Lecture Note: Discrete Mathematics for Computer Science
Bài Giảng: Toán Rời Rạc Cho Khoa Học Máy Tính

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Tóm tắt nội dung

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  TEX: URL: https://github.com/NQBH/advanced_STEM_beyond/blob/main/discrete_mathematics/lecture/NQBH_discrete_mathematics_lecture.tex.

Slide:

- *Discrete Mathematics for Computer Science – Toán Rời Rạc Cho Khoa Học Máy Tính.*
  PDF: URL: https://github.com/NQBH/advanced_STEM_beyond/blob/main/discrete_mathematics/slide/NQBH_discrete_mathematics_slide.pdf.
  TEX: URL: https://github.com/NQBH/advanced_STEM_beyond/blob/main/discrete_mathematics/slide/NQBH_discrete_mathematics_slide.tex.

Mục lục

1 Basic

2 Combinatorics – Tổ Hợp

2.1 Combinatorics using SciPy

Problem 1 (Permutation, arrangement, combination)**.** *Given $n, k \in \mathbb{N}^\star$, $k \leq n$. Write* Pascal/Python/C/C++ *programs 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 2 (Pascal triangle & Newton binomial expansion)**.** *Given $m, n \in \mathbb{N}^\star$. Write* Pascal/Python/C/C++ *programs to print the 1st $n+1$ lines of the Pascal triangle & Newton binomial expansion of $(a+b)^n, (a+b+c)^n, \left(\sum_{i=1}^m a_i\right)^n$, $\forall a, b, c, a_i \in \mathbb{R}$, $\forall i = 1, \ldots, m$.*

Problem 3 (Count number of lines formed by some points)**.** *Write* Pascal/Python/C/C++ *programs to count the number of lines formed by $n \in \mathbb{N}^\star$ distinguished points in (2D) plane.*

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Hint. There are

$$C_n^2 - \sum_{i=1}^{m} C_{a_i}^2 + m = \frac{n(n-1)}{2} - \sum_{i=1}^{m} \frac{a_i(a_i-1)}{2} + m \tag{1}$$

lines, where n given points is partitioned into exactly $m \in \mathbb{N}$ disjoint subsets A_i of collinear points, where $a_i \coloneqq |A_i| = \operatorname{card} A_i$, $\forall i = 1, \ldots, m$.

Problem 4 (Count number of intersections formed by some lines)**.** *Write* Pascal/Python/C/C++ *programs to count the number of intersections of $n \in \mathbb{N}^\star$ distinguished lines in (2D) plane.*

Hint. Nếu trong n đường thẳng đã cho có đúng $m \in \mathbb{N}$ bộ lần lượt gồm $a_1, \ldots, a_m$ đường thẳng song song đôi một & $k \in \mathbb{N}$ bộ lần lượt gồm $b_1, \ldots, b_k$ đường thẳng đồng quy thì số giao điểm:

$$C_n^2 - \sum_{i=1}^{m} C_{a_i}^2 - \sum_{i=1}^{m} C_{b_i}^2 + k = \frac{n(n-1)}{2} - \sum_{i=1}^{m} \frac{a_i(a_i-1)}{2} - \sum_{i=1}^{k} \frac{b_i(b_i-1)}{2} + k \tag{2}$$

3 Graph Theory – Lý Thuyết Đồ Thị

4 Number Theory – Số Học/Lý Thuyết Số

5 Miscellaneous