Discrete Math Review

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Abstract

Discrete Math is a topic containing too many things, I would say it contains basic logic, number theory, probability theory, linear programming, set theory, graph theory, etc.

Considering the comprehensive nature of discrete math, I will pick topics that I don't have deep understanding or those I hope to review.

This note will basically be a speed run for now, but I expect to add more contents in the future if I have time to dive deep into certain topics.

Some contents will heavily depend on MIT 18.310 and book K. H. Rosen and K. Krithivasan, Discrete mathematics and its applications, 7. ed., Global ed. New York, NY: McGraw-Hill, 2013.

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Chapter 1

Logic and Proofs

1.1 First-order logic

First-order logic – also called **predicate logic**, **predicate calculus**, **quantificational logic** (wikipedia).

Definition 1.1.1 (Proposition). A **proposition** is a declarative sentence (that is, a sentence that declares a fact) that is either true or false, but not both.

Example. Examples of proposition:

- Washington, D.C., is the capital of the United States of America.
- Toronto is the capital of Canada.
- $1 + 1 = 2$.
- $2 + 2 = 3$.

Propositional logic cannot adequately express the meaning of all statements in mathematics and in natural language.

Example. Suppose we know:
"Every computer connected to the university network is functioning properly".
No rules of propositional logic allow us to conclude the truth of the statement:
"MATH3 is functioning properly".
where MATH3 is one of the computers connected to the university network.

Chapter 2

Number Theory and Cryptography

Chapter 3

Counting

Chapter 4

Discrete Probability

Chapter 5

Graphs

Chapter 6

Linear Programming

Chapter 7

Fourier Transform

Chapter 8

Information Theory