

SOICT

Discrete Mathematics

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Discrete Mathematics

Discrete Mathematics deals with

- “Separated” or discrete sets of objects
(rather than continuous sets)
- Processes with a sequence of
individual steps
(rather than continuously changing processes)

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Kind of problems solved by discrete mathematics

- How many ways are there to choose a computer password?
- What is the probability of winning a lottery?
- Is there a link between two users in a social network?
- What is the shortest path between two cities using a transportation system?
- How can a list of integers sorted in increasing order? How many steps are required to do such a sorting?

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Importance of Discrete Mathematics

- Information is stored and manipulated by computers in a discrete fashion
- Applications in many different areas
- Discrete mathematics is a gateway to more advanced courses
- Develops mathematical reasoning skills
- Emphasizes the new role of mathematics

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The new role of Mathematics

- Make the computer to solve the problem for you
- Modeling (vs. calculations)
- Using logic
 - to choose the right model
 - to write a correct computer program
 - to justify answers
- Efficiency
 - make the computer to solve the problem fast
 - choose the more efficient model

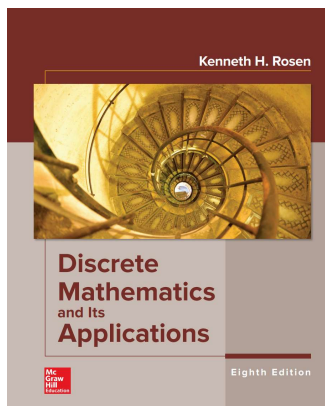
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Goals of this course

- Study of standard facts of discrete mathematics
- Development of mathematical reasoning skills (emphasis on modeling, logic, efficiency)
- Discussion of applications

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Text book



Rosen K.H. *Discrete Mathematics and its Applications (8th Editions)*. McGraw - Hill Book Company, 2019.

Use lecture notes as study guide.

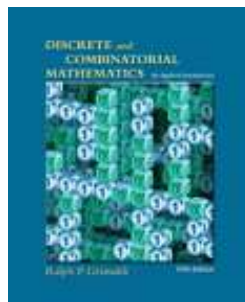
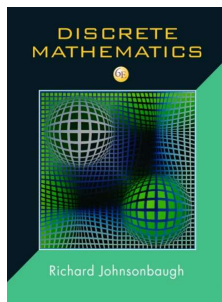
Text book

**Nguyễn Đức Nghĩa,
Nguyễn Tô Thành**
TOÁN RỜI RẠC
(in lần thứ ba)
Nhà xuất bản Đại học
Quốc gia Hà nội, 2003,
290 trang



References

1. **Johnsonbaugh R.** *Discrete Mathematics*. Prentice Hall Inc., N. J., 1997.
2. **Grimaldi R.P.** *Discrete and Combinatorial Mathematics (an Applied Introduction)*, Addison-Wesley, 5th edition, 2004.
3. **R. Graham, O. Patashnik, and D.E. Knuth.** *Concrete Mathematics*, Second Edition. Addison-Wesley, 1994.



References

4. **Nguyễn Hữu Anh.** *Toán rời rạc*, NXB Giáo dục, 1999.
5. **Nguyễn Xuân Quỳnh.** *Cơ sở Toán rời rạc và ứng dụng*. NXB KHKT, Hà nội, 1996.
6. **Đỗ Đức Giáo.** *Toán rời rạc*. NXB KHKT, Hà nội, 2001.

PART 1

COMBINATORIAL THEORY

(Lý thuyết tổ hợp)

PART 2

GRAPH THEORY

Contents of Part 1: Combinatorial Theory

Chapter 1. Counting problem

- This is the problem aiming to answer the question: “How many ways are there that satisfy given conditions?” The counting method is usually based on some basic principles and some results to count simple configurations .
- Counting problems are effectively applied to evaluation tasks such as calculating the probability of an event, calculating the complexity of an algorithm (how long the algorithm will take to run),



Street art

Given N paintings in a row over a distance of M centimeters. Each painting i ($1 \leq i \leq N$) will be drawn on a length of t_i cm, so $t_1 + t_2 + \dots + t_n = M$. The K city's most famous artists have been selected to do this work, each artist will be assigned to draw at least one painting. To facilitate the artist's work, if someone is assigned to draw more than one painting, the paintings must be adjacent to each other on the street art

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Chapter 2. Existence problem

In the counting problem, configuration existence is obvious; in the existence problem, we need to answer the question: "Is there a combinatorial configuration that satisfies given properties ?"

Chapter 3. Enumeration problem

This problem is interested in giving all the configurations that satisfy given conditions.

Chapter 4. Combinatorial optimization problem

- Unlike the enumeration problem, this problem only concerns the "best" configuration in a certain sense.
- In the optimization problems, each configuration is assigned a numerical value (which is the use value or the cost to construction the configuration), and the problem is that among the configurations that satisfy the given conditions, find the configuration with the maximum or minimum value assigned to it

Contents of Part 2: Graph Theory

Chapter 1. Fundamental concepts

- Basic definition on graph: type, path, cycle, connectedness..

Chapter 2. Graph representation

- How to represent graph on computer

Chapter 3. Graph Traversal

- BFS, DFS algorithms and their applications

Chapter 4. Tree and Spanning tree

- PRIM, KRUSKAL algorithms to find minimum spanning tree

Chapter 5. Shortest path problem

- Some basic algorithms to find shortest path on graph: Dijkstra, Bellman-Ford, Floyd-Warshall

Chapter 6. Maximum flow problem

- Ford-Fulkerson to find maximum flow on the network