Lesson 1.1

DISCRETE MATHEMATICS
Knowledge has Organizing Power

Wholeness of the lecture: Knowledge of discrete structures like sets, graphs, matrices, trees, algorithms, sequences, functions, and relations gives us organizing power that can solve problems of sorting, searching, counting, and optimizing. Knowledge has organizing power; knowledge is for action, achievement, and fulfillment. *Science and Technology of Consciousness:* Our practice of the Transcendental Meditation technique enlivens the pure knowledge inherent within our consciousness.

Main Points

1. To solve a real-world problem, formulate it as a mathematical problem, solve the mathematical problem, and translate the solution into the terms of the real-world problem. Go from the surface level of the problem to a deeper, more abstract level of the problem where there is greater organizing power. *Science and Technology of Consciousness:* In the Transcendental Meditation technique, we experience the deepest level of our mind, our own pure consciousness, and enliven our own infinite organizing power.
2. Many problems involve objects and how they are related to each other. Graphs model such problems using vertices (objects) and edges (relationships). Since graphs are abstract, they help us model and solve many different types of problems. *Science and Technology of Consciousness:* Regular practice of the Transcendental Meditation technique develops problem-solving abilities.[1]

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Connecting The Parts Of Knowledge With The Wholeness Of Knowledge

Solving Finite Problems

1. There are many real-world problems like sorting, searching, counting, and optimizing that are finite or discrete in their nature.
2. Discrete mathematics gives us universal mathematical techniques to solve discrete problems.

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3. **Transcendental Consciousness** is an infinite field of all possibilities.
4. **Impulses within the transcendental field** structure the finite isolated parts of creation.
5. **Wholeness moving within itself:** In Unity Consciousness, we find the solutions to all finite problems in the infinite unboundedness of our own Self.

[1] Dillbeck, M.C. Meditation and flexibility of visual perception and verbal problem-solving. *Memory & Cognition* 10(3): 207–215, 1982.

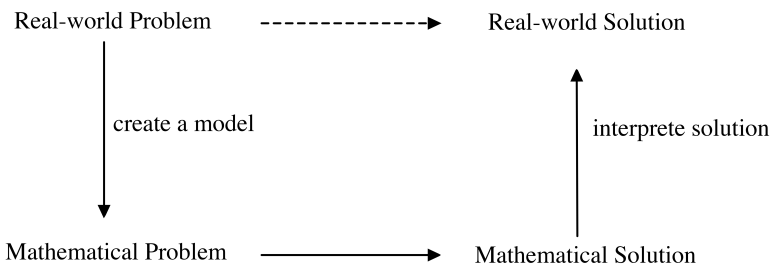

Figure 1: Solving a real-world problem with a mathematical model

When presented with a problem, we can ask many questions:

1. Does the problem have a solution? (Existence)
2. What information do you need to solve the problem?
3. What are the steps of solving the problem?
4. What will a correct answer look like? For example, the answer might be a number, a cost, a list of names, or a sequence of cities.
5. How many solutions are there? (Counting)
6. Of all possible solutions, which is the best (optimal)? (Optimization)
7. What characteristics will an optimal solution have?
8. Will a computer be useful to solve this problem?
9. Will a computer solution be different from a paper-and-pencil solution?
10. Are there other types of problems that are like this and for which you could use your method of solution?

Some Problems in Discrete Mathematics

Each group or pair gets one type of problem to analyze. The questions given above may help you. You may use your book, the Internet, or any other resources.

Traveling Salesperson	A salesperson must visit each city on a given map. You know how much it costs to travel between any two pair of cities. What is the cheapest route for the salesperson?
Shortest Path	Find the shortest path from one vertex to another through a network.
Optimal Search	Find the largest number in a sequence of integers.
Location Search	Find the location of a given number in a given sequence of numbers.
Sorting	Sort alphabetically the names of all of the students in this class.
Database Structure	You have a large quantity of data. Each piece of data has many attributes. How do you organize the database to make it readily accessible and useful?
Algorithm Analysis	Analyze a given algorithm to see if it correctly solves a problem and to see how long it will take to solve the problem.

Matching Problem	You are given students and internship openings; each student has ranked the openings and each company has ranked the students. How do you match students with internships so that there is the greatest satisfaction among students and companies?
Locating Stores	You want to locate ten stores in a given region. A store's territory is the area that is closer to that store than any other store. Where should you put the stores so that all territories have equal area? What if there are already nine stores in a region and you want to add a tenth store; where can you put it to maximize its territory?
Knapsack Problem	You have items of different weights totaling 30 pounds and you have given them numerical utility ratings. You can pack 20 pounds into your backpack. How can you choose what to pack so that you have the highest total utility?
Linear Programming	A company has certain quantities of several resources and products that can be made from those resources. You know how much of each resource is used for each product and the profit obtained from each product. How can the determine a production schedule that maximizes profits?
Data Compression	How can you send a message efficiently? Efficiently can mean using the least number of bits or the least time.
Error-Correcting Codes	How can you send a message correctly?
Cryptography	How can you send a message privately?

Topics to be Covered in this Course

- Graph Theory
- Trees
- Algorithms
- Induction
- Recursion
- Combinatorics (Counting Techniques)
- Logic
- Set Theory
- Functions and Relations
- Boolean Algebra

Tools for Solving Problems in Discrete Mathematics

The methods that we use for solving problems in discrete mathematics reflect the principles of nature's functioning that we study in the Science and Technology of Consciousness.

Greedy Algorithms	Greedy algorithms are used for optimization problems, where some quantity is to be made as large or as small as possible. Make the best possible choice

	(largest or smallest) first, then the next possible choice, and so on. This is like the principle of the highest first.
Brute Force	Brute force is also used for optimization problems; you just list all possible feasible solutions to the problem and choose the best of them. This method demonstrates the principle of operating from the field of all possibilities.
Divide and Conquer	Take a large problem, break it up into smaller problems which are easier to solve. Then take the smaller solutions and build a solution to the large problem. This is based on the principle that the whole is contained in every part.
Recursion	Some problems can be solved by doing the same thing over and over again. This is similar to how consciousness creates, curving back on the self again and again, through self-referral.
Database Structure	You have a large quantity of data. Each piece of data has many attributes. How do you organize the database to make it useful? You must use your knowledge about the nature of the data to organize the database.
Algorithms	An algorithm is a systematic procedure for solving all problems of a certain type. An algorithm is a technique for successful action.
Graph Theory	Graph theory uses principles describing the relationships between objects to solve problems. The knowledge of how objects are related structures a graph that can be used to study the objects and their relationships.
Creative Intelligence	The greatest tool in problem solving is your own creative intelligence, which is developed by transcending from the level of thoughts to the level of pure creative intelligence, the source of thought.

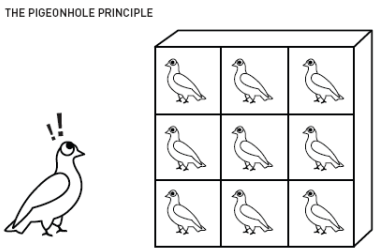

Figure 2: The Pigeonhole Principle—there are more pigeons than slots!