Math/EECS 1028M: Discrete Mathematics for Engineers

Winter 2015

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Course page: http://www.eecs.yorku.ca/course/1028

Administrivia

Lectures: Mon-Wed-Fri 1:30-2:30 pm (CLH G)

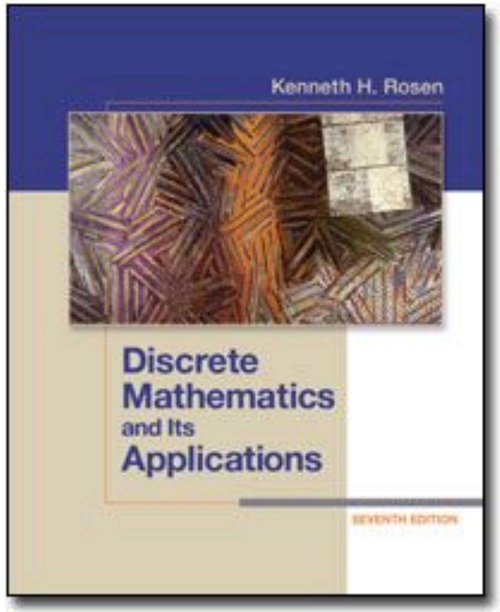
Exams: 3 tests, 15% each*(35%),
final (45%)

Homework and Tutorials(20%):

Slides: should be available after the class

Office hours: Tue-Thu 1-3 pm or by appointment at CSEB 3043.

Textbook:



Kenneth H. Rosen. *Discrete Mathematics and Its Applications, 7th Edition*. McGraw Hill, 2012.

Course objectives

We will focus on two major goals:

- Basic tools and techniques in discrete mathematics
  - Propositional logic
  - Set Theory, Functions and Relations
  - Simple algorithms
  - Induction, recursion
  - Sums
  - Introductory Graph Theory
- Precise and rigorous mathematical reasoning
  - Writing proofs

My expectations

- You will attend classes and tutorials regularly
- Want to solidify your Math foundations
- Ask for help when needed
- Learn about academic honesty (see the class webpage for more details on policies).
- .

To do well you should:

- Study with pen and paper
- Ask for help **early**
- Practice, practice, practice…
- Follow along in class rather than take notes
- Ask questions in class or outside class
- Keep up with the class
- Read the book, not just the slides
- Be timely -- HW submitted late will not be graded

Mathematical Reasoning

- What is Mathematics?
  – Mathematics as a precise language

- Motivation (for EECS)
  – Specification (description, modeling)
  – Reasoning (Making precise, rigorous claims)

- Procedure
  – Axioms
  – Inference
  – Facts/Theorems

Examples of reasoning about problems

- 0.9999999999999999….=1?
- There exists integers a,b,c that satisfy the equation $a^2+b^2 = c^2$
- The program that I wrote works correctly for all possible inputs…..
- The program that I wrote never hangs (i.e. always terminates)…

Today: review of basic concepts

- Sets
- Number Systems
- Basic algebra

Sets

- Unordered collection of elements, e.g.,
  - Single digit integers
  - Nonnegative integers
  - faces of a die
  - sides of a coin
  - students enrolled in 1028M, W 2015.
- Equality of sets
- Note: Connection with data types

Describing sets

- English description
- Set builder notation

Note:

The elements of a set can be sets, pairs of elements, pairs of pairs, triples, …!!

Cartesian product:

$A \times B = \{(a,b) | a \in A \text{ and } b \in B\}$

Sets - continued

- Cardinality – number of (distinct) elements
- Finite set – cardinality some finite integer n
- Infinite set - a set that is not finite

Special sets

- Universal set
- Empty set ϕ (cardinality = ?)

Sets vs Sets of sets

- $\{1,2\}$ vs $\{\{1,\},\{2\}\}$
- $\{\}$ vs $\{\{\}\} = \{\phi\}$

Sets of numbers

- Natural numbers
- Whole numbers
- Integers
- Rational numbers
- Real numbers
- Complex numbers
- Co-ordinates on the plane

Natural numbers, Integers, Reals

- Natural numbers (**N**): {1,2,3,.....}
- Whole numbers (**W**): {0,1,2,3,...}
- Integers (**Z**): {...,-2,-1,0,1,2,....}

  Notation: $\mathbf{Z}^{+}$: positive integers = **N**

- Real Numbers (**R**): ?

  Notation: $\mathbf{R}^{+}$: positive reals

- Q: How are reals represented on a computer?

Rational and Irrational Numbers

- Rational numbers (**Q**): {x| x=m/n for some integers m,n, and nis non-zero}

- Irrational numbers: all real numbers that are not real. Examples: π (Pi), e, √2

- Q: how do we know that the above are irrational?

Cartesian Products

- $A \times B = \{(x,y) \mid x \in A, y \in B\}$

  "Set of ordered pairs"

- $\mathbf{R} \times \mathbf{R} = \{(x,y) \mid x \in \mathbf{R}, y \in \mathbf{R}\}$

  "Coordinate plane" or "the real plane"

Basic Algebra

Therorem 1, pg A-7

- $b^x * b^y = b^{x+y}$
- $b^x / b^y = b^{x-y}$
- $(b^x)^y = b^{xy}$

- Solving linear and quadratic equations