Current Developments in Mathematics

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ABSTRACT

Today, we are in the age of 21st century , we have made many development with the increase of super computers, internet increase in raw computing power, we can expert even, more developments in the years ahead. A high technology in computer science is strongly correlated with mathematics. Many of the procedure, algorithms developed and used in computer are based on the mathematics concept. So in order to make more and more development in computer science is basically required to develop the mathematics. In Mathematics a new formula for PI is developed . In Riemen Zetta function how to find a constant , a new approach has been developed in mathematics. In mathematics to fast the work parallel processing has been developed.

INTRODUCTION

Back in the 1970s, when the first symbolic computing tools became available, their limitations were quite evident – in many cases, these programs were unable to handle operations that could be done by hand. In the intervening years these programs, notably the commercial products such as Maple and Mathematica, have greatly improved. Another recent development that has been key to a number of a new discoveries is the emergence of practical integer relation detection algorithms. Let $x = (x_1, x_2,...,x_n)$ be a vector of real or complex numbers. x is said to posses an integer relation if there exist integers a_i, not all zero, such that $a_1x_1 + a_2x_2 + ... + a_nx_n = 0$. By an integer relation algorithm, we mean a practical computational scheme that can recover the vector of integers a_i, if it exists, or can produce bound within which no integer relation exists.

High precision arithmetic, when intelligently used with integer relation detection programs, allows, researchers to discover heretofore unknown mathematical identities. There is a growth in the power of visualization when used with high performance computation. The zeroes of all polynomials with 1 co-efficient of degree at-most 18 were visualazied in a picture. One of the most striking features of the picture, its fractal nature excepted, is the appearance of different sized "holes" at what transpire to be roots of unity. This observation which would be very hard to make other pictorially led to a detailed and different analysis of the phenomenon.

A New Formula for Pi

From the last many decades the mathematician are trying their efforts to simplify the things as general as possible. All of these things becomes difficult with the use of IT but with the wide spead use of IT these things becomes easier and practically possible. A recent example in this regard appeared recently when David Bailey of NASA discovered a remarkable, simple new formula for Pi. Here is their formula:

$$\pi = \sum_{k=0}^{\infty} \frac{1}{16^k}\left(\frac{4}{8k+1} - \frac{2}{8k+4} - \frac{1}{8k+5} - \frac{1}{8k+6}\right)$$

To detect this formula at the fist instance is what took some effort. The formula's discovery was "a combination of inspired guessing and extensive searching using the PSLQ integer relation algorithm". The PSLQ algorithm is a method for recognizing whether a constant is a combination of other, more fundamental, constants . The discoverers sought such a formula because they were aware that it could be used to compute the nth digit of Pi (in base 16), without computing any prior digits. This goes completely against conventional wisdom, and totally eliminates high-precision requirements from a computation of, say, the billionth hexadecimal digit! The big question now is whether such a method exists for the base-10 digits of Pi.Though the centuries mathematicians have assumed that there is no shortcut to determining just the n = th digit of . Thus it came as no small surprise when such a scheme was recently discovered. In particular, this simple algorithm allows one to calculate the n–th hexadecimal (or binary) digit of without computing any of the first n – 1 digits, without the need for multiple-precision arithmetic software, and requiring only a very small amount of the memory.

This formula was found using months of PSLQ computations but simpler n–th digit formulas were identified for several other constants, including log (2). This is likely the first instance in history that a significant new formula for was discovered by a computer.

Identities for the Riemann Zeta Function

The Riemann Zelta function is an extremely important as well as an important function of mathematics that arises in definite integration and is intimately related with deep result surrounding the prime number theorem. While many of the properties of this function have been investigated, there remain important fundamental conjectures that remain unproved to this day. The Rimen Zelta function is defined over the complex plane for one complex variable. Another applications of computer technology in mathematics is to determine whether or not a given constant , whose value can be computed to high precision, is algebraic of some degree n or less. This can be done by first computing the vector x = to high precision and then applying an integer relation algorithm. If a relation is found for x, then this relation vector is precisely the set of interger coefficients of a polynomial satisfied by . Even if no relation is found, integer relation detection programs can produce bounds within which no relation can exist. In fact, exclusions of this type are established by integer relation calculations, whereas "identities" discovered in this manner are only approximately established, as noted above.

Consider, for example, the following identities, where is the Riemannn zeta function at n. These results have led many to hope that might also be a simple rational or algerbraic number. However, computations using PSLQ established, for instance, that if Z_5 satisfies a polynomial of degree 25 or less, then the Euclidean norm of the coefficients must exceed 2×10^{37}. Given these results, there is no "easy" identity, and researchers are licensed to investigate the possibility of multi-term identities for .

Identifications of Multiple Sum Constants

A large no. of identities were experimentally discovered in some recent research on multiple sum constants. After computing high-precision numerical values of these constants, a PSLQ program was used to determine if a given constant satisfied an identity of a conjectured form. These efforts produced empirical evaluations and suggested general results. Later, elegant proofs were found for many of these specific and general results [13], using a combination of human intution and computer-aided symbolic manipulation. Three examples of experimentally discovered results that were subsequently proven are :

where again is a value of the Riemann zeta function and $Li_n(x)$ = denotes the classical polyogarithm function.

Mathematical Computing Meets Parallel Computing

The uses of information technology is everywhere and going on advance stage having the wide application in mathematics and physics and other area also. In Computer science parallel computing is widely used nowadays. The potential future power of highly parallel computing technology has been seen in some recent results. The various computations that takes place involve the constant computation of 80 binary digits of beginning at the five trillionth position, using a network of 25 laboratory computers. He an many others are presently computing binary digits at the quadrillionth position on the web. The most recent computational result was Yasumasa Kanada's calculation of the first 206 billion decimal digits of . This spectacular computation was made on a Hitachi parallel supercomputer with 128 processors, in little over a day, and employed the Salamin-Brent algorithm with a quardically convergent algorithm from as an independent check., Several large-scale parallel integer relation detection computations have also been performed in the past year or two. One arose from the discovery by Broadhurst that where = 1.176280818 ... is the largest real root of Lehmer's polynomial. The above cyclotmic relation was first discovered by a PSLQ computation.

Connections to Quantum Field Theory

In another surprising recent development, David Broadhurst has found, using these methods, that there is an intimate connection between Euler sums and constants resulting from evaluation of Feynman diagrams in quantum field theory. In particular, the renormalization procedure (which removes infinities from the perturbation expansion) involves multiple zeta values. As before, a fruitful theory has emerged, including a large number of both specific and general results.

Broadhurst has now shown using PSLQ computations, that in each of ten cases with unit or zero mass, the finite part the scalar 3-loop tetrahedral vacuum Feynman diagram reduces to 4-letter "words" that represent iterated integrals in an alphabet of seven "letters".

Future Outlook

Computer software is generally used nowadays in every type of field such as Science, technology as well mathematics too. Many Unversity departments now offer courses where the use of one of these software packages is an integral part of the course. Expansion of these facilities into high schools has been inhibited by a number of factors. These factors inclue the fairly high cost of such software, the lack of appropriate computer equipment, difficulties in standardizing such coursework at a regional or national level, lack of trained teachers and many other demands on their time. The cost of hardware continues downward and on the other hand power continuously increased. It thus appears that within a very few years, powerful symbolic computation facilities can be incorporated to relatively inexpensive hand calculators, at which point it will be much easier to successfully integrate these tools into high school curricula. Thus it seems that we are poised to see a new generation of students coming into university mathematics and science programs who re completely comfortable using such tools. This development is bound have a profound impact on the future teaching, learning and doing of mathematics. A large number of software vendors produces the software products much useful in the mathematics operations too. Future enhancement is to use more and more power algorithm to find out the solution of the things in hand. We conclude that more powerful computer system will be available in future to make the task easier related to mathematics work.

A likely and fortunate spin-off of this development is that the com-m vial software vendors who produce these products will likely enjoy a b ader financial base, from which they can afford to further enhanc their products geared at serious researchers. Future enhancements arc like to include more efficient algorithms, more extensive capabilities mixm numerics and symbolics, more advanced visualization facilities, and so ware optimized for emerging symmetric multiprocessor and highly parallel , distributed memory computer systems. When combined with expected creases in raw computing power due to Moore's Law — improvements which almost certainly will continue unabated for at least ten years and probably much longer — we conclude that enormously more powerful co uter mathematics systems will be available in the future.

Reference Books

1. Anderson, K. 1961. Arithmetic tests for 3rd year juniors (London: Harrap)
2. Bass, D. 1963. Mathematics (London: Cassell) Burn, E.W., Tamblin,
3. Mathematics- A New approach
4. Modern Arithmetic (Harlow: Longmans) James, E. J. 1962.