

Discrete Mathematics for Computer Science

Toán Rời Rạc Cho Khoa Học Máy Tính

Nguyễn Quản Bá Hồng

Presented at University of Management & Technology of HCMC (UMT)

Ngày 28 tháng 12 năm 2024

Table of Contents

1 Introduction to Discrete Mathematics

2 Applications of Discrete Mathematics

What is Discrete Mathematics?

Definition (Discrete mathematics)

Discrete mathematics: study of countable, distinct, or separate mathematical structures.

Old nickname: Finite Mathematics, to distinguished with “Continuous Mathematics”, including e.g., Calculus, Mathematical Analysis.

Example (Pixel)

Phones, computer monitors, televisions, modern screens, & Disney cartoons, animated films for kids & for adults, e.g., Rick & Morty.

Some Critical Thinking Questions

Targets. Typical super-lazy unmotivated undergraduate/graduate students majored in Natural Science.

Some purpose-driven questions

- *Why do undergraduate or graduate students need to learn mathematics?*
- *Which type of mathematics do undergraduate or graduate students need to learn?*
- *Why do CS-major students need to study Discrete Mathematics?*

Motivations

- Learn Discrete Mathematics just for fun, for entertaining yourself.

Example (*Good Will Hunting* (1997))

WILL HUNTING learned History, Sociology, Psychology Ψ , Advanced Mathematics, Combinatorial Discrete Mathematics to flirt hot girls in bars, & even Advanced Organic Chemistry for fun & to help her girlfriend.

- Learn enough Discrete Mathematics to understand different branches of Computer Science.

Main Goal: Focus strongly on writing programs, developing software, & building useful applications.

- If looking for research-oriented jobs, especially Theoretical Computer Science, then need to learn Discrete Mathematics much harder.

Main Goal: Build some new useful theories, then find their theoretical- or practical real-world applications.



Combinatorics using SciPy

Problem (Permutation, arrangement, combination)

Given $n, k \in \mathbb{N}^$, $k \leq n$. Use Pascal/Python/C/C++ to compute the numbers of permutations P_n , of arrangements A_n^k , of combinations C_n^k .*

Solution.

$P_n = n!$, $A_n^k = \frac{n!}{(n-k)!}$, $C_n^k = \frac{n!}{k!(n-k)!}$. Run `combinatorics.py`. □

Problem (Pascal triangle)

Given $n \in \mathbb{N}^$. Use Pascal/Python/C/C++ to print the 1st $n + 1$ lines of the Pascal triangle.*

[GKP89] RONALD L. GRAHAM, DONALD ERWIN KNUTH, OREN PATASHMIK. *Concrete Mathematics: A Foundation for Computer Science*. 2e.

[WR21] RYAN T. WHITE, ARCHANA TIKAYAT RAY. *Practical Discrete Mathematics: Discover math principles that fuel algorithms for computer science & machine learning with Python*.