
# Fuzzy Logic Air Conditioner

**Author**

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# Contents

# Introduction

The purpose of this report is to outline the implantation of a Fuzzy Logic Air Conditioner controller. The way this will work is the room temperature will only be affected by the outside temperature if the air conditioner (AC) button is turned off. If the AC button is turned on the room temperature should reach the target temperature. The target temperature can be set by the user using the dial on the interface.

# Linguistic Variables

The program uses two input variables (room and target) and one output variable (command). Both room and target use the same number and named linguistic variable terms.

## Room Linguistic Variable Term

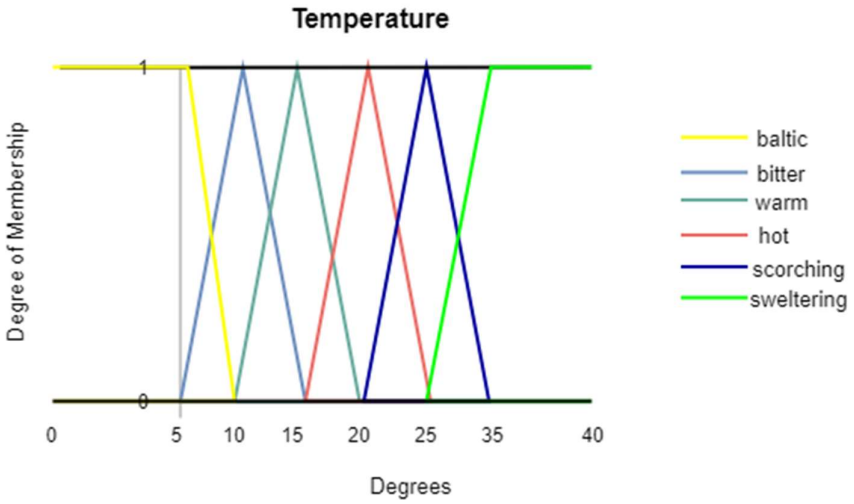


*Figure 1 - Membership Function Room Term (Input variable 1)*

The room term temperature ranges from 0 - 40 degrees and is split into six terms,
**baltic –** uses a trapezoid membership and covers the range of 0 – 10 degrees.
**bitter –** uses a triangle membership and covers the range 5 – 15 degrees.
**warm -** uses a triangle membership and covers the range 10 – 20 degrees.
**hot -** uses a triangle membership and covers the range 15 – 25 degrees.
**scorching -** uses a triangle membership and covers the range 20 – 35 degrees.
**sweltering -** uses a trapezoid membership and covers the range 25 – 40 degrees.

## Target Linguistic Variable Term

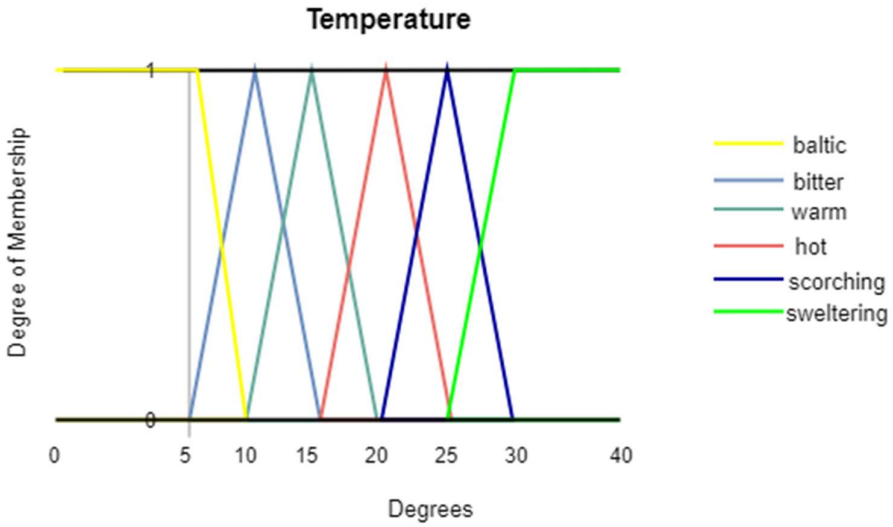


*Figure 2 - Figure 1 - Membership Function Target Term (Input variable 2)*

The target term temperature ranges from 0 - 40 degrees and is almost identical to the room term except for, scorching covers the range of 20 -30 degrees while the room term's scorching covers the range 20 – 35 degrees. The six terms that make up the target linguistic variable are,

**baltic –** uses a trapezoid membership and covers the range of 0 – 10 degrees.
**bitter –** uses a triangle membership and covers the range 5 – 15 degrees.
**warm -** uses a triangle membership and covers the range 10 – 20 degrees.
**hot -** uses a triangle membership and covers the range 15 – 25 degrees.
**scorching -** uses a triangle membership and covers the range 20 – 30 degrees.
**sweltering -** uses a trapezoid membership and covers the range 25 – 40 degrees.

## Command Linguistic Variable Term

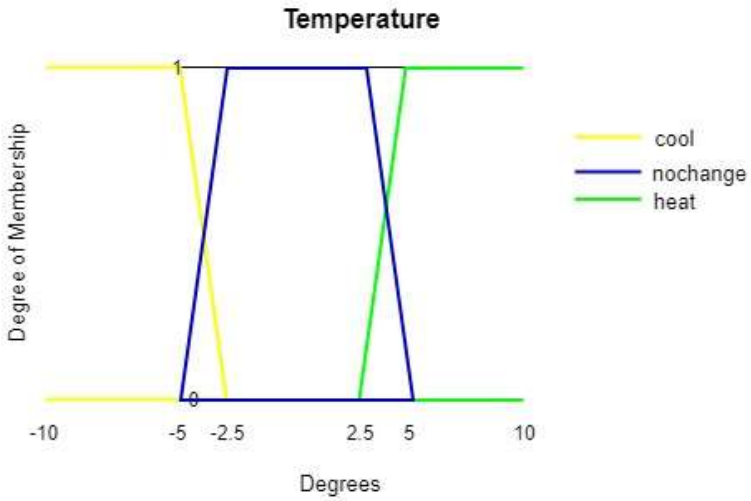


*Figure 3 - Membership Function Command Term (output variable)*

The command linguistic variable temperature ranges from -10 to 10 degrees. It is made up of three trapezoids',
**cool –** covers the range of -10 to -2.5 degrees.
**nochange –** covers the range of -5 to 5 degrees.
**heat –** covers the range of 2.5 to 10 degrees.

## Rule Terms

The rules that have being defined and implemented for the output variable can be seen in the rule matrix figure 4.

| | Target Temperature | | | | | |
|---|---|---|---|---|---|---|
| **Room Temperature** | baltic | bitter | warm | hot | scorching | sweltering |
| baltic | No-Change | Heat | Heat | Heat | Heat | Heat |
| bitter | Cool | No-Change | Heat | Heat | Heat | Heat |
| warm | Cool | Cool | No-Change | Heat | Heat | Heat |
| hot | Cool | Cool | Cool | No-Change | Heat | Heat |
| scorching | Cool | Cool | Cool | Cool | No-Change | Heat |
| sweltering | Cool | Cool | Cool | Cool | Cool | No-Change |

*Figure 4 - Rule Matrix*

In the above rule matrix on left of the table we have the room temperature terms and to the top we have the target temperature terms. In the centre of the table is the commands which are to be applied to the system depending on chosen target temperature. For example, if the target temperature is hot and the room temperature is bitter then the command is heat. Which will bring the room temperature in line with that of the target temperature.

The rules that have being defined from the above rule matrix to control the output variable use the If-Then (condition and conclusion) operator they are,

| |
|---|
| if (room is baltic) and (target is baltic) then command is nochange |
| if (room is bitter) and (target is bitter) then command is nochange |
| if (room is warm) and (target is warm) then command is nochange |
| if (room is hot) and (target is hot) then command is nochange |
| if (room is scorching) and (target is scorching) then command is nochange |
| if (room is sweltering) and (target is sweltering) then command is nochange |
| if (room is baltic or room is bitter) and (target is warm) then command is heat |
| if (room is baltic or room is bitter) and (target is hot) then command is heat |
| if (room is baltic or room is bitter) and (target is scorching) then command is heat |
| if (room is baltic or room is bitter) and (target is sweltering) then command is heat |
| if (room is bitter or room is warm or room is hot or room is scorching or room is sweltering) and (target is baltic) then command is cool |
| if (room is baltic) and (target is bitter) then command is heat |
| if (room is warm) and (target is bitter) then command is cool |
| if (room is hot) and (target is bitter) then command is cool |
| if (room is scorching) and (target is bitter) then command is cool |
| if (room is sweltering) and (target is bitter) then command is cool |
| if (room is hot) and (target is warm) then command is cool |
| if (room is scorching) and (target is warm) then command is cool |
| if (room is sweltering) and (target is warm) then command is cool |
| f (room is warm) and (target is hot) then command is heat |
| if (room is scorching) and (target is hot) then command is cool |
| if (room is sweltering) and (target is hot) then command is cool |
| if (room is warm) and (target is scorching) then command is heat |
| if (room is hot) and (target is scorching) then command is heat |
| if (room is sweltering) and (target is scorching) then command is cool |
| if (room is warm) and (target is sweltering) then command is heat |
| if (room is hot) and (target is sweltering) then command is heat |
| if (room is scorching) and (target is sweltering) then command is heat |

## Conclusion

To conclude, after some trial and error with the linguistic variables values and terms we feel the defined terms and ranges work well on the system. The room temperature is usually in line with the target temperature or within one or two degrees of it. And because of this we feel the system meets the criteria outlined within the assignment brief.