Math/EECS 1028M: Discrete Mathematics for Engineers
Winter 2017

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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 (40%)
* worst test to be scaled to 5%

Homework and Tutorials(25%):

Slides: should be available before class

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

Textbook:

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

• $0.999999999999999999…=1$?
• 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:
\[ A \times B = \{(a,b) \mid a \in A \text{ and } b \in B\} \]
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 $\emptyset$ (cardinality = ?)
Sets vs Sets of sets

• \{1,2\} vs \{\{1,\},\{2\}\}
• \{\} vs \{\{\}\} = \{\emptyset\}
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 (\( \mathbb{N} \)): \{1, 2, 3, \ldots \}
• Whole numbers (\( \mathbb{W} \)): \{0, 1, 2, 3, \ldots \}
• Integers (\( \mathbb{Z} \)): \{\ldots, -2, -1, 0, 1, 2, \ldots \}

Notation: \( \mathbb{Z}^+ \): positive integers = \( \mathbb{N} \)

• Real Numbers (\( \mathbb{R} \)): ?

Notation: \( \mathbb{R}^+ \): positive reals

• Q: How are reals represented on a computer?
Rational and Irrational Numbers

• Rational numbers (Q): \( \{x | x = \frac{m}{n} \text{ for some integers } m, n, \text{ and } n \neq 0 \} \)

• Irrational numbers: all real numbers that are not real. Examples: \( \pi \) (Pi), e, \( \sqrt{2} \)

• 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"

• $\mathbb{R} \times \mathbb{R} = \{(x,y) \mid x \in \mathbb{R}, y \in \mathbb{R}\}$
  "Coordinate plane" or "the real plane"
Basic Algebra

Theorem 1, pg A-7

• $b^x \cdot b^y = b^{x+y}$
• $b^x / b^y = b^{x-y}$
• $(b^x)^y = b^{xy}$

• Solving linear and quadratic equations