Izmir Institute of Technology

CENG 115

Discrete Structures

Slides are based on the Textbook
***Discrete Mathematics & Its Applications* (6th Edition)**
by Kenneth H. Rosen

Module #0:
Course Overview

Course Info

Instructor: Yalın Baştanlar
(Computer Eng. Dept.)

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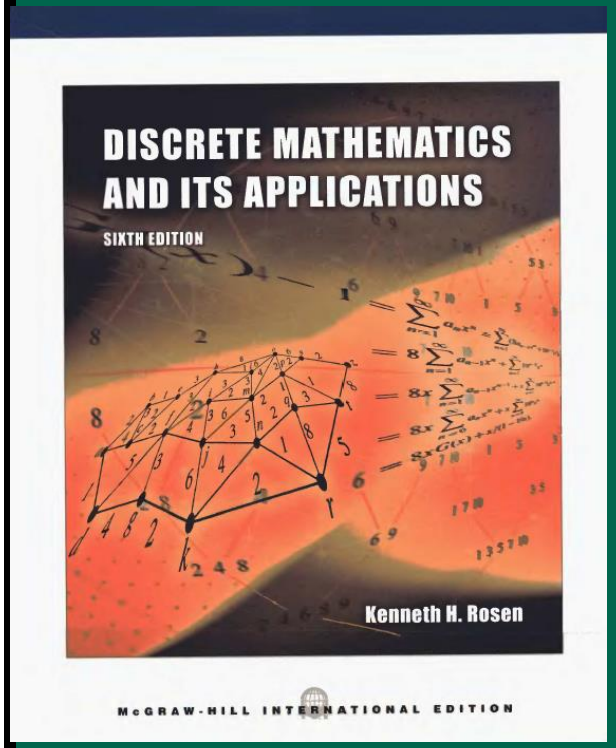
Textbook: Kenneth H. Rosen. Discrete Mathematics and Its Applications. 6th Ed. 2007.

Slides and homework assignments will be available on MS-Teams (Team name: CENG115 Fall 2023 Section-A)



Course Info

Grading: Un-announced quizzes (~10%), homeworks (~15%). One mid-term exam (~35%), one final exam (~40%).

Assistants: Didem Genç, Yağız Nalçakan, Burak Korcuklu

Lectures: Every Thursday 9:45.

Recitation hours: 2-3 times during the semester.

Cheating: You're expected to solve the questions in the quizzes, homeworks and exams individually.

So, what's this class about?

What are "discrete structures" anyway?

- "***Discrete***" (≠ "discreet"!) - Composed of distinct, separable parts. (Opposite of *continuous*.)

  Think that an analog signal is continuous but a digital signal (*e.g.* 1 0 1 1 0 1) *is discrete.*

- "***Structures***" - objects built up from simpler objects according to a definite pattern.
- "***Discrete Mathematics***" - The study of discrete, mathematical objects and structures.

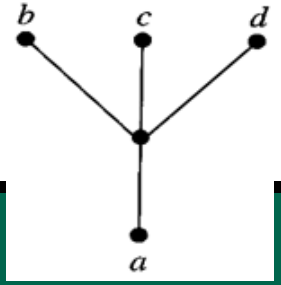
What is Mathematics?

- Mathematics is not necessarily about numbers!
- Mathematics deals with

  - entities that are defined precisely, so that there can be no misunderstanding about what is meant.

  - rules to manipulate and interpret those entities.
- Entities can be symbols, patterns, numbers *etc*.

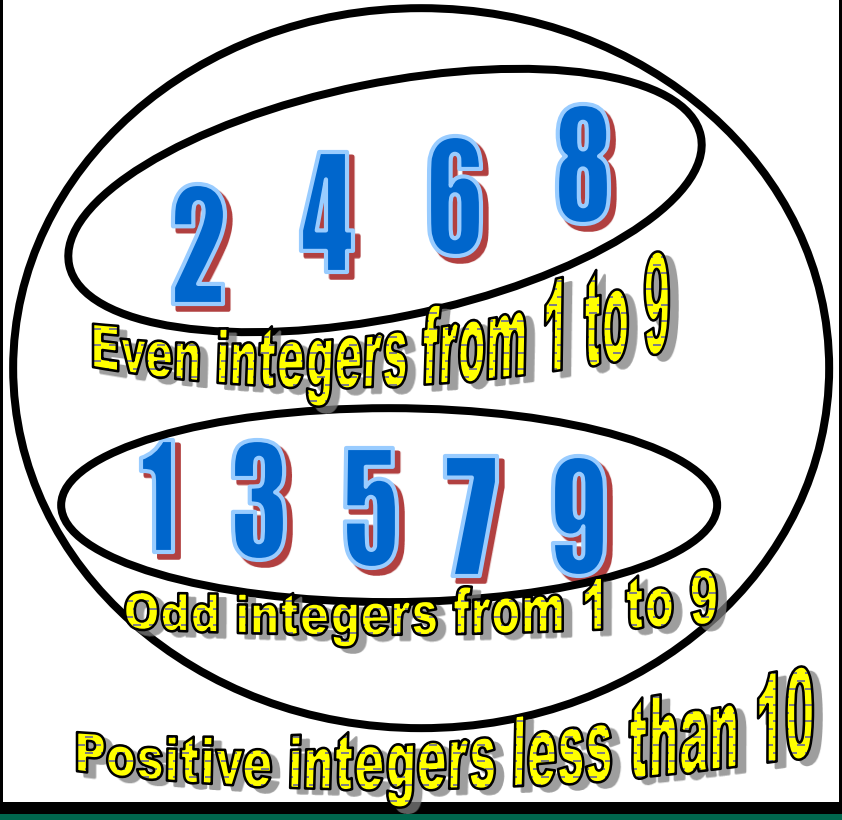
$b \vee d \rightarrow \neg g$



$$\sum_{k=1}^{n} k^3$$

Some Discrete Structures

- Sets



- Sequences

$\{a_n\} = a_1, a_2, \ldots,$ where

$a_n = f(n) = 1/n^2.$

Then, $\{a_n\} = 1, 1/4, 1/9, ..$

- Summations

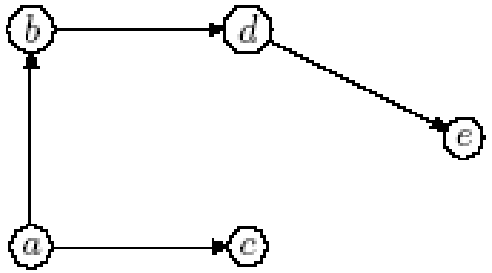
$$\sum_{k=1}^{n} k^2 = n(n+1)(2n+1)/6$$

Some Discrete Structures

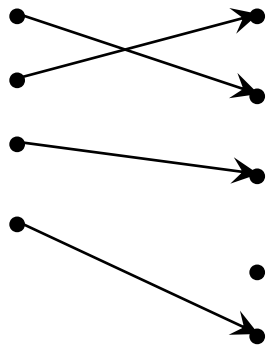
- Combinations

  How many distinct 7-card hands can be drawn from a standard 52-card deck?

- Graphs



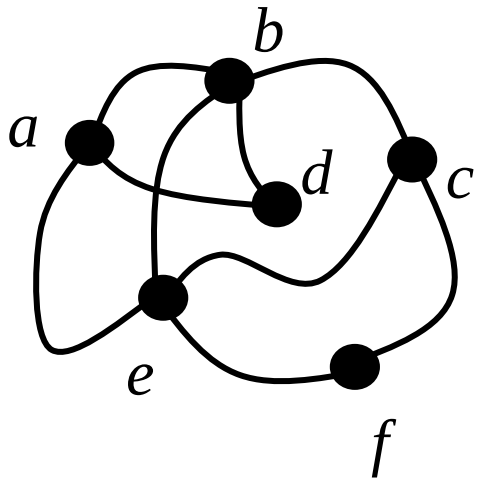
- Functions



One-to-one

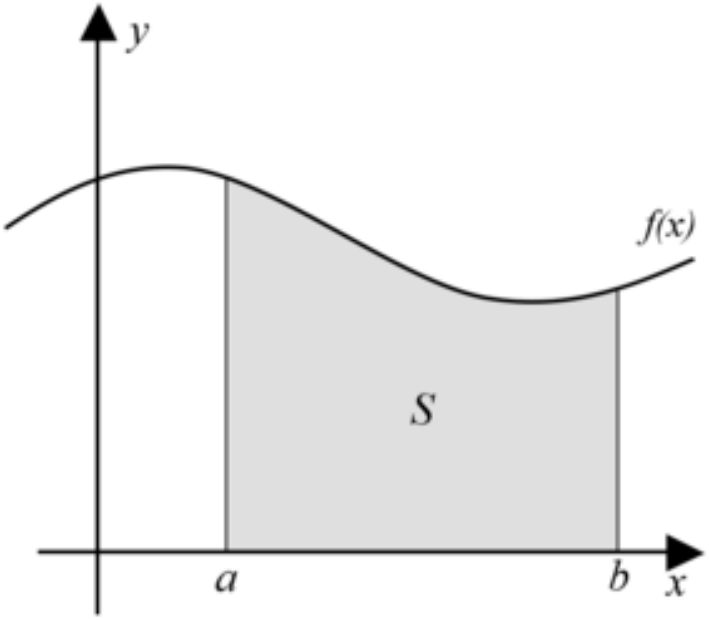
Question

- Is this a discrete structure?



Question

- Is this a discrete structure?



$$S = \int_b^a f(x)dx$$

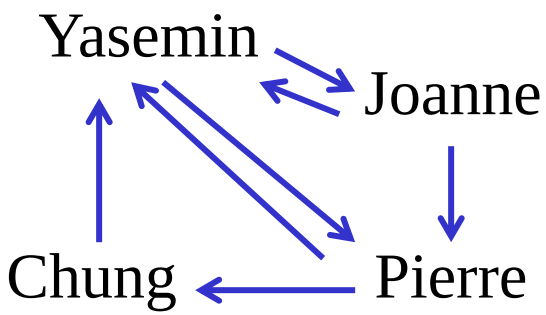
Question

- Is this a discrete structure?

$$S = \begin{bmatrix} 1 & 4 & 0 \\ -4 & a & 0 \\ 0 & 0 & b \end{bmatrix}$$

Question

- Is this a discrete structure?



Note: "→" means "likes"

Why Study Discrete Math?

- It's the basis of all digital information processing: *Discrete manipulations of discrete structures represented in computer memory*.
- It's the foundation of almost all topics of computer science such as formal languages, algorithms, computer security, operating systems.
- Discrete concepts are also widely used throughout engineering, economics, biology, *etc*.

Course Objectives

- After taking this course, you will be able to:

  Represent and analyze logical statements.

  E.g.:

  - For my husband's birthday, I bring him gifts. ($b \rightarrow g$)
  - Today, either it is my husband's birthday or I work late in office." ($b \vee l$)
  - I did not bring my husband gifts today. ($\neg g$)

  "Therefore, today I worked late."

Course Objectives

- After taking this course, you will be able to:

Prove the equations.

$$\sum_{i=1}^{n} i = n(n+1)/2$$

Prove the statements.

"If n is an odd integer, then n^2 is an odd integer."

Course Objectives

- After taking this course, you will be able to:

  Develop algorithms and analyze the complexity of them.

  E.g.:

  How can a list of integers can be sorted so that they are in increasing order and how many steps are required to do such a sorting?

Course Objectives

- After taking this course, you will be able to:

  Use effective algorithms to compute

  $7^{194} \; mod \; 11 = ?$

  Encrypt messages.

  E.g.:

  Original message: *Last name: Smiley*

  Encrypted message: 28530116147821503906425614452462

Course Objectives

- After taking this course, you can show that:

  - There must be at least 1 week during the year in which at least 2 students in this class have a birthday.

  - How many colors do we need to color a map such that no neighbouring regions have the same color?