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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 0.3¹, 0.4² (skip e), 0.5, 0.6, and 0.7

Exercise 1-3

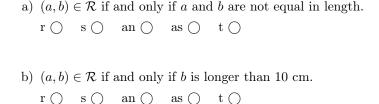
In each of the following cases, determine whether the relation ρ is reflexive, symmetric, anti-symmetric, asymmetric or transitive.

- (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 $C \neq \emptyset$, 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) ρ (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).



c) $(a,b) \in \mathcal{R}$ if and only if a and b have at least two common points.

 $r \bigcirc s \bigcirc an \bigcirc as \bigcirc t \bigcirc$

¹Exercise 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.