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Three-state logic - trit

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Abstract

Information technology (IT) is currently using a binary system based on logic yes / no. However, many life situations can not be dealt with by the type of answer.
This paper deals with the possibilities of using three-valued logic in solving many economic problems as well. In common life, many times the problem is to answer the given question by the answer yes / no. There is often a degree of indeterminacy in our responses. This indeterminate state can be confused with the third state of the basic unit of measurement. We try to replace the two-bit bit with a three-dimensional trit.
The idea of creating a tri-state unit of information is not entirely new. The new is only an approach to its effective use, especially in the area of complex economic problems.
This contribution is also an introduction to creating a theory that will connect the basics of fuzzy logic and the three-logic. Each of these systems yields a degree of uncertainty. By their active connection, it will be possible to create a new theory for solving problems of economy, energy, medicine, etc., where the problem is clearly answered yes or no.

Keywords:
trit,
bit,
algebra with triple system,
general optimization tasks,
problem solving with indeterminacy,
fuzzy logic

1 Introduction

Current computer systems work with a two-bit base unit (1/0). A major drawback of these systems is the need to decide clearly what value a given bit has in answering various questions. In life, it is very often that we can not tell whether the statement is true or false, whether or not we do the job or whether we can use that or other tool. We very often answer with the word "maybe", we will call still, do not know yet, etc. We do not have this option when using dual-logic. In the process of education, a student often answers different questions not quite accurately. And in this case we can use the "possible" label.
This deficiency can be replaced by a three-valued logic, which instead of states contains no / yes / yes. In numerical terms, the values are -1.0.1 or sometimes 0.1.2.
Many problems regarding the ambiguity of many mathematicians or workers from other industries are trying to solve other ways. One of them is the introduction of fuzzy mathematics. It is precisely the expression of the values of certain variables with a given probability as the path to the introduction of the three-state logic. If we say that the answer is not more than 0.9, we assume it is -1. If we evaluate the given situation with a response of more than 0.9, we can also consider the answer as equivalent to the value of tritu 1. In other cases, we are not sure of its answer and therefore we can choose the value 0 - i. maybe. Additional value - the ambiguity of logic occurs already in Aristotle's first logic theory, which put third option between confirmation and rejection - perhaps yes, perhaps not. In the following period, the logic has been simplified as a result of the third state. Such a form of logic has evolved rapidly and settled, not to mention that it often does not correspond to an inaccurate and not always deciphering of yes / no reality.

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Different scientists Okkam, Leibnitz, Hegel, Krroll and some other scientists have tried to extend the logic at different times. However, Polish scientist Jan Lukasevič worked out three-state logic at the beginning of the 20th century.

2 The triple system and its possibilities.

The triple system (Figure 1) or the three value system is much closer to basic human thinking. We rarely have a clear answer to many questions. It is precisely the system that allows us to respond in a form close to real life and can also help to solve some problems better and more efficiently.

Figure 1 Alegoria a triple system

In the detailed comparison of the triple system with the binary system, it can be seen that the triple system has much wider possibilities. With a 9 character binary code, we have 2^9 = 512 numbers and the triple system offers 3^9 = 19683 numbers, which is $3^9/2^9$ = 38.4 times more. With a larger number of characters, 27, this share is $3^{27}/2^{27}$ = 56815,13 times. In addition to an expanded number of numbers that can be expressed using the same number of characters, the use of the system also has other benefits. Very advantageous is the use of a symmetric three-state code in the form of -1.0.1. Such a form of writing does not require the conversion of numbers to negative numbers in subtraction operations. This also makes mathematical number processing very fast. The presence of positive and negative characters allows direct representation of both positive and negative numbers. There is no need to introduce additional codes to perform arithmetic operations. The sign of the number in the triple symmetric system is given by the sign of the most significant number, if positive, then the number is positive; if negative, then the number is negative. For example,

$79_3 = 100\bar{1}1_3 = 3^4 - 3^1 + 1 = 81 - 3 + 1$ It's a positive number.

$-79_3 = \bar{1}001\bar{1}_3 = -81 + 3 - 1$ The number is negative.

Obviously, for the change of the sign, the characters of all its digits (ie, reversal of the code) must be changed. For example:

$10\bar{1} = 8$

$\bar{1}01 = -8$

It can be concluded that if a balanced symmetric triage system is removed, the possibility of subtraction is removed. By deducting addition and subtraction operations, we accelerate the operation of the system. Different scientists have attempted to extend logic at different times, such as, for example, Okkam, Leibniz, Hegel, Kerroll and some other scientists. Three-state logic was developed at the beginning of the 20th century by the Polish scientist John Lukashevich.

2.1 Basic operations with trit

In the literature, there are quite a large number of triathon operations. However, many authors distinguish each other by writing, the value of the result of the operation. One of the basic problems is how to mark the tritu value. It is a so-called symmetric and asymmetric code where the individual states values are either -1.0.1 or 0,1,2. In solving many economic problems, it is necessary to consider the ambiguity of the operations with the tritium. For better clarity and clarity in solving selected tasks, it is necessary to define the basic operations with the tritium

Single value operations

These operations represent the value of the given trit after the implementation of the operation. An exception for a standard binary system is the existence of a positive or negative shift. It is this operation that says the values of the statement may change in order to obtain a higher or lower value. Also interesting is the position of negation. We assume that negation of the positive state we get negative and vice versa. By negating an indeterminate state we get an indeterminate state.

Value of the variable	Negation	Positive shift	Negative shift	Note
-1	1	0	-1	
0	0	1	-1	
1	-1	1	0	

A	B	AvB	A^B
-1	-1	-1	-1
-1	0	-1	0
-1	1	0	0
0	-1	-1	0
0	0	0	0
0	1	1	0
1	-1	0	0
1	0	1	0
1	1	1	1

Ddouble value operation with trit

This system of operations addresses the question of the result of the interaction of statements using the three-valued logic. In solving operations between two statements, there is a problem with the use of the state possible. For class -1/0, the same rules apply as in the binary system. In dealing with relationships with an indeterminate state, the problem of correct interpretation of ambiguity may sometimes arise. Based on many experience, individual tables can be modified.

The great benefit of using logical operations with tritos is to create a larger number of operations. In the case of a classical compound or sum of two elements in the binary system, we have 4 possible results. Using trit - the number of these operations is 9. It means that if teachers use triple logic, students have much greater possibilities to develop their answers. And in this case, it is possible to see the positive contribution of the triple system in education.

2.2 Development of three-state system computers

The first computer with a three-state system was created by the English amateur inventor Tomas Fouler in 1840. His machine was mechanical and completely wooden. The Foulera machine was simple, efficient, and utilized an innovative approach - instead of the tenth system, it operated with triads - three levels.

The three-volume symmetric code system was used in the Setun computer, which was developed in 1958 at the Moscow State University of Lomonosov, led by Nikolai Petrovich Brusents. The three-state principle of Brusensova was based on three main ideas:

- Three state logic,
- Three-state symmetric numerical system,
- Trit - memory element (triple triger).

The three state digital technology is based on three-way signals and three stable memory elements (tritos). Objects that contain three values are implemented as a whole. The operations on these objects are performed as sequences of three-logic operations. The byte analog is six-digit characters. Two-valued objects and operations on them are contained in triple technique such as trivial degeneration and three-valued logic operation

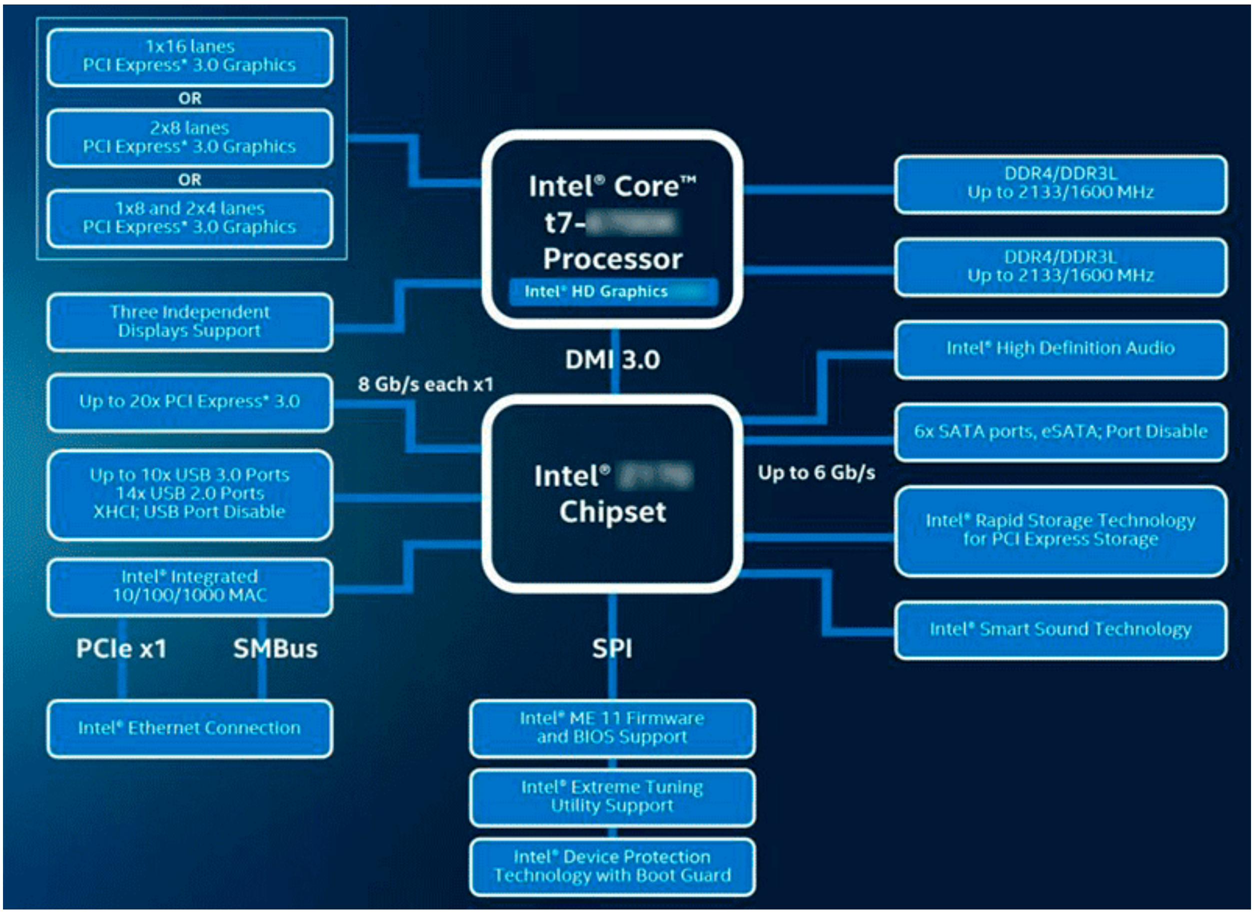

Figure 2 A diagram of a computer with a triple system

In the fifties, the practical implementation of three-state systems was started in the creation of three-tier computers. In the 60s of the last century, a group of scientists from Moscow University headed by Nikolai Petrović Brusencova developed a computer based on trit-Setun [1], which was produced in series. Later, the new Setun-70 was developed. Then there was a break in development for some time. Not counting this fact, Setun was the only serial-produced computer. The Setun computer was not very large for those ratios. It contained 27 orders, where 3 were not yet used. The program code was very simple, so it was not necessary to create your Assembler. They spent 95-98% of their time on tasks. Computers of that period reached a maximum of 60%. A new version of Setun-70, which worked in MGU until 1987, was also developed.
The second phase of development was initiated by Intel. In the US, a similar Ternas computer has been developed. The first Intel Core processor models (which will have the index t - eg Core t3) will appear in the next year, when the processor will be finished. It's a sensational novelty, but it's a necessary step that needs to be done. Three state processors have a great future (Figure 2). The main scheme of the triple processor is almost unlike binary.

2.3 Three-state system and quantum computers

A quantum computer is a computer device that works on the basis of quantum mechanics. The quantum computer fundamentally differs from classical computers working on classical mechanics.
Due to the huge rate of decomposition to primary factors, the quantum computer will allow decrypting encrypted messages using the popular asymmetric cryptographic algorithm RSA. Until now, this algorithm is considered to be relatively reliable because an effective method of decomposing numbers into primary factors for a classical computer is currently unknown. For example, to get access to a credit card, you have to divide into two simple multipliers, numbers that have several hundred digits. Even in the case of the fastest modern

computers, this work will last a hundred times the age of the universe. Thanks to the Shore algorithm, this task becomes quite feasible if a quantum computer is built.
D-Wave, a Canadian company in February 2007, said it would create a quantum computer sample of 16 qubits. This device works on qubits - quantum bit analogs.
But you can build computers not on bits, but on coutrites - analogs of tritas on a quantum computer. Coutrate is a quantum cell with three possible states.
The real innovation of the Lanon method is that by using universal curves instead of qubits, researchers can significantly reduce the number of gates required. Lannion argues that a computer that typically uses 50 traditional quantum gates can only manage nine if it is based on a three-dimensional view. Also, according to some studies, the use of coutrites instead of qubits will simplify the implementation of quantum algorithms and computers.
It is clear that the triple symmetric system is better than the binary system in some indicators, but it does not have a great benefit. But with the advent of quantum computers, the ternary computer gained new life. Universal quantum logic gates - the cornerstones of newly-born quantum computing systems - require hundreds of gates to complete one useful operation. The quantum computer of the Canadian company D-Wave, which was announced last year, consists of only 16 quantum bits - qubits - the minimum quantity required for the controlled valve "NOT". Using a quantum quantum computer would require much less to complete one operation. I think that if production and testing of such computers were started, the results would be better than the results of conventional computers, mass production would begin soon and everyone would forget about binary computers.

3 Some common features of fuzzy logic and triple system

Fuzzy Logic - a set of not strict rules in which the radical ideas, intuitions and experience of experts in the field can be used to achieve the goal. Fuzzy logic is characterized by the absence of strict standards. It is most often used in expert systems, neural networks and artificial intelligence systems. Instead of the traditional values of truth and false in fuzzy logic, a wider range of values is used, as is true, untrue, possible, sometimes I do not remember (as if yes, why not, can not say ...). Fuzzy logic is necessary in cases where there is no clear answer to the question (yes or no, "0" or "1"), or in advance all possible situations are unknown. For example, in fuzzy logic, an expression of "X is a large number" is interpreted to have an inaccurate value, which is indicative of some fuzzy sets: Artificial Intelligence and Neural Networks are an attempt to model human behavior on a computer. only black and white, it is necessary to use fuzzy logic. [2] It is precisely a form of such modeling that can be used in three-logic logic.

4 Some decision making tasks

In solving many decision-making tasks, not only in ordinary life but also in economics, technology, pedagogy, it is necessary to take a solution. It is with three-state logic that you can solve multiple standard tasks. These include:
- solution of the optimal selection of the production program
- solution of the optimal way of supply
- the optimal choice of medicines
- solving pedagogical problems.

For all of these types of tasks, it is necessary to develop decision-making processes, which are calculated with ambiguity. An example of this can be the decision-making of drugs during a particular disease. It is generally known that some drugs must be administered because they contain the active substances necessary for the patient. Some can not be given because they also have negative properties. Others may be because they contain a similar active ingredient and do not have very strong negative side effects.
Similar examples are the education process. Some assignments have to be done by the student, others may, because they will contribute to their development. Others do not have to deal with when dealing with other tasks.

5 Conclusion

Solving many tasks from working life requires a number of decision alternatives. In the context of teaching and pedagogy, it is also necessary to incorporate the process in the field of education. Students, in their answers, can find solutions that are not entirely correct and are not incorrect. Simply put - they can be. And it is precisely such procedures that will allow us to address new approaches using tri-state logic.

This contribution was the result of many problems in solving not only economic tasks but also tasks from other areas. The problem is so great that it is not only mathematicians, but also companies involved in the production and development of computers. Intel is also starting to build a new kind of processor, which will be built on a three-state logic. The three status trit had almost the same chance in the past as the two status bits. It is unclear what direction the development would take and how computers would work when processing the value "can be". We propose to analyze the question.

References

[1] Брусенцов Н. П., С. П. Маслов, В. П. Розин, А. М. Тишулина «Малая цифровая вычислительная машина Сетунь», Издательство Московского университета, 1965

[2] Illustrated Computer Dictionary for Dummies, 4th Edition — by Sandra Hardin Gookin & Dan Gookin — IDG Books Worldwide/John Wiley & Sons Inc (Computers) (February 2000) — ISBN 978-0764581250