Discrete Mathematics

Computational Thinking

1. Formulate the Question in English.
2. Determine the Problem you need to Solve.
3. List all the pertinent Parameters.
4. Build a Mathematical Model -- Formulas, Equations, . . .
5. Construct an Algorithm to Solve the Problem.
6. Develop Data Structures and Code to Implement Algorithm.

Computational Thinking

1. Formulate the Question in English.
2. Determine the Problem you need to Solve.
3. List all the pertinent Parameters.
4. Build a Mathematical Model -- Formulas, Equations, . . .
5. Construct an Algorithm to Solve the Problem.
6. Develop Data Structures and Code to Implement Algorithm.

WHAT'S MISSING?

WHAT'S MISSING?

4. *Build a Mathematical Model*
    - Standard Mathematical Methods?

5. *Construct an Algorithm*
    - Standard Algorithms?
    - Proofs of Correctness?

6. *Develop Data Structures*
    - Standard Data Structures?

Mathematical Tools of the Trade

Mathematical Methods

- Combinatorics and Probability
- Functions, Sets, Relations, . . .

Proof Techniques

- Induction and Logic

Algorithms

- Shortest Path Algorithms
- Searching and Sorting Algorithms

Theorems

- Binomial Theorem

Data Structures

- Graphs and Trees

Discrete Math vs. Continuous Math

Discrete	*Continuous*
N or **Z**	**R** or **C**
Counting	Limiting
Sequences (Discrete Functions)	Continuous Functions
Sums	Integrals
Differences	Derivatives

Discrete Math vs. Continuous Math (continued)

Discrete	*Continuous*
Number Theory*	Calculus
Digital	Analog

* Other Topics -- logic, proofs, recursion, induction, combinatorics, probability, sets, functions, relations, regular languages, finite automata,...

Why Discrete Mathematics in Computer Science

- Digital Computers
- Discrete Data Structure
  -- Lists, Trees, Graphs, Sets, ...
- Discrete Programs
- Mathematical Tools of the Trade
  -- Not just Programming Languages
  -- Data Structures
  -- Mathematical Methods -- logic, recursion, relations, combinatorics, probability
  -- Algorithms and their Correctness

Motivation for Discrete Mathematics

Many, Many Applications

Fundamental Data Structures

Neat Algorithms

Engaging Theory

Novel Mathematics