MACM 101 Lecture 1.1

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1 Chapter Summary

- Propositional Logic
  - The Language of Propositions
  - Applications
  - Logical Equivalences and Implication
  - The Laws of Propositional Logic
- Predicate Logic
  - The Language of Quantifiers
  - Nested Quantifiers
- Proofs
  - Rules of Inference
  - Proof Methods
  - Proof Strategy

This document covers everything from Rosen 1.0 to 1.3.

2 Definitions

2.1 Deduction/Deductive Logic

Deduction is the process of deriving a conclusion from a given set of axioms or premises. In Logic, we start from the ground (axioms) and work our way up to the conclusion.

2.2 Truth Value

A truth value can be either true or false, but not both. This comes from the *principium tertii eclusi* of Aristotle.

2.2.1 True and False

We will use 0 and 1 to denote true and false, respectively.

2.2.2 Unknown Truth Value

The proposition u is *unknown truth value.*

2.3 Proposition

A proposition is a declarative sentence (or statement) that possesses truth value.

2.3.1 Notation

Lowercase letters denote primitive propositions, and uppercase letters denote complex propositions.

Primitive propositions are:

- Propositions that cannot be decomposed into anything simpler
- $p : 3 + 5 = 8$
- q : It is raining

2.4 Examples of things that are not propositions

- p : Sit down! $\rightarrow$ not a proposition because it is not a declarative
- q : The statement you are reading is now false. $\rightarrow$ not a proposition because it is a contradiction.
- r : The number x is an integer. $\rightarrow$ not a proposition because it contains an unspecified variable, which means it's truth value cannot be definitively determined without additional information.

2.5 Syntactics and Semantics

Syntatic reasoning is what can be shown.

Syntax = grammar (rules of sentance construction), the structure of propositions

Semantics reasoning is what is true

Semantics = meaning (truth value), the truth value/tables of propositions

2.6 Literals

A *literal* is either a primitive proposition or its negation (some textbooks use to denote a literal)

3 Operator Syntax

1. Negation - $\neg$
   q : it is raining, $\neg q$: it is not raining
   Everything in this list other than $\neg$ is known as a *logical connective*

2. Conjunction - $\wedge$ - Logical and
   $p \wedge q$: it is raining and it is sunny
   $p \wedge \neg q$: it is raining and it is not sunny

3. Disjunction - $\vee$ - Inclusive Or
   $p \vee q$: it is raining or it is sunny
   $p \vee \neg q$: it is raining or it is not sunny

4. Disjunction - $\oplus$ - Exclusive Or
   $p \oplus q$: it is raining xor it is sunny
   $p \oplus \neg q$: it is raining xor it is not sunny
   XOR is generally what is meant in english slike "the meal comes with either soup or salad"

5. Implication - $\rightarrow$ - "If, then"

6. Biconditional - $\leftrightarrow$ - "If and only if"

Nobody knows why OR and XOR are both called Disjunction

All propositions formed with logical connectives are called *compound propositions*, as opposed to *primitive propositions*

Compound propositions need not have causal relations between atomic components (they can sound nonsensical and still be valid) – material implication as opposed to causal implication, which lacks temporal ordering. (straight from the slides, p. 34)

4 Semantics

TRUTH TABLES. that's basically all semantics is

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