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CSEN 502 Theory of Computation, Winter Term 2021
Assignment1

Exercise 1-1

Reading

Read Chapter 0 to page 20 of the text. You may skip the section on Boolean logic.

Exercise 1-2

Exercises from Textbook

Sipser (*pp* 25 - 27 International Edition): Solve exercises 0.3[1], 0.4[2] (skip e), 0.5, 0.6, and 0.7

Exercise 1-3

In each of the following cases, determine whether the relation ρ is reflexive, symmetric, anti-symmetric, asymmetric or transitive.

(a) $\rho \subseteq \mathbb{Z} \times \mathbb{Z}$, where $a \ \rho \ b$ if and only if there is $n \in \mathbb{Z}$ such that $a = bn$.

(b) For a given universe $\mathcal{U}$ and $C \subseteq \mathcal{U}$, where $C \neq \varnothing$, define $\rho \subseteq P(\mathcal{U}) \times P(\mathcal{U})$ (ρ is a set of ordered pairs of sets over $\mathcal{U}$) such that $A \ \rho \ B$ if and only if $A \cup C = B \cup C$.

(c) $\rho \subseteq \mathbb{Z} \times \mathbb{Z}$ where $x \ \rho \ y$ if and only if $x + y$ is odd.

(d) $\rho \subseteq (\mathbb{Z} \times \mathbb{Z}) \times (\mathbb{Z} \times \mathbb{Z})$ where $(a, b) \ \rho \ (c, d)$ if and only if $a \leq c$.

Exercise 1-4

Extra Problem

In each of the following cases, and by filling the appropriate *circles*, indicate whether the relation $\mathcal{R}$ on the *set of line segments in the plane* is reflexive (r), symmetric (s), anti-symmetric (an), asymmetric (as), or transitive (t).

a) $(a, b) \in \mathcal{R}$ if and only if a and b are not equal in length.
r ◯ s ◯ an ◯ as ◯ t ◯

b) $(a, b) \in \mathcal{R}$ if and only if b is longer than 10 cm.
r ◯ s ◯ an ◯ as ◯ t ◯

c) $(a, b) \in \mathcal{R}$ if and only if a and b have at least two common points.
r ◯ s ◯ an ◯ as ◯ t ◯

[1] Exercise 0.4 in normal edition
[2] Exercise 0.1 in normal edition

Exercise 1-5

Programming

Using your favorite programming language, implement an abstract data type for sets. Your implementation should include functions/methods/clauses for checking set membership, checking subset relations among sets, and computing set intersections, unions and differences.