

Introduction to Fuzzy Logic Toolbox

Objective: getting used to the functions and graphical interfaces of Fuzzy Logic Toolbox, part of MATLAB/Simulink

Note: MATLAB/Simulink is accessed online (<https://matlab.mathworks.com/>), by logging in with the MS Teams student credentials (surname.name@student.utcluj.ro).

Terms and abbreviations: *FLS, FIS, fuzzy set, membership degree, control surface*

○ Functions and graphical interfaces

MATLAB/Simulink offers 6 categories of functions and graphical interfaces dedicated to fuzzy sets and systems (fuzzy inference system – FIS, fuzzy logic system - FLS):

- *GUI editors* – graphical interface editors
- *Membership functions*
- *Command line FIS functions* - functions for creating/modifying/exploring a FLS
- *Advanced techniques*
- *Miscellaneous functions*
- *GUI helper files* - additional files used by the GUI editors

To visualize the available functions and graphical interfaces in MATLAB, type the following in the command line:

```
help fuzzy
```

○ Working with the functions

To explore how the functions work, type "*help [function_name]*" in the command line. As an example, for the "*trimf*" function, the code is:

```
help trimf
```

Exercise 1

Run the example presented in the "*trimf*" function help. Analyse what happens, line by line.

Exercise 2

Rerun exercise 1 for another function in the "*Membership functions*" category. Analyse what happens, line by line.

- Launching the graphical editor for creating a FLS

Type the following in the command line:

```
fuzzyLogicDesigner
```

Exercise 3

Load a previously created FLS in the graphical editor – the FLS for computing the tip for a meal at the restaurant, available here: <http://www.bel.utcluj.ro/dce/didactic/sf/matlab/tip.zip>

Download "*tip.zip*" and place the archive (using *drag-and-drop*) in the current directory of MATLAB. Double click to unzip and view the contents of the folder.

From the graphical editor, using "*Import -> From file...*" select "*tip.fis*".

Fuzzy Inference System (FIS) Plot Membership Function (MF) Editor Rule Editor : PROPERTY EDITOR: FIS

System: tip

service (3 MFs)

food (3 MFs)

Mamdani Type 1

tip (3 MFs)

System tip: 2 input, 1 output, 5 rules

Type: Mamdani Type-1

Name:

And method:

Or method:

Implication method:

Aggregation method:

Defuzzification method:

Inputs: 2

Outputs: 1

Rules: 5

Analyse the properties of the fuzzy system.

Analyse the membership functions for each variable of the fuzzy system.

Visualise the control surface.

Analyse the rule base and the activation of the rules, from the *Rule Inference* menu. What happens when the connection of a rule is changed?

- Functions for creating/modifying/exploring a FLS from the command line

Exercise 4

Load "*tip.fis*" in the workspace variable "*tip*" using:

```
tip = readfis ('tip.fis');
```

To view the properties of the FLS:

```
getfis (tip)
```

To view the diagram of the FLS:

```
plotfis (tip)
```

To view the control surface of the FLS:

```
gensurf (tip)
```