Если указано целое число, то ищется точное совпадение среди id товаров.

Если нет, то неточное совпадение по полям

pagetitle - название товара

longtitle - расширенное название

description - описание

introtext - вводный текст

article - артикул товара

made_in - страна производства товара

Название производителя товара (name привязанного msVendor)

Название категории товаров (pagetitle родительской msCategory)

Если включена системная настройка ms2_category_show_nested_products (по умолчанию), то выводятся все вложенные товары на глубину до 10 подкатегорий. Поиск также идёт с учётом этой настройки, что позволяет, например, зайти в корневую категорию каталога и найти все товары одной подкатегории по её названию.

Отличить прямых потомков категории от вложенных товаров других подкатегорий очень просто - они выделены жирным шрифтом.

У каждого товара есть список действий в колонке справа. Вы можете выделять сразу несколько строк, используя Shift или Ctrl (Cmd).

Можно:

- открыть товар на сайте, в новом окне;
- открыть товар для редактирования, в этом окне (также можно кликнуть на ссылку с названием товара);
- сделать копию товара;
- опубликовать \ снять с публикации товар;
- удалить \ восстановить;
- спрятать \ показать товар в дереве ресурсов.

В ModX также присутствует понятие контекстов - специальных состояний системы, которые могут быть настроены в соответствии с нуждами пользователя на каждый сайт, то есть из одной системы управления можно работать с совершенно разными сайтами и их ресурсами, переключаясь лишь между контекстами [2].

1. <https://itchief.ru/modx/resources/>
2. B. Ray, M. Hickey. ModX: The official guide, MODX, 2011.

Shkirdov R.V., Zhukova Yu.V. The history and development of fuzzy logic

*Ulyanovsk State Technical University
(Russia, Ulyanovsk)*

doi: 10.18411/trnio-12-2021-117

Abstract

This article describes the fuzzy logic history and distinctive features from classical logic. The main periods of the development of fuzzy logic are given.

Keywords: fuzzy logic, Lotfi Zadeh, boolean logic.

Аннотация

В данной статье описывается история возникновения нечёткой логики и отличительные особенности от классической логики. Приведены основные периоды развития нечёткой логики.

Ключевые слова: нечёткая логика, Лотфи Заде, булева логика.

Introduction

Inaccurate information has been used by people for over a thousand years. However, until recently it could not be applied in any way within the framework of methods based on mathematics. As a result, it was lost. For this reason, the effectiveness of many methods of design, control, modeling, forecasting and decision-making was very limited, especially in cases where there was no other information about the system under study but inaccurate one. In addition, each portion of “accurate” information changes with a certain (often significant) error. It means that in fact it is also inaccurate [1].

The much-vaunted “artificial intelligence” that could easily cope with the task of managing complex technical systems was helpless with the simplest statements of everyday life such as “high pressure, medium speed, and high quality steel” and so on. To create intelligent systems capable of adequately interacting with a person, a new mathematical method was needed that translates ambiguous life statements into the language of defined and formal mathematical formulas.

The fuzzy logic history

In 1965, the paper “Fuzzy Sets” was published in the journal “Information and Control” that laid the foundation for modeling human intellectual activity and became the initial impetus for the development of a new mathematical theory – the theory of fuzzy sets. The author of this theory is Lotfi Zadeh, an American scientist and mathematician, a professor at the University of California, originally from Azerbaijan.

The main reason for the emergence of a new theory was the presence of fuzzy and approximate reasoning when a person describes processes, systems, objects.

Formulating the main property of fuzzy sets Lotfi Zadeh relied on the works of his predecessors. In the early 1920s, the Polish mathematician Lukashevich worked on the principles of multivalued mathematical logic where the values of predicates could not be only “true” or “false”. In 1937, another American scientist M. Black applied the multivalued logic of Lukashevich to lists as sets of objects and called such sets as indeterminate.

The theory was adopted with some skepticism both in the United States and in scientific community throughout the rest of the world. The reason for this was the contradiction of this theory to the logic of Aristotle himself that people have been guided by for many centuries [2].

Distinctive features of fuzzy logic from classical logic

The founder of the classical theory of logic that has been developing since ancient times is Aristotle. According to the classical theory, logic is a very strict, theoretical science. Many scientists are believers in this idea.

However, classical and Boolean logic have a big drawback – they are useless in the case of describing human thinking. The problem lies in the fact that it is possible to deal with two variables only – true and false. There are no average values. Boolean logic, binary logic, compares two numbers, determines the state of the system and recognizes only ones and zeros. There are no problems with computing machines but the description of the surrounding world in two concepts is practically an unsolvable task. Fuzzy logic is able to cope with this task.

Linguistic variable is a concept of fuzzy set theory where a variable is able to take on the values of phrases. For example, the linguistic variable “temperature” can have the following values: “high”, “normal”, “low”, etc. This is how physical quantities are described requiring more positions than just 0 or 1. Using this approach computing systems can work with fuzzy definitions, which is a human nature [2].

The classical theory assumes the element determination to the given set through 0 and 1 where 1 is the element that belongs to the set under study, and 0 is the element that does not belong to the set under study.

According to Lotfi Zadeh’s theory, the membership function grades the degree of membership of the elements of the fundamental set to a fuzzy one. The value 0 means that the element is not included in the fuzzy set, 1 describes the fully included element. A value between 0 and 1 indistinctly characterizes the included elements [3]. Figure 1 shows a comparison of a fuzzy set and a defined set.

Figure 1. Fuzzy set and defined set

The main periods of the development of fuzzy logic

Fuzzy logic as a scientific direction was not easy to develop, and it did not escape accusations of pseudoscience. Even in 1989, when there were dozens of examples of successful application of fuzzy logic in defense, industry and business, the US National Science Society discussed the issue of excluding materials on fuzzy sets from institute textbooks.

1. The first period of development of fuzzy logic.

The development of fuzzy logical systems (late 1960s – early 1970s) is characterized by the development of the theoretical apparatus of fuzzy sets. In 1970, Bellman and Zadeh developed the theory of decision making in fuzzy conditions.

In his work “Fundamentals of a New Approach to the Analysis of the Process of Complex Systems and Decision Making” (1973) Lotfi Zadeh using linguistic variables and compositional conclusions based on the theory of fuzzy sets proves that such a method allows one to form an approximate, adequate way of describing functioning of non-trivial fuzzy systems for the description of which it is impossible to use rigorous mathematical techniques.

This is particularly relevant in studies that are carried out in the social and humanitarian fields, and are related to the study of society. Since there are no mathematical methods for measuring the behavior of such a complex system as society, the application of this method today is the only effective way to study a complex dynamic system of society.

2. The second period of development of fuzzy logic.

In the 1970s – 1980s, the first practical results in the field of fuzzy control of complex technical systems appear.

In 1975, I. Mamdani designed the first controller operating on the basis of the Zade algebra to control a steam turbine.

Since 1978, the journal “Fuzzy Sets and Systems” has been published. It is the official body of the International Association of Fuzzy Systems (IFSA).

In 1983, the Japanese company “Fuji Electric” implemented a plant for the treatment of drinking water based on fuzzy control algorithms.

In 1987, the control system for the new subway in Sendai was put into production that was operated on the same principles by Hitachi.

At the same time, much attention began to be paid to the invention of expert systems based on fuzzy logic and to the development of fuzzy controllers. Fuzzy expert systems for decision support have found wide application in medicine and economics.

3. The third period of development of fuzzy logic.

During the third period (late 1980s – till the present time) software packages for constructing fuzzy expert systems appear. Application fields of fuzzy logic are significantly expanding, for example, automotive, aerospace and transportation industries, household appliances, finance, analysis and management decision making and many others.

In addition, the proof of the famous B. Cosco's FAT (Fuzzy Approximation Theorem) that stated that any mathematical system can be approximated by a system based on fuzzy logic played a significant part in the fuzzy logic development.

The following publications significant for fuzzy logic appear: "Fuzzy logic – calculations in words" (1996), "The theory of granulation of fuzzy information" (1997) and "From digital calculus to calculations in words – manipulation of sizes and images of feelings" (2001) where Lotfi Zadeh writes: "The main contribution of fuzzy logic is the development of a methodology for performing calculations in words. So far, there is no other methodology for this".

In business and finance, fuzzy logic gained acceptance after the fact when in 1988 a fuzzy rule-based expert system for predicting financial indicators was the only one predicting a stock market crash.

At the University of California, L. A. Zade founded a laboratory called "the Berkeley Agile Computing Initiative" that aimed at developing fuzzy technologies.

Until the 1990th year, about 40 patents related to fuzzy logic appeared (30 of which are Japanese). In Japan, this direction is experiencing a real boom. A specially created Laboratory for International Fuzzy Engineering Research (LIFE) functions here. The program of this organization is to create computing devices closer to a person. LIFE unites 48 companies including: Hitachi, Mitsubishi, NEC, Sharp, Sony, Honda, Mazda, Toyota. Among the foreign (not Japanese) LIFE participants, one can be singled out: IBM, Fuji Xerox as well as NASA shows interest in LIFE activities.

The Japanese government is funding a 5-year fuzzy logic program that includes 19 different projects from systems for assessing global air pollution and predicting earthquakes to automated control systems for factory floors. The result of the execution of this program was the emergence of a number of new mass microchips based on fuzzy logic. Today they can be found in washing machines and camcorders, workshops of factories and motor compartments of cars, in control systems for warehouse robots and combat helicopters.

In 1991, Japan exported a total of more than \$ 25 billion in goods that used fuzzy logic components in one way or another.

In the United States, the development of fuzzy logic follows the path of creating systems for big business and the military. Fuzzy logic is used when analyzing new markets, stock market play, assessing political ratings, choosing an optimal pricing strategy, etc.

In 1990, the US Export Control Committee added fuzzy logic to the list of critical defense technologies not to be exported to a potential adversary.

Thus, the technology not appreciated around the world turned into one of the key technologies in Japan so it attracted a huge attention at once. Today, many leading companies in the USA, Germany, France and a number of other countries offer a wide variety of products and systems using the principles of fuzzy logic mastering more and more new areas of application.

Conclusion

The theory of fuzzy logic by Professor Lotfi Zadeh has become an important achievement in terms of the development of exact sciences. The described approach is used in almost all modern IT technologies from washing machines to automated vehicle control. In many European countries, fuzzy logic methods are used to control technological processes in large industrial facilities. Today, the theory of fuzzy logic is used in linguistics, sociology, psychology, philosophy, economics, politics and other subject areas.

The theory has found even wider application with the development of artificial intelligence technologies. Expert systems capable of replacing a human-specialist partially or completely in solving a problem situation are also based on methods of fuzzy logic. The construction of models of approximate human reasoning opens up new possibilities in the application of artificial intelligence technologies in robotics [5].

There are advantages of systems based on fuzzy logic. They are:

- functioning under conditions of uncertainty;
- operating with qualitative and quantitative data;

- using expert knowledge in management;
- building models of approximate human reasoning;
- stability under all kinds of disturbances acting on the system.

Among the disadvantages of systems based on fuzzy logic are:

- a lack of the standard methodology for designing fuzzy systems;
- impossibility of mathematical analysis of fuzzy systems by existing methods;
- the use of a fuzzy approach in comparison with the probabilistic approach does not lead to an increase in the accuracy of calculations.

1. Pegat, A. Fuzzy modeling and control. M., Binom, 2012. 798 s.
2. Zadeh L. The concept of a linguistic variable and its application to making approximate decisions. M., Mir, 1976. 168 s.
3. Ryzhov A. P. Elements of the theory of fuzzy sets and its applications: textbook. M., Dialog - MSU, 2003. 81 s.
4. Novak V., Perfilieva I., Mochkrozh I. Mathematical principles of fuzzy logic, ed. Averkina A. N. M.: FIZMATLIT, 2006. 352 s.
5. Gavrilova T. A., Khoroshevsky V. F. Knowledge bases of intelligent systems. St. Petersburg, St. Petersburg, 2000. 384 s.
6. Korneev V. V., Gareev A. F., Vasyutin S. V., Reich V. V. Databases. Intelligent information processing. M., "Nolidzh", 2000. 352 s.