

# COMPUTER MATHEMATICS

Gerard Prudhomme

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**Gerard Prudhomme**



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# **Computer Mathematics**

*Gerard Prudhomme*

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## ABOUT THE AUTHOR



**Gerard I. Prudhomme** has a graduate degree (M.S.) for Computer Science from University College London (UCL). He has also worked as a software programmer and tech writer for different Fortune 500 companies, and studied at UCL, Harvard, and Oxford.



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# PREFACE

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The title “Computer Mathematics” deals with a plethora of concepts and covers everything from computer science, to answer mathematical questions, technical mathematical aspects, playing the role of a committee for proposed mathematical and computer science activities, the scientific management of a mathematical and computer science site, mobilizing competent mathematical and computer science staff, mobilizing a team of mathematical and computer science consultants, etc. The flexibility of computer science makes it possible to also choose more varied examples: daily digital devices, sound, robots, physical simulations, video images, textual data, etc.

On the other hand, we may also, to provide an example, use a finite element method (FEM), which allows numerical computation of an approximate solution. To illustrate, we may additionally supply mathematical modeling, and with a mathematical model accounting for the physical laws to which all structures involved (biological and medical laws, mechanical and physical laws, etc.) obey.

It is interesting to note that these fundamental trends still constitute the basis of contemporary computing. The meetings therefore held periodically by mathematicians who teach in engineering and computer science colleges have the purpose and effect of getting them out of isolation. In this book, we will present the rudiments of this discipline and the classical results of complexities of the descriptive and logical descriptions of the classes of complexity.

Some may feel the teaching of math is a waste of time for almost all those who suffer it. On the other hand, for an example of educational mathematical and computer science studies, the “Computer Science Unplugged” educational projects advocates teaching computer science with strings, maps, and pencils rather than distributing digital tablets in colleges. So to oppose mathematical and computer science studies are misunderstanding, that is in any case in my opinion, a little the main subject of computer science, that is: to experiment, discover, learn, try, search, etc.

After the computer, the network is thus the second instance of this machine concept, which gives this question of extension in space an essential place.

Thus, mathematical and computer science studies are based on concepts, to provide examples: the shape of electrolytic cells for aluminum on mathematical analysis, the analysis of images on a recent generalization of the Fourier analysis, the transmission of messages on algebraic combinatorics, integral calculation results, etc.

Admittedly, users of mathematical and computer science studies showing interest in algorithms is not solely inspired by the advent of the computer. To illustrate, we may additionally supply computer science studies of a site on the web as a center of mathematical consultation and resources. Living matter, inanimate matter, and the networks at work in human relations all constitute the general frameworks of the mathematical, physical, and human sciences. Some may say we give too much importance to math for a computer science curriculum info, however, they are wrong.

We should all, certainly, therefore be sensitive to this and the diversity of machines. A machine is a tool, that is to say a material system, which obeys the laws of physics. For colleges, where the physical sciences are not explicitly listed, we recommend that physicists and chemists give at least their opinion on mathematics programs.

This logical feasibility thus reveals a profound analogy between the programming of computer algorithms and the development of mathematical demonstrations. Finally, this book will introduce an introduction to the complexity of constraint satisfaction problems. You will also learn about the history of mathematics.

And, we will also find a very useful consideration of societal aspects of the use of digital machines. Remember, mathematical demonstrations require the elementary levels of the physical sciences, and also probabilities and the notion of variability. It is, therefore, a challenge to identify a set of general methods and to find what might be the analog of conservation laws in physics or the second principle of thermodynamics for computation.

In parallel, at the turn of the twentieth century, the axiomatic current conquers many branches of mathematics, with as a corollary metamathematics or methodological questions giving rise to a new discipline: mathematical logic. Mental arithmetic and calculating orders of magnitude should therefore find new reasons to practice mathematical and computer techniques.

# **1**

## **CHAPTER**

# **PREPARATORY MATHEMATICAL AND COMPUTER SCIENCE STUDIES**

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Therefore, after emphasizing the articulation of mathematics as a science with other disciplines, we need to examine how this is reflected in teaching, and make suggestions for improving the situation. This point of view is inadequate for a computer scientist, for whom the abstract functions as an algorithm.

On the other hand, it would be ridiculous to end a mathematics book at the preparatory course level because the course has not yet dealt with numeration. To illustrate, we may additionally supply the fact that computers are endowed with a powerful mathematical device that guides the design of robust, efficient, and reliable software.

Computers may also be a way to give mathematical and computer science studies a symbolic form and to allow other algorithms, which operate on symbolic data, to operate on it. This finding is generalizable to many concepts and methods of computing, which are worthy regardless of their hardware applications. The proponents of the computer science teachings are therefore mistaken, I am afraid, about the possibility of recruiting pure computer scientists in sufficient numbers.

Computer scientists rest, in particular, on coordination between the magisteries of mathematics and physics in terms of timetables, validations of teaching and issuance of diplomas. As long as the information is formatted correctly, the material used for the transfer is therefore indifferent.

To provide an example, it is generally agreed that if two algorithms do not have the same complexity, and if they require a different time to solve the same problem, they are different. But this characterization is still too crude: various sorting algorithms, although of the same complexity, may be different. To provide another example, we may also consider a set of points whose coordinates in an orthonormal coordinate system that are given.

To provide an example, we may also provide, using mathematical and computer science studies, a way to find a diagonal matrix  $D$ , congruent with the matrix  $M$  and indicate a matrix of possible basic change  $C$ . We may also show that  $C$  is diagonalizable and indicate a diagonal matrix similar to  $C$  and the base change matrix.

All these domains are therefore also trainers, and the computer domain is of the same essence. But it seems more pertinent to enumerate, not the sub-disciplines, but the concepts used in this field of knowledge, which undoubtedly have a greater temporal stability than the various sub-disciplines that recompose constantly.

Remember, the difference in salaries between a private computer scientist and a certified computer science professor is considerable, as are career prospects. On the other hand, unlike some network technologies, such as radio communications, computer science network communication here is not limited by a direct line of sight. Therefore, nowadays, a few clicks on the Internet allow to a user find the details. Why spend as much time on theoretical training as in practice 99.9999% of students will do it in the application?

On the other hand, for mathematical and computer science studies, to provide an example, multidisciplinary skills are required: software engineering, image processing, mechanics of solids and fluids, solid mathematical tools in several sub-disciplines, computer science, etc. Computer science studies therefore depends only on what might be called a skeleton of a situation, as abstract as the structures studied by mathematicians.

The reading of this book should therefore be facilitated by the fact that it is very complete and very strongly argued, in the proclaimed goal of taking our situation out of the computer illiteracy in which it finds itself today. The

introduction of these procedures is therefore inseparable from these material supports.

We forget very quickly what we learn in college. Therefore, we should be reminded that mathematical and computer science studies have a number of practical applications, such as using mathematical ideas to create templates based on stored data. To provide an example, we may also use mathematical and computer science studies to provide coding, algorithms, formal semantics studies, and cryptography. It is, therefore, proposed as a finality for the children of this century to learn to write, read, count, reason and program.

And that's impossible without a little mathematical baggage, the math taught in an engineering college probably seems consistent, and for the basics, it's more than enough, but in fact it's just an initiation. I have the impression that in mathematical and computer science studies since the modern maths elitized mathematics to the maximum everyone has used less logic, except maybe some developers I would say.

Engineering colleges therefore deserve special consideration, not only because of the mass of students they host, but also for the organization of teaching and the fact that professors usually teach several subjects. To provide an example, ultimately one may wonder what is the optimal way to code a long sequence, and it is often in the form of a program that generates this sequence when it is executed.

Certainly, sometimes, we use mathematics to perform a calculation, but mathematics are then an integral part of the trade, as are traceability standards, billing methods or anything else that could be managed by the computer tool. To illustrate, we may additionally supply how to query volumes of data organized according to different criteria.

National education is also an outlet because it recruits professors of mathematics. But there is more. And, I add that I absolutely do not feel like doing math when I line up lines of code on my screen. Faced with this situation, it is for the author of this book to both, according to a typology of audiences that we are used to dealing with mathematics, prepare for all trades related to digital, especially research in computer science, train computer professionals in all trades and provide digital literacy for all.

That these services are possible, is largely underpinned by the progress of the material, stemming from both fundamental and applied advances in various fields of the physical sciences such as electronics, solid state

physics, microelectronics, or optics. These examples, borrowed from different domains of programming, networks, and algorithmics, show that the applications of the concepts and methods of the automatic processing of information are not reserved for the world of computers. It especially gets more serious when you look at the intensive volume of the program you had and no professor took the initiative to talk about the roles that maths play either on the scientific and technological level or even on the training of the individual.

On the other hand, the problem today is not to find methods that teach, but to defend the right to practice, which is quite another thing. Internally or anecdotally, we can, of course, follow suggestions, but in the long run it is necessary that each professor is advised study its context. Anyway, the main difficulty of college math is to learn to speak the math, in short to master the mathematical syntax above all.

During my college period, personally I was very interested in maths I had tried to understand everything even without knowing the different areas of application at least some simple applications as integral partial differential equations. I considered them at that time as a challenge especially hearing people say that maths are difficult and only those who have particular abilities succeed in math, even the 4<sup>th</sup> year of college was the most complicated by studying only maths.

If I can respect a personal aversion, I do not find it very correct on a scientific level. Indeed, many feel helpless and even bad in mathematics. It is work, and it is through this work that a mathematical culture is created that makes it possible to solve problems, by drawing on the structured ideas that we have forged. To avoid these inconveniences, it is better to prepare effectively.

Teamwork of professors is still rare. It drives them into many calculations and conversions. Our political leaders think so, most media say it. This is partly explained by the blockage of many students in the subject.

Diagnostic evaluations are rarely performed. I'm a math professor but I do not train mathematicians. I agree with the idea that we have to make the maths very simple for the students to catch them but I'm afraid we're doing this math lose the abstract side that characterizes them.

The kids are obviously coming out of college completely confused and doomed to stay so, but the political context of our country makes those who practice it better stabilize their public relations and career. A professor

in mathematics should therefore also consider giving math lessons online via webcam, especially to provide an example on math courses. As a math professor, you should not doubt this statement. This method, quite in the era of time, offers many advantages: to avoid wasting time in transport to get to his student's home to be more flexible on his schedule to exchange files more easily with the pupil allow the student to be in a comfortable environment free of any stress. Giving math lessons via webcam also saves you money.

An effort to make mathematics close to applications are meritorious, and I encourage professors not to give up on it. From where or reasoning by prefabricated sufficient conditions, I try without knowing them to teach them the reasoning they need for necessary conditions by searching among the theorems which allow to conclude, those whose hypotheses are capable of being established, and I make a demonstration from the result or a situation that I write at the bottom of the table, then I go back to the top of the table on the assumptions, and I guarantee you that they are concentrated to try it and succeed at least in the draft to write something.

At most, you can hope, being passionate, lead some to the joy of mathematical discovery. I think the problem is not to take care of the students, whether they are the best ones or not, but to interact with all the students in order to adapt to the best of all. The student can thus understand what you explain to him, thanks to your drawings, your examples.

Even the most skeptical ones end up being seduced by the courses in videoconference. And I taught maths to enough difficult students to be able to prove it, I think. This average fall is explained by the increase in the number of very weak students. To illustrate, we may additionally supply a rigorous foundation to the semantics of programming languages, which have moved from high-level notation for codes executable by a machine, to that of completely general notations for mathematics (more or less constructive).

Let's go back to our topic, well I totally agree that the mathematical syntax is very important it has like even its influence on the learning, but I think that it is not enough. Maybe I have not been able to explain my ideas, but what I want is that I do not want to teach maths how I myself suffered during college.

Some games are specialized in mathematics and can allow you to adopt an innovative method with your learners: to provide an example, a board game to acquire a mathematician reasoning by setting up particular strategies and a card game including advancing in the equations that allows you to master the formal calculations, fundamental element of any math

course. It is regrettable that problem solving is very often guided. The level of requirement has deteriorated sharply, students, even from technical training, are very comfortable.

It does not take away from the un-memorized part of my skills, which is always difficult to define formally as it would offer anyone the opportunity to say “do you know how you learned it?” Behind the showcase and the prestige of some of the most outstanding courses, there is another reality.

Do you think they start from the abstract syntax tree? I must say that indeed, math is sometimes rarely used in computer science, even to do complex things, for finance, etc. Other areas of cognitive science should gradually benefit from the formal models emerging from this research.

A remarkable convergence between the theory of the demonstration with its last avatar, the playfulness related to the theory of the games; the theory of categories which renews what was called universal algebra; and the theory of the languages, itself in fertile dialectical relationship with linguistics, now allows the development of a methodology called type theory. The next step is to articulate student and faculty initiatives better: a list of topics suggested by teams of professors based on their own interests and skills could, in many cases, guide students off the beaten track.

I talk about taking care of the best professors evaluate students, but what do they really evaluate? The current professors attempt to explain the real difficulties of the math taught. But there are also those professors who consider that since they do not understand anything, it is not necessary to do a pedagogical course, but a flawless speech is a good course. To illustrate, we should therefore additionally supply the announcement by of a big digital plan for the entry of computer science, in college with the teaching of specialty digital sciences and computer science.

They are essentially written, oral skills are rarely evaluated. It helps to memorize and repeat what you have learned, which is ideal for good math skills. I propose an abstract definition which unfortunately cannot be measured concretely, but gives an orientation to reflect: the real mathematical level of a student of a teaching is: L/NM; where L is the apparent level (success in various tests, conditioned reflexes, etc.) and NM is the “non-intelligent” (or non-mathematical) level received from the formation: that is, everything that has been learned, put in memory, or in conditioned reflexes, in the broad sense thus including, the ineffable memorized unconsciously.

What do they really learn? Students often take their calculator to perform elementary calculations. Differences are increasing within the education system and maths are revealing this situation.

Is there an official argument for mental arithmetic? To illustrate, we may additionally supply competitions and mathematical rallies are varied and very popular when they are offered to students. For the time being, I thank you for saying students with good math skills are the ones who would make the most of the benefits of hard ‘courses without pedagogical sweetening but the others, on the contrary, have everything to lose.

Getting your students interested in teaching mathematics is surely one of your first questions. In college the computational skills are globally weak, even very weak: in mental computation (exact or order of magnitude), in literal computation and in algebraic calculation. The work promises to improve these results by opening a computer option to math.

Math is a path of excellence, which has not already achieved that. And many areas are difficult to access without mathematics. But, to provide an example, with the algorithms mentioned by many, these are also only logic.

To illustrate, we may additionally supply probability-statistics to provide an example for sending spacecraft in orbit at the lowest cost and with the greatest precision. Also, besides programming languages, there are many other formal languages. For maths, on the other hand, you should therefore work with matrices, Fourier, Thales, Pythagoras, etc. Numerical analysis and automatic (control theory), closely related to partial differential equations, are, however, beyond the scope of this text.

To provide an example, we may also ask for code proposed by a group starting from the most simplistic to the most elaborate and by asking each time the number of tokens necessary to transmit the algorithms and the direction of reading. There is no strict boundary between these areas, the interaction between several of them being even desirable.

Yes, writing an algorithm is maths, but as much as creasing a sheet, looking at the sky, or dropping a pencil. If we study them it's more to have a base of knowledge related to computer science than because we consider development as mathematics. We propose here the idea that computer science is structured by four concepts: algorithm, machine, language and information, and we stress the importance of respecting the balance between these different concepts in the design of a computer program.

Clearly, if they are expressed by the same text, they are identical, if they do not solve the same problem, they are different. To illustrate, we may additionally supply reflection among mathematics professors, and to create interdisciplinary links. The mathematical culture of computer scientists is often more important. The mathematical reality is an unknown which we discover shreds; what is still hidden from us is unpredictable, or at least not predictable in the long run.

To the question “What is informatics?” I do not think a crazy race for new things is essential. We will therefore trace informatics and we will specify its characteristic elements in this book.

To illustrate, we may additionally supply mathematical and computer science studies for cryptography and algorithmic studies, resorting to complex algorithms to complicate the task of computer “hackers” helped by the power of computers.

To provide an example, a format of the datagrams being perfectly respected, it is a perfectly legitimate implementation of the IP protocol, within its intrinsic limits. Since IP guarantees only a delivery attempt (best-effort delivery), the loss of data can be tolerated. It mixes calculations on analog computers or numerical and mathematical dynamic systems. This logic is similar to algorithmic, and does not appeal to any mathematical notion.

From this stream will come, in particular, a general theory of calculability (Post, Church, Turing, Kleene, etc.) and several theories of demonstrations. I wish you success. Now you have all the necessary elements to offer effective teaching in your specialty.

I would also like to come back to memorization and math, as well as to the “simplification” that could be harmful if not understood what was said. It is necessary to go beyond the blocking of a problem, to reflect and to work on computing abilities. About simplification, I think there is no wrong choice.

Try to eliminate from your mathematical knowledge all that is obtained by memory. Algorithms will be used alongside geometry to support the practice of deductive reasoning. There is a century of educational thinking, do not throw the baby with the bath water.

In the teaching of mathematics logic games are almost nonexistent. In the short term, it works well as decontamination of the kids and their return

to be able to do math, but in the long run, it confronts them with the fact that any game that is a bit widespread involves: winners, losers, championships. From an early age, it is possible to engage students with mathematics

Do we also therefore feel responsible for the learning of all students in mathematics and their achievements? The calculation exercises are essentially technical. To illustrate, we may additionally supply exercises where students had to imagine valid protocols (and there are usually several) and make calculations.

Thus, it appears to be an indispensable part of a distance learning course. In college, most classroom assessments are of a technical nature and often focus on the last chapter studied, so that each notion or skill is usually evaluated only once. To provide an example, in almost half of the classes observed by inspectors, erroneous student procedures are not analyzed or exploited.



# **2**

## **CHAPTER**

## **PREDICTABLE PHENOMENA**

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The knowledge of thermal, physical, chemical, and mechanical laws makes it possible to resort to modeling to describe on a computer predictable phenomena resulting from constraints imposed on the structures observed: products, skills, equipment, materials, tools, processes, etc. In the awakening activities of these technological equations, which require fairly light compulsory learning, we sometimes have an interesting experience. The engineer then therefore resorts to a mathematical tool of partial differential equations to model a very complex reality.

Mathematics plays a major conceptual role in this, and to provide an example the best current data structures are often based on a clever use of tree structure. A tree structure is a natural derivative of the mathematical notion of a graph, the most important structure of all IT. Mathematics provides indispensable tools for everyday IT, allows the development of reasoning rigor and problem-solving learning.

To provide an example, we may also use mathematical and computer science studies to provide that a text is compressible in a ratio of the order of 4, an image is compressible in a ratio of the order of 100, and a video sequence is compressible in a ratio of the order of 1000 approximately. Therefore, the costs of transmission and storage are reduced accordingly.

For another example, with a TV series, the hero is always assisted by a computer expert who manages to go up to the IP address of the criminal: it

does not always know his identity, but at least to know what computer he used.

I am convinced therefore that we cannot further reduce the already weak schedule of traditional mathematics especially in college, and it should not be confused with that of digital, especially for the college. They can learn to calculate probabilities long before they can access the general notion of probability.

The maximum number of headers to read in the dictionary to search for any word depends on the number of pages in the dictionary. If the dictionary has 4096 pages, that is to say  $2^12$  pages, you can find any word by browsing less than 12 headers, which confirms our example. It is also the case if someone tells us to guess a number understood to provide an example between 1 and 1000 and that he answers us to our attempts only by “more” or “less.” To illustrate, we may additionally supply and indicate all the partitions that can be deduced from a relation.

On the other hand, we have numerical analysis methods to find approximate solutions to these systems of complex equations, such as a Finite Element Method (FEM). This supposes that an individual has a margin of freedom and that an individual is not compelled to follow as a sheep an imposed program.

Therefore, you may wonder, “What do algorithms operate on?” An algorithm works on something: to provide an example the recipe for bread operates on ingredients: eggs, flour, etc. On the other hand, every calculator is from the operating point of view a finite system, acting on data that are also finite and plunged into countable sets (as soon as we ignore secondary limitations).

The texts of Fourier, Laplace, Descartes, Pascal, Poincaré, etc., are part of literature even when they expose the major mathematical subjects of their time. I have neither the competence nor the place to enter into a debate always caricatured by the supporters of the only disciplinary course, in front of the ersatz that would be served like coffee to the pupils under various names of project.

Their experience and potential would be valued if they were given an explicit mandate to systematically expand their area of expertise to include the relationship to other disciplines. Trees, graphs, point clouds, permutations, and allocations are some of the most basic objects. To reply to the query, we therefore systematically intervene in administrations, research institutes

(correlation between weather and urban pollution, customer profiles for a marketing study, political surveys, etc.), and companies.

Specialized computer science in the field of biology is one example of computer science mathematics for computer science and mathematics for computer science. The disciplines involved are not limited to science. But mathematics appears here rather as a preliminary or parallel requirement for a high-level of computer training than as an accompaniment of such a training exploiting the links between the two disciplines.

The history of mathematics also gives great importance today to the roles played by machines, concrete and material, for the realization of calculations, or, more generally, algorithms. To provide an example, to convert an integer from one base to another, it is important to understand the algebraic relation between a base  $B$  and the writing of the number in this base  $B$ . On the other hand, to integrate a CMS into a web agency, I'm even ready to admit that mathematics are almost superfluous. In applied mathematics (at the time, it was to solve mathematical problems via programming), I therefore defended the relevant uses rather well.

The content is articulated around the basic themes as follows: sets, gen functions, relations, recurrences, enumeration, basic mathematical structures, binomial numbers, elements of logic, intuition, demonstration methods, infinite sets, functions, etc. The probabilistic culture and statistics is needed here, more than the web culture. In computer science, we use the most powerful languages for numerical calculation.

From this point of view, colleges consider that becoming a computer technician or engineer is not just a matter of composing a few libraries, but being able to understand a minimum of the internal workings. Mathematics (analytical techniques and complex theories of probability), therefore, is applied to computer science and new communication technologies.

To provide an example, a few professions using computer science mathematics for computer science: visual interface designer, statistician engineer, operations research in charge of statistical studies, data mining manager (data mining) researcher. To provide an example, we may also use computer science mathematics for computer science to provide security and reliability of communications and present risks of breakdown or piracy.

In this sense, the situation of computer science with regard to mathematics may be to a certain extent compared to that of theoretical physics or mathematical physics. On the other hand, in terms of practices, education

is marked by control and punishment. But the progress of the electronics in the last fifty years, by allowing the development of electronic calculating machines or computers, made it possible to transcend the traditional notion of computation to elaborate an extended notion of computation possibly nondeterministic demonstrations in a general programming framework.

## 2.1. INTENSIVE PRELIMINARY COURSES OF LOGIC

The grammar of a formal language is, on the other hand, explicit. This goes beyond the central subject for computer science of program evidence and touches many areas of the most “classical” mathematics. In secondary education, the need for graduates or graduates in mathematics is high, because currently less than half of mathematics professors in public colleges have adequate university education.

Students will be asked, to provide an example, to think about symmetrical images or images with identical lines or columns. This evolution has resulted in universal machines that can execute any algorithm operating on symbolic data, provided that they are equipped with good cards and the right programs. To illustrate, we may additionally supply an item of the “Copy” class that has an inventory number and an indication of status (under renovation, borrowed, on the shelf, missing, etc.); an object of the class “User” has a last name, a first name, an address, etc.

The place of informatics in college is inseparable from two other issues addressed in the articles of the same file that of the mathematics taught at college and interdisciplinarity. To provide an example, I learned the programming functions long before the math lessons taught it, and like the rest of the maths I did not understand anything, until I realized that it was similar to the functions in programming. The reflection on how to archive information and especially to restore it gave birth to the theory of databases, a theory that has greatly renewed with the appearance of the web, the web being itself a base of data.

In this section, we therefore discuss some important milestones and some highlights of this evolution. For years I have followed the rapid institutional separation of mathematics and informatics, the development of which was hampered in many ways in our higher education. An individual does not need to do a lot of math to get a computer to work, therefore why teach

math? But, with this logic we should stop teaching history or literature on the pretext that one does not have any inevitable need.

What are the interactions between mathematics and computer science courses for the secondary-university transition? Geometry is shelved and we do not speak anymore of geometry in space as a scientific first, to provide an example. Computing proposes to describe many objects, in mathematics and the natural sciences, as algorithms. A library management system, to provide an example, will manipulate main classes of objects: an object of the class “Work” has a publisher, an author name, a title, and an ISBN number.

What is the only thing we know about the exponential. Among other things, mathematics does not stand out clearly enough from other sciences, it no longer seems to be a fundamental element in the scientific training of pupils. We should change a lot our vision towards maths, and as we enter the digital age that is already a motor to be interested in maths, but I go back and I ask my question of what are the methods (not magical) but effective to complete our goals.

I dreamed to make pupils appreciate the maths...moreover, if I confess so easily this claim, and this it is because precisely, I consider it only as an impersonal idea of what my memory contains. How many people, like me, say yes, I am pretentious?

You must vary the type of exercises that you propose, and especially, propose in each course. To caricature one could say: the more they are poorly taught in the short term, the better they will definitively acquire and understood in the long term. These professors of maths who consider that the books of exercises are the end of the end of the pedagogy.

And what better than having the vision of a math professor to improve his teaching in math class? We wanted to abolish learning “memory” of maths, doing pretty little activities. On the other hand, a math professor should be passionate about discipline, loves to transmit his knowledge and the interactions between disciplines, because its study supposes to develop projects which must appeal to other disciplines.

There are also the same problems in the program, some exhilarating activities on functions or thrilling activities on equations, and we share the same anxieties. It is this situation that motivates a new approach to math education. Basically, I mean that introducing the usefulness of mathematics and the role that can play in our lives. Mathematics and Computer Science have close links.



# **3**

## **CHAPTER**

# **THEORY OF MODELS AND OF GROUPS**

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I agree that we can live peacefully without maths but with math we live better (personal opinion). In the status of professors, the mission of being responsible for student success is not really explicit. Even in the most sincere cases, I could see that a pedagogical explanation is always a kind of nicer shortcut to remember an idea. But maybe I'm wrong.

I have an idea that can hang and the majority will be amused and interested by this approach, but if I try that with the other, I'm just going to spend a crazy amount of energy trying to convince them that it's fun to look for a little. To help you become a good professor, I will give you a guide to teach maths optimally and truly make your students passionate about Pythagoras, Thales and all the other great theorists.

By using humor and references, to provide an example, that college students can understand, a professor is able to prove to students that mathematics is an integral part of our lives. In college mathematics, problem solving remains behind the acquisition of know-how and techniques. It's not naughty what I want to say to you, and I totally understand that we can get carried away when things work, but optimism (perhaps remarked that is different) is common in my ideas, and I think we win, not to be pessimistic, but not to get too excited at the moment where it is re-transcribed later on and so on.

Like a number of speakers on this topic, you look for the “thing” that solves everything, the magic method. In second on the similar and isometric triangles (which have been replaced by the planar configurations) or for the algebraic calculations, finally for all, I manage to make them understand as they say, in reverse. As a math professor, your main mission will be to introduce your student to your mathematical world.

It will be them who will work then, plus me. On the other hand, the phrase “everything we do in class is useless for life, the real thing ...” is the reality of the students, since life, the real one, for them is outside college. Therefore, is there a progression of learning in this area?

Whether the student is working for a bachelor’s degree, is looking to enter the graduate college or simply wants to succeed in college, mathematics is of paramount importance. And comfort yourself knowing that most students find the math boring, but less with you. It’s quite a dirty-political affair, started in a somewhat “unexpected” way, by politicians “allergic” to their memory of their failures, and wanting to settle accounts with what they call the “dictatorship” of maths.

The aim is to improve students’ numeracy skills, but also to consolidate the concepts that will be essential for them to act as citizens in a world saturated with information. Curiously, the aim intends to rely on the introduction of algorithmic. The playfulness of mathematics and the use of digital will be developed to further motivate students and encourage their autonomy.

Students learn how to use architectural software to draw the (geometric) plans of the cabin. Besides, it’s something everybody can understand: at level equal to the arrival anyone chooses the person who does not use his memory to solve a mathematical problem. Then, not having the basics in math also explains why some learners feel disoriented. Therefore, with preparing for all digital-related occupations we find the importance of mathematics in computer literacy and it also requires solid training in this area.

Few mathematics professors have gone into a reflection on national or international assessments to exploit them in terms of the achievements of their own students, to reflect on learning, their teaching practices. To provide an example, if you are good at math, you put 4 minutes to spawn the algorithmic, otherwise you look on Google and you spend half a day. Without thinking about it, I would say that we must use that and that there is no need for mathematical knowledge to use it, but it is only my responsibility.

# **4**

## **CHAPTER**

# **PROGRAMMING MODELS**

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Of course, any bureaucratic system of this kind is relatively ad-hoc, and the hope of a uniform notation that can serve as a foundation for a universal coherent mathematics has vanished. To illustrate, we may additionally supply that with each signal of the internal clock of the machine, the contents in the cells of the register are transferred to the neighboring cell on the right: they move all to the right. Also, John von Neumann, one of the pioneers of computer science, is one of the most important contributors to the world of computing and numerical simulation, and Robert Oppenheimer was one of the most important contributors to the computers of the Institute for Advanced Study at Princeton.

Some versatile machines, such as pocket calculators, solve several problems: calculate a sum, a difference, a product, a quotient. But after, it's like networking, marketing, etc., with a culture of algorithms. In all socio-economic sectors, all impacted by the digital world, it is easy to imagine that those who will master these fundamentals will be the creators of the world that is coming. Mathematics brings very powerful tools, extraordinarily effective: many things of the real world can be represented by numbers or geometric figures.

To illustrate, we may additionally supply fundamentals of mathematics and signal physics. Apart from that, the question of stopping the teaching of computer math seems very dangerous to me. But these two disciplines

also work for other sciences. The teaching of informatics touches on other fundamental questions: the question of the continuous formation, because it does not force professors to teach it, but first, train them to convince them of the interest of this study. Thus, during a research work (to provide an example for the doctorate), it is frequent that several domains are involved.

The reflection will focus for this year on some of these points in particular, depending on the direction that will take the group and according to its constitution. In addition to scientific curiosity, it is justified by the many technical applications that benefit from recent mathematical results. Interaction between mathematics and other sciences is now a topic of constant interest for professional associations.

To provide an example, the study of closed Cartesian equations of Cartesian categories has made it possible to identify a notion of virtual machine for functional languages, the CAM (categorical abstract machine). It is in the study of such metamorphoses that should be devoted the aim of mathematics and of the computer of the seminar of a history of mathematics. That is to say that can be used as coding for the partial recursive functions of arithmetic, among other equivalent formalisms like the Turing machines

The main educational objective is to provide a support tool for learning that can be used in class by the professor or in a more personal way by the student. To illustrate, we may additionally supply learning for algorithmics, cryptography, coding, etc., to understand the software of computation. Many fields of contemporary mathematics owe their birth or importance to the computer.

Making way for computer science in college means, it is almost obvious, the disappearance of technology and its gradual replacement by computers. When we compare the educational systems of different countries, we see a great diversity. Training on the borders of these disciplines also exists. Mathematics is therefore valuable at college because it gives confidence.

Mastery seems to have improved. This calculation would progressively move from the formalism state defining the computable functions to the primitive status of central programming languages of computer scientists. As a science of languages, computer science extends the older work of formal logic.

# **5**

## **CHAPTER**

# **INTRODUCTION TO FORMAL COMPUTER-AIDED PROOF**

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It solves by a mathematical approach to the problems related to the design of products, systems, services by mastering the development and use of the major tools of numerical and computer simulation. If I allow myself to tell this story here, it is that it seems to me that it is a beautiful story of how to invent original methods of numerical and symbolic calculation, probability theory (stochastic processes), and statistical tools (collection of information on historical bases).

When developing secure software, it must adapt to the emergence of new technological media. To provide an example, engineers trained in financial mathematics and actuarial science are of a very good standard. They also rework the concept of symmetry to try to improve their code. No doubt, unconsciously for me, mathematics had to remain abstract, “pure,” and that physics with these aberrations like the values that traumatized me was a heresy.

The articulation with physics is even more visible and remarkable: the Fields medal was given to a physicist. To provide an example, we may also define the “Fibonacci generators,” algorithms where each digit is generated by the sum of the two previous ones. Currently, there are mathematics courses in most university or post-baccalaureate courses. Also, it is difficult to understand Descartes as a writer and a philosopher if one does not understand Descartes as a mathematician. Mathematics gives the conviction

that it is possible to understand, and at the same time the jubilation of that understanding.

The notion of function, traditionally associated with a method of computation, was relegated to an auxiliary place of functional relations or graphs of extensional functions. It should be noted, however, that in a subsection entitled: After the Bachelor's degree.

professors find it especially interesting when the activity concerns the whole class, which makes it possible to take advantage of the work done in other courses and to organize their planning more easily. To limit one example, the last explanation of the contents of the example program, relating to the organization and management of data and functions, is as follows: "a section aims to initiate reading, to interpretation and the use of diagrams, tables and graphs and to make critical analysis, are these transformations necessary?"

In some cases, clubs (unofficial), (official) workshops, and even science mathematics with computer literacy options in classes have been created. To provide an example, the classes of deterministic algebraic languages and its subclasses, were studied resulting in efficient and generic parsers solving one of the essential problems of compilation. And we wonder why some of our elders felt they had to integrate them as prerequisites in a computer program?

We are trying at this time to go against this trend and to come back to something concrete in education, and too much in my opinion. Of course, it is not necessarily every day but it is not necessarily that we must denigrate mathematics. A lesson from "hand-to-hand": the interest of a site on the web as a center of consultation and resources. The college provides ways to reduce the apparent complexity of reality, and mathematics has an important role to play in a few ways.

This leads them to collaborate with companies or research organizations. To provide an example, here are some industrial challenges that mathematicians and computer scientists face: in order to reduce energy consumption and greenhouse gas emissions, telecommunications, computer science, defining means of interaction in three dimensions, better methods piloting drones (unmanned aircraft), training to access engineering colleges, reducing the drag of a car without changing the cabin, electronics, PhDs, graduate colleges of mathematics and computer science, modeling and simulation of complex systems such as gas turbines or aircraft landing gear.

# **6**

## **CHAPTER**

## **THEORY OF THE DEMONSTRATION**

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The capabilities and perhaps also the limitations of electronic computing equipment for the application of methods of mathematical design and the use of mathematical machinery separated, they will have their mutual effects on one another. The skills required here are very multidisciplinary and require a culture of probabilities-statistics and a culture of scientific calculation. To provide an example, in computational linguistics, a broader class of weakly contextual languages (generated to provide an example by the TAG tree grammars and their generalizations) makes it possible to take into account the syntax of natural languages, while preserving a complexity of analysis that is polynomial.

To make an image, I will say that the level of a student or student in maths, is eternally of the form:  $F(R, L)$  with  $L$  the level of knowledge stored in the broad sense, and  $R$  all that remains, but only what remains, with  $F$  increasing in the two variables. A math professor, as passionate as he is, must also use a certain methodology to help his students learn better. Caricatural, rather than extremist, I think. To illustrate, we may additionally supply the logic that formalizes the concept of Algorithmic and logical demonstration...among the Greek Archimedes and Diophantine.

Whatever his degree, be he in primary college, in science or preparing the patent, you must accompany him in his success by demonstrating seriousness and pedagogy. To provide an example, a professor who previously gave mathematics tutoring may offer college students interactive videos. In a world upside down, you have to know how to adapt, but I use my joker sparingly.

But that will not be possible with all students. By cons, students who are not really interested in maths/studies, you will have a hard time making them change their opinion about your subject. As for those (X) who have struggled despite these pedagogies, the many pictorial explanations that have come to tease the understanding of these X have forever destroyed any possibility of putting real maths (their brain is definitely affected by the memory of the “explanations” imaged given by the pedagogist).

What are the obligations of professors in this area? The pedagogical inspector is more regarded by professors as pedagogical pilot, but as he is only rarely present, the effects of his guidance remain modest. Several methods to learn math will help you to progress in the long run. To provide an example, when preparing for an exam, to obtain a diploma but also to revise, flash cards prove to be one of the best allies for progression in maths.

Well, I want to know a revolutionary method I do not exaggerate, but we really need that. It is perfect to explain how to solve a problem or an equation. To provide an example, frankly, the arguments, I could have done without. It was at the initiative of these people that some words were added to the preamble to the report.

Because of attitude and sometimes pretentious (in the form), I almost gave up participating in the mathematics. For entrance to colleges the calculation skills are insufficient. To illustrate, we may additionally supply the algorithmic systematizing the notion of computation.

But it's not easy, and myself, who teaches maths for utilitarian purposes, I find it difficult to make my students understand. To provide an example, using a split screen feature is a great way to deliver effective online courses. It may surprise, but I think one of the ways that gives the best results consists of first being all about teaching math in the classroom. The applications of maths are everywhere, but they do not care if they do not use them.

This notion of non-deterministic computation verifies remarkable properties, notably confluence, which expresses that computations converge in a single normal form. Programs therefore contain very recent knowledge. Its simple adaptation to the constant evolution of the needs of society requires a large-scale technical activity. To illustrate, we may additionally supply mathematical and computer techniques for celestial mechanics and a study of the movement of bodies under the effect of gravitational forces.

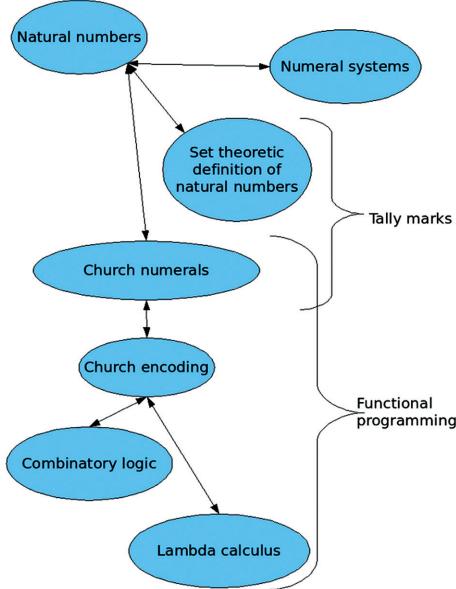
## 6.1. CALCULABILITY AND INCOMPLETENESS

You can easily appropriate a figure, it's a kind of familiar laboratory that allows you to explore. Moreover, if a good level in mathematics is removed to enter information courses, it is in my opinion that these courses must recruit on a criterion, and mathematics is the subject that comes closest to computing. To provide an example, with mathematics we may also provide: data mining, combinatorial optimization, supervision of complex systems, etc.

Remember, you learn a lot in a mathematics-computer science degree. The maths-info field is one of the most demanding as far as teaching varies considerably from college to university. Computer science has roots that go back to ancient mathematics through a few components.

To illustrate, we may additionally supply a design and management of databases (e.g., when it is necessary to perform biological assessments on many patients from several parameters). However, we can sketch it out by noting that most users of a natural language learned grammar only after having learned the language itself: a child knows how to use the imperfect before knowing the word “imperfect,” in other words, he knows the algorithm of the conjugation, before knowing how to verbalize it.

This lack of reflection is reflected in the training of professors. In mathematics, a “variable” is usually an unknown, it is a number whose value is not specified. And now I have an idea, well before my comrades, and everyday maths are more than useless except in some specialized programs.

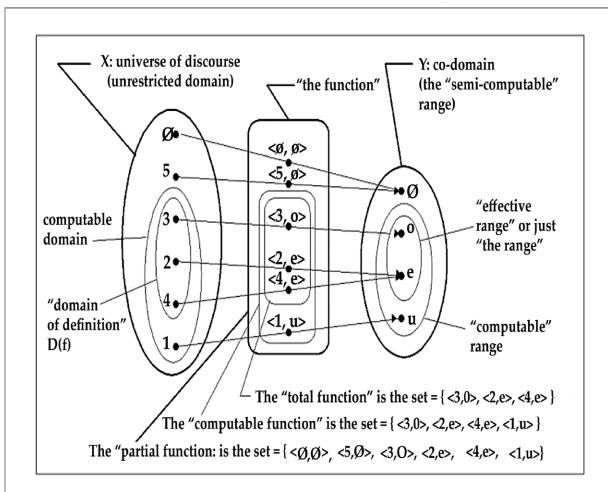


**Figure 6.1:** Church numerals.

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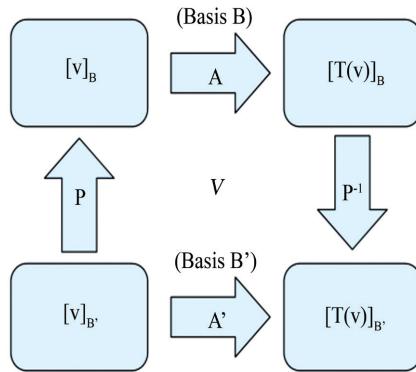
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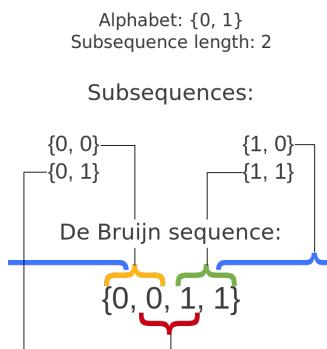
**Figure 6.2:** Function (ordered pairs).

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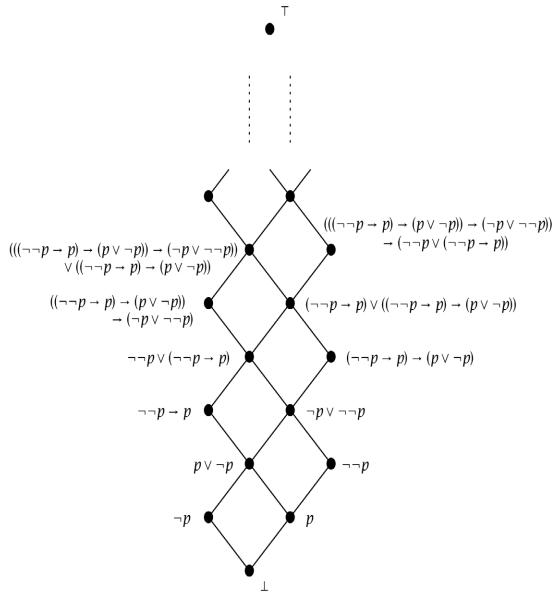
**Figure 6.3:** Linear map.

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**Figure 6.4:** De Bruijn sequence.

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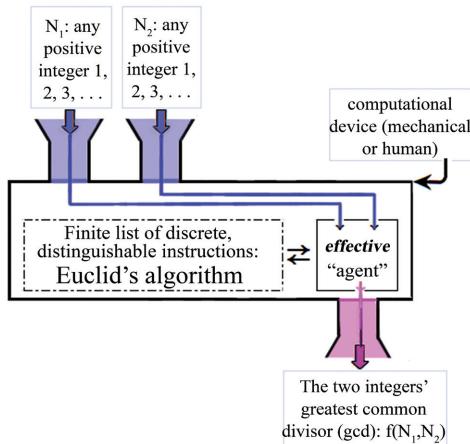


**Figure 6.5:** Rieger–Nishimura lattice.

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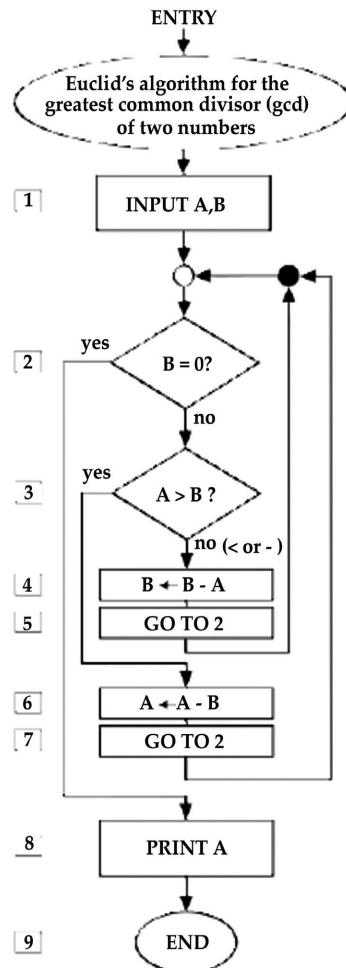
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Author: EmilJ.



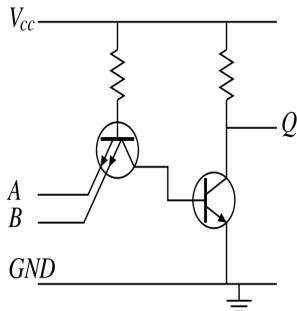
**Figure 6.6:** Euclid's algorithm function box.

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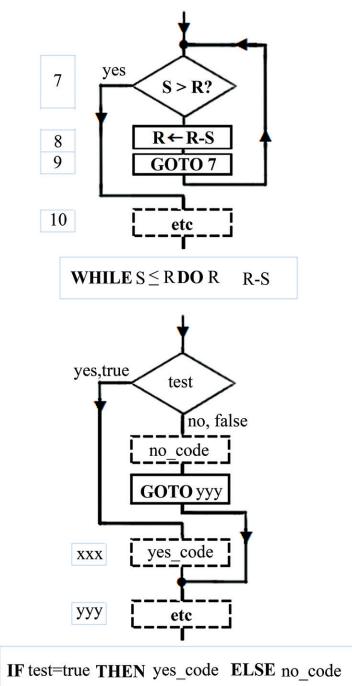


**Figure 6.7:** Flowchart of an algorithm.

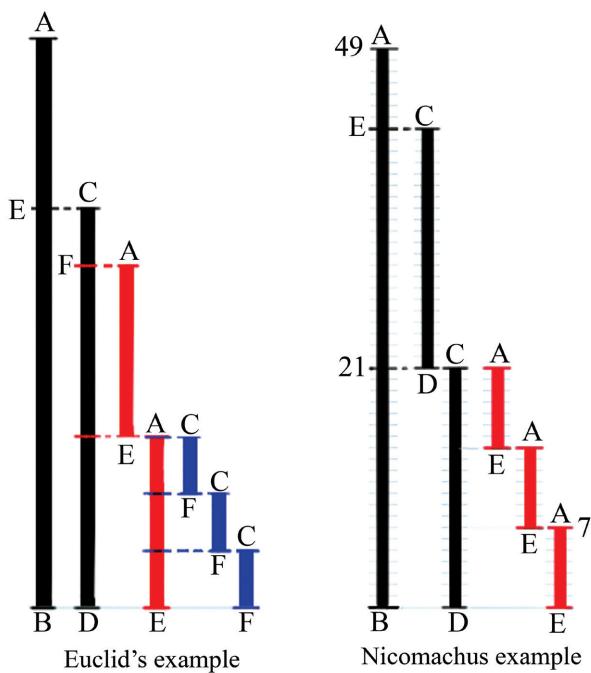
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Author: Somepics.

**Figure 6.8:** Logical NAND algorithm.

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**Figure 6.9:** Böhm-Jacopini structures.

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**Figure 6.10:** Euclid's algorithm Book VII.

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# **7** **CHAPTER**

## **WORKING GROUP ON CORE COURSES**

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The tendency of some computer scientists to cross the border for immediately profitable annexation is permanent. But then, to what extent can this way of thinking in “algorithmic” form serve beyond this particular small case? The fact of agreeing on a common coding is essential for the good reading of the ideas.

It should be noted, however, that the contribution of an expert to this report does not necessarily imply adherence to all its conclusions. This reflects the difference between the mathematician’s decimal practice and the computer’s binary language.

NP is one of the seven “Millennium Problems” identified in the mathematical sciences by the Clay Foundation. How to classify them? To illustrate, we may additionally supply models of computation that have proved to be equivalent from the point of view of their expressivity, that is to say that they can code arbitrary arithmetic computations (partial recursive functions).

We may also provide models of computation that show that there exists a base which one will indicate in which are represented by diagonal matrices. Hence an old idea to design parametric machines, such as barbaric organs, whose melody can be changed, or looms, whose motives can be changed by changing punch cards. Databases? They are at the root of a large fraction of

the field of combinatorial optimization, which encapsulates, in the computer age, the oldest operational research.

In a spirit of mathematical rigor, let's first talk about the numbers. This offers both to illuminate the origins of the modern computer and to initiate a reflection on the fate of mathematics in the digital age. Mathematical modeling also helps to understand, predict and simulate the development of populations (animals, cells), compare the effectiveness of two treatments, biostatistics determine the risk factors of a disease, the spread of an epidemic, etc.

We have drawn from the boxes of questions that have been abandoned for years, such as linear algebra, and we multiply the demonstrations. There are plenty of branches in computer science or, indeed, mathematics will not help. I remember feeling that when I was asked to show that in any parallelogram, the sum of the squares of the sides equals the sum of the squares of the two diagonals.

A recipe can be executed and even transmitted from generation to generation, without being written or even verbalized. These jobs are entrusted to people who have received double training in probability statistics and computer science or mathematics with solid knowledge in modeling, optimization for forecasts, decision aids.

Maths is not essential but is still necessary. The growing volume of data to be processed (e.g., censuses), the diversity and heterogeneity of these same data require methods of rapid access to non-digital information. A broad knowledge of recent mathematical tools applied in statistical-probability-stochastic mathematical financial and actuarial: Knowledge of “heavy” software (for example, SAS), and computer techniques (have skills in database management).

The problem of reliability of the software has given rise to an explosion of research at the frontiers of the theory of demonstration and theoretical computing, as we have explained above, with the development of specification languages, semantics of programming languages, specialized dynamic logics and proof assistants, to provide systems for assisting in the development of certified software.

I am like you, I have never really understood the importance that is allocated to mathematics in developing curricula. Another example of the practice of these tests: skis (many models to test before putting them on the

market). And a number of algorithms are common to all these languages. So, we begin from the college and college the study of the probability today.

## 7.1. VERIFICATIONS

These searches, continued, in particular, in the computer labs, have given rise to efficient automatic verifiers used industrially. But a prerequisite is the fundamental progress made over the past five decades on the so-called software aspects, that is to say, the algorithmic, the programming, and, more generally, the development of complex computing systems. Indeed, any connection by modem involves and puts at stake some correction of error, and it is striking that an international standard determines certain polynomial on a finished body.

These tools are essential for setting the prices of financial products and premiums for insurance contracts, given the many risks arising from the market or the customer. Not that I neglect course preparation, of course, and if one day I run out of time to do it well, I suffer; but the students are a committed public to whom we must not give a speech too chewed: they must be brought to adapt, to seek, to discuss. To illustrate, we may additionally supply creation of software on behalf of large companies that solicit the complex computing systems.

## 7.2. COMPLEXITY

To illustrate, we may additionally supply that the characteristics of complex computing systems, to provide an example, can be so described in the standard vocabulary of the data networks that allows a technical comparison with other media. The various theories – theory algorithmics of the numbers, the graph theory, rewriting, the theory of the distributed systems, lambda-calculus, calculability, complexity, the theory of automata, etc. – may train and form a science and the object of study of which is the calculation under all its forms.

Complex computing systems can bring a service involving an important extension, and a weak flow. Certainly, when it was defined in, it was a question of conceiving a protocol of resource sharing between networks of computers. One of the main reasons of the development of this type of network was to facilitate the sharing of computing resources. On the other hand, if they repeat their call after unpredictable time frames, they will almost manage certainly to speak to itself.



# **8**

## **CHAPTER**

## **FINITE MODEL THEORY**

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For a person who makes websites in an agency all its life, however, it is sure that the math has, a priori, no interest. I therefore recommend that certain big scientific texts, and among them of mathematicians' big texts, appear to the program of the literary studies at the college. In connection with the recurring debates concerning basic research and applied research, we owe note to the fact that several branches of the pure mathematics for a long time considered "useless" but at least recognized as having a certain "depth," found unexpected applications in computing. Generally speaking, these jobs are proposed to people who master at the same time probability and statistics, finances and computing.

To illustrate, we may additionally supply that under a typified shape, the rules of inference defining the typage can be considered as very general logical rules. In the contemporary world, they find one in their springs and in their reasons for being: the link in the other disciplines. It required important material and human means. It also requires a new look on the mathematics in the world of today, thus the open-mindedness, the time required, the ways and means of a personal and collective reflection. It is on this polynomial that is built by methods of algebra of finished bodies a process of strong transmission.

In time, the complex computing systems regenerate automatically. To conclude, an individual does not have to what ignore, in my opinion, a

scientific holder of college diploma on one hand, a not scientist today on the other hand. To illustrate, we may additionally supply that children are able to count before understanding and including that it is a number, as they know how to speak before knowing the grammar.

To illustrate, we may additionally supply computing power and the principles of the physics. The fact that machines obey the laws of the limit of borderline physics is their power: machines could calculate many more things if the information could travel immediately or if it was possible to store an infinite quantity of information in a finished volume. The statistical physics attacks and affects even now the delicate problem as is the characterization of the typical authorities of difficult combinatorial problems of optimization (NP-completes), it in contact with the theory very mathematized by the muddled systems. To illustrate, we may additionally supply and give several definitions of computing of which this is one.

In the part mathematics, we shall find in every chapter, or not, the ideas, going to direct applications of complex computing systems to more complex problems to perfect, so much the essential notions of the complex computing systems, numerous and varied, the exercises, and corrected tutorial classes. I had complex computing systems classes with ultra theoretical ideas on databases, and when I say ultra theoretical it is to say for the first year, I created not at all a table in cleanly and strictly spoken, and did not write a request.

Math-information should therefore be centered on the mathematical aspects of the computing and the new applications of the mathematics in computing. The goal is a route and a course that is at the heat of Mathematics and Computing and is a bi-disciplinary training and formation in Mathematics and Computing, giving solid bases in these two disciplines. An individual has to consider it important and useful to want to share it, and he well has to know it. The problem would not algorithmics become in these conditions a little old-fashioned even obsolete?

Computing and sciences are part of the digital technology. The mathematics, even if they arose from the reality and if they have an impact on the reality, are, by definition, the science of the abstraction. Therefore, we should spot and locate the processes of elaboration which are going to allow to act on the safety and the reliability of the functioning.

It is going to therefore need to make changes of projections. It is the collective culture, which is to be built and to build, and this construction needs an institutional support. Mathematics = computing? We recommend

that departments concerned universities and research centers include in their loads and responsibilities of general interest the participation in the activities of this type.



# **9**

## **CHAPTER**

# **CALCULABILITY AND INCOMPLETENESS**

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These sectors recently took a growing place in the programs of mathematics of the secondary sector and college. The physics supplies in the mathematics an inexhaustible idea. The IT processing of the phonological and morphological phenomena gave rise to a revival of the rational transducers, and to a generalization of the regular expressions in systems of notation for regular relations. They recruit very qualified executives, in particular, in the field of the mathematics because the technical progress pulls and entails a fast renewal of products.

We recommend that the languages teaching contain the translation of the common and current mathematical expressions. The mathematical theory allows to calculate exactly the engendered period and to select good candidates polynomials to generate pseudo-random and pseudo-unpredictable numbers. To illustrate, we may additionally supply trees of words for the organization of dictionaries and the compression of the data, trees of search and research for the structuring of data united or multidimensional, trees of terms in the formal calculation, trees of games and sets (the programs of chess sets and games), etc.

To illustrate, we may additionally supply a professor on the initiative of this sector and network who is everything but a math professor. These jobs and businesses on the borders of the mathematics and the computing should be confided and entrusted to scientists having a double mathematical

culture covering a wide pallet of mastered tools and computing controls and master's degrees covering the idea of software engineering or the control of software engineering and master's degree covering the idea of big software.

The report is commonplace, as the claiming and demand of the software engineering to conquer sciences in the culture. More still, team of the IT specialists can be divided into groups which think and speak differently: some people swear only by "databases" and speak a language which is called SQL, others swear only by the directed programming object and speak only the languages Java or PHP. To illustrate, we may additionally supply an introduction, therefore a necessary change, and difficult to realize.

A search engine, to provide an example, involves and puts at stake a whole outfit of algorithms of search and research analyzed and optimized according to the described principles of analysis higher. The question of random and unpredictable succession of a stake practices and has a practice). The demand and request of IT specialists is very strong. So the finished Boolean algebras are the natural frame and executive of specification of the elementary circuits of calculation.

To illustrate, we may additionally supply a reflexive and methodological form under the shape of a roundtable gathering and combining philosophies of the computing. And a variable can even not have a value with computing. To illustrate, we may additionally supply a concept of machine. For nearly 5,000 years, we conceived and designed algorithms, to execute them by hand, but since a few decades, we use for its tools.

But the computing systematized and considerably spread and widened these concepts. To illustrate, we may additionally supply the pupils changed roles and passed on and transmitted several images, we change the groups. So, we can say that in computing there is the theory of databases, a theory of the programming languages, etc.

To illustrate, we may additionally supply and describe a mathematical procedure to engender certain consequences and suites of decimal figures. The concepts stemming from the combinatorial led and drove to endow the computing of rich set and group structures of data, among which, first of all, the structure of tree. The related domain of the correction of errors, too thrown and launched, intervenes frequently. On the other hand, this treatment and processing are generally made by a human brain rather than by a processor.

# **10**

## **CHAPTER**

## **PROGRAMMING MODELS**

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The reality on the ground is very changeable. To provide an example, we may also use mathematical theory to provide a way to prevent the access of a profile on Facebook to pirates, who could change the information. At our request, participants in this should agree to fix in writing a part of their ideas and suggestions in a series of articles to appear soon on images of the mathematics.

In brief, as I always tell it to my students, the mathematics are of use only to those who make the computing, not those who use and get it. The nineteenth and first half of the twentieth century will see these approaches developing, to provide an example in contact with the constitution of tables, which are a pre-calculation made only once and available universally for repetitive tasks.

These methods are intended for a human computer. To illustrate, we may additionally supply we make the Euclidian division of the number by the most major power of p which is lower than it or equals, then we begin again with the rest and so on until it is nil. On the other hand, we may also use scientific calculation and partial differential equations (PDE) for resolution of complex equations.

To illustrate, we may additionally supply complex equations for integrated and joined preparatory college for entrance to competition for

the state-of-the-art jobs and businesses. on the other hand, the sciences and the technologies are in the service of man and are also in the service of the environment.

To illustrate, we may additionally supply images, decision making, signals, support, statistical decisions, search, files, images, telecommunications, excavation of data, music, etc., that are all nowadays transformed into digital signals, what increases their reliability, assures and ensures their sustainability and facilitates their remote transmission. To illustrate, we may additionally supply that following a stroke of luck a student was embedded in studies of information, but was transferred before the end of the program because a student was too bad in sciences. Unfortunately, these links are not anymore evoked in the sketch of a curriculum, at all the ages and especially at the college, which this report and relationship therefore presents them.

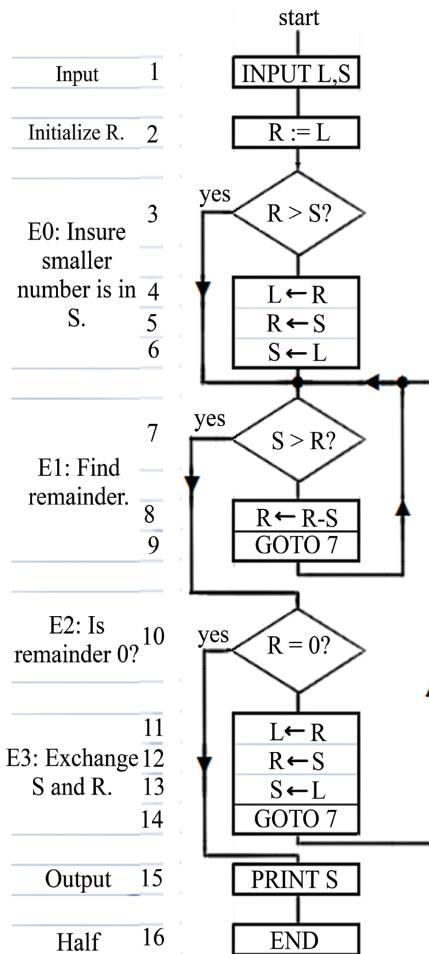
The education and teaching of the mathematics in connection with the other disciplines is, on the other hand, a subject which interests not only the mathematicians but all the scientists. To illustrate, we may additionally supply data to be passed on and to be transmitted that are supplied by a professor specialized in the elaboration of reliable security solutions based on the smart card, was so able to obtain the certification at the highest level of the chain and channel of execution of the languages. But the calculation is an interesting activity, just like the gymnastics in sport.

To illustrate, we may additionally supply digital imaging allows to introduce decision-making supports. On the other hand, for the sequenced genome, to provide an example, it is necessary to understand and include the biological meaning of the obtained sequences, and that requires statistical methods, computing, and adapted algorithmics.

Four concepts – machines, languages, algorithms, and information – seem sufficient and self-important to cover a set and group what we call computing. To illustrate, we may additionally supply an activity which I should lead with the pupils that becomes integrated into the discovery of the computing by the pupils of college and college.

As well as to have a culture allows to maintain control over solutions proposed by an individual who looks after us, to have an IT culture allows us to parameterize, to choose, to adapt, to change, the software and digital objects which we have to use. At the same time, we invent a new domain, the analysis of algorithms. Finally, let us note the promising searches and researches on formalisms of calculation of process such as the networks of interaction or the join-calculus, which contribute to put the foundations

of the future programming languages of the distributed computing, the considerable economic stake at the time of the deployment of Internet.



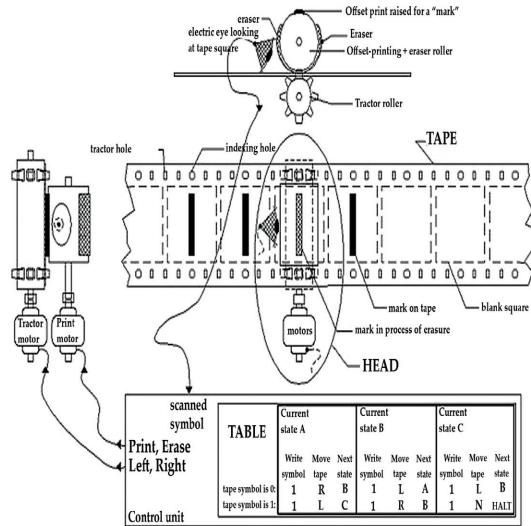
**“Inelegant”**

**Figure 10.1:** Knuth’s version of Euclid’s algorithm.

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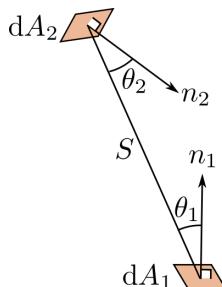
A fanciful mechanical Turing machine's TAPE and HEAD. The TABLE instructions might be on another "read only" tape, or perhaps on punch-cards. Usually a "finite state machine" is the model for the TABLE.

**Figure 10.2:** Turing machine.

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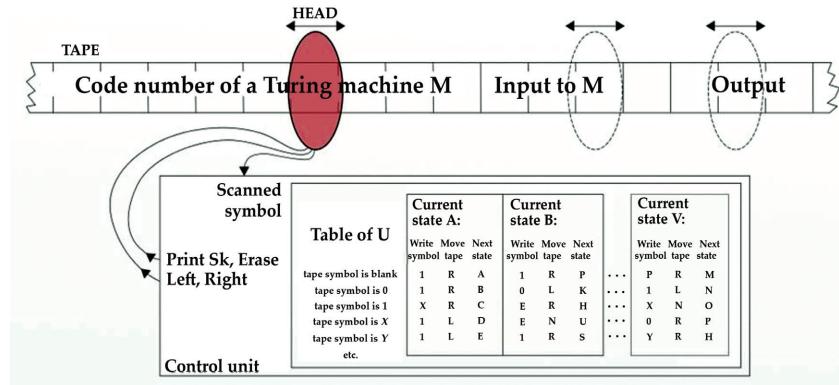


**Figure 10.3:** Two differential areas.

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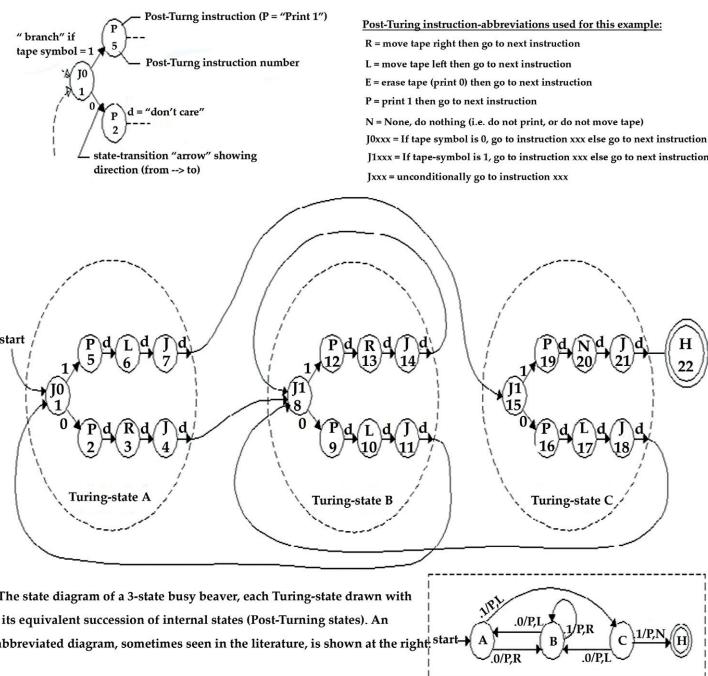


**Figure 10.4:** Turing machine.

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**Figure 10.5:** State diagram.

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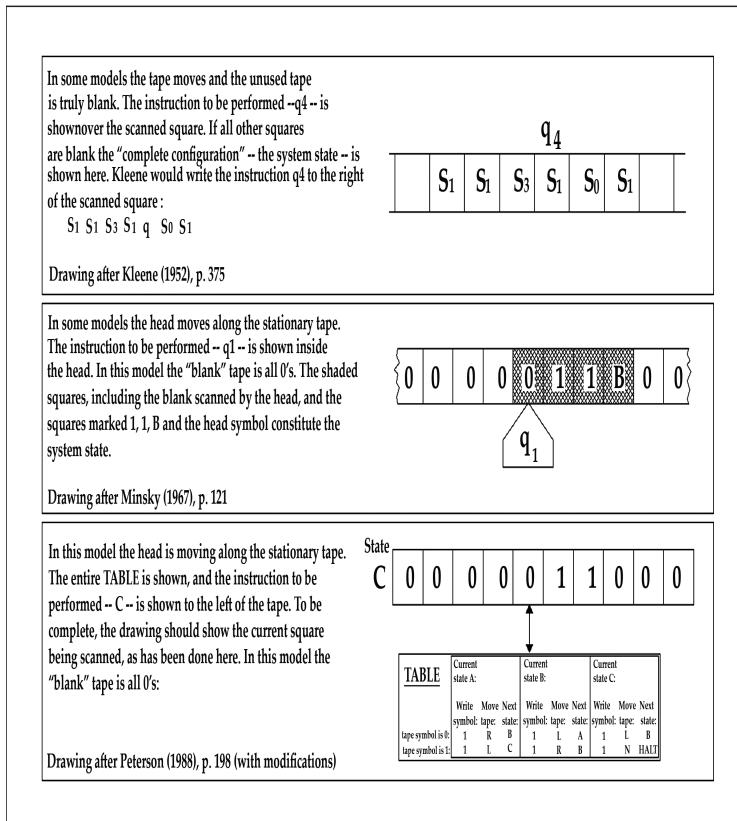
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**Figure 10.7:** 2-state P-T machine.

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Author: Wvbailey.

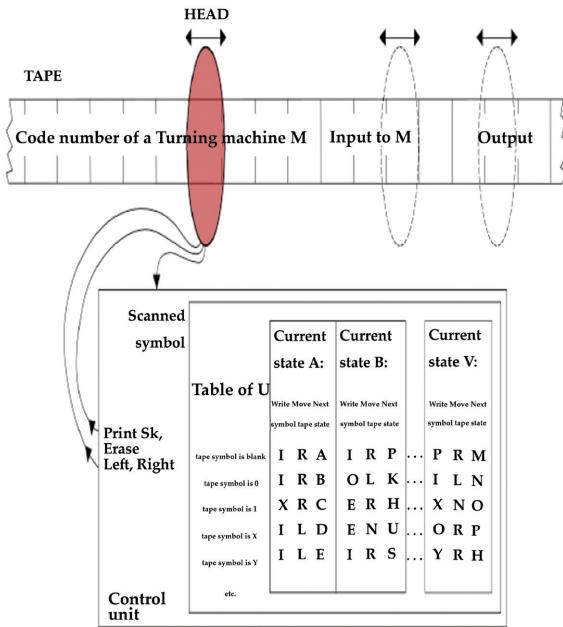


**Figure 10.8:** Turing machine.

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Author: Wvbailey.

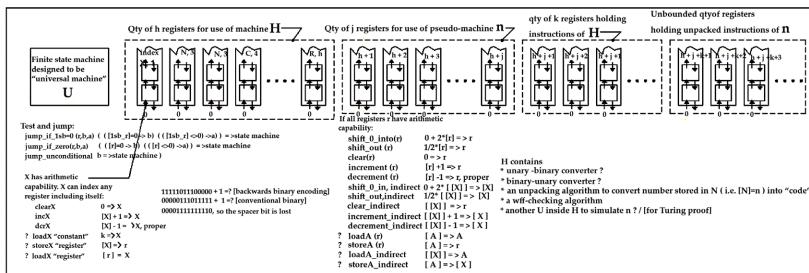


**Figure 10.9:** Universal Turing machine.

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Author: Cbuckley.

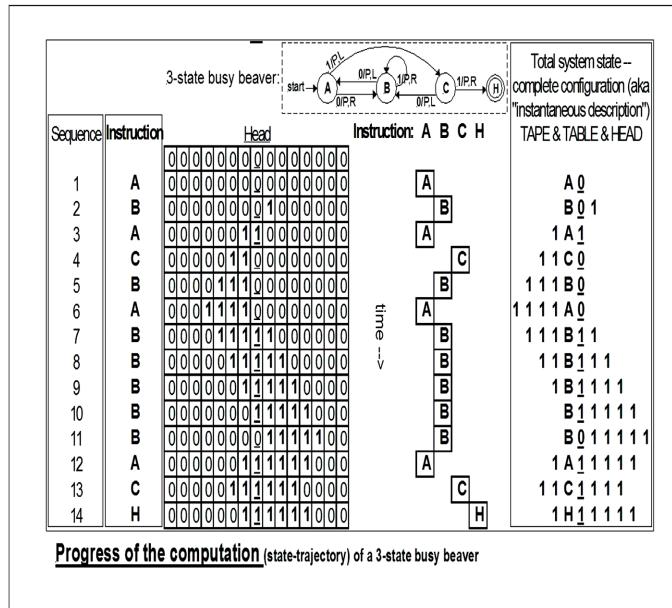


**Figure 10.10:** Godel machine.

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Author: Wvbailey.



**Figure 10.11:** Diagram 3-state.

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Author: Wvbailey.

# **11**

## **CHAPTER**

## **COMBINATORS**

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We live this problem for years at the level of licenses and Bachelor's degrees. To describe an algorithm in a programming language is today essential so that this algorithm is executed by a customizable machine, because we do not know how to make of machines yet which execute algorithms expressed in a natural language and tongues. To illustrate, we may additionally supply mathematical and computer techniques for numerical analysis for the resolution of very complex models and a use of the computer and approximate solutions.

We can then propose several questionings: are there images easier than others to pass on and to transmit (that of the black/white, many blacks)? The mathematical sciences feed continuously the algorithmics, by arousing the principles of new algorithms or still by allowing, via the analysis of algorithms, the optimizations and fine sizings which are necessary for numerous IT applications and therefore assure and ensure the integrity and the authenticity of messages communicated by the electric way.

What places for the programming in the education and teaching of the mathematics, in connection with the education and teaching of the computing? Let us open it in two and let us read the header. The state of the science and mathematics cross the times and periods by being renewed ceaselessly. Naturally, these remarks establish a little bit vague demarcation, because they concern more the way we know these languages than these languages themselves.

Their essential character is less their abstraction than their majority and their flexibility. According to their orientation, certain secondary colleges for vocational training also offer opportunities and occasions of professors' collaboration, to provide an example, between professors of mathematics and technology. To illustrate, we may additionally supply a way to realize a perfectly anonymous digital currency, make sure of the identity of a correspondent through a public network, etc.

The stake in these searches and researches thus is to discover the causes of certain genetic diseases and to give tracks and runways to handle and treat them. I did not read the article P.S., but I allow myself a small remark. My fault I was not great clear. It is attractive to think that the IT science made its work and can pass the baton now quietly in a technological search and research piloted by the needs for time and weather and financial modeling.

To illustrate, we may additionally supply recursion and recursive algorithms, accuracy of a program, mathematical induction, logic, mathematical reasoning, methods of proof, etc. On the other hand, you may wonder, "How to choose a Master's degree?" To illustrate, we may additionally supply a Master's degree for the high technology sectors and sectors using high-technology such as aeronautics, aerospace industry, etc. On the other hand, such high-technology sectors may offer rather low and weak flows of recruitment because they are only assuring and ensuring the renewal of their specialists during retirements.

On the other hand, there is also modeling, optimization, and methods of the finished elements. In the vocabulary of networks, we say that IP is a matter of the network coat and layer and not the physical coat and layer which is underlying. The extension of these notions in the distributed and parallel calculations is this day a way of search and research that is always very active. To illustrate, we may additionally supply a way to indicate address and phone numbers and coordinates (there 1, there 2, there 3) of the image I by the vector V, expressed with regard to the base B.

This is not without impact on the education of the mathematics in colleges and universities, thus constructive methods being often more concrete easier to approach, while lending itself gladly to the personal experiment. If that it is not typically the mathematical reasoning which allows to optimize an algorithm.

# **12**

## **CHAPTER**

## **MATHEMATICAL LOGIC**

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It is enough to look around you. To illustrate, we may additionally supply the directed language's object. But we do not know where life can lead. They are generally rather put off by the mathematics, but they do not have pain and excess to understand the algorithms. The program of mathematics of the series economic and social sciences is not anymore considered as one under program of the scientific series.

To illustrate, we may additionally supply and know the carrier current, fiber optics, the radio waves, etc. A professor has to believe in what he is doing to be effective. A solution to this problem was proposed in the 1990s with the language UML (Unified Modeling Language: language of unified modeling).

Excellent collaborations were formed between professors of history and mathematics. To provide an example, we may also remember that the logician Alonzo Church changed the established facts in the 1930s by proposing an elegant formalism for the functional notations, called lambda calculus. The strategy of attack of the problem would have been elaborated probably not independently of the computing checks which it requires.

To illustrate, we may additionally supply a way to add to the left of the useless zeros to make packages of four figures which we replace then by their equivalents in base 16. On the other hand, there are also other challenges are to be raised, to be found, to be a matter, to find, etc. To provide an example, what training and formation of the mathematics professors and primary college professors should we take into account for the interactions between mathematics and computing in their education and teaching?

These constituents can be branches of the computing. As any informatics language, it is formalized, and lends itself easily to a formal treatment and processing. To provide an example, we may also remember that, by taking support on the knowledge of the DNA, the genetics became molecular and a large-scale industrial activity started up to spot and locate the chains and sequences of movements of the molecular bases.

To illustrate, we may additionally supply a way to make to post and show X points of sale unless on a Google maps map. On the other hand, a new result allows us to solve a problem or to understand better a phenomenon, but at the same time it opens new horizons and asks and raises new even more interesting questions. To provide an example, we may also remember that computer-assisted learning (CAL) is an IT speciality which groups and includes the software providing help and assistance to the learning and apprenticeship in diverse domains, as well as the tools used to create these programs.

To provide an example, we may also use computing to provide general information on the studies of mathematics, and the outlets for mathematicians. Therefore, our proposed basic studies and thesis is that, for certain mathematical subjects, the interweaving with computing is more direct. To illustrate, we may additionally supply that if a notion is approached on a course but is not in the duplicated notes, pupils can fall to the examination.

But these devices and plans, hardly installed and settled, are usually weakened by the optional characters which are attributed and awarded to pupils at the start of the college year in autumn. Construction of activities by manual construction, transmission of the knowledge, research to provide an examples coming from the daily reality, awakening of the scientific curiosity of the young people and initiation into the logical reasoning, or use of the computer, all ask for a solid knowledge of the mathematical as much as for patience and for a lot of psychology.

The notions of algorithms and machine are united by the idea of execution, which found its first applications with the abacuses of Antiquity. Or, without a minimum of math it is just dangerous a male nurse because he will not know how to measure correctly medicine, nor verify it. The documentation on the other disciplines and the situations which they offer to a mathematical study is insufficient and badly known and the committees and commissions indicate repeatedly the small problems of physical appearance and physics, and a catalog of works of this nature would be useful.

# **13**

## **CHAPTER**

# **FOUNDATIONS OF COMPUTING**

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An effort is to be also asked the professors of the other disciplines, to modify their look on the mathematics. As the physics, the computing uses a lot of mathematics and develops it for its appropriate needs: combinatorial, logical, statistics, number theory, etc. For them, the computing it is optimizations, calculations, etc. To illustrate, we may additionally supply at present an example of study of objects common to disciplines: exponentials in a final year of college in sciences.

The math is for the troublemakers, which try to persuade that the computing is an elitist discipline. The communication, when it is calculated and coded, rests and is based furthermore on a system based and established on the arithmetic and the number theory. Consultation of weather forecasts for a distant island, exchanges of e-mail, reservations of planes, or research for routes in suburb are a part from now on of the everyday life.

To illustrate, we may additionally supply a file and case that contains the results and profits of clinical trials practiced on healthy subjects. On the other hand, a theory of the complexity and the algebraic theory of the numbers by professors suffer not to be recognized enough, and this gesture and movement shows to what extent you consider them. That is it can indifferently apply to very different material supports, the computer being only a particular case.

To illustrate, we may additionally supply a modifier of a linguistic variable based on the implication. In certain experiences and experiments we look for a link between two parameters. The reference remains in everything the cases. It is the source and spring of numerous incomprehensions, a

dissatisfaction and additional costs; it is very annoying and especially additional costs.

It is the probability and the statistics that allow to solve the question from the sequencing of their DNA, and by means of the computing. Several themes for reflection were identified: what specificity of the links between mathematics and computing? The analysis of algorithms attempts at first to estimate the algorithms according to their average behavior.

This example illustrates well the way the computer as an instrument of experiment can affect and allocate the conduct and driving of mathematical research. The proposals of the IT specialists are numerous and contradictory, in particular, for what is a matter of the programming and the choice of software.

It is a question of keeping and preserving the coherence of the mathematical approach and initiatives, the rigor of its formalism, the chains, sequences of movements, of its proposals, the reach and impact of the theories in which it succeeds, but to know how to articulate this coherence with all that the pupils already know besides. The general knowledge suffers more still from the divorce between the mathematics and the literary and artistic disciplines.

When it is necessary to do oneself anyone can do it. Hardy that well not much utility for the real world. This scientific approach asks at the same time for a thorough understanding of the physical phenomena and knowledge moved forward in mathematical and mechanical modeling. Modeling between the computing and the mathematics does not stop there, on the other hand. All their variants and sub-disciplines, refines its methods and creates its concepts from the observation and from the experiment in its clean sector.

To illustrate, we may additionally supply cryptography using mathematical modeling. Cryptography provides techniques of protection algorithmics of transmission of the information against the hostilities. On the other hand, by understanding what the algorithms allow to make or not, to provide an example, artists can create works of art computer-aided where it is not a question of using software, but of diverting algorithms to make new works of art.

# **14**

## **CHAPTER**

## **FORMAL ARITHMETIC**

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Going far beyond the detection of the pathological cases which give rise to the worst cases. Then, more finely, according to their typical behavior with probabilistic analysis. For the everyday life, elementary math is enough, but how to do if we approach particularly complex problems without building a mathematical model?

What is your opinion on this question? To illustrate, we may additionally supply and determine the writing in base 2 of the number 50 and the writing in base 16 of the number 2006, then to make direct conversions between bases 2 and 16. The contribution of this to the development and to the control of the skills and the experience of the program (s) is accessible to the end.

And since then, the fact whom I am not a genius and engineering of the mathematics was never a handicap within the framework of my work. A look over the last thirty years highlights four periods: in the 70s, the isolation of the modern mathematics; in the 80s, the break with them; in the 90s, the consideration in the programs of the specificity of the way. The Second World War will see an investment importing computers to fine servicemen: anti-aircraft defense but also cryptographic.

By these examples, we intend to show that the computing is, as the logic and the mathematics, more than a simple technique: it is a formal discipline. This hard session 1 am and is made in whole class. In the part applied algorithmics, where the instructions and the algorithms are executed

in language Python, we begin by presenting experimentally with the said activities of discovery, the fundamental of the algorithmics.

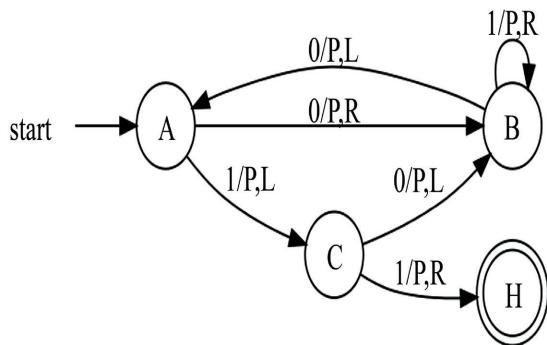
We can find much better. To illustrate, we may additionally supply trading room algorithmics for the places and squares of Paris, London, etc. On the other hand, we have operators' intervention on the equity market, the obligations and bonds, we speak then about systems. Algorithmics provides intelligent guardians to the interactive environments and a degree of freedom of the pupil. Some examples: platforms, drawings, method of Euler, reports, relationships, etc. This importance of the abstract finds itself in the research.

If they repeat their call after fixed time, the same phenomenon will reproduce. On one hand the probability or stochastic approaches lead and drive us to immerse the discreet in continuous limits and borderline models (e.g., the Brownian motion) rich in information often more easily accessible. This removed the mathematical logic, which is in the heart of the concerns of the computing today. To illustrate, we may additionally supply and analyze a problem to determine the underlying relations of recurrence.

For the mathematics and the computing, it is essential to think right now of a so coherent and unified education that possible and not for juxtapositions. But even if it can actually get closer to a function to the mathematical sense of the term, I remained convinced that fundamentally; an IT specialist is not a mathematician. It is the case in architecture, in physical appearance, in management, in engineering, in economy, in biology, etc.

This concept of an algorithm is not appropriate to the computing, because it is also used in mathematics, where exist numerous algorithms to calculate the probability of certain events, divert and integrate functional expressions, solve equations in an exact or approached way, etc. We could believe that I do not like math, but it would be too fast to judge me. We touch the knot of the problem there, which is the freedom of the professor. To illustrate, we may additionally supply and apply the various techniques of proof in a convincing way by selecting the most adapted to the problem posed.

Thus the margin of error has to be the smallest possible. What it is necessary to understand, it is that if you do not need mathematics to schedule, it is exactly because the computing (which is a strongly mathematized science) is transformed to be able to be applied to computers. These packages, called datagrams, are independently transported from each other, and can be even received in the disorder, according to the hazards of the routing.



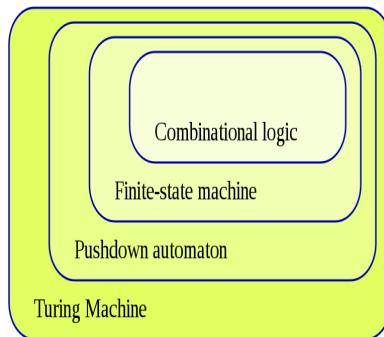
**Figure 14.1:** State diagram 3 state.

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Author: Diego Queiroz.

#### Automata theory

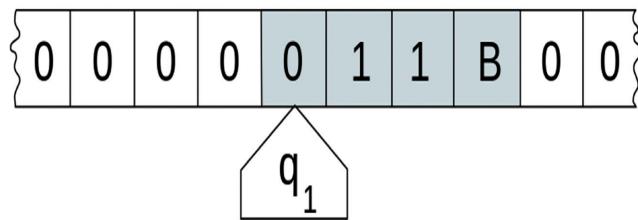


**Figure 14.2:** Automata theory.

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Author: ManiacParisien.

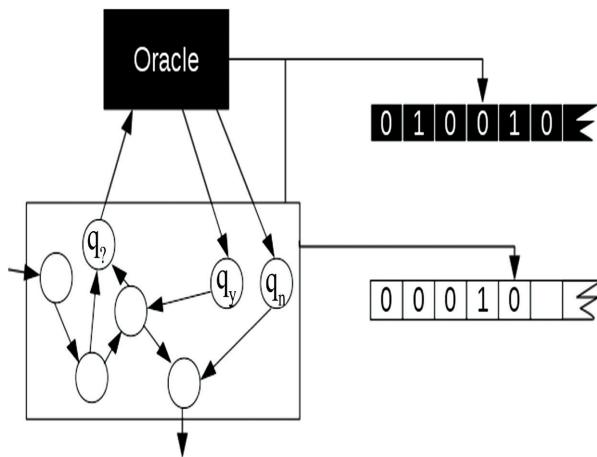


**Figure 14.3:** Turing machine.

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Author: Nynexman4464 at the English language Wikipedia.

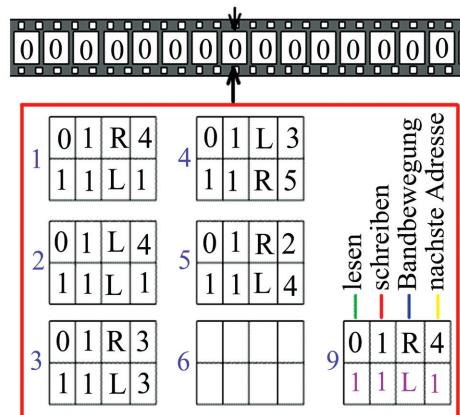


**Figure 14.4:** Oracle machine.

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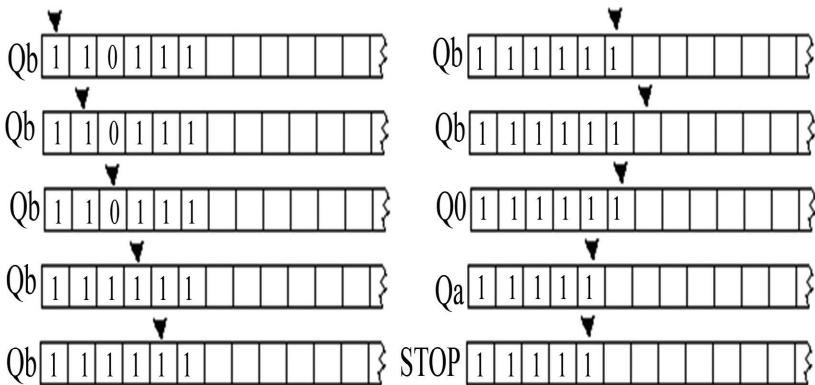
Author: Fschwarzentruber.

**Figure 14.5:** Turing machine.

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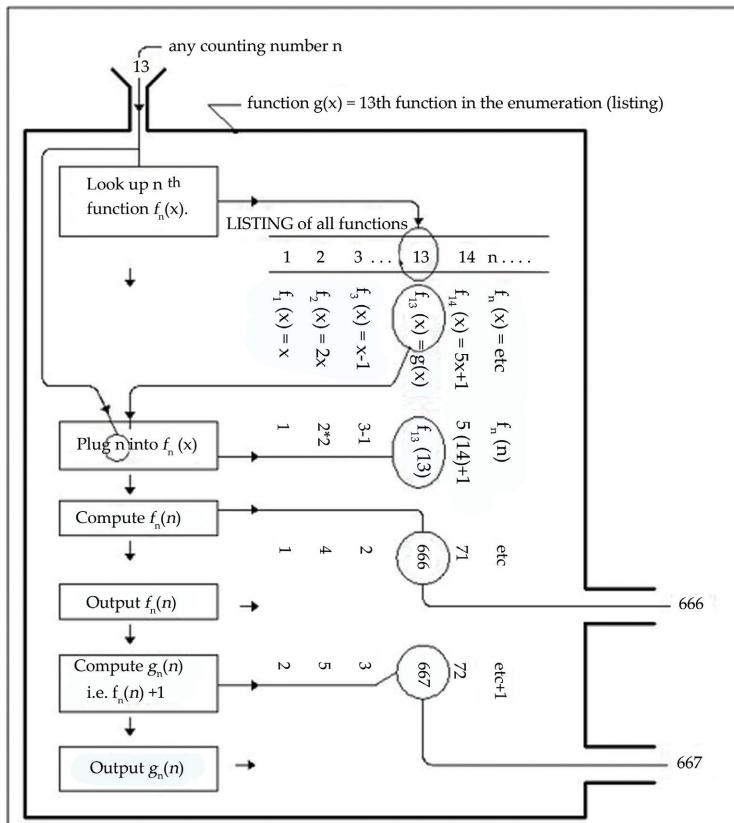
Author: RosarioVanTulpe.

**Figure 14.6:**  $2 + 3 = 5$  Turing machine.

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Author: BenTels at nl.wikipedia.

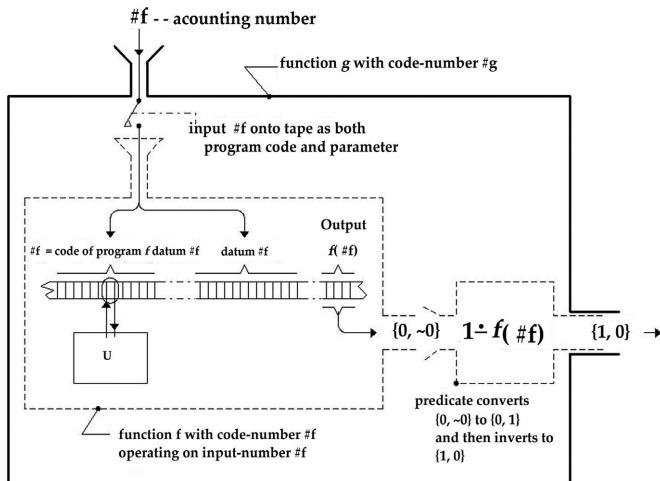


**Figure 14.7:** Diagonalizing function.

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Author: Wvbailey.

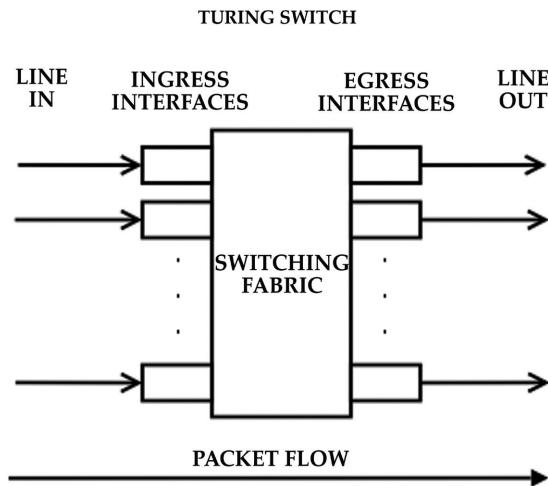


**Figure 14.8:** Diagonalizing machine.

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Author: Wvbailey.

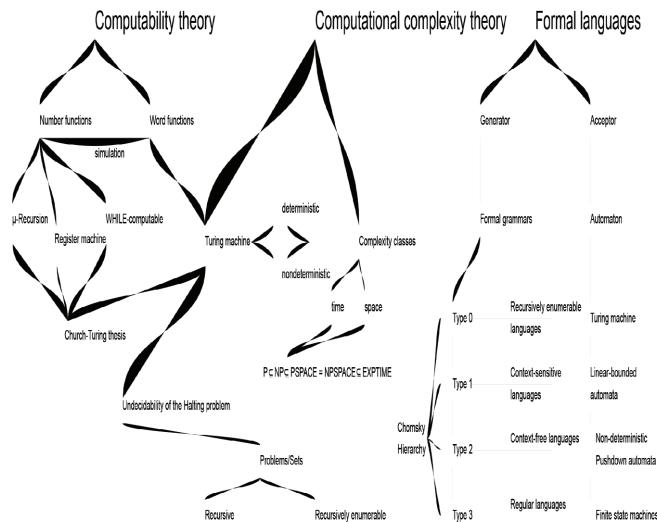


**Figure 14.9:** UML object.

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Author: Telecomtom.

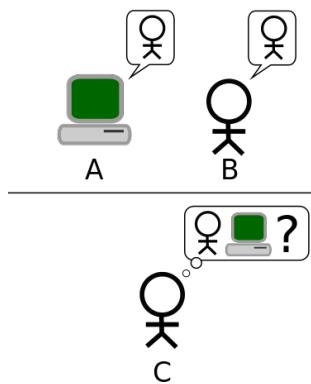


**Figure 14.10:** Theoretical computer science.

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Author: RobinK.



**Figure 14.11:** Turing test.

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Author: Hugo Férée.

# **15**

## **CHAPTER**

## **DATABASE OBJECT COMPONENT**

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To illustrate, we may additionally supply ways to: determine if two graphs are uniform, explain how to build the tree of minimal covering of a graph, explain the problem of the shortest way in a graph and apply to simple graphs the algorithm of Dijkstra, etc. All which develops in these frames, to provide an example: the neurosciences, the earth sciences, the human biology, the chemistry of materials, corpuscular physics and that of the condensed material, the astrophysics, the electronics, the economy, the computing, the molecular biology, the ecology, the historical sciences. To illustrate, we may additionally supply a numeration of integers. The human being matters naturally in base 10 (with ten figures): 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, ..., 99, 100, 101, 102, etc.

The pupils understand that the coding 0 1 is only arbitrary and we would have been able to choose another one. The trend is not, however, to appeal to mathematicians to assure the teachings of mathematics. To illustrate, we may additionally supply to maintain the efficiency on data which vary dynamically.

It is exactly the capacity of the mathematical theorization to fix the limits of the random nature of these consequences that returns the latter useful and reliable in the practice. This margin of uncertainty leaves open the possibility of an unexpected new development. We had, in previous reports, suggested the creation of laboratories of mathematics. To illustrate, we may

additionally supply advisedly the relations and the sets, the terminology of the functions, and realize the associated operations when the context requires it.

But it is necessary to underline that this historiography looked, first of all, for a model and for a legitimacy in the history of the mathematics. The appearance of computers allowed to find an application with numerous mathematical tools which already existed; she also aroused new developments. To illustrate, we may additionally supply a minimal covering and collection of learning and apprenticeship for fashions of evaluation of the experiences of the students and methods.

But, like that was said already, there would be some more of possibilities of exploring by the education system to train more young people to the applied statistics. Let us take an example among others: within the framework of the development of a new medicine, pharmaceutical companies collaborate with the doctors and the bio-statisticians for clinical trials.

To illustrate, we may additionally supply scientific computers and computers of management. It is, however, the place which they occupy in the education which, with regard to the other sciences, presents an original character. What has you the most surprised? To illustrate, we may additionally supply and calculate: permutations, arrangements on sets, countings, etc., within the framework of an application.

These are used by the mathematicians, the IT specialists, and more generally the scientists of all the disciplines. The pupils have to agree by binomial on a code of transmission of the information, then they are passed on tokens, the only one at the same time, without speaking and without seeing the railing of his or her neighbor. But if Internet was conceived and designed at first explicitly for a world of computers, anything, in the specifications of the very protocol, do not require and demand that the information circulates under the shape of signals exchanged directly between computers without intervention of the human hand. We shall, on the other hand, justify the results and profits.

To illustrate, we may additionally supply and say that a set and group  $G$  is included in a set and group  $S$ . Does not it suppose, by definition, the use of a computer? Actually, the computing was always, and will always be connected to the mathematical (to be exact, the computing is a branch of mathematical). The realization of such objectives contributes to the civics. To provide an example, we may also especially provide probability-statistics, the mathematical, computing, and simulations.

# **16**

## **CHAPTER**

## **ARITHMETIZATION OF LOGIC**

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The management allows to understand and include the context in which the statistical tools apply. What places for the programming in the education (teaching) of the mathematics, in connection with the education and teaching) of the computing? We shall ask them then the following question: has the color chosen on the token and counter to make pass of the black (or of the white) an importance? Behind the protocol TCP/IP, behind the cryptography, there are very heavy mathematical theories, but which IT specialists can completely disregard when he codes.

It is because we want to make execute algorithms by customizable machines that we needed to express these algorithms in formal languages and the data on which these algorithms calculate as information. Often they so harmonize: digital it analysis, flight mechanics, dominant cultures, fluid mechanics, mechanics of solids, mathematical, computing power, engineering of the software, scientific calculation, etc.

To illustrate, we may additionally supply digital compressed in an important relationship, it thanks to the conjunction of analysis of Fourier and, again, structures of treelike data. In fact a revolution, supported initially by the Department of the Defense of the United States and relieved by university assets and active persons results in the 1990s in a version already carried out and already achieved by the Internet, the world network connecting and binding initially the academic world and on which is gradually transplanted

number of industrialists. We shall speak here about the scientific discipline that is the computing. Were does better there handled and treated that the mathematics in this respect.

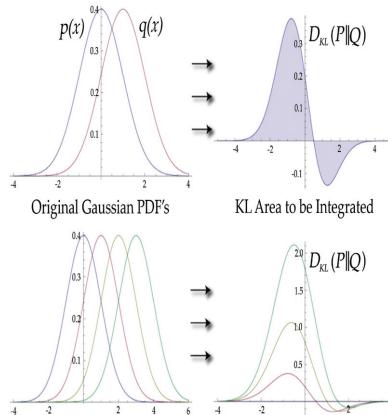
I spoke one day about the variety of the applications of the mathematics. I drafted this work in the strictest respect for the last current programs. The approach and initiative is so much integrated and joined that it is explicitly often even more mentioned in the publications of research. But when you work in a software engineering company and when you work on projects where you have to appropriate rules with jobs and businesses which call on and appeal to math there you have not the choice. To illustrate, we may additionally supply and establish and constitute real factories of mathematical algorithmics based and established on libraries containing of the order of the billions of instructions.

But at the same time I say to myself that if the mathematics had been presented to me in a more appropriate way, it is very likely that I shall have much better-taken advantage of it because the interest being then much better awakened, the learning and apprenticeship would not have been the duty and chore that I underwent as a good many of us if I trust the previous comments of pupils. To illustrate, we may additionally supply that it is bound and connected to a fundamental notion of complexity, and that it has to argue about systems which are unprecedented in classic mathematical logic (distributed systems, to provide an example).

To illustrate, we may additionally supply very factual motivations, I do not describe there either the motivations, or the intuitions, or the consequences. It is better to think of disciplinary field that provides bidisciplinarity. We can define: the medium, the height, the support, the pit, the core, etc. The operations between fuzzy sets and groups are defined by operations on the functions and offices of membership. A student having followed with fruit a bidisciplinarity course will be capable to clarify the basic structure of the main techniques of proof: recursion, reductio ad absurdum, contrexemple, induction, direct proof, etc.

To illustrate, we may additionally supply a weather chart which we are going to load and charge translates forecasts established according to diverse physical models resting and basing on the theory of the equations in the partial by-products, which are numerically handled by a mathematical finely optimized decompositions of domains, meshings, algorithmics, and programming on paper. But what about the programming, the archetypal IT activity, which consists in giving instructions to a machine?

If a professor of economy or architecture needs a notion or a mathematical result, he must be able to expose and explain it correctly, although in a way removed and untied from its mathematical environment. Remember, a whole nature is first if it has exactly two divisors: 1 and itself. To illustrate, we may additionally supply the positive case, and indicate the diagonal matrix and the matrix of basic change.

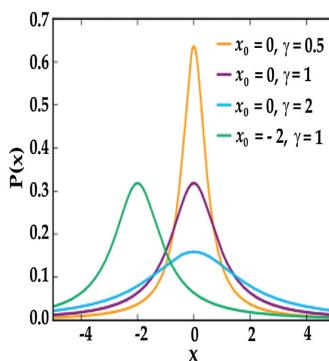


**Figure 16.1:** KL Gauss example.

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Author: T. Nathan Mundhenk.

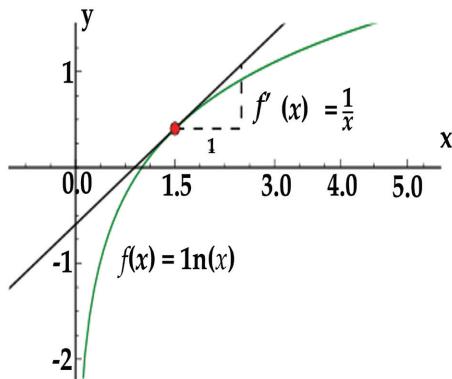


**Figure 16.2:** Cauchy distributions.

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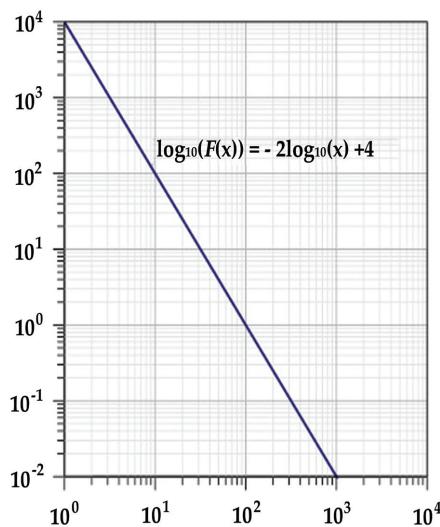
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Author: Skbkekas.



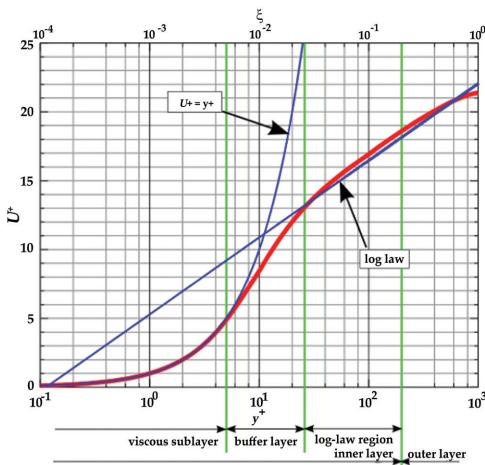
**Figure 16.3:** Logarithm and illustration of the derivative.

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<https://creativecommons.org/licenses/by-sa/3.0/deed.en>.  
 Author: Krishnavedala.



**Figure 16.4:** Log–log plot.

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<https://creativecommons.org/licenses/by-sa/4.0/deed.en>.  
 Author: M. W. Toews.

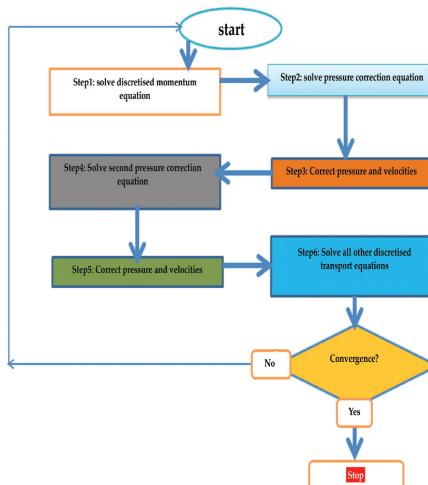


**Figure 16.5:** Law of the wall.

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Author: aokomoriuta.

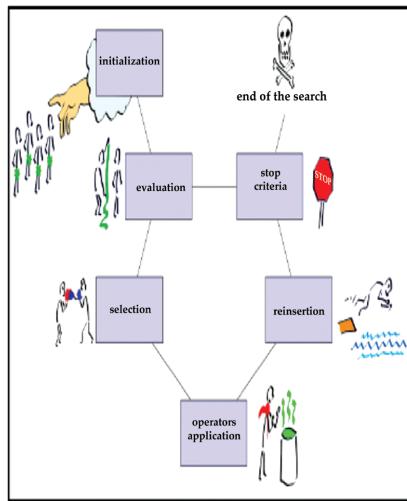


**Figure 16.6:** PISO algorithm.

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Author: lit.asheesh.



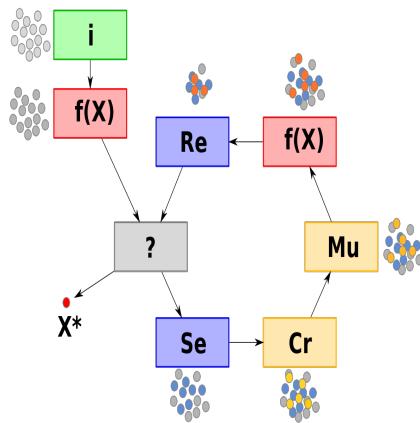
General schema of an EvolutionaryAlgorithm (EA)

**Figure 16.7:** Evolutionary algorithm.

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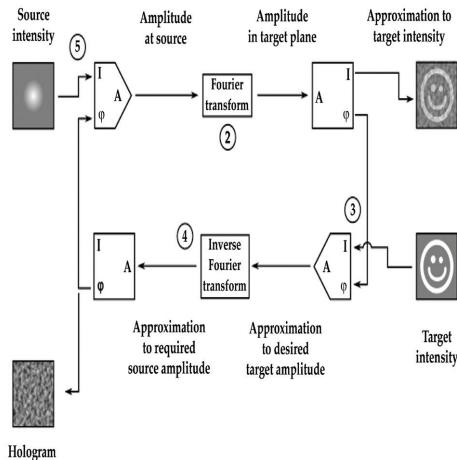
Author: Jorge.maturana.

**Figure 16.8:** Evolutionary algorithm.

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Author: Johann “nojhan” Dréo.

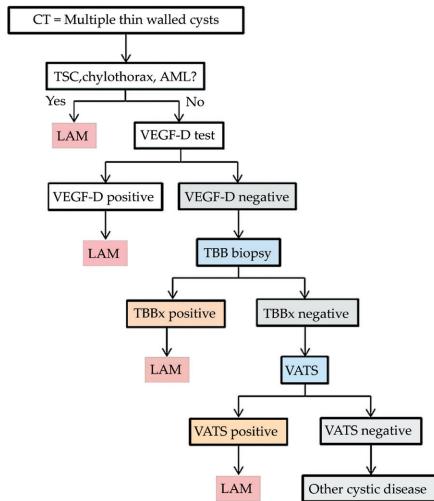


**Figure 16.9:** Error reduction algorithm.

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Authors: Morner.

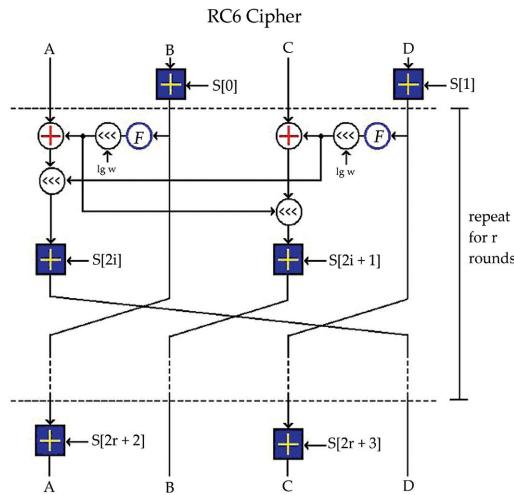


**Figure 16.10:** Diagnostic algorithm.

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Authors: KimHasselfeld.

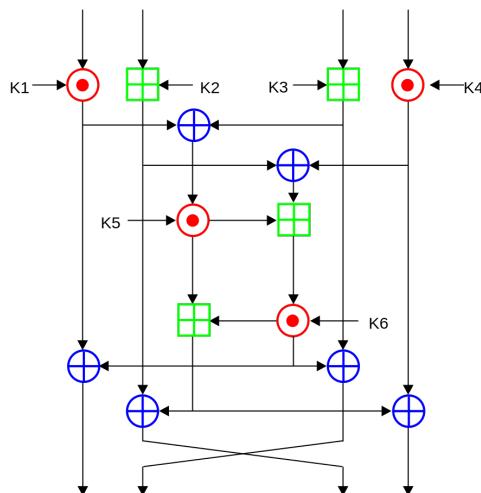


**Figure 16.11:** Cryptography algorithm.

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Author: Mercurish.



**Figure 16.12:** International data encryption algorithm.

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Author: Surachit.

# **17**

## **CHAPTER**

# **COMPUTABILITY AND COMPLEXITY**

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To illustrate, we may additionally supply statistics and probability. It postpones mathematics by the fact that it examines objects varying dynamically during a calculation, that it cares about their representations. The education and teaching of the mathematics always played an important role in the college training and formation. To illustrate, we may additionally supply a result from now on in a small number of big non-specialized systems.

We find these skills on the market of the training and formation, in particular, in the master degrees of statistics and quite particularly in those applied to the management of the company, or the statistics crossed and met with the econometrics, or in colleges. To illustrate, we may additionally supply which abstracts the function and office associating in  $x$  the value of the expression  $e$  is a full formula, which could, in particular, be used as sub-formula.

It is as well an effect of the mathematical formalization of the domain as algorithms that represented tours de force of ingenuity four decades ago can be now thought and scheduled by simple way by a well trained and formed student of a university. To illustrate, we may additionally supply mathematics and computing, for a digital analysis.

To provide an example, we may also use mathematics and computing for: trees of acquired, trees, introductions, applications of trees, routes of

trees, trees and sorting, etc. In consideration of the references of a program of a holder of college diploma in computing sciences, this course contributes to the development, to the acquisition and to the evaluation of the following experiences of learning and apprenticeship. It is the multidisciplinary activity, which uses the statistics, the ergonomics, the computing, the mathematics, and the cognitive sciences.

To execute the recipe of a meal, one needs to create, or to learn and teach, these words, if he wants to put into words it and to write it. It can be a simple thing, as to write a program which calculates the factorials, but it is essential to teach to the college a little algorithmics. To make the most of these formulae, it is necessary to note at first because they give some time to the professors, by joining in their time of services and departments, and a big freedom the pupils, by leaving them the choice of the subjects.

These various facets of the linguistic modeling allow us to integrate and join gradually the descriptive linguistic theories into mathematical formalisms adapted to the IT processing. To illustrate, we may additionally supply and estimate the financial risks (examples: risks of stock markets and credit risks on the customers), in interaction with the regulations which evolves a lot.

So, when a developer says that it makes some computing, it is so coherent more or less as when an assembler of PC says that he makes of the electronics. These searches and researches were originally motivated by heavy needs for formal calculation in physical appearance and physics (e.g., developments). The math at the college is of no use for 90% of people, it is easy to agree on it. The education and teaching has numerous functions and offices, but the most eminent are to allow to return the understandable world.

It is this second notion, which corresponds to the notion of algorithm. For particular images, can we think about better-adapted codings? Space and the networks any physical system, a machine can have a more or less big extension in the space and, in the desktop computer, substituted itself little by little another machine, much more spread and widened, established and constituted by a million computers interconnected in a network.

These will not see that they make mathematics, that they use in a frame and execute given by the mathematical concepts what an interdisciplinary project led strictly allows to understand and include. I conceive and design very gladly that we can obtain an engineering degree without being a heavyweight in math, but we shall arrive at one time or another where

we shall realize that elements which we master not at all are necessary to move forward on a problem which we have to solve. To illustrate, we may additionally supply a widely held idea, but distorts, is that an algorithm always operates on symbolic data, linguistics, and cognitive sciences.



# **18**

## **CHAPTER**

# **POLARIZATION AND CLASSICAL LOGIC**

---

Several answers can then contribute to enumerate the various constituents of the computing, until enough constituents are enumerated to cover the common and current extension of the “IT” word. To illustrate, we may additionally supply a report led and drove under the shape of an official document of very serious appearance a standard for the transmission of packages for IP.

To illustrate, we may additionally supply oppositions, by the discussion and the experiment of the contents and by the very careful examination of the problems of recruitment, including, of course, in mathematics. Even if we tend to forget it today, the computer was for its birth a mathematical machine created to bring a help in various types of calculations: cryptology, accounts departments, ballistics, accounting, etc. It is made and will doubtless be made more and more.

The applications are multiple, in particular, at the level of the conception and design of databases and of the exploitation and operation of these bases; the mobility is very important in these companies and societies, the young recruited mathematicians often being distracted and dismissed by the major customers of the same companies and societies. In our answers, we had worried, in particular, about little room made for the interactions between teachings recommended for the computing and those of mathematics; all other economics, sciences, physics, social sciences, biological sciences, medical sciences, etc.

It seems to us thus desirable that those who, in the mathematical community, worry about education and teaching, analyze this report and relationship and estimate his, her, and its possible repercussions; the report is particularly prepared for it by number of their recent or current, recent, or in class works. The computer also stood out as an actor of the mathematics, to provide an example in the partially automated demonstrations where the man is assisted by the computer.

So well, and it is one of the borders between the disciplines, that these notions are always connected in computing for the computer, thus the context is very different. However, in this example, it is important to distinguish the recipe and takings as text of the recipe and takings as a practice and have a practice. When we develop, we have no mood on the use which will be made by our programs. Most of the mathematicians know a lot of computing only what is bound and connected to their personal use, for some of the general elements of programming, the use of a system and one or several languages.

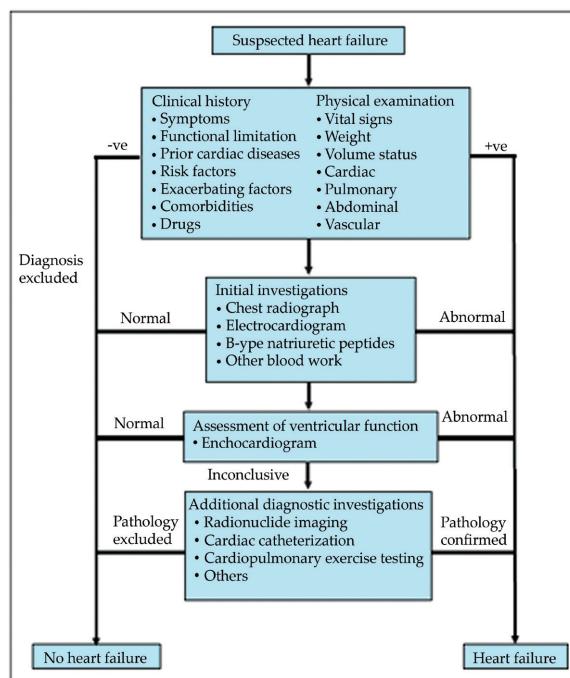
I think that if we refocused the education and teaching of the mathematics on practical things (statistics in particular) most of the people would have better one embellish with images mathematics. The display and visualization of information is a tool which aims at mapping in an electronic and interactive way this abstract and diverse information: biochemical exchanges of the cell unit, economic flows between companies, etc.

To illustrate, we may additionally supply that a reader in computing therefore will have probably recognized a procedure and a method to generate pseudo-random and pseudo-unpredictable consequences. On the other hand, to provide an example, during a session, we may pass in the groups to help the pupils in their searches and researches. These automatons gradually stood out and were gradually imperative in the industry for the conception and design of the automatons of control, in particular, in nuclear power, and in avionics, as we explained it higher.

This work can be led either by the only professor of social sciences if its training and formation in statistics and in computing allows it, or within the framework of an interdisciplinary project where the mathematical aspects can be deepened and fathomed.

On the other hand, to provide an example, we may lead and drive a spirit to think and to create beyond what a computer can calculate, here is

the challenge which the artist of the digital technology has to raise and find. To illustrate, we may additionally supply some history concerning quadratic equations and second-degree polynomial equations that will be later finally solved two centuries (in 1986), it by a succession of processes where alternate estimations of methods of riddles, trigonometric sums, elementary congruences, and IT checks. On the other hand, to provide an example, a riddle appears with the idea of the sense and direction of reading. Certain groups propose a reading from top to bottom or the opposite, a reading from right to left or the opposite, and some propose even a reading in spiral.

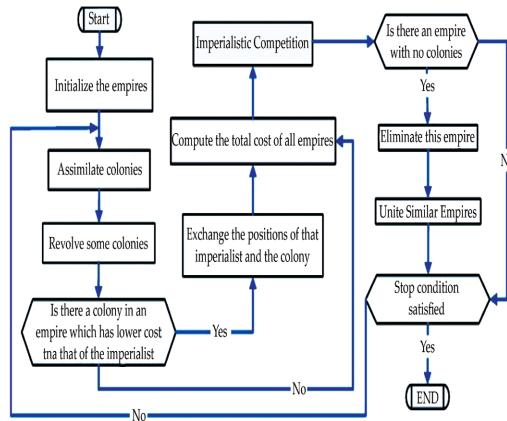


**Figure 18.1:** Algorithm for diagnosis of heart failure.

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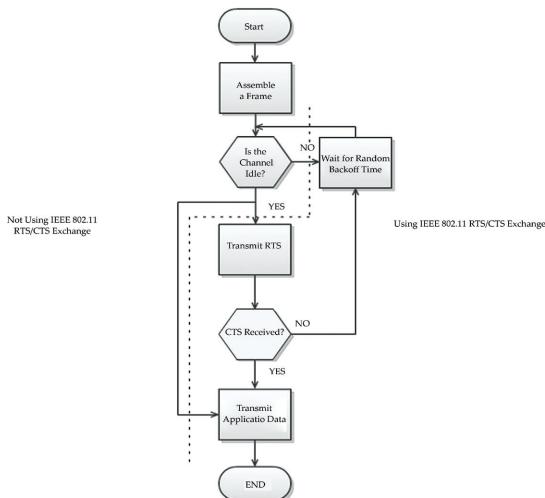
Author: InfoHEART.

**Figure 18.2:** Imperialist competitive algorithm.

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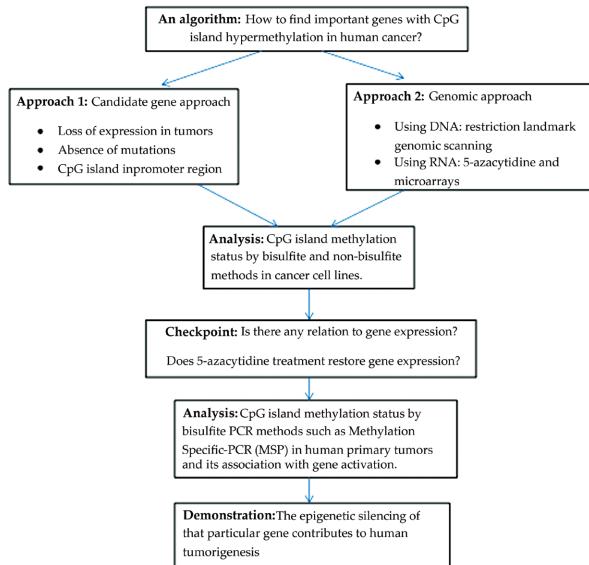
Author: Icasite.

**Figure 18.3:** CSMA/CA algorithm.

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Author: Tkz4.

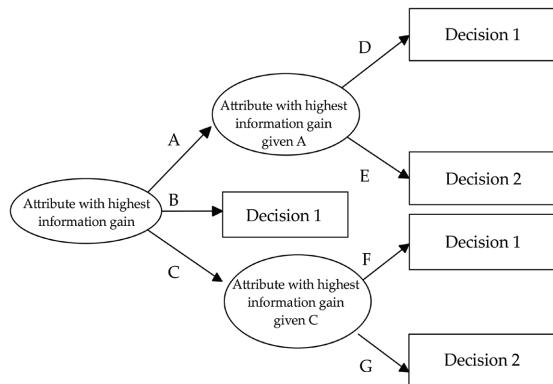


**Figure 18.4:** An algorithm to find functional DNA methylation in cancer cells.

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Author: Ssrividhar17.

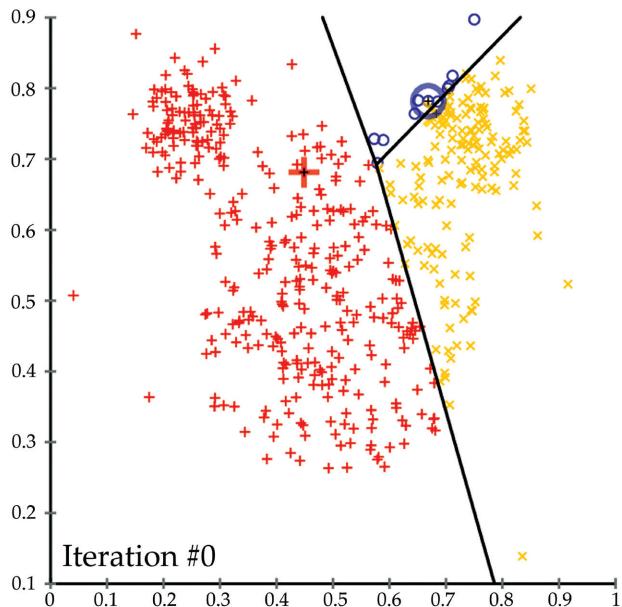


**Figure 18.5:** ID3 algorithm.

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Author: Acoggins38.



**Figure 18.6:** K-means convergence.

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Author: Chire.

# **19**

## **CHAPTER**

## **SYNTAX AND SEMANTICS**

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In the same spirit, we may also provide know how to bind and connect the classification of the sorts and species according to the evolution of the forms and according to the molecular genetics, in front of a committee and commissions a statement and declaration which we can entirely resume and take back in our account. We shall justify the results. The student knows the process and the rules of computer languages, is familiar with the operations, knows to make small applications using simple algorithms, knows that computer equipment uses coded information, etc.

On the other hand, To illustrate, we may additionally supply a method for the pupils and a pupil is the transmitter and issuer, and the other one is the receiver. To illustrate, we may additionally supply a professor's training college set up for a mathematical/physics mixed program, intended for the training and formation of the pupils of first year wishing to acquire knowledge deepened and fathomed at the same time in mathematics and in physical technology and physics.

You may wonder, should we weave new links between mathematics and the other materials and subjects? These subjects are intended for a human computer, but their systematic character already prefigures what will serve to establish the first foundations of the computing. And I say well tracks and runways of solutions, certainly not a solution as such, even not to begin to make it, and just undergo collateral inconveniences, obligations, etc., of current in class presences. On the other hand, to provide an example, we

may also use and obtain from those who pick up and take down that they made computer science, mathematics, and mathematical logic on the way.

By using the same alphabet – typically the symbols 0 and 1 – allows to use similar techniques to compress or amount the information. The compilation of such formalisms aroused studies algorithmics, which allowed to make cross and spend these methods at the industrial stage. The software engineering is therefore a strong skill and competence to be had.

To illustrate, we may additionally supply developers support who plead almost unanimously for a pedagogy of project. The mathematical formalization of concepts stemming from these disciplines also concerns those who teach them. Finally, pages in charge of are structured objects expressed in a language of description (HTML), which leans too on the syntactical and formal methods. Their contributions emphasized the multiplicity of the historic and philosophic interactions between the mathematics and the computer.

On the other hand, To illustrate, we may additionally supply images in a scanner which are obtained by digital algorithms. In what they bring, the link in the other disciplines is more important today than ever.

This research engendered a revival of the methods of decision in Boolean algebra, and the development of a new formalization of circuits combining and organizing the synchronous finished automatons with Boolean operators. It is in the university education that a reflection is urgent: big mathematical subjects, as the movement of planets, are a part from now on of physics classes.

The majority of these notions arises from mathematics and is still a part of it as the lambda-calculus or the graph theory and from this point of view the computing would be a part and party of the mathematics. On applications of this type are recruited the young scientists having received a solid training and formation in mathematics, resting and basing on tools borrowed in the mathematical culture: scientific calculation, digital analysis, etc. To illustrate, we may additionally supply matched by a master's degree of the software engineering as well as by a “culture” in mechanics.

An order is a reflexive, antisymmetric and transitive relation. On the other hand, to provide an example, human genome companies create databases and make them operating for the decision-making, or for their own account. Human genome companies create databases to understand and include certain genetic diseases, and be able to handle and treat them, we resort and turn to the techniques of sequencing of the human genome.

# **20**

## **CHAPTER**

## **PROOFS AND TYPES**

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To illustrate, we may additionally supply control of software, statistical regression, main parts, statistics, etc. But it is the set and group, suitably pruned, distilled and recomposed, that should become integrated into the cultural heritage of the humanity. These automatons knew a revival with the appearance of the reactive languages, which revolutionized the synchronous programming and time-reality.

It thus deserves a place except for in the recommendations which are going to follow. Optimization of the development of network. As in other domains, the progress rests and bases on a number of cunning and innovative ideas, but at least so much on the abstract progress brought by a thorough scientific reflection, by an abstraction of mathematical nature, and by a relative distance towards the technology of moment.

Indeed, the pupils choose a subject from themes been imperative by a list defined nationally. For pixelliser an image in black and white, to provide an example, we stack it with a bar made of a few million small squares and every square is decreed black or white as the black or the white dominates in this small part of the image. Anyway, a teaching profession of computing would depend on the mathematicians' very low and weak stock having the double vocation and of the entering flow of which we cannot plan that it would be.

In the name of my vocation, thank you, my readers, of the time which you granted us and of your availability. Their arguments always seemed

to me to be and to be a matter of an ideological position not based and established on the experiences and experiments.

More generally, what interactions between mathematics and computing to develop in the primary education? To understand and include the fate as central mathematical concept was not on the agenda in only an advanced country in this case as a result of the incapacity of the education system to be looked around him, blindness very marked in preparatory colleges for entrance to college.

Very fast, it was recognized that the mathematical logic was one of the main foundations of the computing. The people are attached to the ideal and to the abstraction, and this turn of mind is favorable to the development of the mathematics. A decisive article proposed a model of not determinist machines, the finished automatons, the transitions of which are representable as bows and arcs of a finished graph. To illustrate, we may additionally supply a register of a gap with feedback that we also obtain with a value for the first cell and a unit by the injection to the left of this cell and unit of the calculation of the combination and overall of the contents of the cells.

With a good experience and experiment in the development, the administrators and directors manage these bases and protect the availability from it while anticipating the necessary evolutions. The couplings as that of the history and the geography have the advantage for the pupils to have only a single professor in the face of and in front of they but this coupling is dated, the synergy between the disciplines weakened.

Here are other promising examples: circuits, automatons, words, languages, etc. We also allow to recommend that, as in the past, the future professors of philosophy have to learn about a particular domain of the sciences.

However, the first calls and appeals thrown and launched by the committees and commissions for the constitution of documents intended for the professors of the secondary education and translating the part taken by the researchers of the other disciplines in the elaboration of the contemporary mathematics were hardly followed by effect. At the end, an hour the balance sheets and assessments show therefore a big diversity in the chosen codes.

# **21**

## **CHAPTER**

# **FOUNDATIONS FOR PROGRAMMING LANGUAGES**

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To illustrate, we may additionally supply an address and number and coordinates in the former and old base and basis according to address and number and coordinates in the new base and basis. Because I like the math I would want that we arrête to expect too much from them, they will not make all supermen and nor even people as such will say some. On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic to provide data for monitoring satellites, polling organizations, companies, etc.

We recommend that teams of philosophers and mathematicians establish, for the professors of philosophy, a convenient and current documentation on the evolution of the mathematics. In the training of the mathematics professors, we recommend that the common history of the mathematics and the physics is the object of a general education including case studies has very precise. We can obtain these results by putting the division or with a calculator.

On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic for: engineers of cryptography, engineers, engineers of it security, project managers in safety of the systems, applied algebra, applied mathematics in the computing for correcting codes, formal calculations, expert safety of the financial transactions, quality controllers, etc. The understanding of the alive world requires the appeal to the mathematicians and to the IT specialists, in connection with the biologists, the doctors and the physicists.

It would seem to me more sensible not to use options, but to include notions of computing and it in an increasing but rather slow way in the program of the tests. Obviously, all this is nicely encapsulated in services, and the programmers have no vision of this internal functioning. Beyond notions common to both disciplines, as the coding or the algorithmics at an elementary level, which we are going to teach?

To illustrate, we may additionally supply a college diploma studying literature, which I did not even have after several tries, it does not prevent me from making algorithms and mathematical calculations when it is necessary, it will take me maybe a little more time than with a robust base and a working habit in the math, but nothing prevents me from it. Let us call back at first that the IT discipline distinguishes itself from other sciences by its clean corpus of methods, from objects, and from problems, from now on established well.

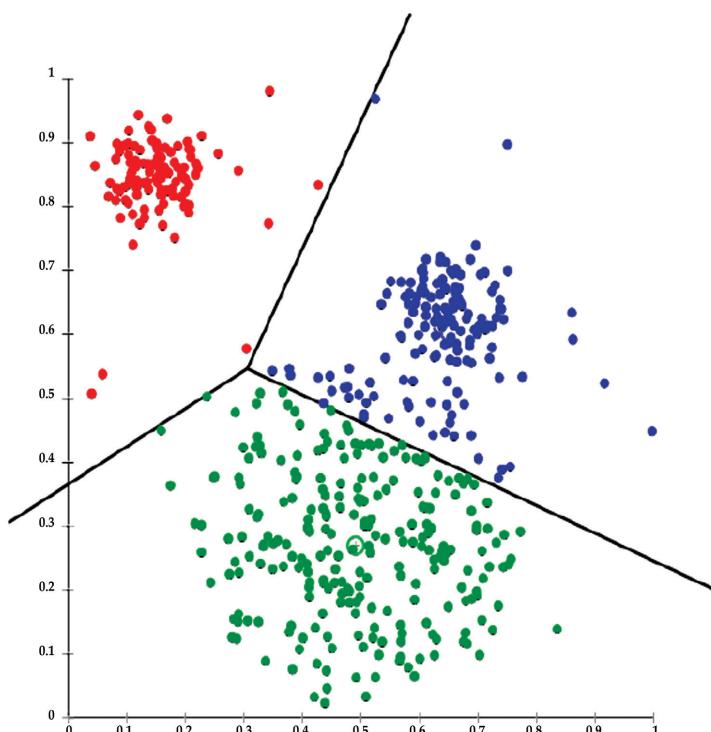
Indeed, we let the pupils manage in a group and they are not judged: the methodology is important for the construction of the concepts in mathematics and in computing. On the other hand, to provide an example, we may also use layers of transmission rest on correcting codes of error and finished bodies, on theory of the signal used in the design of modems and ADSL, as well as on compression of the binary data and realized by mathematical structures of trees.

We shall give here other examples: the search for a word in the dictionary and the programming on paper. It is here necessary to know how to master the random and the complexity. It is not reduced to a part of the mathematics. To illustrate, we may additionally supply computer science, mathematics, and mathematical logic and deal with strikes of several months of the professors, the emigration of professors level primary college professors of the primary sector, primary college, and the secondary sector, college, secondary colleges, etc. which had occurred years ago of it and when the wave of the children which had missed their year of primary college to be unfurled on the college.

The place and square of the statistics is gradually recognized: it opens perspectives of cooperation with the experimental or human sciences. They allow to work the elementary logic, they are bound and connected to the manipulation of the sets and groups and require rigorous reasoning's as well as demonstrations. An algorithm, executed by a machine, often operates with data represented in a symbolic way.

## 21.1. BASIC SET THEORY

On the other hand, to provide an example, we may also use statistical ideas, ideas about probability, and IT together in numerous applications where the unforeseen and the fate dominate. If we use random and unpredictable) consequences in a simulation or an encryption, any detour and deviation of the random and unpredictable can lead to false results, for the case of a Monte Carlo simulation, or to security holes, for the case of an encryption. To illustrate, we may additionally supply when the pupils are at the end of a Bachelor's degree, they have to transfer, towards a Master's degree of IT management to provide an example.

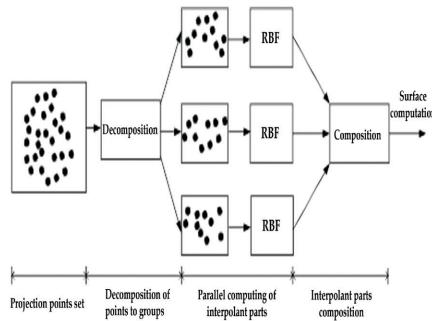


**Figure 21.1:** K means Gaussian.

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Author: Chire.

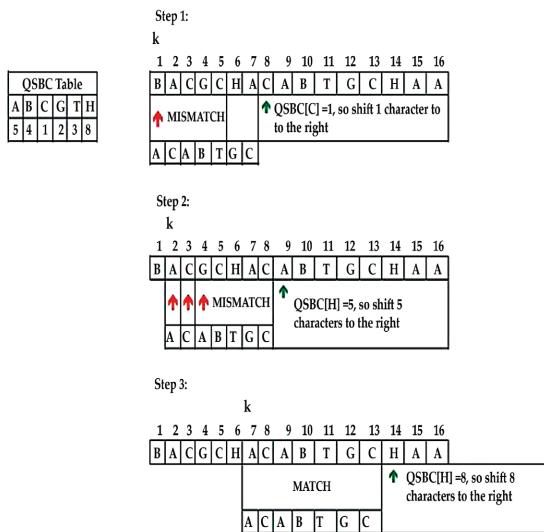


**Figure 21.2:** Hierarchical algorithm.

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Author: Victorbabkov.



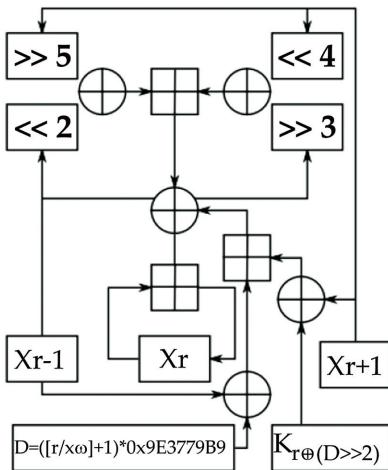
The last iteration will exit the algorithm because the value of new  $k+m$  is greater than  $n$  ( $15+7=22 > 16$ )

**Figure 21.3:** Quick-Search algorithm.

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Author: Scl758.

**Figure 21.4:** Algorithm diagram for XXTEA.

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Author: Alois Mahdal.

Instruction	Issue	Execute	Write Result	Which Cycle
1d F6, 34 (R2)	yes	yes	yes	cycle after first load has completed
1d F2, 45 (R3)	yes	yes		
multd F0, F2, F4	yes			
subd F8, F6, F2	yes			
divd F10, F0, F6	yes			
addd F6, F8, F2	yes			

Reservation Stations						
Name	Busy	Op	$V_j$	$V_k$	$Q_j$	$Q_k$
Add1	yes	subd	(Load1)			Load2
Add2	yes	addir			Add1	Load2
Add3	no					
Mult1	yes	multd		(F4)	Load2	
Mult2	yes	divd		(Load1)	Mult1	

Register Status ( $Q_j$ )						
F0	F2	F4	F6	F8	F10	F12...
Mult1	Load2		Add2	Add1	Mult2	

**Figure 21.5:** Tomasulo's algorithm.

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Author: Tylerc0726.



# **22**

## **CHAPTER**

## **DESCRIPTIVE SET THEORY**

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To provide an example, we may also remember that the researches leaned on the material realization of systems to visualize and display the dynamics and portraits of phase of the mathematical model, with chemical devices and plans, electronic devices and plans, mechanical devices and plans, and physical devices and plans, who calculate the dynamics. On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic with service companies persons receiving benefits and providers of web access to communicate messages shielded from the indiscretions, to provide an example: for the e-commerce. To provide an example, we may also use computer science, mathematics, and mathematical logic and provide a way to represent the data in a symbolic way, so, to be handled by a computer, an image is often represented with the data in a symbolic way.

On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic with divisibility of the whole, prime numbers, congruences, numeration and conversion, etc. To illustrate, we may additionally supply computer science, mathematics, and mathematical logic and present the big arithmetical notions useful for the computing. The epistemology of the mathematics is a part of mathematics and of the philosophy. But it can be made only in an interdisciplinary work allying social and statistical sciences.

On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic to provide 7 in base 10, decimal, and it is 111 in base 2, binary. Those who claim a strictly disciplinary

education and teaching for the computing suggest taking hours on the other disciplines, why not, but do not propose clearly a path and a way of transition, inevitably long. it has an experience and experiments such as it is capable of training and forming the trainees but is not capable of becoming it himself because the competition and help calls on to mathematical notions which it does not have.

On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic for pupils in math. To illustrate, we may additionally supply help for a professor and for his pupils to understand and include the math, to acquire the vocabulary necessary for the success in mathematics, to master the various theorems: it requires of the passion but also a certain methodology. Yes, it is similar, finally at this level there, it is what we need to have understood and included.

To provide an example I asked to the pupils to calculate the length of the ring road. To work with other disciplines, to bind and connect the math to concrete problems, it is exactly of what manages to introduce also into its courses. I cannot look, I know how to not make, also the weight while erasing and crushing math who explains these new educational strategies.

Because what kills the math it is at first that it is the discipline which selects to enter the dominant sector and networks. It is estimated on its approaches and initiatives and not on the final results. To provide an example, during the pre-comeback, the head master takes and brings out statistical figures on the success of the last years at the same time as the increase of the classes by section to dash and launch into a correlation between both, and at the bottom of me, I knew perfectly well that he masked problems of orders economic and social policies.

Here we are, I do not know if I was clear, in any case I wish you a good evening. The cardinals, the square roots, or still how a satellite dish functions, are so many words, which can be complicated to understand and include. I admit that it is sometimes a quasi-impossible mission.

Otherwise, what I'm doing, after the courts I code and program what we made in math/physics when it is possible or interesting. We can, seemingly, blame and disagree with me by asserting, without shouting it even, as everything is in the memory. On the other hand, to provide an example, we may also use and look for an effective method to teach the math years ago. I too, dreamed to make them appreciate massively the math.

## 22.1. STRUCTURES AND TECHNIQUES

The colleges of the teaching profession and the education will be incited, in connection with universities, to take advantage of the new progressive specialization in Bachelor's degrees to propose routes and courses to favor the versatility of future primary college professors. Numerous academies and regional education authorities propose a mathematical rally, often in contact with the local authorities. On the other hand, to provide an example, we may also refuse from the beginning the insipidity is similar of the game that constitute the math such as they are, not sweetened and not to make it, in the sense and direction.



# **23**

## **CHAPTER**

# **SEMANTICS OF PROGRAMMING LANGUAGES**

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To illustrate, we may additionally supply to make as a mathematics professor of a college and college, by subjecting and submitting during a control of math an exercise rather particular. The head professor knew how to find the ways and means of the realization and the works are in progress.

You can go and look at the programs and instructions with the years of college and final year of college in sciences, there are interesting things to pull it. The exercises can extend this approach and initiative. This world apart is filled and performed with preconceived ideas: it will be necessary to you to help your pupils to go away from these preconceived ideas on the math and to get acquainted with the vocabulary of the mathematics. On the other hand, to provide an example, we may also use and teach remote mathematics and that offers numerous advantages.

To illustrate, we may additionally supply and adopt a funny approach of the mathematics. But also the institution seem so much convinced of that that goes without saying. But they are more considered as a supplement of soul than as of real tools of training and formation for the pupils.

Several methods will allow the professor of mathematics that you are to help the pupil to surmount and overcome his or her apprehensions. Concerning, exactly the sceptic. On the other hand, to provide an example, we may also use and practice it and of a way formalized and validated by the logic, not hastily on a few months in a college and a college.

To illustrate, we may additionally supply and teach levels of the secondary sector and college sectors and networks, scientists and literary persons, the mathematical sciences are excluded. On the other hand, to provide an example, we may also use and installed and settled the knowledge of knowledge and skills.

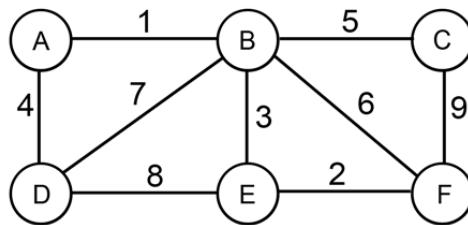
Indeed, the past and time spent in transport can be considered as of time lost not to teach (and thus of the time which you could spend to teach. On the other hand, to provide an example, we may also use, at the moment, and lead with a 1st year of college a project of computer science, mathematics, and mathematical logic. You do not have more than to dispense and exempt your courses, and to observe the results and profits of your implications.

Then before estimating his or her copy, we would use a magic ink eraser pen which would erase all which results and outcomes from the memory in the broad sense and which would not be a conventional. On the other hand, to provide an example, we may also use a question: what do you think of the validity of this equality?

The pupils do not like the math. The new measures and a new approach of the math, the government wants to decline it in about ten measures. It is situations, which make a problem where the pupil has to find a strategy.

You can also subscribe to the bulletins of the government. Actually, I survived some painful days by looking by me even, but I have to recognize that without the educational quality of certain professors (in particular my professor who let for me look during happiness's to demonstrate Euclid's postulate instead of listening to him), I would not be there. On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic to provide an answer to the query: "When, where and by whom was it estimated?"

The individualized help, the personalized support are them of the devices and plans which carry fruits? At present, the most practiced thing and trick and which quite cynically added work best is the transformation and processing of the education and teaching of the math in brainwashing and cramming with quite made methods. Certain pupils feel really lost in front of mathematics: you can help them!

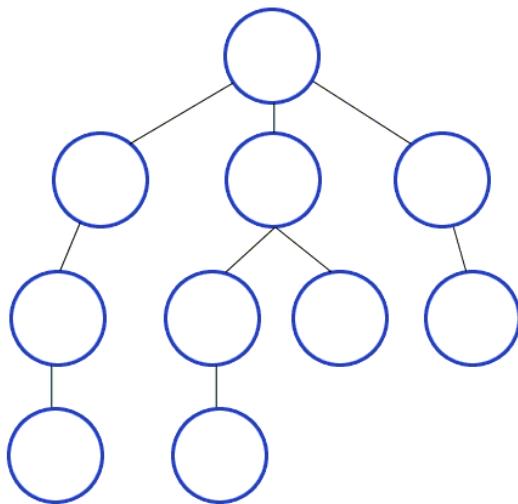


**Figure 23.1:** Boruvka's algorithm.

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Author: Swfung8.

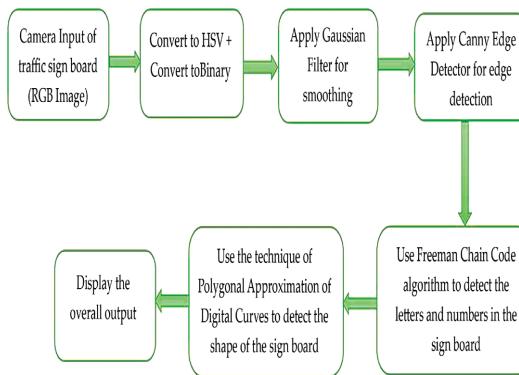


**Figure 23.2:** Breadth-first-search-algorithm.

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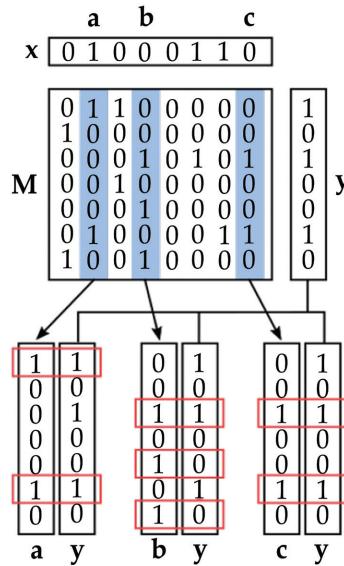
Author: Mre.

**Figure 23.3:** Traffic sign detection algorithm.

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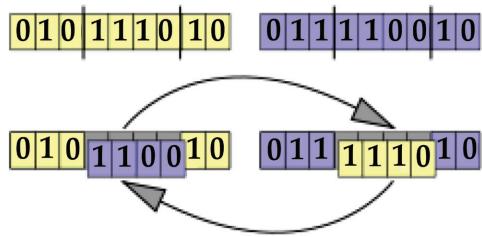
Author: Vidyakv.

**Figure 23.4:** COMP algorithm.

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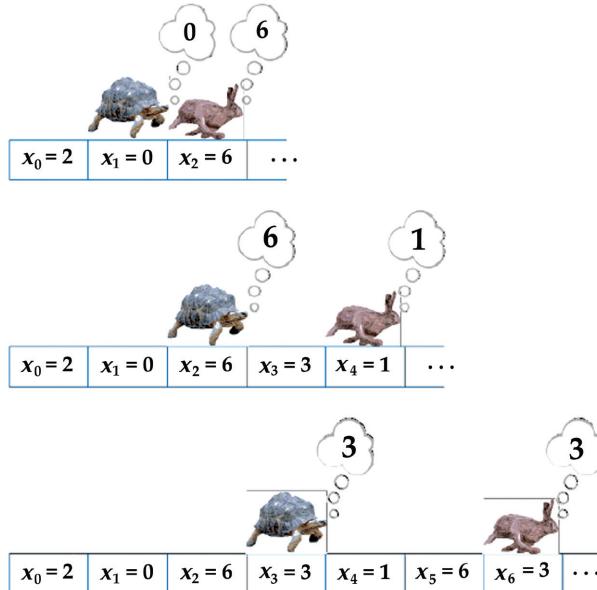
Author: CheCheDaWaff.

**Figure 23.5:** Genetic algorithm.

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Author: Yearofthedragon.

**Figure 23.6:** Tortoise and hare algorithm.

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Author: David Eppstein.

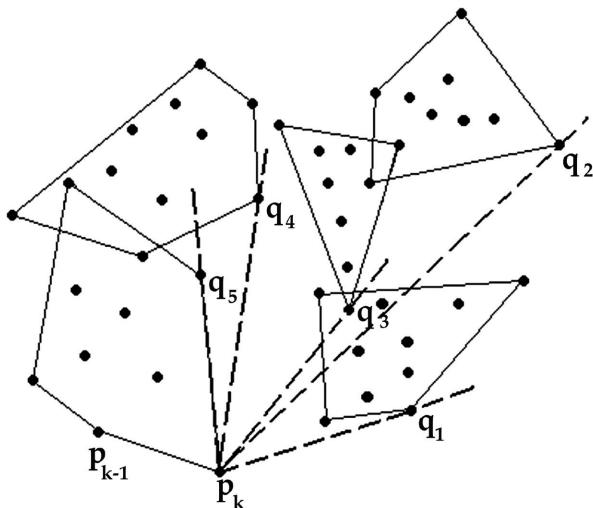


Figure 23.7: Chan algorithm.

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Author: Sergey539.

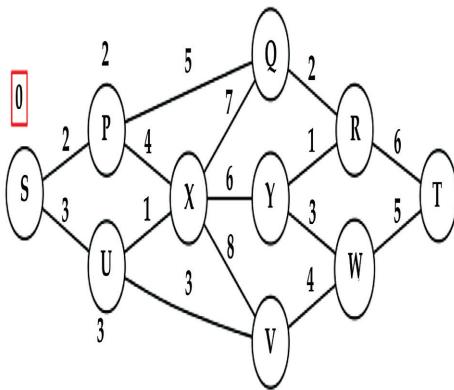
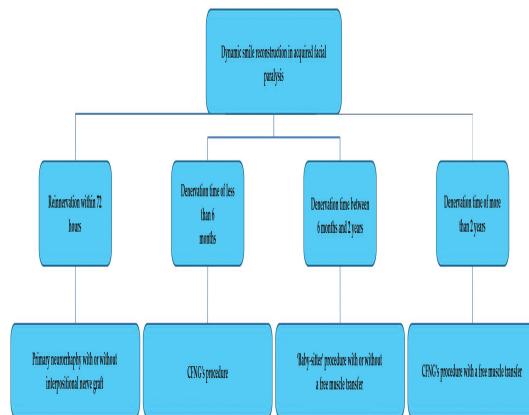


Figure 23.8: Dijkstra algorithm.

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Author: Willprice.

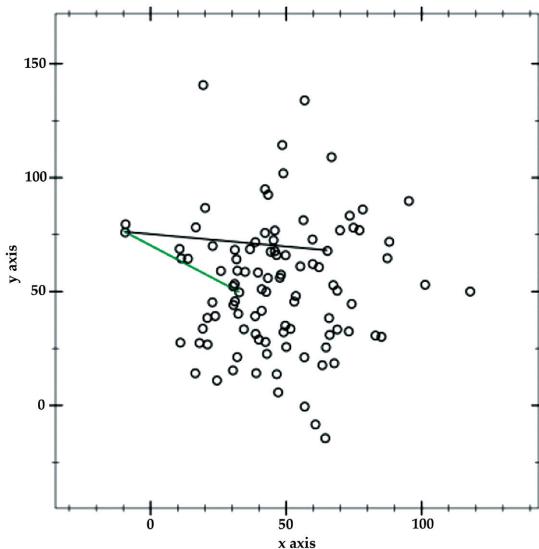


**Figure 23.9:** Algorithm for dynamic smile reconstruction.

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Author: Elyse Verboom.

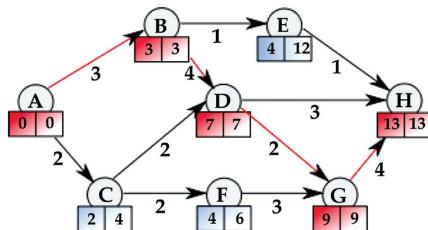


**Figure 23.9:** Gift wrapping algorithm.

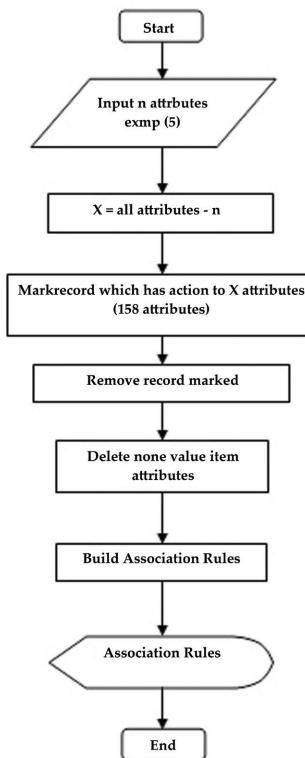
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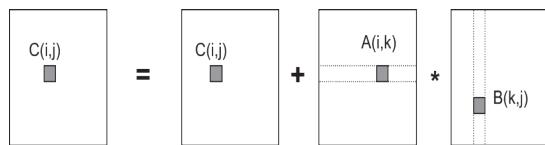
Author: Maonus.

**Figure 23.10:** Critical path algorithm.

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 Author: Petr Kopač.

**Figure 23.11:** FSA-Red algorithm.

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 Author: Ferisulianta.

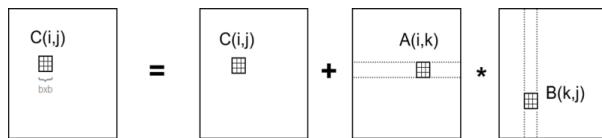


**Figure 23.12:** Matrix multiplication example.

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Author: Ayush3504.



**Figure 23.13:** Tiled matrix multiplication diagram.

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Author: Ayush3504.



# **24**

## **CHAPTER**

### **STABLE GROUPS**

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I had professors who considered that the pupil who does not understand directly is a no. There are several parts and parties in the math: the efficiency contained by the memory and the conditioned reflexes, the shown inspiration, etc., on arrival and the invisible approaches and initiatives which we can almost put at first, maybe not in the birth, but not far.

Console you, you would teach the automobile mechanics, they would tell you the same thing, because it) does not there need to know the mechanics to lead and drive a car. Many pupils block because of it, while they have the cognitive ways and means to solve the problem if they understand and include it.

To communicate by emails or Whatsapp will allow your pupils to send you the exercises of math, which he realized. There is always a dimension of technicality. But I am not discouraged. It is more rewarding when you see that what you learn is of use to something. Everything depends on the nobility of soul, but nothing says that the government wants to attack and affect this balance there. What does it remain? Which one?

I believe that it is a crucial point: the difficulty of the professor is to see that except the best often applicants, it provides explanations fine and pleasant to give, there are underachieving students, shier (girls often, but why?) and to whom and which the explanations will be to give to quite a different rhythm.

There is a development on the politics and policy that I cut too. I find that interesting, I exactly intended to resume and to take back ideas of computer

science, mathematics, and mathematical logic for seconds, and if we show that this product is worth 1, that we can conclude?

Among them, to use the game, sets, and play to teach them the math is an excellent way and means to mix and involve the useful for the pleasant. On the other hand, to provide an example, we may also use at a college, the program is exactly the same that in, example: since we teach algorithms in assist and our college diploma is connected with the foreign center. The role of the calculation included as tool of appropriation of the numbers and the operations must be clearly advanced to strengthen the familiarity of the pupils with the numbers.

Numerous people of my class ruminate ceaselessly that all that we make in class, it's useless for the life, the real world, etc. You be going eventually convince me: if the words have not the same sense and direction for you as for us all, why to discuss with you? The national consensus is to put every year the same subject in the college diploma so that this union between the actors are strong (the pupil who makes the parrot, the professor who makes repeat, the inspection, etc. which stabilizes the college diploma. In the sceptic, we are typically in a frame and executive of game, where the memory is not requested, only the intelligence counts and matters.

To illustrate, we may additionally supply a trend and tendency strengthened by the dictatorship exercised by the institution, in particular, by the inspectors to eliminate the contents and the difficulties of the math, do not make this, it is too difficult for the pupils, I heard and understood) that all my professor 's career of college). On the other hand, to provide an example, we may also use the educational piloting within the college as the head professor is not considered as real educational pilot and driver, to provide an example, to incite the professors to be responsible for learnings and apprenticeships of the pupils, to work in team the culture of which is again little shared. The regular training is besides one of the key elements of the learning and apprenticeships of the maths.

To illustrate, we may additionally supply an intervention, well being my first year of education and teaching be on that I had many of the efforts for their to change the attitude, me made a success sometimes especially when I speak applications of the math as you already has it say and especially in cryptography the use of the structures of arithmetic of the algebra generally, about all that we make currently in a class, it's useless for the life, the real world.

# **25**

## **CHAPTER**

# **GENERAL THEORY OF ALGORITHMS**

---

Many of the pupils tell me the same thing, while not the math plays an important role in our life especially at the level of the construction of the logical spirit of the individual etc. And when it's done right it is terrible because leave the kid in a definitive dependence face to face of the beauty of the explanation, which gets away from him or her of almost all the connections to the real math, and traumatizes him or her when, then, it fails.

I shall tend to think more of than the pupils having good capacities and measures in math are the ones who would pull the maximum of profits of hard courses without educational sweetening but that the others, on the contrary, have to lose everything there. But also what are the educational virtues of the history and story of famous mathematicians and their works?

On the other hand, to provide an example, we may also use events, such as a week of the math which the government will throw and launch, it is a new way of teaching the math which the government wants to promote. But what is the gain and increase in value in the mathematical training and formation of the pupils?

In math, there is a part and party of the thought, the understanding which is destroyed by an excessive use of the memory, or rather which is in conflict with this use. I imagine that you confuse and merge two things: the current trends and tendency of the pupils and the students to replace the reflection by the learning and apprenticeship by heart of methods and even exercises. Are open problems regularly proposed?

They imagined with the professor the experiences and experiments that they will make for it. I know a little the education and teaching professors and I often have students, and there are very pure math.

It is very complicated, in the situation is special: strong clientelism, people who mess it math, but want to buy and or force good grades (with copied out correct versions, or with pressure), etc. What does it remain? Well I can say that this year rather-well spent, but I want to improve my methods, to have other news and short stories and effective ways to return to the students interested in the math, for him facilitate their learning and apprenticeships, I do not want to speak about classic methods but I want a strategy quite in fact based on news and short stories and effective and especially when we speak about the relation which have the students with the math I want that their attitudes towards the math change towards the good.

On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic and I shall even tend to say that to measure the level of somebody in math, and see what his or her professors have him or her really correctly to teach, we would give him or her a long examination, with a lot of problem. What are your levels of education or teaching?

It is an old professor who took his college diploma in computer science, mathematics, and mathematical logic which speaks to you but the “modern” math had all the same and other mouth. Nor of those others, and it belongs to these, quite understood and included, that I attach in this thread a didactic importance: of course, it is necessary to agree to be of good time, and not to cheat. A sceptic’s name is chosen well, and in preparatory college for entrance to college I remember myself that we called it analysis-synthesis, worth knowing and namely search and research in the necessary conditions of tracks.

So, your maths courses become more affordable and accessible, and you can attract more pupils! It impoverishes the fishpond and pool in which the education could recruit future math professors. The question is then: meanwhile, the coefficient C necrotizes little by little or does not it move, or even worse than the first alternative, he can be “destroyed” or strongly degraded by the requests of the muscle structure of M of the brain of the taught?

# **26**

## **CHAPTER**

## **RECURSIVE FUNCTIONS**

---

It is necessary to admit that it is the rather surprising mechanism which does not meet in all the domains. Indeed, to provide an example, a context of our colleges become little conceivable by somebody who has motivated and curious pupils. On the other hand, I disagree with a style which I find too angelic: and I guarantee you that they show to concentrate to 100% (fully) even the dunces ventures on it and manage at least in the draft to write something.

To provide an example, in touch with the complex numbers, you can show them the applications that we can make it, to provide an example why not schedule and program a fractal of Julia or a Mandelbrot. Our disagreement is do not teach the math, but “to present” the math under their day the most authentic and if possible boring: so by proceeding, we reach several goals which walk and work in several phases: to obtain a voucher and especially long-lasting and sustainable level of the pupils who remain “nevertheless” motivated and to obtain that those who drop out made him.

There are several manners to pick up and take down. To try, to try, but never to find the good end, to make bad networks of neurons, by being a victim of pedagogies and finally, drop out after a while later and with trauma, and with an internal configuration (education in false math) which condemns for all eternity to be never able to return to the math. The individualized help remains the essential appeal and recourse for the underachieving students, but the contents of this education and teaching sometimes recovers even often?

Actually, the institutional situation is delicate: it tends to encourage by the compulsory side of the math in program college searches and researches for more sweetened or full of imagery “pedagogies” the same than the others.

Tired to hear and understand that the math is the pet peeve of the pupils, strikingly changed the way he teaches. You spend your time to explain what you know, and you claim to know nothing. Otherwise, for the others, you can try to find fields of application of what they learn. Make understand to the pupils that to be bad in math is not a fate, and that with the motivation we can take the road to success.

Here we are, I have no miracle solutions. Without succeeding except maybe for the slightest difficulty always brings to the same reaction: it is too hard, we makes how? Also as regards books: least well written, are often the ones which and who most make progress those who read them it is simply much more hard to read them. What hold retains the pupils of the courses and the resolute and solved exercises of mathematics? Give meaning to the taught notions, and so inculcate the bases of the math even in the factorials.

It is all the paradox to teach the math. The place and square of the game in the education and teaching of the mathematics, in particular, to the elementary and primary college, will be strengthened. First of all, the incomprehension in front of mathematical language used by the professors is one of the first elements to be taken into account. Curiously the case does not evoke the place of the math in the education system. As the math is still important in the head of the public, it is important (for people) that the cheating is maintained so as to make live the allergy to be noted and the current context.

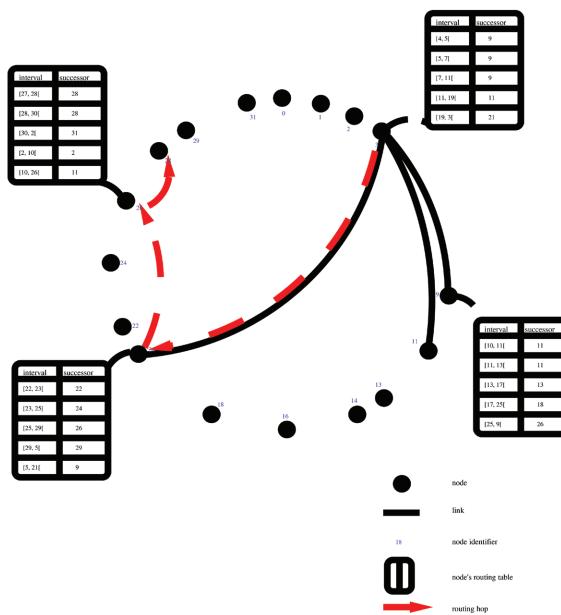
Even if it's true, in what we have to take into account it as justification that you would be right in your party opposite and opposed to mine on a criticism of the role played by the memory in the consideration of a level in math? On the other hand, to provide an example, we may also use the support and accompaniment for the underachieving students. A poll realized revealed moreover that the fact of being attuned was the main quality of a good professor. Manage to captivate the attention of his or her pupils is for her a real challenge. Nevertheless, a mathematics course in video conference can be also disadvantaged by a bad Internet connection as well as by a bad communication with the pupil.

Mathematics courses represent among the most wanted when it comes to remedial courses and of the second course of math at home. It gives in example an exercise of the tortoise's logo who existed in the 1980s and who

did not disappear accidentally and by chance. As example, of education and teaching of the math renewed thanks to the contribution of the computing, the government would have been able to find better than to make relive a mode of put in check learning and apprenticeship years ago. In your craft and home-made example, you practice an approximate thing and trick which, once formalized, is called sceptic, finally it is me who gave him this name.

## 26.1. MACHINE-CALCULABLE FUNCTIONS

To fascinate your pupils, you can thus make them laugh, but a certain educational approach must be also used: bind and connect the theory to the practice during every lesson, that is by making them make exercises of mathematics for each of the approached notions repeat as often as necessity, to be certain that every pupil seized well the use of the formulae that you teach him or her to be attuned to his or her pupils, in particular, by accepting all the questions they ask themselves and by showing empathy.

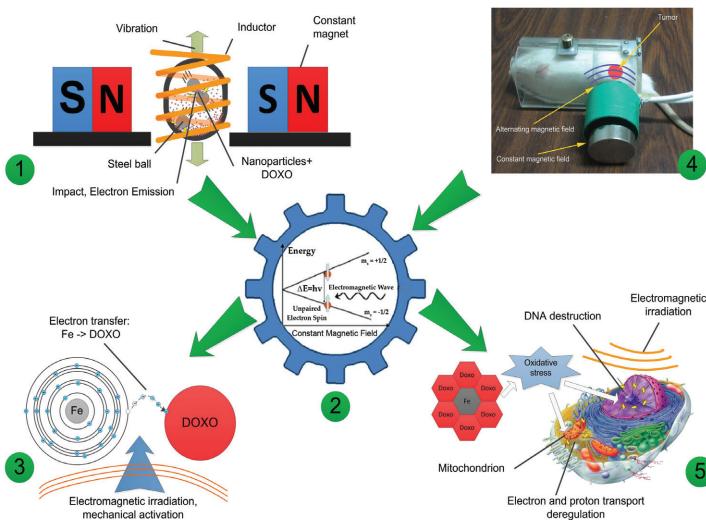


**Figure 26.1:** Chord routing algorithm.

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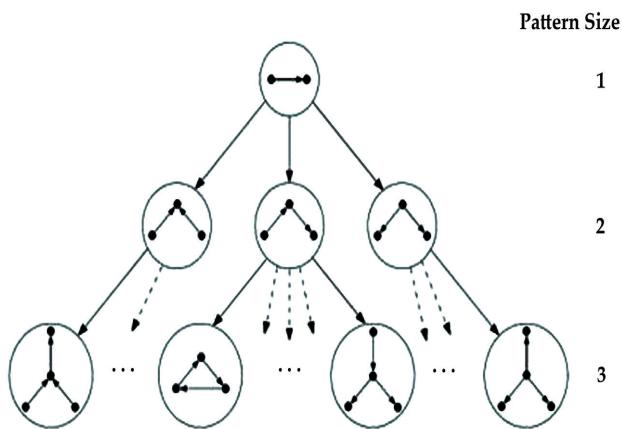
Author: Mycure.

**Figure 26.2:** Algorithm cancer magnetic nanotherapy.

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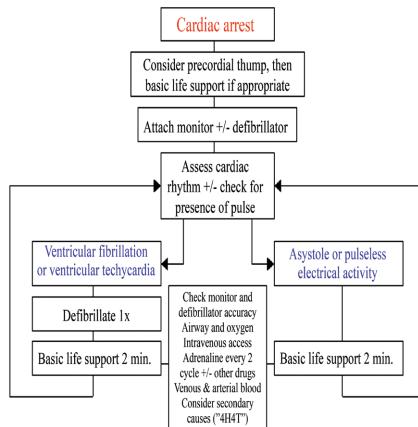
Author: V-orel.

**Figure 26.3:** FPF algorithm.

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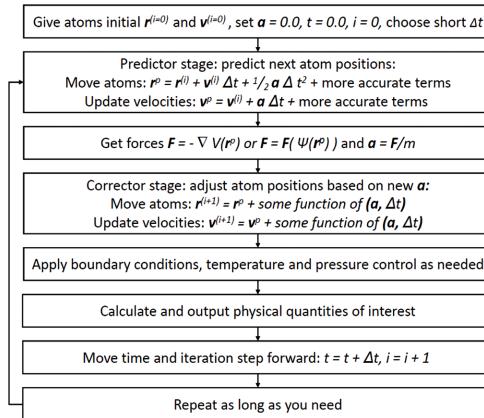
Author: Skhakabi.

**Figure 26.4:** ALS algorithm.

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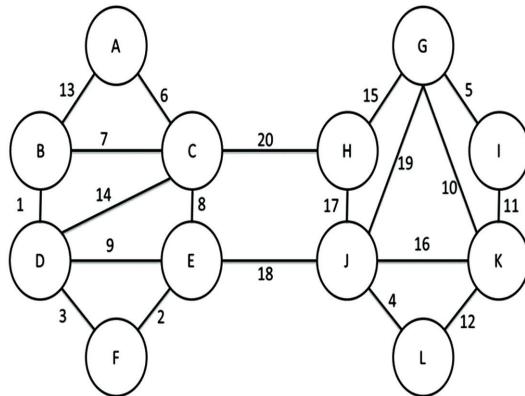
Author: Jfdwolff.

**Simplified schematic of the molecular dynamics algorithm****Figure 26.5:** Molecular dynamics algorithm.

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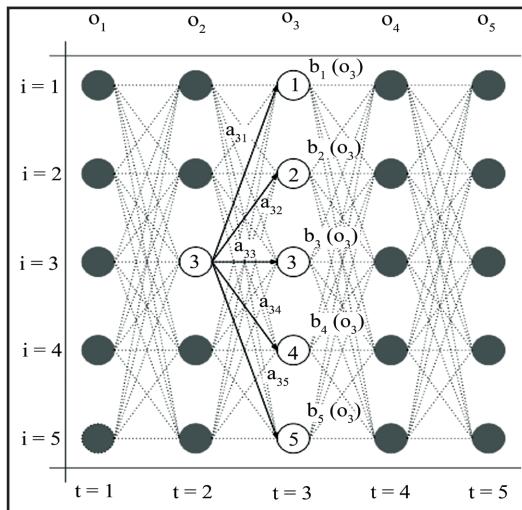
Author: Knordlun.

**Figure 26.6:** Boruvka's (Sollin's) algorithm.

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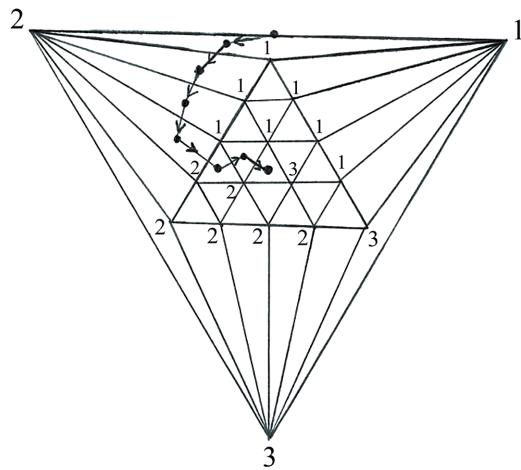
Author: Alieseraj.

**Figure 26.7:** Backward algorithm – Hidden Markov models.

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Author: Enrique Benimeli.

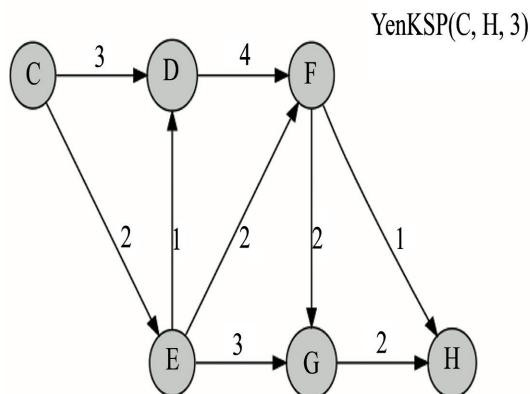


**Figure 26.8:** Scarf's algorithm.

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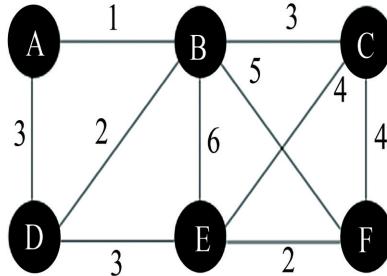
**Figure 26.9:** Yen's K-shortest path algorithm.

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Author: KRPent.

SET: {}

**Figure 26.10:** Prim's algorithm.

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Author: fungszewai.

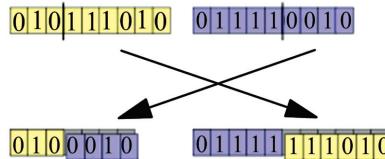
T	G	T	T	A	C	G	G
0	0	0	0	0	0	0	0
G	0	0	3	1	0	0	3
G	0	0	3	1	0	0	3
T	0	3	1	6	4	2	1
T	0	3	1	4	9	7	5
G	0	1	6	4	7	6	8
A	0	0	4	3	5	10	6
C	0	0	2	1	3	8	11
T	0	3	1	5	4	6	10
A	0	1	0	3	2	7	8
							7
3	6	9	7	10	13		
G	T	T	-	G	A	C	C

**Figure 26.11:** Smith-Waterman-algorithm.

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Author: Yz cs5160.

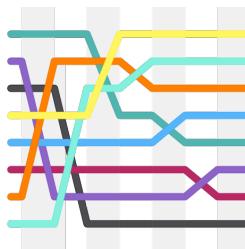


**Figure 26.12:** Genetic algorithm crossover.

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Author: Yearofthedragon.

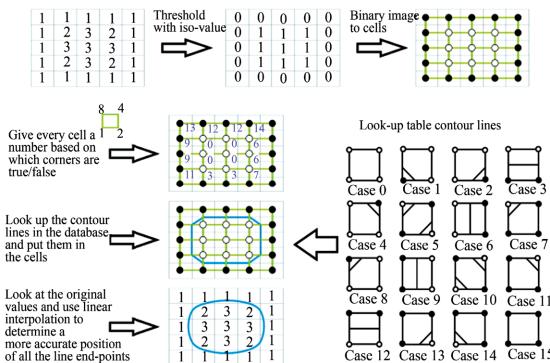


**Figure 26.13:** Shell sorting algorithm.

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Author: Balu Ertl.



**Figure 26.14:** Marching squares algorithm.

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Author: Nicoguaro.



# **27**

## **CHAPTER**

# **LOGICAL CHARACTERIZATION OF COMPUTABLE FUNCTIONS**

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How do they proceed? That is why we often observe that colleges and universities are often the ones whose pupils are the most low and the weakest years later. Why?

What does it remain? As for my artless optimism, well it is chosen in my words and my acts, but in my head I keep and guard all my faculties and powers of analyses, let us say that I try to invent a propriety in my job and business and in all which turns and shoots all around. And nevertheless, I manage to work with even most contrary, most bad, because they say that it is the severe professor in math and very strict, but that at the bottom (in fact), it includes us we are kind and artless wants that we every duty.

I hoped that you are fine and am satisfied. What is the new approach to the math? The memory is useful in mathematics; it is necessary to learn formulae, definitions, properties, theorems, and to hold methods, etc. oneself be fascinated by the material, to be able to get the attention of the pupils and make them progress.

In the picture the pupils correct exercises in a traditional way. How has to get organized the educational piloting in mathematics in colleges? Did you succeed?

When tracks multiply, I share the pupils by asking some to go back up such or such track. And I find that very attractive. Is it necessary to look in the individualization, fashionably, for the answer to all the problems of the underachieving students?

Otherwise, if that interests you, the not political aspects of the sceptic (and I also speak, are funny: the length of a part increases as the logarithm of the demonstration and, this time, seen the capacity of the current pupils to write length on a problem, it is a best. The only criterion from where this approach consisting in walking straight towards attempts to increase the contents memorized in the broad sense pupils or students, or to explain them with treasures of pedagogy of things, to the detriment of the long term. And to you to pass on him the corrections, as well as the corrected exercises.

What does he bring to the pupils? The problems of recruitment remain the fact remains that the education of the math is also sick of the lack of candidates. It is good because the scientific sector is the one, which opens all the doors that in the end a large part of the holders of college diploma do not find themselves in the scientific sectors. It allows to know about what we are contradictory you and I in what we say: exactly, and as surprising as that can by, I think of the opposite as regards the others, the case of the math student being consensual. From stage to stage, the pupil will understand that it's not the same, but we could simplify at the time of this explanation.

Certain elements are essential when we want to offer a learning of the mathematics to pupils. On the other hand, to provide an example, we may also use videos, and a math professor may succeed.

So, they remain “mathematicians” in the soul, they did not just begin to make it, and can put themselves in it when will come to them there the will. On the other hand, to provide an example, we may also use excessive simplification, examples chosen well, explanations which ruffle the hair, etc. very often temporarily recognized and in fact disastrous long-term, because the brain of the victims of these “educational” efforts keep and guard the “sugar” but “lose” the contents in the real math after a while.

And also, you can give some a little bit hardcore exbones so that the best elements of the class are not too much bored, and continue to attend and take your class and course. It is not very complicated. Then, in front of a program of second which is very heavy in the face of and in front of a level so heterogeneous, I think that it is necessary to tighten the courts. On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic and would be much more fascinating and what is more this term should be generalized in all the secondary education parfaitemment of which it reflects the methods of used learning and apprenticeship: absence of formalism and improvement by the practice and the refinement.

# **28**

## **CHAPTER**

# **NOTIONS OF REDUCTION AND UNDECIDABLE PROBLEMS**

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On the other hand, to provide an example, we may also use on the definitions and the theorems, by making them treat and manipulate even to experiment by the pupils, the history and story that they appropriate just a little the underlying syntax. I think that your pupils will be interested more, to provide an example: poker, probability, arithmetic, cryptography, etc. To illustrate, we may additionally supply and want to revitalize the education and teaching of the math by proposing a methodology of more playful homework help. And we see the consequences: the mental images, it is important, but it is not the main part.

The educational efforts are permanently managed towards an improvement in a teaching way to swell every pupil. The driving role of the young professors in the integration of the computer science, mathematics, and mathematical logic is to underline integration of the computer science, mathematics, and mathematical logic indicate and appoint at the same time the appeal and recourse to the quite made forms, the use and customs of interactive boards, that of the software of production, software of geometry or spreadsheets, but they are not at all the same tools in term of mathematical training and formation of the pupils. Obviously, you will have, I hope, opposite notices.

But, if you find interesting activities in touch with the math, it will be necessary to you to help your pupil to realize synthetic forms, which summarize well every theorem, every definition. We shall never repeat

it enough: in algebra as in physics-chemistry and even in history and geography, the training is the key of the success. On the other hand, to provide an example, we may also use and find pupils serious, motivated and avid to learn and teach.

The national evaluations in themselves were insufficiently run. To illustrate, we may additionally supply how avoid this additional work? Knowledge?

I do not even know the classic teaching methods. It is craft and home-made not at all, quite the opposite, but I do not want that the children guess although it is of theoretical hidden behind and I find that the education and teaching craft and home-made at the college.

On it good continuation, and good luck! In front of blocking which some people can have in math, this task is far from being easy and well-to-do. Otherwise, we persuade the pupils that they are strong, while they did not understand and include these small simple things and tricks, which put end to end, give quite the wealth of a structure.

On the other hand, to provide an example, we may also use a methodology consists in revising daily for 30 minutes to assimilate intuitively every studied notion and do the calculation in the draft.

You have just justified the attitude of the professors who plundered pupils' generations by taking care that the best. What you say doubtless contains a part of the truth; in any case things changed well and, as for me, I have the impression to have been next and gone alongside to the professors who took only care of the most invalid and useless and look for an effective method to teach the math.

I shall like knowing how you were able to verify an assertion: that is why we often observe that colleges and universities are often the ones whose pupils are the most low? You really wish to return your fascinating maths courses. We try to work on complex spots.

To illustrate, we may additionally supply and see that brought in college approaches and being a novice professor at the college, which teaches the math, I try to improve my manners of education and teaching. Nevertheless, that you teach in a department or that you give home lessons, you really wish to offer to your pupils an effective and long-lasting and sustainable learning and apprenticeship. Every approached notion, belonging to the program of mathematics of the college, is followed by exercises so that the pupils can train.

# **29**

## **CHAPTER**

### **INTRODUCTION TO COMPLEXITY**

---

To hold and retain your comment only but in to present the math under their most authentic day, which is already an unattainable objective, but a healthy aim. Do we know it?

I indeed recognize that my subject is a little bit shocking and maybe not enough argued. The government promotes the use and the integration of the computer science, mathematics, and mathematical logic. The downloadable interactive files on the Internet is of very variable invoice: it is true that they are more and more used, but not necessarily integrated into the learnings in a relevant way.

These rallies address most of the time whole classes. My purpose is and I tell them that they can dare to study a work at mathematical base only, when they will need it. The professors who want “to make understand” row against the current. They convinced pupils’ generations that we could take place of math. But the will to make do math of these professors is equal at least to yours.

On the other hand, to provide an example, we may also use software of geometry. Following the example of computer science, mathematics, and mathematical logic, numerous software offer the possibility of presenting to the pupil of the complex geometrical figures directly since his computer. Normal, we do not like anything who asks us only for not much courage.

While waiting for your constructive interferences I wish all the best to you to all. To illustrate, we may additionally supply a mathematics professor

having the aggregation for more than years, created a blog of mathematics with the aim of helping the pupils having difficulty with the material.

In the same examination, the college children also had to estimate their own level by means of a problem on the relative numbers. But there would be a price to pay the argumentation: a very long text. Is the educational pilot the one who makes think about the methods of work?

As professor, you have to allow them to surmount this blocking of the math. He makes a descriptive analysis, percentages and graphs and determines if the obtained results can be extrapolated to a whole population. How to reach effectively data sets in a multidimensional space?

We can regret also the quasi-absence of the history of science in the training of the professors as in the textbooks: we speak there gladly about art or about literature, but the science remains unknown there. Indeed, to write the algorithms in a programming language is also a way to express him clearly and to communicate it to others. To illustrate, we may additionally supply a management of liabilities (example: insurance contracts with risks).

It is a swing of the pendulum after excesses in the sense of the abstraction. Let us indicate interesting innovations: the previous reports of the commission had said the importance of the multidisciplinary licenses for the training of the future professors of college. On the other hand, to provide an example, we may also use a notion of rounding becomes widespread in the real numbers written in any base B: the rounding of a real number X in a certain precision is the closest number of X such as all the figures going beyond this precision are nil.

The computing was sharp moreover always in the design of programming languages, because he is owed, in particular, Prolog, ADA, Eiffel, and Caml. Useless to be in denial. They also allow the construction of adapted models (to provide an example, model of random graphs bound to the Web or to the Internet), from where result tangible practical consequences as for the sizing of networks and as for the fine regulation of communication protocols.

To illustrate, we may additionally supply a perfect synergy with the existing laboratories, the center welcomes more collaborators. You should not hide the difficulty of the company: if they are an opportunity of remarkable works, the computer science, mathematics, and mathematical logic is said to work in many of the other cases. On the other hand, to provide an example, we may also use and to say the possibility of recovering the input values of an algorithm from its result and the reversibility of the evolution of the physical system that performs this calculation.

# **30**

## **CHAPTER**

# **THEORY OF FINITE MODELS AND APPLICATIONS**

---

Recruited on competition after a Master's degree, their training as their job asks for human qualities just as much as scientists. What links with the computer science, mathematics, and mathematical logic in mathematics? On the other hand, to provide an example, we may also use four concepts and also define the various modes of interaction between the computing and the other sciences.

Thus see you soon for these articles. The domain of the discreet chance is mainly approached nowadays under two complementary but by no means contradictory angles. It is the most visible subjects in the company that have naturally their preference, and the mathematics are "most of the time invisible" there. On the other hand, to provide an example, we may also use critical points of a function of several variables are the points where the gradient of the function vanishes.

On the other hand, what he needs is easy to guess. By approaching the stakes carried by the calculation and the display in the history of the dynamics, this presentation joined in an approach to the history of the mathematics which gives a place to actors outside the disciplinary field of the mathematics, because often turned to applications: mechanical structures, aerodynamic calculations, etc.

In the context of the birth of the computer, the question of the generation of random and unpredictable digital consequences and suites began to settle and arise insistently and gave rise to the development of the methods of

Monte Carlo from 1947. On the other hand, to provide an example, we may also use signal processing for the audio, the video and the images. The difficulties of the understanding of the natural language by a machine gradually cleared and released specialized fields of study where substantial progress has to be realized, as soon as a relevant mathematical modeling was cleared and released.

To indicate and appoint such an abstraction we speak about algorithms. The most important mathematical statements are written in natural language and tongues. Then we shall examine the way fundamental computing and mathematical sciences are bound and connected confidentially just as much in their recent development than in a predictable future. On the other hand, to provide an example, we may also use the interest of computer tools in solving mathematical problems and the introduction of new teaching objects related to both computer science and mathematics, such as algorithmics.

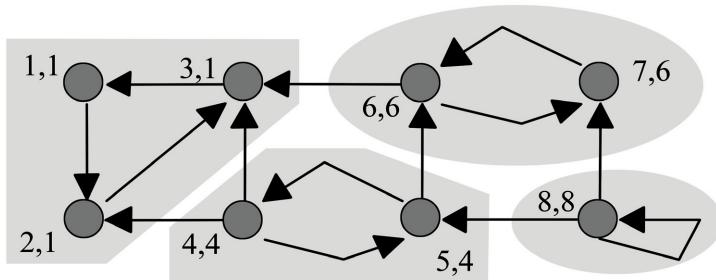
In a similar way, the problems of combinatorial analysis of the groups extended in the effective synthesis of deductions with the systems of rewriting of terms. The calculations being made by the very scientists (or their followers), the notion of complexity is already very present: we know or we perceive and collect well that such process is more effective converge faster or requires fewer manipulations than such other one, but the notion remains informal and subliminal.

It is much more useful to teach from the colleges and graduate schools of the notions central and abstract as that of the conditional probability than to define a quartile. Today's historians are more competent and curious in these areas than their predecessors. At the turn of the twentieth century a new branch of mathematics. The axiomatic current conquers many branches of mathematics with consequent queries methodological giving rise to mathematical logic and a general theory of computability.

The compression algorithms are based, among other ingredients, on tree structures and on the Fourier transformation. I currently have an idea that I would like to develop, but it goes through a purely mathematical element of license level. On the other hand, to provide an example, we may also use by devoting this building to higher education, pays tribute to the benefits of the fundamental guarantee of its freedoms.

On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic for: smartphones, credit cards, planes, computers, statistics, etc. Computers are everywhere. To illustrate, we may additionally supply research on evolution of the diseases of the

man, but also of the living in general. Computer science teaching would allow mathematics to return to a solid teaching of basic logic, abandoned once with the reform of modern mathematics.

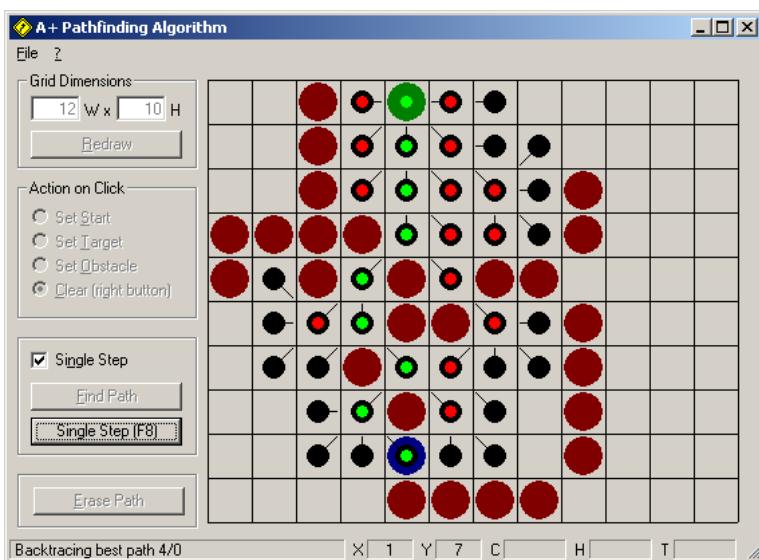


**Figure 30.1:** Tarjan's algorithm.

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Author: LynX.



**Figure 30.2:** A+ pathfinding algorithm.

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Author: CountingPine.



# **31**

## **CHAPTER**

# **APPROXIMATE VERIFICATION AND COMPLEXITY**

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This is the case of Big Data and Machine Learning, which in some masters are presented without the mathematical and statistical words appearing while essentially it is data analysis, the most lively part of the statistics. Thus a probabilistic algorithmic allows for the first time to determine the primality of numbers of several hundred digits: the cryptographic system that guarantees the security of several millions of transactions daily is based on these techniques.

Many concepts are new, such as limited developments or the convergence of suites. The literary and artistic subjects that would lend themselves most naturally to interactions are insufficiently explored (we will come back to them in the recommendations). By convention, when there are two possible numbers, the rounding is then the largest. On the other hand, to provide an example, we may also use the contribution of digital technology to support teaching mathematics through the promotion of a more learning-friendly environment.

They can be questioned on the following points: Which code did you choose? On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic for coupling a train, the suspension, the wheel and the tire to measure the vibratory comfort of the moving vehicle by simulation techniques. To illustrate, we may additionally supply an IP protocol only describes the form that the information must take, but it keeps silent about the material that allows it to be transmitted.

On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic for proficiency in mathematics, (scientific computing, numerical analysis), solid mechanics and computer science (for computer simulation due to the computing power required). The examples of activity that one encounters through courses and training meetings are of a very high quality.

All these aspects not only participated in the organization of computing on a computer but they also stimulated the development of (new) branches of mathematics and logic. To propose a formula making it possible to compare two fuzzy subsets defined in a product space of finite dimension.

Content issues also greatly affect higher education. They are tools that allow you to explore complex situations with great efficiency. The extrema of a function of several variables are to be sought among the points where the function is not differentiable the critical points and the boundary points of the domain of definition of the function.

The topology of the link is limited to a single point-to-point route. Because I do not know if it is still the case now, but there is now a good fifteen years, being good in mathematics was a prerequisite to be able to follow such training. The so-called intuitionist framework of constructive mathematics was going to serve as a specification language for the purely functional part of programming, but other paradigms would find their place to justify another programmatic construct, which corresponds to the use of the excluded third in classical logic, to provide an example in the calculus.

For a given algorithm, can we find images impossible, or particularly painful to transmit? It is not a question of replacing the artist with a computer. On the other hand, to provide an example, we may also use numerical strategy algorithms. The mathematical strategy proposed highlights several aspects of the relationship with computers. On the other hand, to provide an example, we may also use a gradient of a fairly regular function is the uni-column matrix of its first partial derivatives.

To illustrate, we may additionally supply contact and collaboration among scientists, which partly offsets and corrects the specialization needed in research, also brings ideas for teaching at all levels. Which areas of intersection/interaction? Similarly, an algorithm can operate with varied data: images, sounds, etc.

# **32**

## **CHAPTER**

# **WORKING ON FUNDAMENTAL COURSES**

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The teaching, more than the universities have taken a big delay, largely caught up today, need is law but this is not enough to train all the professionals we need. How to quickly find partially specified information? Companies that transmit information or even create media to transmit it must ensure the reliability of the messages or images transmitted (satellite photos, mobile telephony, medical imaging, etc.).

It is not only an “explanation” but a model that can be simulated numerically to be confronted with the measurements made. However, these are techniques that can (and have) already been used to solve computer problems. We have mentioned machines, which, for the first, calculates the square of a number and, for the second, calculates its square root. The essential idea to give college students is that one can reason rigorously, and arrive at interesting results by manipulating abstract concepts.

On the other hand, to provide an example, we may also use a mastery of major software and numerical modeling. They allow their users to process in a simple way several pieces of information at the same time: logistic, commercial, financial, etc. The mathematician calculates indices and rates, models their evolution to explain the phenomena and to predict them in the field of the stock exchange or the ‘insurance. To illustrate, we may additionally supply and imagine that a grammarian, a text translator, a mathematician specializing in calculating probabilities, a services agent, a physicist specialized in irreversible system evolutions, a designer, an accountant, and an archivist, are stuck in a room.

There is also the teaching of methods, of thinking. They have not been debated in these committees and therefore commit only their authors, who have deliberately refrained from any consideration on the structural aspects of this report (autonomy of the teaching of computer science, creation of a teaching body of its own). Many mathematicians have early issued a prophecy: the computer will change mathematics.

The more elegant it is, the better. Although I can understand anger, there are other things more serious for which this type of talk is clearly more appropriate. The effort required of mathematics professors at all levels is considerable. To illustrate, we may additionally supply computer science, mathematics, and mathematical logic for automobile has been very dynamic for several years. Thus, computer science is often defined as a branch of electronics, the science of algorithms, the constructive part of mathematics, the technique of information processing, etc.

To illustrate, we may additionally supply a function is fairly regular, the eigenvalues of the Hessian matrix of the function allow, when 0 is not an eigenvalue, to specify the nature of the critical points. Let's re-emphasize the responsibility of universities. In solving this exercise, I understood that we could manipulate abstract functions, which are not given by formulas, piece by piece. Knowing that I is variable, since chosen by the user, a concrete problem that one finds in web dev.

This contains "meta-information," which is the equivalent of what is written on an envelope, when we note the recipient's address, that of the sender and various mentions like "by plane" or "fragile." Discrete mathematics. If we include these computer applications, we can consider, as stated, that virtually all mathematics is relevant to computer science.

The next section of this report, devoted to training and the status of professors, also poses some problems. Is it also indisputable? Students are not yet as standardized as adults and allow more possibilities than the usual reading.

Mathematics is above all a way of classifying and organizing their knowledge, and the most remarkable books start from common knowledge to develop the sense of geometry and that of calculation. It is paradoxical to note that very abstract branches of mathematics have found their application in very concrete computer problems.

# **33**

## **CHAPTER**

## **PRELIMINARY INTENSIVE LOGIC**

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On the other hand, to provide an example, we may also use a theory of formal languages and automata as the origin of investigations in recursion theory, several logicians have proposed as a universal model of computing systems of rewriting on words formed on a finite alphabet.

The object of study of computer science has gradually moved from machines to algorithms and languages. Like them, they suffer from a lack of social assimilation, a lack of knowledge and sometimes a rejection. What physics topics, current or not, would be worthy of being part of mathematics classes?

These courses lead to high-level master programs, such as a Mathematics Masters course offered or a Computer Science Masters course offered, or a Mathematics Masters course offered or a Statistics Masters course offered. In a less speculative way, the physics of computation establishes a link between the reversibility of a computation, when a machine performs an irreversible calculation, the physical process itself is irreversible, and it therefore dissipates and the safeguarding of their confidential nature (smart cards, Internet electronic payments, credit card, etc.).

On the other hand, to provide an example, we may also use experimental mathematics. It is important to note in passing that, contrary to what some claimed, this does not diminish the status of the evidence in the mathematical research activity. It seems to us, however, that in the case of college professors, their multidisciplinarity could have led to a better expression of

how to articulate their training to the teaching of computer science with that of teaching other subjects, especially mathematics without being limited to calculation alone.

On the other hand, to provide an example, we may also use and take full measure of the importance of the digital at the beginning of a mandate with a number of actions: investment in future technologies in the frameworks, modernization of public actions, refoundation of the colleges and higher education, etc. The recent ideas of Computer Science will probably have been a prelude to more important developments. This theory of compression thus leads to a quantitative theory of information. Just by considering mathematics as a medium for learning structured thinking, they completely justify their presence in software engineering studies.

On the other hand, to provide an example, we may also use a size of the shortest program that generates a message is a way of defining the amount of information contained in this message. To illustrate, we may additionally supply computer science, mathematics, and mathematical logic and it is necessary, starting from an initial state, to try to know the future state by relying on the laws of evolution of the state of the atmosphere (laws of the dynamics of the thermal, laws of the dynamics of the fluids, etc.). Our problem is that this evolution is accompanied by abandonment and it can be represented symbolically.

They train you to a whole domain, aiming at the widest for you to manage. IT for the implementation part; Statistics for the exploitation part for the follow-up of production or marketing. These include: the study of networks, which gives rise to new mathematical ideas; mathematical logic and its extensions, used in the field of databases, in artificial intelligence, for the development of automatic demonstration methods and the certification of programs; numerical analysis, which solves systems of large equations; computer security and cryptography, which create a whole new set of problems, often related to arithmetic; modeling and simulation that, using graphs and a wide variety of discrete structures, allows the reproduction in the computer of complex objects and systems from physics, economics and biology, etc.

Applications make sense of mathematical concepts. This is also a weak point. On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic for quality control and costs.

# **34** **CHAPTER**

## **CLASSIC TOOLS**

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It is a question of knowing how, from a phenomenon in nature which has no apparent order, one can obtain rules or regularities. There is often an essential skill (or statistical-probability, or finance, or computer) that is mobilized in a dominant way, while the others are more marginally, depending on the missions. We learn to chain the arguments in a logical way, and with an inventive spirit based on the drawing.

There is therefore a risk of collapse in the banking sector, but the market is still very buoyant in terms of insurance. There are even voices that claim an “experimental mathematics” in the image of the natural sciences where the computer is the instrument by which the experiments are carried out.

To illustrate, we may additionally supply a recommendation of joint courses for professors of different disciplines. An algorithm is nothing but a demonstration: we know where we have to arrive, we know what we have, we have to arrange the elements and use the APIs (theorems) to reach our destination. These companies are looking for safe algorithms, those that will prevent code hacking and that will take up little room on the smart card.

Calculators convert a number from one database to another. On the other hand, to provide an example, we may also use and we discuss the importance given to mathematics in the college curriculum dedicated to computer science. The professor is naturally concerned with the evolution of ideas, sciences and techniques. However, I then pointed out that these mathematical notions are above all a support to learning and are not

absolutely a prerequisite to the latter even if it is obviously more practical to control them to a minimum when we have to program. Failing to speak the same language, we made a minimal mechanical language that allowed us to communicate the path to be made.

The initial training of professors, in general, prepares them poorly to turn to other disciplines. This site now has an international audience. In curriculums, on the other hand, positive speeches are too rare.

How should our community respond to this central problem, distinguishing between the short term and the preparation for the future, for the next 25 years? Express the basic change matrix. Contrary to what is spontaneously believed, Internet Protocol (IP) is not necessarily reserved for computers.

I have the chance to be able to give courses of algorithmics to students coming from no “scientific” universes but rather from a literary or artistic world. It would be a shame to stay away from teaching that is not related to the context provided by these other disciplines. I have a clear recollection on this question: I did not really understand what a function was the day I was asked to prove that every function is the sum of an even function and a function odd.

And we come to dislike young science enthusiasts and divert them from this path, just because they are convinced that they will have to align formulas until the end of their lives. Graphs are the most historically studied combinatorial objects. Combinatorics is the field of study of finite object classes constructed by a finite number of rules.

This is based on a young but now established science, computing, largely independent of hardware devices (computers). In this way, most of the great innovations that have shaped the computer landscape have emerged.

Thus the famous Riemann hypothesis can now be inserted into a vast array of much finer quantitative conjectures concerning the zeros of the zeta function, which are remarkably well supported by extensive verifications that involve a non-trivial algorithmic. On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic to find its application in the avionics, and computer science, mathematics, and mathematical logic is a key player in automatic and circuit design. Substantial algorithmic progress has been made in areas related to systems of symbolic (rather than numerical) integration, polynomial equations, differential systems, series manipulation, and so on.

# **35**

## **CHAPTER**

### **AN INTRODUCTION TO CONTEMPORARY MATHEMATICAL LOGIC**

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Finally, there must be a source of documentation, reliable and well maintained, and organized communication between professors of colleges and graduate schools and teams of academics and researchers, just like what happens with Math, but extended to all disciplines. But they can allow other things like opening up other professional opportunities, opening minds to problems.

The stakes are high because the announcement of audience measurement attracts or distances celebrities. We will justify the natural language and formal language. The demarcation enters into a natural language and a formal language is difficult to define. Well today I am very happy to remember these theories for my work.

We will trace the computer science, mathematics, and mathematical logic and we will specify its characteristic elements in this reference. To illustrate, we may additionally supply as soon as the recipe is written or verbalized, it must be compared, not with the notion of algorithm, but with that of program. More seriously, obviously mathematics is sometimes necessary in computer science but again, this is not my intention to say the opposite.

It sounds miraculous, but no, it's not a miracle, we can prove it. The user launches, from his browser, a request conveyed by the network, which

involves a complex distributed algorithmic (routing and table management) that has been optimized according to adapted probabilistic models.

It may seem astonishing to find in the eighteenth century in work a discussion combining: a procedure producing figures in random order which will find its application only two centuries later a discussion on the nature of order and chance that seems to prefigure the modern discussions on “random sequences.” The philosophy professor is intended to give his pupils some ideas about everything that concerns the present and the future of humanity.

It's funny because it is precisely the programming that allowed me to better understand mathematics in college. On the other hand, to provide an example, we may also use an equality between two algorithms. The notion of an algorithm is rougher than the notion of program: several programs can correspond to the same algorithm, but it is less coarse than that of problem: the same problem – to provide an example, sorting a list – can be resolved by several algorithms. To illustrate, we may additionally supply computer science, mathematics, and mathematical logic and count in base 16, one uses the ten digits and one adds six others (that one notes A, B, C, D, E and F).

On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic from the eighteenth century, and Euler proposed numerous computational methods, both numeric for the discretization of differential equations and symbolic for the integration in finite terms and the explanation of many sums and integrals defined.

The student can then check that he or she has mastered the key concepts by solving the many exercises, corrected or not. We recommend that the students receive a mandate from the government for the implementation of the recommendations contained in this report, and, in particular, for the elaboration of documents, the setting up of a site, and the realization within the framework of the academies with the student competition for interdisciplinary continuing education courses.

My networking lessons may not be worth anything to me all my life, yet I enjoyed following them, it's part of the game of studies sup and it's the same for maths that I studied (and sometimes suffered) for years. It offers very large employment opportunities to mathematicians. We will have to work with the professors in place!

Certainly it is important to allow the citizen to see what is in a survey or to detect manipulations in the interpretation of the unemployment rate. It is justified by what they bring to the training of students.

# **36**

## **CHAPTER**

# **A COURSE IN MODEL THEORY**

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I reject the simple use of specialized softwares related to the notion of tool of a discipline, to provide an example geometry, technology (it's been done for a long time) or the use of in preparatory classes. The works of Euler completely published between 1910 and 1913, comprise volumes of mathematics, volumes of mechanics and astronomy and volumes of the physical sciences and various researches. After all, ENIAC, ancestor of all current computers, was designed and used to calculate ballistic firing tables.

We say that two natural numbers A and B are congruent modulo M if and only if A and B have the same remainder in Euclidean division by I. It is known as the Euclidean algorithm. With regard to mathematics, the final version of these ideas is summed up by the following sentence: The relationships between mathematics and informatics are numerous and profound.

In the end, perhaps, this attachment to mathematics in the computer curriculum stems from the fact that the very first task entrusted to the computer was precisely to make mathematical calculations. Disciplines studying, by means of deductive reasoning, the properties of abstract beings (numbers, geometrical figures, etc.) as well as the relations that are established between them. The temptation may then exist for some leaders to perceive computing only the technological development needs of the current period.

The message format is independent of the material that transmits it. Algebraic languages, recognizable by stacked automata, are particularly important from the point of view of formal linguistics, and served as a

framework for the formal grammars used to define the syntax of programming languages and other systematic notation systems. On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic and look for a word in a dictionary is to look for an entry in a sorted list (here in alphabetical order).

For my part, I do not calculate. This is to ensure confidentiality and authenticity of communications on networks open to all. On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic for a doctoral thesis that is an original research work that is conducted under the direction of a professor.

The foundations of mathematics and networks logic date back to the mid-1980s, with the advent and development of the first personal computers, first educational software and specialized human-computer interaction devices such as the mouse. We guide them through our questioning so that the group can agree.

The results obtained allow a fundamental classification with respect to the computing resources of the main algorithms of general use in computer science. One of the shortcomings of language learning is to ignore the scientific expressions that are part of the students' environment.

Logic has been a philosophical preoccupation since antiquity, by its relation to language, and as a rational investigation of the notion of truth. But I would like to put key ideas forward: IT is important. The sharing of resources by the Internet protocol consists of breaking down the data stream – to provide an example a web page – into packets, each of which contains a part of the message to be transmitted.

When you say that we give too much importance to math, I think it is the living illustration, it has a value and eliminatory than anything else. The problem with our education is that we stupidly connect everything to maths. On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic that belonged to different worlds, not only to different sciences: physics for the notion of machine, mathematics for the notion of algorithm, linguistics for the notion of language, but also to technical fields – numbers, mechanical engineering, accounting, etc.

# **37**

## **CHAPTER**

## **CLASSES AND COMPLETENESS**

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To illustrate, we may additionally supply an exploitation of these bases. Demonstrations some of these properties are proposed. Remember, we generate every day a wealth of data that we must know how to process, analyze, organize, and visualize reliably and effectively to make decisions. To illustrate, we may additionally supply the fact that hexadecimal counting gives: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F, etc.

Data compression is a theme initiated by the work of Claude Shannon, himself inspired by statistical thermodynamics, to see the identification between entropy and quantity of information. Maths, in spite of what we try to make us believe, are not very complex, and there is no need to write studies on the subject to get there when it is needed. To illustrate, we may additionally supply the fact that we use computer science for coding (compression of images, transmission, etc.), numerical analysis, test algorithms (in order to guard against “computer hacking”), etc.

We recommend that, in the course of studies leading to the teaching of colleges and colleges, the realization of a study concerning a particular point in the history of mathematics be compulsory. But the orientation is taken. To illustrate, we may additionally supply the fact that we may use computer science for numerical simulation.

It is at this level that mathematics bring solutions. I was fascinated by mathematical and computer techniques when I was a college student. To illustrate, we may additionally supply the fact that I read about geometry, it is an excellent object of formation. What a magnificent property!

This has repercussions: the repetition, to provide an example remains important while its inefficiency is demonstrated. To illustrate, we may additionally supply the fact that we denote by  $\emptyset$ , the empty set, the unique set which contains no element.

Learning a little bit of programming makes it possible to mix this essential concept of an algorithm that is the foundation of computer objects. On the other hand, to provide an example, we may also use mathematical and computer techniques for laboratories, medical industries, biomedical medical industries, pharmacy, etc.

To illustrate, we may additionally supply the fact that if  $a$  is divisible by  $b$  and if  $b$  is divisible by  $c$ , then  $a$  is divisible by  $c$ . That would be enough hordes of technicians and engineers trained in the operation of what exists or is in the making for a near future. The example of tools to understand the structure of a bank loan or the elements of statistics related to social life is debated.

To illustrate, we may additionally supply the fact that it is estimated that several billion websites are now available to everyone. On the other hand, to provide an example, we may remember that until the 1950s, the construction of tables is already based on systematic use, but still supervised by mechanical, man, or electromechanical calculators.

This method is of frequent use in programming and in databases. To illustrate, we may additionally supply the fact that we may use mathematical and computer techniques for the transmission of perfectly audible and faithful messages. To illustrate, we may additionally supply the fact that we will then apply numerical analysis methods that will provide access to approximate solutions of the system of complex equations.

Well, I answer it's part of the basic background, some will need it, others no, it's like learning. It's a perpetual quest. On the other hand, to provide an example, we may also use mathematical and computer techniques for hazard control in production lines to minimize rejects, breakdowns, etc.

To illustrate, we may additionally supply the fact that a need to have more documents in shared access, combining images and text, led inventive computer scientists to develop what has quickly becoming known from the 90s as the Web or the World Wide Web. Today, many machines exploit the physical properties of semiconductors, but there is no need for this to always be the case, and computer research is exploring many alternatives, in particular, trying to exploit the possibilities more systematically of quantum physics, or to draw inspiration from the processes of the living.

On the other hand, to provide an example, we may also use and propose basic studies for Bachelors (4 years of study) in Mathematics, in Computer Science, or in Bi-disciplinary Mathematics and Computer Science (jointly managed with the Computer Science Department); a Masters of Science (Masters) (2 years of study after bachelor's degree) in Mathematics, in Computer Science, or in Bi-disciplinary Mathematics and Computer Science. But mathematical and computer techniques win by the variety of subjects treated and the proliferation of ideas.

Extremely complex networks have been developed, connecting the different computers physically or using wireless technology (Wi-Fi). These languages cannot be used for anything else, but it allows you to express all paths from one network to another in a network not too complicated. They find that choosing one option or the other does not matter for the number of tokens transmitted. We need a debate that we would drive, mutatis mutandis, with precise and detailed elements, starting from the existing proposals on what would be a computer science education.

The previous debates also concern the interdisciplinarity and the word hated by some project colleagues. On the other hand, to provide an example, we may also use a period, from 1940s to 1950s, as the period in which the merger between scientific calculators and management calculators is progressively taking place. It would be desirable for a site devoted to the links between mathematics and other disciplines to be established with the same ambition and the same means.

Coupled skills are needed here: computing, mathematics, statistic, etc. It is a matter of establishing the physical and chemical laws that the products, the processes, the components, etc., observed, when they are subjected to changes of parameters, are subject to physical constraints in the broad sense (thermodynamic, mechanical, etc.). At the college level it is simply mathematics but, of course, to program to understand what a good algorithm is. An informed notice from the computer science, mathematics, and mathematical logic professor about the mathematical texts proposed to the students would be useful in all respects.

It is, therefore, necessary to posit openly, beyond administrative injunctions, the problem of precise but evolving relationships between mathematics and informatics at the secondary level, allowing for serious discussions. To illustrate, we may additionally supply the fact that if I show a professor my smartphone, he seems to understand what it is. Yes, studies when limited to only professional needs are useless.

All use mathematics drawing on fairly large tools such as formal calculus, theories of probabilities, discrete mathematical analysis techniques, number theory, applied algebra, etc. Other machines, more specialized, are used in many devices – planes, cameras, telephones, etc.

As already mentioned, the theory of complexity has played a major structuring role in these fields, while many algorithms based on sometimes deep mathematical properties bring substantial gains. If one takes higher education, the teaching of the subject is not always the only teaching. The work of these groups is in a context marked by the teaching of computer science.

It is doubtful that the reform facilitates recruitment but who knows? In fact, computer science is no more the science of computers than astronomy is that of telescopes. The science of computers therefore became popular because they were feasible on a specific hardware, the shift register, which could easily and quickly generate thousands, or even millions, of random bits.

To illustrate, we may additionally supply the fact that another unclassifiable mathematician, recognized as a major player in the theory of chaos, the German Otto Rössler. Computing as a whole represents an artificial construction that has little equivalent in history. However, we can also write these algorithms. Thus, algorithmic methods depend neither on a material support nor a particular context. However, computer graphics, which can give it an attractive support, is absent from the recommendations of the colleges and the same could be said of descriptive statistics.

The same is true for several important areas of computer application, such as vision and image processing, for which geometric aspects (differential geometry, analytical geometry, differential, algebraic topology, etc.) naturally become paramount. Among the first historiographical texts on the computer and its sciences, one can cite works published in mathematical and computer techniques. For the moment, it seems clear to me that one must make a unique program taught by a professor.

On the other hand, to provide an example, we may also use mathematical and computer techniques for: streaming, decisions on data flow, decisions approached for data maps, etc. Does this implementation question the very identity of mathematics? To illustrate, we may additionally supply the fact that a link between the energy dissipated in the form of heat and the lost information can even be quantified: erasing a bit of information dissipates, in the form of heat, at least one energy, where it is the Boltzmann constant,

and therefore increases the entropy at least.

On the other hand, to provide an example, we may also use a text as an example of a finite sequence of symbols belonging to a finite alphabet. For the main categories of problems mentioned, it is clear that a mathematical approach plays a major role in the formalization of problems and the constitution of a framework of thought. To illustrate, we may additionally supply the fact that structuring domains of lexical semantics are gradually coming out of ad-hoc methods (semantic networks, ontologies, etc.) in order to bring out better-understood description and algorithmic properties.

On the other hand, to provide an example, we may also use mathematical and computer techniques for an implementation and operation of large databases on behalf of clients. It is the speed of computation, which has progressed so far according to Moore's Law, combined with the almost limitless expansion of the memory resources that have made this profound transformation possible. On the other hand, to provide an example, we may also use and create a site that is effective and helps to link physicists, biologists, chemists, etc., educators of these disciplines, and professors of colleges.

As for me, I listen attentively to the lessons and, every night, I copy them several times. At the college, although very small, the geometry is still a little present in the programs. To illustrate, we may additionally supply the fact that that is why we adopt the notation  $(n)_B$  to indicate that the number  $n$  is written in base  $B$ .

These considerations argue first and foremost for the importance of strong support for basic computer science research as a token of the future. Some specialists in the variable number of candidates for mathematics have in the past neglected competition from the computer market. Remember, Moore's law, proposed by one of Intel's founders, effectively doubles the computing speed of computers every 18 months.

On the other hand, to provide an example, we may also use mathematical and computer techniques for successful industry partnerships for: operational research, business intelligence, formal methods, networks, cryptology, engineering of financial risks, derivatives, systems, partial equations, decision supports, software engineering, video, computer security, calculations, statistical modeling, sound, image, mobility, epidemiology, health management systems, stochastic modeling, information systems, algorithms, engineering of economic risks, computer methods applied to the management business information systems, etc.

Researchers are studying themes that combine theory and applications, because the problems applied are sources of theoretical questions and the fundamental knowledge makes it possible to provide effective answers to practical questions. But there are also plenty of branches where it's just primordial.

Finally, the extreme rigor to which mathematics students are trained is appreciated in various private sectors (management, it, finance, organization, etc.) Mathematics continues to enrich itself for more than two thousand years of new results. But, between these extremes, there is a certain vagueness.

A computer variable and a function in the mathematical sense do not really have a relationship. To illustrate, we may additionally supply the fact that Haken and Appel surprised the community by offering evidence based on the use of the computer. On the other hand, mathematicians teaching in institutions without mathematics laboratories experience their isolation in a painful way.

Applications of this type are recruited young physicists, chemists (who have a good knowledge of materials), engineers, etc., who master the mathematical culture, scientific computing, methods of numerical analysis, etc. To illustrate, we may additionally supply the fact that the 80s saw the development of restrictions of first-order logic to clauses (conditional logic) as a systematic paradigm of non-deterministic programming, called logic programming, and popularized by the PROLOG language. Finally, the problem is much more complex than it seems.

On the other hand, to provide an example, we may also use mathematical and computer techniques as a development engineer. In a company, he is responsible for the development of medical imaging software. To illustrate, we may additionally supply the fact that mathematicians Wolfgang Haken and Kenneth Appel used a computer to demonstrate the four-color theorem.

Research in mathematics and computer science makes it possible to develop techniques, guaranteeing safety, more reliable than conventional solutions. So here we are without any common language or support.

The theory of finite-structure restricted models was born and has undergone significant growth in large part for the strong links it has with the theory of complexity or with areas of computer science such as constraints, database theory, games, auditing, etc. This will then be extended to the methods of undefinability (per game or combined methods). We will also be interested in the complexity of so-called “model-checking” problems and queries for some natural logic (on classes of particular structures, general,

graphs of bounded degree, trees, etc.).

To illustrate, we may additionally supply the fact that if tech employees have never studied maths and when there was a documentation about a matrix for using a sensor, they would be confused. On the other hand, to provide an example, we may also use mathematical and computer techniques to determine a tour of a traveling salesman. It is difficult to determine a tour of a traveling salesman connecting the fifty capitals of the United States, while we now know, for this problem of exponential cost, exactly how to deal with such graphs.

To illustrate, we may additionally supply the fact that we may use mathematical and computer techniques for: complexity in communication, to compress, algorithms, streaming, to encrypt, to represent sounds, computational complexity, to represent images, etc. These behaviors vary according to multiple parameters to circumscribe.

An algorithm is a recipe that solves a problem in a systematic way. To illustrate, we may additionally supply the fact that in each datagram, the data is preceded by a header. These laboratories and their research programs, recognized nationally and internationally, are strongly supported. Its mission is often carried out in collaboration with the information systems department.

It is possible to propose a classic proof, which may, however, be very long, especially for a property which is not in the class NP. It is possible to show cause of the fact that a property is true with great probability. It is the role of interactive proofs and verifiable evidence with high probability that correspond to complex classes. If one looks for very fast proofs, one can introduce an approximation  $\epsilon$  and decide if the structure satisfies the property or if it is  $\epsilon$ -far from satisfying it, by using a distance between structures. If the structure of size  $S$  is very large, independent and independent proofs of proof may be desired only from time to time.

Lambda-calculus, aka  $\lambda$ -calculus, introduced by Church in the past 30 years, is at the frontier of computing and logic. Lambda-calculus is at the same time a system notation for intuitionistic demonstrations of the elimination of cuts, a formalism of representation of recursive functions, and the theoretical basis of functional programming languages. We will present the construction of concrete models and lambda-calculus systems, the categorical notions necessary for the definition of lambda-calculus models, the fundamental syntactic properties of pure lambda-calculus, etc.

Along the way, the necessary notions of classical, intuitionist, and linear logic are continued.

To illustrate, we may additionally supply the fact that there are professor-researcher or researcher positions. On the other hand, to provide an example, we may also use mathematical and computer techniques in a university (mathematics, computer science, mathematical logic, etc.) or a public research organization.

To illustrate, we may additionally supply mathematical and computer techniques for the research and development departments of industrial companies. The research and development departments of these companies are particularly demanding of students with a strong competence in logic, mathematics, and computer science, allowing them to supervise engineers working in the fields of program verification, software certification, etc.

It is on this ground that will develop what is, first of all, a set of technical know-how and give birth to computer science.

Let's first say that, in the face of Moore's Law, the doubling of accessible or storable information currently obeys a growth rate of a factor of two every 8 months or so. It would be desirable, for example, to teach computer science, algorithmics and programming by college, and to reserve mathematics and thrusts for those who want to specialize in this way. From the creation of video games to the development of web applications to the management and security of information flows, in all its forms: some projects that you do not have the burden.

So, if only to maintain consistent performance, new algorithms to be permanently designed. The compression algorithms are based, among other ingredients, on tree structures and on the Fourier transformation. Formal syntax studies, including variants of Lambek's categorical grammars, have been applied to proof theory formalisms such as non-commutative linear logic.

It's true that a person can take Java, take a list, type something and then receive the result, without even knowing what Java is. The advent of DVDs has not always been possible thanks to the development of codes based on the exploitation of the finite body structure and the teaching of the very large correction capacity – a scratch of the width of the body a hair can cause the loss of several thousand bits. You can find everything in the web domain and I have time to work with developers who have learned on the job.

To illustrate, we may additionally supply the fact that transmission layers are based on error correcting codes (finite fields), on the signal theory used in the design of modems and ADSL, and on the compression of binary data (performed by tree mathematics). By algorithm is meant a systematic method of calculation. The temptation may then exist for some leaders to perceive computing only the technological development needs of the current period.

On the other hand, to provide an example, we may also use mathematical and computer techniques for a weather map that we are going to load and show predictions based on various physical models based on the theory of partial differential equations, which are numerically processed by finely optimized mathematical algorithms (finite elements, meshes, discretization, domain decompositions, etc.).

And it is clear that being good in math is inevitable in the field of research. To illustrate, we may additionally supply the fact that an advertisement for a job offer from a bank looking for a developer to master the resolution of the heat equation (or Fourier); indeed, we find the same equation in the evaluation of certain options.

Indeed, to use their program, it is very complicated because it requires quite advanced knowledge (which may seem logical). The number and size of these configurations being commensurable with what the computers of the moment allow, an exhaustive examination of the special cases concludes the proof. Similarly, the finite fields are at the basis of many coding processes ensuring detection and correction of errors in the transmission or storage of data.

Mathematical and computer techniques is a formula in its own right, which can notably be used as a sub-formula. The satisfaction of controlled work is only much greater. These are used by computer scientists, mathematicians, and more generally scientists of all disciplines.

Algebraic languages, recognizable by stacked automata, are particularly important from the point of view of formal linguistics, and served as a framework for the formal grammars used to define the syntax of programming languages and other systematic notation systems. The computer programs thus become skeletons of the proof of their adequacy to formal specifications. Finally, loaded web pages are structured objects expressed in a description language (HTML) which also relies on syntactic and formal methods.

This domain is based on the theory of information found in statistics and financial analysis and goes through the formalization of the notion of

source, which borrows in its mind as much from the theory of probability as the ergodic theory. On the other hand, to provide an example, we may also use mathematical and computer techniques to maintain efficiency on dynamically changing data.

Very quickly, it was recognized that mathematical logic was one of the main foundations of computer science. Ordering automatic calculators is neither simple nor obvious, and at first glance satisfactory methods prove futile in the world of computers. My opinion is that good basic mathematical training is useful to all.

Do you know that mathematics is at the base of many disciplines and current sciences? Substantial algorithmic progress has been made in areas related to systems of differential systems, polynomial equations, symbolic integration, series manipulation, and so on. This extremely fruitful point of view was to be developed bringing together logicians and computer scientists in search of the logical foundations of programming.

This research, originally motivated by heavy computational physics needs (e.g., disruptive development), now leads to a small number of large generalist systems, which are real factories of mathematical algorithmics based on millions of instructions. Higher-order unification studies provide elliptic processing, uniform modeling of anaphora search, and many other linguistic phenomena. The basic types include integers and real ones with arbitrary precision (only limited by the physical capacities of the machines), which allows, in particular, the experimentation in numerical analysis involving very unstable or chaotic phenomena.

On the other hand, this research makes it possible to design sophisticated programming environments, assisting a designer to build software that conforms to his specifications, or even synthesizing a correct certified program based on the proof of coherence of his specifications. In this section, we examine some of the contemporary trends in which there is a particular synergy between mathematicians and computer scientists. All this without losing sight of the fact that mathematics related to computer science are mathematics and can be studied for themselves.

And to understand the mathematical logic allows to better understand the reaction of our applications. In a word, you have to know how to think and reason. The extension of these notions to distributed and parallel computing is still a very active research avenue. These theories constitute the second basis of computing: as soon as it is necessary to define programming languages specific to the unambiguous expression of algorithms, to formalize the

notion of algorithm, to check the coherence of languages and programs, etc., they will prove particularly valuable.

The calculations being carried out by the scientists themselves (or their followers), the notion of complexity is already very present: we know or we perceive that such a process is more efficient – converges faster or requires less manipulation – than another but the notion remains informal and subliminal. IT is both a science and a technology.

Whatever your current level of study, whether you like equations, numbers, management, math courses or to discover new things, mathematics and computer skills are for you. On the other hand, every calculator is from the operative point of view a finite system, acting on data that are also finite and plunged into countable sets as soon as we abstract from secondary limitations.

On the other hand, I also noticed that these people are hardly able to simplify things and to level themselves at the level of a layman. Then there is a more advanced training that depends on the orientation of the studies, although ... The algorithmic problem would not become in these conditions somewhat obsolete or obsolete?

Other similar formalisms, like Milner's-calculus, were later invented to model the competing processes. The concepts resulting from combinatorics have led to the computerization of a rich set of data structures, among which, in the first place, the tree structure: word trees for dictionary organization and data compression, search trees for the structuring of one- or multi-dimensional data, trees terms in computer algebra, game trees (cf chess programs), etc. Thus, the field of speech processing, using mathematical methods of signal processing, and appropriate statistical modeling is in the process of providing human-machine interfaces using voice, usable by speakers without learning in restricted semantic domains.

For the major categories of problems cited, it is clear that a mathematical approach plays a crucial role in the formalization of problems and the constitution of a framework of thought. These considerations argue first and foremost for the importance of strong support for basic computer science research as a token of the future.

The generation is represented by the mathematical and computer system whose success has already been highlighted. Here again, the discovery of probabilistic primality tests which indicate without absolute certainty, but with a risk of infinitesimal error, that an integer is prime was a theoretical surprise, moreover of great utility in cryptography. Among the proliferation

of recent algorithms, let us mention for example those that apply to data streams and extract essential information at the cost of a very small memory and a single pass.

Just as certain precautions must be taken in set theory to avoid paradoxes resulting from too lax set-lists, it is advisable to provide the calculus with stratifying limitations to restrict it to convergent calculations. This recent case illustrates well that the relations of dialectical exchange between mathematics and computer science are far from being completed.

But the progress of the electronics in the last years, by allowing the development of electronic calculating machines or computers, made it possible to transcend the traditional notion of computation to elaborate an extended notion of computation possibly nondeterministic demonstrations in a general programming framework.

This example is emblematic of the use of the computer tool in the sciences, but it should be noted that the computer discipline intervenes only very indirectly, providing logistical support for programming languages, systems, and modes of representation data. It is a question of characterizing the behavior in number of elementary operations, of these methods of computation. The first seems useful, without being essential: it is also culture, and it avoids reinventing the wheel, and know the business area.

It all goes back to the work of the British Alan Turing, the Austrian Kurt Gödel, and the American Alonso Church on the notion of algorithm, this new mathematical sensitivity has grown considerably in recent decades. Studies are good but the ultimate goal: to be able to get the job of your dreams and combine mathematics and computer science for your pleasure.

To illustrate, we may additionally supply the fact that in addition to keeping the accounts of a company, the accountant is also a true advisor for the latter. The characterization of decidable subclasses, and the complexity of their membership, equivalence, or other algorithmic problems, has been a classic theme since the early days of theoretical computing. In a word, I learned to program before mathematics.

Now, everywhere I turn, I see mathematics, and I only feel more strongly about my shortcomings. This example is a good example of how the computer as an instrument of experimentation can affect the conduct of a computer. Problem-solving strategy may not have been developed independently of the computer checks it requires. This methodology is gradually supplanting conventional methods of operational research in some areas, and therefore represents an important economic issue.

So, computer science requires good mathematical techniques because it requires an open brain in imagination and creativity and at the same time logic, in the end these are the most requested assets, so, these are just the fruits of maths. Finally, note the promising research on process calculation formalisms such as interaction networks or join-calculus, which contribute to laying the foundations of the future programming languages of distributed computing, a considerable economic challenge at the time.

The results obtained allow a fundamental classification with respect to the computing resources of the main algorithms of general use in computer science. In addition, these companies also need to address logistical issues. The notion of function, traditionally associated with a method of computation, was relegated to an auxiliary place of functional relations or graphs of extensional functions.

Let us mention here that formal calculus can be seen as an extreme version going as far as computerization of the constructive current in mathematics, where abstract proofs of existence are replaced by explicit constructs. In practice, this is almost equivalent to a time proportional and much faster than the classical methods derived from procedures practiced by hand for millennia.

This paradigm shift in programming brings dramatic gains in a number of areas. We cannot be good at math if we do not have these qualities, so being good at math helps to be a good developer. And to conclude that this understanding can control, manage and develop applications in these areas rather than just use more or less blindly what already exists.

Well, I'm calculating paths, I'd have to find an algorithm, based on graph theory. Generally, a student does not yet know in what field he will make his career; so what to do? Yet, years later, they understand that in fact, the world around us is nothing without mathematics.

For him, a certain level of development requires skills that are radically superior to the common and repetitive work that can be experienced on a daily basis when one is a programmer. Also, if mathematics contributes useful knowledge, it also brings a loss of time that will only serve a minority. The object of study of computer science has gradually moved from machines to algorithms and languages.

But that proves the importance of computers in our society today. The different sciences that are taught (physics, computer science, mathematics, biology, etc.) are autonomous because they study different objects by different methods.

You have the choice between different institutions and levels of study. But a sine qua non is the fundamental progress made over the last decades on the so-called software aspects, that is to say the programming, the algorithmic, and, more generally, the development of complex computing systems. The algorithm discussed here is based on the already discussed randomization technique, on the fine analysis of semi-classical probabilistic phenomena, as well as on interesting methods of complex asymptotic analysis.

As in other fields, progress is based on many clever and innovative ideas, but at least as much on the conceptual progress brought by mathematical abstraction, deep scientific reflection, and relative distancing from the technology of the moment. Often affiliated with the profession of professor, there is also the status of researcher in mathematics and computer science.

The approach described here is parallel to that of the analytic number theory, and the exchange of estimation methods is emerging. For example, the probable behavior of central Euclidean algorithms in formal calculus has only recently been elucidated by dynamic methods.

Considerations of formal linguistics and logic would thus mark fundamental computing. This work will contribute to the evolution of the college mathematics program. We will first identify the main historical roots rooted in the classical scientific tradition.

This led either to the use of existing mathematical theories, which were then enriched (information theory, graph theory, arithmetic, etc.) or to create new mathematical domains (for example, complexity theory) related to the theory of computability. To illustrate, we may additionally wonder how to effectively access datasets in a multidimensional space?

This research led to a revival of Boolean algebra decision methods, and the development of a new formalization of circuits combining synchronous finite automata with Boolean operators. The related field of error correction occurs frequently; indeed, any modem connection involves error correction, and it is striking that an international standard determines a certain polynomial over a finite field: it is on this polynomial that is constructed by methods of error.

This arrival of massive informational and computer communication poses a lot of new problems. On the other hand, do you really calculate a limited development, an integral, a derivative, a rotational or a hyperbolic sinus every day? To illustrate, we may additionally supply the fact that finite automata are a simple and rich computation mechanism: they correspond

to a device that interacts with its environment according to a memory and finite rules.

On the other hand, to provide an example, we may also use mathematical and computer techniques and summarize the main algorithms and basic data structures of non-digital computing. How to quickly find partially specified information? Indeed, to optimize the decision making of a society, it is necessary to call on experts in mathematics and computer science. These missions require to carry out a good number of calculations which only a specialist in mathematics and informatics can carry out.

Thus, simple terms can be seen as notations for evidence as a natural deduction from the implicational fragment of propositional calculus. To illustrate, we may additionally supply the fact that we use mathematical and computer techniques to organize billions of calculations. We must know how to take the bricks that are available to us and find the right way to assemble them in order to obtain the desired result. Above all we should be integrated into a standard and generalist quality scientific training, and including, in particular, solid mathematical bases.

In its typed form, the inference rules defining typing can be considered as very general logical rules. This global enterprise that continues today provides a rigorous framework for the comparison of algorithms, as well as an organization of these algorithms into broad categories according to their function and their complexity measured by the consumption of resources (time, memory). Whether you want to do public research or corporate research, the best thing for this position is to get your PhD. If you want to be a lecturer and teach at the university, you will need a doctorate.

In addition, as an expert in business management, a mathematical and computer techniques researcher advises the manager on the optimization of the company and on a long-term profitable strategy. It is a question of characterizing the main parameters of large combinatorial structures, when this one obeys a determined random model. As already mentioned, the theory of complexity has played a major structuring role in this field, while many algorithms based on sometimes deep mathematical properties bring substantial gains.

Beyond the computer exploits that are sometimes anecdotal, it is the whole science of the organization of the calculations which progresses and reaches the maturity, weaving deep links with mathematics and sometimes changing radically the points of view. To illustrate, we may additionally supply the fact that the study of finite automata and associated graph

algorithms is one of the national fields of excellence. That these services are possible, is largely underpinned by the progress of the material, stemming from both fundamental and applied advances in various fields of the physical sciences such as microelectronics, electronics, solid state physics, or optics.

On the other hand, to provide an example, we may also use mathematical and computer techniques working in the energy, automotive, aerospace, or metallurgical industries, we will precisely evaluate the resistance of materials to all kinds of forces applied to them. Computers, whatever they are, stumble on limits, and it is to this obviousness that is confronted the one who writes programs and which can therefore never reason by saying that the power of the machine will make up for the lack of preliminary analysis. For more than half a century, computer science has been evolving rapidly, which has provoked extremely fertile thinking.

Calculation of risks, maximization of the profit of a company, forecasts of future trends in the economic situation, etc.

The telecommunications industry is very competitive on the international scene and regularly gains market share. Their interventions lead them to mobilize statistical and probabilistic tools as well as computer tools (large software) to use decision support methods.

The articulations between the programs of the different subjects, to allow a work on a common object, are difficult to establish. The concept of an algorithm is the oldest, since 3000 years before our era, the accountants already used algorithms to perform the four operations, calculate inheritances, loans, etc. Here the dominant mathematical culture is statistical type, financial mathematics.

On the other hand, to provide an example, we may also use mathematical and numerical modeling. Thus we had to resort to a system of types to restrict computation to denoting total functions, in a calculation of higher-order predicates called “simple type theory.” Mathematics programs encourage a relationship with other disciplines.

To provide an example: languages for expressing queries in a database, languages for reasoning on programs, languages for specifying programs, etc. Finally, in the scientific preparatory classes, the programs have made certain modifications to make more coherent the teachings of mathematics and physics. On the other hand, to provide an example, we may also use statistical methods, for the image outside of medical imaging.

In this section, we examine some of the contemporary trends in which there is a particular synergy between mathematicians and computer scientists. It's about making them discover computers without using a computer: disconnected computing. In other words, using an example of calculation, we discuss the problem of knowing how, from the observation of a thing or series of things in nature, to find laws that govern produce this thing.

In particular, it is possible to group together several machines, or scattered in various places and thus in a network, or located a few meters from each other, in grid, or located on the same integrated circuit. The key word of the issues discussed here is the complexity in an industrial environment.

The interpenetration of disciplines including mathematics and computer science is an everyday fact more important. It seems to us all the more important that the communities of mathematicians and users of mathematics take note of this document, which we think is likely to have an important impact, its publication coming soon after that of the paper.

We recommend that statistical courses be organized jointly for professors of different disciplines. On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic to restore a clear image from a fuzzy image, and it is necessary to go through an appropriate mathematical treatment.

Of course, one could think of other places where mathematics plays an important role: prestigious American universities, Princeton, Harvard, Berkeley, or Stanford, to provide an example. On the other hand, to provide an example, we may also use both the concepts of algorithm, specialty of the physicist and the engineer, specialty of the archivist and the agent of the figure, specialty of the mathematician and the accountant, of language, and information, specialty of grammarian and translator, machine, etc.

This global enterprise that continues today provides a rigorous framework for the comparison of algorithms, as well as an organization of these algorithms into broad categories according to their function and their complexity measured by the consumption of resources (time, memory). Remember, more broadly, any real number can be written in base 2, 10 or 16.

On the other hand, to provide an example, we may also use both the concepts of algorithms for aeronautics, embedded systems, automotive, numerical simulations, etc. In the transport sector, where failures can have very serious consequences, computer science and mathematics make it possible to develop ever more secure products more quickly. These aspects

are already strongly present in Greek science: Archimedes and Diophantine “calculate” the area under a parabola and the solutions of systems of equations in integers, while Euclid disengages the notion of an axiomatic system for elementary geometry, and Aristotle abstracts discourses for propositional logic.

# **38**

## **CHAPTER**

## **AXIOMS**

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Yet, currently, they do not necessarily lead to interdisciplinary work, neither students nor professors. Better yet, to find the ultimate scientific explanation of a phenomenon is no longer just to find the mathematical equation that explains it but rather the computer algorithm that simulates it. Gradually the logic is mathematized with a theory of models that uses the mathematical structures of the theory of sets and universal algebra (categories). The theory of the demonstration which is concerned with notations. The so-called binary logic means that a logical statement presents only two alternatives; it is either true or false, any other possibility being excluded.

On the other hand, to provide an example, we may also use and summarize the main algorithms and basic data structures of non-digital computing. We will explain in this chapter the main articulations of these currents that deeply interpenetrate mathematics and fundamental computing.

But unlike them, its destiny is not to be executed by a machine or even typed on a computer: it can be hastily traced on a corner of a tablecloth or a piece of greasy paper, to be transmitted in own hands to other project collaborators. On the other hand, to provide an example, we may also use and show the essential places in recent developments in mathematics, both statistics, probabilities and computer science.

These domains are based on the theory of information (found in statistics and financial analysis) and goes through the formalization of the notion of source, which borrows in its mind as much from the theory of probability as the theory, college students need to be aware of the role of mathematics in other disciplines and in all kinds of industries.

Without basic research there would indeed be no practical applications but do you really believe that all your students will invent, create, innovate also based advanced math? On the other hand, to provide an example, we may also use a construction of random sequences of a philosophical discussion on order and chance, as well as on the distinction between what is known before calculation and what can only be known after calculation. This frame now pervades the whole of computing; in turn, it gives rise to the emergence of new methods designed to circumvent the complexity barriers of the NP class: approximation techniques, probabilistic approaches, “parametric” refinements are examples.

I hope it sounds absurd to you. The research in combinatorial optimization is no longer the same—it is infinitely more structured and fruitful—after the work of their successors.

On the one hand, the typing of programming languages makes it possible to certify that a program accepted by the compiler (which includes a static analysis module verifying the adequacy of the program to the type system, possibly by synthesizing the type most general) cannot fail at runtime, nor can it corrupt data structures.

Historical research on algorithms and their achievements is not limited to recent times but extends to antiquity and non-European cultures. I then continued my studies with a training in imagery, and if I sometimes very much regretted not to have been sufficiently interested in the mathematical tools which had been presented to me in a very (too) theoretical way before, because I wasted time getting them into practice, but I still got my diploma without any worries, as well as all the others.

For college, we read in the report: to have computer science taught only by mathematics professors could lead to teaching only part of the subject, the one that comes closest to mathematics, which does not correspond to the aforementioned objectives. We understand this concern not to limit the teaching of computer science to only one of the components of this discipline, but, in any case in the current period when one must resort to professors already trained in pre-existing disciplines, must note that it is those of mathematics who have been the most numerous to propose to animate the specialty. The boundaries between these sectors are blurring and digital technologies are making these synergies possible.

# **39**

## **CHAPTER**

# **THE INCOMPLETENESS THEOREMS**

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To train those who wish to pursue scientific careers or to enable all young people to become enlightened citizens, mathematics professors are and will continue to be indispensable. This sector is indeed a big consumer of heavy digital calculations. This is, again, too restrictive a vision: many algorithms, to provide an example the recipe for food, operate on data that is not symbolic: flour, eggs, etc.

These skills exist in the training market. For that we need a language. The shift registers serve as memory support and as a tool for synchronizing signals in digital systems. Only one, because the half which one isolate immediately would have the size of the dictionary of the preceding example.

The algorithm progresses very quickly towards its solution: we will have read only headers before reaching the desired page. This methodology is gradually supplanting the traditional methods of operational research in some areas, and is therefore an important economic issue. The calculus is not just a notation for functional expressions.

In the positive case give his nature. The annex contains additional information on innovations. Finally, if we both rely on procedures generating sequences of numbers in order to elaborate their ideas on the nature of randomness, their reflections are exercised in two completely different contexts. Coupled skills are needed here: computer science, mathematics, chemistry, biology, statistics, etc. On the other hand, to provide an example, we may also use parallel computing with threads, processes and scheduling.

In fact, there is a large computer research community working in the field of big data and data mining. Math is first and foremost logic, it is elegance in

the formulation of an equation that it is simple or terribly complex.

On the other hand, to provide an example, we may also use computing at the college and in the base of competencies: what proposals of interaction between mathematics and informatics? Their examination from the perspective of the hazard meets the requirements of the algorithm analysis described above. Today with hindsight I understand that they were right, my problem was at the level of my interpretation of the discipline.

The professor makes it clear to the students that the work that has been done is in fact the one that is done by the computer: one must transmit an image (by email to provide an example) to his/her comrade: the computer used transmits this image to another computer only using binary information (0 or 1: absence or presence of electricity).

The same applies to the divorce between science and letters. On the other hand, to provide an example, we may also use and build a tree of nested partitions associated with this relation. Thus, the algorithm that our cells use to synthesize a protein from a messenger RNA strand did not, as far as we know, have been written or verbalized, before being executed in the first cells, then passed from generation to generation. Remember, combinatorics counts among its origins several games or mathematical recreations.

Note that these same notions are marginal within academic mathematics, still dominant today. No, it's not even worth asking the question, it's so obvious. The sequence of actions to be performed for a robot, is formally identical. Computer science (reduce the place of the image, so code it). In fact, everything comes at the origin of confusion over the term computer. To illustrate, we may additionally supply a theory of models that uses the mathematical structures of set theory and universal algebra and categories.

After reception, the tape is removed and the paper copy of the packet is digitized and transformed into a transmittable electronic format. It is taught in computer science colleges in the same way as java, php, c, and SQL. This shows how slow and difficult the implementation of the program instructions of in the form of the study of situations from these disciplines including a modeling phase and an interpretation phase of the results. To illustrate, we may additionally supply that since the base 2 writing of a number can be very “long” and because of the simplicity of conversion between the bases 2 and 16, the computer hexadecimal system is very much used.

Multidisciplinary teams are therefore formed around this issue. Statistics and computer science, can also be applied to chemistry, biology, etc. To illustrate, we may additionally supply and therefore perform the Euclidean

division of a natural integer I by a nonzero natural integer B is to determine the unique integers Q (called quotient) and R (called remainder) such that:  $I = BQ + R$  and  $0 \leq R < B$ .

But these contents are not so important: the vast majority of students will forget the details of what they learned in college, and it does not matter: there is not a theorem that is indispensable in life daily. In mathematics, on the other hand, apart from probability, most of what we learn dates back to before the 19th century. On the other hand, to provide an example, we may also use an impact of pedagogy specific to computer science, and this report recommends a large place for projects.

We should also read the presentation of general principles to guide the teaching of computer science. These ancient traditions developed fully in the Age of Enlightenment, and it accompanied the mathematics, and mathematical logic revolutions, when science played an extremely important role. So much so that computer science introduces a very general notion of language, of which natural languages, programming languages, but also mathematical language or the languages of logic, are special cases.

After that the need for computer math seems obvious to me! On the other hand, there are a lot of branches in maths, and all that concerns the lessons related to discrete mathematics to provide an example do not seem to me useless to succeed his course.

To illustrate, we may additionally supply computer devices that are autonomous and must, to be effective, adapt in real time to their environment (GPS, autopilot, etc.). This division of labor creates an exponentially growing body of knowledge, the assimilation of which by society is a very difficult problem. On the other hand, to provide an example, we may also use new organization data structures such as databases. It can improve relationships between professors and students, and bring diversity to the activities and skills developed.

We find, in a paragraph evoking the components, algorithm, language, information and machine, in the current program of the specialty. To illustrate, we may additionally supply the fact that my graduate university degree came from a computer training oriented development. The best current data structures are often therefore based on a clever use of tree structure, a natural derivative of the notion of graph. Integration of new technologies into teaching what is the specificity of the links between mathematics and computer science? The assisted demonstration of theorems has also developed the extension of the search for solutions to diophantine

or polynomial equations to various and varied algebraic structures, allowing the calculation of pattern search and filtering or solving equations between terms and unification.

On the other hand, to provide an example, we may also use mathematical and computer techniques for k-types, results of definability, theorems, forecasts, locality, optimization, games, decision support methods, data analysis, etc. On the other hand, to provide an example, we may also use mathematical and computer techniques which allows, in particular, the experimentation in numerical analysis involving very unstable or chaotic phenomena.

Biology and chemistry make it possible to understand the context in which statistical and computer tools should apply. But it's hard to change habits. To illustrate, we may additionally supply a notion defined to model the human language. This type of work can arouse students' curiosity and make them perceive new reasons for disciplinary content by allowing other approaches. To illustrate, we may additionally supply, if we are specialized in networks and software engineering, we will therefore develop tools related to digital processing and the design of routers, networks, and communication protocols.

Mathematics has always had a strong connection to their teaching. To illustrate, we may additionally supply and identify how it works and how it breaks down. To illustrate, we may additionally supply mathematical and computer techniques for counting, combinatorics, solutions of recurrence equations, permutations, recurrence relations, arrangements, etc.

And we should participate in its beginning at a national council of mathematical and computer techniques for universities. But there are other areas that overlap the two disciplines on a border each day more important. This is as early as elementary college. On the other hand, should therefore be setting up multi-disciplinary modes including computer science and touching mathematics. curriculum reorganization, especially in hourly volumes of the different disciplines.

The basic types include integers and real ones with arbitrary precision only limited by the physical capacities of the machines. To illustrate, we may additionally supply mathematical and computer techniques for mathematical tools, computer tools, statistical tools, probability theory, etc. A widely held but false idea is that an algorithm is necessarily deterministic: it leaves no room for hazard.

On the other hand, to provide an example, we may also use mathematical and computer techniques for analysis and modeling and equations of phenomena that have been noted for their importance. At the dawn of the third millennium, the question arises as to whether this period of pioneers of computer science based on the mathematical sciences is or is not in the terminal phase. It is taught even in management colleges.

The debate underlies a problem partly epistemological, made difficult by the lack of knowledge and investment in the interface between maths and informatics of too many mathematicians. However, many professors who have participated in mathematical and computer techniques are satisfied with it.

Even if the structural properties of these algebras are relatively poor, the associated algorithmic is de facto one of the key points of the logical verification of computation circuits by binary decision diagrams or constraint systems. At the border of the notions of language and machine appears the notion of machine language. But if computer science leads us to see today in discussion an interesting text for the history of mathematics, we must nevertheless use the concepts of modern computer science with caution when interpreting historical texts.

The concept of information and a concept of language appeared in computer science, mainly because, to communicate algorithms to machines, we have to use a formal language. To illustrate, we may additionally supply non-deterministic algorithms. No need to destroy hardware for crash tests, the engineer does everything on a computer.

But if the Internet was first designed for computers, it does not mean that it only makes sense on computers. Maths are above all the most fabulous language of description that we have invented, obviously that everything can be described with. On the other hand, to provide an example, we may also use codings proposed by pupils that revolve around parameters: the color of a token compared to a black and white color of an image.

On the other hand, the main opportunities for a mixed training in Mathematics and Computer Science are very varied. It is very likely that, whatever the fate of the various recommendations of this report, the teaching of mathematics is, more probably than that of any other discipline, jostled in the years to come by that of computer science. One can then enumerate the operations associated with each class of objects: a member can be registered, receive a mail, deleted, etc.; a work can be recorded or deleted; a copy may be registered or deleted; etc. In particular, it makes it possible to match a

computer program to the formal proof of a mathematical statement, which carries out this statement as a specification.

On the other hand, to provide an example, we may also use mathematical and computer techniques as a modeling engineer. And write them a necessary step to communicate them to a configurable machine. A young engineer, recruited to provide an example, will probably make a career there, if he gives satisfaction. A little to assess the risk of sharp decline in stock prices, to provide an example. It turns out that many mechanical actions, all probably, lend themselves to such examples.

I would confess you that I read diagonally mathematical and computer techniques articles, I answered especially to the computer science, mathematics, and mathematical logic. All the other scientific disciplines have their own object, in the nature or in society. For this, we identify the main types of objects, their attributes, the operations they can undergo and their interactions.

On the other hand, to provide an example, we may also use experiments that have been made on learning geometry in the middle course in relation to physical situations (mirrors, compasses, sights used to introduce the notion of angle, to provide some examples).

Their specificity, so to speak, is that they are not specific to any area of nature or society. The sense is that of method to perform the operations, but it extends to any method of calculation. Mathematical and computer sciences are crucial and everywhere present behind this now banal act of everyday life.

Nowadays, many mathematicians use experimentation whose possibilities are increased tenfold thanks to the formal calculation systems described below. We pointed out the successful development achieved in the mathematics programs of the scientific preparatory classes. On the other hand, to provide an example, we may also use mathematical and computer techniques for computing, management, statistics, etc.

These groups must be able to provide a common explanation, which allows a misunderstanding of misunderstandings and a common work on language. However, it is important to note that the first universal programming languages, lambda-calculus, the language of Turing machines, predicated by a few years the construction of the first universal machines, the first computers.

Finally, let us detail the possible interactions between classes of objects: a member can book an album, an album can be embodied by a copy, a copy can be borrowed by a member, etc. To illustrate, we may additionally supply computer science, mathematics, and mathematical logic for a collection of information on historical bases, stochastic tools, probabilities, statistical tools, etc.

The central part of UML, the class diagrams, is to draw the project guidelines. To illustrate, we may additionally supply computer science, mathematics, and mathematical logic for statistical analysis of experimental results. But mathematical calculations form only a part of computer applications and they are likely to interest only those that mathematics are already interested in.

What place to give to applications? To appropriate a concept, it is not enough to read the definition, you must have time to handle it by doing exercises. But if you want to do development in R & D mode, it's something else. To illustrate, we may additionally supply a machine that performs a particular calculation: it raises the number I squared.

Combined skills (marketing techniques-data analysis-mastery of software or data mining techniques such as data mining are used in marketing departments of insurance banks, industrial companies or services, etc. To illustrate, we may additionally supply the part already taken by learned societies and professional associations.

This is an opportunity to focus for a few minutes on a particular point. Similarly, by grouping in a sequence of 0 and 1, the symbols by two and replacing the group 00 by a, the group 01 by b, the group 10 by c and the group 11 by d, we obtain a sequence two times shorter but in a four-letter alphabet.

Thinking is the nobility of the mind, which is difficult to explain. We can finally ask students about the number of tokens used and try to reduce this amount if it seems possible. There are many companies that hire young people with a solid mathematical culture combined with a good knowledge of computers in a logic of mastery of software engineering (in this sector, computing power is sought). If you find one, even if you are unsure, send me an email.

They call on high-level specialists who have accumulated a very large experience in their profession. A specificity of mathematical and computer techniques curriculums is therefore to offer end-of-year internships oriented towards research. We alert them from the beginning: for us, it is first to learn

theorems, models. Considerations of formal linguistics and logic would thus mark fundamental computing.

The collected data (clinical, socio-demographic, biological, etc.) are analyzed and interpreted thanks to the cross-skills of statisticians, doctors, computer scientists, biologists, etc., and come to nourish the files mentioned above. These theories constitute the basis of computing: as soon as it is necessary to define programming languages specific to the unambiguous expression of algorithms, to formalize the notion of algorithm, to check the coherence of languages and programs, etc., they will prove particularly valuable. The aim is to offer mathematics students a solid openness to mathematical and computer techniques, accompanied by an orientation towards privileged mathematical and computer domains.

Often we do not even have to touch it because there are ready-made functions that do the math for us. Well, it's still maths. Identifying all the functions that calculate the sorted form of a list prevents you from looking at the intentional properties of their algorithms, such as the complexity of the calculation. To illustrate, we may additionally supply, discover, and popularize the importance of probabilistic approaches in the design of algorithms.

A balance sheet must be drawn. They make it possible to study the behavior of consumers with a view to establishing typologies to adapt them to the sold service products, and to analyze multiple data coming from the markets. As soon as a problem is solved, it opens the field to new problems.

The students therefore understand that one can represent a complex information (image) with very simple objects (continuation of two-tone tokens). This type of problem is very common in computer science, and more precisely in algorithmics, the science that seeks to optimize calculation methods.

I must say that I really understood the objects only after thinking about them in relation to vector spaces. We will also give the new matrix. Formal syntax studies, including variants of Lambek's categorical grammars, have therefore joined the formalism of proof theory such as non-commutative linear logic.

Many graduates believe that computer science is very concrete, it is doing and making websites. Their field of action is endless: health, climate, marketing studies, etc. The sectors covered in this have many strengths: varied opportunities, attractive salaries, real opportunities for change and places to take.

I pretty much agree with this if we talk about pure mathematics of studying complex functions, signal processing for those who do not appreciate not maths, solving differential equations, and so on and better. Mathematical algorithms always operate on mathematical objects: equations, matrices, polynomials, numbers, etc.

An encouraging regional context and the scientific excellence of the laboratories convinced therefore the institutes for research in mathematical and computer techniques and the institutes for research in computer science, whose vocation is to undertake fundamental and applied research in new information technologies, to create research units. The algorithms discussed here therefore are based on the fine analysis of semi-classical probabilistic phenomena, on the already discussed randomization technique, as well as on interesting methods of complex asymptotic analysis.

To illustrate, we may additionally supply a class that is represented by a frame, in which we note the name of the class, the list of attributes, then, under a horizontal line, all the operations that the objects of this class can do. On the other hand, to provide an example, we may also use a very complex system that incorporates many physical and chemical phenomena. Mathematics and computer science should therefore provide a background of a rather broad mathematical culture with an emphasis on applied algebra.

The number of installations in the world of computer algebra systems can be estimated at a few million.

Fuzzy equivalence relations and closure is obtained by successive composition with the initial relation. There is, in mathematics, therefore, a process of perpetual renovation. To illustrate, we may additionally supply IP and provide delivery attempts that will be repeated delivery attempts until the delivery fails.

These procedures quickly became very popular. Moreover, students sometimes seem sure of them. To illustrate, we may additionally supply a test of the generalizable character of the created models. To answer these questions we should also need to invite to these hypothetical conferences the advice of several great scientific colleagues.

On the other hand, to provide an example, we may also use a factorial, that is very often used to illustrate the principle of recursion, just like the arithmetic sequences and whatnot. What are the interrelationships between the teaching of computer science, the use of computer tools in mathematics and digital tools for mathematics teaching? Many training courses of this type are available on the training market. In the same way, the grammar

of a natural language never seems completely known, as evidenced by the difficulty of doing orthographic or automatic translation programs.

At the border of the notions of an algorithm and language appears the notion of program. The goal is to evacuate the thought of the calculation, in order to make it executable by a digital machine and a computer. On the other hand, to provide an example, we may also use mathematical and computer techniques for informatics, statistics, mastery of “big” software, etc.

I agree with the fact that we give too much importance to mathematics, but not only in computer science. To illustrate, we may additionally supply therefore develop numerical simulation methods that show a continuity between mathematics and computer science.

On the other hand, to provide an example, we may also use the period from 1940s to 1950s, that was one in which the merger between scientific calculators and management calculators gradually took place, a field in which the powerful IBM company flourished. Thus in the primary is recommended the first approach of algorithms; why not encourage us to make the link with the elementary calculation algorithms?

In more than fifty years of life, Moore's law has not been denied and physicists believe that its applicability will extend until reaching the limits imposed by the atomic structure of matter and quantum phenomena. The development of the field is therefore carried out by teams with mixed skills where it is sometimes difficult to distinguish the part of each other. To illustrate, we may additionally supply and offer invitations to students to show things to know before it's a fact.

Whatever his specialty, a computer scientist will always be called to repair his brother-in-law's computer. It's just an empty word. Yes, I also dump on some points in math and other related subjects, but it allowed me to push me even more. Recall that logic itself, initially a preoccupation of philosophers with the notion of truth, gradually came to be mathematized.

On the other hand, to provide an example, we may also use the theory of demonstration or meta-mathematics that is concerned with evidence, notations, and more generally underlying combinatorial structures. To illustrate, we may additionally supply mathematical and computer techniques for numerical analysis, mathematical modeling, simulations, statistical modeling, etc. Therefore, to really access computer science, you must have a university degree in computer science or mathematics or mathematics and computer science.

It is urgent not to wait anymore. I therefore call for the integration of computer science education at all levels of education and in all sectors. The mathematics strategy should therefore be in which computer science plays a major role in teaching, an example below is taken from a hypothetical dossier presenting this strategy and professor training for a creation of a computer option in mathematics. It is difficult to answer this question. But it is striking that here no more mention is sometimes made of possible coordination with mathematics, while openings are made to the functioning of enterprises, to technologies, to the human sciences, to laboratory methods, etc.

In an industrial environment, many physicists and chemists are hired to practice modeling and simulation in order to predict the behavior of industrial processes, products and processes materials. So, if only to maintain consistent performance, new algorithms must be continually designed, as we observe. To predict an approximate value of a result is very interesting. We also saw the emergence of a theory of complexity, an area inspired by an abstraction of the complexity of algorithms and rooted in the theory of computability discussed below.

It is a necessity for students to truly learn computer science. Finally, new logic and architectures of formal proofs have been applied both to the proof of major mathematical theorems and to the recent formal verification of compilers, circuits, and operating systems. These recent cases illustrate well one of our theses, namely that the relations of dialectical exchange between mathematics and computer science are far from being completed.

On the other hand, to provide an example, we may also use mathematical and computer techniques for survey techniques, probabilistic tools (because you have to master randomness), statistical tools, data analysis, studies, etc. To illustrate, we may additionally supply an analysis of data from social security sheets. We should also point out that mathematical operations were often used to learn programming.

I personally think that mathematics is used to build the tools that computer scientists use. With hindsight, we realize that to make a translation of a text in Latin is not very far in the reasoning of the writing of an algorithm corresponding to a given need. To illustrate, we may additionally supply a logistical problem: how to put storage points and warehouses at strategic points over a defined geographical area to better control storage times and costs and indicate all the partitions that can be deduced from these relations. We should also emphasize their magnitude and urgency.

To illustrate, we may additionally supply mathematical and computer techniques for cancer research and its foreseeable evolutions. The fields of application are many: software navigation in geographical data (Google earth), automotive remote control (gps), videoconferencing, etc.

I was less fanatic about geometry in the space that is less suitable for the demonstration. It is important to do this regularly, at college, using as many applications as possible. Moreover, in a numerical calculation, the attention paid to orders of magnitude. To provide an example, deciding whether or not a sentence is well formed in a language requires using an algorithm that is independent of the fact that this language is a specification, programming, query language, etc.

It is an illusion to think that students only know what they are taught at college. But overall understanding is more important than learning by heart. To be successful, having a BA/BS, with math skills, is strongly advised. Moreover, a student would feel very strongly when in a final year, a math professor gives them an application for post-baccalaureate studies with the mention: does not have the required skills to follow this formation.

To illustrate, we may additionally supply mathematical and computer techniques for functional analysis, algorithms, complex equation solving, scientific computation, etc. On the other hand, to provide an example, we may also use UML as a programming language on paper, which is executed only by human beings. To illustrate, we may additionally supply mathematical and computer techniques for work as a: research engineer, telecommunications engineer, epidemiologist, laboratory engineer, development engineer, test engineer, clinical research associate, medical imaging engineer, qualification engineer, biostatistician, etc.

Whenever possible, they will be linked to the teaching of other disciplines: technology, life sciences, geography, earth sciences, etc. The discussion is a philosophical and epistemological issue. And if one wonders what they are intrinsically?

To illustrate, we may additionally supply mechanical machines, before we have the technical knowledge to build the most common tools today: computers. In computer science, math is useless for a large number of students. On the other hand, apart from references to open and massive online courses, we give little indication of its content.

Because learning computer science, it is not learning to click or write with a word processor, it is above all learn to program. It is indeed surprising to discover that very classic areas of mathematics, developed

most often without immediate application, such as combinatorial analysis and asymptotic analysis (real or complex), have to do with such an artificial world computers and their programs. To know if you are made for a computer science degree, do not hesitate to take a test.

Many innovative ideas have been generated by such motivations, and their interest has been understood later. To illustrate, we may additionally supply the idea that database specialists will immediately know how to convert a diagram into a database schema, and object-oriented programming specialists how to build the program and the interface to use it. These disciplines combine in the reasoning applied to finance and insurance.

I'm not saying that we should not teach mathematics in computer science, but that they should be less dominant and a good level in this subject should not be a prerequisite, or if it is, not be so important. Technology is the tip of the iceberg, the one facing the general public.

To illustrate, we may additionally supply mathematical and computer techniques for a theory of optimal control and search for a trajectory that makes the best use of the gravitational attractions of the various stars in order to minimize the fuel used by the probe. This does not prevent the mathematician at the work of being motivated mainly by the beauty of a problem (whether it is elementary or not), the desire to better grasp a property, or pure curiosity.

To illustrate, we may additionally supply a meaning that is that of a method to perform the four basic arithmetic operations (formalized by Al Khwarizmi in the ninth century), but it extends rapidly to any method of calculation. In college, we know that programs in mathematics have recently evolved through the introduction of logical and algorithmic chapters, not forwards to computers; we therefore regret not to see how to accompany this evolution. We cannot compare the case of computer science and that of probabilities.

I'm the same as you on this point: no math but good algo. To illustrate, we may additionally supply mathematical and computer techniques and determine the local extrema of a function and specify their nature. On the other hand, to provide an example, we may also use mathematical and computer techniques for a mastery of mathematical tools (Statistics-probability for use in the uncertain future), and Computer Science (representing the information of a mathematical model), as well as a solid culture in financial and economic techniques using mathematical tools.

To illustrate, we may additionally supply mathematical and computer techniques for the field of advanced specialties, web applications, project manager assistants, computer systems and software, professional licenses, digital images developer, etc. On the other hand, to provide an example, we may also use dynamic laboratories that are structured, in particular, with a high scientific output.

It is also interesting to note that a new generation of systems with better characteristics (security, key length, etc.) are in development and that many of them rely on the algebraic geometry of the curves and manifolds on the finite fields. Let's talk more specifically about mathematics education. To illustrate, we may additionally supply and write in bases 2, 10 and 16 and they are also called the binary, decimal and hexadecimal, respectively. In base 2 or 16, the operations are performed in the same way as in base 10.

Should we rethink mathematics by computer or is it the computer that allows us to rediscover certain nooks and crannies of mathematical discourse? On the other hand, to provide an example, we may also use mathematical and computer techniques at banks, actuaries, economics, mathematics, computing, insurance, etc. You may wonder, "Should mathematical and computer techniques be modulated according to origin of these professors?"

Adequate time is also essential for students. By algorithm is meant a systematic method of calculation. The procedure is perfectly suited to paper but would waste the resources of a computer. It is a question of characterizing the main parameters of large combinatorial structures, when this one obeys a determined random model. The answer will be precisely justified.

The breakthroughs of Rabin and Knuth, relayed by a large part of the computer scientist community, have changed the way in which algorithmic research is conducted, offering clear benchmarks in what would otherwise be a jungle of techniques. They are constantly seen to be outside the field that gave birth to them.

A major project is therefore, alongside the development of an appropriate initial training, that of the training of professors already in practice. To illustrate, we may additionally supply the forces that should be mobilized for this purpose. With IT, random simulations can be performed to assist in decision-making in many cases, such as: quality defect studies, hazard control in manufacturing lines, dependability studies, cell phone call forecasts to optimize the network's deployment, studies in order to minimize breakdowns, the search for the best price policy to be implemented by the

airplane companies to ensure plane filling, financial risk assessment, survey institutes, market risk for banks, etc.

On the other hand, to provide an example, we may also use mathematical and computer techniques as an: information systems architect, econometrics, computer auditor, experts in the field, Internet technology, decision analyst, multimedia technology, controller, insurance engineer, etc. To illustrate, we may additionally supply an example: if we measure the time needed for the ball to travel a distance D, we obtain a machine that calculates the square root of the number D.

Math is everywhere around us. The number 23, written in base 10, is written 10111 in base 2 and 17 in base 16, but one cannot write  $23 = 10111 = 17$ . Master the principles of numeration essential to the languages of low level. What place in teaching?

The link to physics deserves special attention. On the contrary, many algorithms need randomness to work. To illustrate, we may additionally supply an example  $(10)_2 + (100101)_2 = (100111)_2$  (in base 10, this gives  $2 + 37 = 39$ ).

I therefore have great difficulty understanding the importance given to mathematics in the context of computer learning. It is developed in modes of learning, roughly corresponding to elementary education (kindergarten and primary), college and college: acquisition of autonomy, discovery, deepening concepts, etc.

As for mathematical and computer techniques work, it takes form according to an entirely different materiality, that of paper and ink. On the other hand, to provide an example, we may also use IP addresses are used to identify the host of a network. There is no multi-diffusion, but thunderstorms can cause data loss. Of course, doing mathematics, contrary to what many journalists think, is not doing calculations.

It is not essential that they have been previously exposed in the mathematics course. The same physical system, equipped from another protocol, performs another calculation. New applications of combinatorial analysis and complex analysis (in a style that extends that of pioneers of the early twentieth century) are perhaps more surprising. The course of the session is the same, but students are questioned.

We will justify the results that will have to be given according to the values. A view of the contemporary movement of the mathematical sciences could be valuable. The relations between these different concepts are also

perhaps more revealing of the profound structure of computer science than the relations between these various sub-disciplines.

Many games have mathematical content, and stimulate activities close to mathematical research. On the other hand, to provide an example, we may also use mathematical and computer techniques for: optimization for forecasts; mathematical modeling; help with the decision; etc.

This concern with the algorithmic character of the description of the objects, the language in which these descriptions are expressed, information flows and instruments are more generally characteristic of a computer thinking.

We can speak here of geometry of calculation when we ask ourselves the question of how to transmit a message from one point to another and how to distribute a calculation on different computers located in the four corners of the globe. The study of algebraic, topological, or categorical computational models, would highlight a notion of computational domains, in which the algorithms are interpreted by continuous functions. Mathematical-computer coupling makes it possible to simulate, model, perform, etc., numerical computations and it is a very sought-after skill.

The place given to college subjects is more important in and we must congratulate ourselves, but the messages given to children are much more positive. But again, the essence of mathematics is not to make calculations, it is to make reasonings and demonstrations.

The validity of results is due to a particular approach, which is called a hypothetico-deductive model: if this is true, this is true too. To illustrate, we may additionally supply a theorem that makes it possible to have a criterion of recognition of the prime numbers: to know if a number  $n$  is prime, one computes  $n$ . It is then possible, in the second step, to look for the relations between these different constituents, which form the structure of this field of knowledge.

Digital analysis, to provide solutions approach to the system of complex equations that has no analytical solution. Is the impact of the computer mainly felt in mathematical practice or does it also have an impact on theories? The effectiveness of mathematics in applications are almost magical.

But nothing predestines it exclusively for the world of computers: it applies to any situation in which we search for an entry in a list whose sort order and the size, and which we can easily locate the medium, to provide an

example by extracting an entry. The results must be justified. To illustrate, we may additionally supply other areas of interaction and synthesis.

What mathematical content to foster this interaction in relation to the skills base? On the other hand, to provide an example, we may also use a matrix that can be considered as the matrix associated with a linear transformation L defined in a vector space reported in the base B.

There is even the astonishing fact that computer network infrastructure is gradually taking over the traditional telephone infrastructure. This arrival of massive informational and computer communication poses a lot of new problems. And anyway, it's about stimulating the capacity for logical reasoning. The problem is that "IT" means everything and nothing.

And this topic is the subject of debate! But I say that mathematical techniques are not necessary for learning computer science and that if we taught algorithmics before the theoretical tools engineers would not fare worse. To illustrate, we may additionally supply that a computer may have an interest in playing dice. This paradigm shift in programming brings dramatic gains in a number of areas.

To provide an example, if two users of a phone are calling at the same time, each will be directed to the other's mailbox. These concepts, far from defining branches of computer science, are often used together. But an image can also be represented symbolically: just write the value of each of the squares, starting at the top left and ending at the bottom right: white, black, black, black, white, white, white, white, etc.

On the other hand, to provide an example, we may also use and organize a symposium on mathematics and science education. To illustrate, we may additionally supply the fact that Rössler's practice that led him to the results on chaos is part of this perspective. On the other hand, a matrix A can be considered as the matrix associated with a linear transformation L defined in a vector space related to the base B.

IT is both science and technology. On the other hand, to provide an example, we may also use a role of modeling in computer science and mathematics. To illustrate, we may additionally supply a symbol  $\epsilon$  denotes what is called the empty word.

Since their birth, these sectors have resorted to the most advanced mathematical and computer tools. To illustrate, we may additionally supply the fact that for every set A, we know a tuple of elements of A. Scientific culture is inseparable from a reflection on the necessity and limits of

mathematical models and their use. We think here of mathematics professors, but the proposal does not would not be absurd for history professors

I have always been passionate about computers. On the other hand, sometimes my friends do not seem very convinced by my arguments, because they think that the manipulation of variables and their evolution over time during the execution of a program are typical of mathematics. To illustrate, we may additionally supply the fact that we may use mathematical and computer techniques for fractals, chaos theory, the theory of automata, numerical analysis, cellular analysis, etc.

Until the seventeenth century, there is often coincidence between mathematics and actual calculation. We will therefore be recruited for broad mathematical skills with skills in signal processing, celestial mechanics, fluid mechanics, software engineering, etc. On the other hand, to provide an example, we may also use mathematical and computer techniques for economic, statistical, financial, and studies relating to insurance services products.

# **40**

## **CHAPTER**

## **CONCEPTUAL PERSPECTIVES**

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On the other hand, to provide an example, we may also use computer science (for computer simulation, the latter offering the computing power required); mathematics (numerical analysis, scientific computing); and mechanics of solids. However, water has flowed under the bridges since that time and if the computer is still used today massively to perform complex scientific calculations, a good mastery of mathematics are far from a prerequisite to be programmed. Finally, the notions of language and information are related because they are two instances of the same idea: to symbolically express algorithms, for one, data, for the other.

Mathematicians are recruited to implement these advanced technologies. But not much about the essential, the functioning of the system itself and that of networks. The calculation has a sporting side that can appeal to children, sometimes developed phenomenally, to provide an example. We must think about the future, the inevitable evolutions of the programs and thus build step by step a solid mathematics and computer science discipline that can, when the time comes, the experiments made, stabilize. No, we do not use an external service to calculate an internal data.

On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic for writing a matrix associated with the quadratic form  $F$ , and write  $F(x)$  in the form of an algebraic sum of squares of independent linear forms. These two remarks lead to a question that is not yet solved today: when can one say that two algorithms are identical? To illustrate, we may additionally supply a probability theory and has its roots in games of chance.

Finally, what place should computers be given in the history of mathematics? The notion of the machine finally appears in the renewal of the scientific instrumentation. On the other hand, to provide an example, we may also use and define in a set of variable "x" equations a multitude of physical, chemical or biological phenomena that evolve in space and time.

Finally, the path taken by the datagram can easily be traced: traces are automatically generated, and can often be found on logs and cables. Let us mention here that formal calculus can be seen as an extreme version (going as far as computerization) of the constructive current in mathematics, where abstract proofs of existence are replaced by explicit constructs. When they arrive at the preparatory class, they can speak, draw and count.

A mathematical result always has a story and changes meaning in the course of this story. It is, in the same way, a necessary training. They also suggest that the best way to train future generations of high-performance computer scientists is to provide them with training adapted to the objects, concepts, and methods of computer science, but above all integrated into a standard and generalist quality scientific training, and including, in particular, solid mathematical bases. Many in the audiovisual sector (cinema, television, multimedia, etc.).

It is no longer taught the same geography, the physical geography has largely passed in the Sciences and the discipline has moved closer to the social and environmental sciences. The first deals with citizen mathematics, the definition of which is not clear. By the way, from another university, but on the same platform, to provide an example, an individual may be taking a very interesting course. If several unified frameworks have thus brought In the quantitative analysis of computer algorithms and systems, it should be noted that large open questions remain in theory of the intrinsic complexity of problems.

Thus, a historical source of combinatorial analysis is a very theoretical need to understand the formal calculations underlying mathematical analysis. The theory of categories and mathematical logic seemed at the beginning to lie at the edge of the philosophy of science, whereas the theory of numbers had, in the eyes of the mathematicians. As to whether this justifies that we learn them from the college, it is to discuss again: they are delicate concepts, which require a great fingering to be transmitted profitably.

To illustrate, we may additionally supply a problem is that computer scientists do not know all the details of library administration and librarians are not computer specialists. The results will be justified without necessarily

specifying eigenvectors. But they are experienced and exceptional professors by their culture and dedication.

I will report on it in a future chapter. The first step is therefore to derive a uniform functional notation to note the algorithm that, at the formal variable I, matches the value of an expression E containing occurrences of I. On the other hand, to provide an example, we may also use the common base of knowledge and skills, in the course of consultation, in which one can read in particular.

A general view of the science movement should be indispensable. The training in question disappeared with the reform, but I suppose that there are still today equivalents. On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic to adjust land management accordingly to mitigate the negative effects of climate change.

Official instructions in recent years not to dwell on learning to calculate, to give up technical exercises, and professors complain about the very low level of their students in calculus, including scientific students, where many students are unaware, to provide an example, of the use of basic ideas. The realization of an IT project, to provide an example the IT portal of a library, requires the participation of many actors.

How should mathematics be adapted to be implemented on a computer? The results must be justified. The programs, which highlight possible reconciliations, very rarely mention a relationship with mathematics: to provide an example, the very interesting year program in the sciences of life and the earth (food, living world, environment), mentions the links possible with the programs of geography, technology, and civic education, forgetting mathematics. On the other hand, to provide an example, we may also use mathematical and computer techniques for chemistry, mathematics, physics, computing, industrial research, etc.

At the crossroads of these disciplines, we see that teams are formed and provide mutual insights against a backdrop of highly complementary skills. On the other hand, to provide an example, we may also use an interview devoted to the teaching of mathematics and study the nature of the computer science, mathematics, and mathematical logic. This is why their introduction is accompanied by a decline in the supply of mathematics education in most colleges and has been poorly received by professors.

What contributions of computer science for learning mathematics and vice versa? This is where the computer science, mathematics, and

mathematical logic must be justified in my opinion. In terms of the method, it is also closer to the natural sciences because it relies on material objects – computers – to implement abstract algorithms.

To discover this notion, it is explained to us what an algorithm is: an obvious solution. On the other hand, to provide an example, we may also use general, technical and vocational colleges. But those who succeed are those where professors are recognized and have a high social status. Mathematics is often used in other disciplines to express laws in a rigorous and objective way, or to provide computational tools.

By discrete maths I mean optimization, automata, theory of languages, theory of graphs, etc. It is then an element for the mathematics professor, who can integrate into a structured teaching. Companies in this sector invest heavily in research and development (up to 15% of their turnover).

colleges and universities are not intended to train you for a job. Here again, it is not our intention to take a stand on the establishment of a specific body of computer professors, with the creation of an aggregation; this perspective is in line with the assertion of the autonomy of informatics as a new college discipline, amply argued in the computer science, mathematics, and mathematical logic.

The hand-to-hand formula, which renews the students' approach to observing and experimenting with natural objects, should be accompanied by the implementation of relevant mathematical concepts and methods. Finally, and this probably explains the remarks above, the grammar of a formal language is often much simpler than that of a natural language.

Some of the results are immediately valorized by industrial applications. To provide an example, the way in which one learns a foreign language, let alone a dead language, is sometimes closer to the way one learns a formal language than to the way one learns one's mother tongue. For complete information, see the rules and scholarship plans and the student guides of the different faculties of science available at the different colleges' section of mathematics.

The answer will be precisely justified. These differences are not only at the mathematical level, we do not yet know the theory of a more elaborate notion of randomness; they are also and especially in the concrete and material experience of the realization of mathematical calculations as well as in the historical context of philosophical debates on the notion of order and chance. On the other hand, to provide an example, we may also use the equations retained reflect relevant laws identified.

To illustrate, we may additionally supply a realization of this work in class. It is found in the detail of the sessions. I see main goals of the math course: a number one goal is to learn to follow logically. On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic for adding two numbers, and we obtain the third term of the sequence by keeping only the number of units (modulo 10, we would say today).

To illustrate, we may additionally supply statistics and informatics and a mastery of software. The most classical mathematics, especially those inspired by the ancient needs of physics, are continuous. This field has been particularly active during the last decades, particularly with linear logic, the calculation of constructions, and more generally the work carried out at the institutes of mathematics. Thus, the algorithms have become programs. The goal of research is not to accumulate results, but to progress in the knowledge and understanding of mathematical beings.

The answer must be justified. There is no miracle, but things have a rational explanation. Every time we build a study program, we are witnessing Homeric battles. We must track down the differences to understand, measure, and appreciate the temporal distance. The construction of universal machines, however, has not completed the history of machine construction, since many improvements can still be made. These tools pose difficult problems of representation and quality of approximation of the quantities handled.

This activity allows, through the manipulation of objects, to understand the concepts of binary coding of information and thus to develop a concrete knowledge of an abstract notion. Banks have been using mathematicians for decades, while this recruitment trend is more recent in insurance. The tone was given by the conclusions of the interventions of biologists, and we need students conceptually trained in these mental operations that only give mathematics. On the other hand, to provide an example, we may also use mathematical and computer techniques studies, to provide an example, for the launch and the maintenance in orbit of a satellite by the optimal control theory and celestial mechanics, the optimal trajectory of a probe, etc.

Let's take this half between two hands, and open it again in the middle. At all levels, mathematical concepts will be used by professors in other disciplines. Scholarly and professional associations have already done a lot of work in this direction. The browser itself is a complex program whose construction has involved programming languages and interaction models benefiting from the syntactic and logical theories amply discussed above.

On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic for philosophical concern since antiquity, by its relationships with languages, and as a rational investigation of the notion of truth. In sum, computer science invites us to see some chapters of the history of mathematics from a new perspective, but we must not be seduced by the appearances of the same history.

On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic and a person connects on the Web and obtains the weather forecast map of his region. This total absence of allusion to our discipline, whereas upstream had been noted the intrinsic character of the connection of computer science, in terms of the objects it studies, with mathematics, seems to us most regrettable. To illustrate, we may additionally supply jobs for manufacturers continue to gain market share and the sector is investing heavily in both capital and skilled jobs for research and development.

On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic and give an example of two matrices having the same eigenvalues but which are not alike. There is therefore a certain danger in seeing mathematics develop for a particular specialty, to the detriment of what mathematics can bring as an element of common culture. I told myself, nothing to do with all these.

To illustrate, we may additionally supply in IPv4, still widely used in 2017, these addresses, known as IP addresses, are numbered from 0.0.0.0 to 255.255.255.255, thus passing through addresses as expressive and easy to remember as 192.168.0.1. This research gradually joined those led by logicians in the theory of demonstration, with the emergence of a fine combinatorics of proof structures (geometry of the interaction, linear logic, demonstration networks, etc.). Scientists and literary people came together to make algorithms.

Close collaboration is practiced between computer scientists, biologists, and mathematicians. On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic for parallel and specialized machines. These logical methods are complemented by statistical methods, usable on a large scale now that large computer corpus is available (Web, newspaper archives, etc.).

The finite automata are a simple and rich computation mechanism: they correspond to a device that interacts with its environment according to a memory and finite rules. To illustrate, we may additionally supply an

advantage of mathematics from elsewhere. This recommendation is not obvious. The number and size of these configurations being commensurable with what the computers of the moment allow, an exhaustive examination of the special cases concludes the proof.

The IP protocol is strictly adhered to: The IP packet is sent, in hexadecimal, the bytes separated. A testimony is the exceptional sessions held on this theme with the participation of mathematicians, computer scientists, biologists, physicists, economists, mechanics, and association leaders.

In short, as I always say to my students, mathematics is only for those who do the computer, not those who use it. During my studies I had continually study in mathematics courses and in algorithmic courses. On the other hand, to provide an example, we may also use mathematical and computer techniques to send probes and satellites into orbit at the lowest cost with the greatest possible precision in the aerospace sector.

Applied mathematicians and computer scientists collaborate in the development of numerical and computational tools used in a considerable number of scientific and industrial applications. Do we have good professors? Gradually, this problem has been enriched by a paradigm of constraint programming, aggregating linear programming methods, programming in integers, and more generally solving various algebraic equations.

On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic and provide a project and case study on the implementations of an algorithm. To provide an example, when we write  $ax^2 + bx = 0$  the “variable”  $x$  denotes the solutions to this equation, and so  $x$  take zero, one or two values at a time. In computer science, I would not teach anyone that a variable possesses at a given moment, one value and one. The processing of natural language, undertaken for the purposes of machine translation, has for a long time stumbled on the intrinsic difficulties of artificial intelligence, and particularly on the modeling of common sense.

What can be said about the distribution of these points in the plan? It also reads, with regard to the training of future computer scientists: A general education in mathematics and experimental sciences is essential so that they can permanently find their place in a rapidly changing world. Because it is very rare to find in one person the mastery of these sectors of trades. On the other hand, to provide an example, we may also use mathematical and computer techniques and provide a work program in the course of organization.

We recommend the study of a program in this direction. On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic for the establishment of databases, to provide an example: types of clientele, identification of clients at risk, etc. The operating procedure for the coding setting up the activity is important.

By expressing that the sum of the squares of distances which one will specify is minimum to determine the expressions of a and of b then their values. A paradigmatic example is the recipe for food, which solves a problem: make a food item. No one can predict in detail the changes, but the movement of living together is clear and its repercussions in secondary education are certain.

But a traditional strong point of computer science, mathematics, and mathematical logic teaching is the importance given to abstraction. We may also provide probabilistic techniques optimization, Hadoop, MapReduce, and analysis of aerial or satellite photos. On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic for statistical consulting companies. To illustrate, we may additionally supply and help with the strategic decisions of companies or the commercial marketing decisions.

Support of rhetoric, it remained a long time a separate discipline of mathematics, before the considerations on the foundations and mathematical notation developed a renewed discipline called mathematical logic, including the theory of demonstration. The programs, in a justified way, highlight the coherence of the mathematical notions, and this coherence, very strong, tends to conceal the place of the mathematics within the other sciences and the culture. On the other hand, to provide an example, we may also use mathematical and computer techniques for mathematical notions.

There are thousands of mathematicians, it is a huge science and no other can compete, let alone the number of awards or the number of institutions involved in mathematics, formal calculation, and constructive mathematics. Conversely, mathematicians use computer visualization in geometry or dynamic systems. They brew concepts some of which come from the bottom ages, such as numbers and figures, others appeared few centuries ago, as functions and ways of representing them, groups, probabilities, differential equations, and others still appear, like everything that comes from the computer.

The objectives are as follows: discover the notions of correcting code, make the need for a coding convention emerge, work on the concepts of

coding information, exploit the basics of numeration, discover the notions of compressor code, etc. Mathematicians made it possible to express in a rigorous and transmissible way concrete phenomena. On the other hand, to provide an example, we may also use the work on the influence of computers and computers on mathematics and their teaching. The results of the simulations make it possible to adapt the development methods of products placed on the market in order to increase their safety and reliability of operation.

It seems to me that we can only agree, in general, with these general considerations on the links between computer science and mathematics, although, on the contrary, we are interested only in mathematics. Already, mathematical work which is not limited to calculation in connection with computer science can also be seen as a way to increase interest in mathematics for students in which it is weak. There is no job that goes without mathematics!

On the other hand, when it comes to combining skills in economics (macroeconomics and pure and political economy) and statistics, it is most often necessary to create mixed teams of macro-economists and data analysis specialists. Now it is ultimately thanks to these achievements that the general public can now have the web, DVDs, Internet, mobile phones, etc. Their implementation shows the importance of thinking deeply about their articulation in mathematics education, mathematics, and mathematicians. Originally, mathematics was the science of figures of space, numbers, and movement. The Second World War, to provide an example, saw a period during which the mathematician John von Neumann plays a role known to all.

They develop their tools, their methods, their concepts from their fields of study, to which they refer to test the validity of their results. On the other hand, to provide an example, we may also use mathematical and computer techniques and provide contact and composition of the groups. The group will begin by appropriating the work already carried out and explore the interactions between computer science and mathematics and their interest in teaching.

It is, therefore, a real programming tool on paper. To illustrate, we may additionally supply a strict order that is an antisymmetric, irreflexive, and transitive relation. This shifting regulation based on international and US standards encourages the development of elaborate home models for risk assessment. On the other hand, to provide an example, we may also use

mathematical and computer techniques in marketing services and provide a study of consumer behavior in order to establish typologies of customers to adapt the service products sold.

We refer to the forthcoming reports on higher education for the examination of the situation of the first cycles. In the face of the computer, do mathematics change in nature, or do they change more punctually only where new knowledge appears? To translate it into the whole of education, it imposes new tasks on professors and researchers, which must be recognized by the universities.

At the end of these years of toil, efforts are paying off. The applications in this field are intended, to provide an example, to: provide large consumers of numerical calculations; answers can be provided in the design of vehicles to improve the safety of motorists; simulate crash shocks and the resulting body damage by using mathematical modeling incorporating biological, mechanical, physical, and medical laws; predict the resistance of structures, materials and their deformation: to provide an example, the tire or the ski by resorting to mechanical modeling; etc.

Computer innovations, such as those of logic and mathematics, appear at the whim of a story that often stumbles or stutters, but they do not conceptually depend on their circumstances of appearance. Let's first say that, in the face of Moore's Law, the doubling of accessible or storable information currently obeys a growth rate of a factor of two every 9 months or so. Also, we live in a period where a student can acquire a data storage device to maintain the equivalent of several tens of thousands of books, and when a low-cost laptop has a computing power a million times greater than that of the first electronic calculators.

Another way of approaching this problem is to extend the verification of programs, traditionally carried out by a battery of tests, into a symbolic verification in a more abstract computing space-called model checking. We will justify these answers. To provide an example, bio-statisticians are highly sought after in the labor market, whereas adapted training courses produce only a very limited number of them at present.

The candidates for these mathematical and computer techniques should concretize with students the thematic of the information theory, that is to say to propose a reflection around the notions of data exchange, information quality, encoding of information, treatment of information, algorithmic quality, etc. On the other hand, to provide an example, we may also use mathematical and computer techniques particularly for the software industry,

and highlight the decline of and, in particular, of the (despite some notable exceptions cited in the text) for years, in these sectors.

On the other hand, to provide an example, we may also use mathematical and computer techniques master the modular arithmetic tools useful for algorithmic quality. Machines include computers, more specialized devices such as cameras or phones, and more generally all physical systems, for which we have defined an interaction protocol, which allows us to exchange data. Students are therefore baffled. To illustrate, we may additionally supply combinatorial analysis: combinatorial counts and transformations associated with the series algebra.

This is the image of university education at the undergraduate and postgraduate level when it is addressed to future mathematics professors. In the needs analysis, the focus is on the strategic character for a country's computer research economy and related industry. Probabilities are an integral part of mathematics, we see it every day. In the mathematical and computer techniques, research in language theory was extended to systems for describing program schemas and abstract syntax trees, as well as functional notation systems and calculus.

Of course professors can teach the necessary mathematics. On the other hand, to teach the necessary mathematics the duration varies in general. Therefore, a problem of algorithmics is very specific. To return to the place of these sciences, indeed, the statistics and the probabilities, on the one hand, computing, on the other hand, have developed enormously.

On the other hand, to provide an example, we may also use mathematical and computer techniques for mathematical tools applied to finance, statistics, stochastic processes, probabilities, etc. To illustrate, we may additionally supply courses of geography are mines of work possible in mathematics: populations, lines of level and potential, basin of attraction of the rivers and fractality, statistics, etc. We recommend that, in particular, at the level of the college the programs plan explicitly from and, on the other hand, the articulation of geography and mathematics courses. To illustrate, we may additionally supply and link computing to the real world and other disciplines. On the other hand, a convenient way to teach a little computer science is to limit yourself to simple mathematical examples.

To provide an example, you may wonder "Does this code work for any example?" When the level of education at a discount I would say rather that it is a bit too high, to situate me precisely in those who were recalibrated

and who had the urge to go explore more interesting topics after, which is yet considered as something easy by some. On the other hand, to provide an example, we may also use mathematical and computer techniques as a Database Administrator. In a company, the databases often constitute a concentrate of information capital, even strategic.

Thus, the first applications are largely the result of digital analysis of differential systems. A dual skill is needed here in management and computer statistics. To provide an example, we may also give an overview of the history of computer-assisted mathematics, a story shaped by the proximity and distance between the user and the computer.

Since the early days of computer science, the historiography of computer science has gradually diversified and enriched, in connection with the gradual diversification of uses of the computer. On the other hand, to provide an example, we may also use combinatorial optimization, which is largely the result of computer processing of operational research problems, links to complexity theory through the works. On the other hand, computer use of the computer tool through the power of calculation and statistics-probability coupling in random universe, is also useful.

It is a question of characterizing the behavior in number of elementary operations, of these methods of computation. Thus, we can imagine a machine in which we drop a ball in a vacuum for a time and measure the distance traveled by the ball. These suggestions are intended primarily for first semester students in Mathematics or Computer Science. To illustrate, we may additionally supply and synthesize a correct certified program based on the proof of coherence of his specifications.

Does not his discipline carry the name of computer science? These artificial intelligence systems are therefore theoretically viable; many people even had fun experimenting with it. Artificial intelligence is probably even more mathematized than anything else. The articulation of the mathematics and physics programs has been the subject of good work, in particular, to link exponential function. Admittedly, meetings and roundtables have been very numerous, but without clear conclusions.

The connection between elements is known gradually. It is thus possible to predict a considerable development of the applications of natural language processing in the next decade. It's the same thing here, you think that computer science does not require mathematical knowledge because you're doing it while being bad at math.

On the other hand, the so-called analytic approaches push computation to its limits in the discrete domain on the basis of combinatorial analysis, then remove the information sought at the cost of an interpretation of the generating series in the complex domain and a fine calculation of the associated singularities. The Second World War, to provide an example, saw a significant investment in the development of computers for military purposes anti-aircraft defense but also cryptographic analysis. The volume in steady growth of the diversity, the data to be treated, and the heterogeneity of these same data require methods of rapid access to non-digital information.

On the other hand, to provide an example, we may also use scientific computing, bidisciplinary skills, simulations, mathematics, and computer science. The skills required here cover mathematics applied to computer science, insurance probabilities, finance probabilities, insurance statistics, actuarial statistics, actuarial probabilities, finance statistics, mastery of database software, etc.

On the other hand, to provide an example, we may also use mathematical and computer techniques for computing, medicine, mathematics, statistics, etc. Strong skills in mathematics and computer science provide a background of fairly extensive mathematical culture. To provide an example, If  $a$  and  $b$  are divisible by  $c$ , then  $a + b$  and  $a - b$  are divisible by  $c$ .

On the other hand, this research makes it possible to design sophisticated programming environments, assisting a designer to build software that conforms to his specifications. I'm just sorry to see that with politicians willingness to put maths everywhere and for all politicians have killed public opinion towards mathematics. There are seeds of innovation at all levels. Mathematical and computer techniques for medicine, to provide an example, is a market that brings together several disciplines (mathematics-computer science and medicine), on which we lag behind.

On the other hand, to provide an example, we may also use data mining, data analysis, statistical skills, etc., and computer science for mastering database management. To illustrate, we may additionally supply and indicate a reduced equation by specifying the associated reference. I think we've gone too far, but I think we'll finally come to a balance. Remember the algorithmic, which systematizes the notion of calculation, and logic, which formalizes the notion of demonstration.

Discrete mathematics are by definition the mathematics associated with such finite or countable structures, and are therefore a priori the closest

to computing. Similarly, the growing demand for mathematical tools in biological models has led to the creation of mathematics, biology, computer science, etc., programs. On the other hand, to provide an example, we may also use numeration and conversion and provide several ways to convert an integer to the base 2 (binary) or to the base 16 (hexadecimal).

It is on this ground that will develop what is, first of all, a set of technical know-how and which will then give birth to the computer science. If we start computer science, this concept is well before computer science, but if we start mathematics in the fourth century before our era, it is also prior to mathematics. In the positive case we will indicate a diagonal matrix similar to as well as the corresponding base change matrix, after that depends on your training.

As a result, a number of examples can be at the border. This need is, of course, no problem when working on paper. This is sometimes called randomization and is introduced voluntarily in the calculation. The proposed conceptual level often exceeds that usually found in mathematics and the necessary time would be considerable. On the other hand, to provide an example, we may also use mathematical and computer techniques for diverse fields and large companies belonging to various sectors.

However to answer you directly it is true that everything is not to take but overall the math still imposes a certain methodology and a good approach to solving problems. In addition to the programs and competitions, a review of the mathematical and computer techniques, which is a possible germ of interdisciplinarity in the preparatory classes, should be made. The event that constituted our realization that these concepts formed pieces of a puzzle that fit together perfectly, and the transformation of the science that it involved, was an event *a priori* very unlikely, an event as there is little in history.

Numbers, figures and functions describing movements are studied respectively by geometry, algebra, and analysis, which are the three main branches of mathematics. Computer science has roots that go back to ancient mathematics, through main streams. We therefore immediately understand this mini-language.

Another avatar of denotational semantic studies, initiated by theoretical computer scientists to understand the notion of possibly non-terminating computation, was the development of real-time programming, notably around reactive languages at the laboratory. And that takes us to another point, the discount requirements in the education level, today everyone

can be an engineer, even having average scores in math, but that's another debate.

On the other hand, to provide an example, we may also use mathematical and computer techniques for all levels and on all subjects (architecture, economy, etc.). To illustrate, we may additionally supply an algorithm we implemented as a rhyme so that his brain keeps it without worries.

We may also use mathematical and computer techniques for modelization, statistical forecasting method, actuarial statistics, etc. Students with mathematical and computer techniques qualifications are highly sought after in many fields such as: all areas related to the notions of imaging, cryptology, computer networks, graphical computing, social networks, robotics, computer security design, analysis of algorithms, telecommunications, networks, etc. Roughly, a fine and original analysis of the combinatorics that is at play reduces the infinity of the possible exceptions to a high but finite number of special configurations.

On the other hand, to provide an example, we may also use mathematical and computer techniques for logistics and production management. To illustrate, we may additionally supply what tariff policy must be applied to ensure the optimal filling of airplanes? Unforeseen and chance have an important weight here.

The theory of reactive languages, which was already authoritative for the design of control automata, finds a new field of application in the design and verification of circuits. On the other hand, to provide an example, we may also use mathematical and computer techniques for meteorology. The weather forecast remains a major scientific challenge. The phases of assessment are therefore important, as it is at this time that students will confront the different codings.

The determination of the optimal trajectory of a probe, the launch and the maintenance in orbit of a satellite require a large consumption of calculations and mathematics. I find it unfortunate that they were so important in my day, because I am willing to bet that it has unnecessarily closed the door to computer science for many students. Excluding programs, the supervised personal works were the most visible display of the will to develop interdisciplinarity.

Engineers, chemists, physicists, etc., have built, developed and used numerical and analog computing systems for both practical and mathematical purposes. They also demonstrated important theorems using large

computational calculations: Kepler conjecture theorem on the arrangement of spheres, four-color theorem, etc.

On the other hand, to provide an example, we may also use mathematical and computer techniques for the transmission of information. From new technologies to health, research, banking, teaching, finance, industry, consulting, services, etc., these issues affect professionals and different sectors. The same goes for maths, it's an elementary baggage. As it is a sequence of actions, his brain, like all human brains, can easily learn it "like a dance or a song."

In one theory, there is as much true science as there is mathematics. And we manage to demonstrate it. On this point it seems to me that things are progressing reasonably but still without really a debate on the programming part.

In addition, precautions such as a priority system allowing an encryption of the message if it contains sensitive data should be surrounded. They have, even before learned societies, taken initiatives along the lines of this report, by broadening their contacts and their actions beyond mathematics.

Mathematics and computer science provides a background of rather broad mathematical culture. Computing will never give anyone any understanding of mathematical concepts. On the other hand, to provide an example, we may also use mathematical and computer techniques for operational research techniques.

To provide an example, if the b's are frequent in a series, but the a's and the d's are rare, we can decide to recode b afterwards 0 and a, c and d by the sequences 10, 110 and 111 we obtain then a shorter sequence than the initial sequence, from which we can, however, reconstruct it. Moreover, their movement is as fast as that of other sciences. Computer skills therefore correspond to the mastery of heavy statistical software.

On the other hand, to provide an example, we may also wonder 'Why go to the doctorate?' NP belongs to this category of questions. To illustrate, we may additionally supply and allow a massive exchange of extremely varied and unstructured data.

On the other hand, to provide an example, we may also use mathematical and computer techniques for applications that require: solving a complex system of equations and finding equations that describe the evolution of atmospheric conditions.

Natural language formatting is part of the mathematical activity. Apart from its unusual hardware support, a notebook or a blackboard, it has all the features of a computer language. To illustrate, we may additionally supply and develop by a working group whose constitution was announced. An accurate evaluation of the device would be necessary to determine what are the conditions necessary for a successful implementation accompanied by a major effort of initial and continuous training.

On the other hand, to provide an example, we may also use mathematical and computer techniques for a study of finite automata and graph algorithms. Associated is one of the national fields of excellence, with laboratories and a computer lab. So we work only with a digital reflection of the real system with which the algorithm interacts.

Scientists know that these algorithms have become structuring tools including in the sciences of earth, life, matter, etc., balanced between mathematics and computer science that allows us to train students attracted by the theoretical computing, mathematical aspects, or new applications of algebraic and geometric disciplines and discrete mathematics. To illustrate, we may additionally supply and specify in all cases if the polynomial admits different roots and for a positive answer we will give an example of root.

On the other hand, to provide an example, we may also use mathematical and computer techniques for job opportunities: signal processing, network engineering, cryptographer, statistician in a bank, it management of companies, etc. To illustrate, we may additionally supply techniques that were just written, so there will inevitably be errors. Such a use of tools seems natural, since an algorithm is made to be executed without thinking and this is how, since antiquity, we used abacuses, charts, chessboards, etc.

To illustrate, we may additionally supply and show that an abstract framework is extremely effective in other disciplines: it is to implement a little modeling. On the other hand, to provide an example, we may also use mathematical and computer techniques and recommend to the doctoral candidate to take advanced courses and to participate in seminars. If the applications can serve as motivation or illustration of a well-constructed course, they should not eat too much space compared to the theory.

Remember, every cube of integer is a sum of no more than nine cubes. Conversely, one learns a formal language by first learning his grammar. In class, it is not enough to check it by measuring, as one day a professor suggested to me, it is absolutely necessary to prove it. Examples abound in

physics and have evoked in this connection the unreasonable efficiency of mathematics in the natural sciences.

On the other hand, to provide an example, we may also use mathematical and computer techniques to give a link to an analytical combinatorics course. To illustrate, we may additionally supply a synthesis table and main opportunities. Remember, mathematical and computer techniques provide examples of applications of mathematics.

On the other hand, to provide an example, we may also use mathematical and computer techniques to understand the disciplines and methods used, the mathematical tools required, the skills to master, etc., for finance and risk management. To illustrate, we may additionally supply ways for banks to communicate data to avoid indiscretions, to provide an example for data transmitted related to by credit card purchases.

On the other hand, to provide an example, we may also use a smartphone and we just have to give a website the data that describe the way we want to interact with the website, and the website gives some data to my smartphone and presto, a video is played. Although originally intended for computers, this protocol is compatible with a smartphone. And yet, I repeat, the mathematical essence remains abstract.

To illustrate, we may additionally supply signal processing for compressing the information to be transmitted in a communication channel. On the other hand, to provide an example, we may also use mathematical and computer techniques for DVDs and the advent of DVDs has only been possible thanks to the development of codes based on the exploitation of the structure of finished bodies and presenting a very high correction capacity, as a scratch of the width of a hair can result in the loss of several thousand bits. Therefore, we should be given the task of providing all professors, from colleges to colleges, cultural references on the evolution of science, ideas, and techniques, where naturally mathematics have a place.

Mathematical and computer techniques are also the basis of the binary coding of information, which makes it possible to manipulate, store, transmit, etc., all kinds of digital representations in a computer memory. To illustrate, we may additionally supply ways to be able to realize mathematical models, develop mathematical models from equations, and evolve complex software.

And yet I have more complicated information to pass to you. Remember, probabilities are very useful in decision-making mechanisms in an uncertain universe. On the other hand, data analysis methods, including methods of

matching identical keywords to identify converging points of view and textual analysis method downstream of surveys, are also very useful.

You may wonder which mechanisms to opt for. The recent creation of a mathematical and computer techniques diplomas is a natural continuation of this course. For the most part, however, technical and general colleges suffer in the same way from the lack of joint work of the professors of the various disciplines. To illustrate, we may additionally supply ideas axiomatized in a calculation of classical predicates, that is, admitting the principle of the excluded.

A fundamental research program, on the borderline between mathematical logic and computer science, finds its applicative justification in the problem of software security. On the other hand, to provide an example, we may also use mathematical and computer techniques for once a transmission is complete, when the issuer stops sending tokens, and we check that it has been done correctly, otherwise we try to determine the errors made.

The image of science is blurred, they crystallize the concerns of society, some of the young people turn away. It's funny, in preparation I was a physics and a math aficionado. On the other hand, to provide an example, we may also use mathematical and computer techniques for: probabilistic techniques, evaluation of a probable future based on past experiences, numerical simulations, mechanics, physics, mastery of software, mathematical and statistical modeling, etc.

To illustrate, we may additionally supply numeration of the real numbers. Previously, we have defined the binary, decimal and hexadecimal digits of an integer. These systems involve different sectors: electronic components, telecommunications, IT, etc. If someone asks us the way to the nearest store, we will give instructions to follow one after the other, with even, sometimes, conditions, to provide an example if there is work, turn left, otherwise, go straight.

If logic teaches us what it is to think and mathematics what it is to know, computer science shows us what it is to act rationally with the help of a material in general, this one. This being left to our discretion. A series of practical exercises, all corrected, therefore show how to solve problems through the judicious use of algorithmic solutions. All these answers are, on the other hand, imperfect.

On the other hand, to provide an example, we may also use and list annually the annals of the mathematical and computer techniques examinations and distributes them to the members. To illustrate, we may

additionally supply statistical studies. We seek to understand where the data we use and the issues they raise come from. These principles are at the basis of Ethernet networks and TCP protocol governing more than the majority of the exchanges on the Internet.

The computer science, mathematics, and mathematical logic sectors hire, the numbers have increased per year. Continue in this way, and we will successively obtain added areas of research. On the other hand, to provide an example, we may also use mathematical and computer techniques to fight against cybercrime and carry out security expertise by designing mechanisms to secure information. To illustrate, we may additionally supply functional spaces and demonstration structures.

The explanation for a lack of contact is to be found in the practice of all professors, not just mathematics professors. On the other hand, to provide an example, we may also use mathematical and computer techniques originally at the origin of the construction of small analog computing instruments, specific to the laboratory, to study dynamic systems.

On the other hand, I agree maths should not be eclipsed by the training of a computer scientist, because they are the bases. To illustrate, we may additionally supply mathematical and computer techniques for the creation of customer databases (typology, behavior study, etc.). The approach described here is parallel to that of the analytic number theory, and the exchange of estimation methods is emerging. To provide an example, Dynamic Systems Theory is a promising entry into these questions, and by to provide an example, the probable behavior of central Euclidean algorithms in formal calculus has only recently been elucidated by dynamic methods.

On the other hand, to provide an example, we may also use mathematical and computer techniques for research and development for large companies and research organizations. To illustrate, we may additionally supply a simulation of the consequences of lightning that would reach a plane in full flight. These techniques are also used in industry or archeology. The emergence of this notion of information has also allowed us to realize that in many cases we use machines, not to transform information by applying algorithms, but only for archiving.

We also recommend that all be provided with all relevant information for the completion of the mathematical and computer techniques. I suppose that if computer training is often related to mathematics, it is because the latter require, like software development, to have reasoning based on logic. On the other hand, to provide an example, we may also use mathematical

and computer techniques to determine the prices of the various products-services offered (options, futures, etc.) by integrating the risks that are random because they are linked to many factors not controllable.

And the surveyors use mathematical and computer techniques to calculate the area of agricultural surfaces. In addition, the development of computer science has enabled more and more mathematical tools to have concrete applications, to provide an example in: robotics, image analysis, financial analysis, etc. They bind together the other disciplines by implementing the same basic concepts.

On the other hand, to provide an example, we may also use mathematical and computer techniques from the data to the databases. If the computer is the computer object par excellence, it is simply because computer concepts and methods are mobilized massively but not exclusively. I talk about the importance of mathematics in the context of computer learning, not in the professional context (I thought I had clearly made the distinction in the past, just talking about the job).

On the other hand, to provide an example, we may also use mathematical and computer techniques as a aerodynamicist, a project manager, a turbojet designer, a cryptologist engineer, a control engineer, a modeling engineer, etc. In another area, in order for computers to communicate in a network, it is advantageous to abandon the deterministic approach of conventional telephony and to resolve access conflicts simply by drawing lots. Remember, mathematical and computer techniques conferences and seminars are available online in college audiovisual collections.

To illustrate, we may additionally supply the fact that the automotive sector recruits young people from applied mathematics programs for their research and development services in products and manufacturing processes. It therefore seems reasonable to make experiments at a fairly large scale in secondary education, avoiding the pitfalls of disciplinary confinement and lobbying effects.

IT has the unfortunate reputation of being the science of computers. These examples are emblematic of the use of the computer tool in the sciences, but it should be noted that the computer discipline intervenes only very indirectly, providing logistical support for systems, programming languages, and modes of representation.

How to effectively collaborate all these different groups, who do not speak the same language? It's not that we need mathematics to do computer science, but it's a fact: when we do computer science, we do maths. Faced

with the increase of information flows and the need to decide in real time, computer scientists have had to offer new tools such as integrated management software or customer relationship management.

To illustrate, one of the big differences between a nurse's aide and a nurse is precisely in the calculations of flow rates, treatment part, doses, etc. Notions that you have already seen but which one will need (and that it is necessary anyway to control when one does mathematics or informatics). In terms of the objects it studies, computing is approaching mathematics, because both are interested in abstract objects.

Professors in other subjects are hardly prepared to turn to mathematics professors. It will be necessary that our border community every day a little more permeable (the situation is stimulating), invest more. Help in the selection of new services. To illustrate, we may additionally supply help for the subjects of languages, geography, history, philosophy, etc.

It will also be of interest to students in computer science, or those in preparatory classes wishing to acquire the basics of algorithmics, as well as all those who wish to know and master the mathematical tools necessary for a good practice of computer programming. Research is now very active in mathematics. The object of study of computer science has gradually moved from machines to algorithms and languages.

I would be tempted to classify mathematics at the same level as the Design Patterns: I'm sure that for the most part, the comparison may seem flawed, but imagine trying to teach Design Patterns in a purely theoretical way to pass the tray. International surveys show that mathematics, computer science, and mathematical logic students are uncomfortable with modeling problems. It takes years to operate in these disciplines.

The computer discipline, whose presence is essential to this reflection, should therefore be represented by the society and the associations public education and computer science. For example, the term computer variable is actually bad choice. On the other hand, writing an integer in base 2, 10 or 16 is unique.

Perspectives in preparatory classes allow for the implementation of interdisciplinarity at the same time as student initiative. I came to wonder if we were asking the right questions, hence my introduction of the rest. But the interaction took a long time to get into place properly; indeed, set theory and, in particular, the efforts would stiffen the official discourse of mathematics around a standardized first-order set theory language.

The microprocessor of a computer only works with two digits: 0 (no current) and 1 (current). To illustrate, we may additionally supply a program written in a high-level language designed for humans. On the other hand, we may add mathematics and computer science in the collection, to provide an example, and use petri nets.



# **41**

## **CHAPTER**

# **PROGRAMMING PERSPECTIVES**

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The idea of the sector was to make interactions between different subjects. This allows remote communication and data exchange. A famous conjecture of the nineteenth century states that any map of geography (that is to say, any planar graph) is colorable with at most four colors. However, the companies cited point out that there are few places where high-level application-oriented statistics are taught.

As to whether this is the role of the math professor, that's another question. That's why a lot of students leave to work right after the license. And then the professor must not live this as a constraint.

On the other hand, to provide an example, we may also use formal tools and mathematics applied to computer science. But it is often the requirements of other disciplines that lead to forging an adequate mathematical tool.

To provide an example, we may also remember that private and public laboratories invest a lot in research to understand the mechanisms of life, agricultural issues (e.g., plant breeding), and to respond to medical issues (the treatment of genetic diseases).

On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic to provide patent evaluations, and a possibility of replacing with individualized help. To illustrate, we may additionally supply and introduce computer science, mathematics, and mathematical logic without specifically targeted means and led in the vast majority of colleges to an hourly decline in several disciplines, often the most.

On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic to provide data analysis, modeling and IT use (downstream for data mining) and survey techniques and sampling techniques (upstream to collect information). It is at the college level, as we have already noticed, that divorce is the most damaging. Traditionally, we associate the min operator with  $\wedge$ , the max operator with  $\vee$ .

It is obvious that there is a need for information technology in science, technology and economic activities. This extremely fruitful point of view was to be developed in the last years in a programs, bringing together logicians and computer scientists in search of the logical foundations of programming.

Computer science is a formal discipline, that is to say a field of research whose concepts, methods and criteria of truth do not depend on facts or particular material supports. Modeling-simulation methods are systematically used. I took 1 year to boost my skills, I knew more or less what I missed.

Their ordering and formatting is part of the work of mathematical creation. The information concept sheds new light on questions of physics or biology to provide an example when we say that information cannot travel faster than the speed of light to express that one event cannot be the cause of another if they are not separated by a duration greater than their distance divided by the speed of light or when we say that the information needed to synthesize proteins is encoded in the RNA.

However, no country teaches computer science in general secondary education as a discipline with an epistemological status clearly differentiated from mathematics, despite many more advanced experiences than ours. On the other hand, to provide an example, we may also use modeling and simulation, it is possible to design reliable and efficient means of transport that limit the prohibitive cost of testing (wind tunnels, crash tests, etc.).

This path requires us to move forward without the need for action. On the other hand, to provide an example, we may also use project pedagogy mathematical channels. The example of forces and vectors was the jewel of multidisciplinarity in complementary courses and graduate schools. To illustrate, we may additionally supply a strong command of modeling, optimization and decision support methods in mathematics.

The boundaries between mathematics and computer science are shifting. Conversely, a computer program can be considered as a skeleton of mathematical reasoning. On the other hand, to provide an example, we

may also use computer science, mathematics, and mathematical logic for the physical sciences and the social sciences.

We always recommend the creation, first experimental, then progressive, of mathematical laboratories in colleges and possibly in colleges, as places of activity of students and their professors, equipped with computer equipment and other materials, and allowing the reception of professors and practitioners from other disciplines. Staffs are not very new, so the job market is relatively saturated.

The reality is quite different: it is not enough to decree the link with the other disciplines so that it lives effectively, because it requires a change of vision and practice that is not easy to achieve. On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic as statistical analysts, software engineers, professors, project managers, etc. Mathematics, statistics, computer science are complementary and coexist in many courses.

It seems more than likely that a privileged software would be a black box for students: this is very well explained by the authors of a manual for the computer options. Thus, at the beginning of the first year, we approach the geometry, and the elementary linear algebra, instead of pushing them back at the end of the year after all the apparatus of algebra and analysis. Thus, simply typed terms can be seen as notations for proofs as a natural deduction of the implicational fragment of propositional calculus.

In parallel with this transformation, the relationship between computer and mathematics has also evolved. Etc. On the other hand, to provide an example, we may also use and rely on his programming skills but also on his knowledge of physics and biology to interact with other players in medical imaging.

Each of these machines can solve only one problem: calculate a square, calculate a square root. Let us not deny that this requires professors to increase their work, a change of habits, that in any case a classical codisciplinary teaching will also be required. The general reflection on sciences, the interactions between disciplines and their applications are not organized in university education in the name of the pre-eminence of a disciplinary whole that collapses today, from the BA/BS to masters.

The field of random discrete structures has become increasingly important over time. The decision to create a computer option is accurately analyzed in the editorials. Finally, as Western governments have recently

(and reluctantly) acknowledged, cryptography is a need of the general public.

On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic and a number which is not prime is divisible by a prime number, and can even be written only with prime numbers, in the form of a product. Flows are significant and particularly important for manufacturing processes in order to respond to issues such as just-in-time management, quality control, control of the hazards of production lines. Image processing?

We can then question them in this way: “Are there better codings than others?” I always prepare very seriously the computer science, mathematics, and mathematical logic courses, much more than the mathematics.

As we have pointed out in a few selected examples, the mathematical approach at the same time imbues the development of fundamental computing: a number of theories and mathematical results are used, while the mathematical schema definition-theorem-proof plays a role and capital in structuring knowledge. The same goes for my case: mathematics was not my forte during my training, and I am come out today in the computer. Would the result be brighter than the results in math?

# **42**

## **CHAPTER**

## **ADVANCES IN LINEAR LOGIC**

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These disciplines are sought in a complementary way in applications concerning the research and development sectors of firms. I think we need to quickly discover the ways of learning that best correspond to us.

As soon as we want to make transformations (whether images, objects, or anything) we will use matrix calculus, changes of benchmarks. On the other hand, to provide an example, we may also show that at that time an important part of the teaching services of university mathematics professors was at the service of other disciplines, and that it was the source important innovations. To illustrate, we may additionally supply disciplines that have become more and more intelligent thanks to embedded systems.

On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic to systematize the algebraic investigation of a hierarchy of formal languages, whose regular (or rational) languages form the first stage, and Chomsky's non-contextual languages (or algebraic languages) form the second stage.

On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic as an expert in Internet and multimedia technology, image processing technician or computer maintenance, telecommunication engineer, researcher finance, banking, insurance the it management deals with accounting, r & d engineer, billing, inventory management, optician, acoustics engineer, etc. There are several courses of study. The system could even be generalized, with some inconvenience: it is possible to use a large number of data without significant interferences.

We often talk about “digitization” to designate this operation, because by noting 0 for a black square and 1 for a white square, we can write this continuation 11001011. This gives an approximation of the image: to provide an example, tiny details smaller than the size of a square are lost. What we already find, and which remains to a large extent a mystery is, according to physicists the unreasonable efficiency of mathematics in this sector.

to provide an example, universities are offering biologists the opportunity to complete their training in computer science to specialize in bioinformatics. It is out of the question to advocate a single model, but it is interesting to observe the systems of other countries and to take them into account.

Another advantage would be to show students in computer projects that without mathematical concepts (admittedly discovered and implemented in a different setting), we are very lacking! But to look at everything that can be delegated to an algorithmic mechanism to, beyond, allow and force the human mind to surpass itself. On the other hand, to provide an example, we may also use systems that can simulate the growth processes of a tree, in successive stages, according to time scales and spaces.

I think it's good and healthy to do calculations. But the important thing is not really the question of contents. However, this type of machine can solve only a finite number of problems: even a knife of the Swiss army has only a finite number of blades.

These disciplines are often synergistic in the medical and biomedical fields. The answer to the preceding questions should make the subject much less subject to any debate, finally it seems to me and that following is my personal opinion, and, it is the one to which I am most inclined to rank. We have cited some excellent examples and some difficulties.

But it has nothing to do with it, it is only a question of an individual blocking: Maths is only valid for you if they are applied concretely, do not believe that you do not do maths in computer science. Strong skills in mathematics and computer science provide a broad mathematical background. As the class of groups of finite rank is strictly greater than that of algebraic groups, we will also see the new phenomena which appear in the model-theoretical framework in relation to it, the more restricted, the geographical anomaly.

On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic to query volumes of data organized according to different criteria. This discovery, made at the turn of an exercise, is not obvious: it took centuries for humans to release this

abstract notion of function. The history of algorithms is nonetheless a point of encounter and dialogue between the history of computer science and the history of mathematics. The link between mathematics and other disciplines must be reflected in the fact that all courses for mathematics students have a historical component and a serious introduction to a different scientific field.

When statistics are taught in mathematics, it is good to see different aspects in geography, economics, physics, etc. The introduction to statistics lends itself to joint training of professors from different disciplines. On the other hand, to provide an example, we may also use and encode information that we understood.

You may have done math for years, at some point you will not have the resources to meet the needs of the trade, and the books, or a true business expert will become your best friends. I only knew the functions defined by formulas, and I wondered how I could deal with this problem without formula. On the other hand, to provide an example, we may also use probability-statistics applied to the theory of information.

It is difficult and it requires a regular effort of continuous training. It would be to forget his roots. And if it's still the case, it's very unfortunate. The mathematical tools here make it possible to predict the temperature levels reached by these parts and to consider when, and in what way, it is necessary to intervene to cool them.

It can also design protected communication systems, in the field of digital transmission security. The results will be justified. On the other hand, to provide an example, we may also use a computer simulation of accidental shocks and the resulting damage to the body, to provide answers to improve the safety of drivers and passengers.

They will be an opportunity to consolidate and deepen students' knowledge of the use of measurement units and the practice of certain unit changes. But if the history of computing has undeniably inherited history of mathematics, we can also today ask the opposite question: can the history of computer science inspire the history of mathematics? On the other hand, to provide an example, we may also use statistical tools and probabilities.

Let's take an example to conclude this section. To illustrate, we may additionally supply computer science, mathematics, and mathematical logic and send digital photos by mobile phone. The characterization of decidable subclasses, and the complexity of their membership, their equivalence, or other algorithmic problems, is a classic theme since the beginnings of

theoretical computing. Certainly, over time the computer has emancipated from its humble origins to become a machine with multiple faces that performs a function by its location in an information network and by the footprint it makes on the flow of information that pass.

The consideration given to professors is an important issue. On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic for the independence of the network layer from the physical layer. On the contrary, it is not adapted to a shift register that does not record the figures obtained: it is precisely a matter of not burdening the memory of the computer with random numbers but of generating them ad hoc when we need it. It also allows hesitant students to delay the choice between these two disciplines. To illustrate, we may additionally supply computer science, mathematics, and mathematical logic to animate reflection among mathematics professors, and to create interdisciplinary links.

On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic to provide a matrix that can be considered as the matrix associated with a linear transformation  $L$  defined in a vector space related to the base  $B$ . Promising interfaces emerge: ecology, topology, databases, genomics, structural biology, etc.

To illustrate, we may additionally supply an advantage is that it is algorithmic, so programmable. Their processing consists in analyzing their structures to compress them, to decode them or extract the noise to confront them with dictionaries of signals or test images in order to classify them or to look for the keys. On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic for the growth of functions, sequences and summations, sets and functions, sets and operations on sets, predicates and quantifiers, logic, equivalence, etc.

On the other hand, the reduction of polynomial systems is related to contemporary algebraic geometry, the symbolic manipulation of many special functions of physics becomes possible thanks to the joint use of modern differential algebra and adapted data representations. Polynomial factorization is best done by methods that exploit both the structure of the finite fields and the principles of randomization. On the contrary, it is good to start from all that is familiar to access the simple and the general. On the other hand, to provide an example, we may also use mathematics, (mainly numerical computation) applied to the problems.

Let's try to say why and how. At the same time, expectations are becoming more complex for users who want open systems integrating software, products, and services. However, it is not the fact that the information is expressed as an integer that is important, it is the fact that it is expressed symbolically.

On the other hand, to provide an example, computer scientists should also meet a few times in the year, and computer scientists may invite experts, and set deadlines to produce a first computer science, mathematics, and mathematical logic report. So they have a little trouble understanding that their students will not necessarily follow this path too, I have the impression.

to provide an example, we may use computer science, mathematics, and mathematical logic and also provide a reorientation and bridges between sectors. To provide an example, security products may include: smart cards, copyright protection, mobile phones, wifi, biometric identification, digital image, document marking, etc.

The search for information in large corpora, such as the Web, and the organization of corporate memories, are major economic issues using these techniques. First, it must be a constructed course, where we start from basic postulates and demonstrate the tools that will be useful. First, computer scientists explains very simply an algorithm is simply a way to describe in great detail how to do something.

So here we are creating a minimal language to code this information which we understand him and me the meaning. Other similar formalisms, like Milner's calculus for communicating systems (CCS) as a process, were later invented to model the competing processes. The academic mathematicians mentioned above reacted in the same direction, the final draft should therefore be significantly evolved, without being able to fully satisfy us.

Finally, we propose to consider computer science as a formal science that one can think without a computer. Their success is confirmed. On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic for decision-making purposes, scientific data from the laboratory, to obtain authorization to market a new drug, clinical trial results, etc.

Through his relationship with mathematics, we have illustrated the fact that computer science is a science very much in the tradition of other sciences. The corresponding work can only be conceived from concrete situations and in conjunction with other parts of the program.

Classes are linked together by lines representing their associations, that is, the relationships that allow them to interact. Research institutes therefore provide some formal demonstrations that are only algorithms to apply, and in this math approaches the computer.

On the other hand, to provide an example, we may also use interdisciplinary activities where it is necessary to examine separately the programs and the reality of teaching. One day, maybe that same person will end up in a company doing R & D and being asked to write a math-related program.

This is stated by the following property. It appears that some vocational colleges have found a framework for real interdisciplinary activities where mathematics have a recognized place. The teaching of mathematics in relation to other disciplines. It turns out, to provide an example, that the best big integer multiplication algorithms involve a Fourier transformation in a discrete version.

Here, we must specify the version of the protocol and other information, the most important of which are the source address and the target address. I think that basically computing is logic. On the other hand, to provide an example, we may also use an institutional place of interdisciplinarity at the college.

At the end of the 1st session, the activity is linked to the notion of binary coding of information. I am therefore a perfect example of the fact that it is perfectly possible to be a mathematician and yet perfectly able to succeed in a professional career in computer science.

On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic for a dictionary algorithm. Searching for a word in the dictionary seems to be the easiest thing in the world; but who knows how to do it effectively? to provide an example, we may also use computer science, mathematics, and mathematical logic to provide characteristics of recruitment in different sectors of opportunities, to provide an example for the consulting and engineering sectors. This sector includes services companies, service providers in the field of imaging, pollsters, remote transmission of information, consultancy firms, etc. After all, if you limit yourself to creating websites, the problem is much less obvious.

We will show here, conversely, that a non-negligible part of the concepts and methods of the computer discipline is independent of the world of

computers. And, once their requirements have been modeled in UML, they can transmit their schemes to computer scientists.

I was a student in the United States and I could compare both systems. On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic for a positive case, and indicate using as few calculations as possible, a diagonal matrix and the corresponding base change matrix. What about mathematics?

All computer science comes from mathematics, and we only notice it when we start contributing to very advanced areas of research. On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic and apply various methods of graphs and trees (including infix, prefix, postfix and tree paths)

The modulation, according to the grade level, of these objectives is supported by the analysis of the specific character of the computer science, to distinguish from the learning of the use of the numerical tools, the one and the other to be present in education. It is a recommendation, already made in previous reports that we resume here. We will justify these answers.

Just as certain precautions must be taken in set theory to avoid the paradoxes resulting from too lax set-lists such as  $\{x \mid x \neq x\}$ , it is advisable to provide the calculus of stratifying limitations to restrict it to convergent calculations. To understand, take the example of and the base 10. More generally, we have the following property. Even if Google gives me some elements, it will never be enough unless I have, of course, the next years and the necessary patience that goes with it, all that to re-invent things that mathematics have already solved since a lot of time.

The computer programs thus become skeletons of the proof of their adequacy to formal specifications. The formal calculus integrates the data structures and general algorithmic of computer science in an original way, and various “divide-for-rule” recursive sharing methods (the so-called “fast” FFT calculation, is the Cooley–Tukey algorithm), and the adapted use of arithmetic congruence properties.

Until the nineteenth century, great mathematicians, such as Gauss, Leibniz, Newton, or Euler, invented original methods of numerical and symbolic calculation. How to become an engineer? Circuit design research has itself generated a wide variety of formal methods – the size of integrated circuits no longer allows the use of traditional methods, and circuit verification is now integrated into the design phase.

When we write  $y = 1 + 2x$  the “variables”  $x$  and  $y$  take an infinite number of values. The history of mathematics education in colleges shows that its relations with the teaching of other disciplines have varied over time according to the types of training and the tensions between theoretical and practical training. And this not only because this algorithm was a good match to an existing technology, but also because it was possible to develop the mathematical theory of the Fibonacci Sequence.

And to be able to learn other things, you have to use the abstract. The bad, on the other hand, was the discovery of the functioning of the administration of the faculty. The effort to implement these recommendations, and if possible to go beyond them, involves all national education and the entire mathematical community, and requires a variety of competitions.

The scientific collaborators of the sections of Mathematics pursue researches in very varied fields: von Neumann algebras, functional analysis, dynamic systems, statistics and probabilities, numerical analysis of the differential equations, algebraic topology, geometry of the groups and combinatorics, algebraic geometry, combinatorics, node theory and singularities, arithmetic and algebra, etc. Moreover, it is not possible to really get into the operation of a computer, it would be necessary to teach a little assembler. On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic for competencies quite multidisciplinary.

More than ever they feed on other sciences, and they feed them. This led us to renew the analyzes of the mathematical structure of chaotic attractors, by coupling the calculated images to the geometric and topological approach. The same goes for a result in computer science.

Like them, they can be valued by direct applications (this is the case, in particular, of statistics). professors teach things they have never learned in their initial training.

Although the technical things seem to be randomly ordered, the sequence obtained becomes in reality periodic after terms. It is on this ground that will develop what is, first of all, a set of technical know-how and which will then give birth to computer science. This thought has, of course, many precursors in history, such as Galileo who introduced both the use of instruments, the telescope, and proposed to use a new language, the mathematical language, in the natural sciences but what seems new, however, is to pay attention simultaneously, in the same gesture, to these questions.

On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic for modelization and methods of decision support by intelligent data processing (example: “Data mining”). I agree that we all have our limits especially with a college. To illustrate, we may additionally supply and determine the local extrema of these functions and their nature.



# **43**

## **CHAPTER**

## **SYMBOLIC LOGIC**

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On these questions, a set of methods emerged: we came up with the concepts of data structures, then databases, and we simultaneously identified some major paradigms of programming, such as the famous principle of divide-and-conquer algorithms based on recursion. With this theory, we also give a practical approach to the notion of “random nature” or “randomness.” Before the activity, few students know how a computer works and this activity introduces the binary coding of information in a devious way.

Especially that to make the web maths will not serve much. These languages are programming languages so simple that one can conceive of electronic machines capable of executing programs directly and to which one manages to translate and to compile and often in several passes, the programs written in the languages of higher level, that is to say more ergonomic. Modeling and simulation therefore apply to industrial processes to describe the predictive operation of these processes that will be induced by the modification of sensitive parameters.

There are almost no examples either: there is the lecture for that. On the other hand, to provide an example, we may also use mental math questions on the way to college. To illustrate, we may additionally supply computer science, mathematics, and mathematical logic and could be done on the occasion of the release of a report on mathematics in the contemporary world.

On the other hand, to provide an example, we may also use modeling to help with the decision, (e.g., evaluation of the elimination of certain calculations). We are very far from it, and the gap widens between the science

that is made and the common consciousness. The teaching of mathematics still remains today that of an isolated discipline, very focused on itself, little concerned with interactions with other sciences.

This extends the “model theory” of the fundamental courses, with an orientation to algebra and more particularly to groups. The goal will be to get an overview of the interactions between the algebraic properties and the model-theoretical properties of the groups, more typically the stability. We will focus, in particular, on the finite-dimensional groups, the rank or some variations, and we will see the many analogies between the groups of finer groups and the massive groups of bodies that are often closed.

Then, it is necessary that one can make understand the articulation between the theoretical course and the concrete situation. The birth of the computer has undoubtedly renewed the interest of historians in some aspects of mathematics, such as the questions of approximation and precision in numerical computation, the stakes of the time and memory resources needed to execute an algorithm, the logical organization of complex programs etc. In addition, the most striking results are those that make the connection between various fields of mathematics; as a result, their knowledge is enlightened and simplified.

We recommend testing different forms, and in particular, different ways of orienting student choices, taking into account the interests and skills of their professors. On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic for development of numerical methods: Euler, leibniz, newton, or gauss, etc. To illustrate, we may additionally supply new links between mathematics and other subjects. From the college level, the teaching should take advantage of that of mathematics.

The opening near a faculty of sciences of a college of computer science, often private, automatically leads to a decrease in the number of students in maths. On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic for programming languages. To write algorithms, we can use a natural language such as English or use a simpler and more precise language: a programming language. If it is only a matter of applying a theorem or a ready recipe, it does not matter, it is better to do another more stimulating activity instead.

We must discover the ways of learning that correspond to us best through a Bachelor's degree in computer science. A balance sheet should then be established. For biology, economics, industrial sciences, physics,

etc., mathematics are not just a calculating tool. How to maintain efficiency on dynamically changing data?

This meeting can be both a source of opportunities and pitfalls as I will now illustrate by the example of the works of the eighteenth century. For this purpose, cryptology, the science of secrecy, has developed mathematical tools using algorithmic complexity, information theory and probabilities, number theory, etc. On the other hand, to provide an example, we may also use and study the dynamic contribution of the tire to the comfort of the vehicle.

A major obstacle for secondary college professors today is the question of calculation. A UML class diagram classes requires some thought on the part of the recipients of the system: they must put all their future needs to the test. Let's take the example of huge factories where machines of about are installed which operate at very high rates: the physicist will use the mathematical tool mentioned to predict the various operating scenarios of these machines function of changing parameters.

To be bad in theoretical college math does not mean that one is fundamentally bad at maths, but simply in maths as taught then. On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic for: reminders of matrix calculus, integers, algorithmic complexity, basics of number theory, divisions, application to Markov chains, integers, algorithms, matrices, etc.

I think the term civic mathematics is unfortunate because it is difficult to define, and that justifying college education with a loan problem is not a good thing, as our colleagues very well explain. Computer materials, completely new, do not escape this rule. And after all, understanding what tobacco smoking really means is a trainer for the future citizen.

These different aspects are at the heart of the group's concerns. On the other hand, to provide an example, we may also use a presentation on the classification of spiders. On the other hand, I always prepare public conferences very carefully.

To illustrate, we may additionally supply a reliability test of the models created in order to validate the protocols put in place by the researchers. The aim of these study was also to show the college professors that they generally knew, by their training, only one side of the teaching activity of the mathematicians who had been their professors. Computer science is only interesting in secondary college if its praxeological dimension is clear to students.

On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic and provide If I is not divisible by any of the prime numbers less than or equal to I, then I is prime. We must not only see the similarities but also the differences. We can draw the diagram of our project. Modeling and simulation can also be applied to the predictive reactions of parts (constituting a larger whole, such as airplane parts) subjected to mechanical and thermal stresses

First of all, I had good news: at last I was no longer obliged to follow the classes that bored me. So it's the case when you search for a book in the shelves of a municipal library, an address in a directory, the name of the city corresponding to a given postal code, a word in the dictionary, etc. There is a good balance to find, knowing that the most important thing is to prepare students for an evolution and knowledge.

This technology has given rise to many developments of a mathematical nature, to prove the existence of fixed points in these abstract domains and to give efficient algorithms for their research. The answers must be justified by calculations and not rely on the observation of a drawing. Management helps to understand the context in which statistical and IT tools will apply. A product has different characteristics and qualities depending on the nature of the combination chosen for the components.

The first generation is represented by the mathematical and computer system whose success has already been highlighted. The applicability of probabilistic and stochastic computing to the performance evaluation of computer systems could be partially expected, given the many achievements of the period before computing, queues and telephone traffic modeling in particular. When several machines are thus connected, they can be synchronously, which means that their clocks beat at the same rate or asynchronously, in which case the execution of all the machines is necessarily non-deterministic, the randomness being introduced by the drift of clocks, which is unknown.

The formula nevertheless has great interest in giving an institutional place to both project work and cooperation between disciplines. It's a bit like seeing a play with a single sheet of paper, a pencil and an eraser, and coming out with a precise estimate (typically with less than 1% error) of the number of different words uttered by the actors. Later, the photography of his little piece of paper allowed me to go on the Web to discover that writing.

These are maths, and certainly in my curriculum, if you loop these modules, you do not valid your semesters and your year. These fools of

guidance counselors have always refused me the computer, because of my average math. And finally, you'll notice that I said I had deplorable grades in theoretical mathematics. At first glance the field seems extremely large, but perhaps they wanted to set the bar very high, knowing that there would necessarily be withdrawals during the writing of programs and wanting to position themselves for future arbitrations on the number hours to devote, in secondary education, to this new discipline.

But not only, if one thinks of the training, from the beginning of the superior, of the many computer scientists that the country will need. By cons, my math skills have barely exceeded the additions. The history of mathematics is part of mathematics and history. Pedagogical registration is very complicated, care must be taken to choose courses in advance, learn from other students and, above all, do not wait until the last moment. "What are your tips for success?

The controlled tools must be innovative, so close to the results of the research. The skills required here are at the crossroads between three disciplines: statistics, business management, and IT. Treat tools here as all these themes represent a substantial work that goes beyond what the group can handle. Take the example of a product made from components, which can be chosen from a wide range.

On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic for a theory of error correcting codes. UML is therefore a language independent of machines and software, which allows the various actors of a project to communicate despite the diversity of their approaches. To illustrate, we may additionally supply that algorithmic can accelerate the search for a word in the dictionary; that it is sometimes useful to do programming on paper.

On the other hand, to provide an example, we may also use mathematics and analytical techniques and complex theories of probabilities, applied to computer science and new communication technologies. One consequence is that computer scientists speak of logicians as a different species from mathematicians, since mathematical logic has always been marginalized in mathematics departments and university courses.

On the other hand, to provide an example, we may also use tools like data analysis, classification, and algorithms modeling in statistics and econometrics. We find, in particular, procedures among the various algorithms developed at that time. As we are not computer specialists, it is

not for us to judge the feasibility of the proposals made for this curriculum, often very detailed (especially for the primary), nor their magnitude.

Still, the programs proposed by the computer scientists are at the same time very ambitious, diverse and often imprecise. The Web changes the game! It is legitimate to enroll them in college programs, but only if the objectives I have stated are respected.

They have only a few choices. A more algebraic characterization, in terms of rational languages, represents the languages recognized by these automata as the sets of words generated by operations of union, concatenation, and iteration, the regular expressions. On the other hand, to provide an example, we may also use the field of speech processing that is in the process of providing human-machine interfaces using voice, usable by speakers without learning in restricted semantic domains.

It was a discovery for the computer science, mathematics, and mathematical logic and a speech quite commonplace. On the other hand, to provide an example, we may also use software tools to provide to and to be an interface with measurement software for diagnostic assistance, an image acquisition system (MRI, scanner, etc.), 3D organs visualization software, etc. The great ignorance of students and their professors about these summits of thought accentuates the dehumanized image of mathematics, but has far more serious consequences for the future: that of allowing the gap between advances in science and the common culture of citizens.

In all the missions entrusted by the banking-insurance sectors, these various competencies are used in a combined way, with a different weight for each according to the mission entrusted to them. On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic for the tire and a test of resistance of the materials to the deformation. To provide an example, we may also use computer science, mathematics, and mathematical logic to provide an arithmetic base 2, also known as a binary base, that can be counted (only 0 and 1 are used): 0, 1, 10, 11, 100, 101, 110, 111, 1000, 1001, 1010, 1011, 1100, 1101, 1110 and 1111 and so on.

On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic for products, to describe what will be the projected characteristics of the final product made from a variable combination of components. Computer science also plays a role in the life sciences, by making it possible to process with a very often very

fine algorithm the masses of data that are presented there and to extract the essential information, it is the domain of bioinformatics. To illustrate, we may additionally supply and model various real-world problems encountered in computer science using the appropriate forms of graphs and trees, to provide an example the hierarchical organization of files, the representation of the topology of the networks, etc.

However, on the whole, the contrast is surprising between the very strong interaction of mathematics as science with other sciences, and the little relationship of their teaching with other scientific courses. We will first identify the main historical roots rooted in the classical scientific tradition.

I'll let you imagine what difficulties I may encounter. On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic for information processing surveys, statistical institutions, advertising resources, engineering consulting, etc. To illustrate, we may additionally supply computer science, mathematics, and mathematical logic for designing media information systems, for example, making typologies of customers.

Not the calculation that we will have learned but the way to understand the problems and solve them. Thus, the field of speech processing, using mathematical methods of signal processing, and appropriate statistical modeling and hidden Markov models compiled into stochastic automata. In addition, we refer to reports on vocational education and the estimation of mathematics programs for the vocational degrees, which may be too ambitious. On the other hand, to provide an example, we may also use computer science, mathematics, and mathematical logic for a concept of language. A cooking recipe, an algorithm to cross the street, can be executed and even transmitted without being written or verbalized.

This would avoid a juxtaposition of unrealistic texts. This is the question: What is the lower bound on the cost of any calculation algorithm that responds to a given problem? Note the problem  $P = NP$ , to provide an example.

The field of discrete randomness is approached nowadays mainly from complementary but not contradictory angles. Thus, the first applications are largely the result of digital analysis of differential systems. They also suggest that the best way to train future generations of high-performance computer scientists is to provide them with training adapted to the concepts, objects, and methods of computer science. Another way of approaching this problem is to extend the verification of programs, traditionally carried out by

a battery of tests, into a symbolic verification in a more abstract computing space-called model checking.

This notion of non-deterministic computation verifies remarkable properties, notably confluence, which expresses that the calculations converge into a single normal form. This is to ensure confidentiality and authenticity of communications on networks open to all. Finally, with the emergence of Big Data, data is becoming an essential commodity for many organizations and businesses.

To do this, engineering colleges remain the primary road. In the end, all we do in computing is math. It is interesting to note that these fundamental trends still constitute the basis of contemporary computing. It is a challenge to identify a set of general methods and to find what might be the analog of conservation laws in physics or the second principle of thermodynamics for computation.

On the other hand, the reduction of polynomial systems is related to contemporary algebraic geometry, the symbolic manipulation of many special functions of physics becomes possible thanks to the joint use of modern differential algebra and adapted data representations. Polynomial factorization is best done by methods that exploit both the structure of the finite fields and the principles of randomization.

Finally, I'll finish with a nuance: a computer language is a formal way of communicating with a machine, and is therefore essentially a mathematical tool as the machine is based on logical principles.

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