

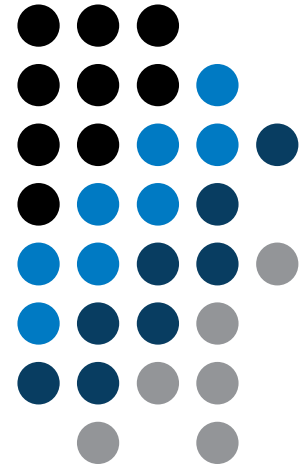
AE0B17MTB – Matlab

Part #10



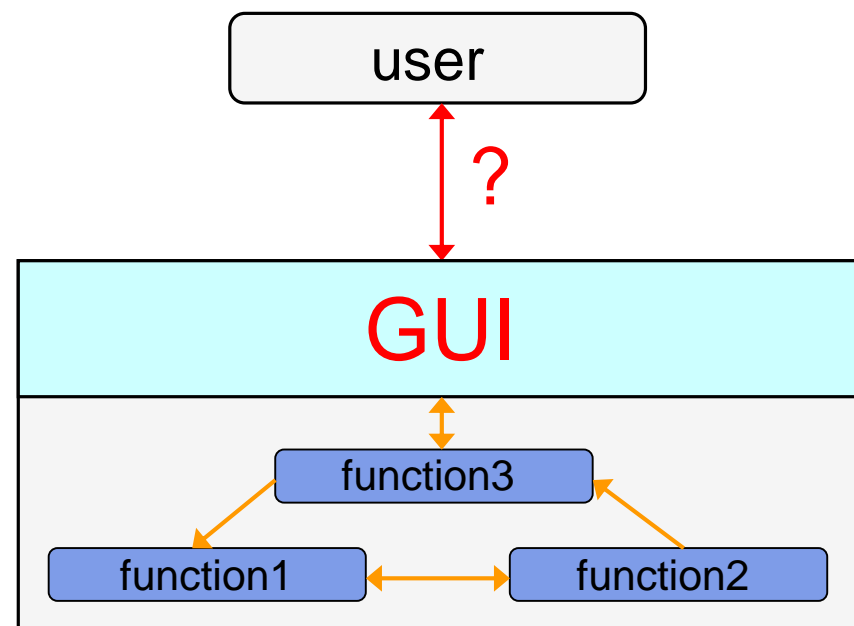
Miloslav Čapek
miloslav.capek@fel.cvut.cz
Filip Kozák, Viktor Adler, Pavel Valtr

Department of Electromagnetic Field
B2-626, Prague



Learning how to ...

GUI #2



!!! **Attention:** CHANGES IN GRAPHICS SINCE MATLAB R2014b !!!

Techniques of GUI design - sorting


- there exist several approaches (methodologies) to create GUI
 - design using GUIDE tool
 - not recommended
 - switch-board technique
 - not recommended
 - utilization of side and nested functions as callback functions
 - standard
 - fully OOP approach (including functional part of the code)
 - ideal

>> guide

Evaluation of callback function

- callback function is evaluated as a handle function

```
hb = uicontrol('Style', 'pushbutton', 'String', 'Plot line')  
  
% Calling function using handle function  
set(hb, 'Callback', @myFunc)
```




```
function myFunc(hObject, callbackdata)  
% Callback function always adds two basic inputs  
  
hObject      % reference to the object raising the callback  
callbackdata % structure of various events (can be empty)
```

Evaluation of callback function

- callback function is evaluated as a handle function

```
hb = uicontrol('Style', 'pushbutton', 'String', 'Plot line')  
  
% Cell array, where first element is a handle function  
set(hb, 'Callback', {@myFunc, inp1, ..., inpN})
```



```
function myFunc(hObject, callbackdata, inp1, ..., inpN)  
% Basic inputs added to first positions again  
  
hObject      % reference to the object raising the callback  
callbackdata % structure of various events (can be empty)  
  
inp1, ..., inpN % other inputs
```

Evaluation of callback function

- callback function is evaluated as a string


```
hb = uicontrol('Style', 'pushbutton', 'String', 'Plot line')  
  
% 3rd way of calling callback function  
set(hb, 'Callback', 'plot(rand(20,3))')
```

- the string can contain variables as well
 - only the variables from base Workspace are evaluated correctly

Evaluation of callback function

- callback function is evaluated as an anonymous function

```
hb = uicontrol('Style', 'pushbutton', 'String', 'Plot line')  
  
% TIP - anonymous function can be used in the case of  
calling a function that doesn't support basic inputs of  
callback function  
set(hb, 'Callback', @(a, b)myFunc(inp))
```



```
function myFunc(inp)
```

```
inp % the input are only variables defined by user
```

Callback functions – list

| | |
|-------------------------------|---|
| Callback | context menu, uiobjects |
| CellEditCallback | uitable |
| CellSelectionCallback | uitable |
| ButtonDownFcn | axes, figure, button group, panel, uiobjects |
| ClickedCallback | push tool, toggle tool |
| CreateFcn, DeleteFcn | axes, button group, context menu, figure, menu, panel, uiobjects, ... |
| OffCallback, OnCallback | toggle tool |
| ResizeFcn (<R2014b) | figure, panel, button group |
| SelectionChangeFcn | button group |
| KeyPressFcn | figure, uiobjects |
| KeyReleaseFcn | figure |
| WindowButtonDownFcn | figure |
| WindowButtonMotionFcn | figure |
| WindowButtonUpFcn | figure |
| WindowKeyPressFcn | figure |
| WindowKeyReleaseFcn | figure |
| WindowScrollWheelFcn | figure |
| CloseRequestFcn | figure |

Callback functions – list

| | |
|-------------------------------------|---|
| Callback | context menu, uiobjects |
| CellEditCallback | uitable |
| CellSelectionCallback | uitable |
| ButtonDownFcn | axes, figure, button group, panel, uiobjects |
| ClickedCallback | push tool, toggle tool |
| CreateFcn, DeleteFcn | axes, button group, context menu, figure, menu, panel, uiobjects, ... |
| OffCallback, OnCallback | toggle tool |
| SizeChangedFcn (>=R2014b) | figure, panel, button group |
| SelectionChangeFcn | button group |
| KeyPressFcn | figure, uiobjects |
| KeyReleaseFcn | figure |
| WindowButtonDownFcn | figure |
| WindowButtonMotionFcn | figure |
| WindowButtonUpFcn | figure |
| WindowKeyPressFcn | figure |
| WindowKeyReleaseFcn | figure |
| WindowScrollWheelFcn | figure |
| CloseRequestFcn | figure |

Functions `gcf`, `gca` and `gco`

- serve to easily access identifiers of objects that are currently active, in particular:
 - `gcf` – returns identifier of current object `figure`
 - `gca` – returns identifier of current object `axes`
 - `gco` – returns identifier of the object that was last to mouse-click on (tolerance is 5 px)

```
figure
figRef = gcf
```

- these functions can be used as input identifiers for other functions requiring reference to object `figure` or `axes`

```
set(gcf, 'color', [0 0 0])
```

Exercise – mouse position

600 s ↑

- create a text array showing mouse position over figure.
 - reference to the figure can be obtained using function `gcf`
 - information on the position is to be found in one of figure properties

Function `findobj`

- finds an object(s) with required property
- returns reference to the object (or an array of references)

```
>> figHndl = gcf      % figHndl = figure;
>> axsHndl = gca      % axsHndl = figure;
>> htx1 = uicontrol('style','text','string','hello','tag','tx');
>> htx2 = uicontrol('style','text','string','test1','tag','tx2');
```

```
>> h = findobj('Style','text','-and','Tag','tx')
```

h =

[UIControl](#) (tx) with properties:

```
    Style: 'text'
    String: 'hello'
    BackgroundColor: [0.9400 0.9400 0.9400]
    Callback: ''
    Value: 0
    Position: [20 20 60 20]
    Units: 'pixels'
```

Show [all properties](#)

```
>> h = findobj('Style','text')
```

h =

2x1 UIControl array:

```
UIControl      (tx2)
UIControl      (tx)
```

Exercise – keyboard scan

600 s ↑

- create a text array that displays last key pressed
 - information on the key pressed is to be found in `callbackdata` parameter
 - get the reference to the text array using `findobj`

Function `findall`, `allchild`

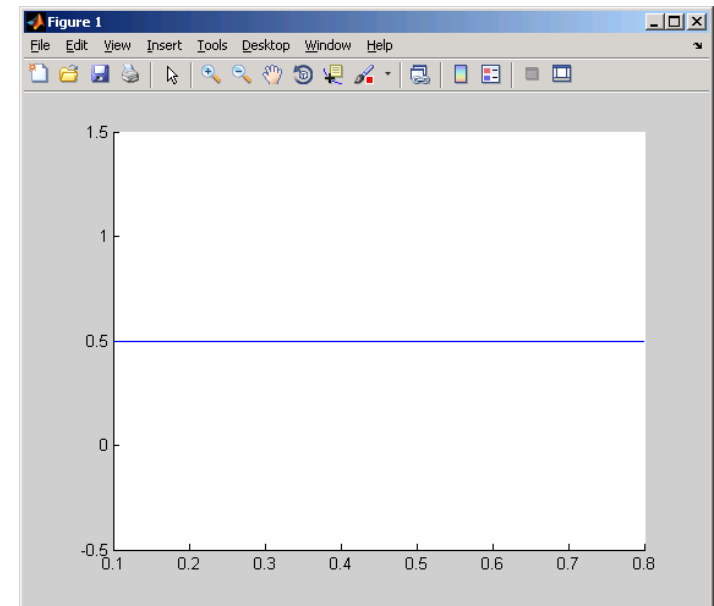
- `findall` finds all graphic objects (including hidden), `handle_list` can be for instance `gcf`
- `allchild` finds all children of selected object (including hidden)
- if `handle_list` is a identifier vector, Matlab returns cell array (`cell`)

Function `copyobj`

- this function enables to have an influence on lifecycle of an object
 - copies object and its descendants
- more `>> doc copyobj`

```
>> hf = figure
>> ha = axes
>> h11 = line([0.1 0.8], [0.5 0.5])
>> h12 = copyobj(h11,ha)
>> ishandle(h11) && ishandle(h12)

ans =
     1
```



Function delete, reset

- these functions enable to have an influence on lifecycle of an object
- delete removes file(s) or graphic object(s) together with its descendants

```
>> delete(hf) % hf see previous example
>> ishandle(h11) && ishandle(h12)
ans =
     0
```

- reset sets all values of an object back to implicit values

```
reset(h)
```


Advanced visualizing in Matlab

- function `gobjects` predefines variables

```
% preallocation
h = gobjects(3,1);

h(1) = figure;
h(2) = plot(1:10);
h(3) = gca;
class(h)
```

- function `isgraphics()`

```
x = 1:10; y = sin(x);

p = plot(x,y);
ax = gca;

isgraphics([p, ax])
```

- function `ishandle` finds out whether variable is a handle

```
>> figHandle = figure;
>> ishandle(figHandle)
```

- >> doc **Graphics Object Identification**

Storing data in GUI

- how to store data in GUI?
 - global variables (extreme case, keyword `global`)
 - unacceptable
 - using property `UserData` (depends on size of the application)
 - acceptable
 - using functions `guidata` or `setappdata` a `getappdata`
 - suitable
 - fully OOP access (including functional part of the code)
 - ideal

Function `guidata`

- enables to store or get data
- the procedure is as follows:
 - get data copy: `data = guidata(object_handle)`
 - carry out data modification / calculation required
 - If the data is changed, store `guidata(object_handle, data)`
- data is therefore related to a handle that exist during whole lifetime of GUI

Function guidata

```
>> fhndl = figure('Toolbar', 'none');  
>> allFigHndl = guidata(fhndl);  
>> guidata(fhndl, allFigHndl);
```

function guidata returns references of all visible objects in figure

```
function myCallback()  
% ...  
myAllFigHndl = guidata(gcbo);  
myAllFigHndl.time = clock;  
guidata(gcbo, myAllFigHndl);
```

function gcbo returns reference of the object callback of which is being evaluated

Functions `setappdata`, `getappdata`

- `setappdata`: enables to define new data (pair name-value) for given application

```
setappdata(hndl, 'speedA', value)
```

- `getappdata`: enables to get previously defined data of selected object

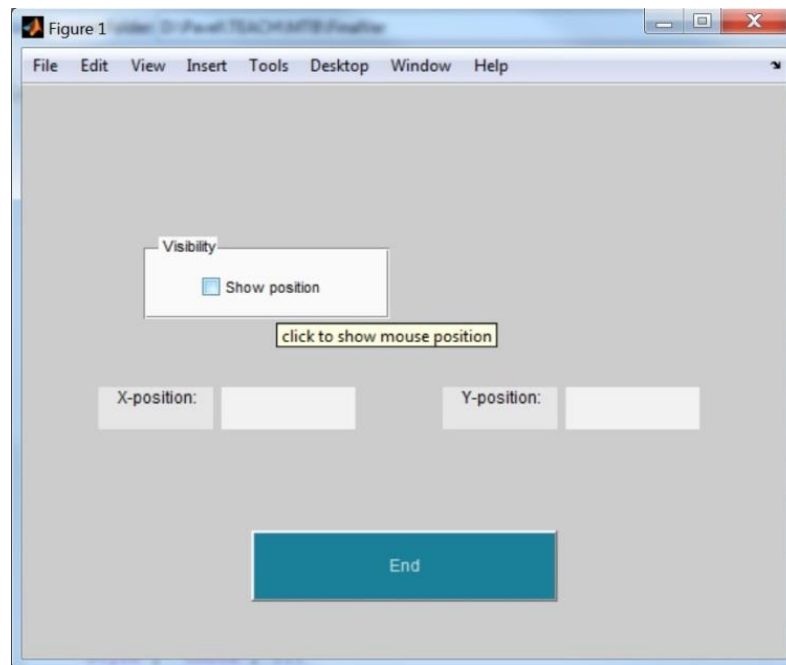
```
value = getappdata(hndl, 'speedA')  
  
% values is a structure  
values = getappdata(hndl)
```

Exercise – mouse movements + buttons

600 s



- create application according to picture below
 - button „End“ terminates application
 - left and right mouse button changes font type of label „X-position“ and „Y-position“ from normal to bold and vice versa
 - in the case checkbox is ticked, program displays cursor position



Exercise – mouse movements + buttons

Cvičení – pohyb myši + tlačítka

Predefined dialog windows

- The most common operations user ↔ GUI are predefined
- the most common ones are displayed below (most of them):

→ user

helpdlg

msgbox

warndlg

errordlg

→ GUI

inputdlg

listdlg

questdlg

file ←

uigetdir

uigetfile

uiopen

→ file

uiputfile

uisave

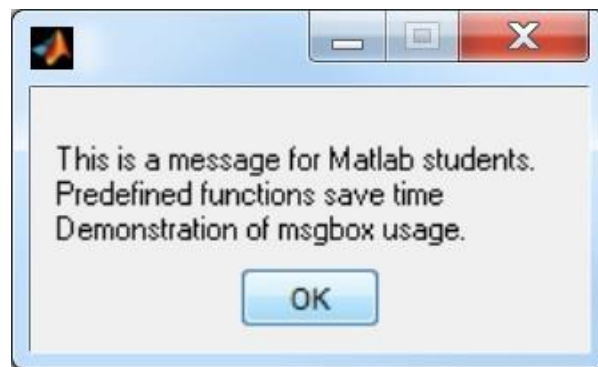
→ user

waitbar

Function `msgbox`

- displays message for the user

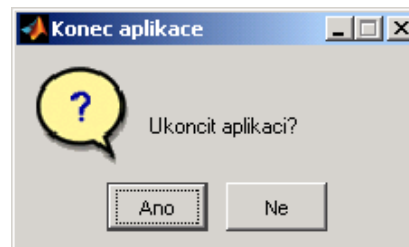
```
>> h = msgbox({'This is a message for Matlab students.', ...  
             'Predefined functions save time', ...  
             'Demonstration of msgbox usage.'})
```



Function `questdlg`

- displays a question, returns answer

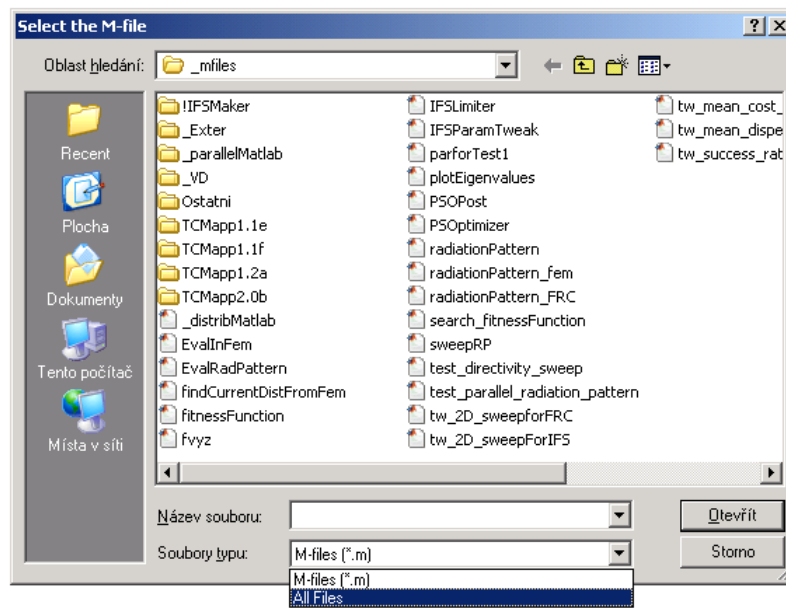
```
>> query = questdlg('Terminate application?', ...  
                    'End of application', 'Yes', 'No', 'Yes')
```



Function `uigetfile`

- user can select file(s) from file dialog box
 - files can be filtered by their suffix

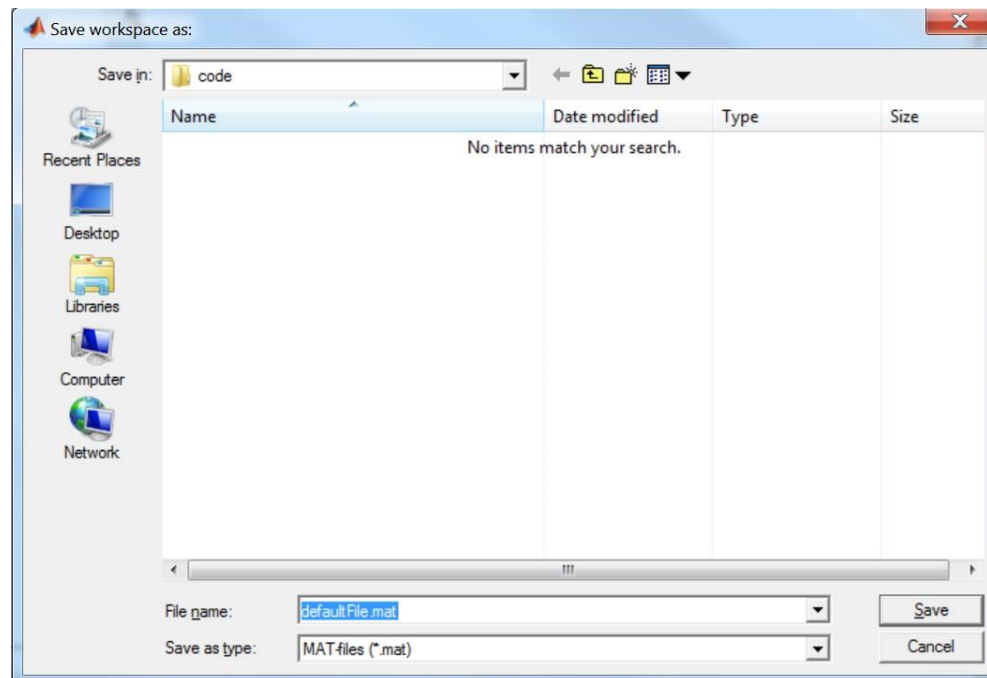
```
>> [FileName,PathName] = uigetfile('*.*', 'Select the M-file');
```



Function `uiputfile`

- opens dialog for file saving
 - files can be filtered by their suffix

```
>> [file,path] = uiputfile('*.*mat', 'Save workspace as:', ...  
    'defaultFile.mat')
```



Exercise – saving into file

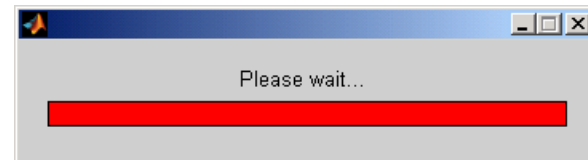
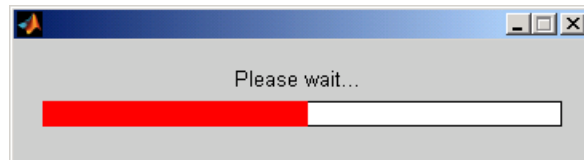
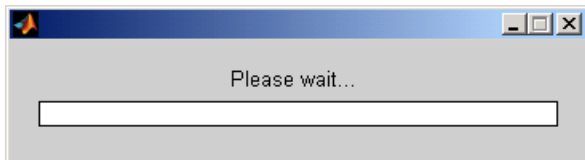
400 s ↑

- save data from Workspace in a file using dialog box

Function `waitbar`

- displays state of a process

```
>> h = waitbar(0, 'Please wait...');  
nsteps = 1000;  
for k = 1:nsteps  
    waitbar(k/nsteps);  
end  
close(h);
```



Design of a simple GUI #1

- what the GUI should do (detailed description of functionality)
- what are the user inputs
- required outputs

- objects used (scheme of GUI, list of elements, design of tags and properties)
- callback functions, dynamic elements

- saving of identifiers and data in GUI
- programming style

- implementation of individual parts

- getting it to work, testing...

Discussed functions

gcf, gca, gco

findobj, findall, allchild

copyobj

delete, reset

gobjects, ishandle, isgraphics

helpdlg, msgbox, warndlg, errordlg

inputdlg, listdlg, questdlg

uigetdir, uigetfile, uiopen

uiputfile, uisave

waitbar

guide

guidata, setappdata, getappdata

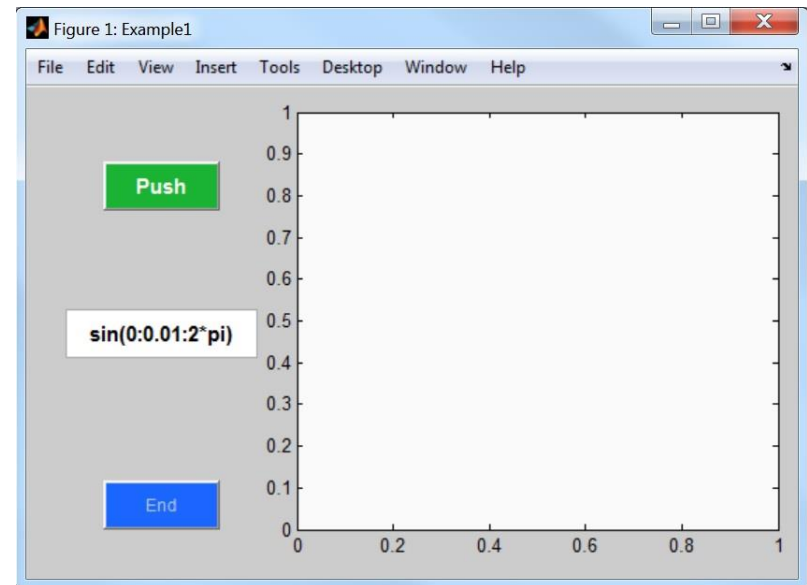
-
-
-
-

Exercise – displaying graph of a function

600 s ↑

- expand previous function so that it enabled to draw graph of a function defined by user
 - use `try—catch` to eliminate erroneous inputs
 - use function `reset` to clear graph before another drawing
 - what function do you use to evaluate the text input?

```
>> MTB_GUI1edit
```



Exercise – displaying graph of a function

Exercise – displaying graph of a function

Thank you!



ver. 4.2 (09/12/2015)
Miloslav Čapek, Pavel Valtr
miloslav.capek@fel.cvut.cz

Apart from educational purposes at CTU, this document may be reproduced,
stored or transmitted only with the prior permission of the authors.
Document created as part of A0B17MTB course.

