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Logic 101

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This presentation is a mash-up of material from Peter Kreeft and others, with some original material.

I. Structure of a Proof

Premise and Conclusion

Every argument has two basic parts: the premises and the conclusion. The conclusion is the truth claim. (For example: "Obama is the 44th president" can be a conclusion.) Premises are statements that, if true, support or prove your conclusion. (For example, statements that support the claim above might be: "Obama won the presidential election" and "there were 43 U.S. Presidents before 2004.")

Clear Terms

Both premises and conclusions are expressed in *words*. Human words can do many things: they can praise, sing, blame, declare, persuade and so on. The importance of words for arguing well is that they express *concepts*.

Concepts are the basic units of rational thought. Where do we get our concepts? Concept-acquisition is an interesting process. People disagree about how it works. A basic version is that the mind acquires concepts by a process called "apprehension". Here's a description from from Peter Kreeft:

> "Simple apprehension" is a technical term. It means basically "conceiving," "understanding," or "comprehending" one object of thought, one concept, such as 'mortal' or 'man' or 'triangle' or 'triangle with unequal angles.' Animals apparently cannot perform this act of understanding; if they can, they do not express it in words. Computers certainly cannot do this; a computer no more understands what you program into it than a library building understands the information in the books you put into it.

The two basic kinds of concept in logic are "subjects" and "predicates." Subjects are what the proposition is about ("Obama") and predicates are anything being claimed about the subject ("is the 44th president").

Most terms (especially important ones) need definition. State the definition of your key terms (not all of them, just the crucial ones). Don't cite the dictionary — the dictionary records how people use words (even incorrectly), not how they ought to be used correctly. Explain how you are using the term, and move on.

True premises

Propositions relate two concepts. Take "Fido" and "dog". "Fido is a dog" affirms that Fido is a particular kind of thing, a canine kind.

Propositions can either affirm or deny. "Fido is not a dog" is a denial." This activity is also called "judgement" or the activity of "Judging" – not evaluating but simply affirming or denying.

True premises are propositions we already know to be true or that we are reasonably confident are true. True beliefs originate from five main sources: experience, memory, testimony, authority, and reason.

- Experience. 1st-person observation, experience, insight in the present;
- Memory. 1st-person observation, experience, insight from the past;
- Testimony. 2nd-person testimony of someone else's experience (from a non-expert or non-authority);
- Authority. 2nd-person testimony from an expert or authority. All other true beliefs are inferred validly from premises derived from one of these sources.

Some truths are self-evident foundations of thinking. For example, the classical "laws of thought":

1. Every thing is identical to itself (A=A)
2. No thing can be A and not A at the same time in the same respect. (X cannot be A and not-A)
3. Every affirmation is either true or false. (A=true or A=false)

A Valid Inference

A argument or proof is composed of premises (propositions which are themselves composed of terms) that prove a conclusion (a proposition that one hopes is true).

What is the "support" or "proof" relationship between premises and conclusions? That is the mysterious move we call *inference*. This is moving from the known to the unknown.

An argument where the premises necessarily entail the conclusion is called **valid**.

Validity, in the technical sense, is not the same as truth. Some true arguments are invalid, and some false arguments are valid. For example, "all penguins have feathers; my dog has fur, therefore Greenland is an island" consists of all true statements, but the inference is invalid. Likewise, "If my grandmother is a duck, then she can fly. My grandmother is a duck. Therefore, she can fly," is a valid inference, but the argument is false since the second premise is false (obviously).

But if an inference is valid, then it is impossible for the premises to be true and the conclusion false.

In sum, a bad argument may have one or more of three properties: unclear terms, false premises, or an invalid inference. A good argument has three properties: clear terms, true premises, and a valid inference.

Example: 1. All humans die eventually. (known by observation and generalization) 2. Socrates is human. (known by conceptualization, reocgnition) 3. Socrates will die eventually. (conclusion, known by deductive inference)

A few common, valid, good argument forms are:

'All X are Y.' All human beings will die. All Z are X,' Socrates is a human being.
therefore all Z are Y.' Therefore, Socrates will die. (Called "Barbara")

'No X are Y, all Z are X, No pigs can fly. Babe is a pig. therefore no Z are Y.' Therefore Babe cannot fly. (Called "Celarent")

If X then Y. If it rained today, then the game was cancelled. X. It rained today.
Therefore Y.' Therefore, the game was cancelled. (Called "Modus Ponens")

'If X then Y. If a global nuclear war has occurred, then the world would be a wasteland. Not Y. The world is not a wasteland. Therefore not X.' So a global nuclear war has not occurred. ("Called "Modus Tollens")

II. All of Logic in 2 pages, by Peter Kreeft

The ancient philosophers defined Man as the "rational animal." To be human is (among other things) to reason, to give reasons for believing things to be true. We can see common forms, or structures, in all human reasoning, no matter what the contents, or objects, that we reason about. Logic studies those structures. The fundamental structure of all reasoning is the movement of the mind from premises to a conclusion. The conclusion is what you are trying to prove to be true; the premises are the reasons or evidence for the truth of the conclusion. The two basic kinds of reasoning are *inductive* and *deductive*. Inductive reasoning reasons from particular premises (e.g. "I' m mortal" and "You're mortal" and "He's mortal" and "She's mortal"), usually to a more general or universal conclusion (e.g. "All men are mortal"). Deductive reasoning reasons from at least one general, or universal premise (e.g. "All men are mortal") usually to a more particular conclusion (e.g. "I am mortal"). Inductive reasoning yields only probability, not certainty. (It is not certain that all men are mortal merely on the basis that four men, or 4 million, are.) Deductive reasoning, when correct, yields certainty. (It is certain that if all men are mortal, and if I am a man, then I am mortal.) A deductive argument succeeds in proving its conclusion to be true if and only if three conditions are met. **These are the three check points of any deductive argument.** (1) **First, all the terms must be clear and unambiguous.** If a term is ambiguous, it should be defined, to make it clear. Otherwise, the two parties to the argument may think they are talking about the same thing when they are not. (2) **Second, all the premises must be true.** You can (seem to) "prove" anything from false premises: e.g. "All Martians are infallible, and I am a Martian, therefore I am infallible." (3) **Third, the argument must be logically valid.** That is, the conclusion must necessarily follow from the premises, so that if 'the premises are true, then the conclusion must be true.

(1) A "term" in logic is the subject or the predicate of a proposition (a declarative sentence). Terms are either clear or unclear. Terms cannot be either true or false. E.g. "mortal" is neither true nor false. The proposition "All men are mortal" is true, and the proposition "Some men are not mortal" is false.

(2) Propositions are declarative sentences. They are either true or false. "True," in commonsense usage, means "corresponding to reality," and "false" means the opposite. There is no one simple and infallible way of telling whether any proposition is true or false. (3) There is, however, a fairly simple and truly infallible way of telling whether an argument is valid or invalid: the laws of logic, which you will learn in this book.

A deductive argument is logically valid if its conclusion necessarily follows from its premises, invalid if it does not. There are various forms of argument, and each form has its own inherent rules for validity.

All the rules for each form of argument are natural to that form of argument and to the human mind. If at any point in this book you think that any of its logical laws contradict what you already implicitly know by innate common sense, please stop and check; for you must be misunderstanding either the laws of logic or what you think common sense tells you, for logic does nothing more than make explicit the rules everyone knows innately by common sense. Arguments are made up of propositions (premises and a conclusion), and propositions are made up of terms (subject and predicate). Terms are either clear or unclear.

Propositions (whether premises or the conclusion) are either true or false. Arguments are either logically valid or invalid. Only terms can be clear or unclear; only propositions can be true or false; only arguments can be logically valid or invalid. **So the three questions you should habitually ask of yourself** when writing or speaking, and of others when you are reading or listening to them, are:

(1) Are the terms all clear and unambiguous? (2) Are the premises all true? (3) Is the reasoning all logically valid?

If the answer to all three of these questions is Yes, then the conclusion of the argument must be true. **So in order to disagree with any conclusion, you must show that there is either (1) an ambiguous term, or (2) a false premise, or (3) a logical fallacy in the argument such that the conclusion does not necessarily follow from the premises.** (You will soon learn the rules for judging that.) If you cannot do any of these three things, then honesty demands that you admit that the conclusion has been proved to be true. (All this applies to deductive arguments only; inductive arguments do not claim certainty.)

III. Fallacies: Your Argument is invalid

1. Formal fallacies = your argument is invalid.
2. Informal fallacies = something else is wrong with your argument.

The terms are unclear. A premise is false. The conclusion is assumed in the premises. Something has gone wrong.

There are about 216 different informal fallacies. We can categorize them into about four major groups. Fallacies of Relevence, Fallacies of Presumption, and Fallacies of Ambiguity, and Fallacies of Faulty Inference.

Fallacies of Irrelevance

1. **Ad Hominem.** (Attacking the person): This fallacy occurs when, instead of addressing someone's argument or position, you irrelevantly attack the person or some aspect of the person who is making the argument. The fallacious attack can also be direct to membership in a group or institution. Example: "Socrates' arguments about human excellence are rubbish. What could a man as ugly as he know about human excellence." "No, I will not reply. I see no need to defend my views against the objections of ignoramuses."
2. **Appeal to Ignorance**. This fallacy occurs when you argue that your conclusion must be true, because there is no evidence against it. This fallacy wrongly shifts the burden of proof away from the one making the claim. Example: "You know that scientists can't prove that UFO's do not visit the Earth, so it makes sense to believe in them." "Since all who have tried to prove freedom of the will have failed, we are safe in assuming we are not free."
3. **Appeal to (Irrelevant) Authority**. You appeal to authority if you back up your reasoning by saying that it is supported by what some authority says on the subject. Most reasoning of this kind is not fallacious, and much of our knowledge properly comes from listening to authorities. However, appealing to authority as a reason to believe something is fallacious whenever the authority appealed to is not really an authority in this particular subject, when the authority cannot be trusted to tell the truth, when authorities disagree on this subject (except for the occasional lone wolf), when the reasoner misquotes the authority, and so forth. Although spotting a fallacious appeal to authority often requires some background knowledge about the subject or the authority, in brief it can be said that it is fallacious to accept the words of a supposed authority when we should be suspicious of the authority's words. Example:"The moon is covered with dust because the president of our neighborhood association said so." "Pacifism is a good idea because the brilliant scientist Einstein advocated it."
4. **Ad Populum (Appeal to the People, Appeal to Majority)**. If you suggest too strongly that someone's claim or argument is correct simply because it's what most everyone believes, then your reasoning contains the Fallacy of Appeal to the People. Similarly, if you suggest too strongly that someone's claim or argument is mistaken simply because it's not what most everyone believes, then your reasoning also uses the fallacy. Agreement with popular opinion is not necessarily a reliable sign of truth, and deviation from popular opinion is not necessarily a reliable sign of error, but if you assume it is and do so with enthusiasm, then you are using this fallacy. It is essentially

the same as the fallacies of Ad Numerum, Appeal to the Gallery, Appeal to the Masses, Argument from Popularity, Argumentum ad Populum, Common Practice, Mob Appeal, Past Practice, Peer Pressure, and Traditional Wisdom. The "too strongly" mentioned above is important in the description of the fallacy because what most everyone believes is, for that reason, somewhat likely to be true, all things considered. However, the fallacy occurs when this degree of support is overestimated. Example: "You should turn to channel 6. It's the most watched channel this year."

5. **Faulty Analogy**. This fallacy consists in assuming that because two things are alike in one or more respects, they are necessarily alike in some other respect. Examples: "Medical Student:"No one objects to a physician looking up a difficult case in medical books. Why, then, shouldn't students taking a difficult examination be permitted to use their textbooks?" "Because human bodies become less active as they grow older, and because they eventually die, it is reasonable to expect that political bodies will become less and less active the longer they are in existence, and that they too will eventually die."
6. **Group think**. A reasoner uses the Group Think Fallacy if he or she substitutes pride of membership in the group for reasons to support the group's policy. If that's what our group thinks, then that's good enough for me. It's what I think, too. "Blind" patriotism is a rather nasty version of the fallacy. Example: "We K-Mart employees know that K-Mart brand items are better than Wall-Mart brand items because, well, they are from K-Mart, aren't they?"; "97% of scientists agree that human caused climate change is real."

Fallacies of Presumption

1. **Begging the Question.** The fallacy of begging the question occurs when an argument's premises assume the truth of the conclusion, instead of supporting it. In other words, you assume without proof the stand/position, or a significant part of the stand, that is in question. Begging the question is also called arguing in a circle. Example: "Erica:"How do you know that the bible is divinely inspired?" Pedro: "Because is says right in the third chapter of II Timothy that 'all scripture is given by divine inspiration of God.';"People who deny the truth of Marxism are simply dancing to the tune of their capitalist masters, as Marx understood so well."
2. **False Dilemma**. When you reason from an either-or position and you haven't considered all relevant possibilities you commit the fallacy of false dilemma. Examples: "Are you a Republican or a Democrat?" "Good students will study and learn without the threat of an exam, and bad students won't study and learn even with the threat of an exam. So, exams serve no purpose."
3. **Loaded question**. Assuming something false as a premise of a question. Example: Prosecutor to defendant: "So how did you feel when you robbed the bank?" Reporter to politician: "When will you stop being a racist?"
4. **Hedging**. You are hedging if you refine your claim simply to avoid counterevidence and then act as if your revised claim is the same as the original. Example: "Samantha: David is a totally selfish person. Yvonne: I thought we was a boy scout leader. Don't you have to give a lot of your time for that? Samantha: Well, David's totally selfish about what he gives money to. He won't spend a dime on anyone else. Yvonne: I saw him bidding on things at the high school auction fundraiser. Samantha: Well, except for that he's totally selfish about money."
5. **No True Scotsman**. This error is a kind of Ad Hoc Rescue of one's generalization in which the

reasoner re-characterizes the situation solely in order to escape refutation of the generalization. Example: "Smith: All Scotsmen are loyal and brave. Jones: But McDougal over there is a Scotsman, and he was arrested by his commanding officer for running from the enemy.Smith: Well, if that's right, it just shows that McDougal wasn't a TRUE Scotsman."

Fallacies of Ambiguity

1. **Equivocation**. An equivocation trades upon the use of an ambiguous word or phrase in one of its meanings in one of the propositions of an argument but also in another of its meanings in a second proposition. Example: "Really exciting novels are rare. But rare books are expensive.Therefore, Really exciting novels are expensive."
2. **Amphiboly**. An amphiboly can occur even when every term in an argument is univocal, if the grammatical construction of a sentence creates its own ambiguity. Example: "A reckless motorist Thursday struck and injured a student who was jogging through the campus in his pickup truck. Therefore, it is unsafe to jog in your pickup truck."

Fallacies of Faulty Inference

1. **Hasty generalization.** This fallacy occurs when we we make a generalization on the basis of insufficient evidence. This may occur when we rely on too small of a sample or an unrepresentative sample to support the generalization. Example: "Children of faculty are brats. I baby-sit for one of my professors and his children are spoiled and demanding."; "You don't want to take history from a man. They always have a sexist bias."
2. **Composition and Division.**
3. **Straw man**. Your reasoning contains the Straw Man Fallacy whenever you attribute an easily refuted position to your opponent, one that the opponent wouldn't endorse, and then proceed to attack the easily refuted position (the straw man) believing you have thereby undermined the opponent's actual position. If the misrepresentation is on purpose, then the Straw Man Fallacy is caused by lying. Example: "Opponent: Because of the killing and suffering of Indians that followed Columbus's discovery of America, the City of Berkeley should declare that Columbus Day will no longer be observed in our city. Speaker: This is ridiculous, fellow members of the city council. It's not true that everybody who ever came to America from another country somehow oppressed the Indians. I say we should continue to observe Columbus Day, and vote down this resolution that will make the City of Berkeley the laughing stock of the nation."
4. **Non Sequitur**. When a conclusion is supported only by extremely weak reasons or by irrelevant reasons, the argument is fallacious and is said to be a Non Sequitur. However, we usually apply the term only when we cannot think of how to label the argument with a more specific fallacy name. Any deductively invalid inference is a non sequitur if it also very weak when assessed by inductive standards. Example: "Nuclear disarmament is a risk, but everything in life involves a risk. Every time you drive in a car you are taking a risk. If you're willing to drive in a car, you should be willing to have disarmament."
5. **Slippery Slope**. In a slippery slope argument, a course of action is rejected because, with little or no evidence, one insists that it will lead to a chain reaction resulting in an undesirable end or ends. The slippery slope involves an acceptance of a succession of events without direct evidence that

this course of events will happen. Example: "We can't permit the sale of marijuana by doctor's prescription, because that will lead people to believe it's an acceptable drug; this will open the floodgates to the complete legalization of the drug for use by every pothead in the country."; "If Texas adopts a personal income tax, I'm moving away. An income tax at the state level is just a first step to communism."

IV. Conclusion

There are many other fallacies. But begin to recognize and avoid these. For a larger list of awesome fallacies, read here.

For two hilarious essays on how NOT to argue:

1. How to Argue, Dave Barry
2. How to be persuasive, Wes Boyer and Samuel Stoddard

And for my Sources:

1. Bradley Dowden, http://www.iep.utm.edu/fallacy/#NoTrueScotsman
2. Peter Kreeft, *Socratic Logic*
3. Garth Kemerling, The Philosopy Pages, "http://www.philosophypages.com/lg/e06c.htm"
4. Texas State University Philosophy Department. http://www.txstate.edu/philosophy/resources/fallacy-definitions/Unwarranted-Generalization.html

Final Summary

(Logic does not deal with interrogative sentences (questions, like "What time is it?"), imperative sentences (commands or requests, like "Pass the mus• tard, please"), exclamatory sentences (like "Oh! Wow! What a hit!"), or perfor• mative sentences (like "I dub thee knight"), but only with declarative sentences, sentences that claim to state a truth.) Non-declarative sentences are not proposi• tions.

The difference between logic and language is (1) that languages are man- made artifices and therefore (2) there are many languages that are different in place and time, while (1) logic is not made but discovered, and (2) there is only one logic. There is no "Chinese logic" or "American logic," no "19th century logic" or "20th century logic," or even "masculine logic"«or "feminine logic," just logic. (What is often called "feminine logic" is intuition rather than logic: a formidable and invaluable power of the mind but not teachable by textbooks.) Like mathematics, logic is objective, universal, and unchangeable in its basic laws or principles. But the forms in which these unchangeable laws of logic are expressed are linguistic forms, and these forms are changing and varied.

A term has no structural parts. It is a basic unit of meaning, like the num• ber one in math or like an atom in the old atomic theory (when they believed atoms were unsplittable and had no parts).

A proposition has two structural parts: the subject term and the predicate term. The subject term is what you 're talking about. The predicate term is what you say about the subject. The word "subject" and "predicate" mean the same thing in logic as in grammar.

An argument has two structural parts: the premises and the conclusion. The premises are the propositions that are assumed. They are the reasons or evidence for the conclusion. The conclusion is the proposition that you are trying to prove.