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History of primary school mathematics—Take the history of division algorithm an example

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Abstract: From the point of view of the history of mathematics, this paper discusses the development of the method and its application in various fields. First, this paper goes back to ancient times and summarizes the early application of the algorithm in ancient Greece, China, India and other civilizations, thus revealing the deep historical background of the algorithm. Then, the paper analyzes the basic theory and definition of the method in number theory in detail, and systematically combs the relationship between it and prime number, the greatest common divisor and other important mathematical concepts. In particular, this paper focuses on the introduction of Euclidean algorithm, and emphasizes its core position and key role in the field of number theory. Finally, this paper further discusses the wide application of the method in modern science, including the practical application and significance in many fields such as computer science, cryptography and communication. Through the comprehensive analysis of its historical origin and modern application, this paper fully demonstrates its significant position and far-reaching influence in the history of mathematics and modern science.

1. Introduction

Turning-turn division is an ancient and important algorithm for solving the maximum common divisor of two integers. It has a profound influence in the history of mathematics, not only widely used in the field of arithmetic and number theory in ancient times, but also plays an important role in the modern computer science. This paper analyzes the perspective of the mathematical history and aims to explore its origin, development and application in modern science. The development of ancient algorithms laid the foundation for the formation of the division algorithm. In ancient times, people's understanding of mathematics mainly focused on the field of arithmetic, and the division method, as an effective method to solve the greatest common divisor, has been widely used in ancient Greece, China, India and other ancient civilizations. For example, the ancient Greek mathematician Euclid de systematically described the division method for the first time, which established its position in number theory. The importance of tossing and division in number theory is self-evident. As a discipline of studying the nature and structure of integers, division algorithm provides a simple and effective tool to solve the problems such as the largest common divisor and the minimum common multiple. As a special case of the division algorithm, Euclidean algorithm has become one of the basic algorithms in the research of number theory, which provides great convenience for the research of later mathematicians and scientists in the field of number theory. With the development of computer science, the method of division algorithm is more and more widely applied in modern science. In computer science, the division method is widely used to realize the division operation of integer, solve the maximum common divisor and other problems. In addition, in the field of cryptography and communication, the phase separation method is also used to achieve data encryption and decryption, as well as error detection and correction and other functions, playing an irreplaceable role.

To sum up, as an ancient and important algorithm, tossing and turning division plays an important role in the history of mathematics. From the development of ancient algorithms and the application of number theory, to the practical application of modern science, the historical origin and modern significance are comprehensively discussed, in order to provide certain reference and inspiration for readers with an in-depth understanding of this algorithm[1].

2. The development of the ancient algorithms

The development of ancient algorithms is one of the important backgrounds for the formation of the division algorithm. In ancient times, people studied mathematics mainly on the field of arithmetic, which was the foundation of ancient mathematics. The development of the ancient algorithm provided the basis and the opportunity for the formation of the later division method. The development of ancient algorithms can be traced back to ancient civilizations, including ancient Greece, China, India and other civilizations. These civilizations have made unique contributions and developments in the field of arithmetic.

2.1 The ancient Greek algorithm

In the golden age of ancient Greek mathematics, many scholars' research on number and shape has reached an unprecedented height. Among them, Euclid is undoubtedly one of the most prominent representatives. He not only made great contributions to geometry, but also his book Geometry Original is known as the masterpiece of the "The Father of Geometry". In the book, in addition to the systematic elaboration of geometry, Euclidean also introduces a method of finding the maximum common divisor of two integers—the division algorithm, also called the Euclidean algorithm." Geometry Original" records: " There are unequal two numbers. If the decimal is constantly subtracted from the large number in turn, if the remainder is always not the number in front of it, until the last remainder is a unit, then the two numbers are mutual element."[2]

2.2 The Chinese algorithm

As a comprehensive work of ancient Chinese mathematics, it is rich in content, covering all aspects of mathematical knowledge at that time, including but not limited to the solutions to practical problems such as land survey, food distribution and engineering construction.

In "Nine chapters of arithmetic", "more phase detraction": " half, half, not half, the secondary denominator, children, to reduce more, more phase damage, and so. "About the calculation method of maximum common divisor (Greatest Common Divisor, GCD) and minimum common multiple (Least Common Multiple, LCM), although it does not use the Euclidean algorithm common in modern mathematics, but the method used also reflects the wisdom of ancient Chinese mathematicians. For example, the "more impairment method" mentioned in the book is a method of finding the maximum common divisor, which obtains the maximum common divisor by constantly exchanging the sizes of two numbers and then subtracting the smaller numbers until the two numbers are equal. This process is actually similar to the idea of the Euclidean algorithm. In addition, the solution of the minimum common multiple in The Nine chapters of Arithmetic also reflects the profound insight of ancient Chinese mathematicians into the laws of mathematics. In the book, the minimum common multiple is solved by the proportional relationship, which is different from the modern common division method, but it is still able to solve the problem effectively. The value of The Nine Chapters of Arithmetic lies not only in the algorithms and methods that it contains, but also in its discussion of the principles behind these algorithms. The book not only has specific calculation steps, but also has discussions of various situations arising in the calculation process, which help readers to better understand the principles and applications of the algorithm.[3]

2.3 The Indian algorithm

The mathematical tradition of ancient India has a long history, and its contribution to the development of the algorithm cannot be ignored. In the ancient mathematics works of India, the mathematics classic is undoubtedly one of the most representative works. This work not only covers a wide range of mathematical fields, including arithmetic, algebra, geometry, etc., but also contains a number of advanced computational methods that were revolutionary at the time and had a profound influence on later generations.

In the Mathematical Classic, the calculation method of the largest common divisor (Greatest Common Divisor, GCD) and the minimum common multiple (Least Common Multiple, LCM) is the highlight. These methods proposed by ancient Indian mathematicians, although formally different from Euclidean algorithm, essentially embody the interrelationship of logarithm and the profound grasp of operation laws. For example, they use specific subtraction sequences to efficiently find the greatest common divisor of two numbers, a method that still has applications in computer science today, known as "more phase subtraction." In addition, ancient Indian mathematicians also showed their creative thinking when dealing with the problem of minimum common multiples. They not only proposed effective computational methods, but also try to systematize these methods so that they can be applied to a wider range of mathematical problems. The proposal of these methods not only enriches the mathematical theory, but also provides a powerful tool for solving practical problems. Ancient Indian mathematicians' understanding of algorithms was not limited to specific computational techniques, they also tried to explore the principles and logical structure behind the algorithms. This pursuit of a deep understanding of algorithms reflects their spirit of exploration of the nature of mathematics. To sum up, the ancient algorithms have a rich development history in ancient Greece, China, India and other civilizations, which has laid a foundation for the formation and development of the later separation method. The development of these ancient algorithms not only enriched the mathematical knowledge, but also provided an important reference and inspiration for later mathematicians to research in the field of number theory and algorithms[4].

3. The division algorithm in number theory

3.1 The basic principle and definition of the division algorithm

The division algorithm, also known as the Euclidean algorithm, is a method for calculating the maximum common divisor of two non-zero integers. The basic principle is to repeatedly remove another with one number and replace the original divisor with the resulting remainder until the remainder is zero. At this time, the divisor is the maximum common divisor of the original two numbers. In other words, if we have two positive integers A and B (assuming A is greater than B), then the maximum common divisor of A and B gcd (A, B) is equal to the maximum common divisor of B and A mod B gcd (B, A mod B). This theorem can be applied recursively until the remainder is zero. When the remainder is zero, the final divisor is the maximum common divisor of the original two numbers. For example, for the greatest common divisor of requirements 34 and 19, we first divide 34 by 19 to obtain the remainder 15. Then, we divide 19 by 15 to obtain the remainder 4. Next, we divide 15 by 4 to obtain the remainder 3. Finally, we divide 4 by 3, the remainder 1, and 3 by 1 and the remainder 0. So, we get 3 is the greatest common divisor of 34 and 19.

3.2 The relationship between division algorithm and prime numbers and the greatest common divisor

The division algorithm method is closely related to the prime number and the greatest common divisor. A prime number is a positive integer that can only be divisible by 1 and itself, while the maximum common divisor is the largest factor shared by two integers. The method can be used to determine whether two numbers are equal, that is, whether their greatest common divisor is 1. If the maximum common divisor of two numbers is 1, they are not equal; otherwise, they are not equal[5].

3.3 Euclidean algorithm and extended Euclidean algorithm

The Euclidean algorithm is a special case of tossing-turning division, used to calculate the maximum common divisor of two non-zero integers. The basic step is: divide the smaller number by the larger number to obtain the residue, then replace the divisor with the divisor, and repeat the above step until the residue is zero. At this point, the divisor is the maximum common divisor of the original two numbers. The extended Euclidean algorithm is an extended form of the Euclidean algorithm that, in addition to computing the maximum common divisor, can solve a linear combination of two integers such that they are equal to their maximum common divisor. This has important applications in the field of cryptography and communication, such as for calculating modular entitlements and settling linear congruent equations.

4. The application of division algorithm in modern science

As an ancient and important algorithm, division algorithm is still widely used in modern science. Mainly reflected in the fields of computer science, cryptography and communication. In computer science, the division algorithm is often used to realize the division of integers. Especially when dealing with large integers, the division algorithm method is more efficient than using the division algorithm directly. In addition, division algorithm can be used to calculate the greatest common divisor of two integers, which is often used in programming, and in cryptography to calculate modular negative elements. Mode anti element is a useful concept in modulus operation, which can be used to solve some encryption and decryption problems. Division algorithm can also be used to solve linear congruence equations, which also has important applications in cryptography. In the field of communication, the phase separation method can be used to realize the function of error detection and correction. By encoding and decoding the data and using the turning-and-turning method to calculate the check bits, errors in communication can be effectively detected and corrected, and the reliability of communication can be improved. Therefore, the phase separation method still has an important application value in modern science. It not only embodies the wisdom of ancient mathematics, but also makes contributions to the development of modern science and technology.

5. Conclusion

In the long history of mathematics, the method of division algorithm is a bright pearl, which is not only an important milestone in the development of ancient mathematics, but also one of the cornerstones of modern science. Through the in-depth discussion of the division method, we can not only understand the important role of ancient algorithms in the field of mathematics, but also realize the important contribution of mathematics development to the progress of human civilization. The development of ancient algorithms provides valuable experience and inspiration for the formation of the division algorithm. The mathematicians in ancient Greece, China, India and other ancient civilizations established the position of division and division in the history of mathematics through the study of arithmetic and number theory. As a special case of the division algorithm, Euclidean algorithm has become one of the basic algorithms in the study of number theory, which provides an important tool for later mathematicians and scientists in the field of number theory. With the development of modern science, the division method is widely used in computer science, cryptography and communication. It not only provides an important algorithmic basis for computer science, but also makes an important contribution to the development of cryptography and the progress of communication technology.

References

[1] Yan Jiali. Tracing the origin of "shifting the division algorithm" and "Changing phase Reduction" - How do teachers interpret textbooks [J]. Middle School Mathematics Journal, 2012, (11): 8-11.

[2] Yan Jiajia'. The different presentation of the division method in history [D]. Shanxi Normal University, 2012.

[3] Duan Qing. The "more impairment" technique is not the "tossing and turning" method [J]. Guizhou Education, 1998, (09): 37.

[4] Wang Yuxin. Practical application of division algorithm method in computer programming [J]. Digital Technology and Application, 2016, (03): 116. DOI:10.19695/j.cnki.cn12-1369.2016.03.079.

[5] Chen Zhantie. A matrix expression calculated by tossing and turn division [J]. Journal of Liaoning Provincial College of Communications, 2015, 17 (05): 32-33 + 39.