Discrete Mathematics for Computer Science
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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

Will Hunting learned History, Sociology, Psychology Ψ, & even Advanced Organic Chemistry for fun & for flirting girls in Good Will Hunting (1997).

- Learn enough Discrete Mathematics to understand different branches of Computer Science.
  Main Goal: Focus strongly on writing programs, develop software, & build 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 applications.

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Combinatorics using SciPy

Problem (Permutation, arrangement, combination)

Given $n, k \in \mathbb{N}^\star$, $k \leq n$. 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`. $\square$

Problem (Pascal triangle)

Given $n \in \mathbb{N}^\star$. 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*.