



Fuzzy logic

Matlab Fuzzy Logic Toolbox

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Introduction

MATLAB Fuzzy Logic Toolbox facilitates the development & simulation of fuzzy-logic systems using:

- graphical user interface (GUI) tools
- command line functionality
- simulations with Simulink / Fuzzy Logic Toolbox blockset

The tool can be used for building, testing and simulating

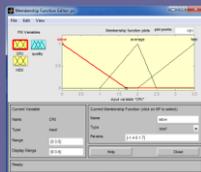
- Fuzzy Expert Systems
- Adaptive Neuro-Fuzzy Inference Systems (ANFIS)

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Graphical User Interface Tools

- There are five primary GUI tools for building, editing, and observing fuzzy inference systems in the Fuzzy Logic Toolbox:

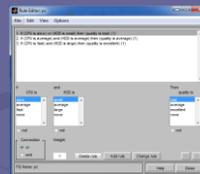
Membership Function Editor



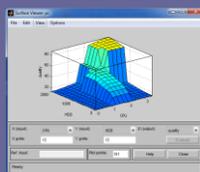
FIS Editor



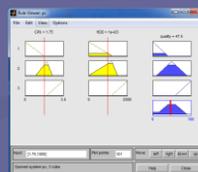
Rule Editor



Surface Viewer



Rule Viewer



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Graphical User Interface Tools

Fuzzy Inference System (FIS) Editor

The screenshot shows the FIS Editor interface. The main workspace displays a fuzzy inference system diagram with input variables CPU and HDD, a rule block 'pc (mamdani)', and an output variable 'quality'. Below the workspace are two configuration panels. The left panel contains dropdown menus for 'And method', 'Or method', 'Implication', 'Aggregation', and 'Defuzzification'. The right panel is for 'Current Variable' configuration, including fields for Name, Type, and Range. Red circles highlight the workspace diagram, the configuration panels, and the 'Current Variable' section.

FIS structure display (number & names of input and output variables, engine type)

Adjust fuzzy engine methods

Edit names of input and output variables

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Graphical User Interface Tools

Membership Function Editor

The screenshot shows the Membership Function Editor interface. The top part features a plot of membership functions for 'CPU' with labels 'slow', 'average', and 'fast'. Below the plot are configuration panels. The left panel shows 'Current Variable' settings (Name, Type, Range, Display Range). The right panel shows 'Current Membership Function' settings (Name, Type, Parameters) with a dropdown menu open showing various function types like 'trimf', 'trapmf', etc. Red circles highlight the plot area, the 'Current Variable' panel, and the 'Current Membership Function' panel.

Select & edit attributes of membership function

Display & edit universe of current variable

Name & edit parameters of membership function

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Graphical User Interface Tools

Rule Editor

The screenshot shows the 'Rule Editor' window with the following content:

- List of rules (automatically updated):** A text area containing three rules:
 1. If (CPU is fast) and (HDD is small) then (quality is bad) (1)
 2. If (CPU is average) and (HDD is average) then (quality is average) (1)
 3. If (CPU is fast) and (HDD is large) then (quality is excellent) (1)
- Create and edit rules:** A configuration area with dropdown menus for 'CPU is' (average, fast, none), 'HDD is' (small, average, large, none), and 'Then quality is' (bad, average, excellent, none). It also includes checkboxes for 'not', 'Connection' (or, and), and 'Weight' (1).

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Graphical User Interface Tools

Rule Viewer

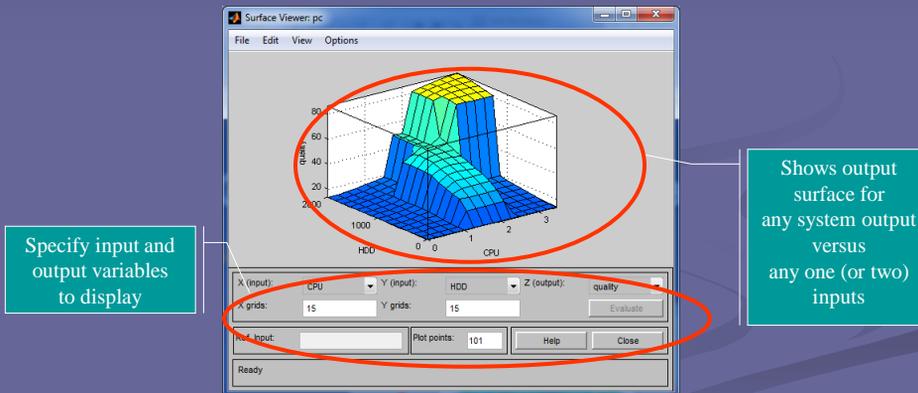
The screenshot shows the 'Rule Viewer' window with the following content:

- Shows how input variable is used in rules:** A grid of plots for CPU and HDD. The CPU input is 1.27 and the HDD input is 1370.03. The plots show the fuzzy membership functions for 'average', 'fast', and 'none' for CPU, and 'small', 'average', and 'large' for HDD.
- Output of rules:** A plot for 'quality' showing the output of the three rules. The aggregated output is 42.6.
- Aggregated output and defuzzified value (red line):** A plot showing the aggregated output and the defuzzified value (red line) for 'quality'.

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Graphical User Interface Tools

Surface Viewer

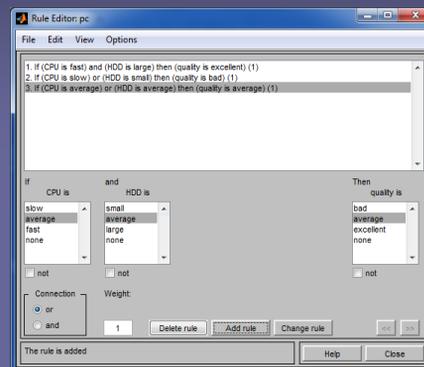


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Example: PC (Configuration Evaluator)

Rules resembling human reasoning:

1. if **CPU** is **FAST** and **HDD** is **LARGE**
then **QUALITY** is **EXCELLENT**
 2. If **CPU** is **SLOW** or **HDD** is **SMALL**
then **QUALITY** is **BAD**
- +
3. If **CPU** is **AVERAGE** and **HDD** is **AVERAGE**
then **QUALITY** is **AVERAGE**



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Example: PC (Configuration Evaluator)

The image displays four screenshots from the FIS Editor software, illustrating the configuration and evaluation of a fuzzy inference system for a PC configuration evaluator.

- FIS Editor pc:** Shows the overall system structure. Callouts identify:
 - Input variables:** CPU and HDD membership functions.
 - Engine methods' type:** The inference engine settings, including aggregation (max) and defuzzification (central).
 - Output variable:** The 'quality' membership function.
- Membership Function Editor pc:** Shows the configuration for a specific membership function. Callouts identify:
 - Membership function type:** The selected function type, such as 'small', 'average', or 'large'.
- Rule Viewer pc:** Shows the rules and their outputs. Callouts identify:
 - Rules' output:** The output of individual rules.
 - Defuzzified output:** The final output value, 'quality = 14.2'.
 - Input Slider:** The interface for adjusting input values like CPU = 0.562 and HDD = 1.75e+03.
- Surface Viewer pc:** Shows a 3D surface plot representing the quality function. Callouts identify:
 - Surface Quality(CPU,HDD):** The 3D surface plot showing the quality output based on CPU and HDD inputs.