

Critical Thinking

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MGM 115

Lecture 2



Lecture 2

Basic logical concepts

From Critical Thinking, Bassham and others

This lecture includes:

- (1) Deduction and induction**
- (2) Indicator words**
- (3) Common patterns of deductive reasoning**
- (4) Common patterns of inductive reasoning**
- (5) Deductive validity**
- (6) Inductive strength**

In the previous chapter, we talked about what arguments are and how we can distinguish them from nonarguments.

In this chapter we introduce some basic logical concepts needed to distinguish good arguments from bad ones.

In evaluating any argument, one should always ask two key questions:

(1) Are the premises true?

(2) Do the premises provide good reasons to accept the conclusion?

Before we can effectively evaluate an argument, we need to understand what kind of argument is being offered.

Traditionally, arguments have been divided into two types:

Deductive arguments and inductive arguments. Because the standards for evaluating deductive and inductive arguments are quite different, it is important to understand the difference between these two types of arguments.

Deductive arguments try to prove their conclusions with rigorous, inescapable logic. Inductive arguments try to show that their conclusions are plausible or likely given the premise(s).

Here are two examples of deductive arguments:

All humans are mortal.

Socrates is human.

Therefore, Socrates is mortal.

If the president lives in the White House, then he lives in Washington, D.C.

The president does live in the White House.

So, the president lives in Washington, D.C.

- **Notice how the conclusions of these arguments flow from the premises with a kind of inescapable logic. Each argument's conclusion follows necessarily from the premises. Arguments are deductive when their premises are intended to provide this kind of rigorous, airtight logical support for their conclusions.**
- **Deductive arguments claim to provide logically conclusive grounds for their conclusions. That is, they attempt to show that their conclusions must be true given the premises asserted**

Inductive arguments

Inductive arguments, simply claim that their conclusions are likely or probable given the premises offered.

Polls show that 75 percent of Republicans favor a school prayer amendment.

Joe is a Republican.

Therefore, Joe likely favors a school prayer amendment.

Differences between Deductive & Inductive

• Deductive

- If the premises are **true**, then the conclusion **must be true**.
- The conclusion follows **necessarily** from the premises.
- It is **impossible** for all the premises to be true and the conclusion false.
- It is logically inconsistent to assert the premises and deny the conclusion; if you accept the premises, you **must accept** the conclusion.

• Inductive

- If the premises are **true**, then the conclusion **is probably true**.
- The conclusion follows **probably** from the premises.
- It is **unlikely** for the premises to be true and the conclusion false.
- Although it is logically consistent to assert the premises and deny the conclusion, the conclusion is **probably** true if the premises are true.

Is the argument deductive or inductive

We have seen that an argument is deductive if its premises are intended to provide conclusive grounds for the truth of its conclusion, and inductive if its premises are intended to provide merely probable grounds for the truth of its conclusion. But it is not always easy to know what a given speaker or writer intends. For that reason, it is sometimes difficult to tell whether a particular argument is deductive or inductive.

4 tests to determine deductive or inductive

- **The indicator word test**
- **The strict necessity test**
- **The common pattern test**
- **The principle of charity test**

some common deduction indicator words :

Certainly

It logically follows that

Definitely

It is logical to conclude that

Absolutely

This logically implies that

Conclusively

This entails that

some common induction indicator words:

Probably

Likely

It is plausible to suppose that

It is reasonable to assume that

One would expect that

It is a good bet That

Chances are that

Odds are that

The Strict Necessity Test

The strict necessity test can be stated as follows:

- **An argument's conclusion either follows with strict logical necessity from its premises or it does not.**
- **If the argument's conclusion does follow with strict logical necessity from its premises, the argument should always be treated as deductive.**
- **If the argument's conclusion does not follow with strict logical necessity from its premises, the argument should normally be treated as inductive.**

The Strict Necessity Test

- **Alan is a father. Therefore, Alan is a male.**
- **Does the conclusion of this argument (“Alan is a male”) follow with strict necessity from the premise (“Alan is a father”)?**
Could it possibly be true that Alan is a father yet false that he is a male? Clearly not, for by definition all fathers are male.
According to the strict necessity test, therefore, this argument is clearly deductive.

- **Jill is a six-year-old girl. Therefore, Jill cannot run a mile in one minute flat.**
- **What about this argument? Could it be true that Jill is a six-year old girl yet false that she cannot run a mile in one minute flat? Yes. Of course, it's not physically possible for a six-year-old girl to run a mile in one minute flat. Six-year-old girls (and human beings in general) just lack the physical equipment to be able to do that. But there is no logical contradiction in thinking that there could be a six-year-old girl who could run that fast. It is logically possible, therefore, that the premise is true and the conclusion is false. Thus, the conclusion does not follow with strict logical necessity from the premises. So, the argument should be treated as inductive.**

Because deductive and inductive arguments often occur in characteristic, telltale patterns of reasoning, we can apply the common pattern test to determine which kind of reasoning we are dealing with.

Consider this argument:

If we're in Paris, then we are in France.

We are in Paris.

Therefore, we are in France.

This argument has a particular pattern or form that occurs frequently in deductive reasoning. The general pattern of the argument is this:

If [the first statement] is true, then [the second statement] is true.

[The first statement] is true.

Therefore, [the second statement] is true.

The Principle of Charity Test

The principle of charity should never be used to reinterpret bad arguments as good ones. The principle of charity is a principle of interpretation, not a principle of argument repair. Its basic purpose, like that of the other three tests, is to help us decide what arguments are actually being offered, not to replace bad arguments with ones we think are better. Thus, the principle should be used only when there is genuine uncertainty about how an argument should be interpreted. It should not be used when it is clear what argument has actually been put forward.

How to Distinguish Deductive from Inductive Arguments

1. If the conclusion follows necessarily from the premises, the argument should always be treated as deductive.
2. If the conclusion does not follow necessarily from the premises, the argument should be **treated as inductive unless**:
 - (a) The language or context of the argument makes clear that the argument is deductive or
 - (b) The argument has a pattern of reasoning that is characteristically deductive.

- 3. If the argument has a pattern of reasoning that is characteristically deductive, the argument should be treated as deductive unless there is clear evidence that the argument is intended to be inductive.**
- 4. If the argument has a pattern of reasoning that is characteristically inductive, the argument should be treated as inductive unless there is clear evidence that the argument is intended to be deductive.**

5. Arguments often contain indicator words—words like probably, necessarily, and certainly —that provide clues in determining whether an argument is deductive or inductive. Keep in mind, however, that indicator words are often used loosely or improperly.

6. If there is significant doubt about whether an argument is deductive or inductive, always interpret the argument in the way most favorable to the arguer.

Common Patterns of Deductive Reasoning

Often, the quickest way to determine whether an argument is deductive or inductive is to note whether it has a pattern of reasoning that is characteristically deductive or inductive. In this section we discuss five common patterns of deductive reasoning:

- **Hypothetical syllogism**
- **Categorical syllogism**
- **Argument by elimination**
- **Argument based on mathematics**
- **Argument from definition**

A syllogism is a three-line argument, that is, an argument that consists of exactly two premises and a conclusion. A hypothetical syllogism is a syllogism that contains at least one hypothetical or conditional (i.e., if-then) premise.

**If I want to keep my financial aid, I'd better study hard.
I do want to keep my financial aid.
Therefore, I'd better study hard.**

A categorical syllogism may be defined as a three-line argument in which each statement begins with the word all, some, or no.

example:

All oaks are trees.

All trees are plants.

So, all oaks are plants

An argument by elimination seeks to logically rule out various possibilities until only a single possibility remains.

Example:

Either Joe walked to the library or he drove.

But Joe didn't drive to the library.

Therefore, Joe walked to the library.

Argument Based on Mathematics

Mathematics is a model of logical, step-by-step reasoning.

Mathematicians don't claim that their conclusions are merely likely or probable. They claim to prove their conclusions on the basis of precise mathematical concepts and reasoning. In an argument based on mathematics, the conclusion is claimed to depend largely or entirely on some mathematical calculation or measurement (perhaps in conjunction with one or more nonmathematical premises).

example:

Eight is greater than four.

Four is greater than two.

Therefore, eight is greater than two.

In an argument from definition , the conclusion is presented as being “true by definition,” that is, as following simply by definition from some key word or phrase used in the argument.

Example:

Janelle is a cardiologist. Therefore, Janelle is a doctor.

Bertha is an aunt. It follows that she is a woman.

Common Patterns of Inductive Reasoning

Six common patterns of inductive reasoning:

- **Inductive generalization**
- **Predictive argument**
- **Argument from authority**
- **Causal argument**
- **Statistical argument**
- **Argument from analogy**

An inductive generalization is an argument in which a generalization is claimed to be probably true based on information about some members of a particular class.

Example:

All dinosaur bones so far discovered have been more than sixty-five million years old.

Therefore, probably all dinosaur bones are more than sixty-five million years old.

A prediction is a statement about what may or will happen in the future. In a predictive argument, a prediction is defended with reasons. Predictive arguments are among the most common patterns of inductive reasoning.

example:

Most U.S. presidents have been tall.

Therefore, probably the next U.S. president will be tall.

An argument from authority asserts a claim and then supports that claim by citing some presumed authority or witness who has said that the claim is true.

Examples:

More Americans die of skin cancer each year than die in car accidents. How do I know? My doctor told me.

Because we can never be absolutely certain that a presumed authority or witness is accurate or reliable, arguments from authority should normally be treated as inductive. Arguments from authority are sometimes deductive, however. For example: Whatever the Quran teaches is true.

The Quran teaches that we should love our neighbors.

Therefore, we should love our neighbors.

Because the conclusion of this argument follows necessarily from the premises, the argument is deductive.

A causal argument asserts or denies that something is the cause of something else.

Example:

I can't log on. The network must be down.

It cannot be assumed, however, that causal arguments are always inductive.

The following causal argument, for example, is clearly deductive:

Whenever iron is exposed to oxygen, it rusts.

This iron pipe has been exposed to oxygen.

Therefore, it will rust.

A statistical argument rests on statistical evidence—that is, evidence that some percentage of some group or class has some particular characteristic.

Because statistical evidence is generally used to support claims that are presented as probable rather than certain, statistical arguments are usually inductive. It should be noted, however, that statistical evidence can be used in deductive reasoning. For example: If 65 percent of likely voters polled support Senator Beltway, then Senator Beltway will win in a landslide.

An analogy is a comparison of two or more things that are claimed to be alike in some relevant respect. In an argument from analogy, the conclusion is claimed to depend on an analogy (i.e., a comparison or similarity) between two or more things.

Example:

Bill is a graduate of Central University, and he is bright, energetic, and dependable.

Mary is a graduate of Central University, and she is bright, energetic, and dependable.

Paula is a graduate of Central University.

Therefore, most likely, Paula is bright, energetic, and dependable, too.

A valid deductive argument is an argument in which it is impossible for all the premises to be true and the conclusion false. Put another way, a valid deductive argument (or valid argument for short) is an argument in which these conditions apply:

- If the premises are true, the conclusion must be true.**
- The conclusion follows necessarily from the premises.**
- The premises provide logically conclusive grounds for the truth of the conclusion.**
- It is logically inconsistent to assert all the premises as true and deny the conclusion.**

Deductive arguments that combine both of these desirable features—that is, deductive arguments that are both valid and have all true premises—are called sound deductive arguments.

Deductive arguments that either are invalid or have at least one false premise, or both, are called unsound deductive arguments.

Inductive arguments, like deductive arguments, can be well reasoned or poorly reasoned. A well-reasoned inductive argument is called a strong inductive argument.

More precisely, in a strong inductive argument, the conclusion follows probably from the premises. Put otherwise, a strong inductive argument is an argument in which the following conditions apply:

- If the premises are true, the conclusion is probably true.**
- The premises provide probable, but not logically conclusive, grounds for the truth of the conclusion.**
- The premises, if true, make the conclusion likely.**

An inductive argument that is not strong is said to be weak. In a weak inductive argument , the conclusion does not follow probably from the premises. In other words, a weak argument is an inductive argument in which the premises, even if they are assumed to be true, do not make the conclusion probable.

Examples of inductively weak arguments:

All previous popes have been men.

Therefore, probably the next pope will be a woman.

Fifty-five percent of students at East Laredo State University are Hispanic.

Li Fang Wang, owner of Wang's Chinese Restaurant, is a student at East Laredo State University.

Therefore, Li Fang Wang is probably Hispanic.

**If an argument both is inductively strong and has all true premises, it is said to be a cogent argument. For example:
No U.S. president has been a U.S. skateboarding champ.
Therefore, probably the next U.S. president will not be a U.S. skateboarding champ.**

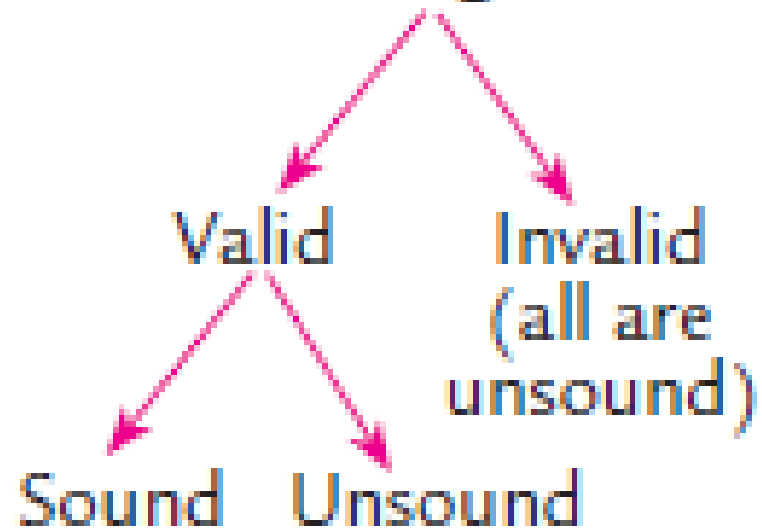
If an inductive argument either is weak or has at least one false premise, it is an uncogent argument.

For example:

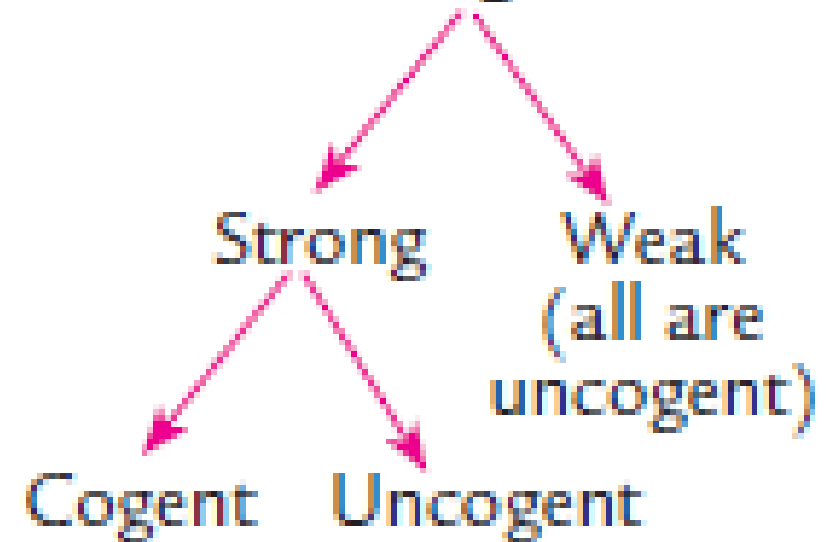
All previous U.S. presidents have been professional football players.

Therefore, probably the next U.S. president will be an astronaut.

Deductive arguments



Inductive arguments





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