Table of Contents

Table of Figures

Introduction to Fuzzy Logic

References

Table of Figures

**III. Introduction to Fuzzy Logic**

Fuzzy logic systems, along with genetic algorithms and neural networks, are an important facet of advanced computational techniques. Sometimes, it is difficult to know the exact parameters and data points of a system. In these cases, programmers use what is known as “fuzzy” logic to simulate the system. For example, rather than knowing that an air conditioning system should turn on the heat when the temperature drops below 70 degrees Fahrenheit, we tell the system to turn on the heat when the temperature is “low.” These “fuzzy rules,” as they are called, define the behavior of the system. This approach to simulating behavior “mimics how a person would make decisions, only much faster” (Kaehler).

Fuzzy logic follows three basic steps: creating the rules, determining membership, and defuzzification. The team’s project will walk through these three steps in greater detail; however, a description of each step is as follows:

1. Creating the rules: First, the parameters of the system are defined. In the case of an air conditioning system, these would be the change in temperature and the rate of change in temperature. Fuzzy rules are then created for every combination of parameters in the form of an antecedent block (If x and y) followed by a consequent block (Then z). For example, one rule for the previously-mentioned air conditioning system would be, “If the temperature has decreased and the temperature is still decreasing, then turn on the heat.” Large systems, such as the one the team will create in this project, could require a plethora of rules.
2. Determining membership: The next step is to construct membership functions for each of the parameters in the system. Example membership functions for the air conditioning system are as shown below (Kaehler).

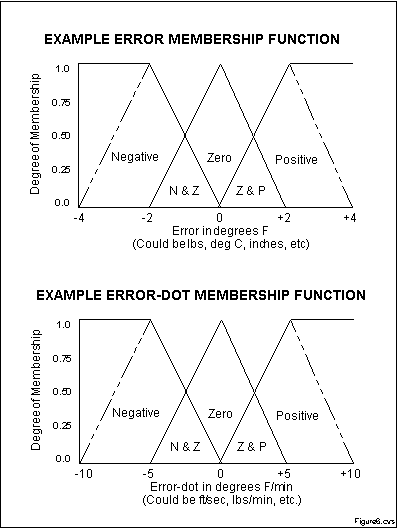


Figure 1. Example Membership Functions

Given that these membership functions provide a range of possible values for each parameter, it is now possible to match up the given values into the system with a value on this function. For example, an error in degrees of -1 degrees Fahrenheit would give a membership of 0.50 for Negative and 0.50 for Zero. The same process is applied for every membership function to give a membership for every possible linguistic variable.

1. Defuzzification:

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<https://www.diabetesselfmanagement.com/blog/what-is-a-normal-blood-sugar-level/>

Low glucose: 50 mg/dL

Medium: 100 mg/dL

High: 150 mg/dL

<http://care.diabetesjournals.org/content/27/9/2161>

Decreasing: -1 mg/dL/min

Constant: 0 mg/dL/min

Increasing: +1 mg/dL/min