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APPLICATION OF FUZZY LOGIC FOR THE GUIDANCE OF COMPUTER SCIENCE STUDENTS

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ABSTRACT

This research aims to better orient computer science students for the choice of the valid option in computer science, using the theory of fuzzy logic. This aims to overcome the problem of ambiguity and uncertainty. First we will present the curriculum of computer scientists after obtaining the baccalaureate and the criteria used which are presence, revision and concentration. Second we will present the theory of fuzzy logic and its stages then we have established the fuzzification of the cited criteria, then the fuzzy rules and after that we have performed the defuzzification. Finally, in order to guide the student specializing in computer science in their best option choices, the three criteria chosen must be excellent and high.

Keywords: orientation, fuzzy logic, computer science, presence, concentration, revision.

INTRODUCTION

It's hard to imagine a world without computers. Today it is omnipresent: In cars, in planes, in houses, in administrations and in banks… etc. computers and information technologies are already an integral part of our lives.

Computer science is considered by many practitioners as a discipline linked to technology and science, as a technology, it is responsible for the design and maintenance of software, as a science, it deploys a set of theories, formal methods and tools that ensure the development of technology [1].

The orientation or the right choice of option for a computer scientist is a crucial step in the school curriculum of every student, computer scientists more precisely, especially in the months preceding the exams of the preparatory classes [2].

A successful orientation must allow each student to exploit their full potential and to integrate professionally. The best career decision is not based on grade averages but on several other criteria.

There are several options in IT including several types of IT engineers:

- IT development of applications or software
- Natural referencing or SEO
- Web design
- Computer systems administration
- Computer network management
- IT project management
- IT maintenance
- IT security
- Big data

We can classify computer science in three main areas mentioned in the table below:

Table-1. It domains and applications [3].

IT domains	Applications
Management and technicalcomputing	It applies to the organization of information in the company: company administration, commercial management, human resources, but also invoicing, inventory and order management ...
Scientific computing	It applies to calculation in the field of exact sciences, to modeling, to tests, to fundamental research, to real-time computing ...
Industrial computing	It covers the field of software applications, intended for the management of production chains and industrial products, simulation and human-machine interfaces.

In light of the above, how can we implement fuzzy logic to help guidance counselors in universities, schools and training centers to better guide and orient students before starting their specialty course in computer science?

METHODOLOGY

In this part we will discuss the fuzzy logic method the authors who used it as well as its steps, then in the case study we will apply the following methodology:

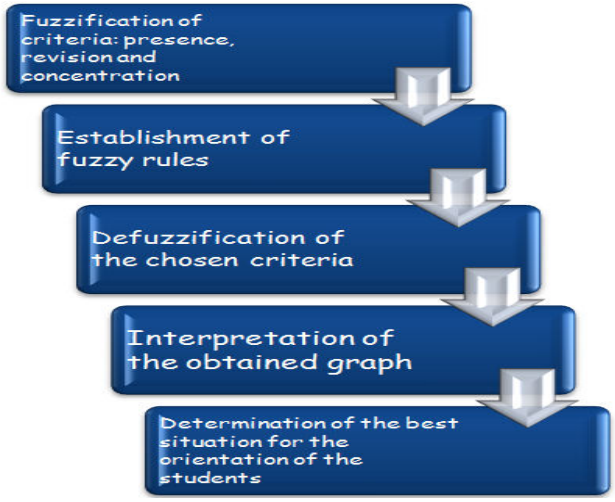

Figure-1. Methodology followed for this research.

RESULTS

A. Fuzzy Logic

Zadeh [4] introduced the theory of fuzzy logic which was able to resolve and give a simple conclusion in the face of uncertainty, ambiguity, imprecision in human thought.

Fuzzy logic has been used in several researches in various fields: Kim *et al*. [5] use fuzzy logic in application for the vehicle classification Algorithm in Loop. Dash *et al*. [6] use fuzzy logic for trend classification for fault diagnosis of chemical processes. Tseng [7] used fuzzy logic and neural networks for Internet. Waris [8] used fuzzy logic in academic setup. Machado *et al*. [9] used fuzzy logic in application in virtual education.

The architecture of the fuzzy logic system is shown in the diagram below:

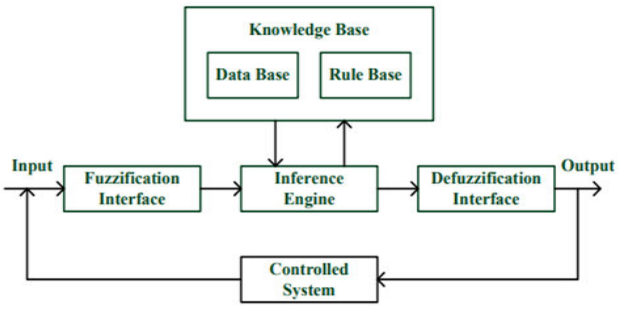

Figure-2. Architecture of fuzzy logic control [10].

According to Bouzoubaa *et al*. [11] and Hayat *et al*. [12] and the structure of a Fuzzy Logic System:

- **Fuzzification:** consists in defining the membership functions of all variables and Converting physical parameters into linguistic variables.
- **Rule Base:** this is where we define and we construct the important rules that link values of linguistic variables together to get results.
- **Inference:** it is the clear indication between inputs and outputs which are linguistic variables, based on the construction rules.
- **Defuzzification:** consists of the linguistic change into numerical value of different variables characterizing the overall efficiency.

We're going to use the center of gravity method.

B. Case Study

Presentation of criteria

Phase 1: The presence of the student in the class is important and his presence not only bodily but also intellectual and also that he notes his course, therefore we consider the criterion of presence.

Phase 2: The student reviews well and assimilates his course well and notes the main questions he will ask the teacher in case of misunderstanding, therefore we consider the criterion of revision

Phase 3: The student concentrates during the exam; therefore we consider the criterion of concentration.

Phase 4: This is the final phase in which the student passes or the grade he will receive in this exam before being oriented towards management informatics or scientific informatics.

Fuzzification of criteria

a) Fuzzification for presence

The table below shows the fuzzification for presence:

Table-2. Range for presence.

Fuzzy	Variable	Range
1	low	0-50
2	Medium	40-75
3	High	70-100

The Figure-3 below shows the membership function was used for presence.

b) Fuzzification for revision

The table below shows the fuzzification for revision:

Table-3. Range for revision.

Fuzzy	Variable	Range
1	low	0-55
2	Medium	45-75
3	High	70-100

The Figure-4 below shows the membership function was used for revision.

c) Fuzzification for concentration

The table below shows the fuzzification for concentration and in Figure-5.

Table-4. Range for concentration.

Fuzzy	Variable	Range
1	low	0-45
2	Medium	40-70
3	High	65-100

d) Fuzzification for orientation

The table below shows the fuzzification for orientation:

Table-5. Range for orientation.

Fuzzy	Variable	Range
1	Bad	0-55
2	Average	50-75
3	Good	70-100

The figure below shows the membership function was used fororientation and in Figure-6.

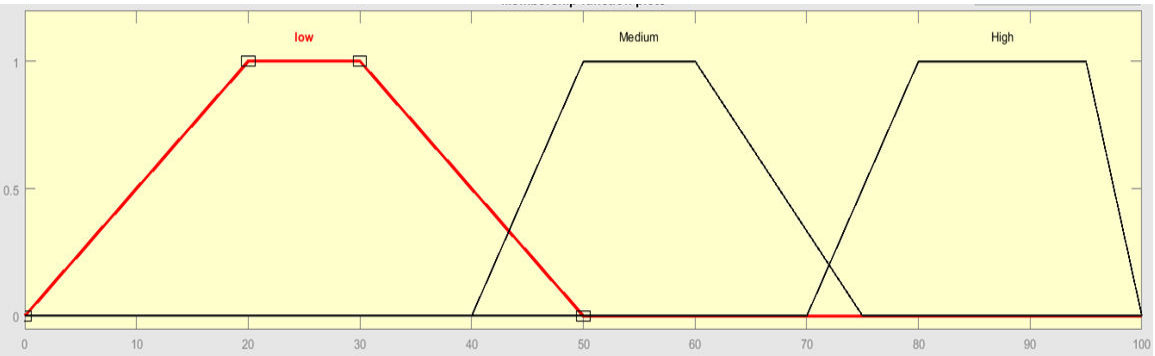

Figure-3. The membership function for presence.

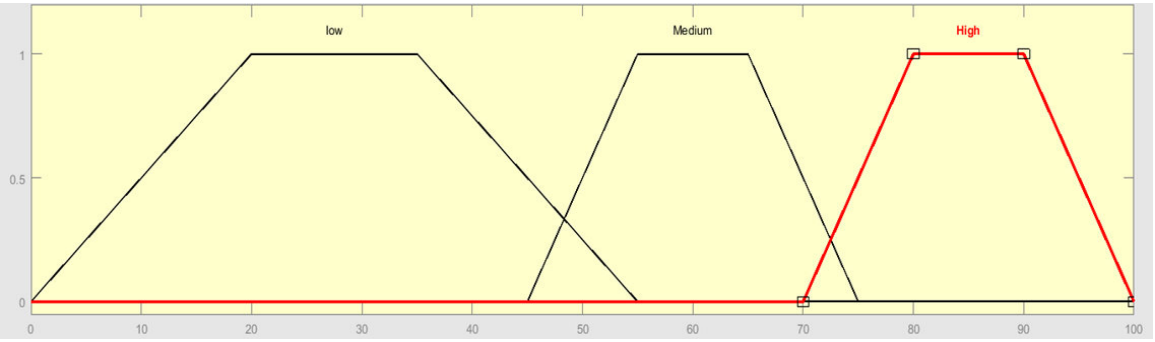

Figure-4. The membership function for revision.

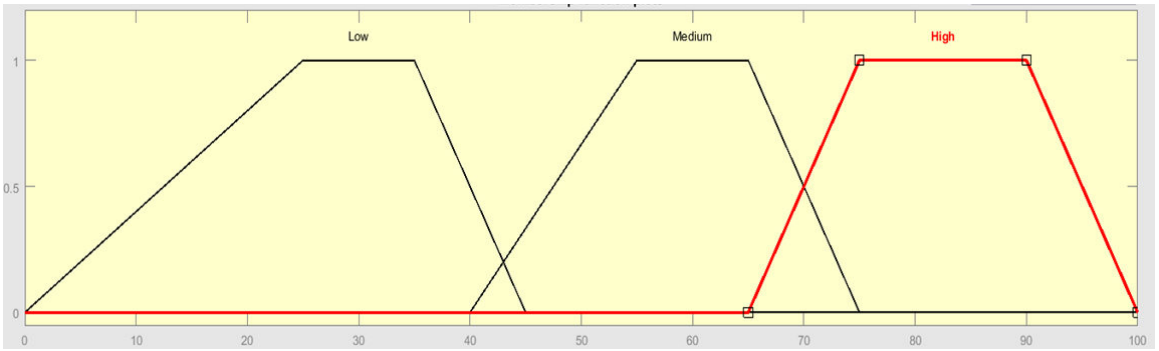

Figure-5. The membership function for concentration.

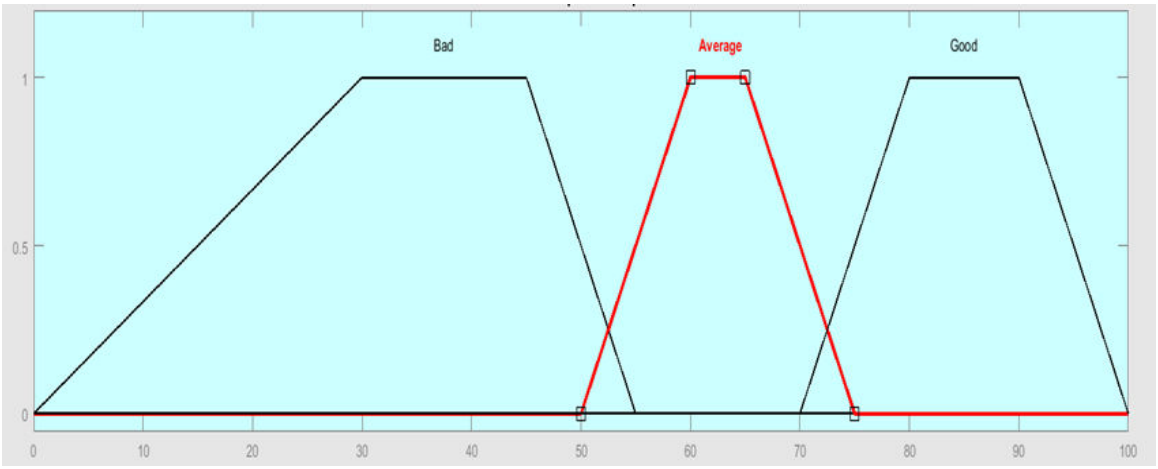

Figure-6. The membership function for orientation.

The rule base and inference of criteria

We construct Fuzzy Rule when Phase 3: Concentration is low.

The table below shows the fuzzy rule when Phase3 is low; "P1" is the abbreviation of Phase1 and "P2" is the abbreviation of Phase2 in the table.

Table-6. Fuzzy rule when phase 3 is low.

P2 \ P1	Low	Medium	High
Low	Bad	Bad	Bad
Medium	Bad	Bad	Bad
High	Bad	Bad	Average

We construct Fuzzy Rule when Phase3 is Medium

The table below shows the Fuzzy Rule when Phase 3 is Medium; "P1" is the abbreviation of Phase 1 and "P2" is the abbreviation of Phase 2 in the table.

Table-7. Fuzzy rule when phase 3 is medium.

P2 \ P1	Low	Medium	High
Low	Bad	Bad	Bad
Medium	Average	Average	Average
High	Average	Average	Average

We construct Fuzzy Rule when Phase3 is High.

The table below shows the fuzzy rule when Phase3 is High; "P1" is the abbreviation of Phase1 and "P2" is the abbreviation of Phase2 in the table.

Table-8. Fuzzy rule when phase 3 is high.

P2 \ P1	Low	Medium	High
Low	Bad	Average	Average
Medium	Bad	Average	Average
High	Average	Average	Good

We get 27 rules as shown by the Matlab software in figure.

1. If (présence is low) and (Révision is low) and (Concentration is Low) then (Orientation is Bad) (1)
2. If (présence is Medium) and (Révision is low) and (Concentration is Low) then (Orientation is Bad) (1)
3. If (présence is High) and (Révision is low) and (Concentration is Low) then (Orientation is Bad) (1)
4. If (présence is low) and (Révision is Medium) and (Concentration is Low) then (Orientation is Bad) (1)
5. If (présence is Medium) and (Révision is Medium) and (Concentration is Low) then (Orientation is Bad) (1)
6. If (présence is High) and (Révision is Medium) and (Concentration is Low) then (Orientation is Bad) (1)
7. If (présence is low) and (Révision is High) and (Concentration is Low) then (Orientation is Bad) (1)
8. If (présence is Medium) and (Révision is High) and (Concentration is Low) then (Orientation is Bad) (1)
9. If (présence is High) and (Révision is High) and (Concentration is Low) then (Orientation is Average) (1)
10. If (présence is low) and (Révision is low) and (Concentration is Medium) then (Orientation is Bad) (1)
11. If (présence is Medium) and (Révision is low) and (Concentration is Medium) then (Orientation is Bad) (1)
12. If (présence is High) and (Révision is low) and (Concentration is Medium) then (Orientation is Bad) (1)
13. If (présence is low) and (Révision is Medium) and (Concentration is Medium) then (Orientation is Average) (1)
14. If (présence is Medium) and (Révision is Medium) and (Concentration is Medium) then (Orientation is Average) (1)
15. If (présence is High) and (Révision is Medium) and (Concentration is Medium) then (Orientation is Average) (1)
16. If (présence is low) and (Révision is High) and (Concentration is Medium) then (Orientation is Average) (1)
17. If (présence is Medium) and (Révision is High) and (Concentration is Medium) then (Orientation is Average) (1)
18. If (présence is High) and (Révision is High) and (Concentration is Medium) then (Orientation is Average) (1)
19. If (présence is low) and (Révision is low) and (Concentration is High) then (Orientation is Bad) (1)
20. If (présence is Medium) and (Révision is low) and (Concentration is High) then (Orientation is Average) (1)
21. If (présence is High) and (Révision is low) and (Concentration is High) then (Orientation is Average) (1)
22. If (présence is low) and (Révision is Medium) and (Concentration is High) then (Orientation is Bad) (1)
23. If (présence is Medium) and (Révision is Medium) and (Concentration is High) then (Orientation is Average) (1)
24. If (présence is High) and (Révision is Medium) and (Concentration is High) then (Orientation is Average) (1)
25. If (présence is low) and (Révision is High) and (Concentration is High) then (Orientation is Average) (1)
26. If (présence is Medium) and (Révision is High) and (Concentration is High) then (Orientation is Average) (1)
27. If (présence is High) and (Révision is High) and (Concentration is High) then (Orientation is Good) (1)

Figure-7. 27 rules.

DISCUSSIONS

We will begin the study and interpretation of the graphs, after defuzzification, while taking into account the orientation of the students according to the three criteria chosen in this piece of research which are: the criteria: "Phase1", the criterion: "Phase2" and finally the criterion: "Phase3"

Important special cases that can be treated:

Case 1: One indicator is fixed and two indicators are changed

Case 2: Two indicators are fixed and one indicator is changed.

a) One indicator is fixed and two are changed

Example 1:

- One indicator is fixed: "Phase1"presence as medium 60
- Two are changed: "Phase2" and "Phase3"

We will analyze the reaction of our system if we give a medium value to the "Phase1" indicator presence (60). We will see how the "Orientation" indicator output will vary according to the two remaining inputs which are "Phase2" and "Phase3" and how they impact it.

The figure below shows the Surface viewers of example N°1:

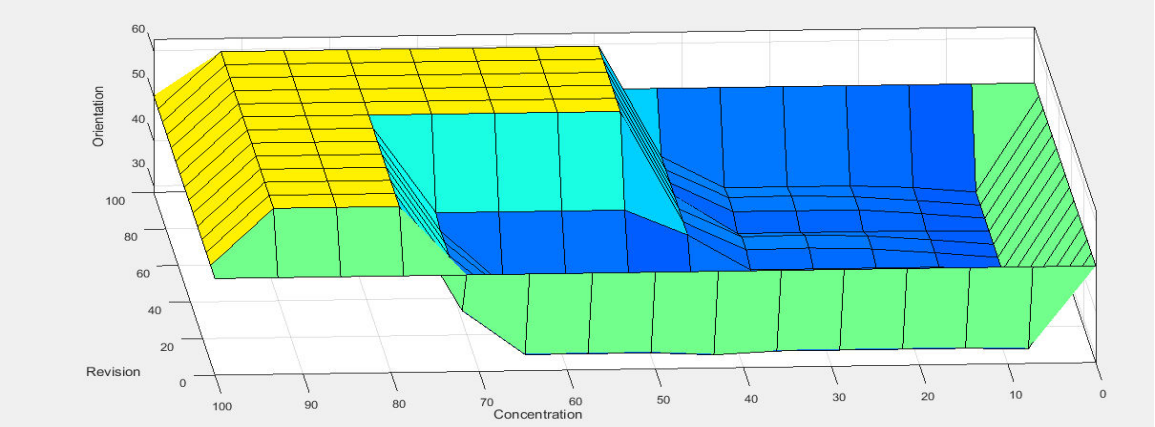

Figure-8. The Surface viewers of example N°1.

Discuss curve of the example N°1:

The curve above shows that we can see the three results of the orientation: The first result which is bad Orientation is where:

- The first area: Concentration is between [0.55] and the revision can be [0.35]
- The second surface: Concentration is between [0.35] and the revision can take any value

The second situation is the case where the "Orientation" is Average:

- Concentration is between [80, 100] and the revision can be [0, 60]
- Concentration is between [50, 80] and the revision can be [60, 100]

As we can see from the figure below: When setting the presence criterion at the value 60, the orientation always remains average regardless of the values of the revision and the concentration,

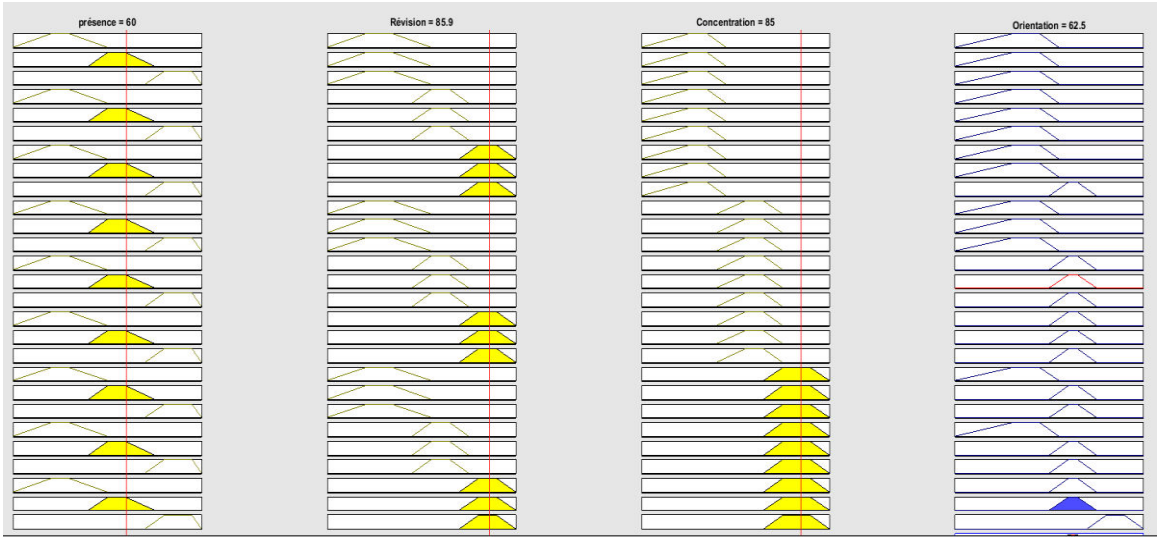

Figure-9. Rules View for “Orientation”.

Example 2:

- One indicator is fixed: “Phase2” (revision) as Medium(70 ou 50)
- Two are changed: “Phase1” and “Phase3“

We will analyze the reaction of our system if we give a Mediumvalue to the "Phase2" indicator (60). We will see how the "Orientation" indicator output will vary according to the two remaining inputs which are "Phase1" and "Phase3" and how they impact it.

The figure below shows the Surface viewers of example N°2:

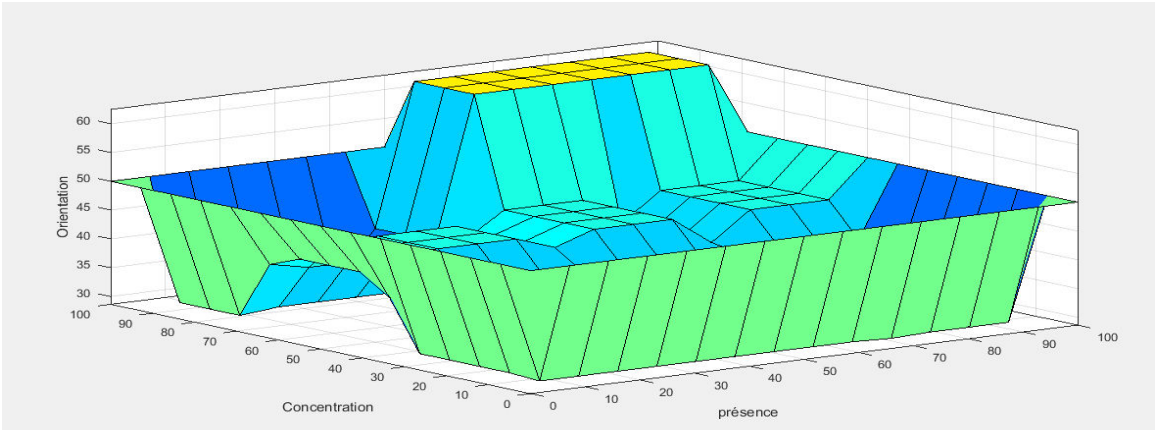

Figure-10. The Surface viewers of example N°2.

Discuss curve of the example N ° 2:

The curve above shows that we can see the two results of the Orientation:

- The first result which is bad Orientation is where Concentration in the interval [0.100] and presence is in the interval [0, 30] or the Concentration [0.50] and presence [30, 100]

- The second situation is the case where the Orientation is Average: is where Concentration [78, 100] and presence [50, 100]

When setting the revision to the value 60, the orientation always remains average regardless of the presence and concentration values in the figure below.

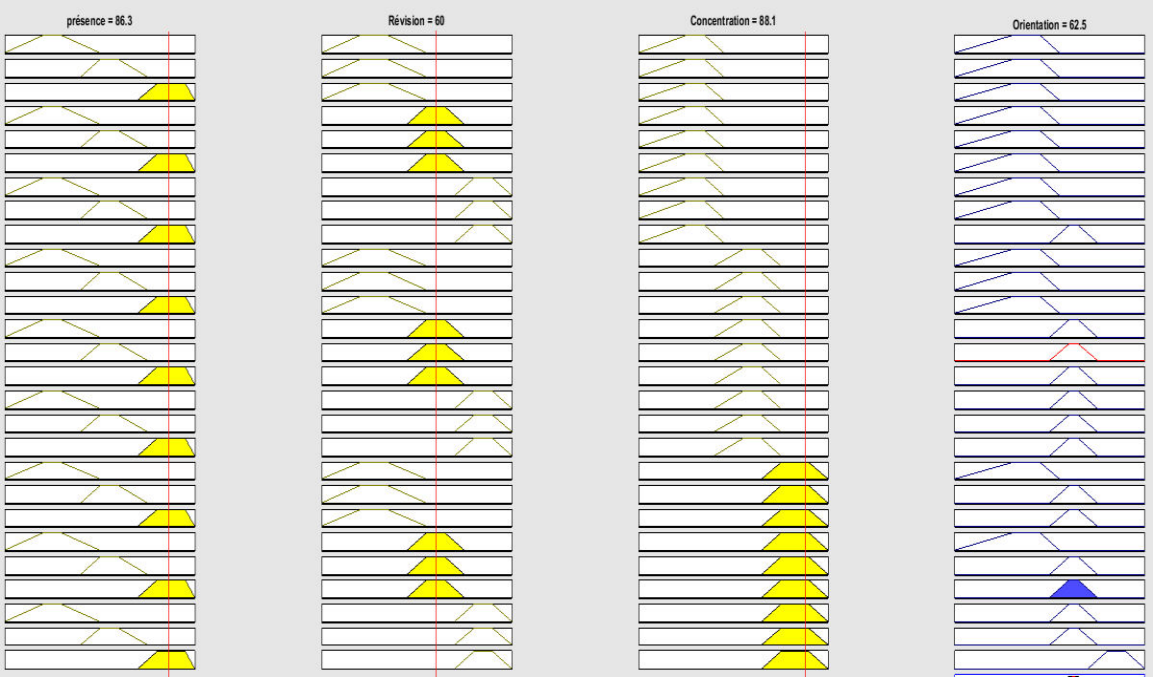

Figure-11. Rules View for "Orientation.

Example 3:

One indicator is fixed: "Phase3" concentration as Mediumat 60

Two are changed: "Phase 1" and "Phase 2"

We will analyze the reaction of our system if we give a Mediumvalue to the "Phase3" indicator (60). We will see how the "Orientation" indicator output will vary according to the two remaining inputs which are "Phase 1" and "Phase 2"and how they impact it.

The figure below shows the Surface viewers of example N°3:

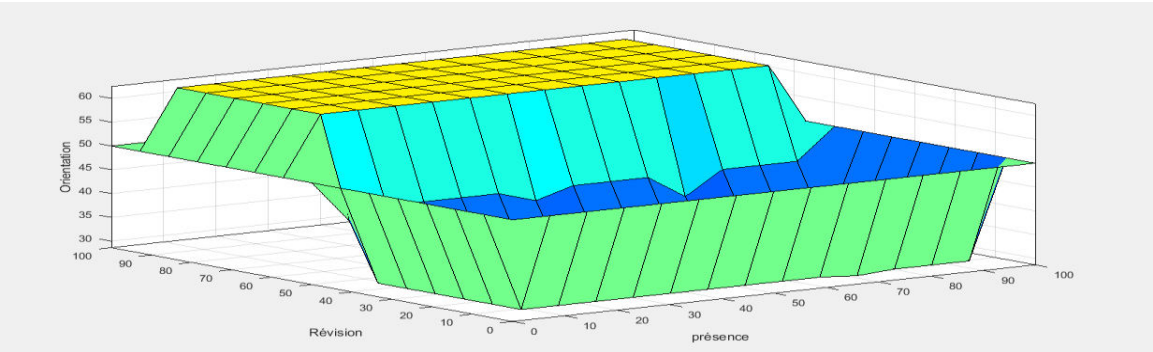

Figure-12. The Surface viewers of example N°3.

Discuss curve of the example N ° 3:

The curve above shows that we can see the three results of the Orientation:

- The first result which is bad Orientation is where Revision [0.55] and whatever the value of the presence
- The second situation is the case where the "Orientation" criterion is Average. This situation is characterized by the fact that la revision [55, 100] and whatever the value of the presence.

When setting the concentration to the value 60, the orientation always remains average regardless of the presence and revision values as shown in the figure below:

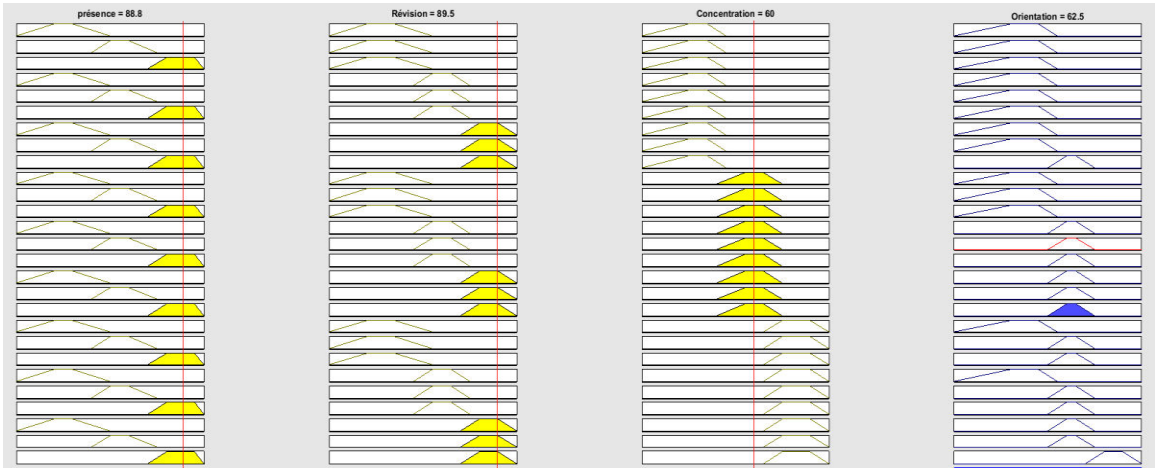

Figure-13. Rules View for "Orientation"

b) Two indicators are fixed and one is changed

Example 4

We set the criterion of Phase 1: Presence and the criterion of Phase 2: Revision at the value 70.

The table below shows the change of orientation with orientation:

Table-9. The change of orientation with phase 3 (concentration).

Phase 3 (Concentration)	Orientation
1	27,6
10	29,1
20	29,1
30	29,1
40	29,1
50	62,5
60	62,5
70	62,5
80	62,5
90	62,5
95	62,5

The figure below shows the change of orientation with Phase 3 (concentration)

Figure-14. The curve of the example N° 4

Discuss the curve of the example N ° 4

We have three stages:

- Initially, the value of the "Orientation" is fixed at 27.6 despite the fact that the parameter: Concentration increases linearly.
- Then the value of the Orientation also increases linearly between the interval [30- 62] with the Concentration.
- The value of the Orientation remains fixed again at the value 62.5 despite the linear increase in Concentration.

Example 5:

We Set the Criterion of "Phase 1" (Presence) and the Criterion Of "Phase 3" (Concentration) At the Value 70.

The Table Below Shows the Change of Orientation with Revision,

Table-10. The change of orientation with phase 2 (revision).

Phase 2 (revision)	Orientation
1	37,7
10	39,1
20	39,1
30	39,1
40	31,1
50	40,7
60	62,5
70	62,5
80	62,5
90	62,5
95	62,5

The figure below shows the change of orientation with revision

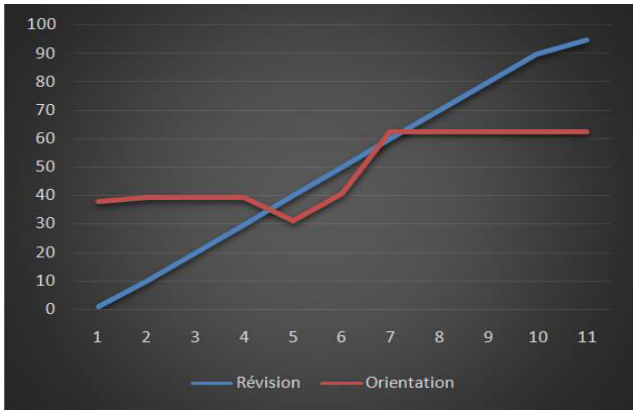

Figure-15. The curve of the example N° 5.

Discuss the curve of the example N°5

- Initially, the value of the "Orientation" increases in [37, 7- 39, 1] despite the fact that the parameter: revision increases linearly.
- Then the value of the Orientation decreases linearly at 31, 1 with the increase of the Concentration.
- The value of the Orientation increases in [40, 7- 62, 5] with the linear increase of Concentration.
- The value of the Orientation is fixed at 62, 5 with the linear increase of Concentration.

Example 6

We set the criterion of "Phase 2" and the criterion of "Phase 3" at the value 70.

The table below shows the change of orientation with presence:

Table-11. The change of orientation with phase 1 (presence).

Phase 1 presence)	Orientation
1	37,6
10	39,3
20	39,6
30	39,6
40	39,6
50	62,5
60	62,5
70	62,5
80	62,5
90	62,5
95	62,5

The figure below shows the change of orientation with presence:

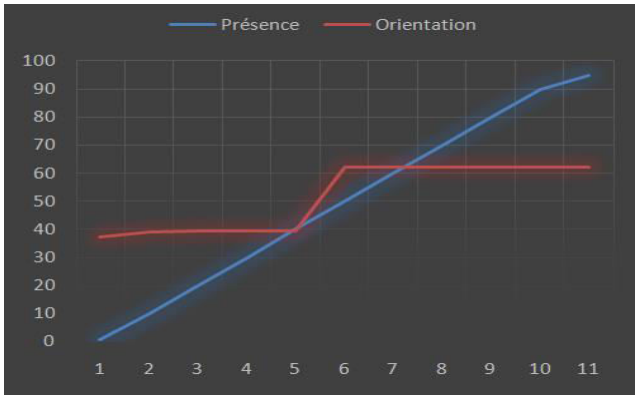

Figure-16. The curve of the example N° 6.

Discuss the curve of the example N°6:

- Initially, the value of the "Orientation" increases in [37, 6 -39, 6] despite the fact that the parameter: presence increases linearly.
- The value of the "Orientation" increases in [39, 6-62, 5] despite the fact that the parameter: presence increases linearly.
- The value of the "Orientation" is fixed at 62, 5 despite the fact that the parameter: presence increases linearly.

Example of a sample made with Matlab for students:

Table-12. Orientation of students.

Student	Phase 1 presence	Phase 2 Revision	Phase 3 Concentration	Orientation
Student 1	40	30	80	30,5
Student 2	10	20	60	29,4
Student 3	90	10	30	29,8
Student 4	80	70	60	62,5
Student 5	50	50	50	43,5
Student 6	60	40	80	62,5
Student 7	20	80	60	62,5
Student 8	30	60	70	39,6
Student 9	80	80	80	85
Student 10	80	80	70	75,1
Student 11	90	90	90	85

Comment: we have a sample of several students; we notice that the orientation is high when the three criteria (phase 1, phase 2 or phase 3) were high

While for other students this is not the case

CONCLUSIONS

For orientation to be better all three criteria must be high at the same time!

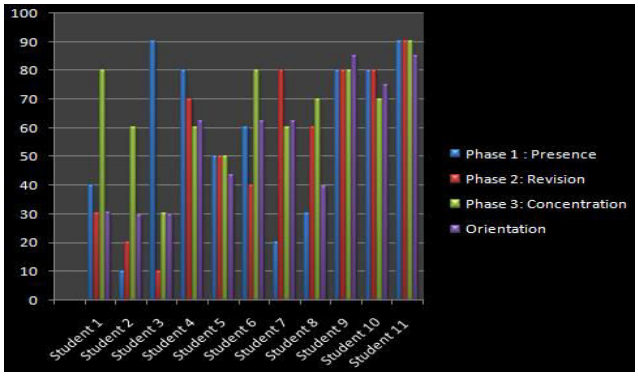

Figure-17. Orientation of students.

We have proposed an artificial intelligence method which is fuzzy logic to get the best orientation of the right option with the computer science student.

First after having determined the course of a student of computer science and in order to avoid the misorientation for the choice of option, we specified the entries or the criteria chosen which are the presence, the revision and the concentration and the exit which the orientation setting.

Second after having determined the fuzzification, the defuzzification the fuzzy rules, we went through two main situations:

First, by setting a single criterion, it was not possible to obtain a favorable result; and even after having fixed two criteria it was not possible to obtain a favorable result.

It is by seeing the graph of the students that one concludes that the Best orientation is obtained that the three criteria are imperatively excellent or high.

Ultimately fuzzy logic allowed us to achieve the desired results while overcoming the problem of uncertainty and ambiguity.

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