Improving usability and accessibility of Fuzzy Logic software systems with a web-based approach

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I hereby declare that this dissertation is all my own work, except as indicated in the text:

Signature ⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯

Date ⎯⎯⎯/⎯⎯⎯/⎯⎯⎯

Abstract

Abstract giving a short overview of the work in your project

Why did you undertake the study? What were you examining, or testing or investigating. Return to your research question and ensure you have re-stated it concisely, coherently and clearly. A good opening is often, "The report examines . . . ".
What was done and how did you do it? Be specific, dont make generalised comments.
What did you find out? State specific outcomes and, if appropriate, draw conclusions. "The results found that 85% of respondents used non-standardised assessments"

Ensure to mention:

1. WHAT IS FUZZY!!!

2. Further work with Type 2

3. Extend with other systems (Joe's dissertation)

4. Changes that Luke makes

5. Friendly errors

6. Things from presentation

7. KeyPress Javascript library

8. Help system is dedicated, but offers links to other, helpful, external resources

Contents

1   Introduction

Fuzzy logic is an ever expanding field, and as such, the tools we are using to work in this field should also be expanding. I also feel that the merits and importance of fuzzy logic should be made apparent to those other than the experts of this field, as this would help to produce more advanced control systems in future.

Many software systems for working with fuzzy logic have already been produced, of which many different approaches have been attempted, and been successful to various degrees. Examples of such systems include: The MATLAB Fuzzy Toolbox[1], An R Package named FuzzyToolkitUoN[2], XFuzzy[3], and fuzzyTECH[4] (a more comphrehensive overview of these systems can be found in section 3.1).

These system are all worthwhile pieces of software, and they fulfil their main objective of allowing for the creation of fuzzy systems. However, whilst researching these systems as part of my second year group project at the University of Nottingham (and actually working on one, in the case of FuzzyToolkitUoN), I noticed that there were two key flaws that the majority of popular fuzzy software systems suffered from: difficulty of use, or difficulty of access (or even both).

The main objective of this project is to produce a software solution for the creation, manipulation, and inferencing of a fuzzy logic system, which is accessible online. With a specific focus on solving the issues that are faced by fuzzy logic software systems that are currently used (difficulty of access and use).

Many different techniques will be employed in solving these fundamental problems, to hopefully create a system that is as easy to use, and as easy to access as possible. Some of these techniques will include: online access; the ability to work with multiple file types, for cross compatibility; an intuitive design; unrestricted navigation, giving the user complete control and freedom; a dedicated, unobtrusive help system, to offer help to those that need it, but not to bother those that do not; and to built in a way that allows for future expansions and extensibility. A comprehensive list of all aspects of the software system can be found in section 4.

It could be argued that *another* fuzzy logic software system is not necessary, as it has been demonstrated that there are already many available systems. But, in contrast to this view, I feel that currently available software suffers from certain issues (those mentioned above), and this project aims to resolve these issues, and attempt to spread the influence of fuzzy logic to those other than experts in the field.

There will, however, be certain areas that this software system will *not* be focusing on, as I do not believe they are relevant to the question posed in this research. Namely, this project will not be focusing on higher levels of fuzzy logic; it will only be focused on type-1. This is because the leap in difficulty from type-1 to type-2 fuzzy logic is very large, and type-2 is simply not a concept that I feel is suitable or appropriate to introduce beginners to. More on this topic, including a definition of both terms, can be found in section 8.1.

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[1]http://www.mathworks.co.uk/products/fuzzy-logic/
[2]http://cran.r-project.org/web/packages/FuzzyToolkitUoN/index.html
[3]http://www2.imse-cnm.csic.es/Xfuzzy/
[4]http://www.fuzzytech.com/

2   Motivation

The motivation of this project is a simple one: to produce a fuzzy logic software system that is easy to access, and easy to use, to help promote the wider adoption of fuzzy logic. The problem with systems currently available is that they suffer from one of the two following pitfalls: difficulty of use and difficulty of access. This means that novices can find it very difficult to get into the field, the software available does not facilitate productive use, and even experts can be held back by the software they are using. Some specific issues include: locating systems to use, complex installation processes, cost to the user, unintuitive user interface, or a requirement of (a considerable amount of) prior knowledge.

As part of my second year group project at the University of Nottingham, I worked on an R Package called FuzzyToolkitUoN. The goal of this system was to expand upon work completed by the IMA group[5], to facilitate the use of fuzzy logic within the R programming language. Whilst working on this project, my group and I conducted a large amount of research into existing fuzzy logic software systems and it was during this research period that I began to notice the two keys flaws that I have mentioned before. Unfortunately, due to the nature of the R programming language, and the package we were producing, our project too fell into one of these pitfalls - difficulty of use.

Motivation explaining the problem being solved

why it is novel/not trivial

3   Background Research

Research section

3.1   Existing Systems

1. Existing systems
   Related work explaining what your project does that is new or is better than existing work in the same field

   (a) FuzzyToolkitUoN

   (b) MATLAB

   (c) otheres... (see pres)

2. Languages used (R, Javascript)

3. Web technologies (tools, languages)

4. Shiny r to html

5. Bootstrap

6. jquery

7. Good user interfaces

4   System Specification

Description of the work explaining what your project is meant to achieve, how it is meant to function, perhaps even a functional specification or user stories?

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[5]http://ima.ac.uk/

4.1   Functional Requirements

4.2   Non-Functional Requirements

5   Designs

Design containing a comprehensive description of the design chosen, how it addresses the problem, and why it is designed the way it is

5.1   The Design Process

5.2   UI Design

5.2.1   First Iteration

5.2.2   Second Iteration

5.2.3   Third Iteration

5.3   Navigation/Control Flow Design

5.4   Internal Design

6   Software Implementation

Implementation containing a comprehensive description of the implementation of your software, including the language(s) and platform chosen, problems encountered, any changes made to the design as a result of the implementation, etc

7   Evaluation

Evaluation explaining how your software was tested (using different datasets or in different environments), statistical evaluation of performance, results of user evaluation questionnaires, etc.

8   Further Work

further... work?

8.1   Type-2 Fuzzy Logic

9   Summary

Summary and further work including a personal reflection on your experience of the project and a critical appraisal of how the project went

References

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