

A Quick Course in Basic Logic

Dennis Earl
Coastal Carolina University
dearl@coastal.edu, <http://ww2.coastal.edu/dearl>

(Some examples taken from Patrick Hurley, *A Concise Introduction to Logic*, 8th Ed. (Wadsworth, 2003))

Outline:

- Arguments, argument indicators, recognizing arguments
- Deductive and inductive arguments
- Validity and soundness, strength and cogency, valid argument forms
- Philosophical analysis
- Informal Fallacies

Arguments, argument indicators, recognizing arguments

Some definitions of basic terms in logic:

Argument—a set of statements such that the premises are claimed to provide rational support for the conclusion

Conclusion—the statement an argument claims to defend or prove

Premise—the statement(s) that give the evidence or support for the conclusion

Two basic claims every argument makes:

- (i) A factual claim—Every argument claims that all of its premises are true, as well as the conclusion.
- (ii) An inferential claim—Every argument claims that its premises support its conclusion (in some way or other)

A corollary of this: Every argument can go wrong in two different ways, corresponding to these two basic claims:

- (i) An argument can be bad on account of having at least one false premise.
- (ii) An argument can be bad on account of its premises not providing adequate support for its conclusion.

Argument indicators

An argument indicator is a word or phrase that *indicates* that an argument is being expressed, and also which *component* (either a premise or conclusion) of an argument is being expressed.

Conclusions are often indicated by the following words or phrases:

‘therefore’	‘hence’
‘thus’	‘consequently’
‘so’	‘implies that’
‘it follows that’	‘accordingly’

What goes *after* such words and phrases typically is intended as a conclusion of an argument or inference. The premises of an argument almost always will appear *before* such words and phrases.

Premises are often indicated by the following words or phrases:

- 'since'
- 'because'
- 'for the reason that'
- 'for' and 'as' (sometimes, especially when used to *begin* a sentence)
- 'insofar as'
- 'given that'

What goes *after* such words and phrases typically is intended as a premise of an argument or inference. A conclusion will typically appear *before* such words and phrases.

Recognizing arguments

In the following passages, identify the premise(s) and conclusion of the argument being given.

1. All crimes are violations of the law. Theft is a crime. Therefore, theft is a violation of the law.
2. Expectant mothers should never use recreational drugs, since the use of these drugs can jeopardize the development of the fetus.
3. Since the good, according to Plato, is that which furthers a person's real interests, it follows that in any given case when the good is known, men will seek it (Hurley 7).
4. The fact that there was never a land bridge between Australia and mainland Asia is evidenced by the fact that the animal species in the two areas are very different. Asian placental mammals and Australian marsupial mammals have not been in contact in the last million years (Hurley 8).
5. Since private property helps people define themselves, since it frees people from mundane cares of daily subsistence, and since it is finite, no individual should accumulate so much property that others are prevented from accumulating the necessities of life (Hurley 8).
6. Every art and every inquiry, and similarly every action and pursuit, is thought to aim at some good; and for this reason the good has rightly been declared to be that at which all things aim (Hurley 9, from Aristotle, *Nichomachean Ethics*).
7. The space program deserves increased expenditures in the years ahead. Not only does the national defense depend upon it, but the program will more than pay for itself in terms of technological spinoffs. Furthermore, at current funding levels the program cannot fulfill its anticipated potential.
8. The stakes in whistleblowing are high. Take the nurse who alleges that physicians enrich themselves in her hospital through unnecessary surgery; the engineer who discloses safety defects in the braking systems of a fleet of new rapid-transit vehicles; the Defense Department official who alerts Congress to military graft and overspending: all know that they pose a threat to those whom they denounce and that their own careers may be at risk (Hurley 9-10, from Sissela Bok, "Whistleblowing and Professional Responsibility").

Deductive and inductive arguments

More definitions: two kinds of arguments

Deductive argument—an argument where the conclusion is claimed to be *guaranteed* by the truth of the premises

Inductive argument—an argument where the conclusion is claimed to be *supported* but *not* guaranteed by the truth of the premises

Examples of deductive arguments

For each of the following arguments, I've written them out in a more formalized way. The premises are listed first, and the conclusion comes at the end. Between the premises and the conclusion is a line, where the line signifies that what is *below* the line is meant to be *guaranteed by* or to *follow from* or to be *deduced from* what is above the line.

From last time, consider once again the passage

All crimes are violations of the law. Theft is a crime. Therefore, theft is a violation of the law.

This argument can be restated as

- (1) All crimes are violations of the law.
- (2) Theft is a crime.

- (3) Theft is a violation of the law.

The argument is deductive, since *if* the premises are both true, the conclusion *must* be true. Here are some other examples of deductive arguments:

- (1) All men are mortal.
- (2) Socrates is a man.

- (3) Socrates is mortal.

Bear in mind that even though Socrates has been dead for quite a while, and thus that (2) is false, the argument is *still* a deductive argument. For once again, *if* both premises are true, then the conclusion must be true too. Here is another one that is deductive, even though I assure you that at one of the premises is false.

- (1) If Dennis is Satan, then everyone in PHIL 101 will fail the course.
- (2) Dennis is Satan.

- (3) Everyone in PHIL 101 will fail the course.

Here is one last one. It doesn't matter who John is—just notice that the way the argument is structured *guarantees* that if both premises are true, then the conclusion must be true too.

- (1) Either John is a theist or John is going to hell.
 - (2) John is not a theist.
-

- (3) John is going to hell.

Examples of inductive arguments

Again, I've written these out in the same sort of formalized way as for the arguments above. Notice though that the line between premises and conclusion is a *double* line—that signifies that the argumentative move or *inference* being made is inductive. That means that the claim being made is that the truth of the premises of the argument would *support*, but not necessarily guarantee, the truth of the conclusion of the argument.

There are several different kinds of inductive arguments, and I'll keep them separate in what follows. The first type of inductive argument is called an *inductive generalization*. The other sort of inductive argument is called an *argument by analogy*.

Examples of inductive generalizations

- (1) The sun has risen every day for the last million years.
-

- (2) The sun will rise tomorrow.

There is only one premise here, and if it is true, then that does seem to give some rational support for the conclusion. But that doesn't *guarantee* that the conclusion is true. Here are two more:

- (1) Every observed emerald has been green.
-

- (2) All emeralds are green.

- (1) Chemotherapy cures cancer 70% of the time.
-

- (2) The next use of chemotherapy will cure that instance of cancer.

Now, consider what might seem to be a trickier case of an inductive generalization. Suppose we've tossed a coin a million times, and the outcome is that given in (1) below. We then make the inference from that evidence to the conclusion as follows:

- (1) The coin toss has come up heads the last million times in a row.
-

- (2) The next coin toss will come up heads.

Is this inductive argument a good inference or not?

Examples of arguments by analogy

In an argument by analogy (or an argument *from* analogy, as they're sometimes called), there are at least two things being claimed to be similar in some stated respect, there is a characteristic that one of those things has, and the argument makes the inference that the *other* thing has that same characteristic. For instance,

- (1) Apes and humans are similar in that they are both advanced primates.
 - (2) Intense exposure to X-rays causes cancer in apes.
-

- (3) Intense exposure to X-rays causes cancer in humans.

(1) draws a comparison between apes and humans. (2) states that one of the things being compared (apes, in this case) has a given characteristic (being such that intense exposure to X-rays causes cancer in them, in this case). The conclusion (3) states that humans have that same characteristic. Here is another example:

- (1) My eye and my watch are similar in that both have a purpose.
 - (2) My watch was designed by an intelligent being.
-

- (3) My eye was designed by an intelligent being.

This is one statement of what is called *the argument from design*, incidentally, and it is an argument some theists use to support their position. Now for a critical question: *What criticism might someone make in opposition to that argument?* Even if you happen to find the argument compelling, think about what might be wrong with the argumentative move here.

Dealing with such critical questions will be included in the next topic, which is the topic of “goodness” and “badness” as far as arguments are concerned.

Validity and soundness, strength and cogency, valid argument forms

Deductive arguments—validity and soundness

Consider these two arguments once more:

- (1) All crimes are violations of the law.
 - (2) Theft is a crime.
-

- (3) Theft is a violation of the law.

- (1) If Dennis is Satan, then everyone in PHIL 101 will fail the course.
 - (2) Dennis is Satan.
-

- (3) Everyone in PHIL 101 will fail the course.

Both arguments are such that the truth of their premises would guarantee the truth of their conclusions. But something is wrong with the second argument: (2) is false. So even though there's something good about that second argument, there's also something bad about it. As it turns out, there are two different notions of "goodness" when it comes to deductive arguments.

Validity. One way a deductive argument can be good is if the truth of its premises would guarantee the truth of its conclusion. If a deductive argument is good in that way, then it's called a *valid argument*. On the other hand, if an argument is such that the truth of its premises would *not* guarantee the truth of its conclusion, then it's called an *invalid argument*. Now, to see if an argument is valid or not, take the argument under consideration and ask the following question:

Suppose that all of the premises of the argument are true. Would that ensure or *guarantee* that the conclusion of that argument is true?

If the answer is 'yes', then the argument is *valid*. If the answer is no, then the argument is *invalid*.

Soundness. The other way a deductive argument can be good is to be a valid argument with premises that are all true. A valid argument with all true premises is called a *sound argument*. Of the two arguments given above, both are valid, but only the first one is sound. Go back and look at them again, and ask the following two questions:

- (1) Is the argument valid?
- (2) Are all of the premises of that argument true?

If the answer is 'yes' to *both* questions then the argument is sound. If the answer is 'no' to *either* question then the argument is *unsound*.

Testing for validity

Sometimes it's hard to tell whether the truth of an argument's premises would guarantee the truth of its conclusion. But there is a method that is helpful here: *The method of imaginative counterexamples*. Ask a slightly different question this time:

Is it *possible* for all of the premises of the argument to be true while at the same time the conclusion is false?

In other words, *could* there be a world where all of the premises of the argument are true while at the same time the conclusion is false? If the answer is 'yes', then the argument in question is *invalid*. But how does one defend a 'yes' answer here? All one needs to do is to *describe an imagined case* where all of the premises are true yet the conclusion is false.

Consider the following argument:

- (1) All Texans are republicans.
- (2) George W. Bush is a republican.

(3) George W. Bush is a Texan.

This argument is invalid, because it is *possible* for all of the premises to be true while at the same time the conclusion is false. First, ask yourself this:

Could it be that all Texans are republicans and that George W. Bush is a republican too?

Yes. It's easy enough to imagine a world where everyone from Texas, along with George W. Bush, is a republican. Now ask one more question:

In *that world*, could it be false that George W. Bush is a Texan?

The answer is 'yes'—It's easy enough to imagine that Bush isn't from Texas in that imagined world where all Texans are republicans and Bush is a republican too. What does all of this show? It shows that it is *possible* for all of the premises of the argument to be true while the conclusion is false, and so that shows that the argument is *invalid*.

Inductive arguments—strength and cogency

For inductive arguments, the qualities analogous to validity and soundness are *strength* and *cogency*.

An argument is *strong*, in this sense, if the truth of its premises would make its conclusion *more likely* (even if it does not guarantee that conclusion). An argument that is not strong is called *weak*.

An argument is *cogent* if it is both strong and has premises that are all true. An argument that is not strong is called *noncogent*.

Consider the following argument once more.

(1) The sun has risen every day for the last million years.
=====

(2) The sun will rise tomorrow.

This argument looks to be strong: Even though the truth of (P1) would not *guarantee* (C), it still would make (C) likely to be true. Is it cogent? Given that the argument is strong, and given that (P1) looks to have good support (at least in temperate latitudes), the argument looks to be cogent. Now consider

(1) The sun has risen every day for the last million years.
=====

(2) The sun will *not* rise tomorrow.

This one is weak: The conclusion is *not* more likely if the premise (1) is true. Thus it is noncogent as well.

Evaluating inductive generalizations (see also Anthony Weston, *A Rulebook for Arguments*, Hackett, 2001)

Are there any general rules for evaluating inductive generalizations? For such arguments, where the premises give instances of a generalization, and the conclusion gives either the generalization itself or makes a claim about the *next* instance of that generalization, there are a few rough rules to follow.

(I) Have a large enough *sample size* for making the generalization.

It seems like a strong argument to infer from the sun's rising every day for the last million years to the claim that it will rise tomorrow. But inferring from the sun's rising *yesterday* to its rising tomorrow doesn't look like enough evidence. Suppose one generalizes from a number of samples of metals expanding when heated to the generalization that *all metals expand when heated*. One needs a decent *number* of samples in order for the inference to be strong.

(II) Have a *variety* of different samples for making the generalization.

Suppose the samples of metals expanding when heated were all made of aluminum. It doesn't seem then as if generalizing to the claim that *all metals expand when heated* is a strong argument. Perhaps we could generalize to *samples of aluminum expand when heated*, but not to *all metals expand when heated*. Some variety among the samples is needed.

(III) Have no *disconfirming samples*—have no samples that count as evidence *against* the generalization.

It hardly counts as a good argument for the claim that *all metals expand when heated* to have among one's evidence a sample of a metal that *doesn't* expand when heated.

Evaluating arguments from analogy

What about arguments from analogy? How does one evaluate them for strength or weakness? Recall the following argument:

- (1) Apes and humans are similar in that they are both advanced primates.
- (2) Intense exposure to X-rays causes cancer in apes.

=====

- (3) Intense exposure to X-rays causes cancer in humans.

This argument looks to be strong, but why? Just what is it about an argument from analogy that makes it strong or weak? The answer depends on the *strength of the analogy* itself, for if the things being compared are similar in a *relevant* respect, the argument is more likely to be strong. On the other hand, if the things being compared are similar in some respect that is *irrelevant* to the inference being drawn, then the argument is more likely to be weak. In the argument above, it seems that the similarity of *being advanced primates* is indeed relevant to the characteristic being projected from apes to humans, the characteristic of *being susceptible to cancer given intense exposure to X-rays*.

Here is a bad argument from analogy:

- (1) Humans and mannequins are similar in that they are both the same overall shape.
- (2) Intense exposure to X-rays causes cancer in humans.

=====

- (3) Intense exposure to X-rays causes cancer in mannequins.

Here the comparison being drawn is irrelevant to the characteristic being projected from humans to mannequins. *Being the same overall shape* is irrelevant to whether something is susceptible to cancer given exposure to X-rays, and so the argument is weak.

Now consider the last example argument from analogy:

- (1) My eye and my watch are similar in that both have a purpose.
- (2) My watch was designed by an intelligent being.

- (3) My eye was designed by an intelligent being.

Is *having a purpose* a characteristic that is relevant to projecting the characteristic of *being designed by an intelligent being* from one thing to another? That's the issue here, and I'll leave that for you to consider further. We will return to this argument (which is a statement of the argument from design, remember) later in the course.

Philosophical analysis

See my "Classical Conceptual Analysis," in Nils Rauhut and Renee Smith, *Readings on the Ultimate Questions*, Longman, 2005. (An online version is at this address:
<http://ww2.coastal.edu/dearl/PHIL101/EarlCCA.pdf>)

Informal fallacies

See my "Dennis' Short Catalog of Informal Fallacies" (online at
<http://ww2.coastal.edu/dearl/PHIL101/Fallacies.html>)