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Table of contents

General overview

The main goal of the practical work of this course is to create a **fuzzy agent-based decision support system (FA-DSS)**, which permits to decide about a certain inputs using a fuzzy inference engine embedded in particular agents.

The system performs two main actions, to prepare the fuzzy agent-based system and to handle the requests from users in order. The initialisation is done according the requirements sent by the user. Once the agent-based system is ready to work, the will use the system in order to evaluate different entries. As we shall explain later, one of the main goals is to create an open system and scalable system that could be used under different circumstances, and taking into account different strategies and topologies.

To illustrate the problem, imagine that we have a lawn watering system. Taking into account some weather variables, the system is able to specify the period of watering. The input parameters could be the soil humidity and the outside temperature, and the output is the watering duration. The inference engine activates the fuzzy rules contained in its knowledge base whose premises are under fuzzy inputs, and then it aggregates all the conclusions of these activated rules. Finally, the inference engine transforms the fuzzy decision to the domain of the output. In this system, there are different elements to take into account such as the definition of all variables (input and output), the knowledge base of rules, the function to evaluate the rules (t-norm), and the function to aggregate the consequents (t-conorm).

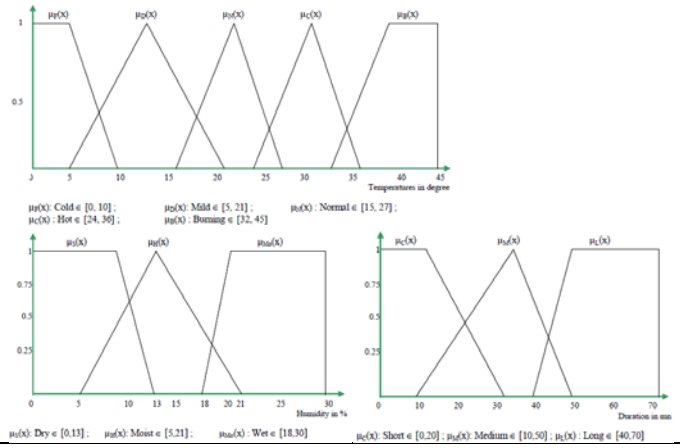
Variables	humidity x temperature → duration_period
Membership functions	
Rules	IF temperature is burning AND humidity is moist THEN the watering duration is average
Inference	Mamdani (t-norm minimum and t-conorm maximum)
Defuzzyfication function	Centre of area (CoG)
Decision	Input: (humidity, temperature) = (18, 38) Output: duration_period = 55 mn

Table 1: Elements of the fuzzy agents

Table 1 depicts the main elements included in a fuzzy system. The first element consists in the variables, distinguishing input and output variables. The next elements are the fuzzy sets associated to each variable which implement the semantic of the variable. Table 1 shows different examples using triagonal (e.g., $\mu_D(x)$) and trapezoidal functions (e.g., $\mu_P(x)$). The

next element to define in any fuzzy inference engine is the knowledge base set of rules. This set can combine conjunction operators, disjunction, and negation operators.

The inference mechanism is defined by the t-norm and t-conorm. Typically, most of the systems use the pair defined by Mandami using the minimum of all inputs as t-norm, and maximum of all inputs as t-conorm. When the final consequent has been evaluated, the decision should create the final decision using the domain of the output variable using one of the available defuzzyfication functions, such as the centre of area.

Agents

As we previously introduced, the system include three different agents named *user* agent, *manager* agent and *fuzzy* agent. Figure 1 shows the interactions between these agents.

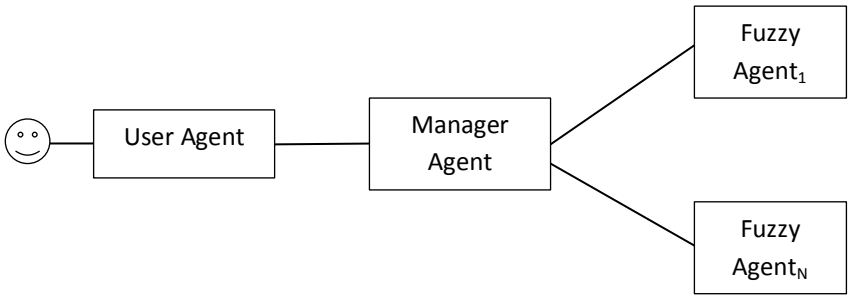


Figure 1: Agents of the system

The user agent is able to interact with the user in order to deal with the two main actions, starting the multiagent system, and answering the requests received from a user.

The manager agent is the gateway between the user agent and the set of fuzzy agents. This agent creates the fuzzy agents as requested, and then, it manages the requests received from the user agent and handled by the fuzzy agents.

The last type of agents is the fuzzy agents. These agents are created when required by the manager agent and embed a fuzzy inference engine. Each fuzzy agent is defined by a fuzzy set, a set of rules and a particular mechanism to handle with data and infer the final response. These agents represent a set of available resources that solve a problem.