,100);
4 y=ones(100,100);
5
6
7
8
Use comments!
Command Window
>>
Array Editor - x
The variable x does not exis
script Ln 5 Col 1 OVR
Start

Plotting with Matlab

Easy visualization of data using the manifold plot options

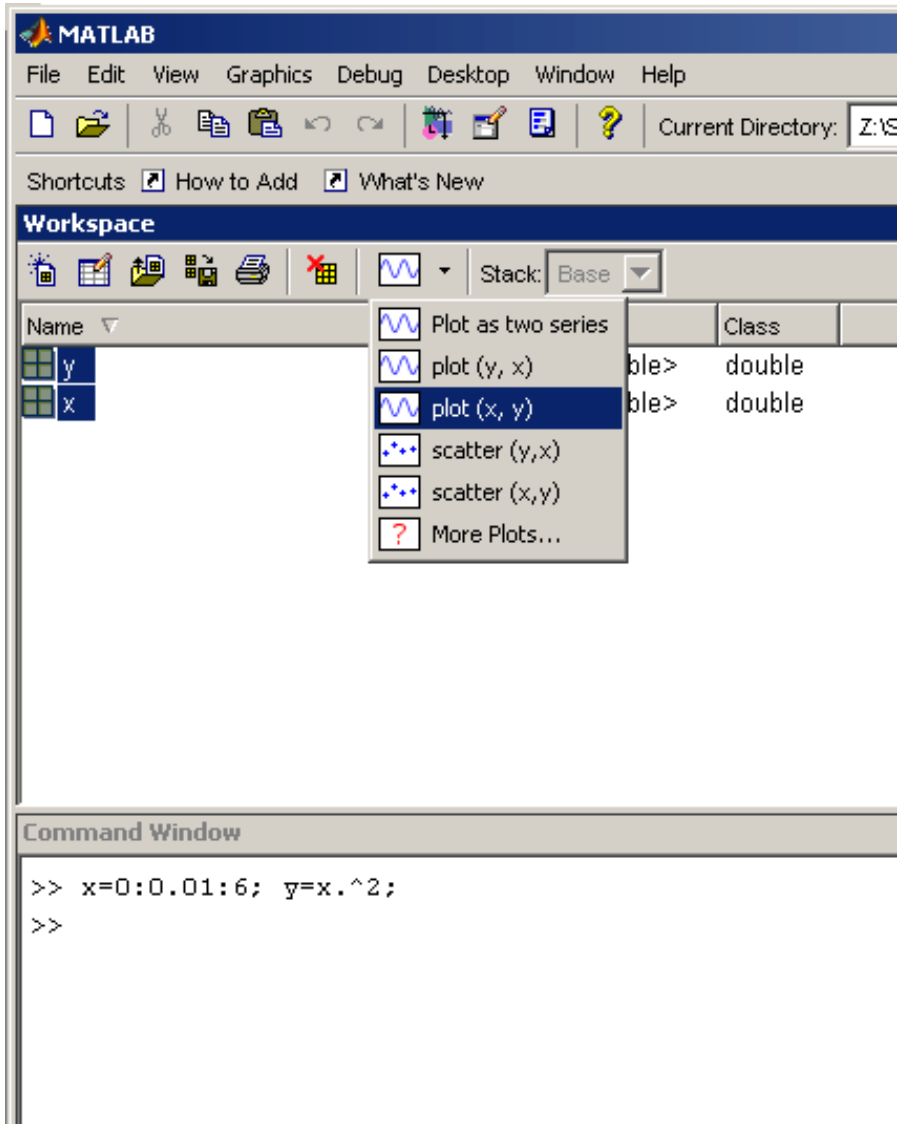
```
>>x=0:0.01:6; y=x.^2;

>>plot (x,y)
```



Short introduction to Matlab

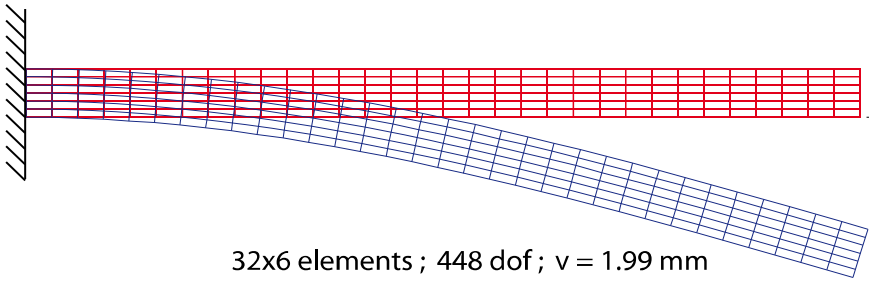
Plotting with Matlab

Or by using the graphical user interface

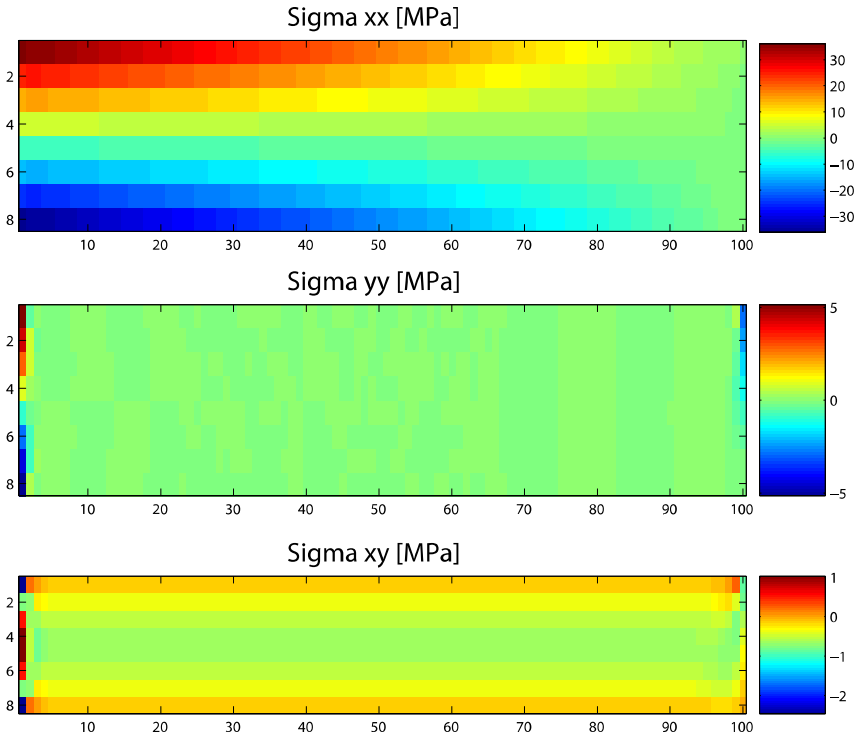


Short introduction to Matlab

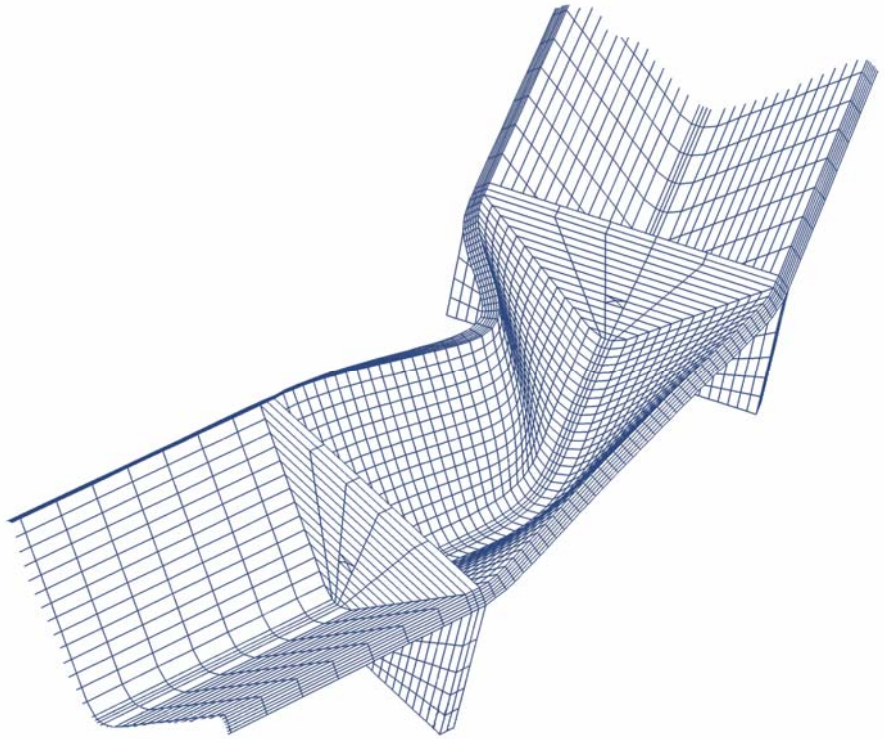
Visualize your FE results by using Matlab



32x6 elements ; 448 dof ; v = 1.99 mm



Short introduction to Matlab



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