Reasoning for Humans: Clear Thinking in an Uncertain World

PHIL 171

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Review: Arguments

Summary

A sentence is **declarative** if it makes a statement: that is, if it asserts something.

The premises and conclusion of an **argument** are not the declarative sentences we use to express the argument, but rather the *propositions* expressed by those declarative sentences.

Some logic/philosophy texts use "statement" or "claim" instead of "proposition".

Many sentences can express the same proposition, and a proposition can be expressed by different sentences.

Argument form/inference pattern

From Ann ordered fish or meat or pasta, Ann did not order fish, Ann did not order meat **infer** Ann ordered pasta

The lecture is in Skinner or in Tydings or on Zoom. The lecture is not in Skinner. The lecture is not in LeFrak. **So**, the lecture is on Zoom.

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$$\varphi \text{ or } \psi \text{ or } \chi, \text{ not } \varphi, \text{ not } \psi \Rightarrow \chi$$

Variables

We use Greek letters (φ, ψ, α, β, $\ldots$) as **variables** for propositions.

This is analogous to the way we use variables to represent any number in algebra: e.g., $x + 2$

So, in the argument: φ or ψ or χ, not φ, not $\psi \Rightarrow \chi$, each of φ, ψ and χ can be replaced by statements (note that the words "or" and "not" have a fixed interpretation) .

- Different variables may be replaced by the same statement
- The same variable may occur more than once in an an expression: You must replace that variable with the same statement.

Evaluating Arguments

Eric had steak for dinner or Eric had fish for dinner. Eric did not have fish. So, Eric had steak for dinner.

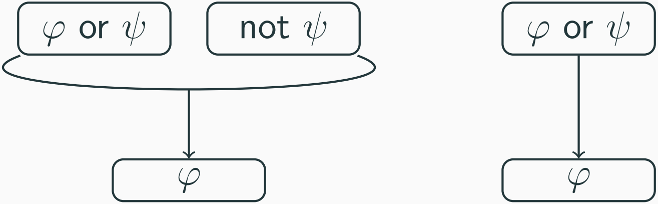
Ann will get an A in PHIL 171 or Ann will get a B in PHIL 171, Ann will not get a B in PHIL 171. So, Ann will get an A in PHIL 171.

φ or ψ, not $\psi \Rightarrow \varphi$

Eric had steak for dinner or Eric had fish for dinner. So, Eric had steak for dinner.

Ann will get an A in PHIL 171 or Ann will get a B in PHIL 171. So, Ann will get an A in PHIL 171.

φ or $\psi \Rightarrow \varphi$


φ or ψ
not ψ
φ
φ or ψ
φ

Valid Arguments

An argument is **valid** if it is **impossible** that all the premises are true and the conclusion is false.

Logical Impossibility

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Logical Impossibility

- It is raining. (contingent fact)
- That spaceship travels faster than the speed of light. (physical impossibility)
- Eric held his breath for 15 minutes. (physical impossibility)
- $2 + 2 = 5$. (arithmetic impossibility)
- Eric grew up in Ohio and Eric did not grow up in Ohio. (logical impossibility)

An argument is...

valid provided that it is impossible for all the premises to be true and the conclusion to the false.

sound provided that the argument is valid and all the premises are true.

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An argument is valid if there is a **transmission of truth** from the premises to the conclusion: Every situation in which all the premises are true, the conclusion is also true.

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Lily is in Chevy Chase. Chevy Chase is in Maryland. So, Lily is in Maryland.

x is in y. y is in z. So, x is in z.

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x is in y. y is in z. So, x is in z.

Water is in beer. Beer is in that can. So, water is in that can.

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E.g., Any claim of the form "P and not P" is (logically) impossible. It doesn't matter which statement P we are talking about (or which objects P is about).

If P is true, then "not P" is false and if "not P" is true, then P is false.

Formulas

Logical Constants

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Examples: the **truth-functional (a.k.a., Boolean) connectives**, which are expressed in English using, e.g., "and", "or", "not", "if...then..."

Two key properties of the Boolean connectives:

1. Their meanings/referents do not vary across sentences that are about different objects.
2. The meanings of these connectives are functions of the truth-values of the statements to which they are applied.

Review: Logical Connectives

English expression	Logical connective
not, it is not the case that, it is false that	$\neg$
and, yet, but, however, both, also, although, nevertheless, still, also, although, moreover, additionally, furthermore	$\wedge$
or, unless, either ... or ...	$\vee$
if ... then ..., only if, given that, in case, provided that, on condition that, sufficient condition, necessary condition, unless (Note: don't confuse antecedents/consequents!)	$\rightarrow$

Logical Constants, continued

Not all connectives are logical constants. Indeed, not all connectives are even truth-functional.

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Another example:

1. I am wet because it is raining.
2. It is raining because I am wet.