Tutorial on Fuzzy Logic using MATLAB

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Outline

• Fuzzy Logic Toolbox
• FIS Editor
• Tipping Problem: Fuzzy Approach
• Defining Inputs & Outputs
• Defining MFs
• Defining Fuzzy Rules
MATLAB: Fuzzy Logic Toolbox
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FIS Editor

- FIS Name: Untitled
- FIS Type: mamdani
- Current Variable:
  - Name: input1
  - Type: input
  - Range: [0, 1]

System "Untitled": 1 input, 1 output, and 0 rules
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?

• Assume that an average tip is 15%, a generous tip is 25%, and a cheap tip is 5%. 
Tipping Problem: Fuzzy Approach

- Antecedent
  - Service
  - Food
- Consequent
  - Tip
- Membership Function
  - Service: poor, good, excellent
  - Food: rancid, delicious
  - Tip: cheap, average, generous
FIS Editor: Adding Input / Output
Tipping Problem: Defining Input & outputs
Tipping Problem: Membership Function

- Membership Function: Service
- Let,
  - Poor : 0-5
  - Good : 2.5 – 7.5
  - Excellent : 5- 10
Tipping Problem: Membership Function
Tipping Problem: Membership Function

- Membership Function: Tip
- Let,
  - Cheap : 0 - 15
  - Average : 7.5 – 22.5
  - Generous : 15 - 30
Tipping Problem: Fuzzy Rules

What we want to express is:

<table>
<thead>
<tr>
<th></th>
<th>Rancid</th>
<th>Delicious</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor</td>
<td>Cheap</td>
<td>Average</td>
</tr>
<tr>
<td>Good</td>
<td>Cheap</td>
<td>Average</td>
</tr>
<tr>
<td>Excellent</td>
<td>Generous</td>
<td>Generous</td>
</tr>
</tbody>
</table>

or

1. If service is poor and the food is rancid then tip is cheap
2. If service is good and the food is rancid then tip is cheap
3. If service is poor and the food is delicious then tip is Average
4. If service is good and the food is delicious then tip is Average
5. If service is excellent then tip is generous

We have just defined the rules for a fuzzy logic system.
Tipping Problem: Fuzzy Rules
Tipping Problem: Fuzzy Rules

- If (service is poor) and (food is rancid) then (tip is cheap) (1)
- If (service is good) and (food is rancid) then (tip is cheap) (1)
- If (service is poor) and (food is delicious) then (tip is average) (1)
- If (service is good) and (food is delicious) then (tip is average) (1)
- If (service is excellent) then (tip is generous) (1)
Saving FIS

[Diagram showing FIS Editor interface with options for New FIS, Import, Export, Print, Close, and FIS details such as FIS Name, My Tip, FIS Type, And method, Or method, Implication, Aggregation, Defuzzification, and Current Variable settings.]
Rule Viewer

The Rule Viewer application is used to visualize and analyze rules. In the image, there is a window displaying the Rule Viewer interface with various graphs and input options. The graphs show distributions labeled as 'service = 1.88', 'food = 3.41', and 'tip = 7.78'. The input section displays the values [1.881, 3.409] and the plot points are set to 101. The interface also includes buttons for moving (left, right, down, up) and options for help and closing.
Surface Viewer