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Basic Logical Concepts

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1 What Logic Is

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

When we reason about any matter, we produce arguments to support our conclusions. Our arguments include reasons that we think justify our beliefs. However, not all reasons are good reasons. Therefore we may always ask, when we confront an argument: Does the conclusion reached *follow* from the premises assumed? To answer this question there are objective criteria; in the study of logic we seek to discover and apply those criteria.

Reasoning is not the only way in which people support assertions they make or accept. They may appeal to authority or to emotion, which can be very persuasive, or they may rely, without reflection, simply on habits. However, when someone wants to make judgments that can be completely relied upon, their only solid foundation will be correct reasoning. Using the methods and techniques of logic—one can distinguish reliably between sound and faulty reasoning.

Logic

The study of the methods and principles used to distinguish correct from incorrect reasoning.

Proposition

A statement; what is typically asserted using a declarative sentence, and hence always either true or false—although its truth or falsity may be unknown.

2 Propositions and Arguments

We begin by examining more closely the most fundamental concepts in the study of logic, concepts presupposed in the paragraphs just above. In reasoning we construct and evaluate *arguments*; arguments are built with *propositions*. Although these concepts are apparently simple, they require careful analysis.

A. Propositions

Propositions are the building blocks of our reasoning. A **proposition** asserts that something is the case or it asserts that something is not. We may affirm a proposition, or deny it—but every proposition either asserts what really is the case, or it asserts something that is not. Therefore every proposition is either true or false.

Biography

Aristotle

Of all the great philosophers and logicians, ancient and modern, none is greater than Aristotle (384–322 BCE), whose works and influence largely ruled the world of intellect for two millennia. He was often referred to as “The Philosopher”; his authority (even when he was mistaken!) was rarely questioned.

Born in Macedonia, in the city of Stagira, where his father was physician to the king, he was viewed from birth as a member of the aristocracy, and was a friend of the king’s son, Philip. When Philip became king of Macedonia, he summoned Aristotle, who had for many years been studying in Athens at Plato’s school, The Academy, to return to Macedonia as tutor to his son Alexander (who later would be known as Alexander the Great). As he advanced on his subsequent conquests in Asia, Alexander remained in contact with his respected teacher, sending back, at Aristotle’s request, specimens and artifacts that contributed to the early growth of the sciences.

Aristotle—one of the trio, with Plato and Socrates, who largely founded Western philosophy—had a truly encyclopedic mind. He investigated, contributed to, wrote about, and taught virtually all subjects on which some knowledge had been accumulated at his time: the natural sciences (biology, zoology, embryology, anatomy, astronomy, meteorology, physics, and optics); the arts (poetry, music, theater, and rhetoric); government and politics; psychology and education; economics; ethics; metaphysics—and of course logic, of which he alone was the systematic founder. His treatises on logic, later combined into one great work entitled *The Organon* (“The Instrument”), constitute the earliest formal study of our subject. The penetration and coherence of his logical analyses, and the comprehensiveness and general accuracy of his scientific studies, justify his acknowledged status as one of the finest thinkers ever to have graced our planet.

At the age of 49 Aristotle returned to Athens and established his own highly influential school, the Lyceum, where he taught for twelve years. He died of natural causes in 322 BCE. In his will, he asked to be buried next to his wife, Pythias.

In logic Aristotle grasped the overriding necessity of determining the rules of correct reasoning. He explained validity and characterized the four fundamental types of categorical propositions and their relations. In the *Prior*



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Analytics, one of the six books of *The Organon*, he developed a sophisticated theoretical account of categorical syllogisms, an account that long dominated the realm of deductive logic and that remains today an effective tool of sound reasoning.

It is said of Aristotle that he was probably the last person to know everything there was to be known in his own time. ■



There are many propositions about whose truth we are uncertain. “There is life on some other planet in our galaxy,” for example, is a proposition that, so far as we now know, may be true or may be false. Its “truth value” is unknown, but this proposition, like every proposition, must be either true or false.

A question *asserts* nothing, and therefore it is not a proposition. “Do you know how to play chess?” is indeed a sentence, but that sentence makes no claim about the world. Neither is a command a proposition (“Come quickly!”), nor is an exclamation a proposition (“Oh my gosh!”). Questions, commands, and exclamations—unlike propositions—are neither true nor false.

When we assert some proposition, we do so using a sentence in some language. However, the proposition we assert is not identical to that sentence. This is evident because two different sentences, consisting of different words differently arranged, may have the same meaning and may be used to assert the very same proposition. For example, “Leslie won the election” and “The election was won by Leslie” are plainly two different sentences that make the same assertion.

Sentences are always parts of some language, but propositions are not tied to English or to any given language. The four sentences

It is raining.	(English)
Está lloviendo.	(Spanish)
Il pleut.	(French)
Es regnet.	(German)

Statement

A proposition; what is typically asserted by a declarative sentence, but not the sentence itself. Every statement must be either true or false, although the truth or falsity of a given statement may be unknown.

are in different languages, but they have a single meaning: all four, using different words, may be uttered to assert the very same proposition. *Proposition* is the term we use to refer to what it is that declarative sentences are typically used to assert.

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*.

However, the concept of a proposition is seen by many as making a useful distinction between a sentence and what the sentence asserts..

The very same sentence can be used to make very different statements (or to assert very different propositions), depending on the context in which it is expressed. For example, the sentence, “The largest state in the United States was once an independent republic,” once expressed a true statement or proposition (about Texas), but if asserted today would express a false statement or proposition (about Alaska). The same words assert different propositions at different times.

Propositions may be *simple*, like those used in the preceding illustrations, but they may also be *compound*, containing other propositions within themselves. Consider the following proposition, from a recent account of the exploitation of the Amazon Basin in Brazil:

The Amazon Basin produces roughly 20 percent of the Earth’s oxygen, creates much of its own rainfall, and harbors many unknown species.¹

This sentence simultaneously asserts three propositions, concerning what the Amazon Basin produces and what it creates and what it harbors. The passage thus constitutes a *conjunctive* proposition. Asserting a conjunctive proposition is equivalent to asserting each of its component propositions separately.

Some compound propositions do not assert the truth of their components. In *disjunctive* (or *alternative*) *propositions*, no one of the components is asserted. Abraham Lincoln (in a message to Congress in December 1861) said, “Circuit courts are useful, or they are not useful.” This disjunctive proposition is plainly true, but either one of its components might be false.

Other compound propositions that do not assert their components are *hypothetical* (or *conditional*) *propositions*. The eighteenth-century freethinker, Voltaire, said, “If God did not exist, it would be necessary to invent him.” Here, again, neither of the two components is asserted. The proposition “God does not exist,” is not asserted, nor is the proposition, “it is necessary to invent him.” Only the “if-then” proposition is asserted by the hypothetical or conditional statement, and that compound statement might be true even if both of its components were false.

In logic, the internal structure of propositions is important. To evaluate an argument we need a full understanding of the propositions that appear in that argument. Propositions of many different kinds will be analyzed in this chapter.

B. Arguments

With propositions as building blocks, we construct *arguments*. In any argument we affirm one proposition on the basis of some other propositions. In doing this, an *inference* is drawn. **Inference** is a process that may tie together a cluster of propositions. Some inferences are *warranted* (or correct); others are not. The logician analyzes these clusters, examining the propositions with which the process begins and with which it ends, as well as the relations among these propositions.

Inference

A process by which one proposition is arrived at and affirmed on the basis of some other proposition or propositions.

Such a cluster of propositions constitutes an *argument*. Arguments are the chief concern of logic.

Argument is a technical term in logic. It need not involve disagreement, or controversy. In logic, **argument** refers strictly to any group of propositions of which one is claimed to follow from the others, which are regarded as providing support for the truth of that one. For every possible inference there is a corresponding argument.

In writing or in speech, a passage will often contain several related propositions and yet contain no argument. An argument is not merely a collection of propositions; it is a cluster with a structure that captures or exhibits some inference. We describe this structure with the terms *conclusion* and *premise*. The **conclusion** of an argument is the proposition that is affirmed on the basis of the other propositions of the argument. Those other propositions, which are affirmed (or assumed) as providing support for the conclusion, are the **premises** of the argument.

We will encounter a vast range of arguments in this text—arguments of many different kinds, on many different topics. We will analyze arguments in politics, in ethics, in sports, in religion, in science, in law, and in everyday life. Those who defend these arguments, or who attack them, are usually aiming to establish the truth (or the falsehood) of the conclusions drawn. As logicians, however, our interest is in the arguments as such. As agents or as citizens we may be deeply concerned about the truth or falsity of the conclusions drawn. However, as logicians we put those interests aside. Our concerns will be chiefly two. First, we will be concerned about the *form* of an argument under consideration, to determine if that argument is *of a kind* that is likely to yield a warranted conclusion. Second, we will be concerned about the *quality* of the argument, to determine whether it *does in fact* yield a warranted conclusion.

Arguments vary greatly in the degree of their complexity. Some are very simple. Other arguments, as we will see, are quite intricate, sometimes because of the structure or formulation of the propositions they contain, sometimes because of the relations among the premises, and sometimes because of the relations between premises and conclusion.

The simplest kind of argument consists of one premise and a conclusion that is claimed to follow from it. Each may be stated in a separate sentence, as in the following argument that appears on a sticker affixed to biology textbooks in the state of Alabama:

No one was present when life first appeared on earth. Therefore any statement about life's origins should be considered as theory, not fact.

Both premise and conclusion may be stated within the same sentence, as in this argument arising out of recent advances in the science of human genetics:

Since it turns out that all humans are descended from a small number of African ancestors in our recent evolutionary past, believing in profound differences between the races is as ridiculous as believing in a flat earth.²

Argument

Any group of propositions of which one is claimed to follow from the others, which are regarded as providing support or grounds for the truth of that one.

Conclusion

In any argument, the proposition to which the other propositions in the argument are claimed to give support, or for which they are given as reasons.

Premises

In an argument, the propositions upon which inference is based; the propositions that are claimed to provide grounds or reasons for the conclusion.

Biography

Chrysippus

Of all the logicians of ancient times, Aristotle and Chrysippus stand out as the two greatest. The enormous influence of Aristotle, who first systematized logic and was its principal authority for two thousand years, has already been recognized. Born a century later, Chrysippus (c. 279–c. 206 BCE) developed a conceptual scheme whose influence has only more recently been appreciated.

The logic of Aristotle was one of classes. In the Aristotelian argument “All men are mortal; Greeks are men; therefore Greeks are mortal,” the fundamental elements are the categories, or terms (“men,” “mortal things,” and “Greeks”). In contrast, the logic of Chrysippus was one built of *propositions* and the connections between them (e.g., “If it is now day, it is now light. It is now day. Therefore it is now light.”). This simple argument form (now called *modus ponens*) and many other fundamental argument forms, Chrysippus analyzed and classified. His logical insights were creative and profound.

Born in Asia Minor, in Soli, Chrysippus studied the philosophy of the Stoics—most famous among them Zeno and Cleanthes—and eventually became head of the Stoic school in Athens. In that capacity he taught the need to control one’s emotions, which he thought to be disorders or diseases. He urged the patient acceptance of the outcomes of a fate one cannot control, and the recognition that the one God (of which the traditional Greek gods are but aspects) is the universe itself.

But it is as a logician that his influence has been greatest. He grasped, as Aristotle did not, the central role of the proposition—“*that which is, in itself, capable of being denied or affirmed.*” From this base he developed the first coherent system of propositional logic. ■



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The order in which premises and conclusion appear can also vary, but it is not critical in determining the quality of the argument. It is common for the conclusion of an argument to *precede* the statement of its premise or premises. On the day Babe Ruth hit his 700th home run (13 July 1934), the following argument appeared in *The New York Times*:

A record that promises to endure for all time was attained on Navin Field today when Babe Ruth smashed his seven-hundredth home run in a lifetime career. It promises to live, first because few players in history have enjoyed the longevity on the diamond of the immortal Bambino, and, second, because only two other players in the history of baseball have hit more than 300 home runs.

This is an example of an argument whose two premises, each numbered, appear after the conclusion is stated. It is also an example of a very plausible argument whose conclusion is false, given that Hank Aaron hit his 700th home run on 21 July 1973, thirty-nine years later.

Even when premise and conclusion are united in one sentence, the conclusion of the argument may come first. The English utilitarian philosopher, Jeremy Bentham, presented this crisp argument in his *Principles of Legislation* (1802):

Every law is an evil, for every law is an infraction of liberty.

Although this is only one short sentence, it is an argument because it contains two propositions, of which the first (every law is an evil) is the conclusion and the second (every law is an infraction of liberty) is the premise. However, no single proposition can be an argument, because an argument is made up of a group of propositions. Yet some propositions, because they are compound, do sound like arguments, and care must be taken to distinguish them from the arguments they resemble. Consider the following hypothetical proposition:

If a state aims to be a society composed of equals, then a state that is based on the middle class is bound to be the best constituted.

Neither the first nor the second component of this proposition is asserted. All that is asserted is that the former implies the latter, and both might well be false. No inference is drawn, no conclusion is claimed to be true. Aristotle, who studied the constitution and quality of actual states in Greece more than two thousand years ago, wrote confidently in *Politics*, Book IV, Chapter 11:

A state aims at being a society composed of equals, and therefore a state that is based on the middle class is bound to be the best constituted.

In this case we *do* have an argument. This argument of Aristotle is short and simple; most arguments are longer and more complicated. Every argument, however—short or long, simple or complex—consists of a group of propositions of which one is the conclusion and the other(s) are the premises offered to support it.

Although every argument is a structured cluster of propositions, not every structured cluster of propositions is an argument. Consider this very recent account of global inequality:

In the same world in which more than a billion people live at a level of affluence never previously known, roughly a billion other people struggle to survive on the purchasing power equivalent of less than one U.S. dollar per day. Most of the world's poorest people are undernourished—lack access to safe drinking water or even the most basic health services and cannot send their children to school. According to UNICEF, more than 10 million children die every year—about 30,000 per day—from avoidable, poverty-related causes.³

This report is deeply troubling—but there is no argument here.

Reasoning is an art, as well as a science. It is something we do, as well as something we understand. Giving reasons for our beliefs comes naturally, but skill in the art of building arguments, and testing them, requires practice. One

who has practiced and strengthened these skills is more likely to reason correctly than one who has never thought about the principles involved. Therefore we provide in this chapter very many opportunities for practice in the analysis of arguments.

EXERCISES

Identify the premises and conclusions in the following passages. Some premises do support the conclusion, others do not. Note that premises may support conclusions directly or indirectly and that even simple passages may contain more than one argument.

EXAMPLE

1. A well-regulated militia being necessary to the security of a free state, the right of the people to keep and bear arms shall not be infringed.
—*The Constitution of the United States*, Amendment 2

SOLUTION

Premise: A well-regulated militia is necessary for the security of a free state.

Conclusion: The right of the people to keep and bear arms shall not be infringed.

2. What stops many people from photocopying a book and giving it to a pal is not integrity but logistics; it's easier and inexpensive to buy your friend a paperback copy.
—Randy Cohen, *The New York Times Magazine*, 26 March 2000
3. Thomas Aquinas argued that human intelligence is a gift from God and therefore "to apply human intelligence to understand the world is not an affront to God, but is pleasing to him."
—Recounted by Charles Murray in *Human Accomplishment* (New York: HarperCollins, 2003)
4. Sir Edmund Hillary is a hero, not because he was the first to climb Mount Everest, but because he never forgot the Sherpas who helped him achieve this impossible feat. He dedicated his life to helping build schools and hospitals for them.
—Patre S. Rajashekhar, "Mount Everest," *National Geographic*, September 2003
5. Standardized tests have a disparate racial and ethnic impact; white and Asian students score, on average, markedly higher than their black and Hispanic peers. This is true for fourth-grade tests, college entrance exams, and every other assessment on the books. If a racial gap is evidence of discrimination, then all tests discriminate.
—Abigail Thernstrom, "Testing, the Easy Target," *The New York Times*, 15 January 2000
6. Good sense is, of all things in the world, the most equally distributed, for everybody thinks himself so abundantly provided with it that even

those most difficult to please in all other matters do not commonly desire more of it than they already possess.

—René Descartes, *A Discourse on Method*, 1637

7. When Noah Webster proposed a *Dictionary of the American Language*, his early 19th-century critics presented the following argument against it: "Because any words new to the United States are either stupid or foreign, there is no such thing as the American language; there's just bad English."

—Jill Lepore, "Noah's Mark," *The New Yorker*, 6 November 2006

8. The death penalty is too costly. In New York State alone taxpayers spent more than \$200 million in our state's failed death penalty experiment, with no one executed.

In addition to being too costly, capital punishment is unfair in its application. The strongest reason remains the epidemic of exonerations of death row inmates upon post-conviction investigation, including ten New York inmates freed in the last 18 months from long sentences being served for murders or rapes they did not commit.

—L. Porter, "Costly, Flawed Justice," *The New York Times*, 26 March 2007

9. Houses are built to live in, not to look on; therefore, let use be preferred before uniformity.

—Francis Bacon, "Of Building," in *Essays*, 1597

10. To boycott a business or a city [as a protest] is not an act of violence, but it can cause economic harm to many people. The greater the economic impact of a boycott, the more impressive the statement it makes. At the same time, the economic consequences are likely to be shared by people who are innocent of any wrongdoing, and who can ill afford the loss of income: hotel workers, cab drivers, restaurateurs, and merchants. The boycott weapon ought to be used sparingly, if for no other reason than the harm it can cause such bystanders.

—Alan Wolfe, "The Risky Power of the Academic Boycott," *The Chronicle of Higher Education*, 17 March 2000

11. Ethnic cleansing was viewed not so long ago as a legitimate tool of foreign policy. In the early part of the 20th century forced population shifts were not uncommon; multicultural empires crumbled and nationalism drove the formation of new, ethnically homogenous countries.

—Belinda Cooper, "Trading Places," *The New York Times Book Review*, 17 September 2006

12. If a jury is sufficiently unhappy with the government's case or the government's conduct, it can simply refuse to convict. This possibility puts powerful pressure on the state to behave properly. For this reason a jury is one of the most important protections of a democracy.

—Robert Precht, "Japan, the Jury," *The New York Times*, 1 December 2006

13. Without forests, orangutans cannot survive. They spend more than 95 percent of their time in the trees, which, along with vines and termites,

provide more than 99 percent of their food. Their only habitat is formed by the tropical rain forests of Borneo and Sumatra.

—Birute Galdikas, “The Vanishing Man of the Forest,” *The New York Times*, 6 January 2007

14. Omniscience and omnipotence are mutually incompatible. If God is omniscient, he must already know how he is going to intervene to change the course of history using his omnipotence. But that means he can’t change his mind about his intervention, which means he is not omnipotent.

—Richard Dawkins, *The God Delusion* (New York: Houghton Mifflin, 2006)

15. Reason is the greatest enemy that faith has; it never comes to the aid of spiritual things, but more frequently than not struggles against the divine Word, treating with contempt all that emanates from God.

—Martin Luther, *Last Sermon in Wittenberg*, 17 January 1546

3 Recognizing Arguments

Before we can evaluate an argument, we must *recognize* it. We must be able to distinguish argumentative passages in writing or speech. Doing this assumes, of course, an understanding of the language of the passage. However, even with a thorough comprehension of the language, the identification of an argument can be problematic because of the peculiarities of its formulation. Even when we are confident that an argument is intended in some context, we may be unsure about which propositions are serving as its premises and which as its conclusion. As we have seen, that judgment cannot be made on the basis of the order in which the propositions appear. How then shall we proceed?

A. Conclusion Indicators and Premise Indicators

One useful method depends on the appearance of certain common indicators, certain words or phrases that typically serve to signal the appearance of an argument’s conclusion or of its premises. Here is a partial list of **conclusion indicators**:

therefore	for these reasons
hence	it follows that
so	I conclude that
accordingly	which shows that
in consequence	which means that
consequently	which entails that
proves that	which implies that
as a result	which allows us to infer that
for this reason	which points to the conclusion that
thus	we may infer

Conclusion indicator

A word or phrase (such as “therefore” or “thus”) appearing in an argument and usually indicating that what follows it is the conclusion of that argument.

Other words or phrases typically serve to mark the premises of an argument and hence are called **premise indicators**. Usually, but not always, what follows any one of these will be the premise of some argument. Here is a partial list of premise indicators:

since	as indicated by
because	the reason is that
for	for the reason that
as	may be inferred from
follows from	may be derived from
as shown by	may be deduced from
inasmuch as	in view of the fact that

B. Arguments in Context

The words and phrases we have listed may help to indicate the presence of an argument or identify its premises or conclusion, but such indicators do not necessarily appear. Sometimes it is just the meaning of the passage, or its setting, that indicates the presence of an argument. For example, during the intense controversy over the deployment of additional U.S. troops to Iraq in 2007, one critic of that deployment wrote:

As we send our young men and women abroad to bring order to Iraq, many of its so-called leaders have abandoned their posts. We have given the Iraqis an opportunity to iron out their differences and they throw it back in our faces. Iraq does not deserve our help.⁴

No premise indicators or conclusion indicators are used here, yet the argument is clear. Indicators are also absent in the following argument in Sam Harris's *Letter to a Christian Nation*, whose premises and conclusions are unmistakable:

Half the American population believes that the universe is 6,000 years old. They are wrong about this. Declaring them so is not "irreligious intolerance." It is intellectual honesty.⁵

Often, however, the force of an argument can be appreciated only when one understands the *context* in which that argument is presented. For example, the undergraduate admission system of the University of Michigan that gave a fixed number of extra points to all members of certain minority groups was held unconstitutional by the U.S. Supreme Court in *Gratz v. Bollinger* in 2003. Justice Ruth Bader Ginsburg dissented, defending the Michigan system with the following argument:

Universities will seek to maintain their minority enrollment . . . whether or not they can do so in full candor. . . . [They] may resort to camouflage. If honesty is the best policy, surely Michigan's accurately described, fully disclosed College affirmative action program is preferable to achieving similar numbers through winks, nods, and disguises.⁶

This argument derives its force from the realization that universities had in fact long disguised their preferential admission programs to avoid attacks based

Premise indicator

In an argument, a word or phrase (like "because" and "since") that normally signals that what follows it are statements serving as premises.

on the equal protection clause of the 14th Amendment to the U.S. Constitution. Chief Justice William Rehnquist's response to Justice Ginsburg's argument is also intelligible only in the context of her defense of the preferential admission system. Rehnquist wrote the following:

These observations are remarkable for two reasons. First, they suggest that universities—to whose academic judgment we are told we should defer—will pursue their affirmative action programs whether or not they violate the United States Constitution. Second, they recommend that these violations should be dealt with, not by requiring the Universities to obey the Constitution, but by changing the Constitution so that it conforms to the conduct of the universities.⁷

Rehnquist's reference to "changing the Constitution" must be understood in light of the fact that the Michigan undergraduate admission system had been held unconstitutional. His reference to the pursuit of affirmative action programs "whether or not they violate the United States Constitution" can best be understood in light of Ginsburg's earlier reference to the possible use of "winks, nods, and disguises."

The full force of argument and counterargument can be grasped, in most circumstances, only with an understanding of the *context* in which those arguments are presented. In real life, context is critical. For example, if you are told that I am bringing a lobster home for dinner, you will have little doubt that I intend to eat it, not feed it.

C. Premises or Conclusions Not in Declarative Form

It is not uncommon for the premises of an argument to be presented in the form of questions. However, if questions assert nothing, and do not express propositions, how is this possible? On the surface they make no assertions; beneath the surface an interrogative sentence can serve as a premise when its question is **rhetorical**—that is, when it suggests or assumes an answer that is made to serve as the premise of an argument. The sentence may be interrogative even though its meaning is declarative.

This use of questions is sometimes obvious, as in a letter dated 7 January 2007 to *The New York Times*, objecting to a new series of U.S. coins that will honor former presidential wives. Irit R. Rasooly wrote:

I am irked by the new set of coins being issued. While some first ladies have influenced our country, should we bestow this honor on people who are unelected, whose only credential is having a prominent spouse?

Plainly, the critic means to affirm the proposition that we should not bestow this honor on such people. He continues:

Wouldn't honoring women who have served as governors, Supreme Court justices or legislators be a more fitting tribute to this nation's women than coins featuring "First Spouses"?

This critic obviously believes that honoring such achievements would be a more fitting tribute, but he again expresses that proposition with a question. His

Rhetorical question

An utterance used to make a statement, but which, because it is in interrogative form and is therefore neither true nor false, does not literally assert anything.

letter also provides an illustration of the need to rely on context to interpret declarative statements that are actually made. The writer's report that he is "irked" by the new set of coins is no doubt true, but this statement is more than a mere description of his state of mind; he means to express the judgment that such a set of coins *ought not* be issued.

Using questions to express a premise is sometimes counterproductive, however, because it may invite answers (by the listener, or silently by the reader) that threaten the conclusion at which the argument aims. For example, the archbishop of the Anglican Church in Nigeria, who is an ardent opponent of homosexuality and views it as deeply sinful, argues thus:

Why didn't God make a lion to be a man's companion? Why didn't He make a tree to be a man's companion? Or better still, why didn't He make another man to be a man's companion? So even from the creation story you can see that the mind of God, God's intention, is for man and woman to be together.⁸

Conclusions drawn about God's intentions, using as premises questions that invite a myriad of different responses, may be undermined by the answers they elicit.

Questions can serve most effectively as premises when the answers assumed really do seem to be clear and inescapable. In such cases the readers (or hearers) are led to provide the apparently evident answers for themselves, thus augmenting the persuasiveness of the argument. Here is an example: Some who find euthanasia morally unacceptable reject the defense of that practice as grounded in the right to self-determination possessed by the terminally ill patient. They argue as follows:

If a right to euthanasia is grounded in self-determination, it cannot reasonably be limited to the terminally ill. If people have a right to die, why must they wait until they are actually dying before they are permitted to exercise that right?⁹

The question is forceful because its answer appears to be undeniable. It seems obvious that there is no good reason why, if people have a right to die grounded in self-determination, they must wait until they are dying to exercise that right. Hence (this critique concludes) the right to euthanasia, if there is one, cannot be limited to the terminally ill. The argument has much merit, but from the perspective of its religious advocates, it may prove to be a two-edged sword.

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. That proposition is likely to be dubious, and it may in fact be false. To illustrate: In 2007 Arab leaders in Jerusalem expressed great anxiety about the safety of the Al-Aqsa mosque when the Israeli government began construction of a ramp leading to the platform (also sacred to the Jews) on which that very holy mosque is

situated. In reviewing the situation, David Gelernter, an Israeli partisan asked: “Is it possible that Arab leaders are more interested in attacking Israel than protecting religious and cultural monuments?”¹⁰ Well, yes, that is possible, of course—but it may not be true, and the question framed in this way is plainly intended to cause the reader to believe that Arab leaders were being duplicitous in voicing their concerns. Did the author assert that such duplicity lay behind the Arab objections? No, he didn’t say that!

Gossip columnists thrive on suggestive questions. Celebrity tidbits commonly appear in the form, “Does Paris Hilton have any talent as an actress?” Similarly, in discussing social issues, rhetorical questions can be an effective method of covert assertion. When riots in France spread through Islamic neighborhoods, many wondered what motivated those rioters. Journalist Christopher Caldwell wrote:

Were they admirers of France’s majority culture, frustrated at not being able to join it on equal terms? Or did they simply aspire to burn to the ground a society they despised?¹¹

Accusers who protect themselves by framing their accusations in interrogative sentences may shield themselves from the indignant complaints of their target. “No,” they may insist, “that is not what I said!”

It is wise policy to refrain from arguing with questions.

In some arguments the conclusion appears in the form of an imperative. The reason, or reasons, we ought to perform a given act are set forth as premises, and we are then directed to act in that way. Thus in Proverbs 4:7 we read:

Wisdom is the principal thing; therefore get wisdom.

Here the second clause is a command, and a command, like a question, is neither true nor false and cannot express a proposition. Therefore, strictly speaking, it cannot be the conclusion of an argument. Nonetheless, it surely is meant to be the conclusion of an argument in this passage from Proverbs. How can we explain this apparent inconsistency? It is useful in many contexts to regard a command as no different from a proposition in which hearers (or readers) are told that they would be wise to act, or ought to act, in the manner specified in the command. Thus the conclusion of the argument in Proverbs may be rephrased as “Getting wisdom is what you should do.” Assertions of this kind may be true or false, as most will agree. What difference there is between a command to do something and a statement that it should be done is an issue that need not be explored here. By ignoring that difference (if there really is one), we are able to deal uniformly with arguments whose conclusions are expressed in this form.

Reformulations of this kind can clarify the roles of an argument’s constituent propositions. It is necessary to grasp the *substance* of what is being asserted, to understand which claims are serving to support which inferences, whatever their external forms. Some needed reformulations are merely grammatical. A

proposition that functions as a premise may take the form of a phrase rather than a declarative sentence. This is well illustrated in the following argumentative passage, whose conclusion is a very sharp criticism of the United States:

What is a failed state? It is one that fails to provide security for the population, to guarantee rights at home or abroad, or to maintain functioning democratic institutions. On this definition the United States is the world's biggest failed state.¹²

The second and third premises of this argument are compressed into phrases, but the propositions for which these phrases are shorthand are clear enough, and their critical role in the author's reasoning is evident.

D. Unstated Propositions

Arguments are sometimes obscure because one (or more) of their constituent propositions is not stated but is assumed to be understood. An illustration will be helpful here. The chair of the Department of Sociology at City College, CUNY, presented two strong but controversial arguments, in parallel, regarding the justifiability of the death penalty. The first premise of each argument is the hypothesis that the factual belief (of the proponent, or of the opponent, of the penalty) about what does in fact deter homicide is mistaken. The second premise of each argument, although entirely plausible, is not stated, leaving the reader the task of reconstructing it.

The first argument went like this:

If the proponent of the death penalty is incorrect in his belief that the [death] penalty deters homicide, then he is responsible for the execution of murderers who should not be executed.¹³

This argument relies on the unstated second premise: "No one should be executed to advance an objective that is not promoted by execution." Hence one who *mistakenly* believes that the objective (detering murders) is achieved by executing those convicted is responsible for the execution of murderers who should not be executed.

The second argument went like this:

If the opponent of the death penalty is incorrect in his belief that the death penalty doesn't deter, he is responsible for the murder of innocent individuals who would not have been murdered if the death penalty had been invoked.¹⁴

This argument relies on the unstated second premise: "Protecting the lives of innocent individuals from murder justifies the execution of murderers if other murderers are then deterred by the fear of execution." Hence one who *mistakenly* believes that the death penalty does not deter murderers is responsible for the lives of innocents who are subsequently murdered.

In each of these arguments the assumed but unstated second premise is plausible. One might find both arguments persuasive—leaving open for empirical investigation the question of whether, in fact, the death penalty does deter murder.

However, the force of each of the arguments depends on the truth of the unstated premise on which it relies.

A premise may be left unstated because the arguer supposes that it is unquestioned common knowledge. In the controversy over the cloning of human beings, one angry critic wrote:

Human cloning—like abortion, contraception, pornography and euthanasia—is intrinsically evil and thus should never be allowed.¹⁵

This is plainly an argument, but part of it is missing. The argument relies on the very plausible but unstated premise that “what is intrinsically evil should never be allowed.” Arguments in everyday discourse very often rely on some proposition that is understood but not stated. Such arguments are called **enthymemes**.

The unstated premise on which an enthymeme relies may not be universally accepted; it may be uncertain or controversial. An arguer may deliberately refrain from formulating that critical premise, believing that by allowing it to remain tacit, the premise is shielded from attack. For example, medical research using embryonic stem cells (cells found in the human embryo that can develop into other types of cells and into most types of tissue) is highly controversial. One U.S. senator used the following enthymeme in attacking legislation that would permit government financing of such research:

This research [involving the use of embryonic stem cells] is illegal, for this reason: The deliberate killing of a human embryo is an essential component of the contemplated research.¹⁶

The stated premise is true: Research of this kind is not possible without destroying the embryo. However, the conclusion that such research is illegal depends on the unstated premise that the killing of a human embryo is illegal—and *that* claim is very much in dispute.

The effectiveness of an enthymeme may depend on the hearer’s knowledge that some proposition is false. To emphasize the falsity of some proposition, a speaker may construct an argument in which the first premise is a hypothetical proposition of which the antecedent (the “if” component), is the proposition whose falsity the speaker wishes to show, and the consequent (the “then” component) is a proposition known by everyone to be false. The unstated falsehood of this second component is the second premise of the enthymematic argument. The unstated falsehood of the first component is the conclusion of the argument. To illustrate: The distinguished political philosopher John Rawls admired Abraham Lincoln as the president who most appreciated the moral equality of human beings. Rawls frequently quoted Lincoln’s enthymematic argument, “If slavery is not wrong, nothing is wrong.”¹⁷ It is of course wildly false to say that nothing is wrong—from which it follows that it is equally false to say that slavery is not wrong. Similarly, distinguished psychiatrist Bruno Bettelheim, survivor of both Dachau and Buchenwald, wrote: “If all men are good, then there never was an Auschwitz.”

Enthymeme

An argument that is stated incompletely, the unstated part of it being taken for granted.

4 Arguments and Explanations

Passages that appear to be arguments are sometimes not arguments but *explanations*. The appearance of words that are common indicators—such as “because,” “for,” “since,” and “therefore”—cannot settle the matter, because those words are used both in explanations and in arguments (although “since” can sometimes refer to temporal succession). We need to know the intention of the author. Compare the following two passages:

1. Lay up for yourselves treasures in heaven, where neither moth nor rust consumes and where thieves do not break in and steal. For where your treasure is, there will your heart be also.

—Matt. 7:19

2. Therefore is the name of it [the tower] called Babel; because the Lord did there confound the language of all the earth.

—Gen. 11:19

The first passage is clearly an argument. Its conclusion, that one ought to lay up treasures in heaven, is supported by the premise (here marked by the word “for”) that one’s heart will be where one’s treasure is laid up. The second passage, which uses the word “therefore” quite appropriately, is not an argument. It *explains* why the tower (whose construction is recounted in Genesis) is called Babel. The tower was given this name, we are told, because it was the place where humankind, formerly speaking one language, became confounded by many languages—the name is derived from a Hebrew word meaning “to confound.” The passage assumes that the reader knows that the tower had that name; the intention is to explain why that name was given to it. The phrase, “Therefore is the name of it called Babel,” is not a conclusion but a completion of the explanation of the naming. In addition, the clause, “because the Lord did there confound the language of all the earth,” is not a premise; it could not serve as a reason for believing that Babel was the name of the tower, because the fact that that *was* the name is known by those to whom the passage is addressed. In this context, “because” indicates that what follows will *explain* the giving of that name, Babel, to that tower.

These two passages illustrate the fact that superficially similar passages may have very different functions. Whether some passage is an argument or an explanation depends on the *purpose* to be served by it. If our aim is to establish the truth of some proposition, *Q*, and we offer some evidence, *P*, in support of *Q*, we may appropriately say “*Q* because *P*.” In this case we are giving an argument *for* *Q*, and *P* is our premise. Alternatively, suppose that *Q* is known to be true. In that case we don’t have to give any reasons to support its truth, but we may wish to give an account of *why* it is true. Here also we may say “*Q* because *P*”—but in this case we are giving not an argument *for* *Q*, but an explanation *of* *Q*.

In responding to a query about the apparent color of quasars (celestial objects lying far beyond our galaxy), one scientist wrote:

The most distant quasars look like intense points of infrared radiation. This is because space is scattered with hydrogen atoms (about two per cubic meter) that absorb blue light, and if you filter the blue from visible white light, red is what's left. On its multibillion-light-year journey to earth quasar light loses so much blue that only infrared remains.¹⁸

The author is not seeking to convince his reader that quasars have the apparent color they do, but rather giving the causes of this fact; he is explaining, not arguing.

However, it may be difficult at times to determine whether an author intends to be explaining some state of affairs, or to be arguing for some conclusion that is critical in that explanation. Here, for example, is a passage that may be interpreted in either way.

I would like to highlight another property of water, unique but also vital to making life on Earth possible. As water cools, approaching its freezing point, its density suddenly decreases, reversing the usual "natural convection" patterns in which colder fluids sink. This reversal causes the coldest strata of water to rise to the top of an ocean or lake. These large bodies of water now freeze from the top down. Were it not for this unique property of water, the oceans and lakes would have long and completely frozen over from the bottom up with dire consequences for any life-sustaining liquid water on Earth.¹⁹

More than one conclusion may be inferred from the same premise, thus presenting two arguments. Similarly, more than one thing may be accounted for by the same fact, thus presenting two explanations. Here is an illustration:

The *Oxford English Dictionary* is a historical dictionary, providing citations meant to show the evolution of every word, beginning with the earliest known usage. Therefore, a key task, and a popular sport for thousands of volunteer word aficionados, is antedating: finding earlier citations than those already known.²⁰

That antedating is a key task for the makers of that dictionary is accounted for by the fact that the *Oxford English Dictionary* is a *historical* dictionary. This fact about the dictionary also explains why, for word aficionados, antedating is a popular sport.

If an author writes "*Q* because *P*," how can we tell whether he intends to explain or to persuade? We can ask: What is the status of *Q* in that context? Is *Q* a proposition whose truth needs to be established or confirmed? In that case, "*because P*" is probably offering a premise in its support; "*Q* because *P*" is in that instance an argument. Or is *Q* a proposition whose truth is known, or at least not in doubt in that context? In that case, "*because P*" is probably offering some account of why *Q* has come to be true; "*Q* because *P*" is in that instance an explanation.

In an explanation, one must distinguish *what* is being explained from what the explanation *is*. In the explanation from Genesis given at the beginning of this section, what is being explained is how the tower of Babel came to have that name; the explanation is that it was there that the Lord did confound the language of all the Earth. In the astronomical example given subsequently, what is

being explained is the fact that quasars appear to be red; the explanation is that as light travels from the very distant quasar to Earth all the blue in that light is filtered out.

If we are sensitive to the context, we will usually be able to distinguish an explanation from an argument. However, there will always be some passages whose purpose is uncertain, and such passages may deserve to be given alternative, equally plausible “readings”—viewed as arguments when interpreted in one way and as explanations when interpreted in another.

EXERCISES

Some of the following passages contain explanations, some contain arguments, and some may be interpreted as either an argument or an explanation. What is your judgment about the chief function of each passage? What would have to be the case for the passage in question to be an argument? To be an explanation? Where you find an argument, identify its premises and conclusion. Where you find an explanation, indicate what is being explained and what the explanation is.

EXAMPLE

1. Humans have varying skin colors as a consequence of the distance our ancestors lived from the Equator. It’s all about sun. Skin color is what regulates our body’s reaction to the sun and its rays. Dark skin evolved to protect the body from excessive sun rays. Light skin evolved when people migrated away from the Equator and needed to make vitamin D in their skin. To do that they had to lose pigment. Repeatedly over history, many people moved dark to light and light to dark. That shows that color is not a permanent trait.

—Nina Jablonski, “The Story of Skin,” *The New York Times*, 9 January 2007

SOLUTION

This is essentially an explanation. *What* is being explained is the fact that humans have varying skin colors. The explanation is that different skin colors evolved as humans came to live at different distances from the Equator and hence needed different degrees of protection from the rays of the sun. One might interpret the passage as an argument whose conclusion is that skin color is not a permanent trait of all humans. Under this interpretation, all the propositions preceding the final sentence of the passage serve as premises.

2. David Bernstein [in *Only One Place of Redress: African Americans, Labor Regulations, and the Courts from Reconstruction to the New Deal*, 2001] places labor laws at the center of the contemporary plight of black Americans.

Many of these ostensibly neutral laws (e.g., licensing laws, minimum-wage laws, and collective bargaining laws) were either directly aimed at stymieing black economic and social advancement or, if not so aimed, were quickly turned to that use. A huge swath of the American labor market was handed over to labor unions from which blacks, with few exceptions, were totally excluded. The now longstanding gap between black and white unemployment rates dates precisely from the moment of government intervention on labor's behalf. In short (Bernstein argues) the victories of American labor were the undoing of American blacks.

—Ken I. Kirsch, "Blacks and Labor—the Untold Story," *The Public Interest*, Summer 2002

3. Animals born without traits that led to reproduction died out, whereas the ones that reproduced the most succeeded in conveying their genes to posterity. Crudely speaking, sex feels good because over evolutionary time the animals that liked having sex created more offspring than the animals that didn't.

—R. Thornhill and C. T. Palmer, "Why Men Rape," *The Sciences*, February 2000

4. Changes are real. Now, changes are only possible in time, and therefore time must be something real.

—Immanuel Kant, *Critique of Pure Reason* (1781),
"Transcendental Aesthetic," section II

5. The nursing shortage in the United States has turned into a full-blown crisis. Because fewer young people go into nursing, one-third of registered nurses in the United States are now over 50 years of age, and that proportion is expected to rise to 40 percent over the next decade. Nurses currently practicing report high rates of job dissatisfaction, with one in five seriously considering leaving the profession within the next five years. . . . Hospitals routinely cancel or delay surgical cases because of a lack of nursing staff.

—Ronald Dworkin, "Where Have All the Nurses Gone?,"
The Public Interest, Summer 2002

6. To name causes for a state of affairs is not to excuse it. Things are justified or condemned by their consequences, not by their antecedents.

—John Dewey, "The Liberal College and Its Enemies," *The Independent*, 1924

7. One may be subject to laws made by another, but it is impossible to bind oneself in any matter which is the subject of one's own free exercise of will. . . . It follows of necessity that the king cannot be subject to his own laws. For this reason [royal] edicts and ordinances conclude with the formula, "for such is our good pleasure."

—Jean Bodin, *Six Books of the Commonwealth*, 1576

8. I like Wagner's music better than anybody's. It is so loud that one can talk the whole time without people hearing what one says.

—Oscar Wilde, *The Picture of Dorian Gray*, 1891

9. Three aspects of American society in recent decades make cheating more likely.

First, there is the rise of a market-drenched society, where monetary success is lauded above all else. Second, there is the decline of religious, communal, and family bonds and norms that encourage honesty. Finally, there is the absence of shame by those public figures who are caught in dishonest or immoral activities. No wonder so many young people see nothing wrong with cutting corners or worse.

—Howard Gardner, “More Likely to Cheat,” *The New York Times*, 9 October 2003

10. Love looks not with the eyes, but with the mind;
And therefore is wing’d Cupid painted blind.

—William Shakespeare, *A Midsummer Night’s Dream*, act 1, scene 1

11. An article in *The New York Times*, “Why Humans and Their Fur Parted Ways,” suggested that the fact that women have less body hair than men is somehow related to greater sexual selection pressure on women. A reader responded with the following letter:

Here is an elaboration for which I have no evidence but it is consistent with what we think we know: sexual selection has probably strongly influenced numerous traits of both sexes.

Youthful appearance is more important to men when selecting a mate than it is to women. The longer a woman can look young, the longer she will be sexually attractive and the more opportunities she will have to bear offspring with desirable men. Hairlessness advertises youth.

Hence a greater sexual selection pressure on women to lose body hair.

—T. Doyle, “Less Is More,” *The New York Times*, 26 August 2003

12. MAD, mutually assured destruction, was effective in deterring nuclear attack right through the cold war. Both sides had nuclear weapons. Neither side used them, because both sides knew the other would retaliate in kind. This will not work with a religious fanatic [like Mahmoud Ahmadinejad, President of the Islamic Republic of Iran]. For him, mutual assured destruction is not a deterrent, it is an inducement. We know already that Iran’s leaders do not give a damn about killing their own people in great numbers. We have seen it again and again. In the final scenario, and this applies all the more strongly if they kill large numbers of their own people, they are doing them a favor. They are giving them a quick free pass to heaven and all its delights.

—Bernard Lewis, quoted in *Commentary*, June 2007

13. About a century ago, we discovered that planetary orbits are not stable in four or more dimensions, so if there were more than three space dimensions, planets would not orbit a sun long enough for life to originate. And in one or two space dimensions, neither blood flow nor large numbers of neuron connections can exist. Thus, interesting life can exist only in three dimensions.

—Gordon Kane, “Anthropic Questions,” *Phi Kappa Phi Journal*, Fall 2002

14. Translators and interpreters who have helped United States troops and diplomats now want to resettle in the United States. They speak many strategically important languages of their region. The United States does not have an adequate number of interpreters and translators who are proficient in these languages. Therefore, we need them. Q.E.D.

—Oswald Werner, “Welcome the Translators,” *The New York Times*,
3 November 2007

15. The Treasury Department’s failure to design and issue paper currency that is readily distinguishable to blind and visually impaired individuals violates Section 504 of the Rehabilitation Act, which provides that no disabled person shall be “subjected to discrimination under any program or activity conducted by any Executive agency.”

—Judge James Robertson, Federal District Court for the District of Columbia,
American Council of the Blind v. Sec. of the Treasury, No. 02-0864 (2006)

16. Rightness [that is, acting so as to fulfill one’s duty] never guarantees moral goodness. For an act may be the act which the agent thinks to be his duty, and yet be done from an indifferent or bad motive, and therefore be morally indifferent or bad.

—Sir W. David Ross, *Foundations of Ethics*
(Oxford: Oxford University Press, 1939)

17. Man did not invent the circle or the square or mathematics or the laws of physics. He discovered them. They are immutable and eternal laws that could only have been created by a supreme mind: God. And since we have the ability to make such discoveries, man’s mind must possess an innate particle of the mind of God. To believe in God is not “beyond reason.”

—J. Lenzi, “Darwin’s God,” *The New York Times Magazine*, 18 March 2007

18. Many of the celebratory rituals [of Christmas], as well as the timing of the holiday, have their origins outside of, and may predate, the Christian commemoration of the birth of Jesus. Those traditions, at their best, have much to do with celebrating human relationships and the enjoyment of the goods that this life has to offer. As an atheist I have no hesitation in embracing the holiday and joining with believers and nonbelievers alike to celebrate what we have in common.

—John Teehan, “A Holiday Season for Atheists, Too,” *The New York Times*,
24 December 2006

19. All ethnic movements are two-edged swords. Beginning benignly, and sometimes necessary to repair injured collective psyches, they often end in tragedy, especially when they turn political, as illustrated by German history.

—Orlando Patterson, “A Meeting with Gerald Ford,”
The New York Times, 6 January 2007

20. That all who are happy, are equally happy, is not true. A peasant and a philosopher may be equally *satisfied*, but not equally *happy*. Happiness consists in the multiplicity of agreeable consciousness. A peasant has not the capacity for having equal happiness with a philosopher.

—Samuel Johnson, in Boswell's *Life of Johnson*, 1766

5 Deductive and Inductive Arguments

Every argument makes the claim that its premises provide grounds for the truth of its conclusion; that claim is the mark of an argument. However, there are two very different ways in which a conclusion may be supported by its premises, and thus there are two great classes of arguments: the *deductive* and the *inductive*. Understanding this distinction is essential in the study of logic.

A *deductive argument* makes the claim that its conclusion is supported by its premises *conclusively*. An *inductive argument*, in contrast, does not make such a claim. Therefore, if we judge that in some passage a claim for conclusiveness is being made, we treat the argument as deductive; if we judge that such a claim is not being made, we treat it as inductive. Because every argument either makes this claim of conclusiveness (explicitly or implicitly) or does not make it, every argument is either deductive or inductive.

When the claim is made that the premises of an argument (if true) provide incontrovertible grounds for the truth of its conclusion, that claim will be either correct or not correct. If it is correct, that argument is *valid*. If it is not correct (that is, if the premises when true fail to establish the conclusion irrefutably although claiming to do so), that argument is *invalid*.

For logicians the term *validity* is applicable only to deductive arguments. To say that a deductive argument is valid is to say that it is not possible for its conclusion to be false if its premises are true. Thus we define **validity** as follows: A deductive argument is *valid* when, if its premises are true, its conclusion *must* be true. In everyday speech, of course, the term *valid* is used much more loosely.

Although every deductive argument makes the claim that its premises guarantee the truth of its conclusion, not all deductive arguments live up to that claim. Deductive arguments that fail to do so are invalid.

Because every deductive argument either succeeds or does not succeed in achieving its objective, every deductive argument is either valid or invalid. This point is important: If a deductive argument is not valid, it must be invalid; if it is not invalid, it must be valid.

The central task of deductive logic is to discriminate valid arguments from invalid ones. Over centuries, logicians have devised powerful techniques to do this—but the traditional techniques for determining validity differ from those used by most modern logicians. The former, collectively known as *classical logic*, is rooted in the analytical works of Aristotle. Logicians of the two schools differ

Validity

A characteristic of any deductive argument whose premises, if they were all true, would provide conclusive grounds for the truth of its conclusion. Such an argument is said to be *valid*. Validity is a formal characteristic; it applies only to arguments, as distinguished from truth, which applies to propositions.

in their methods and in their interpretations of some arguments, but ancients and moderns agree that the fundamental task of deductive logic is to develop the tools that enable us to distinguish arguments that are valid from those that are not.

In contrast, the central task of inductive arguments is to ascertain the facts by which conduct may be guided directly, or on which other arguments may be built. Empirical investigations are undertaken—as in medicine, or social science, or astronomy—leading, when inductive techniques are applied appropriately, to factual conclusions, most often concerning cause-and-effect relationships of some importance.

An illustration of the inductive process will be helpful at this point to contrast induction with deduction. Medical investigators, using inductive methods, are eager to learn the causes of disease, or the causes of the transmission of infectious diseases. Sexually transmitted diseases (STDs), such as acquired immune deficiency syndrome (AIDS), are of special concern because of their great seriousness and worldwide spread. Can we learn inductively how to reduce the spread of STDs? Yes, we can.

In 2006 the National Institutes of Health announced that large-scale studies of the spread of STDs in Kenya and Uganda (African countries in which the risk of HIV infection, commonly resulting in AIDS, is very high) was sharply lower among circumcised men than among those who were not circumcised. Circumcision is not a “magic bullet” for the treatment of disease, of course. However, we did learn, by examining the experience of very many voluntary subjects (3,000 in Uganda, 5,000 in Kenya, divided into circumcised and uncircumcised groups) that a man’s risk of contracting HIV from heterosexual sex is *reduced by half* as a result of circumcision. The risk to women is also reduced by about 30 percent.*

These are discoveries (using the inductive method called *concomitant variation*) of very great importance. The causal connection between the absence of circumcision and the spread of HIV is not known with certainty, the way the conclusion of a deductive argument is known, but it is now known with a very high degree of probability.

Inductive arguments make weaker claims than those made by deductive arguments. Because their conclusions are never certain, the terms *validity* and *invalidity* do not apply to inductive arguments. We can evaluate inductive arguments, of course; appraising such arguments is a central task of scientists in every sphere. The higher the level of probability conferred on its conclusion by the premises of an inductive argument, the greater is the merit of that argument. We can say that inductive arguments may be “better” or “worse,” “weaker” or “stronger,” and so on. The argument constituted by the circumcision study is very strong, the probability of its conclusion very high. Even when the premises are all true, however, and provide strong support for the conclusion, that conclusion is not established with certainty.

*So great is the advantage of circumcision shown by these studies that they were stopped, on 13 December 2006, by the Data Safety and Monitoring Board of the National Institutes of Health, to be fair to all participants by announcing the probable risks of the two patterns of conduct.

Because an inductive argument can yield no more than some degree of probability for its conclusion, it is always possible that additional information will strengthen or weaken it. Newly discovered facts may cause us to change our estimate of the probabilities, and thus may lead us to judge the argument to be better (or worse) than we had previously thought. In the world of inductive argument—even when the conclusion is judged to be very highly probable—*all* the evidence is never in. New discoveries may eventually disconfirm what was earlier believed, and therefore we never assert that the conclusion of an inductive argument is absolutely certain.

Deductive arguments, on the other hand, cannot become better or worse. They either succeed or they do not succeed in exhibiting a compelling relation between premises and conclusion. If a deductive argument is valid, no additional premises can possibly add to the strength of that argument. For example, if all humans are mortal and Socrates is human, we may conclude without reservation that Socrates is mortal—*and that conclusion will follow from those premises no matter what else may be true in the world, and no matter what other information may be discovered or added*. If we come to learn that Socrates is ugly, or that immortality is a burden, or that cows give milk, none of those findings nor any other findings can have any bearing on the validity of the original argument. The conclusion that follows with certainty from the premises of a deductive argument follows from any enlarged set of premises with the same certainty, regardless of the nature of the premises added. If an argument is valid, nothing in the world can make it more valid; if a conclusion is validly inferred from some set of premises, nothing can be added to that set to make that conclusion follow more strictly, or more validly.

This is not true of inductive arguments, however, for which the relationship claimed between premises and conclusion is much less strict and very different in kind. Consider the following inductive argument:

Most corporation lawyers are conservatives.
Miriam Graf is a corporation lawyer.
Therefore Miriam Graf is probably a conservative.

This is a fairly good inductive argument; its first premise is true, and if its second premise also is true, its conclusion is more likely to be true than false. But in this case (in contrast to the argument about Socrates' mortality), new premises added to the original pair might weaken or (depending on the content of those new premises) strengthen the original argument. Suppose we also learn that

Miriam Graf is an officer of the American Civil Liberties Union (ACLU).

and suppose we add the (true) premise that

Most officers of the ACLU are not conservatives.

Now the conclusion (that Miriam Graf is a conservative) no longer seems very probable; the original inductive argument has been greatly weakened by

the presence of this additional information about Miriam Graf. Indeed, if the final premise were to be transformed into the universal proposition

No officers of the ACLU are conservatives.

the opposite of the original conclusion would then follow deductively—and validly—from the full set of premises affirmed.

On the other hand, suppose we enlarge the original set of premises by adding the following additional premise:

Miriam Graf has long been an officer of the National Rifle Association (NRA).

The original conclusion (that she is a conservative) would be supported by this enlarged set of premises with even greater likelihood than it was by the original set.

Inductive arguments do not always acknowledge explicitly that their conclusions are supported only with some degree of probability. On the other hand, the mere presence of the word “probability” in an argument gives no assurance that the argument is inductive. There are some strictly deductive arguments *about* probabilities themselves, in which the probability of a certain combination of events is deduced from the probabilities of other events. For example, if the probability of three successive heads in three tosses of a coin is $1/8$, one may infer deductively that the probability of getting at least one tail in three tosses of a coin is $7/8$.

In sum, the distinction between induction and deduction rests on the nature of the claims made by the two types of arguments about the *relations* between their premises and their conclusions. Thus we characterize the two types of arguments as follows: A **deductive argument** is one whose conclusion is claimed to follow from its premises with absolute necessity, this necessity not being a matter of degree and not depending in any way on whatever else may be the case. In sharp contrast, an **inductive argument** is one whose conclusion is claimed to follow from its premises only with probability, this probability being a matter of degree and dependent on what else may be the case.

6 Validity and Truth

A deductive argument is valid when it succeeds in linking, with logical necessity, the conclusion to its premises. Its validity refers to the relation between its propositions—between the set of propositions that serve as the premises and the one proposition that serves as the conclusion of that argument. If the conclusion follows with logical necessity from the premises, we say that the argument is valid. Therefore *validity can never apply to any single proposition by itself*, because the needed relation cannot possibly be found within any one proposition.

Truth and falsehood, on the other hand, are attributes of individual propositions. A single statement that serves as a premise in an argument may be true; the statement that serves as its conclusion may be false. This conclusion might have been validly inferred, but to say that any conclusion (or any single premise) is itself valid or invalid makes no sense.

Deductive argument

One of the two major types of argument traditionally distinguished, the other being the inductive argument. A deductive argument claims to provide conclusive grounds for its conclusion. If it does provide such grounds, it is valid; if it does not, it is invalid.

Inductive argument

One of the two major types of argument traditionally distinguished, the other being the deductive argument. An inductive argument claims that its premises give only some degree of probability, but not certainty, to its conclusion.

Truth is the attribute of those propositions that assert what really is the case. When I assert that Lake Superior is the largest of the five Great Lakes, I assert what really is the case, what is true. If I had claimed that Lake Michigan is the largest of the Great Lakes my assertion would not be in accord with the real world; therefore it would be false. This contrast between validity and truth is important: *Truth and falsity are attributes of individual propositions or statements; validity and invalidity are attributes of arguments.*

Just as the concept of validity cannot apply to single propositions, the concept of truth cannot apply to arguments. Of the several propositions in an argument, some (or all) may be true and some (or all) may be false. However, the argument as a whole is neither true nor false. Propositions, which are statements about the world, may be true or false; deductive arguments, which consist of inferences from one set of propositions to other propositions, may be valid or invalid.

The relations *between* true (or false) propositions and valid (or invalid) arguments are critical and complicated. Those relations lie at the heart of deductive logic. It devoted largely to the examination of those complex relations, but a preliminary discussion of the relation between validity and truth is in order here.

We begin by emphasizing that an argument may be valid even if one or more of its premises is not true. Every argument makes a claim about the relation between its premises and the conclusion drawn from them; that relation may hold even if the premises turn out to be false or the truth of the premises is in dispute. This point was made dramatically by Abraham Lincoln in 1858 in one of his debates with Stephen Douglas. Lincoln was attacking the *Dred Scott* decision of the Supreme Court, which had held that slaves who had escaped into Northern states must be returned to their owners in the South. Lincoln said:

I think it follows [from the *Dred Scott* decision], and I submit to the consideration of men capable of arguing, whether as I state it, in syllogistic form, the argument has any fault in it:

Nothing in the Constitution or laws of any State can destroy a right distinctly and expressly affirmed in the Constitution of the United States.

The right of property in a slave is distinctly and expressly affirmed in the Constitution of the United States.

Therefore, nothing in the Constitution or laws of any State can destroy the right of property in a slave.

I believe that no fault can be pointed out in that argument; assuming the truth of the premises, the conclusion, so far as I have capacity at all to understand it, follows inevitably. There is a fault in it as I think, but the fault is not in the reasoning; the falsehood in fact is a fault of the premises. I believe that the right of property in a slave is not distinctly and expressly affirmed in the Constitution, and Judge Douglas thinks it is. I believe that the Supreme Court and the advocates of that decision [the *Dred Scott* decision] may search in vain for the place in the Constitution where the right of property in a slave is distinctly and expressly affirmed. I say, therefore, that I think one of the premises is not true in fact.²¹

The reasoning in the argument that Lincoln recapitulates and attacks is not faulty—but its second premise (that “the right of property in a slave is . . . affirmed in the Constitution”) is plainly false. The conclusion has therefore not been established. Lincoln’s logical point is correct and important: *An argument may be valid even when its conclusion and one or more of its premises are false.* The validity of an argument, we emphasize once again, depends only on the *relation* of the premises to the conclusion.

There are many possible combinations of true and false premises and conclusions in both valid and invalid arguments. Here follow seven illustrative arguments, each prefaced by the statement of the combination (of truth and validity) that it represents. With these illustrations (whose content is deliberately trivial) before us, we will be in a position to formulate some important principles concerning the relations between truth and validity.

- I. Some *valid* arguments contain *only true propositions*—true premises and a true conclusion:

All mammals have lungs.
All whales are mammals.
Therefore all whales have lungs.

- II. Some *valid* arguments contain *only false propositions*—false premises and a false conclusion:

All four-legged creatures have wings.
All spiders have exactly four legs.
Therefore all spiders have wings.

This argument is valid because, if its premises were true, its conclusion would have to be true also—even though we know that in fact both the premises *and* the conclusion of this argument are false.

- III. Some *invalid* arguments contain *only true propositions*—all their premises are true, and their conclusions are true as well:

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.

The true conclusion of this argument does not follow from its true premises. This will be seen more clearly when the immediately following illustration is considered.

- IV. Some *invalid* arguments contain *only true premises* and have a *false conclusion*. This is illustrated by an argument exactly like the previous one (III) in form, changed only enough to make the conclusion false.

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.

The premises of this argument are true, but its conclusion is false. Such an argument cannot be valid because it is impossible for the premises of a valid argument to be true and its conclusion to be false.

V. Some *valid* arguments have *false premises* and a *true conclusion*:

All fishes are mammals.
All whales are fishes.
Therefore all whales are mammals.

The conclusion of this argument is true, as we know; moreover, it may be validly inferred from these two premises, both of which are wildly false.

VI. Some *invalid* arguments also have *false premises* and a *true conclusion*:

All mammals have wings.
All whales have wings.
Therefore all whales are mammals.

From Examples V and VI taken together, it is clear that we cannot tell from the fact that an argument has false premises and a true conclusion whether it is valid or invalid.

VII. Some *invalid* arguments, of course, contain *all false propositions*—false premises and a false conclusion:

All mammals have wings.
All whales have wings.
Therefore all mammals are whales.

These seven examples make it clear that there are valid arguments with false conclusions (Example II), as well as invalid arguments with true conclusions (Examples III and VI). Hence it is clear that *the truth or falsity of an argument's conclusion does not by itself determine the validity or invalidity of that argument*. Moreover, *the fact that an argument is valid does not guarantee the truth of its conclusion* (Example II).

Two tables (referring to the seven preceding examples) will make very clear the variety of possible combinations. The first table shows that *invalid* arguments can have every possible combination of true and false premises and conclusions:

Invalid Arguments		
	True Conclusion	False Conclusion
True Premises	Example III	Example IV
False Premises	Example VI	Example VII

The second table shows that *valid* arguments can have only three of those combinations of true and false premises and conclusions:

Valid Arguments		
	True Conclusion	False Conclusion
True Premises	Example I	—
False Premises	Example V	Example II

The one blank position in the second table exhibits a fundamental point: *If an argument is valid and its premises are true, we may be certain that its conclusion is true also.* To put it another way: *If an argument is valid and its conclusion is false, not all of its premises can be true.* Some perfectly valid arguments do have false conclusions, but any such argument must have at least one false premise.

When an argument is valid *and* all of its premises are true, we call it *sound*. The conclusion of a sound argument obviously must be true—and only a sound argument can establish the truth of its conclusion. If a deductive argument is not sound—that is, if the argument is not valid or if not all of its premises are true—it fails to establish the truth of its conclusion even if in fact the conclusion is true.

To test the truth or falsehood of premises is the task of science in general, because premises may deal with any subject matter at all. The logician is not (professionally) interested in the truth or falsehood of propositions so much as in the logical relations between them. By *logical relations between propositions* we mean those relations that determine the correctness or incorrectness of the arguments in which they occur. The task of determining the correctness or incorrectness of arguments falls squarely within the province of logic. The logician is interested in the correctness even of arguments whose premises may be false.

Why do we not confine ourselves to arguments with true premises, ignoring all others? Because the correctness of arguments whose premises are not known to be true may be of great importance. In science, for example, we verify theories by *deducing* testable consequences from uncertain theoretical premises—but we cannot know beforehand which theories are true. In everyday life also, we must often choose between alternative courses of action, first seeking to deduce the consequences of each. To avoid deceiving ourselves, we must reason correctly about the consequences of the alternatives, taking each as a premise. If we were interested only in arguments with true premises, we would not know which set of consequences to trace out until we knew which of the alternative premises was true. But if we knew which of the alternative premises was true, we would not need to reason about it at all, because our purpose was to help us decide which alternative premise to *make* true. To confine our attention to arguments with premises known to be true would therefore be self-defeating.

EXERCISES

For each of the argument descriptions provided below, construct a deductive argument (on any subject of your choosing) having only two premises.

1. A valid argument with one true premise, one false premise, and a false conclusion
2. A valid argument with one true premise, one false premise, and a true conclusion
3. An invalid argument with two true premises and a false conclusion
4. An invalid argument with two true premises and a true conclusion
5. A valid argument with two false premises and a true conclusion
6. An invalid argument with two false premises and a true conclusion
7. An invalid argument with one true premise, one false premise, and a true conclusion
8. A valid argument with two true premises and a true conclusion

chapter Summary

The most fundamental concepts of logic are introduced in this chapter.

In Section 1 we explained what logic is and why it is necessary, and we defined it as the study of the methods and principles used to distinguish correct from incorrect reasoning.

In Section 2 we gave an account of propositions, which may be asserted or denied, and which are either true or false, and of arguments, which are clusters of propositions of which one is the conclusion and the others are the premises offered in its support. Arguments are the central concern of logicians.

In Section 3 we discussed difficulties in the recognition of arguments, arising from the variety of ways in which the propositions they contain may be expressed, and sometimes even from the absence of their express statement in arguments called enthymemes.

In Section 4 we discussed the differences between arguments and explanations, showing why this distinction often depends on the context and on the intent of the passage in that context.

In Section 5 we explained the fundamental difference between deductive arguments, whose conclusions may be certain (if the premises are true and the reasoning valid), and inductive arguments, aiming to establish matters of fact, whose conclusions may be very probable but are never certain.

In Section 6 we discussed validity and invalidity (which apply to deductive arguments) as contrasted with truth and falsity (which apply to propositions). We explored some of the key relations between validity and truth.