Discrete Mathematics – Toán Rời Rạc

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Tóm tắt nội dung

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3.1 Wikipedia/discrete mathematics

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

Set of objects studied in discrete mathematics can be finite or infinite. Term *finite mathematics* is sometimes applied to parts of field of discrete mathematics that deals with finite sets, particularly those areas relevant to business.

Graphs e.g. these are among objects studied by discrete mathematics, for their interesting mathematical properties, their usefulness as models of real-world problems, & their importance in developing computer algorithms.

Research in discrete mathematics increased in latter half of 20th century partly due to development of digital computers which operate in "discrete" steps & store data in "discrete" bits. Concepts & notations from discrete mathematics are useful in studying & describing objects & problems in branches of computer science, e.g. computer algorithms, programming languages, cryptography, automated theorem proving, & software development. Conversely, computer implementations are significant in applying ideas from discrete mathematics to real-world problems.

Although main objects of study in discrete mathematics are discrete objects, analytic methods from "continuous" mathematics are often employed as well.

In university curricula, discrete mathematics are discrete objects, analytic methods from "continuous" mathematics are often employed as well.

In university curricula, discrete mathematics appeared in 1980s, initially as a computer science support course; its contents were somewhat haphazard at time. Curriculum has thereafter developed in conjunction with efforts by ACM & MAA into a course that is basically intended to develop mathematical maturity in 1st-year students; therefore, it is nowadays a prerequisite

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for mathematics majors in some universities as well. Some high-school-level discrete mathematics textbooks have appeared as well. At this level, discrete mathematics is sometimes seen as a preparatory course, like precalculus in this respect.

Fulkerson Prize is awarded for outstanding papers in discrete mathematics.

3.1.1 Topics

1. Theoretical computer science.
2. Information theory.
3. Logic.
4. Set theory.
5. Combinatorics.
6. Graph theory.
7. Number theory.
8. Algebraic structures.
9. Discrete analogues of continuous mathematics.
   - Calculus of finite differences, discrete analysis.
   - Discrete geometry.
   - Discrete modeling.

3.1.2 Challenges

Much research in graph theory was motivated by attempts to prove: all maps can be colored using only 4 colors so that no areas of same color share an edge. KENNETH APPEL & WOLFGANG HAKEN proved this in 1976.

History of discrete mathematics has involved a number of challenging problems which have focused attention within areas of field. In graph theory, much research was motivated by attempts to prove 4 color theorem, 1st stated in 1852, but not proved until 1976 (by KENNETH APPEL & WOLFGANG HAKEN, using substantial computer assistance).

In logic, 2nd problem on DAVID HILBERT's list of open problems presented in 1900 was to prove: $\boxed{\text{axioms of arithmetic are consistent}}$. Gödel's 2nd incompleteness theorem, proved in 1931, showed: this was not possible – at least not within arithmetic itself. Hilbert's 10th problem was to determine whether a given polynomial Diophantine equation with integer coefficients has an integer solution. In 1970, YURI MATIYASEVICH proved: this could not be done.

Need to break German codes in World War II led to advances in cryptography & theoretical computer science, with 1st programmable digital electronic computer being developed at England's Bletchley Park with guidance of ALAN TURING & his seminal work, *On Computable Numbers*. Cold War meant: cryptography remained important, with fundamental advances e.g. public-key cryptography being developed in following decades. Telecommunication industry has also motivated advances in discrete mathematics, particularly in graph theory & information theory. Formal verification of statements in logic has been necessary for software development of safety-critical systems, & advances in automated theorem proving have been driven by this need.

Computational geometry has been an important part of computer graphics incorporated into modern video games & computer-aiddd design tools.

Several fields of discrete mathematics, particularly theoretical computer science, graph theory, & combinatorics, are important in addressing challenging bioinformatics problems associated with understanding tree of life.

Currently, 1 of most famous open problems in theoretical science is P = NP problem, which involves relationship between complexity classes P & NP. Clay Mathematics Institute has offered a $1 million USD prize for 1st correct proof, along with prizes for 6 other mathematical problems." – Wikipedia/discrete mathematics