CIS 275
Discrete Structure I

Introduction

Instructor: Prof. Sana Neji

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Contact

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- **Course Meeting Times:** Find in the syllabus on Canvas.

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What is CIS 275 about?

- This course introduces students to various topics in **discrete mathematics**, such as:
  - **set theory, mathematical logic, trees, and graph theory.**
  - **Applications to relational databases, modeling reactive systems and program verification** are also discussed.

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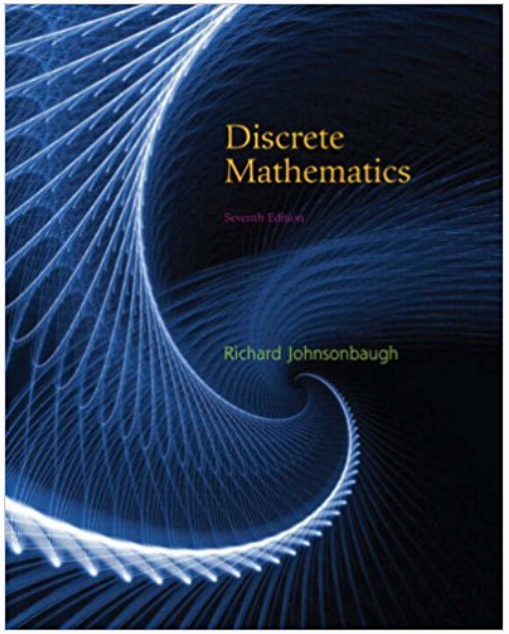
Reference

- Richard Johnsonbaugh, **Discrete Mathematics,** *7th edition*
  - *Not required – Everything are in the slides and Canvas*



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Assessment

- **QUIZZES** (around 7 per semester): 20%
- **Homework** (around 3 assignments): 20%
- **Mid-term Exam**: 30% (2 hours)
- **Final Exam**: 30% (2 hours)

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Grade Scale

- A+ >= 95,
- A >= 92,
- A- >= 90,
- B+ >= 85,
- B >= 82,
- B- >= 80,
- C+ >= 75,
- C >= 72,
- C- >= 70,
- D+ >= 65,
- D > 62,
- D>= 60,
- E<=59.

Chapters

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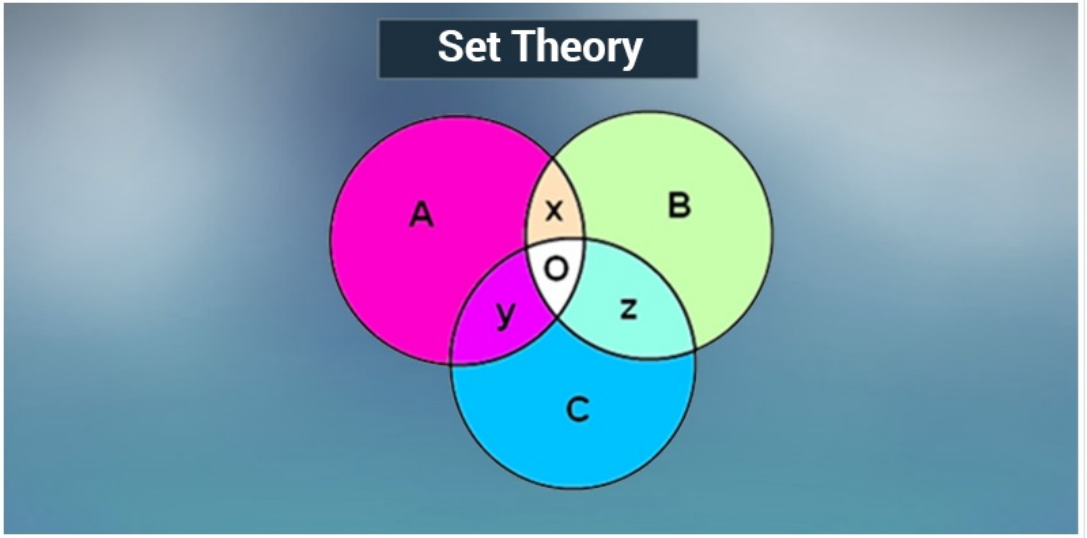
Chapter 1: Sets

- **Set theory** forms the basis of several other fields of study like counting theory, relations, graph theory and finite state machines. In this chapter, we will cover the different aspects of Set Theory.

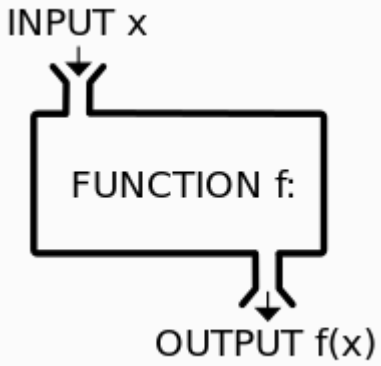


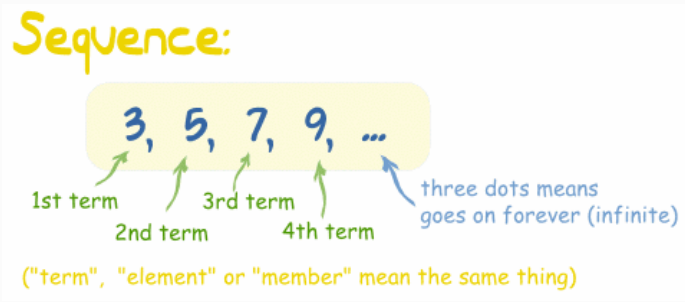
Chapter 2: Mathematical Induction

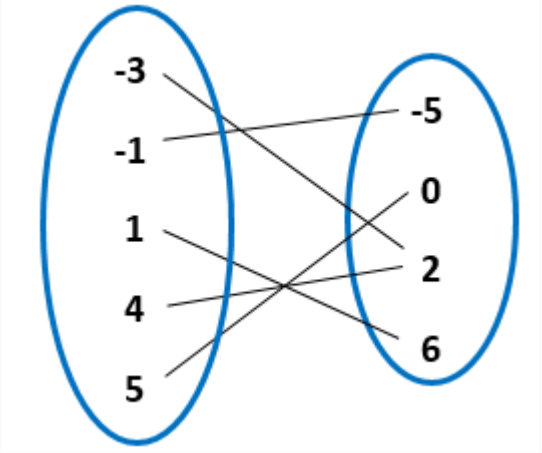
- **Mathematical Induction** is a mathematical technique which is used to prove a statement, a formula or a theorem is true for every natural number.

Chapter 3: Functions, sequences and relations

- A **function** or mapping is a relationship from elements of one set X to elements of another set Y.
- A **Sequence** is a list of numbers in order.
- **Relations** may exist between objects of the same set or between objects of two or more sets.





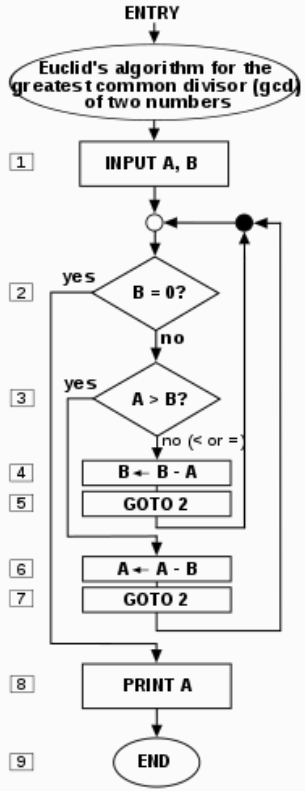


Chapter 4: Algorithms

- An **algorithm** is a finite set of precise instructions for performing a computation or for solving a problem.

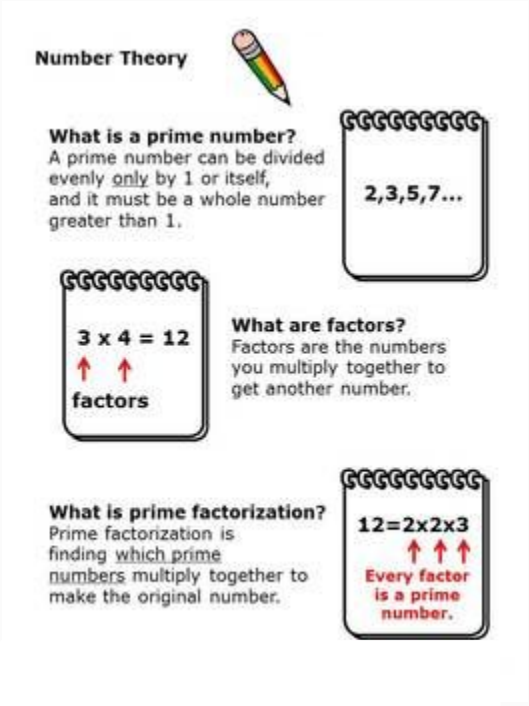
ALGORITHM 3 Multiplication of Integers.

procedure *multiply*(a, b: positive integers)
{the binary expansions of a and b are $(a_{n-1}a_{n-2}\ldots a_1a_0)_2$ and $(b_{n-1}b_{n-2}\ldots b_1b_0)_2$, respectively}
for $j := 0$ **to** $n-1$
  if $b_j = 1$ **then** $c_j := a$ shifted j places
  else $c_j := 0$
{$c_0, c_1, \ldots, c_{n-1}$ are the partial products}
$p := 0$
for $j := 0$ **to** $n-1$
  $p := p + c_j$
return p {p is the value of ab}



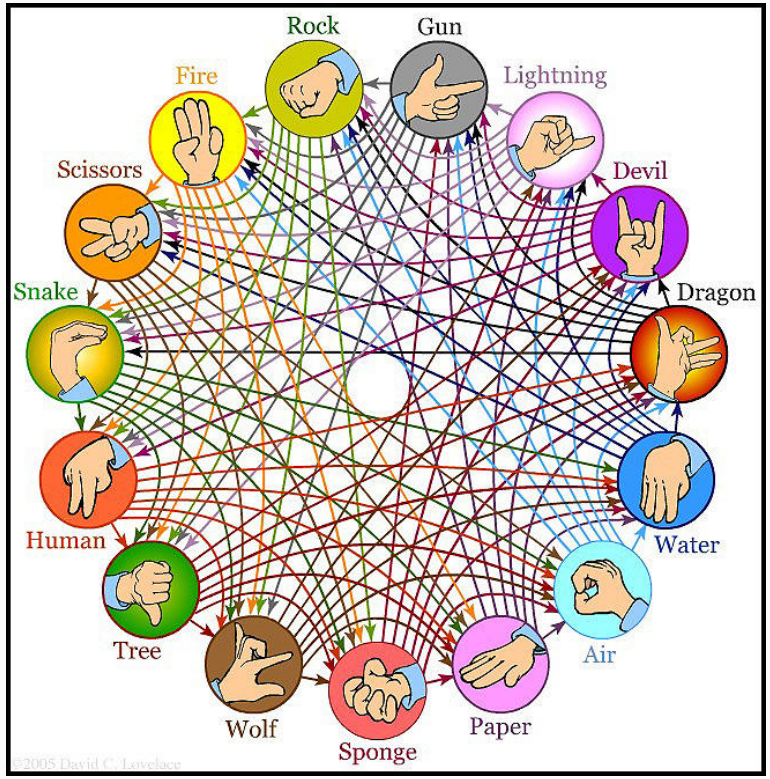
Chapter 5: Introduction to Number Theory

- Number Theory, the study of the integers, is one of the oldest and richest branches of mathematics.
- Its basic concepts are:
  - divisibility,
  - prime numbers,
  - integer solutions to equations,
  - …



Chapter 6: Counting Methods

- Help to find out the number of all possible outcomes for a series of events.
- **Counting Theory** mainly encompasses
  - Fundamental counting rule
  - The Rules of Sum and Product
  - Permutations
  - Combinations
  - The Inclusion-Exclusion principle



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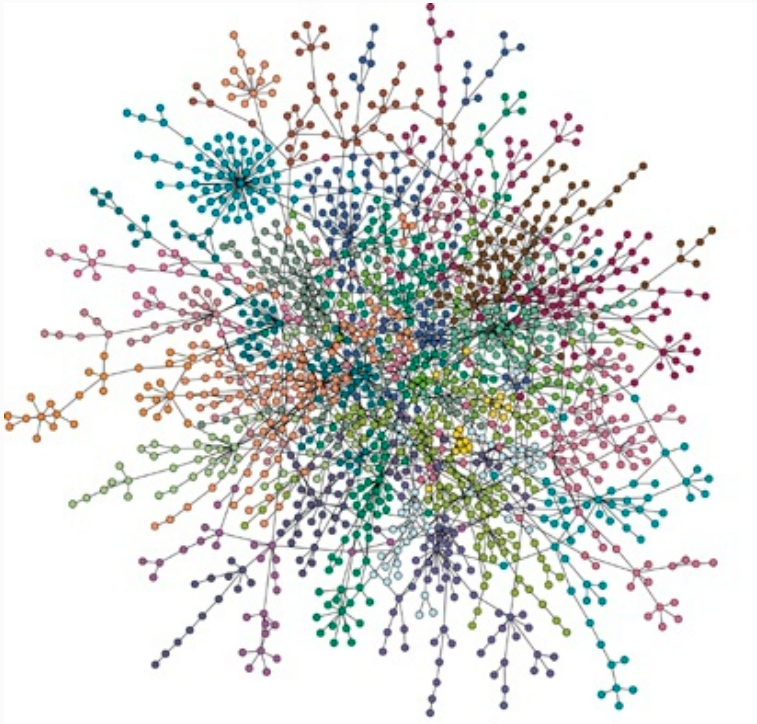
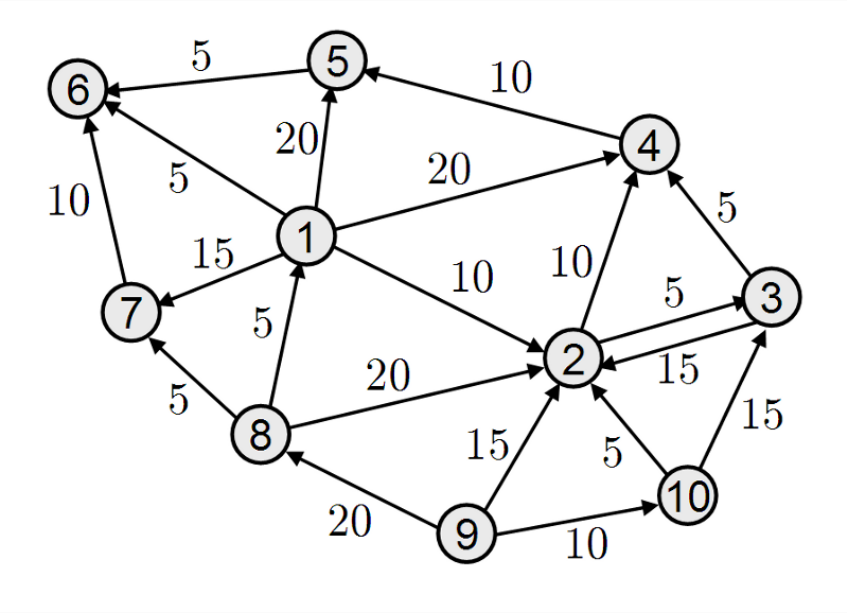
Chapter 7: Recurrence Relations

- A **recurrence** relation is an equation that recursively defines a sequence where the next term is a function of the previous terms.
  - Linear Recurrence
  - Non-Homogeneous Recurrence
  - Generating Functions

Chapter 8: Graph Theory

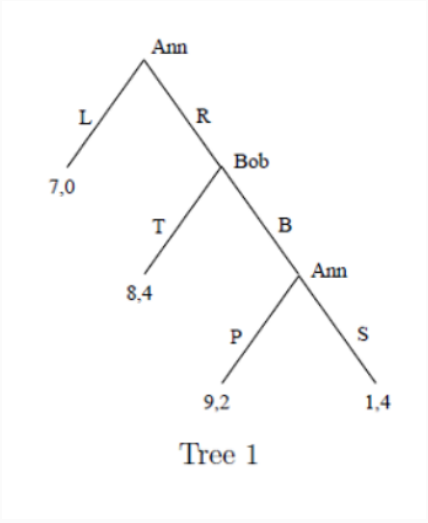
- A **Graph** consists of a non-empty set of vertices or nodes V and a set of edges E.



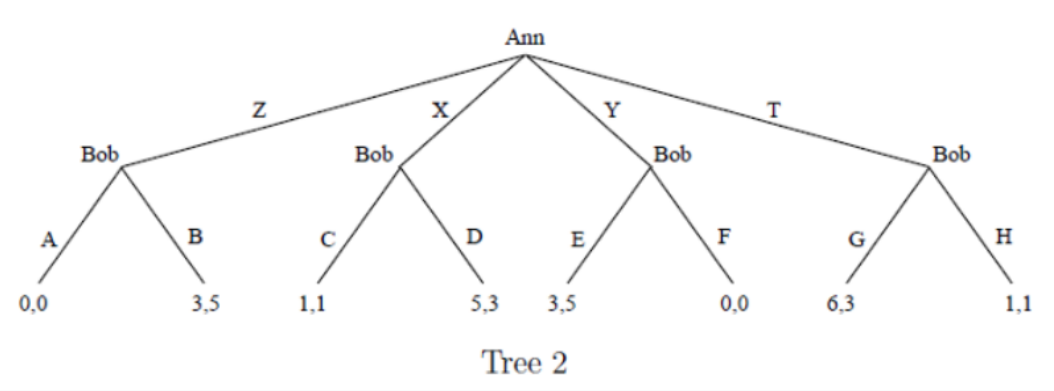


Chapter 9: Trees

- **Tree** is a discrete structure that represents hierarchical relationships between individual elements or nodes. A Tree is a connected acyclic undirected graph.



Tree 1



Tree 2

Chapter 10: Boolean Algebra

- **Boolean algebra** is algebra of logic. It deals with variables that can have two discrete values, 0 (False) and 1 (True).
  - Functions
  - Expressions
  - Identities