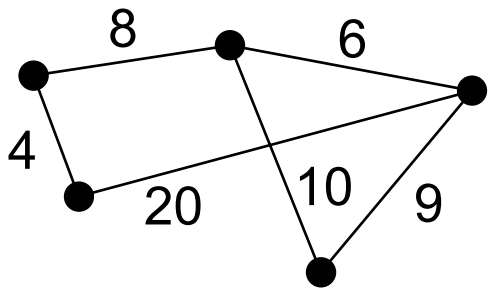
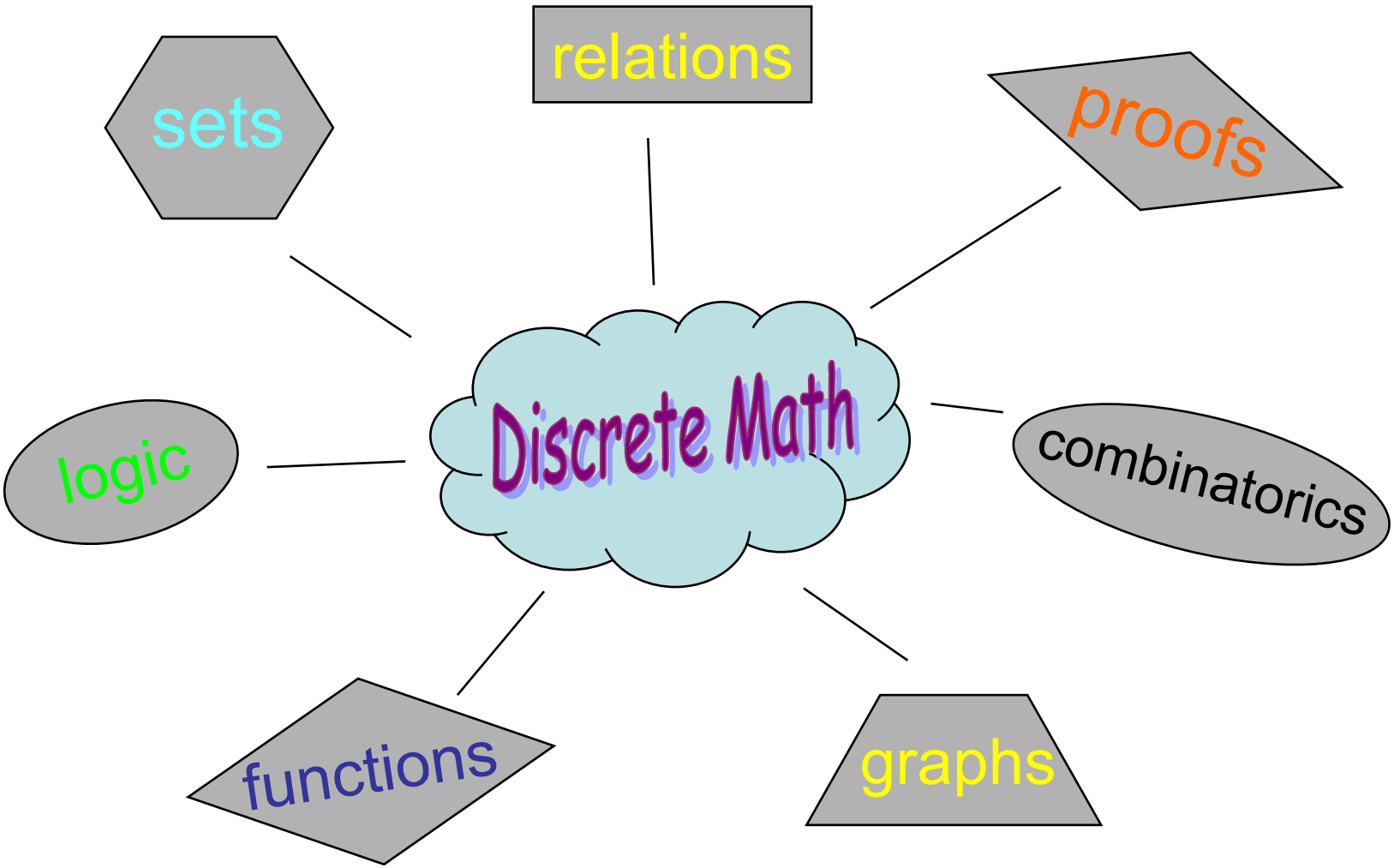
Lesson 0:

Introduction

- Why Discrete Math?
- Course Requirements
- Course Syllabus
- Course Text Book
- Course Web Page
- Example Problem




sets
relations
proofs
logic
Discrete Math
combinatorics
functions
graphs

Discrete Mathematics - מתימטיקה בדידה

Computer Science 203.1850 Semester B 2005-2006

Lecture: Monday 10:00-11:00 Room: Main 701
Wednesday 10:00-12:00 Room: Education 445
Tirgul: Monday 8:00-10:00 Room
Wednesday 12:00-14:00 Room

Lecturer: Dr. Hagit Hel-Or
hagit@cs.haifa.ac.il
Office: 415
Office Hours: Monday 12:00-13:00 (by appointment)

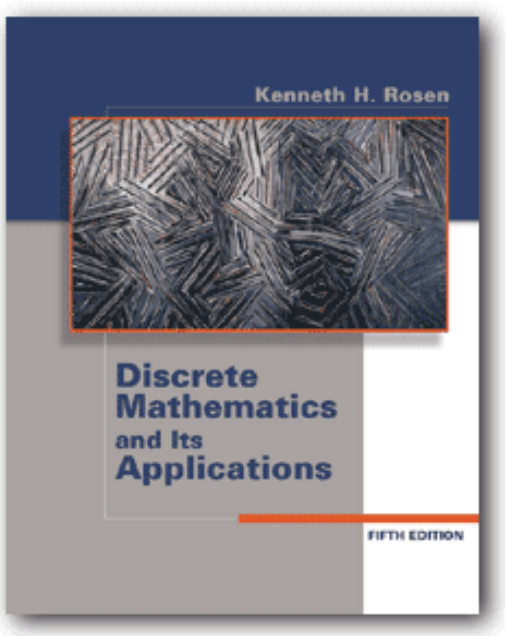
TA : Mr. Ariel Gorfinkel
agorfink@cs.haifa.ac.il
Office: 102, TA room
Office Hours: Tuesday 12:15-13:45

Course Internet Site: **http://cs.haifa.ac.il/courses/DiscreteMath/**

Administration

- Course Web Page:
  - Syllabus, Reference List
  - Lecture slides and Handouts
  - Homework, Grades
- Lectures / Tirgul
- Exercises:
  - Every Week
  - No Late submissions
- Grading policy:
  - Final Grade = 90% exam + 10% exercises
  - Exercises are compulsory
  - Exercises will be weighted
  - You must pass the exam to pass the course !

Course Text Book



Discrete Mathematics and its Applications

by Kenneth H. Rosen

Haifa Library Call #: QA39.R654 2003

http://www.mhhe.com//math/advmath/rosen/r5/

http://www.mhhe.com//math/advmath/rosen/r5/student/index.html

Course Syllabus

Naive Set Theory
Set Definition
Venn Diagrams
Set Operations

Logic
Propositional Equivalences
Predicates and Quantifiers

Functions
Sequences and Summations
The Growth Functions

Methods of Proof
Mathematical Induction
Recursive Definitions
Recursive Algorithms

Counting
The Pigeonhole Principle
Permutations and Combinations

Advanced Counting
Solving Recurrence Relations
Divide-and-Conquer Relations
Inclusion-Exclusion

Relations
n-ary Relations
Closures of Relations
Equivalence Relations
Partial Orderings

Graphs
Graph Terminology
Graph Isomorphism
Euler and Hamilton Paths
Shortest Path Problems

Trees
Applications of Trees
Tree Traversal
Trees and Sorting

Discrete Mathematics

The study of discrete objects.

How many Valid Passwords are available?

Is there a link between 2 computers on the network?

What is the shortest path between 2 computers in a network?

How many possibilities to assign net i.d.s to a group of servers?

Can one prove that the algorithm is fault tolerant?

Discrete computations, discrete structures, problem solving in the discrete world.

Example Problem

The Traveling Salesman (בעית הסוכן הנוסע)

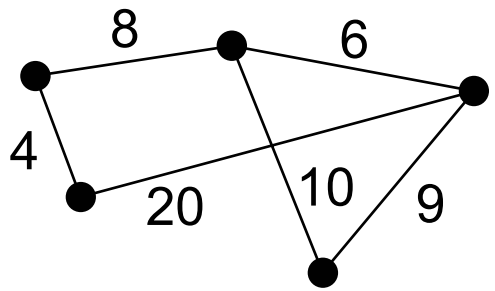
Given:

n cities c_1, c_2, ..., c_n

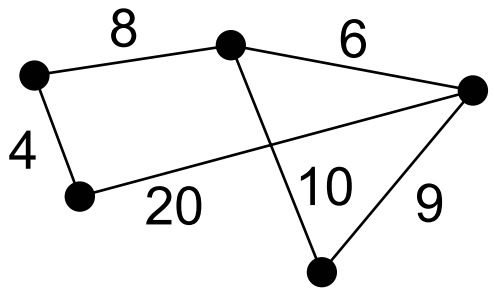
d_{ij} = distance between city i and j

Goal:

Find the shortest tour.



Example Problem



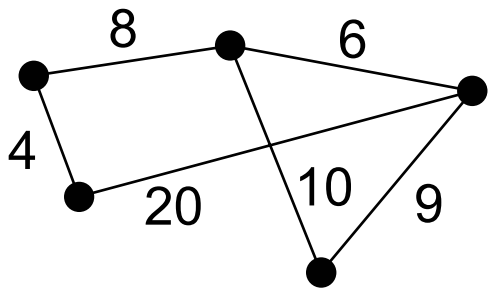
Algorithm: List all possible tours.
For each tour calculate its length
Choose shortest tour.

Cost: (n-1) additions for each tour.

Number of Tours: n*(n-1)*(n-2)*...*1 = n!

Total Cost : T(n) = (n-1)*n!

Example Problem



Assume a fast PC:

1 flop = 1 nanosecond
= 10^{-9} sec.
= 1,000,000,000 ops/sec
= 1 GHz

If n = 8, T(n) = 7*8! = 282,240 flops < 1/3 sec

Example Problem

However: If n = 50,

$T(n) = 49*50!$

$= 1.48 * 10^{66}$

$= 1.49\ 10^{57}$ seconds

$= 2.48\ 10^{55}$ minutes

$= 4.13\ 10^{53}$ hours

$= 1.72\ 10^{52}$ days

$= 2.46\ 10^{51}$ weeks

$= 4.73\ 10^{49}$ years !!

We do not know if there is an efficient algorithm to solve this problem. NP-Complete.