

Critical thinking

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0.1 Propositions and Arguments

Definition 1. *Logic is the study of the methods and principles used to distinguish correct from incorrect reasoning.*

Definition 2. *A proposition asserts that something is the case or it asserts that something is not.*

Questions, commands, and exclamations – unlike propositions – are neither true nor false.

The term statement is not an exact synonym of proposition, but it is often used in logic in much the same sense. Some logicians prefer statement to proposition, although the latter has been more commonly used in the history of logic. Other logicians eschew both terms as metaphysical, using only the term sentence.

Propositions can be simple and compound.

- *Conjunctive proposition:* I am a beatboxer and a computer scientist. (AND)
- *Disjunctive proposition:* You can have a scotch or take a hike. (OR)
- *Hypothetical proposition:* If God did not exist, it would be necessary to invent him.

Definition 3. *An argument affirms one proposition, conditioned upon the truth of others. The proposition that the argument affirms is called the conclusion and the propositions upon which the affirmation of the conclusion depends are called premises, or collectively, the inference.*

Conclusion indicators: therefore, thus, hence, so, accordingly, in consequence, consequently, proves that, as a result, etc.

Premise indicators: since, because, for, as, follows from, as shown by, etc.

Context is important in understanding arguments. (Duh)

Note: Rhetorical questions can serve as premises. Arguments that depend on rhetorical questions are always suspect. Because the question is neither true nor false, it may be serving as a device to suggest the truth of some proposition while avoiding responsibility for asserting it. (Presumption fallacy: plurium interrogatium)

Premises may be considered implicit if they are commonly accepted knowledge.

Explanations look like arguments (same indicators) but are not. (Duh) Figuring out which can be iffy.

Definition 4. *A deductive argument makes the claim that its conclusion is supported by its premises conclusively.*

Definition 5. *Inductive arguments are usually based on repeated observation of a phenomenon.*

Definition 6. *A deductive argument is said to be valid if the claim made by the premises (if true) provide incontrovertible grounds for the assertion of the conclusion.*

Examples of validity:

1. Valid, true inference and conclusion: All mammals have lungs. All whales are mammals. Therefore all whales have lungs.
2. Valid, false inference and conclusion: If I owned all the gold in Fort Knox, then I would be wealthy. I do not own all the gold in Fort Knox. Therefore I am not wealthy.
3. Invalid, true inference, false conclusion: If Bill Gates owned all the gold in Fort Knox, then Bill Gates would be wealthy. Bill Gates does not own all the gold in Fort Knox. Therefore Bill Gates is not wealthy.
4. Valid, false inference, true conclusion: All fishes are mammals. All whales are fishes. Therefore all whales are mammals.
5. Invalid, false inference, true conclusion: All mammals have wings. All whales have wings. Therefore all whales are mammals.
6. Invalid, false inference and conclusion: All mammals have wings. All whales have wings. Therefore all mammals are whales.

Definition 7. *Retrograde analysis: Reasoning that seeks to explain how things must have developed from things that have happened before.*

0.2 Definitions

Definition 8. *Definiendum: The word or symbol being defined*

Definition 9. *Definiens: A symbol or group of symbols that have the same definition as the Definiendum*

Definition 10. *Ambiguity: A term is ambiguous **in a given context** when it has more than one distinct meaning, and the context does not make clear what is intended.*

Definition 11. *Vagueness: A term is vague, when there are borderline cases where the term may or may not apply.*

0.2.1 Types of definitions — (5)

S(tipulative)L(exical)IT(theoretical) P(precising)P(ersuasive)

- **Stipulative definition:** A new definition where some meaning is arbitrarily defined. Such a definition cannot be correct or incorrect. Eg. Zetta has been stipulatively defined to mean 10^{12} .
- **Lexical definition:** Reports the meaning that the Definiendum already has. The report maybe correct or incorrect, so such a definition maybe true or false.
- **Precising definition:** A definition used to eliminate vagueness or ambiguity.
It reports on a word that already exists, but it makes the known meaning more precise. It could increase the precision by stipulating, but the purpose of this stipulation is to *improve a pre-existing* meaning.
- **Theoretical definition:** A definition that encapsulates an understanding of the theory in which the term is a key element.
- **Persuasive definition:** A definition used to resolve disputes by influencing attitudes and stirring emotion. Often uses emotive language.

0.3 Intention and extension

Definition 12. *Extension:* The set of all objects to which a term may be applied.

$$\text{extension}(P) \equiv \{x \mid \forall x \in \text{universe}, P(x)\}$$

Definition 13. *Intension:* The attributes shared by all and only the objects in the class the term denotes. Or, the connotation of the term.

$$\text{intension}(P) \equiv \bigcap_{\forall x \in \text{extension}(P)} \text{attribs}(x)$$

The equilateral triangle example Consider equi-**angular** triangle, whose intention is different from equi-**lateral** triangle.

Both of these have the same *extension* (since the sets are the same), but have different *intentions*.

0.4 Extension and denotative definitions

Means of defining extensive terms:

Definition 14. *Denotative definition:* A definition that identifies the extension of a term, by (for eg.) listing the members of the definition. An extensive definition

Definition 15. *Ostensive definition:* A denotative definition, where the definition is made by pointing.
For example, the word desk means this.

Definition 16. *Quasi Ostensive definition:* Example: the desk is means this article of furniture. This presupposes the meaning of article of furniture.

0.5 Intention and Intensional Definitions

0.5.1 Types of intentional definitions

Definition 17. *Subjective intension: Set of all attributes speaker believes are possessed by objects denoted by that word*

Definition 18. *Objective intension: Total set of characteristics shared by all objects in the word's extension*

Definition 19. *Conventional intension: Commonly accepted intension of a term;*

0.5.2 Techniques for creating intensional definitions

Definition 20. *Synonymous definition: A word, phrase, etc. is defined in terms of another*

Definition 21. *Operational definition: Defined by means of operations. Example: length can be defined by the measuring procedure.*

Definition 22. *Definitions by genus and difference (Analytical definitions): Class whose membership is divided: genus. Subclasses: species.*

0.6 Fallacies

0.6.1 Fallacies of relevance - 8

A3 MARS --- Appeal to logic, emotion, force, Missingthepoint-Adhomenim-Redherrring-Strawman

- **Appeal to populace:** Appeal to people's emotions. Eg. speeches by fascist leaders.
- **Appeal to emotion:** Appeal to base emotions such as pity.
- **Red herring:** Distract from the actual argument with a *deliberately misleading trail*. Etymology: People who used to try and save foxes from being hunted by leaving a smoked herring, which confuses dogs, and also turns red.
- **Strawman:** Misconstrue argument to make it seem weaker than it actually is, and then defeat the weakened argument.
- **Ad hominem — abusive type (Argument against the person):** Attack moral character of person.
- **Ad hominem — circumstantial type:** Attacking someone's argument based on their *circumstance*. Eg. calling a non-vegetarian who argues for reduced meat consumption a hypocrite. This does not reduce the validity of the argument at all.
- **Appeal to force:** Appeal to threats to coerce the other person to accept your argument.
- **Missing the point:** One attacks a different thesis than the one the interlocutor was advancing.

0.6.2 Fallacies of defective induction - (4)

IGNORE AUTHORITY CA(use) GE(generalization)

- **Argument from ignorance:** Arguing that just because something is not *proven* true, it *must* be false, or the converse.

- **Appeal to inappropriate authority:** Appeal to the authority of someone who is not an authority on the subject at hand.
Example: Invoking Picasso on a discussion about economics.
- **False cause:** Arguing for a cause-and-effect relationship where none exists. Eg. you fell sick because of the bees this time of year.
- **Hasty Generalization:** Performing induction from a very small sample size.

o.6.3 Fallacies of presumption - (3)

A(ccident) B(egging the question) C(omplex question) These come from presuming unjustified assumptions.

- **Accident:** Assuming a generalization applies to all concrete cases.
Example: It is wrong to steal. We can create corner cases such as “what if the person was hungry”? This falls under accident.
- **Complex question:** Constructing a loaded question where refuting a part of the question implicitly provides truth to another part, which was unintended.
Example: “With all of the hysteria, all of the fear, all of the phony science, could it be that man-made global warming is the greatest hoax ever perpetrated on the American people?”
- **Begging the question:** Assuming the conclusion in the supposition.
Example: “There is no such thing as knowledge which cannot be carried into practice, for such knowledge is really no knowledge at all.”