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The Importance of Mathematical Formulas in Working with Information

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Abstract: This article discusses the importance of mathematical formulas in working with information and their application to programming issues. In particular, it provides detailed information about the formulas necessary for determining the efficiency of information compression, principal component analysis, information classification, and probabilistic forecasting.

Keywords: Information, program, formula, Bayes theorem, coding, encryption, quadratic equation, algorithm, equation, decoding, entropy.

Introduction: It is an important task today to focus on ensuring that future specialists studying in higher education institutions have thorough professional training based on modern requirements and become skilled masters of their profession.

This idea is confirmed by the Resolution of the President of the Republic of Uzbekistan No. PQ-3775 dated June 5, 2018 "On additional measures to improve the quality of education in higher educational institutions and ensure their active participation in the comprehensive reforms being implemented in the country."

The more educated and skilled the specialist personnel are, the more they can contribute to the development of the country. To do this, they must first have theoretical knowledge of mathematics, computers, and various technical knowledge and the skills to apply them in practice. Mathematical formulas are one of the main tools for encoding, analyzing, and efficiently storing information. Many scientists have contributed to this field.

The following famous scientists have contributed to this field

1. Claude Shannon

He is known among young people as the founder of information theory.

He developed information theory, which used mathematical formulas and algorithms to show how effective methods can be used to encode and transmit information.

Shannon's most important work was aimed at ensuring maximum efficiency in information transmission through mathematical formulas, which are now used in computer networks, cryptography, and many other technological fields.

2. Alan Turing

The concept of the Turing machine and its mathematical foundations form the theoretical basis of information processing.

Turing's work is related to solving problems of automatic information processing and computation, in particular, the principles and algorithms of computer operation.

Turing's ideas were greatly influenced by the development of computer science by expressing them in the form of mathematical formulas and algorithms.

3. John von Neumann

Von Neumann made significant contributions to the application of mathematical formulas to information storage and processing.

He was involved in creating the foundations of computer architecture and developed mathematical formulas that allowed these systems to store and process information efficiently.

4. Andrey Kolmogorov

Kolmogorov is known as the founder of probability theory and made significant contributions to the application of probability calculations in the encoding and transmission of information.

Kolmogorov's work is particularly useful in mathematical modeling of information and noise problems. These concepts use mathematical formulas to show which measurements and rules should be used to transmit information.

5. Donald Knuth

Donald Knuth is a renowned scholar of algorithms and the mathematical foundations of computer programming.

His work, The Art of Computer Programming, covers mathematical approaches to algorithms and data structures and is considered the most important guide to using mathematical formulas to effectively process information.

6. Niklaus Wirth

Applied mathematical approaches to the creation of algorithms and programming languages.

He created the Pascal programming language and is known for his work on optimizing algorithms and programming languages using mathematical formulas.

7. David Huffman

He created the Huffman coding algorithm, which is used to encode information in an efficient and compressed way.

Huffman's formulas are used to increase the efficiency of information transmission in computer networks.

The work of these scientists has had a significant impact on the development of mathematics, computer science, and information technology, and has now created the ability to efficiently store, encode, and process information using mathematical formulas and algorithms.

Today, the rapid development of information and telecommunications and the resulting spread of information in various forms to all sectors of society create the need to perform many operations on them. The main part of these operations is working with mathematical formulas.

Formulas present mathematical concepts and relationships in a concise and clear form, which allows for quick and efficient processing of information.

Mathematical formulas are needed to perform a number of operations on information, and one of these is to summarize data. Formulas can be used to express large amounts of information in a concise and understandable way. The goal is to save time and reduce errors.

Expressing information through mathematical formulas or equations often helps to describe various systems and processes in a clear and simplified form.

In particular, the Entropy-based formula for data compression is of the form

$$C = H(X) \cdot R$$

and this formula is used to determine and enhance the efficiency of information compression. In this formula, C represents the compression efficiency, $H(X)$ represents the information entropy, and R represents the compression ratio (the ratio of compressed information to the original information).

The next use case is to analyze this data. Mathematical formulas are used to simplify data, reduce its size, and find the main differences between them, as well as to determine the performance of systems and the relationships between variables. An example of this is the formula

$$Z = XW$$

used for principal component analysis.

Here, Z represents the new indicators (principal components), X represents the original data matrix, and W represents the vectors for the principal components.

Formulas are used in various fields in optimization and forecasting processes. For example, in many branches of economics, physics, and engineering, formulas are used to predict future outcomes. An example of this is Bayes' theorem.

Bayes theorem

$$P(A\backslash B) = \frac{P(B\backslash A) \cdot P(A)}{P(B)}$$

Here: $P(A\backslash B) -$ the probability of event A given event B,

$P(B\backslash A) -$ the probability of event B given event A,

$P(A)$ and $P(B) -$ the separate probabilities of events A and B.

This theorem is used in statistical analysis and decision-making, particularly in machine learning. It can be used to classify information and make probabilistic predictions.

In information processing, mathematical formulas are used in algorithms and programming languages. They make it possible to automate many processes in data analysis and processing in programming processes.

For example, if we consider the algorithm for finding solutions to a quadratic function, this function is given in the form

$$ax^2 + bx + c = 0$$

The quadratic equation formula can be used to find solutions to this equation. The general algorithm for finding solutions to a quadratic equation is as follows.

1. To determine whether a quadratic equation has solutions, we calculate the discriminant. The discriminant is denoted by the letter Δ and is calculated as follows:

$$\Delta = b^2 - 4ac$$

2. Finding solutions based on the value of the discriminant is performed under the following conditions:

If $\Delta > 0$, the equation has two real and distinct roots.

If $\Delta = 0$, the equation has one real root.

If $\Delta < 0$, the equation has no real roots (there are complex roots).

Of course, these conditions are only valid for the set of real numbers.

If $\Delta > 0$, the equation accepts two real values x_1 and x_2 as solutions, and they are found by the following formulas:

$$x_1 = \frac{-b + \sqrt{\Delta}}{2a}, \quad x_2 = \frac{-b - \sqrt{\Delta}}{2a}$$

If $\Delta = 0$, the equation has a unique solution.

That is:

$$x = -\frac{b}{2a}$$

If $\Delta < 0$, there are no real roots. This is because the expression under the root must always be positive in the set of real numbers.

When working with information, it is necessary to encode all data to keep it confidential, or to separate information of certain types from each other and encrypt it to perform certain functions on it. This work can be theoretically calculated using certain mathematical formulas.

Information encryption is theoretically calculated using the following formula:

$$C = M^e \, mod \, n$$

Here: $C -$ encrypted message,

$M -$ message,

$e -$ encryption exponent,

$n -$ RSA modulus.

RSA is an asymmetric encryption algorithm used to encrypt and decrypt data.

When it is necessary to perform some functions on encoded information, it is necessary to decode it, and this can be theoretically calculated using the following formula:

$$M = C^d \bmod n$$

Here: d- decoding exponent.

When measuring the maximum transmission rate of a channel or the maximum transmission rate for a noisy channel, the following formula is used and it is called the Shannon-Hartley theorem.

$$C = B\log_2(1+\frac{S}{N})$$

Here,

$C -$ maximum channel transmission rate (number of bits),

$B -$ channel width (Hertz),

$S -$ signal strength,

$N -$ noise strength.

For example: If the channel width $B = 1000\ Hz$, signal power $S = 10\ W$, and noise power $N = 1\ W$, the maximum transmission rate is calculated as follows:

$$C = 1000\log_2(1+\frac{10}{1}) = 1000\log_2(11) \approx 1000 \times 3.459 = 3459 \text{ bit/s}$$

So, from the above examples, we can briefly conclude that mathematical formulas are used in various fields such as error detection and correction, system modeling, and many others. In general, these formulas are the main tools for correct and efficient processing, analysis, and forecasting of information. They are necessary for the formation of knowledge, decision-making, and the implementation of a systematic approach.

REFERENCES

O‘zbekiston Respublikasi Prezidentining 2018-yil 5-iyundagi “Oliy ta’lim muassasalarida ta’lim sifatini oshirish va ularning mamlakatda amalga oshirilayotgan keng qamrovli islohotlarda faol ishtirokini ta’minlash bo‘yicha qo‘shimcha chora-tadbirlar to‘g‘risida”gi PQ-3775-son Qarori.

O‘zbekiston Respublikasi Prizidenti Sh.Mirziyoyevning 2020-yil 7-maydagi “Matematika sohasidagi ta’lim sifatini oshirish va ilmiy-tadqiqotlarni rivojlantirish chora-tadbirlari to‘g‘risida” PQ-4708-sonli Qaror.

B.Boltaboev, I.M.Zulfiharov THE ROLE OF PROBLEM EDUCATION IN STRENGTHENING MATHEMATICAL KNOWLEDGE // TJE - Thematic journal of Education Vol-6-Issue- October -2021, r.67-72.

Smale S. Mathematical problems for the next century // Mathematical Intelligencer. 1998. – Vol. 20. № 2, – P. 7-15.

Novikov E.A., Golushko M.I., Solomatina L.E. Global error estimates stiff systems of solving systems of ODE in chemical kinetics // Dynamics of non-homogeneous system. Moscow. 2001. – Vol. 4. – P. 88-100.

Butcher J.C. Numerical methods for ordinary differential equations. Chichester: John Wiley and Son, 2003. –p. 440.

M.I.Skanavi Sbornik zadach po matematike dlya postupayuщіх vo vtuzы // “Vыsshaya shkola”, Moskva, -g.1988.

Зулфихаров И.М., Жўрақулов.Р ЎҚИТИШ – САНЪАТДИР (Математиклар маҳоратига чизгилар) // ТДПУ Zamonaviy uzluksiz ta’lim sifatini oshirish: innovatsiya va istiqbollar Xalqaro miqyosidagi ilmiy-amaliy konferensiya. –Toshkent. –2020, -464-468 б.

I.M.Zulfixarov TALABALARNI MATEMATIKA FANIGA QIZIQTIRISH BIZNING BURCHIMIZDIR // “FIZIKA-MATEMATIKA FANLARI” elektron jurnal, -Toshkent, -2020. 3-son, 1-jild, -11-16 b.

Зулфихаров И.М., Акбаров.С.А Математикани ўрганиш ҳар бир касб эгалари хаёти учун муҳимдир // ПЕДАГОГИКА ВА ПСИХОЛОГИЯДА ИННОВАЦИЯЛАР 2-махсус сон. –Тошкент. -2020 й. -170-177 б.