ENG5009 Advanced Control 5

Laboratory 1 Worksheet

Introduction

This lab exercise is designed to give you time to learn the Fuzzy Logic Toolbox within MATLAB, provide an introduction to the robot model to be used in the assignment and allow you to create and test a simple Neural Network.

You will be required to work your way through the examples provided and keep track of your progress using the answer grid provided on Moodle. This answer grid is to be included as an appendix in the final assignment report and is worth 20% of the assignment mark.

Fuzzy Logic

1. Introduction to Fuzzy Logic Toolbox

The first stage in this tutorial is to learn more about the fuzzy logic toolbox in MATLAB.

The easiest way of doing this is to follow the Mathworks Tutorial "The Basic Tipping Problem" which can be found at:

https://uk.mathworks.com/help/fuzzy/building-systems-with-fuzzy-logic-toolbox-software.html

Complete this tutorial.

Using the standard settings, provide the tipping level for the following input values:

Service	Food
5	5
7	8
10	2

Altering the Defuzzification method to the Mean of Maximum and then the Bisector methods provide the tipping levels for the same input values provided in the table above.

2. Integrating the Fuzzy system into the command line

To use the Fuzzy system developed you need to be able to call it from within a MATLAB script and pass variables out. Ensure you have reset the tipper back to centroid before saving your values.

To use tipper in the command line, do this:

```
tipper = readfis('tipper'); % create a variable name and assign your fis file to it
```

then evaluate the inputs using the following:

```
tip = evalfis([5 7], tipper); or tip = evalfis(tipper, [5 7]); depending on MATLAB version
```

Trial different levels of food and service and ensure the tip is updated as you would expect.

Further information on the integration of the FIS into the command line, or script file, can be found here:

https://uk.mathworks.com/help/fuzzy/evalfis.html

Note the tipping value for the following inputs:

Service	Food
5	5
7	8
10	2

3. Further Fuzzy Logic Example

Using the AC system developed in the tutorial we can use MATLAB to develop a Fuzzy logic controller.

Develop a controller based on the following parameters:

Input range: 5 to 32

Output range: -20 to 20

Five input fuzzy sets:

Fuzzy Set	Type	Parameters
Too Cold	Trapezoid	[4 5 12 14]
Cold	Trapezoid	[12 14 16 18]
Comfortable	Trapezoid	[16 18 22 24]
Warm	Trapezoid	[22 24 26 28]
Hot	Trapezoid	[26 28 32 35]

Five output fuzzy sets:

Fuzzy Set	Type	Parameters
High power cool	Trapezoid	[-22 -20 -12 -8]
Low power cool	Trapezoid	[-12 -8 -6 -2]
off	Trapezoid	[-6 -2 2 6]
Low power warm	Trapezoid	[2 6 8 12]
High power warm	Trapezoid	[8 12 20 22]

Use centroid defuzzification.

The rules can be found in the lecture slides and the tutorial.

What would be the value for the following input temperatures:

Input Temperature, ℃
9
13.1
26.5
20