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# A Fuzzy Logic Approach for Dynamic User Interests Profiling

**Authors:**

Abd El Heq Silem  
Hajer Taktak  
Faouzi Moussa

**Presented by :** Abd El Heq Silem

**Affiliation :** Faculty of Sciences of Tunis,  
LIPAH LR11ES14, University of Tunis El  
Manar

**Email :** [hakou.silem@gmail.com](mailto:hakou.silem@gmail.com)



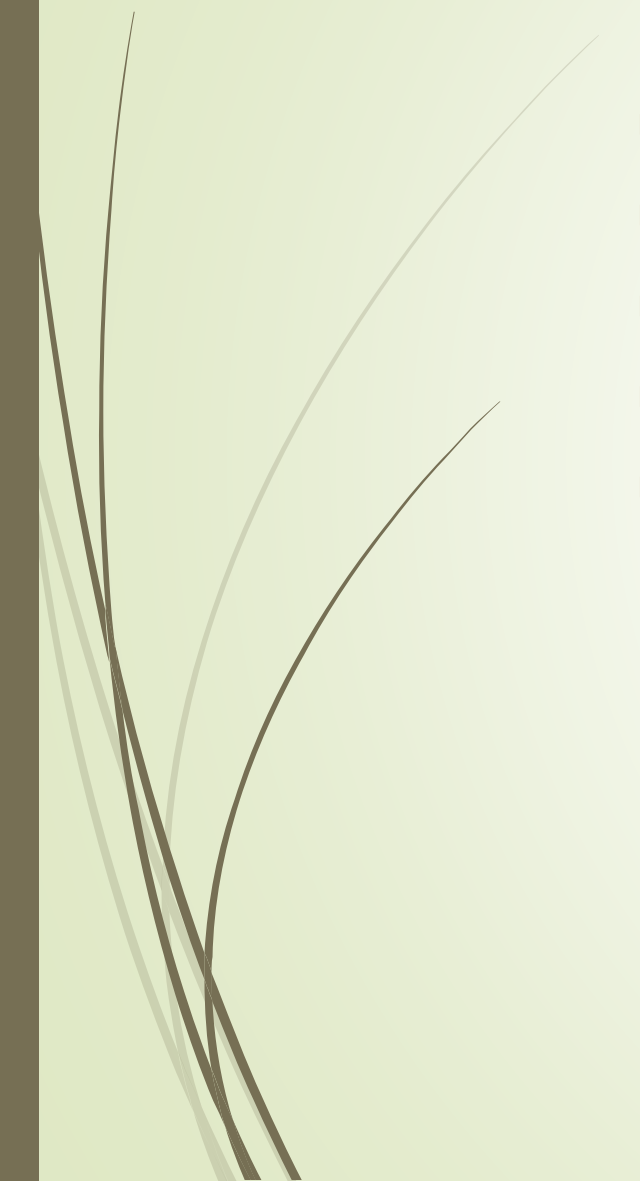
# resume of the presenter

- My name is Silem Abd El Heq, I 'am a PhD student at university of Tunis el Manar.
- I get my master degree in 2017 in the field of distributed architecture (computer science). I have a published paper as a second author in an indexed journal titled : "NorJADE: An Open Source JADE-Based Framework for Programming Normative Multi-Agent Systems".
- Currently, I am working in in the field of context-awareness and personalization systems to get mu PhD.
- Finally, This is my first published paper in this field.





# Plan

- Introduction
  - Related work
  - Fuzzy logic
  - Proposed approach
  - Conclusion
- 



# Introduction



- The exponential growth of information available in the web make the search for specific information very difficult and time consuming.
- The personalization systems has been invented to solve this problem.
- These systems provide relevant information to the user based on his needs.
- The user needs are collected and stored in a database called user profile.
- User profile is a virtual representation of the user that holds variety of user information such us: preferences, interests, enviroments,

# Related works

- ▶ In literature, the researches create the user profile based on
  - ▶ The text retrieved from the visited Web pages (first group)
  - ▶ The text retrieved from the visited Web page and the user behavior in this web page (second group)

First group

Fuzzy logic is a form of many-valued logic in which the truth values of variables may be any real number between 0 and 1

Step1:  
Tokenize  
the text

Fuzzy	Logic	Is	a	form
Of	Many	Valued	Logic	Which
The	Truth	values	Of	variables
may	be	any	real	number
between	0	and	1	

# Related works

Fuzzy	Logic	Is	a	form
Of	Many	Valued	Logic	Which
The	Truth	values	Of	variables
may	be	any	real	number
between	0	and	1	

Step 2:  
Remove  
stop  
words

Fuzzy	Logic			form
		Valued	Logic	
	Truth	values		variables
			real	number
between				

Fuzzy	Logic			form
		Valued	Logic	
	Truth	values		variables
			real	number
between				

Step 3:  
Stem all  
words

Fuzzi	Logic			form
		Valu	Logic	
	Truth	valu		variabl
			real	number

# Related works

Fuzzy logic is a form of many-valued logic in which the truth values of variables may be any real number between 0 and 1

Ste4:  
generate the  
term vector

Term Vector = { (Fuzzi,1), (Logic,2),(Form,1),  
(Valu,2),(Truth,1),(Variabl,1) ,(real,1)  
,(number,1) }

- After the generation of term vector, the approaches will assign a weight to each word based on the occurrence and the position in the document (website).
- The resulted weights will be used to update the user profile
- As a disadvantage, This group of approaches does not differentiate between interesting and uninteresting websites which generate many wrong interests when the user visits uninteresting websites

# Related works

## Second group

Perform all the steps of the first group, then uses the user behavior to calculate a unit score and add it to the weight of each word

The user behavior (factors) such as : bookmarking, copying, scrolling speed , time spent

Discrete variable

continuous variables

Add a unit score X to the calculated weight

Calculate the weight of the captured values with fixed ranges (if  $a < \text{scrolling speed} < b$  then X)





# Related works

Term Vector = { (Fuzzi,1+X<sub>1</sub>), (Logic,2+ X<sub>2</sub>), (Form, 1+X<sub>3</sub>), (Valu, X<sub>4</sub>), (Truth, X<sub>5</sub>), (Variabl,1+ X<sub>6</sub>), (real,1+ X<sub>7</sub>), (number,1+ X<sub>8</sub>) } + User Behavior



Term Vector = { (Fuzzi,1+X<sub>1</sub>), (Logic,2+ X<sub>2</sub>), (Form, 1+X<sub>3</sub>), (Valu,2+ X<sub>4</sub>), (Truth, X<sub>5</sub>), (Variabl,1+ X<sub>6</sub>), (real,1+ X<sub>7</sub>), (number,1+ X<sub>8</sub>)+ Y }

Disadvantage:

The second group of approaches, solve the problem of the previous one. But the evaluation of user behavior (use fixed ranges) is not accurate to all users.



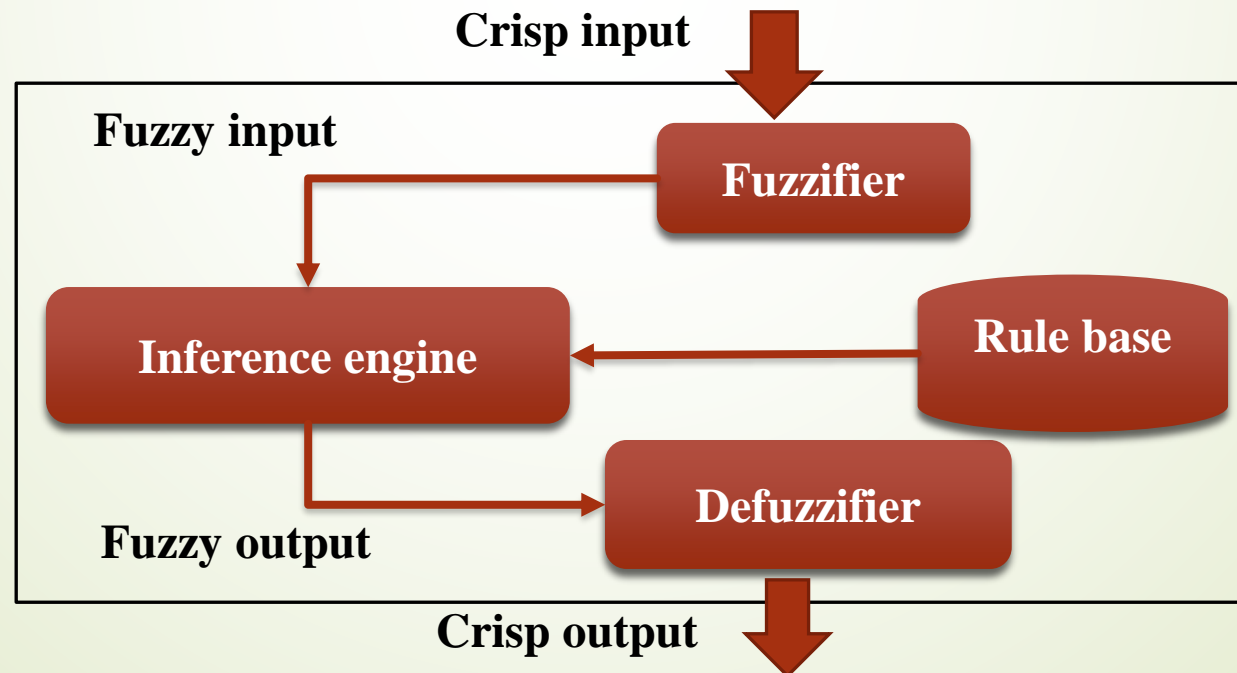
# Fuzzy logic



- Fuzzy logic belongs to many-valued logic.
- the fuzzy logic represents the situation with a continuous value from 0 to 1 unlike the binary logic that represent the situation with 0 or 1.
- The fuzzy logic give the computer the ability to represent the human unclear idea.
- For example: when describing a room brightness using binary logic, we can only represent two situation where the room is dark or bright (0 or 1).
- With fuzzy logic we can represent the degree of light and say little bright (0.6), little dark (0.4), very dark (0), very bright (1).

# Proposed approach

- In this paper, we propose an approach that predict the user interest in the content of a Web page based on three factors are : scrolling speed, Time spent, and number of visits.
- The proposed approach is based on the fuzzy logic
- This approach has three main steps are: fuzzification, inference and defuzzification (see figure below)

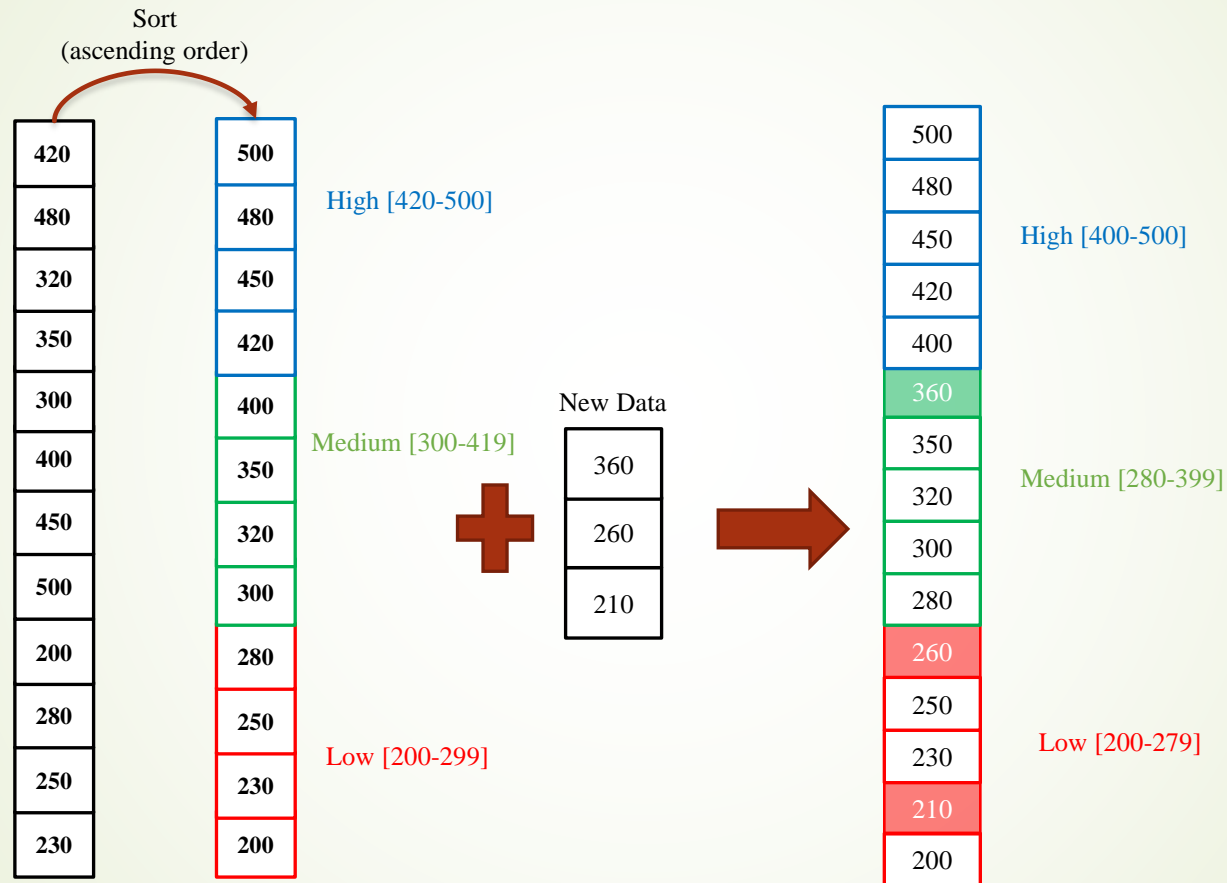


# Proposed approach

## ➤ Fuzzification phase:

- The fuzzification phase is the first phase of the approach. It transform a crisp value to a fuzzy set.
- The fuzzy sets are sets that contains factor values (crisp values) with the same interpretation
- This process adapts the user ranges according to his habits as follow:
  - First the approach collects information about the user (the values of the factor “scrolling speed” in this case). Then, sort all the collected data in ascending order, Finally calculate the initial ranges.
  - When a new data is captured: the approach sort this new data with the old ones in ascending order and recalculate the ranges.
- The figure in the next diapositive explain the whole process of fuzzification

# Proposed approach



# Proposed approach

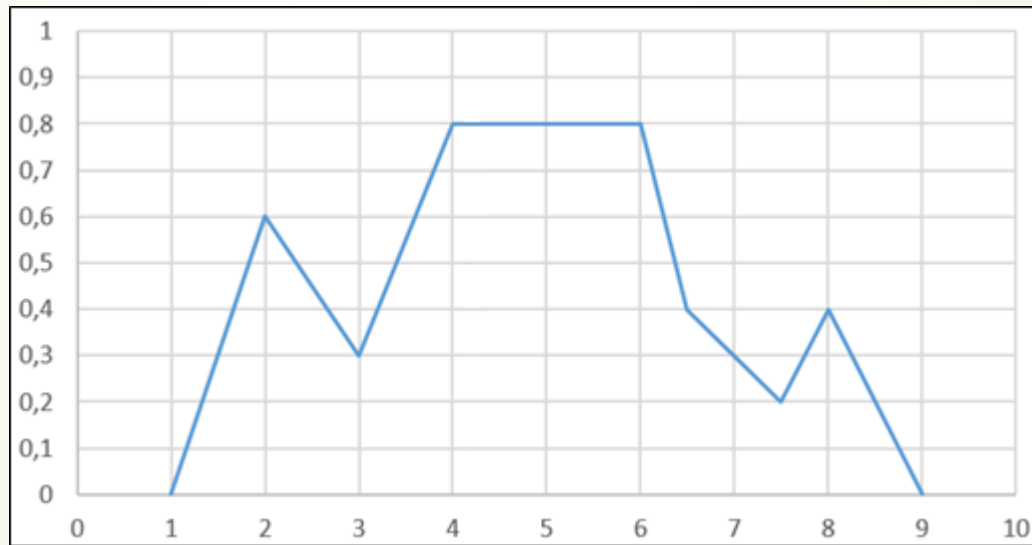
## Inference phase

- ▶ The Inference Engine is the core of the Fuzzy Logic system responsible for the calculation of one fuzzy output from a set of fuzzy inputs (fuzzy inputs calculated in the fuzzification phase).
  - ▶ The inference engine is composed of a set of rules as follows :  
**IF** *input1 is A* **AND** *input2 is B* **AND** *input3 is C* **THEN** *output is D*
  - ▶ Some of the rules used in our Fuzzy logic system :
    - **IF** SC is High **AND** TS is High **AND** NV is High **THEN** User is Interesting
    - **IF** SC is High **AND** TS is Low **AND** NV is Medium **THEN** User is Likely Interesting
    - **IF** SC is Medium **AND** TS is Medium **AND** NV is Medium **THEN** User is Likely Interesting
    - **IF** SC is Low **AND** TS is Low **AND** NV is Low **THEN** User is Uninteresting
- Where SC → Scrolling speed, TS → Time Spent, NV → number of visits.

# Proposed approach

## Inference phase

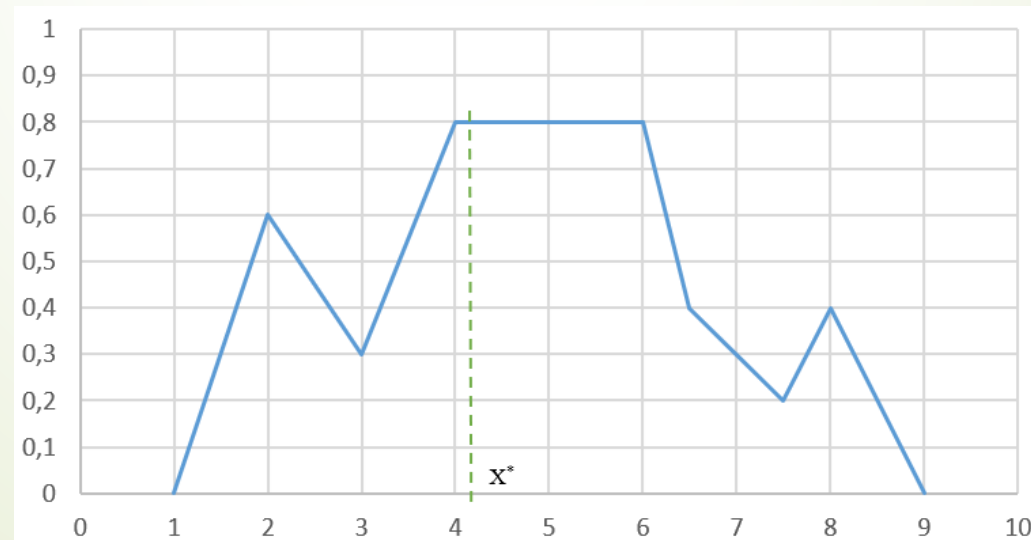
- The out of this phase (fuzzy output) is the aggregation of the results of all rules.
- the figure below represent a fuzzy output .



# Proposed approach

## Defuzzification phase

- ▶ The defuzzification process is the inverse of the fuzzification process.
- ▶ In this phase, the approach transform the fuzzy output (the output of the inference phase) into a crisp output that can be used by other applications.
- ▶ The defuzzification is performed based on a decision-making algorithm called Center Of Gravity (COG), this function return the center of the fuzzy output area (see the figure).





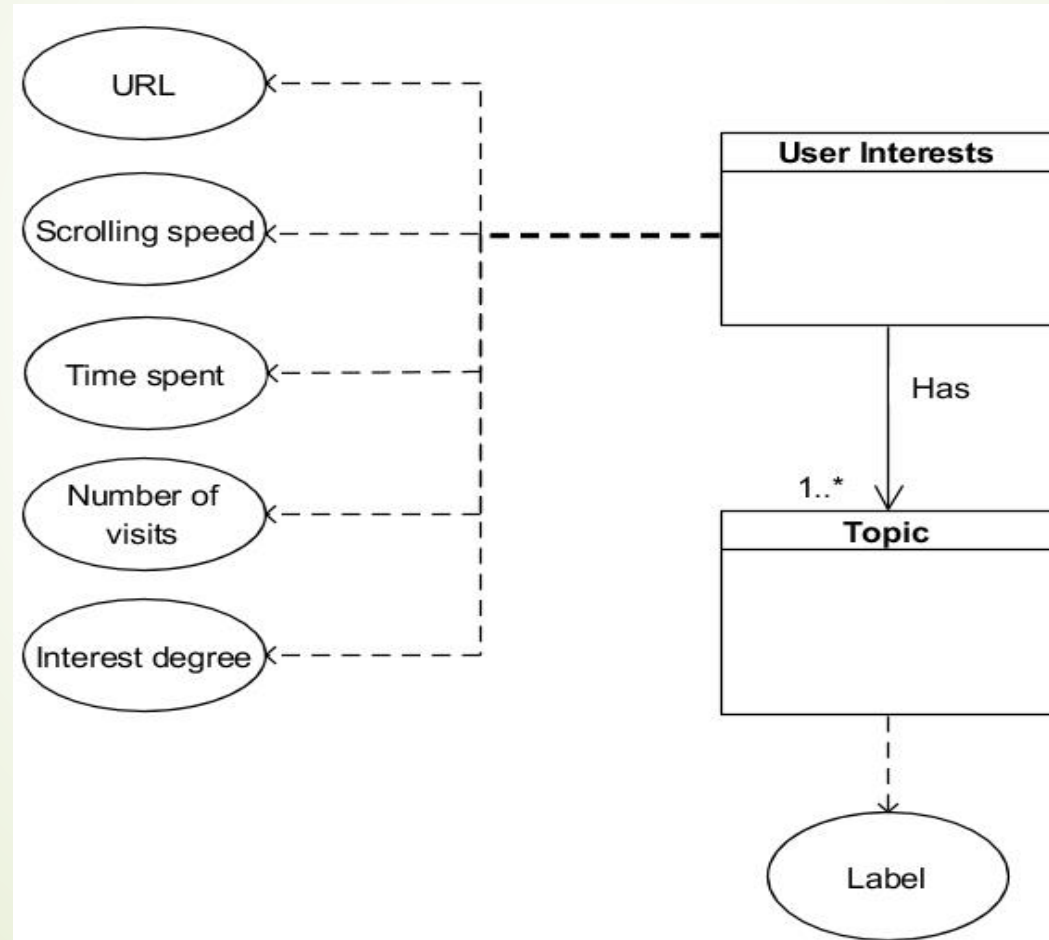
# Proposed approach

## User profile

- ▶ In this paper, we use the ontology-based model to represent and store the user profile.
- ▶ This profile contain the user interesting topics with the interest degree. It has two main classes are:
  - ▶ User Interests: contain user interest websites. This class has five attributes: URL of the website, scrolling speed, time spent, number of visits, interest degree calculated by our approach.
  - ▶ Topic: represents the topic of the website. This class has only one attribute “Label” that represents the name of the topic (e.g., machine learning, sport).
- ▶ The user profile is created manually using protégé (for the first time).

# Proposed approach

User profile



# Proposed approach

## User profile

- ▶ The approach update the user profile every time a new web site arrives (the user browse a website) as follow:
  - ▶ If the website already exist in the user profile.
    - ▶ Update all attributes (the scrolling speed, time spent, number of visits, and interest degree) with the average between the new and the old values (number of visits are rounded).
  - ▶ Else (the website does not exist in the user profile)
    - ▶ Add the new website with all attribute to the user profile.



# Conclusion



- ▶ The user profile contains information about the user that helps the customization systems to provide data or service to the user's needs
- ▶ we propose a new approach to automatically construct and update the user profile using a Fuzzy Logic system.
- ▶ This approach uses three factors are scrolling speed, time spent, and number of visits
- ▶ The approach solves the problems presented in the literature (factor weight misinterpretation and the generation of false interests)



Thank you for your  
attention