Introduction To Cryptography With Open Source Software Discrete Mathematics And Its Applications

Discrete mathematics

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Discrete mathematics is the study of mathematical structures that can be considered "discrete" (in a way analogous to discrete variables, having a one-to-one correspondence (bijection) with natural numbers), rather than "continuous" (analogously to continuous functions). Objects studied in discrete mathematics include integers, graphs, and statements in logic. By contrast, discrete mathematics excludes topics in "continuous mathematics" such as real numbers, calculus or Euclidean geometry. Discrete objects can often be enumerated by integers; more formally, discrete mathematics has been characterized as the branch of mathematics dealing with countable sets (finite sets or sets with the same cardinality as the natural numbers). However, there is no exact definition of the term "discrete mathematics...

Cryptography

Dwyer, John (2011). Discrete Mathematics for Cryptography. Algana Publishing. ISBN 978-1-907934-01-8. Becket, B (1988). Introduction to Cryptology. Blackwell

Cryptography, or cryptology (from Ancient Greek: κρυπτός, romanized: kryptós "hidden, secret"; and γράφειν graphein, "to

write", or -λογία -logia, "study", respectively), is the practice and study of techniques for secure communication in the presence of adversarial behavior. More generally, cryptography is about constructing and analyzing protocols that prevent third parties or the public from reading private messages. Modern cryptography exists at the intersection of the disciplines of mathematics, computer science, information security, electrical engineering, digital signal processing, physics, and others. Core concepts related to information security (data confidentiality, data integrity, authentication, and non-repudiation) are also central to cryptography. Practical applications of cryptography...

Mathematics

of mathematics that may be very old (e.g., arithmetic), especially with respect to transmission security, in cryptography and coding theory. Discrete mathematics

Mathematics is a field of study that discovers and organizes methods, theories and theorems that are developed and proved for the needs of empirical sciences and mathematics itself. There are many areas of mathematics, which include number theory (the study of numbers), algebra (the study of formulas and related structures), geometry (the study of shapes and spaces that contain them), analysis (the study of continuous changes), and set theory (presently used as a foundation for all mathematics).

Mathematics involves the description and manipulation of abstract objects that consist of either abstractions from nature or—in modern mathematics—purely abstract entities that are stipulated to have certain properties, called axioms. Mathematics uses pure reason to prove properties of objects, a proof...

Post-quantum cryptography

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Post-quantum cryptography (PQC), sometimes referred to as quantum-proof, quantum-safe, or quantum-resistant, is the development of cryptographic algorithms (usually public-key algorithms) that are currently thought to be secure against a cryptanalytic attack by a quantum computer. Most widely used public-key algorithms rely on the difficulty of one of three mathematical problems: the integer factorization problem, the discrete logarithm problem or the elliptic-curve discrete logarithm problem. All of these problems could be easily solved on a sufficiently powerful quantum computer running Shor's algorithm or possibly alternatives.

As of 2025, quantum computers lack the processing power to break widely used cryptographic algorithms; however, because of the length of time required for migration...

Theoretical computer science

authentication, and non-repudiation. Modern cryptography intersects the disciplines of mathematics, computer science, and electrical engineering. Applications of cryptography

Theoretical computer science is a subfield of computer science and mathematics that focuses on the abstract and mathematical foundations of computation.

It is difficult to circumscribe the theoretical areas precisely. The ACM's Special Interest Group on Algorithms and Computation Theory (SIGACT) provides the following description:

TCS covers a wide variety of topics including algorithms, data structures, computational complexity, parallel and distributed computation, probabilistic computation, quantum computation, automata theory, information theory, cryptography, program semantics and verification, algorithmic game theory, machine learning, computational biology, computational economics, computational geometry, and computational number theory and algebra. Work in this field is often distinguished...

Digital signature

from a sender known to the recipient. Digital signatures are a type of public-key cryptography, and are commonly used for software distribution, financial

A digital signature is a mathematical scheme for verifying the authenticity of digital messages or documents. A valid digital signature on a message gives a recipient confidence that the message came from a sender known to the recipient.

Digital signatures are a type of public-key cryptography, and are commonly used for software distribution,

financial transactions, contract management software, and in other cases where it is important to detect forgery or tampering.

A digital signature on a message or document is similar to a handwritten signature on paper, but it is not restricted to a physical medium like paper—any bitstring can be digitally signed—and while a handwritten signature on paper could be copied onto other paper in a forgery, a digital signature on a message is mathematically...

Quantum cryptography

electronic records for periods of up to 100 years. Also, quantum cryptography has useful applications for governments and militaries as, historically, governments

Quantum cryptography is the science of exploiting quantum mechanical properties such as quantum entanglement, measurement distrubance, and the principle of superposition to perform various cryptographic tasks. The best known example of quantum cryptography is quantum key distribution (QKD), which offers an information-theoretically secure solution to the key exchange problem. The advantage of quantum cryptography lies in the fact that it allows the completion

of various cryptographic tasks that are proven or conjectured to be impossible using only classical (i.e. non-quantum) communication. This advantage gives quantum cryptography significant practicality in today's digital age. For example, it is impossible to copy with perfect fidelity, the data encoded in a quantum state. If one attempts...

Glossary of computer science

Introduction to Algorithms (3rd ed.). MIT Press and McGraw-Hill. p. 39. ISBN 0-262-03384-4. Rowan Garnier; John Taylor (2009). Discrete Mathematics:

This glossary of computer science is a list of definitions of terms and concepts used in computer science, its sub-disciplines, and related fields, including terms relevant to software, data science, and computer programming.

Discrete cosine transform

"Fast and numerically stable algorithms for discrete cosine transforms". Linear Algebra and Its Applications. 394 (1): 309–345. doi:10.1016/j.laa.2004.07

A discrete cosine transform (DCT) expresses a finite sequence of data points in terms of a sum of cosine functions oscillating at different frequencies. The DCT, first proposed by Nasir Ahmed in 1972, is a widely used transformation technique in signal processing and data compression. It is used in most digital media, including digital images (such as JPEG and HEIF), digital video (such as MPEG and H.26x), digital audio (such as Dolby Digital, MP3 and AAC), digital television (such as SDTV, HDTV and VOD), digital radio (such as AAC+ and DAB+), and speech coding (such as AAC-LD, Siren and Opus). DCTs are also important to numerous other applications in science and engineering, such as digital signal processing, telecommunication devices, reducing network bandwidth usage, and spectral methods...

Philosophy of mathematics

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Philosophy of mathematics is the branch of philosophy that deals with the nature of mathematics and its relationship to other areas of philosophy, particularly epistemology and metaphysics. Central questions posed include whether or not mathematical objects are purely abstract entities or are in some way concrete, and in what the relationship such objects have with physical reality consists.

Major themes that are dealt with in philosophy of mathematics include:

Reality: The question is whether mathematics is a pure product of human mind or whether it has some reality by itself.

Logic and rigor

Relationship with physical reality

Relationship with science

Relationship with applications

Mathematical truth

Nature as human activity (science, art, game, or all together)

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