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Faculty of computers and artificial intelligence

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AI314: Autonomous Multiagent Systems

Technical report #3

Greenhouse

Monitoring/Controlling Agent

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Introduction

A greenhouse is a uniquely controlled environment that allows the gardener to exercise some control over nature where plants are concerned. This gives the northern gardener a longer growing season, allows outside-of-zone plants to be cultivated, protects tender starts and newly propagated plants, and generally creates the ideal growing zone for a host of plant life. Greenhouse watering systems are important parts of creating this ultimate growing climate.

Water for greenhouses may be piped in professionally or brought in through a hose or drip system. Whichever method you use in your approach, the creation of timing, flow amounts, zones, and type of delivery are all part of greenhouse irrigation.

Problem understanding

There are many problems in greenhouses, the most important of which is adjusting the proportions of elements that interfere with the growth of plants and affect their health.

1. Temperature

The optimal greenhouse climate and soil adjustment can enable us to improve productivity and to achieve remarkable energy savings.

High temperatures cause several dangers that threaten plants, the most important of which are:

1- Loss of large quantities of water and drought, as the high temperatures that the leaves are exposed to

2- The imbalance between respiration rates and photosynthesis constitutes a toxic factor or toxic substances. Damage, death, and destruction of the protein components of protoplasm, chlorophyll damage, yellowing of the leaves, and growth inhibition.

2. Soil moisture

The drip irrigation cropping system is like but better than the conventional soil cropping system because it can be used to control crop growth through a regulated supply of water and nutrients. In addition, the system allows reduced relative humidity in the greenhouse because not all the soil is irrigated and because it is compatible with the use of white polyethylene film as light-reflecting mulch.

3. Irrigation duration

Water for greenhouses may be piped in professionally or brought in through a hose or drip system. Whichever method you use in your approach, the creation of timing, flow amounts, zones, and type of delivery are all part of greenhouse irrigation.

Not all plants need the same amount or frequency of water. Over or underwatering can cause plant health problems. To prevent this, install a simple drip system, which can be used to direct larger or smaller flows of water directly to pots or flats. You can regulate this type of water for greenhouses with a timer and flow gauge. Systems start with a base line and then peripheral feeder lines. Off each feeder line is micro-tubing directed straight to the plant at the root line of the soil. You can add or subtract micro-tubing as needed and use the drip or spray heads necessary to deliver the amount of water each plant needs. This is an inexpensive and easy system to maintain for watering greenhouse plants.

Analysis phase

Robot’s abilities, capabilities and the older versions:

The older version of greenhouses agent was a simple system by using a one cabled measurement point in the middle to provide the information to the greenhouse automation system compared to the new version (WSN) it was simple without opportunities to control locally heating, lights, ventilation, or some other activity, which was affecting the greenhouse interior climate and it was slower than (WSN)

Rationality

-Performance measuring success:

One of the primary objectives of this project was to be able to maintain the well-being of a greenhouse using the power of the Internet of Things (IoT) With the versatility of the present tools and software It has proven to be low-cost and easy to build, more efficient in water consumption and facilitates maintenance and monitoring.

– Agents prior knowledge of environment:

The design of our greenhouse is scalable, we provide our software it with different data regarding temperature and soil moisture therefore can calculate function that help it to take its action.

– Actions that agent can perform

our software that provided with our agent can accurately measure temperature, soil moisture.

therefore, calculate most suitable water irrigation rate and accurately control it.

– Agent’s percept sequence to date

our greenhouse is integrated with sensors that monitor the real-time status of the temperature, soil moisture of our greenhouse therefore interacts directly to adjust levels of water irrigation rate

PEAS

- **Performance measure:**

  Maximize the crops yield, it’s scalable, low-cost and easy to build, making it the perfect option to be more efficient in water consumption and facilitates maintenance and monitoring.

- **Environment:**

  Greenhouse, controller, temperature, customer, soil moisture

- **Actuators:**

  Electronic circuit measure temperature, drip irrigation system, Solingen
- **Sensors:**

  Air Temperature, soil moisture

The Environment Type

- **Partially observable:**
  We need to maintain the internal state to keep all states of control system.
- **Stochastic:**
  Environment is random in nature and cannot be determined completely by an agent.
- **Sequential:**
  We need to know the past actions to determine the next best actions.
- **Dynamic:**
  agents need to keep looking at the world at each action.
- **Continuous:**
  There is unlimited number of distinct, clearly defined percepts and actions.

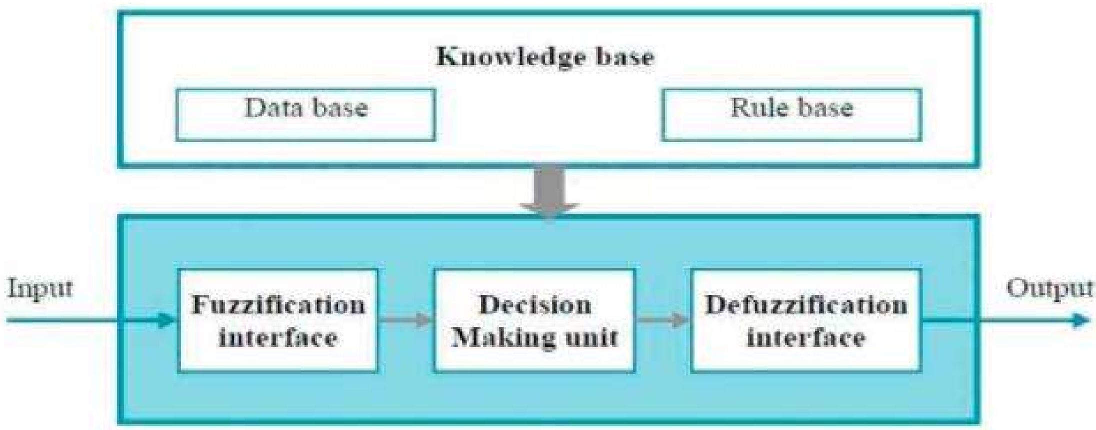
- **Multiagent:**
  Agents model each other's goals and actions; they also interact directly (communicate).

Agent type

utility-based agent

because our system used to grow plants under controlled climatic conditions for optimum produce with terms of water conservation, energy conservation, plants growth, manpower and load conservation so that our system is utility-based agent.

Design



Fuzzy System Design

There are mainly three steps in designing of a Fuzzy System.

1. Pick the nouns or variables for inputs and output This system requires two inputs, namely air temperature and soil moisture of Level Change and one Output namely irrigation duration.

2. Define subsets of inputs and outputs The first input Level may be divided into five levels namely cold, fresh, normal, hot and very hot.

The second input may be classified into three levels namely dry humid and wet. Finally, Set the fuzzy rules.

Finally, long, short and medium considered as the subset of Output.

3 .Set the fuzzy rules

If/and	then
Cold/Dry	long
Fresh/Dry	long
Normal/Dry	long
Hot/Dry	long
Very hot/Dry	long
Fresh /humidity	Medium
Normal/humidity	medium
Hot/humidity	medium
Very hot/humidity	medium
Cold/wet	short
Fresh/wet	short
Normal/wet	short
Very hot/wet	short
Cold/humidity	short

The MIN-MAX inference method was used to determine stress values from rules satisfied during the evaluation process. The consequent fuzzy union was restricted to the minimum of the predicate truth, while the output fuzzy region was updated by taking the maximum of the minimized fuzzy sets. The minimum operator limits certainty of the overall stress condition to the least certain input observation. The final irrigation duration membership function was obtained using the MAX composition process.

Fuzzification

We convert crisp inputs to fuzzy inputs. our system uses the trapezoidal or triangular membership function for Fuzzification of inputs.

Defuzzification

We use centroid as:

Area of triangle = 0.5 * base * height

Area of rectangle = length * width

Center of Area = ((c1 * A1) + (c2 * A2)) / (A1 + A2)

$$COA = \frac{\sum_{i=0}^{n} x_i \mu(x_i)}{\sum_{i=0}^{n} \mu(x_i)}$$

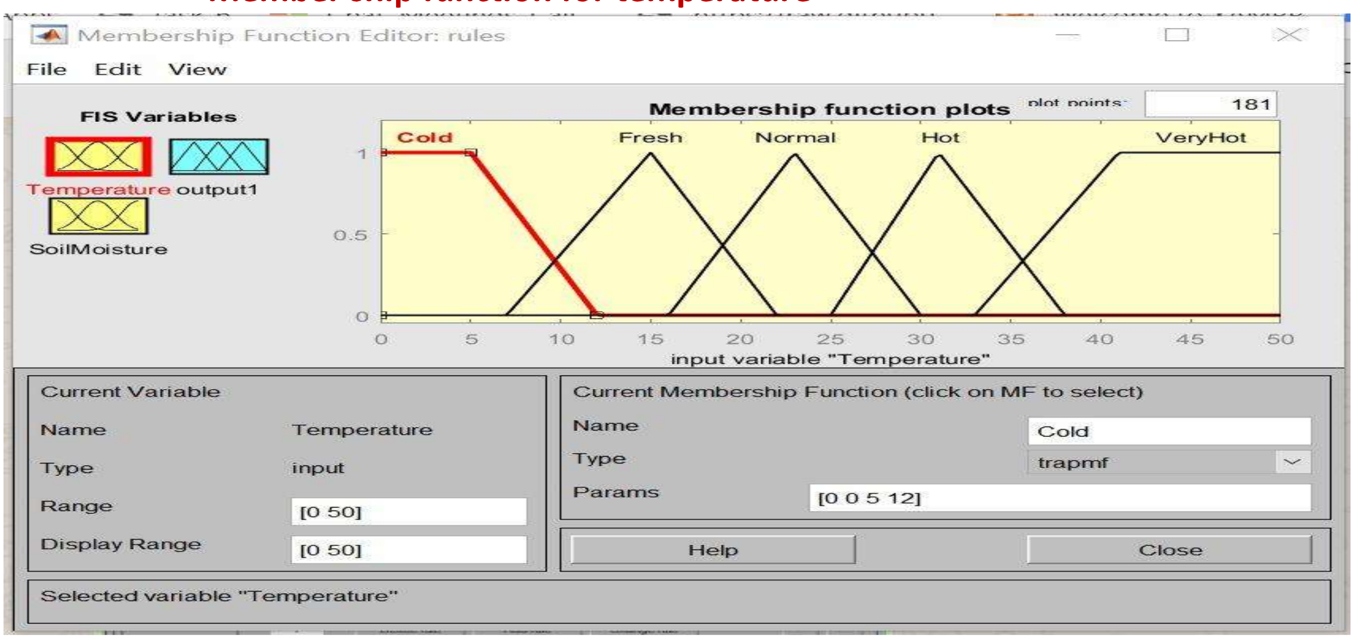
Implementation

Python

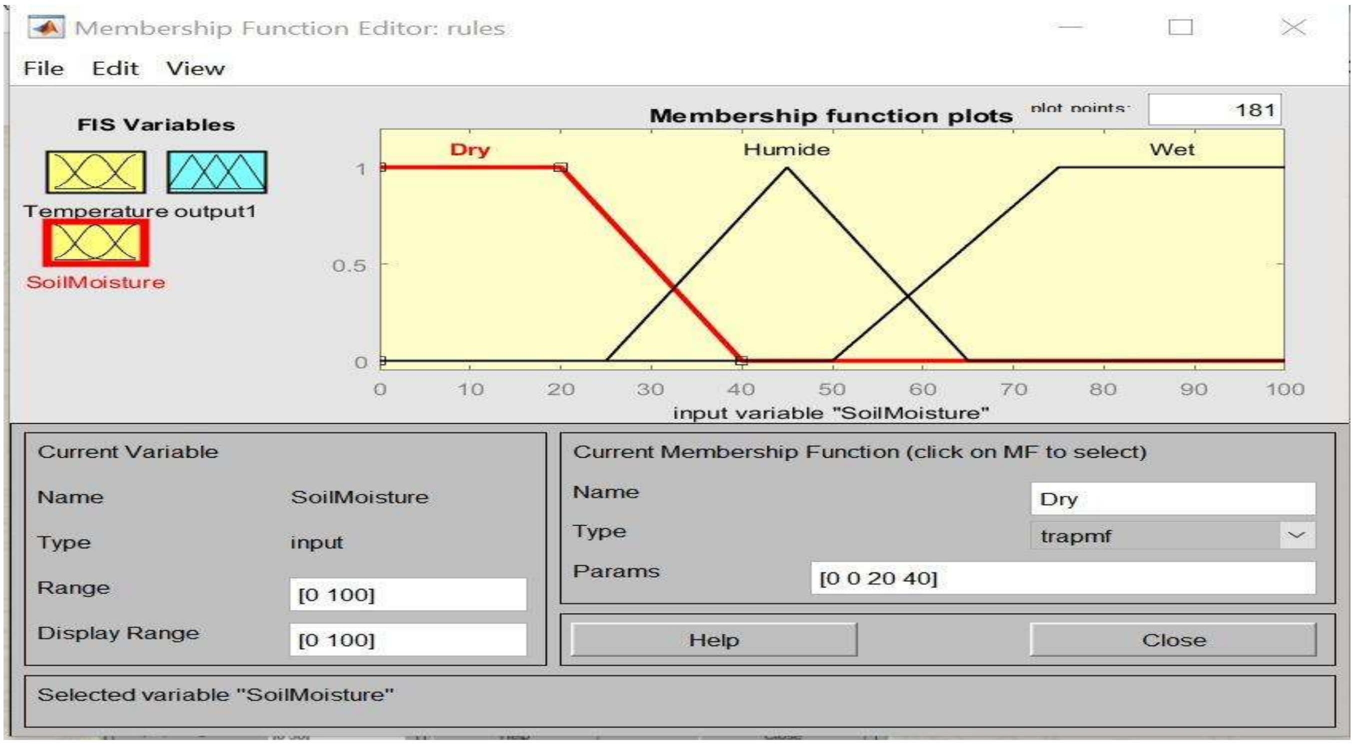
https://colab.research.google.com/drive/143wiNV08lDM60YrfKOuvRf-arTOY3BtX?usp=sharing

MATLAB

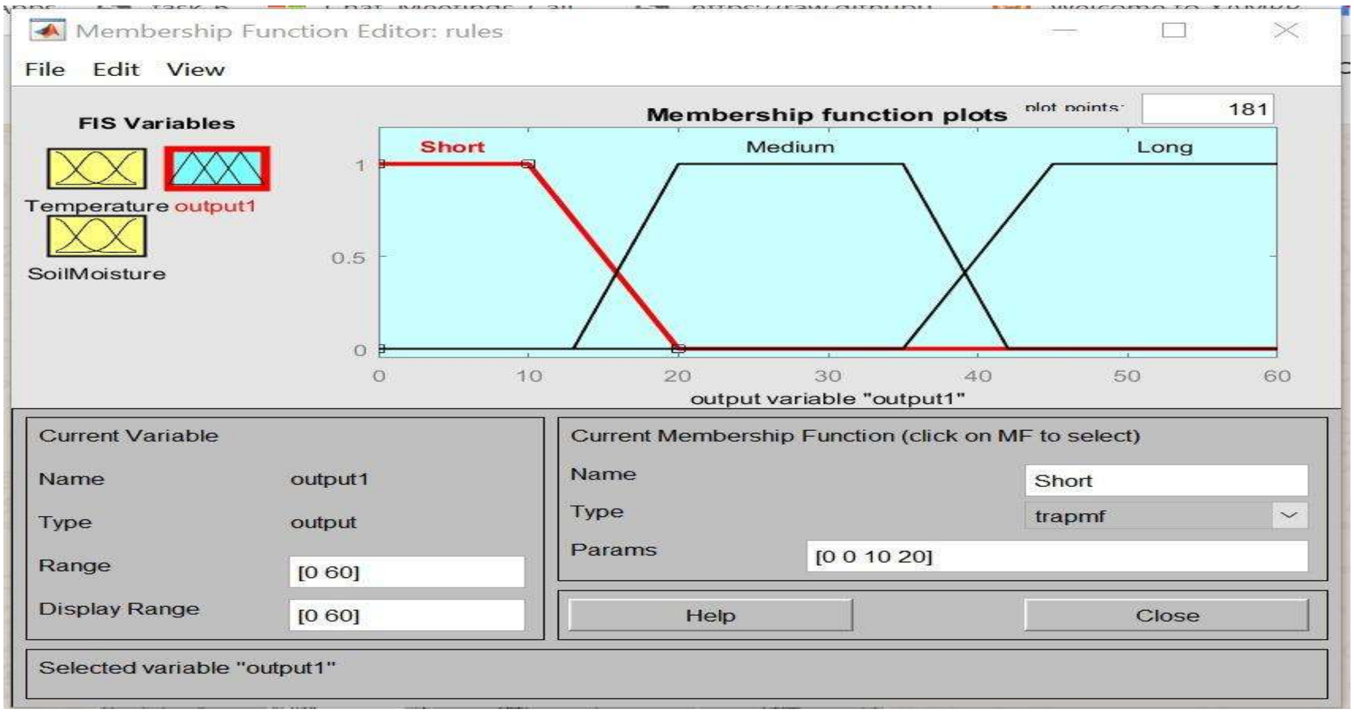
Member ship function for temperature



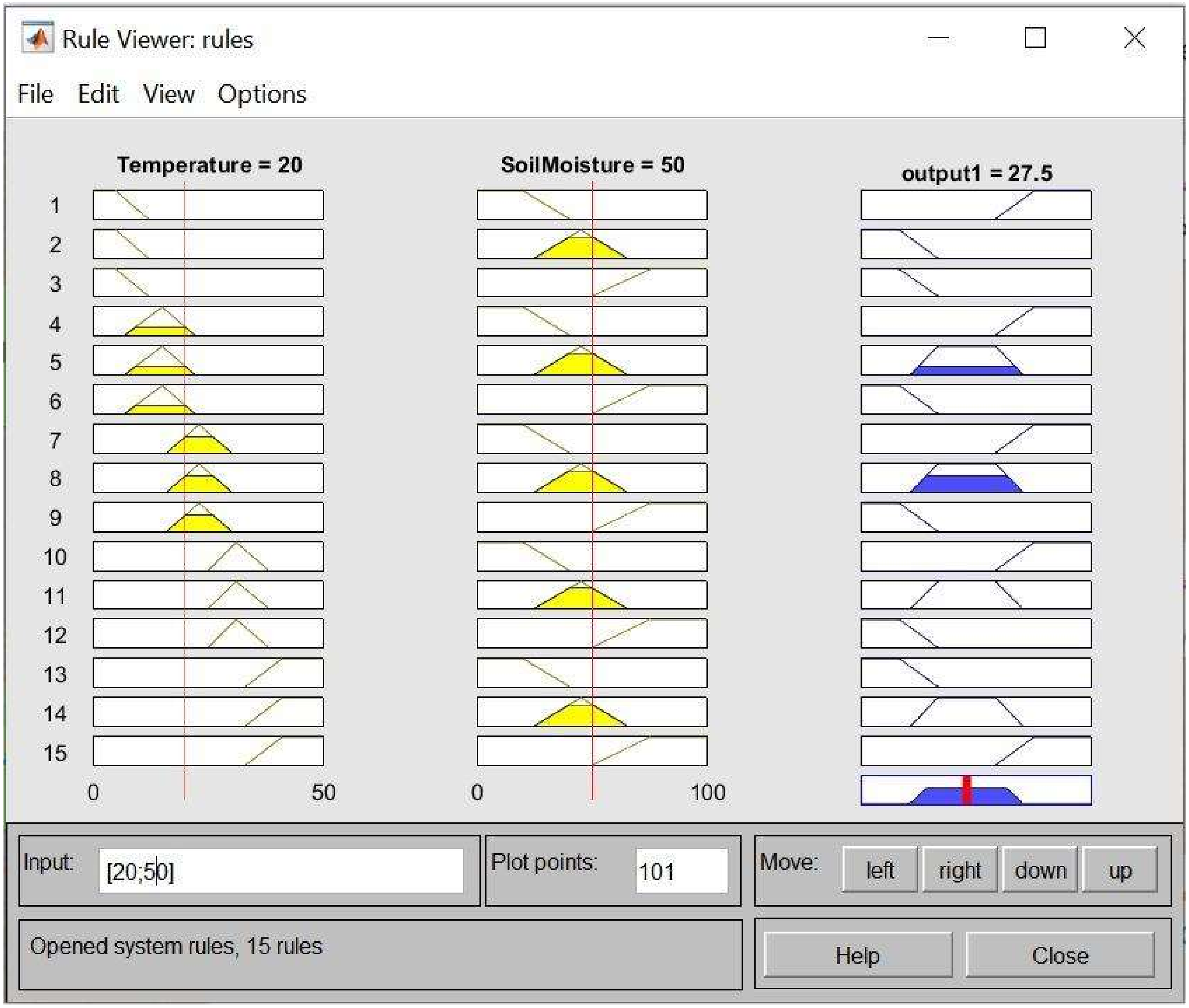
Membership function for soil moisture



Membership function for irrigation duration



Evaluation



Rule Viewer: rules
File
Edit
View
Options
Temperature = 20
SoilMoisture = 50
output1 = 27.5
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
0
50
0
100
Input:
[20;50]
Plot points:
101
Move:
left
right
down
up
Opened system rules, 15 rules
Help
Close

Reference

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Green House
Controlling / monitoring system

Software Life Cycle Development

PROBLEM UNDERSTANDING

ANALYSIS

IMPLEMENTATION

EVALU

Your Log


PROBLEM
UNDERSTANDING

Controllers

1. temperature
2.humidity
4. co2 concentration
5. sunshine
7. salinity
8. Irrig wa
9. Soil moisture

Your Log

Controllers

1. temperature

2.humidity

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Your Log


ANALYSIS

Analysis

Robot’s abilities, capabilities and the older versions

rat

PEAS

Enviro

Agent type

Your Log

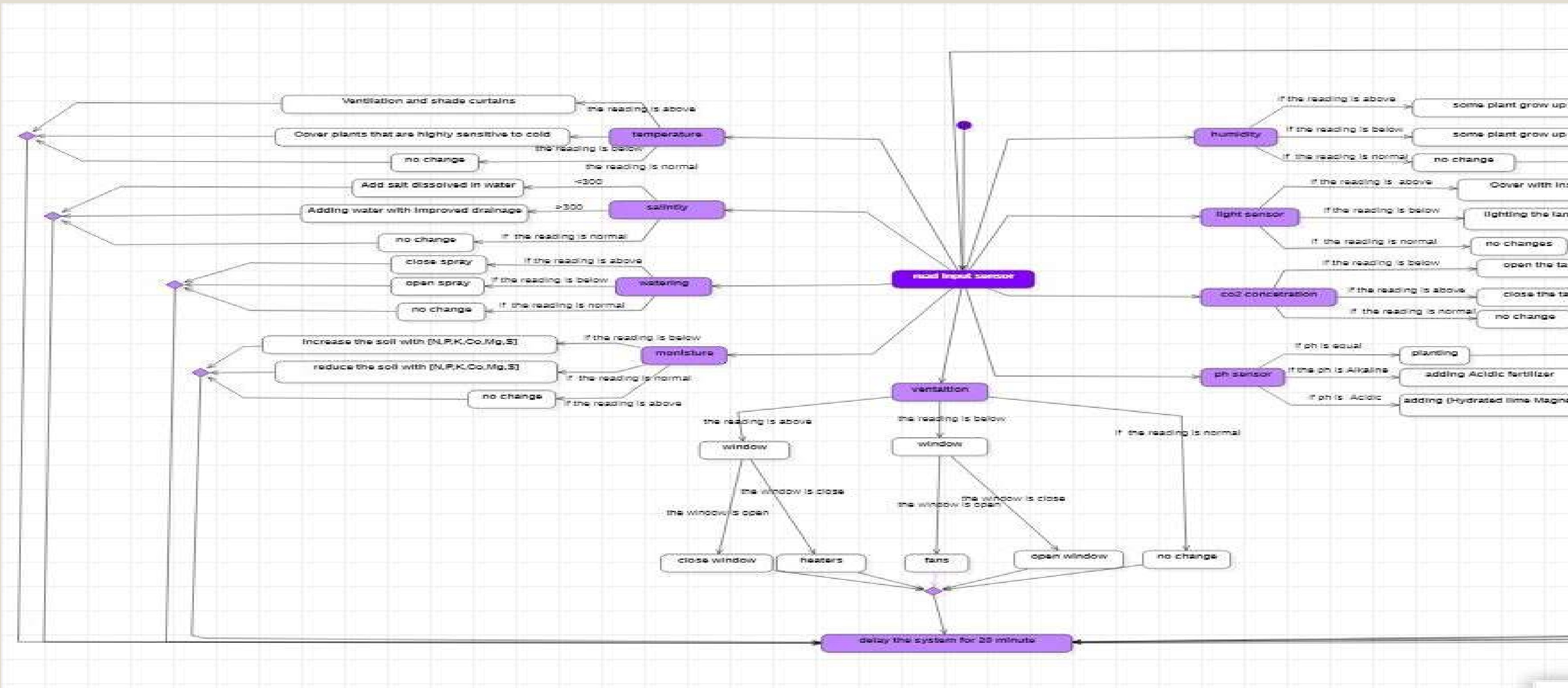
DESIGN

Formulate the problem

- **State space:**
  Green House and sensors
- **Successor function**
  actions : actuators
- **Start state and goal state**
  start state: read input
  goal state: Adjust the proportions of the elements

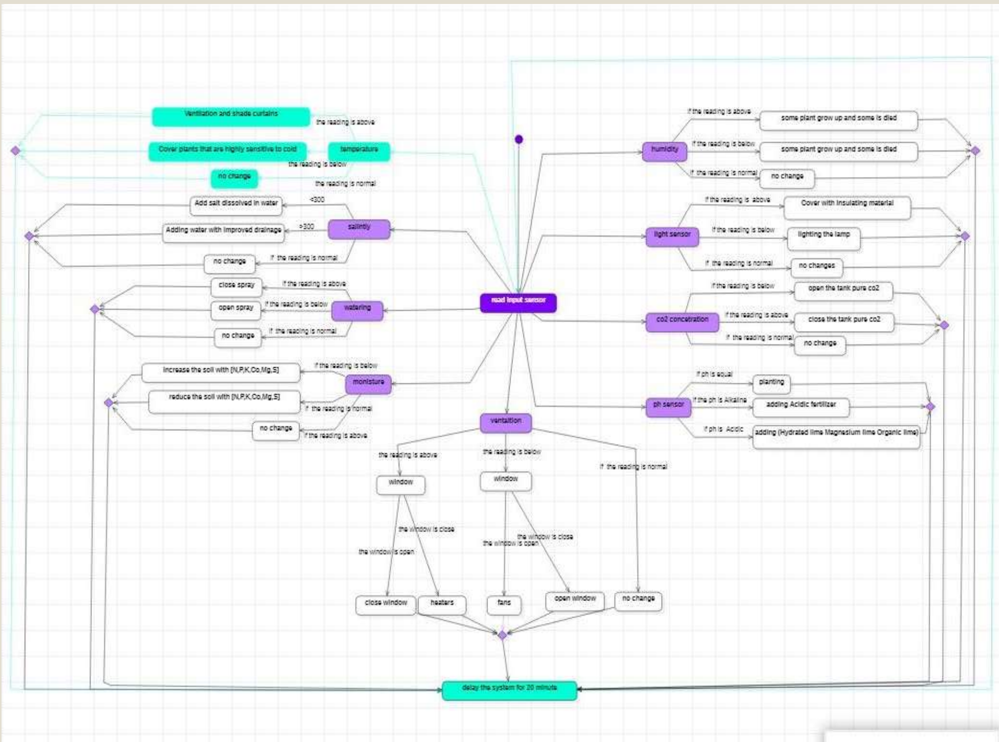

FIRST DESIGN

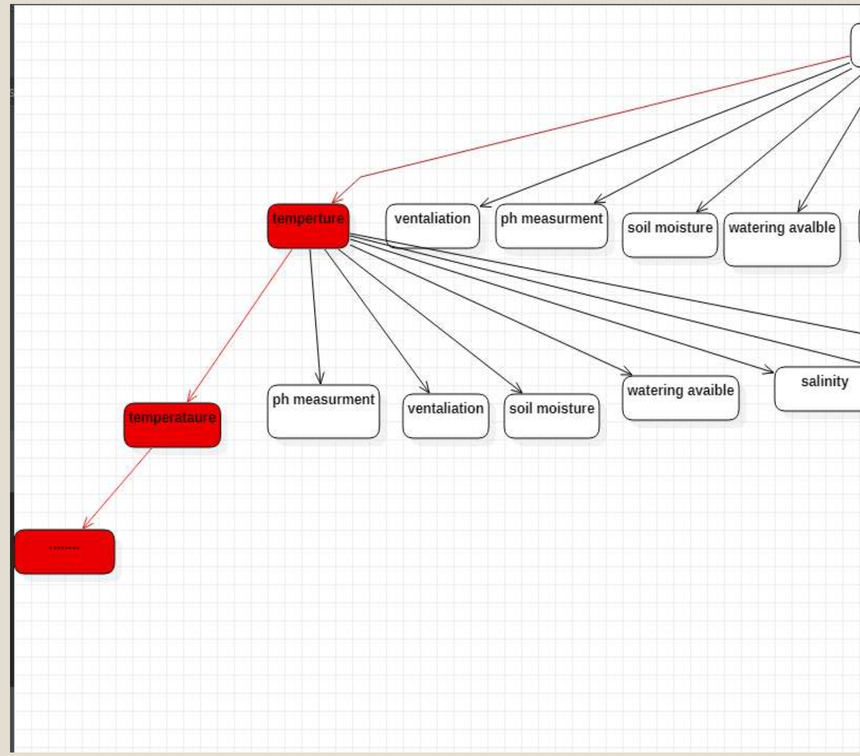
State diagram



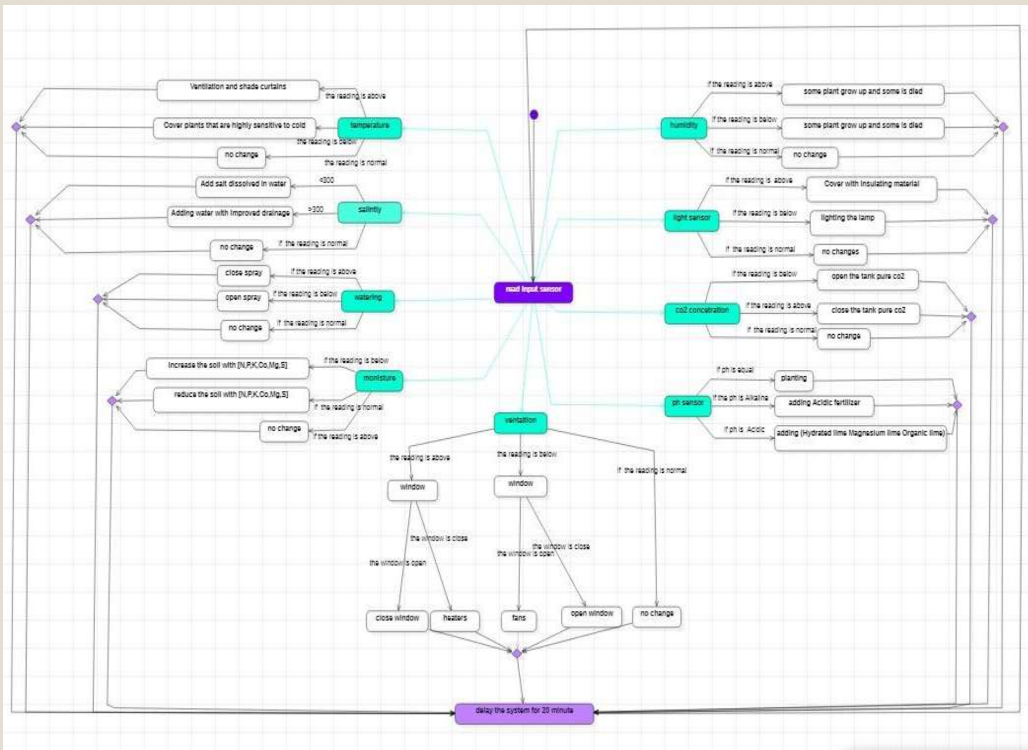
Your Log

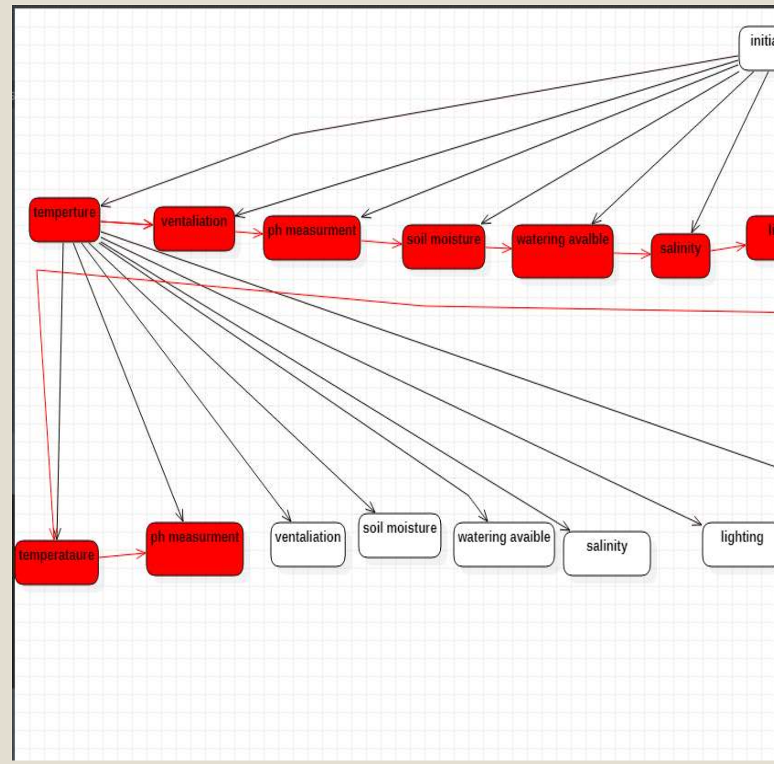
Search algorithm with DFS





Search algorithm with BFS





Your Log


SECOND DESIGN

Fuzzy design

Input variables and linguistic variables

- temperature
- Soil moisture

Your Log

Design

output variables and linguistic variables

Irrigation durati

- Long , medium ,sho

Your Log

Design

Rules

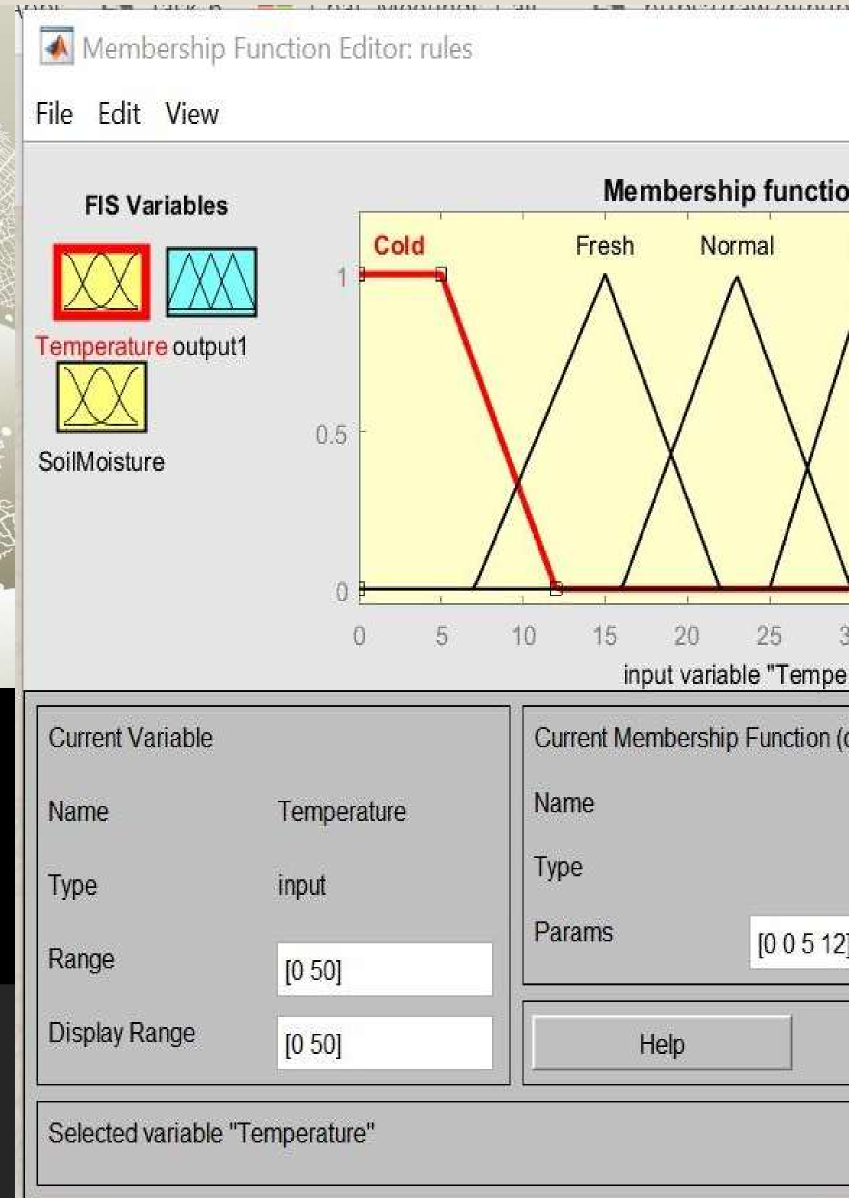
If/and	
Cold/Dry	lo
Fresh/Dry	lo
Normal/Dry	lo
Hot/Dry	lo
Very hot/Dry	lo
Fresh /humid	M
Normal/humid	m
Hot/humid	m
Very hot/humid	m
Cold/wet	sh
Fresh/wet	sh
Normal/wet	sh
Very hot/wet	sh
Cold/humid	sh

Your Log

IMPLEMENTATION

implementation

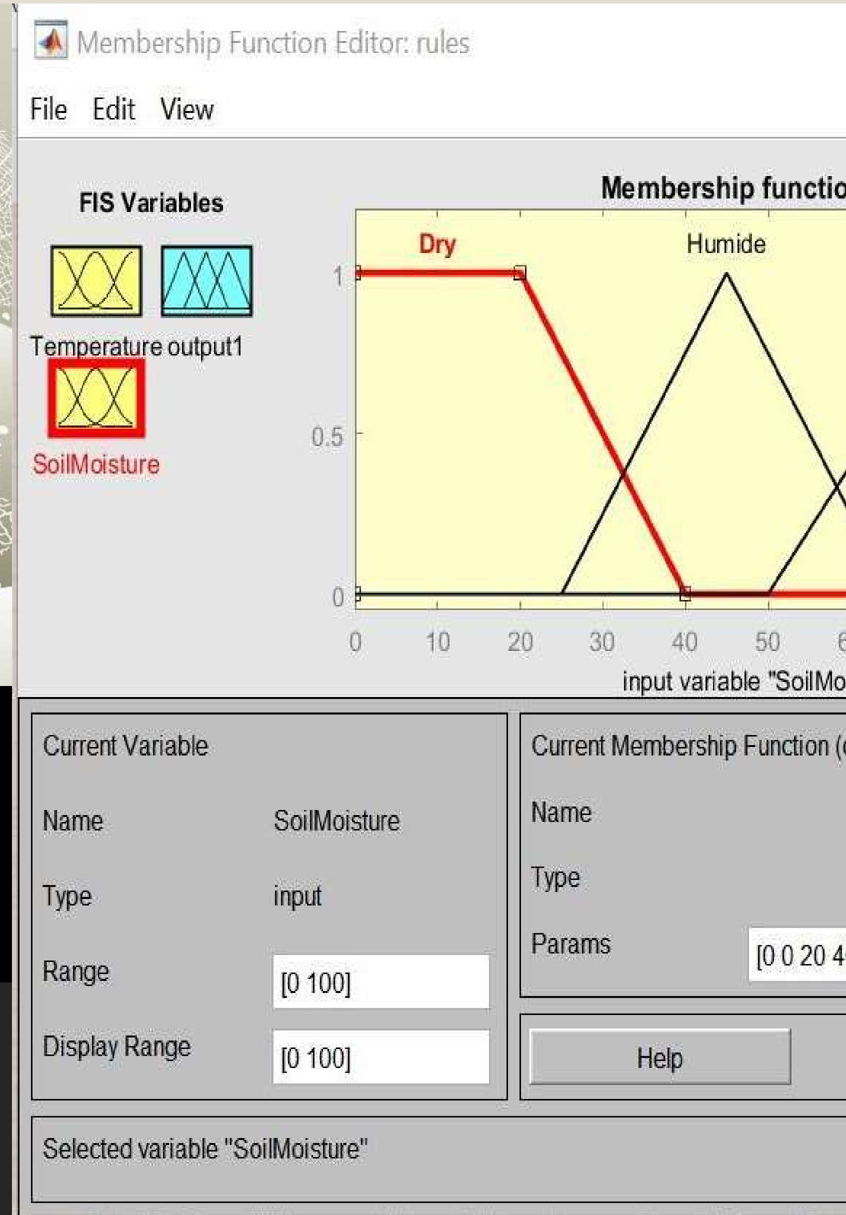
Membership function of temperature



Your Log

implementation

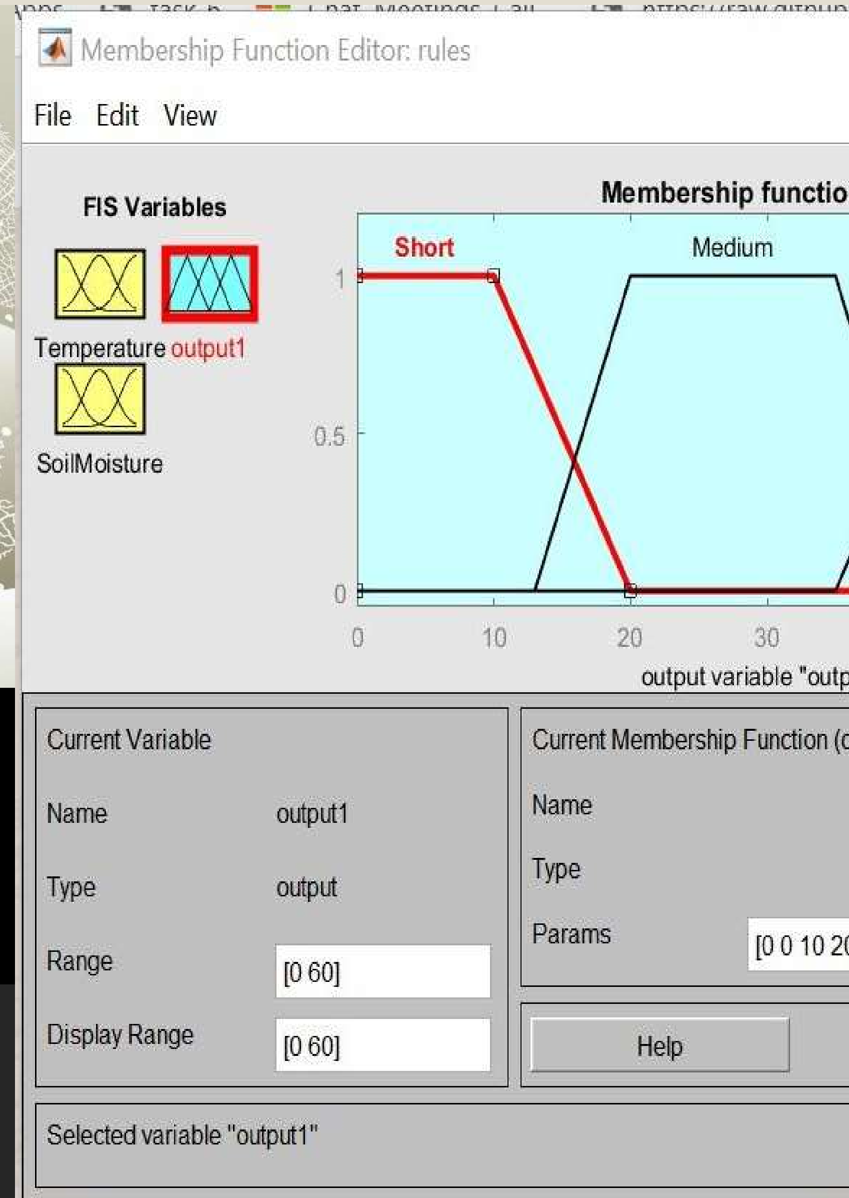
Membership function of soil moisture



Your Log

implementation

Membership function of irrigation duration



Your Log

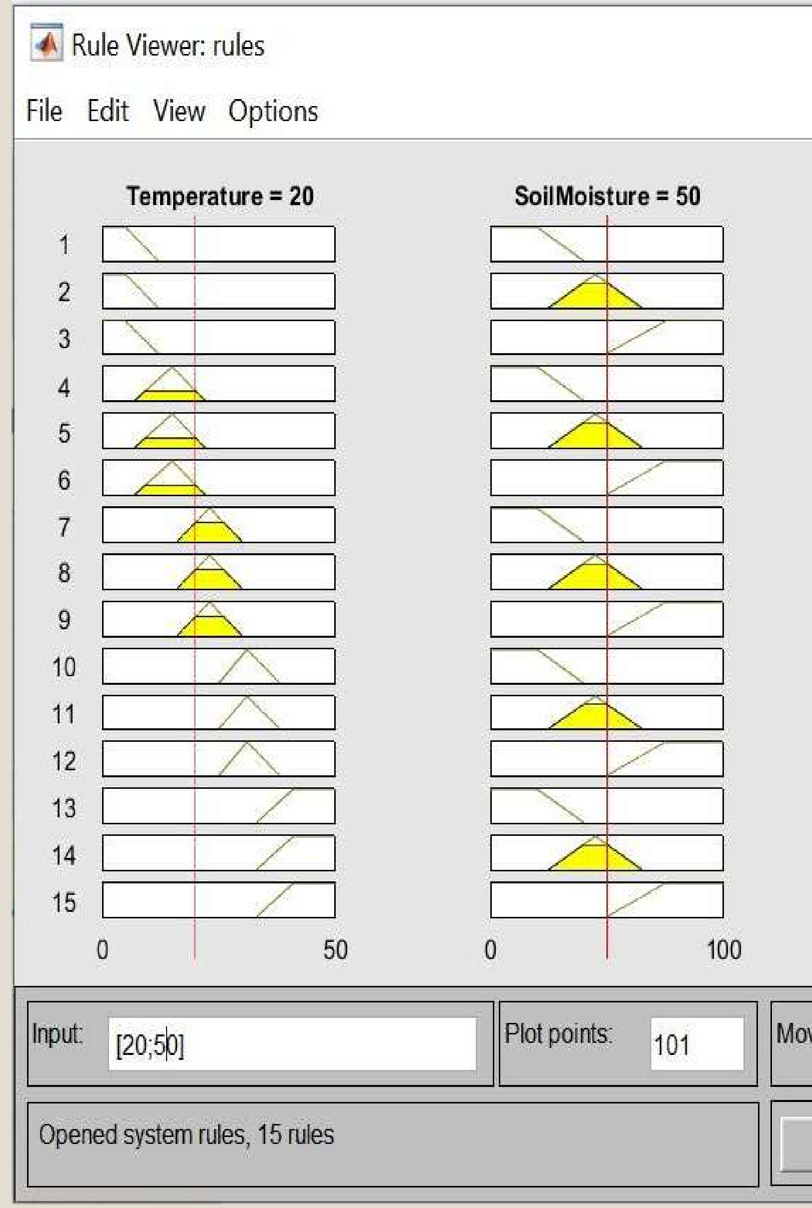
EVALUATION

Evaluation

Temp= 20

Soil moisture =50

What is the duration irrigation?



Your Log

Link of Colab

- https://colab.research.google.com/drive/143wiNV08lDM60YrfKOuvRf-arTOY3BtX?usp=sharing


THANK YOU