

# Fuzzy Logic Toolbox

## Design and simulate fuzzy logic systems

### Introduction

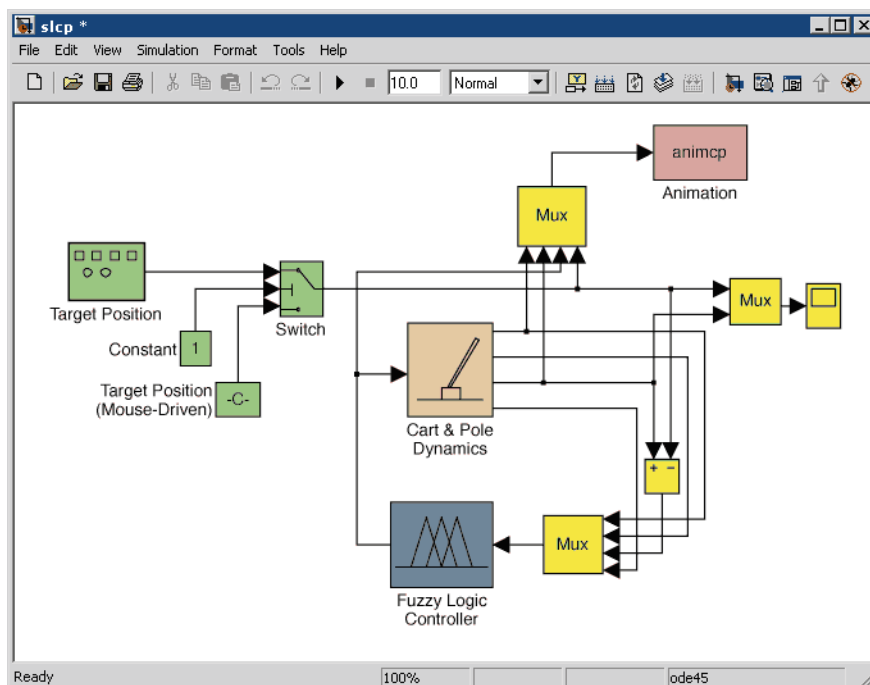
Fuzzy Logic Toolbox™ provides MATLAB® functions, graphical tools, and a Simulink® block for analyzing, designing, and simulating systems based on fuzzy logic. The product guides you through the steps of designing fuzzy inference systems. Functions are provided for many common methods, including fuzzy clustering and adaptive neurofuzzy learning.

The toolbox lets you model complex system behaviors using simple logic rules and then implement these rules in a fuzzy inference system. You can use it as a standalone fuzzy inference engine. Alternatively, you can use fuzzy inference blocks in Simulink and simulate the fuzzy systems within a comprehensive model of the entire dynamic system.

Like all MATLAB toolboxes, Fuzzy Logic Toolbox can be customized. You can inspect algorithms, modify source code, and add your own membership functions or defuzzification techniques.

### Key Features

- Specialized GUIs for building fuzzy inference systems and viewing and analyzing results
- Membership functions for creating fuzzy inference systems
- Support for AND, OR, and NOT logic in user-defined rules
- Standard Mamdani and Sugeno-type fuzzy inference systems
- Automated membership function shaping through neuroadaptive and fuzzy clustering learning techniques
- Ability to embed a fuzzy inference system in a Simulink model
- Ability to generate embeddable C code or stand-alone executable fuzzy inference engines



*Balancing a pole on a moving cart. The system, which is similar to an inverted pendulum, uses a Fuzzy Controller block within Simulink to balance the pole.*

## Working with the Fuzzy Logic Toolbox

The Fuzzy Logic Toolbox provides GUIs to let you perform classical fuzzy system development and pattern recognition. Using the toolbox, you can:

- Develop and analyze fuzzy inference systems
- Develop adaptive neurofuzzy inference systems
- Perform fuzzy clustering

In addition, the toolbox provides a fuzzy controller block that you can use in Simulink to model and simulate a fuzzy logic control system. From Simulink, you can generate C code for use in embedded applications that include fuzzy logic.



### [Getting Started with Fuzzy Logic Toolbox \(Part 1\)](#) 5:05

Use Fuzzy Logic Toolbox to design and simulate fuzzy logic systems.



### [Getting Started with Fuzzy Logic Toolbox \(Part 2\)](#) 8:06

Use Fuzzy Logic Toolbox to design and simulate fuzzy logic systems.



### [Getting Started with Fuzzy Logic Toolbox \(Part 3\)](#) 4:46

Use Fuzzy Logic Toolbox to design and simulate fuzzy logic systems.

Fuzzy inference is a method that interprets the values in the input vector and, based on user-defined rules, assigns values to the output vector. Using the GUI editors and viewers in the Fuzzy Logic Toolbox, you can build the rules set, define the membership functions, and analyze the behavior of a fuzzy inference system (FIS). The following editors and viewers are provided:

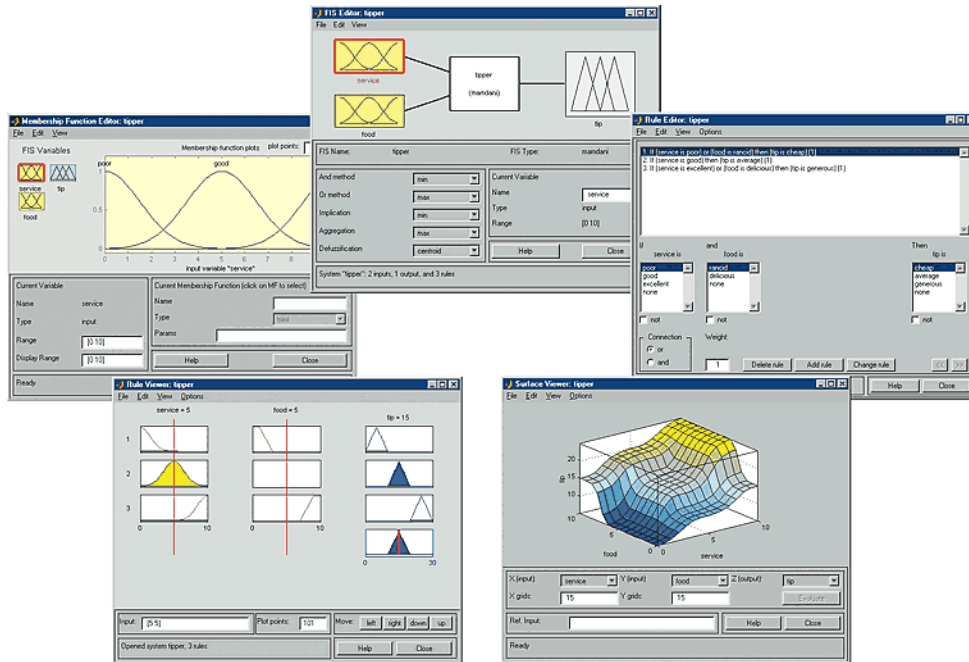
**FIS Editor** - Displays general information about a fuzzy inference system

**Membership Function Editor** - Lets you display and edit the membership functions associated with the input and output variables of the FIS

**Rule Editor** - Lets you view and edit fuzzy rules using one of three formats: full English-like syntax, concise symbolic notation, or an indexed notation

**Rule Viewer** - Lets you view detailed behavior of a FIS to help diagnose the behavior of specific rules or study the effect of changing input variables

**Surface Viewer** - Generates a 3-D surface from two input variables and the output of an FIS



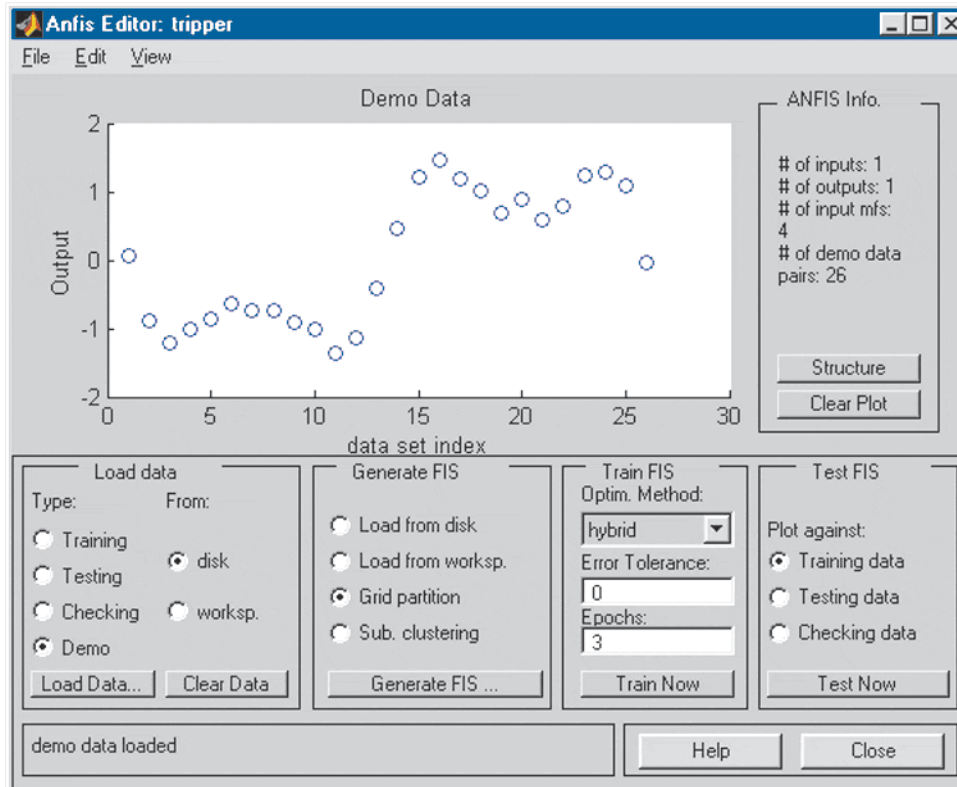
The Membership Function Editor (top left), FIS Editor (center), Rule Editor (top right), Rule Viewer (bottom left), and Surface Viewer (bottom right).

## Modeling Using Fuzzy Logic

The Fuzzy Logic Toolbox lets you apply neurofuzzy and clustering techniques to model and classify system behavior.

## Adaptive Neurofuzzy Inference

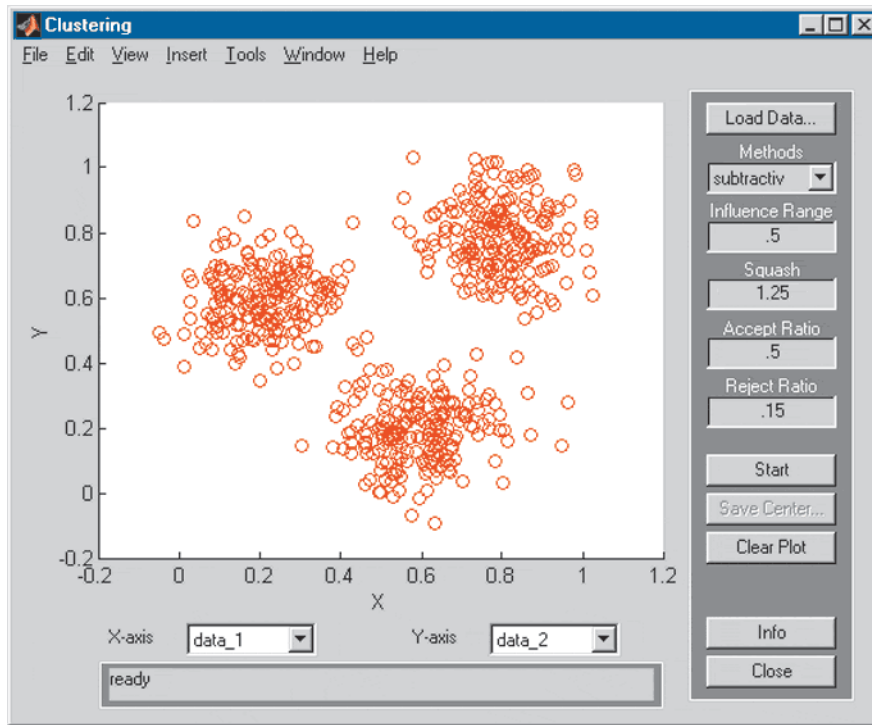
Using the Adaptive Neuro-Fuzzy Inference System (ANFIS) Editor, you can shape membership functions by training them with input/output data rather than specifying them manually. The toolbox uses a back propagation algorithm alone or in combination with a least squares method, enabling your fuzzy systems to learn from the data.



The ANFIS Editor constructs and tunes a FIS based on the data being modeled.

### Fuzzy Clustering

The Fuzzy Logic Toolbox provides support for fuzzy C-means and subtractive clustering, modeling techniques for data classification and modeling.



The Fuzzy Clustering GUI uses numerical data to develop classification and system modeling algorithms.

## Simulating and Deploying Fuzzy Inference Systems

You can evaluate FIS performance by using the Fuzzy Logic Controller block in a Simulink model of your system. The Fuzzy Logic Controller block automatically generates a hierarchical block diagram representation for most fuzzy inference systems. This representation uses only built-in Simulink blocks, enabling efficient code generation (using Simulink Coder, available separately).



### Fuzzy Logic Controller in Simulink 3:44

Integrate a fuzzy logic controller into a Simulink model.

You can also save your FIS in ASCII format for use outside the MATLAB environment. The toolbox supplies a fuzzy inference engine that can execute your fuzzy system as a stand-alone application or embedded in an external application.

## Resources

### Product Details, Demos, and System Requirements

[www.mathworks.com/products/fuzzy-logic](http://www.mathworks.com/products/fuzzy-logic)

### Trial Software

[www.mathworks.com/trialrequest](http://www.mathworks.com/trialrequest)

### Sales

[www.mathworks.com/contactsales](http://www.mathworks.com/contactsales)

### Technical Support

[www.mathworks.com/support](http://www.mathworks.com/support)

### Online User Community

[www.mathworks.com/matlabcentral](http://www.mathworks.com/matlabcentral)

### Training Services

[www.mathworks.com/training](http://www.mathworks.com/training)

### Third-Party Products and Services

[www.mathworks.com/connections](http://www.mathworks.com/connections)

### Worldwide Contacts

[www.mathworks.com/contact](http://www.mathworks.com/contact)