# APPLICATION OF FUZZY THEORY IN UNIVERSITY MANAGEMENT SYSTEM

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**Key Words:**
University Information System, student subsystem, university library subsystem, fuzzy logic, fuzzy query processing

## Abstraction

Information plays an important role in University Management. Information System is an intrinsic component of an University. In this paper the characteristics and functions of University Information System (UIS) are discussed. Some functional subsystems of UIS are examined. UIS uses and processes information, which may be uncertainly, or imprecisely. In order to process and estimate this type information the methods of Fuzzy Logic are used. Application of Fuzzy Logic for solving some problems of the UIS is discussed., also.

## Introduction

Information plays an important role in University Management. An intrinsic component of an University is Information System. The University Information System collects, stores, processes and creates information. How does the UIS use information? What does UIS work with information which has imprecise, or uncertain properties? In this paper we attempt to answer these questions.

In section 1, some aspects of the UIS presented. The topic of the section 2 is the basic terms of Fuzzy Logic and its application for solving some problems of the UIS. In next sections, some systems of the UIS are discussed.

## 1. What is University Information System?

University Information System is one of organizational units of University. UIS helps to make important decisions to achieve to the management's goals, which are high quality education, seriously scientific results and etc.

UIS consists of human, information, software and hardware recourses. UIS provides logical and information relations between organizational units of an University.

Some properties of UIS are followings:

- As any large system, UIS has complex structure and it may be presented as the set of the subsystems. Every subsystem has owns local goals, owns functions and they work with owns information, generally. But each subsystem is related to the others with horizontal or vertical associations.
- The properties of the tasks, the solving algorithms distinct for different subsystems. And they require distinct software and hardware supports.
- For many information system (for example, a manufacture information systems) it is not difficult to express and evaluate general goals and strategies by certain , numeric variables. But we cannot say same thinks about UIS, which the main goals (high quality, high scientific research, activity in social and cultural fields etc.) are presented with linguistic variables, in generally. And estimating of the University activity with only mathematical formulas are not effectively, and sometimes may be impossible, so far as UIS goals has imprecision, uncertain properties.
- There are different users views to same problems in UIS. For example, users of Student Subsystem are students, professors, secretary of a faculty, dean, student officers… Every user needs to access the same data. But what information may be used by what users must be certainly defined.

Main functions of the UIS and its relation with organizational units of an University are presented in Figure 1.

## 2. Fuzzy Logic and its applications in UIS.

Traditional mathematic logic requires precision - on/off, yes/no, right/wrong. But in real life we meet many situations, presentation of traditional mathematic with only single value is not effectively, or even possible. For example, we might all agree that men with 20 age are young and men with 80 are old. But is 35 years old or young? There is not the exact answer. The answer depends on many factors , for examples on a fields, where we use the term "young". Many of our activities are also non-exact.

Fuzzy logic was proposed in 1965 by Lotfi Zadeh at the University of California, Berkeley. Fuzzy Logic allows us to work with imprecision and even to use it to solve problems we could not have solved with traditional methods. Fuzzy Logic consists of a variety of concepts and techniques for representing and inferring information that is imprecise, uncertain, or unreliable.

Fuzzy Logic representations capture the way humans represent and reason with real world knowledge. Fuzzy sets deal with subsets of the universe that have no well-defined boundaries. Members of fuzzy sets can have varying degrees of membership ranging between 0 and 1. Back to owe example, we can say surely that value 20 has membership degree 1 in the fuzzy set "young". But value 35 has membership degree between the 0 and 1.

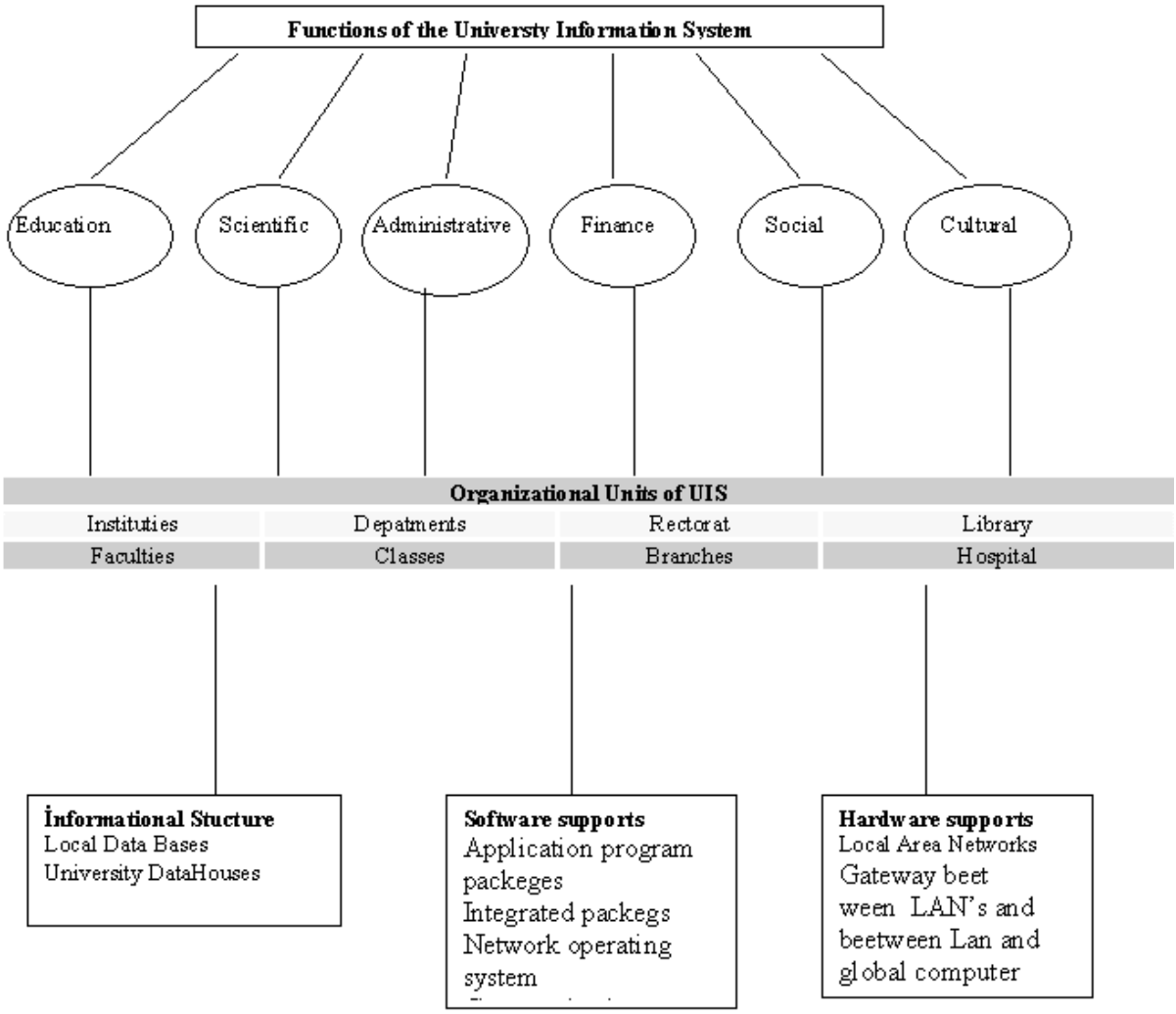


Figure 1. The functions of the University Information System

## 3. Subsystems of UIS

As we see in figure 1. the main functions of the UIS might be classified as followings:

- educations functions;
- scientific functions;
- administrative functions;
- finance and account functions;
- social activities;
- cultural-sportive activities etc.

These functions are carry out with subsystems of the UIS. There are no one-to one relationships between the subsystems and functions. More than one function may be realized by one of the subsystems, or one function may be related to several subsystems. According to organizational structure of the University, creating the subsystems is more effectively. Such

subsystems might be the university management subsystem, faculty subsystem, health service subsystem, scientific research subsystem etc.

We well not consider details of the subsystems. But we examine the queries, which are hold in the UIS and consist of fuzzy information.

**Query 1**. *Which faculties (departments) reached good results in education?*

The query consist of the fuzzy variable "high" . How might define the "high", "good" or "bad" results? Which criteria do we have to use for estimate the degree of the "study"? The information may be used as the criteria are followings:

- grade average point of the students on the faculties for last semester (last 3 years …);
- the numbers of the students, who had received honorary diplomas for years;
- the numbers of the students, who had non-satisfaction grade for last semester;
- the numbers of the students, who had a good grades for last semester;
- attendance of the students to the courses .

It's possible to extent the list.

**Query 2.** *Which faculties (departments) reached good results in scientific fields?*

To answer this question we could have some information, such as:

- numbers of the publications;
- numbers of the faculty personals, receiving scientific degree, prize in last years;
- partitions and organization scientific forums, symposiums, conferences;

It is not difficult to count precisely the numbers of the publications for every faculty (department, professors). But the number of the publications are not only pointer to estimate scientific activities. Prestige of a journal, where was publicized a paper, actuality of the subject are important criteria, also.

Traditional mathematic methods do not allow us to answer these type queries. Now we well examine what we can use fuzzy logic for answer these type queries.

Let us consider to student subsystem. The goal of the system is carry out the problems, relating to the students education. The system is divided into some subsystems-faculties student subsystems (FSS). All FSS are linked to the University System. All consist of the following information:

- grade records;
- course records;
- attendance records;
- curriculum class control system;
- student records and etc.

Suppose that, we have to define the “good students”. Firstly, we must define who a good student is. It is naturally, to think that “a good student” is who has a good grade points average. We again used the term “good” and we must define “a good grade”. It is not difficult, if we divide the “grade line” into several intervals.

One of the dividing is shown in the table 1. Assume that maximum number of the grade is 100 and the number of the intervals is 9. Note that such grade intervals are applying by many Universities.

The bounder value for each intervals (or levels) and its names are given.

Table 1:

| **grade levels** | **names of the grade levels** | **grade levels** | **names of the grade levels** |
|---|---|---|---|
| 90-100 | excellency | 60-69 | middle |
| 85-89 | very good | 50-59 | down of the middle |
| 80-84 | good | 30-49 | bad |
| 75-79 | close to good | 0-29 | very bad |
| 70-74 | top of the middle | | |

Consider such situation: Student A has GPA=100 and student B has GPA=90 and student C has GPA=89. Using owe table we say that student A and B are “excellency”, but student C is “very good”. Moreover, we also think that Student A “more” excellent than student B and student B almost is “very good” or student C almost is “excellency”. Fuzzy theory helps as to define how much closing a values to some linguistics variables. Applying the fuzzy set approach we can say that Student A, B even student C are “excellency”, but they are included to the set of fuzzy variable “excellency” with values degrees. This degree is named a “membership degree”.

There are some way to expression fuzzy variables. One of this way is describing fuzzy variable on trapezoidal form. According this form linguistic variable has four bound values: left found, left singleton, right singleton, and right bound.

We will explain meaning of the values on the example.

If a student has the degree between 32 and 49 we can say certainly that the student is “bad”. 32 and 48 are left and right singleton values of the fuzzy variable “bad”. If a student has degree between 27 and 32 or between 49 and 52 we can not certainly say that the student is in the category of the “bad students”. We also think that he is “very bad” (if the degree is less than 29) or “down of the middle student” (if the degree is big than 49 and little than 52). The numbers 49 and 52 are left and right boundary of the linguistic variable “bad”. (For define of Boundary numbers is exists certainly methods).

We can describe the set of the linguistic values for variable “grade” by the following expression:

B(x) ={excellency, very good, good, close to good , top of the middle, middle, down of the middle, bad, very bad}.

The trapezoidal presentations of the linguistic values FF, FD and AA are shown in the Figure 2.


Figure 2. Representation Fuzzy variables

The grade point average of a student takes into account the results of the examines, laboratory practices, courses projects and etc. Consider that we have N number criteria, to estimate the GPA of students for some courses. The criteria has owns weight - $\omega_n$ . $\omega_n$ is a real value and varies between the [0, 1].

GPA of a student is defined as the sum of the GPA for all criteria.

$$P_{course} = \sum_{l=1}^{N} w_l^k p_i$$

GPA of a student for all courses at the semester may be defined as following:

$$GPA_{semester} = \frac{\sum_{course} p_{courses}}{num - courses},$$

*num-course* is the number of courses..

We can also compute a GPA for class, faculties by similarly.

Now we have to express the GPA via of the fuzzy set B(x). For this goal we use the method "closing of" between the fuzzy variables $a_1$ and $a_2$ :

$$Poss(a_1 / a_2) = \max \quad \min\left(\mu_{a_1}(x), \mu_{a_2}(x)\right) \in [0,1],$$

here Poss($a_1$/$a_2$) points that, who many $a_1$ close to $a_2$ .

Helping the formula we can define the $b_i$ , more closing to the $P_{course}$:

$$P_B = \max\left(Poss\left(p_{course} / b_1\right)\right) = \max \quad \min\left(\mu_{p_{course}}(x), \mu_{b_1}(x)\right) \in [0,1]$$

Now we will consider to the other subsystem - University library subsystem. The subsystem is a distributed information-retrieving multy-users system. The system allows to retrieving information about of the publications on many criteria. (such as, books name, author, publications year and etc.). the system also consists of detail information about of the readers.

Important property of the system is retrieving information on fuzzy criteria. For example, we serch a publication on topics “the application of a computer on marketing” . Consider that do not exists such topics. Then we have to search the publications name on the closing topics. Closing the original topics to one, existing in the system are defined by membership degree. For example, as following:

Topics: Application computers on marketing. Membership degrees of the closing topics are:

Economy-0.7;

Computer-0.4;

Information system-0.9.

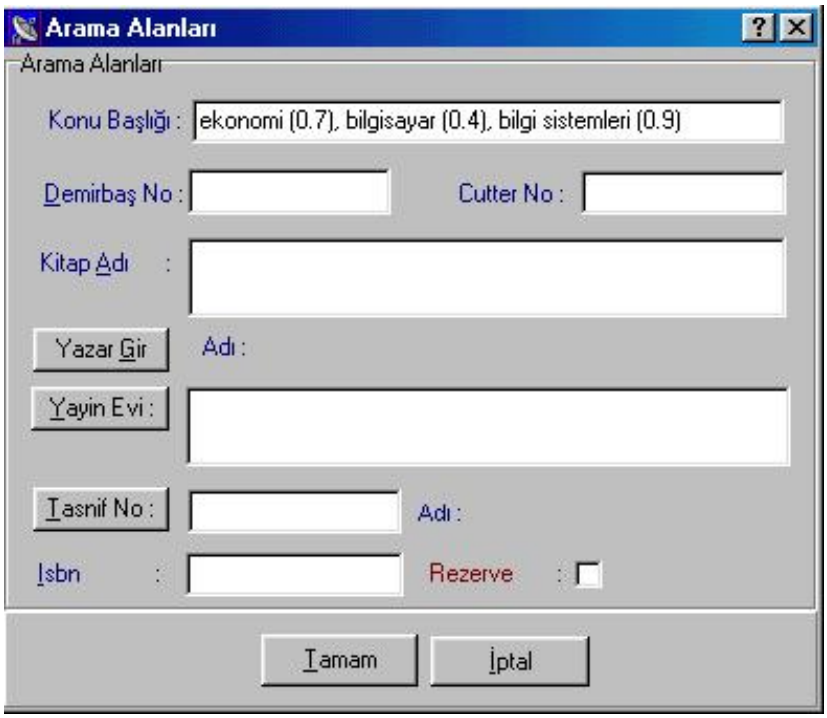


Figure 3.

The result of the such searching will the list publications, closing to the topics.

## 4. The Software Supports and Applications

The program codes of the discussed subsystems wrote in the visual programming language - Delphi. Java was used for the network applications. The systems have been designing at department of Computer Engineering, Çanakkale Onsekiz Mart University.

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