

# Plotting in Matlab and Fuzzy Logic Toolbox -----An Introduction

## PLOT (2-D plotting)

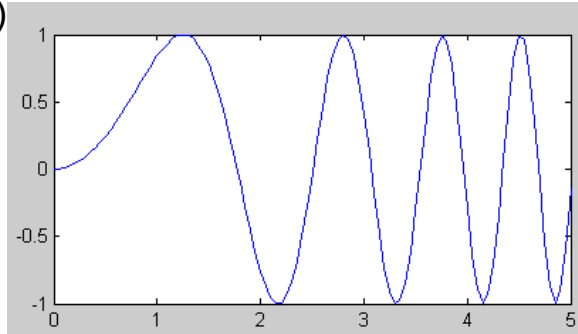
- Linear plot.
- PLOT(X,Y) plots vector Y versus vector X.  
If X or Y is a matrix, then the vector is plotted versus the rows or columns of the matrix, whichever line up.  
If X is a scalar and Y is a vector, length(Y) disconnected points are plotted.
- PLOT(Y) plots the columns of Y versus their index.  
If Y is complex, PLOT(Y) is equivalent to PLOT(real(Y),imag(Y)).  
In all other uses of PLOT, the imaginary part is ignored.

## Line plot

```
x = 0 : 0.05 : 5;
```

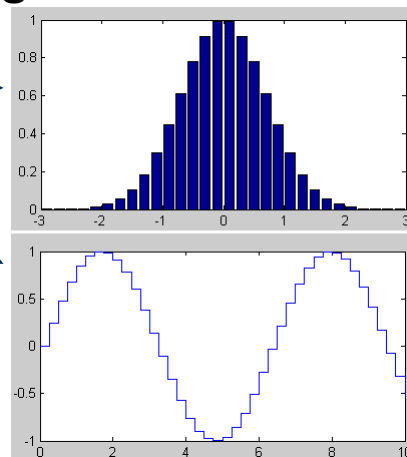
```
y = sin(x .^ 2);
```

```
plot(x, y);
```



## Other 2-D plotting

- bar
- stairs
- errorbar
- polar
- stem

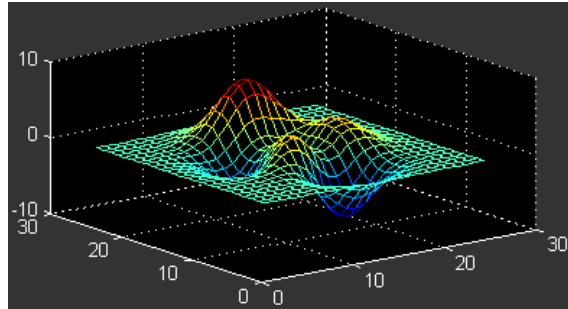


## MESH (3-D plotting)

```
% Mesh Plot of Peaks
```

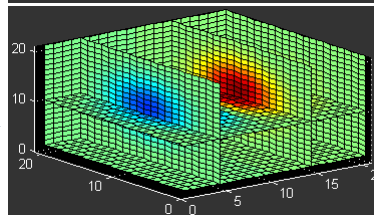
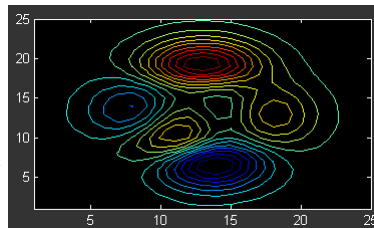
```
z=peaks(25);
```

```
mesh(z);
```



## Other 3-D plotting

- surf
- surfli
- contour
- quiver
- slice



## Example

$$y_{young} = e^{-\left(\frac{x}{20}\right)^2}$$

Membership Function of “young”

Filename: mfyong.m

```
function y = mfyong(x) % member function: young  
y = exp(-power(x/20,2));
```

$$y_{old} = e^{-\left(\frac{x-100}{30}\right)^2}$$

Membership Function of “old”

Filename: mfold.m

```
function y = mfold(x) % member function: old  
y = exp(-power((x-100)/30,2));
```

$$y_{\text{veryyoung}} = y_{\text{young}}^2$$

$$y_{\text{veryold}} = y_{\text{old}}^2$$

$$y_{\text{not\_veryyoung\_and\_not\_veryold}} = \min(y_{\text{veryyoung}}, y_{\text{veryold}})$$

$$y_{\text{veryyoung\_or\_veryold}} = \max(y_{\text{veryyoung}}, y_{\text{veryold}})$$

```
x = 0:1:100; % people age between 0 and 100.
```

```
y=min((1-power(mfyoung(x), 2)),(1-power(mfold(x), 2)));
```

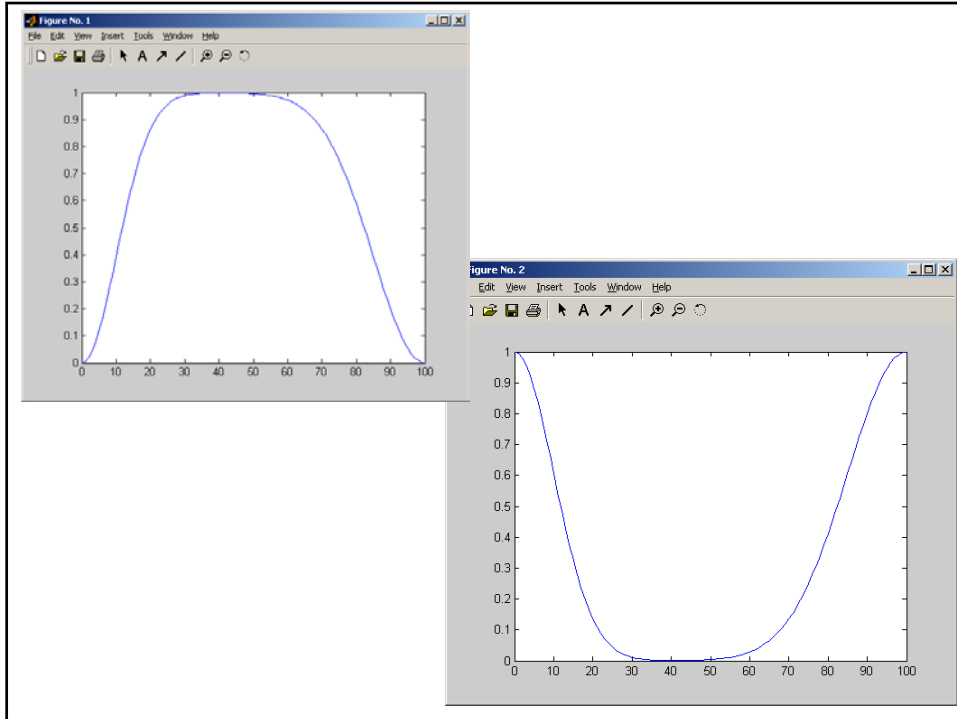
```
% not very young and not very old.
```

```
plot(x,y)
```

```
y=max(power(mfyoung(x), 2), power(mfold(x), 2));
```

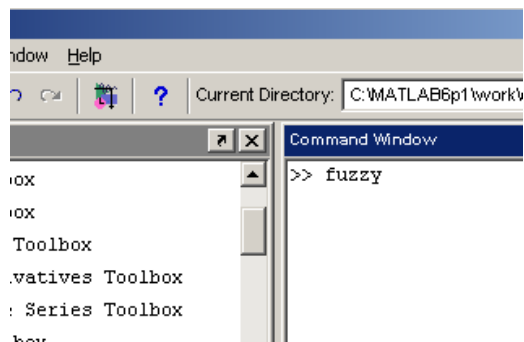
```
% very young or very old
```

```
figure, plot(x,y) % open a new figure window and plot
```



## Fuzzy Logic Toolbox (GUI)

- Start the toolbox:



## FIS Editor

The screenshot shows the FIS Editor window with the following callout boxes:

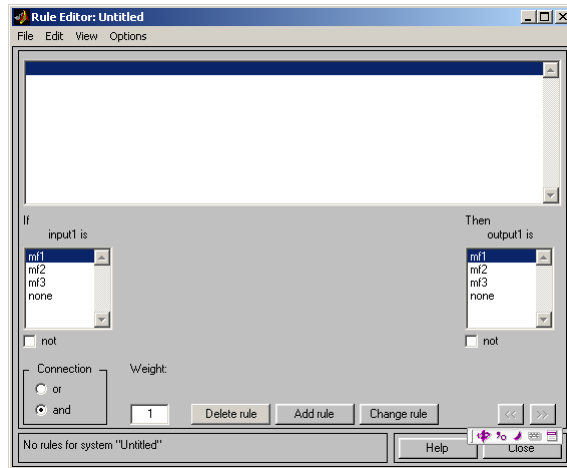
- Top Left:** These menu items allow you to save, open, or edit a fuzzy system using any of the five basic GUI tools.
- Top Middle:** Double-click on an input variable icon to open the Membership Function Editor.
- Top Right:** Double-click on the system diagram to open the Rule Editor.
- Middle Left:** The name of the system is displayed here. It can be changed using one of the Save as... menu options.
- Middle Right:** Double-click on the icon for the output variable, tip, to open the Membership Function Editor.
- Bottom Left:** These pop-up menus are used to adjust the fuzzy inference functions, such as the defuzzification method.
- Bottom Right:** This edit field is used to name and edit the names of the input and output variable.
- Bottom Center:** This status line describes the most recent operation.

## MF Editor

The screenshot shows the Membership Function Editor window with the following details:

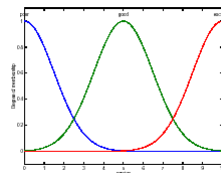
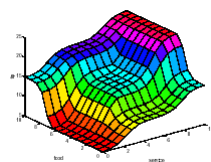
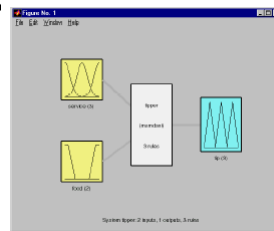
- Title Bar:** Membership Function Editor: Untitled
- Menu Bar:** File Edit View
- FIS Variables:** input1 (red icon), output1 (blue icon)
- Membership function plots:** plot points: 181
- Plot:** A graph showing three membership functions: mf1 (red), mf2 (green), and mf3 (blue) over the input variable "input1" from 0 to 1. mf1 is a decreasing line from (0,1) to (0.4,0). mf2 is a triangular function with vertices at (0.4,0), (0.5,1), and (0.9,0). mf3 is an increasing line from (0.4,0) to (1,1).
- Current Variable:** Name: input1, Type: input, Range: [0 1], Display Range: [0 1]
- Current Membership Function:** Name: mf1, Type: trimf, Params: [0.4 0 0.4]
- Status Bar:** Ready

# Rules Editor



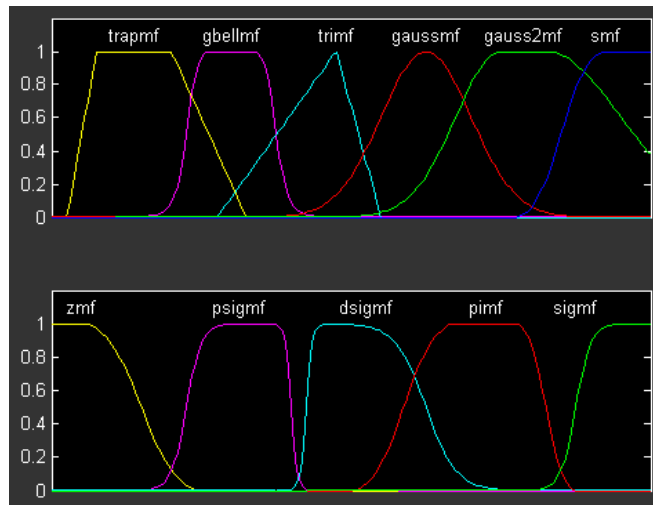
# Command Line functions

- plotfis
- plotmf
- gensurf





## Built-in membership functions



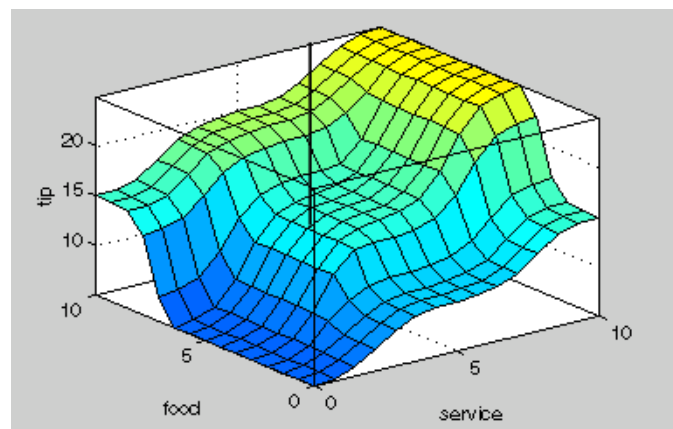
## Building a FIS from scratch

- **The Basic Tipping Problem.** Given a number between 0 and 10 that represents the quality of service at a restaurant (where 10 is excellent), and another number between 0 and 10 that represents the quality of the food at that restaurant (again, 10 is excellent), what should the tip be?

## Building a FIS from scratch (cont.)

- 1. *If the service is poor or the food is rancid, then tip is cheap.*
- 2. *If the service is good, then tip is average.*
- 3. *If the service is excellent or the food is delicious, then tip is generous.*
- We'll assume that an average tip is 15%, a generous tip is 25%, and a cheap tip is 5%. It's also useful to have a vague idea of what the tipping function should look like.

## Decision Surface



- [http://www.mathworks.com/access/helpdesk/help/pdf\\_doc/fuzzy/fuzzy\\_tb.pdf](http://www.mathworks.com/access/helpdesk/help/pdf_doc/fuzzy/fuzzy_tb.pdf)
- <http://www.mathworks.com/access/helpdesk/help/toolbox/fuzzy/fuzzy.shtml>