Propositional Logic Modeling Reference

1. Basic Connectives

These are the building blocks of most logical statements.

Natural Language	Symbol	Logic Notation	Modeling Notes
And / But / Also	$\wedge$	$A \wedge B$	Both must be **True**.
Or (Inclusive)	$\vee$	$A \vee B$	At least one is **True**.
Either A or B (XOR)	$\oplus$	$(A \vee B) \wedge \neg(A \wedge B)$	Exactly one is **True**, not both.
If and only if	$\leftrightarrow$	$A \leftrightarrow B$	Identical truth values.
Not	$\neg$	$\neg A$	Inverts the truth value.

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2. Conditionals (Implications)

The arrow ($\rightarrow$) always points from the **Sufficient** condition to the **Necessary** condition.

Standard Implication: $A \rightarrow B$

- **Phrasing:** "If A, then B" | "A only if B" | "A is a sufficient condition for B"
- **Meaning:** If **A** occurs, **B** is guaranteed to occur.

Converse Implication: $B \rightarrow A$

- **Phrasing:** "A if B" | "A is a necessary condition for B"
- **Meaning:** **B** cannot occur without **A** being true.

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3. Special Case: "Unless"

"Unless" functions as a "negative" requirement.

- **Phrase:** A unless B
- **Logical Translation:** $\neg B \rightarrow A$
- **Logical Equivalent:** $A \vee B$
- **Example:** "*You will fail unless you study*" $\rightarrow$ ($\neg$Study $\rightarrow$ Fail)

Modeling Pro-Tips

- **The "Only If" Rule:** Whatever follows the words "only if" is always the **consequent** (the part the arrow points to).
- **Sufficient vs. Necessary:** * **Sufficient:** "If I have this, it is *enough*."
  - **Necessary:** "I *must* have this for the result to be possible."
- **Precedence:** When modeling complex sentences, use parentheses to clarify order: `(A ∧ B) → C`.