

# Assignment 3

COMP 2230

Due: February 20, 2026 by 11:59 p.m.

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## Exercises from the Textbook (50 points):

Section 6.1: 12

Section 6.2: 42

Section 6.3: 8

Section 6.4: 27

Section 7.4: 15

Section 8.1: 20

Section 8.2: 10

Section 8.3: 12

Section 8.4: 5

Section 8.5: 6

## Additional Exercises (50 points):

1. Prove or disprove the following claim.

Let  $A$ ,  $B$ , and  $C$  be subsets of a well-defined universe.

$$B \subseteq C \rightarrow A \cap B \subseteq A \cap C$$

2. Prove or disprove the following claim.

Let  $A$ ,  $B$ ,  $C$ , and  $D$  be non-empty subsets of a well-defined universe.

$$(A \cap B) \times (C \cap D) \subseteq (A \times C) \cap (B \times D)$$

3. Prove or disprove the following claim.

Let  $A$ ,  $B$ , and  $C$  be subsets of a well-defined universe.

$$A \cup (B - C) = (A \cup B) - (A \cup C)$$

4. Each day in Hell, Satan writes a mathematical description of a subset of integers on a piece of paper and seals it in a (fire-proof) envelope. One lucky soul per day has the opportunity to guess that subset of integers.

If the individual guesses correctly, he or she is freed from the torment of Hell. If the individual guesses incorrectly, he or she is damned to an eternity in Hell without another chance to guess. However, if Satan fails to properly describe a legal set, the soul is freed on a technicality.

Satan, being crafty as well as evil, seals in the envelope a piece of paper with the following description of a set on it:  $\{n \in \mathbb{Z} \mid n \text{ does not belong to the set of numbers that the person guesses}\}$

Thus, if the person said, "The set of even integers," Satan's clever ruse would mean that his description precisely described the odd integers. And, if the person said, "All integers!" Satan's description would describe the empty set, a perfectly legal set distinct from the one chosen. If you were a mathematician who suspected Satan of this kind of trickery, is there anything you could do to escape? Explain thoroughly.

5. For the following problems, consider binary relations on a set  $A$ , where  $A$  has  $n$  elements. When solving these problems, it may be useful to work examples on small sets.
- How many binary relations on  $A$  are possible?
  - Of the possible binary relations, how many are reflexive?
  - Of the possible binary relations, how many are symmetric?
  - Of the possible binary relations, how many are both reflexive **and** symmetric?