1.1 Arguments, Premises, and Conclusions

Logic may be defined as the science that evaluates arguments. All of us encounter arguments in our day-to-day experience. We read them in books and newspapers, hear them on television, and formulate them when communicating with friends and associates. The aim of logic is to develop a system of methods and principles that we may use as criteria for evaluating the arguments of others and as guides in constructing arguments of our own. Among the benefits to be expected from the study of logic is an increase in confidence that we are making sense when we criticize the arguments of others and when we advance arguments of our own.

An **argument,** as it occurs in logic, is a group of statements, one or more of which (the premises) are claimed to provide support for, or reasons to believe, one of the others (the conclusion). All arguments may be placed in one of two basic groups: those in which the premises really do support the conclusion and those in which they do not, even though they are claimed to. The former are said to be good arguments (at least to that extent), the latter bad arguments. The purpose of logic, as the science that evaluates arguments, is thus to develop methods and techniques that allow us to distinguish good arguments from bad.

As is apparent from the above definition, the term "argument" has a very specific meaning in logic. It does not mean, for example, a mere verbal fight, as one might have with one's parent, spouse, or friend. Let us examine the features of this definition in greater detail. First of all, an argument is a group of statements. A **statement** is a sentence that is either true or false—in other words, typically a declarative sentence or a sentence component that could stand as a declarative sentence. The following sentences are statements:

Aluminum is attacked by hydrochloric acid.
Broccoli is a good source of vitamin A.
Argentina is located in North America.
Napoleon prevailed at Waterloo.
Rembrandt was a painter and Shelley was a poet.

The first two statements are true, the second two false. The last one expresses two statements, both of which are true. Truth and falsity are called the two possible **truth values** of a statement. Thus, the truth value of the first two statements is true, the truth value of the second two is false, and the truth value of the last statement, as well as that of its components, is true.

Unlike statements, many sentences cannot be said to be either true or false. Questions, proposals, suggestions, commands, and exclamations usually cannot, and so are not usually classified as statements. The following sentences are not statements:

What is the atomic weight of carbon?	(question)
Let's go to the park today.	(proposal)
We suggest that you travel by bus.	(suggestion)
Turn to the left at the next corner.	(command)
All right!	(exclamation)

The statements that make up an argument are divided into one or more premises and one and only one conclusion. The **premises** are the statements that set forth the reasons or evidence, and the **conclusion** is the statement that the evidence is claimed to support or imply. In other words, the conclusion is the statement that is claimed to follow from the premises. Here is an example of an argument:

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

The first two statements are the premises; the third is the conclusion. (The claim that the premises support or imply the conclusion is indicated by the word "therefore.") In this argument the premises really do support the conclusion, and so the argument is a good one. But consider this argument:

Some crimes are misdemeanors.
Murder is a crime.
Therefore, murder is a misdemeanor.

In this argument the premises do not support the conclusion, even though they are claimed to, and so the argument is not a good one.

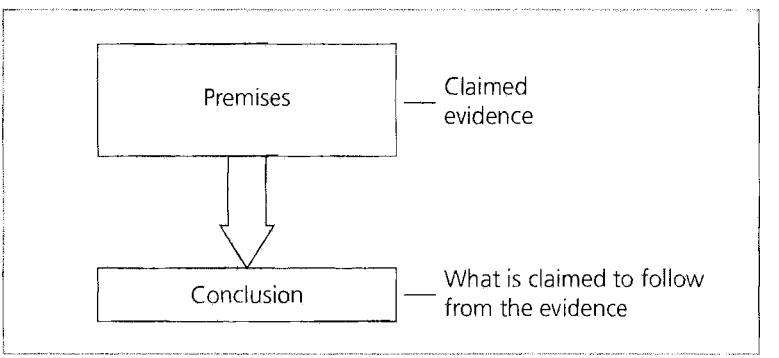
One of the most important tasks in the analysis of arguments is being able to distinguish premises from conclusion. If what is thought to be a conclusion is really a premise, and vice versa, the subsequent analysis cannot possibly be correct. Frequently, arguments contain certain indicator words that provide clues in identifying premises and conclusion. Some typical **conclusion indicators** are

therefore	accordingly	entails that
wherefore	we may conclude	hence
thus	it must be that	it follows that
consequently	whence	implies that
we may infer	so	as a result

Whenever a statement follows one of these indicators, it can usually be identified as the conclusion. By process of elimination the other statements in the argument are the premises. Example:

> Corporate raiders leave their target corporation with a heavy debt burden and no increase in productive capacity. Consequently, corporate raiders are bad for the business community.

The conclusion of this argument is "Corporate raiders are bad for the business community," and the premise is "Corporate raiders leave their target corporation with a heavy debt burden and no increase in productive capacity."



If an argument does not contain a conclusion indicator, it may contain a premise indicator. Some typical **premise indicators** are

since	in that	seeing that
as indicated by	may be inferred from	for the reason that
because	as	inasmuch as
for	given that	owing to

Any statement following one of these indicators can usually be identified as a premise. Example:

> Expectant mothers should never use recreational drugs, since the use of these drugs can jeopardize the development of the fetus.

The premise of this argument is "The use of these drugs can jeopardize the development of the fetus," and the conclusion is "Expectant mothers should never use recreational drugs."

One premise indicator not included in the above list is "for this reason." This indicator is special in that it comes immediately *after* the premise that it indicates. "For this reason" (except when followed by a colon) means for the reason (premise) that was just given. In other words, the premise is the statement that occurs immediately *before* "for this reason." One should be careful not to confuse "for this reason" with "for the reason that."

Sometimes a single indicator can be used to identify more than one premise. Consider the following argument:

> The development of high-temperature superconducting materials is technologically justified, for such materials will allow electricity to be transmitted without loss over great distances, and they will pave the way for trains that levitate magnetically.

The premise indicator "for" goes with both "Such materials will allow electricity to be transmitted without loss over great distances" and "They will pave the way for trains that levitate magnetically." These are the premises. By process of elimination, "The development of high-temperature superconducting materials is technologically justified" is the conclusion.

Sometimes an argument contains no indicators. When this occurs, the reader/listener must ask himself or herself such questions as: What single statement is claimed (implicitly) to follow from the others? What is the arguer trying to prove? What is the main point in the passage? The answers to these questions should point to the conclusion. Example:

> The space program deserves increased expenditures in the years ahead. Not only does the national defense depend upon it, but the program will more than pay for itself in terms of technological spinoffs. Furthermore, at current funding levels the program cannot fulfill its anticipated potential.

The conclusion of this argument is the first statement, and all of the other statements are premises. The argument illustrates the pattern found in most arguments that lack indicator words: the intended conclusion is stated first, and the remaining statements are then offered in support of this first statement. When the argument is restructured according to logical principles, however, the conclusion is always listed *after* the premises:

P_1: The national defense is dependent upon the space program.
P_2: The space program will more than pay for itself in terms of technological spinoffs.
P_3: At current funding levels the space program cannot fulfill its anticipated potential.
C: The space program deserves increased expenditures in the years ahead.

When restructuring arguments such as this, one should remain as close as possible
the original version, while at the same time attending to the requirement that prem-
es and conclusion be complete sentences that are meaningful in the order in which
ey are listed.

Note that the first two premises are included within the scope of a single sentence
the original argument. For the purposes of this chapter, compound arrangements of
atements in which the various components are all claimed to be true will be consid-
ed as separate statements.

Passages that contain arguments sometimes contain statements that are neither
emises nor conclusion. Only statements that are actually intended to support the
nclusion should be included in the list of premises. If a statement has nothing to do
ith the conclusion or, for example, simply makes a passing comment, it should not
e included within the context of the argument. Example:

> Socialized medicine is not recommended because it would result in a reduction in the overall quality of medical care available to the average citizen. In addition, it might very well bankrupt the federal treasury. This is the whole case against socialized medicine in a nutshell.

ne conclusion of this argument is "Socialized medicine is not recommended," and
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Closely related to the concepts of argument and statement are those of inference
nd proposition. An **inference,** in the technical sense of the term, is the reasoning
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Analogously, a **proposition,** in the technical sense, is the meaning or information
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ote on the History of Logic

ne person who is generally credited as being the father of logic is the ancient Greek
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When restructuring arguments such as this, one should remain as close as possible to the original version, while at the same time attending to the requirement that premises and conclusion be complete sentences that are meaningful in the order in which they are listed.

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The conclusion of this argument is "Socialized medicine is not recommended," and the two statements following the word "because" are the premises. The last statement makes only a passing comment about the argument itself and is therefore neither a premise nor a conclusion.

Closely related to the concepts of argument and statement are those of inference and proposition. An **inference,** in the technical sense of the term, is the reasoning process expressed by an argument. As we will see in the next section, inferences may be expressed not only through arguments but through conditional statements as well. In the loose sense of the term, "inference" is used interchangeably with "argument."

Analogously, a **proposition,** in the technical sense, is the meaning or information content of a statement. For the purposes of this book, however, "proposition" and "statement" are used interchangeably.

Note on the History of Logic

The person who is generally credited as being the father of logic is the ancient Greek philosopher Aristotle (384–322 B.C.). Aristotle's predecessors had been interested in the art of constructing persuasive arguments and in techniques for refuting the arguments of others, but it was Aristotle who first devised systematic criteria for analyzing and evaluating arguments. Aristotle's logic is called **syllogistic logic** and includes much of what is treated in Chapters 4 and 5 of this text. The fundamental elements in this logic are *terms,* and arguments are evaluated as good or bad depending on how the terms are arranged in the argument. In addition to his development of syllogistic logic, Aristotle cataloged a number of informal fallacies, a topic treated in Chapter 3 of this text.

After Aristotle's death, another Greek philosopher, Chrysippus (279–206 B.C.), one of the founders of the Stoic school, developed a logic in which the fundamental elements were *whole propositions*. Chrysippus treated every proposition as either true or false and developed rules for determining the truth or falsity of compound propositions from the truth or falsity of their components. In the course of doing so, he laid the foundation for the truth functional interpretation of the logical connectives presented in Chapter 6 of this text and introduced the notion of natural deduction, treated in Chapter 7.

For thirteen hundred years after the death of Chrysippus, relatively little creative work was done in logic. The physician Galen (A.D. 129–ca. 199) developed the theory of the compound categorical syllogism, but for the most part philosophers confined themselves to writing commentaries on the works of Aristotle and Chrysippus. Boethius (ca. 480–524) is a noteworthy example.

The first major logician of the Middle Ages was Peter Abelard (1079–1142). Abelard reconstructed and refined the logic of Aristotle and Chrysippus as communicated by Boethius, and he originated a theory of universals that traced the universal character of general terms to concepts in the mind rather than to "natures" existing outside the mind, as Aristotle had held. In addition, Abelard distinguished arguments that are valid because of their form from those that are valid because of their content, but he held that only formal validity is the "perfect" or conclusive variety. The present text follows Abelard on this point.

After Abelard, the study of logic during the Middle Ages blossomed and flourished through the work of numerous philosophers. It attained its final expression in the writings of the Oxford philosopher William of Occam (ca. 1285–1349). Occam devoted much of his attention to **modal logic,** a kind of logic that involves such notions as possibility, necessity, belief, and doubt. He also conducted an exhaustive study of forms of valid and invalid syllogisms and contributed to the development of the concept of a metalanguage—that is, a higher-level language used to discuss linguistic entities such as words, terms, propositions, and so on.

Toward the middle of the fifteenth century, a reaction set in against the logic of the Middle Ages. Rhetoric largely displaced logic as the primary focus of attention; the logic of Chrysippus, which had already begun to lose its unique identity in the Middle Ages, was ignored altogether, and the logic of Aristotle was studied only in highly simplistic presentations. A reawakening did not occur until two hundred years later through the work of Gottfried Wilhelm Leibniz (1646–1716).

Leibniz, a genius in numerous fields, attempted to develop a symbolic language or "calculus" that could be used to settle all forms of disputes, whether in theology, philosophy, or international relations. As a result of this work, Leibniz is sometimes credited with being the father of symbolic logic. Leibniz's efforts to symbolize logic were carried into the nineteenth century by Bernard Bolzano (1781–1848).

With the arrival of the middle of the nineteenth century, logic commenced an extremely rapid period of development that has continued to this day. Work in sym-

bolic logic was done by a number of philosophers and mathematicians, including Augustus DeMorgan (1806–1871), George Boole (1815–1864), William Stanley Jevons (1835–1882), and John Venn (1834–1923), some of whom are popularly known today by the logical theorems and techniques that bear their names. At the same time, a revival in inductive logic was initiated by the British philosopher John Stuart Mill (1806–1873), whose methods of induction are presented in Chapter 9 of this text.

Toward the end of the nineteenth century, the foundations of modern mathematical logic were laid by Gottlob Frege (1848–1925). His *Begriffsschrift* sets forth the theory of quantification presented in Chapter 8 of this text. Frege's work was continued into the twentieth century by Alfred North Whitehead (1861–1947) and Bertrand Russell (1872–1970), whose monumental *Principia Mathematica* attempted to reduce the whole of pure mathematics to logic. The *Principia* is the source of much of the symbolism that appears in Chapters 6, 7, and 8 of this text.

During the twentieth century, much of the work in logic has focused on the formalization of logical systems and on questions dealing with the completeness and consistency of such systems. A now-famous theorem proved by Kurt Goedel (1906–1978) states that in any formal system adequate for number theory there exists an undecidable formula—that is, a formula such that neither it nor its negation is derivable from the axioms of the system. Other developments include multivalued logics and the formalization of modal logic. Most recently, logic has made a major contribution to technology by providing the conceptual foundation for the electronic circuitry of digital computers.

EXERCISE 1.1

LC I. Each of the following passages contains a single argument. Using the letters "P" and "C," identify the premises and conclusion of each argument, writing premises first and conclusion last. List the premises in the order in which they make the most sense, and write both premises and conclusion in the form of separate declarative sentences. Indicator words may be eliminated once premises and conclusion have been appropriately labeled. The exercises marked with a star are answered in the back of the text.

★1. Titanium combines readily with oxygen, nitrogen, and hydrogen, all of which have an adverse effect on its mechanical properties. As a result, titanium must be processed in their absence.

(*Illustrated World of Science Encyclopedia*)

2. Since the good, according to Plato, is that which furthers a person's real interests, it follows that in any given case when the good is known, men will seek it.

(Avrum Stroll and Richard Popkin, *Philosophy and the Human Spirit*)

3. As the denial or perversion of justice by the sentences of courts, as well as in any other manner, is with reason classed among the just causes of war, it will

follow that the federal judiciary ought to have cognizance of all causes in which the citizens of other countries are concerned.

(Alexander Hamilton, *Federalist Papers*, No. 80)

★4. When individuals voluntarily abandon property, they forfeit any expectation of privacy in it that they might have had. Therefore, a warrantless search or seizure of abandoned property is not unreasonable under the Fourth Amendment.

(Judge Stephanie Kulp Seymour, *United States v. Jones*)

5. Artists and poets look at the world and seek relationships and order. But they translate their ideas to canvas, or to marble, or into poetic images. Scientists try to find relationships between different objects and events. To express the order they find, they create hypotheses and theories. Thus the great scientific theories are easily compared to great art and great literature.

(Douglas C. Giancoli, *The Ideas of Physics*, 3rd edition)

6. The fact that there was never a land bridge between Australia and mainland Asia is evidenced by the fact that the animal species in the two areas are very different. Asian placental mammals and Australian marsupial mammals have not been in contact in the last several million years.

(T. Douglas Price and Gary M. Feinman, *Images of the Past*)

★7. The psychological impact and crisis created by birth of a defective infant is devastating. Not only is the mother denied the normal tension release from the stress of pregnancy, but both parents feel a crushing blow to their dignity, self-esteem, and self-confidence. In a very short time, they feel grief for the loss of the normal expected child, anger at fate, numbness, disgust, waves of helplessness and disbelief.

(John A. Robertson, "Involuntary Euthanasia of Defective Newborns")

8. The classroom teacher is crucial to the development and academic success of the average student, and administrators simply are ancillary to this effort. For this reason, classroom teachers ought to be paid at least the equivalent of administrators at all levels, including the superintendent.

(Peter F. Falstrup, Letter to the Editor)

9. An agreement cannot bind unless both parties to the agreement know what they are doing and freely choose to do it. This implies that the seller who intends to enter a contract with a customer has a duty to disclose exactly what the customer is buying and what the terms of the sale are.

(Manuel G. Velasquez, "The Ethics of Consumer Production")

★10. Punishment, when speedy and specific, may suppress undesirable behavior, but it cannot teach or encourage desirable alternatives. Therefore, it is crucial to use positive techniques to model and reinforce appropriate behavior that the person can use in place of the unacceptable response that has to be suppressed.

(Walter Mischel and Harriet Mischel, *Essentials of Psychology*)

11. Profit serves a very crucial function in a free enterprise economy, such as our own. High profits are the signal that consumers want more of the output of the industry. High profits provide the incentive for firms to expand output and for more firms to enter the industry in the long run. For a firm of above-average efficiency, profits represent the reward for greater efficiency.

(Dominic Salvatore, *Managerial Economics,* 3rd edition)

12. Cats can think circles around dogs! My cat regularly used to close and lock the door to my neighbor's doghouse, trapping their sleeping Doberman inside. Try telling a cat what to do, or putting a leash on him—he'll glare at you and say, "I don't think so. You should have gotten a dog."

(Kevin Purkiser, Letter to the Editor)

★13. Since private property helps people define themselves, since it frees people from mundane cares of daily subsistence, and since it is finite, no individual should accumulate so much property that others are prevented from accumulating the necessities of life.

(Leon P. Baradat, *Political Ideologies, Their Origins and Impact*)

14. To every existing thing God wills some good. Hence, since to love any thing is nothing else than to will good to that thing, it is manifest that God loves everything that exists.

(Thomas Aquinas, *Summa Theologica*)

15. Women of the working class, especially wage workers, should not have more than two children at most. The average working man can support no more and the average working woman can take care of no more in decent fashion.

(Margaret Sanger, *Family Limitations*)

★16. Radioactive fallout isn't the only concern in the aftermath of nuclear explosions. The nations of planet Earth have acquired nuclear weapons with an explosive power equal to more than a million Hiroshima bombs. Studies suggest that explosion of only half these weapons would produce enough soot, smoke, and dust to blanket the Earth, block out the sun, and bring on a nuclear winter that would threaten the survival of the human race.

(John W. Hill and Doris K. Kolb, *Chemistry for Changing Times,* 7th edition)

17. An ant releases a chemical when it dies, and its fellows then carry it away to the compost heap. Apparently the communication is highly effective; a healthy ant painted with the death chemical will be dragged to the funeral heap again and again.

(Carol R. Ember and Melvin Ember, *Cultural Anthropology,* 7th edition)

18. Every art and every inquiry, and similarly every action and pursuit, is thought to aim at some good; and for this reason the good has rightly been declared to be that at which all things aim.

(Aristotle, *Nicomachean Ethics*)

★19. Poverty offers numerous benefits to the nonpoor. Antipoverty programs provide jobs for middle-class professionals in social work, penology and public health. Such workers' future advancement is tied to the continued growth of bureaucracies dependent on the existence of poverty.

(J. John Palen, *Social Problems*)

20. Corn is an annual crop. Butcher's meat, a crop which requires four or five years to grow. As an acre of land, therefore, will produce a much smaller quantity of the one species of food than the other, the inferiority of the quantity must be compensated by the superiority of the price.

(Adam Smith, *The Wealth of Nations*)

21. Neither a borrower nor lender be
For loan oft loses both itself and friend,
And borrowing dulls the edge of husbandry.

(William Shakespeare, *Hamlet* I, 3)

★22. The stakes in whistleblowing are high. Take the nurse who alleges that physicians enrich themselves in her hospital through unnecessary surgery; the engineer who discloses safety defects in the braking systems of a fleet of new rapid-transit vehicles; the Defense Department official who alerts Congress to military graft and overspending: all know that they pose a threat to those whom they denounce and that their own careers may be at risk.

(Sissela Bok, "Whistleblowing and Professional Responsibility")

23. If a piece of information is not "job relevant," then the employer is not entitled qua employer to know it. Consequently, since sexual practices, political beliefs, associational activities, etc., are not part of the description of most jobs, that is, since they do not directly affect one's job performance, they are not legitimate information for an employer to know in the determination of the hiring of a job applicant.

(George G. Brenkert, "Privacy, Polygraphs, and Work")

24. Many people believe that a dark tan is attractive and a sign of good health, but mounting evidence indicates that too much sun can lead to health problems. One of the most noticeable effects is premature aging of the skin. The sun also contributes to certain types of cataracts, and, what is most worrisome, it plays a role in skin cancer.

(Joseph M. Moran and Michael D. Morgan, *Meteorology*, 4th edition)

★25. Contrary to the tales of some scuba divers, the toothy, gaping grin on the mouth of an approaching shark is not necessarily anticipatory. It is generally accepted that by constantly swimming with its mouth open, the shark is simply avoiding suffocation. This assures a continuous flow of oxygen-laden water into their mouths, over their gills, and out through the gill slits.

(Robert A. Wallace et al., *Biology: The Science of Life*)

26. Not only is the sky blue [as a result of scattering], but light coming from it is also partially polarized. You can readily observe this by placing a piece of Polaroid (for example, one lens of a pair of Polaroid sunglasses) in front of your eye and rotating it as you look at the sky on a clear day. You will notice a change in light intensity with the orientation of the Polaroid.

(Frank J. Blatt, *Principles of Physics,* 2nd edition)

27. Since the secondary light [from the moon] does not inherently belong to the moon, and is not received from any star or from the sun, and since in the whole universe there is no other body left but the earth, what must we conclude? What is to be proposed? Surely we must assert that the lunar body (or any other dark and sunless orb) is illuminated by the earth.

(Galileo Galilei, *The Starry Messenger*)

★28. Anyone familiar with our prison system knows that there are some inmates who behave little better than brute beasts. But the very fact that these prisoners exist is a telling argument against the efficacy of capital punishment as a deterrent. If the death penalty had been truly effective as a deterrent, such prisoners would long ago have vanished.

("The Injustice of the Death Penalty," *America*)

29. Though it is possible that REM sleep and dreaming are not necessary in the adult, REM deprivation studies seem to suggest otherwise. Why would REM pressure increase with deprivation if the system is unimportant in the adult?

(Herbert L. Petri, *Motivation: Theory and Research,* 2nd edition)

30. World government and the balance of power are in many ways opposites. World government means one central authority, a permanent standing world police force, and clearly defined conditions under which this force will go into action. A balance of power system has many sovereign authorities, each controlling its own army, combining only when they feel like it to control aggression. To most people world government now seems unattainable.

(David W. Ziegler, *War, Peace, and International Politics,* 4th edition)

II. The following arguments were taken from magazine and newspaper editorials and letters to the editor. In most instances the main conclusion must be rephrased to capture the full intent of the author. Write out what you interpret the main conclusion to be.

★1. University administrators know well the benefits that follow notable success in college sports: increased applications for admissions, increased income from licensed logo merchandise, more lucrative television deals, post-season game revenue and more successful alumni fund drives. The idea that there is something ideal and pure about the amateur athlete is self-serving bunk.

(Michael McDonnell, Letter to the Editor)

2. In a nation of immigrants, people of diverse ethnic backgrounds must have a common bond through which to exchange ideas. How can this bond be accomplished if there is no common language? It is those who shelter the immigrant from learning English by encouraging the development of a multilingual society who are creating a xenophobic atmosphere. They allow the immigrant to surround himself with a cocoon of language from which he cannot escape and which others cannot penetrate.

(Rita Toften, Letter to the Editor)

3. The health and fitness of our children has become a problem partly because of our attitude toward athletics. The purpose of sports, especially for children, should be to make healthy people healthier. The concept of team sports has failed to do this. Rather than learning to interact and cooperate with others, youngsters are taught to compete. Team sports have only reinforced the notion that the team on top is the winner, and all others are losers. This approach does not make sports appealing to many children, and some, especially among the less fit, burn out by the time they are twelve.

(Mark I. Pitman, "Young Jocks")

★4. College is the time in which a young mind is supposed to mature and acquire wisdom, and one can only do this by experiencing as much diverse intellectual stimuli as possible. A business student may be a whiz at accounting, but has he or she ever experienced the beauty of a Shakespearean sonnet or the boundless events composing Hebrew history? Most likely not. While many of these neoconservatives will probably go on to be financially successful, they are robbing themselves of the true purpose of collegiate academics, a sacrifice that outweighs the future salary checks.

(Robert S. Griffith, "Conservative College Press")

5. History has shown repeatedly that you cannot legislate morality, nor does anyone have a right to. The real problem is the people who have a vested interest in sustaining the multibillion-dollar drug industry created by the laws against drugs. The legalization of drugs would remove the thrill of breaking the law; it would end the suffering caused by unmetered doses, impurities and substandard paraphernalia. A huge segment of the underground and extralegal economy would move into a legitimate economy, taking money away from criminals, eliminating crime and violence, and restoring many talented people to useful endeavor.

(Thomas L. Wayburn, Letter to the Editor)

6. Infectious disease is no longer the leading cause of death in this country, thanks to antibiotics, but there are new strains of bacteria that are resistant to—and others that grow only in the presence of—antibiotics. Yet Congress wants to cut the National Institutes of Health budget. Further cuts would leave us

woefully unprepared to cope with the new microbes Mother Nature has cooking in her kitchen.

(Valina L. Dawson, Letter to the Editor)

★7. At a time when our religious impulses might help heal the pains and strains in our society, today's television pulpiteers preach intolerance, censure and discrimination. They package a "believer life-style," and rail against everyone who doesn't fit it—homosexuals, communists, Jews and other non-Christians, sex educators and so on. Such intolerance threatens to undermine the pluralism that marks our heritage. The packaging of that intolerance in slick Hollywood programming or under the guise of patriotic fervor is skillfully accomplished on many fronts. That, however, does not make it right.

(Peter G. Kreitler, "TV Preachers' Religious Intolerance")

8. Ideally, decisions about health care should be based on the doctor's clinical judgment, patient preference and scientific evidence. Patients should always be presented with options in their care. Elective Cesarean section, however, is not used to treat a problem but to avoid a natural process. An elective surgery like this puts the patient at unnecessary risk, increases the risk for complications in future deliveries and increases health care costs.

(Anne Foster-Rosales, M.D., Letter to the Editor)

9. Parents who feel guilty for the little time they can (or choose to) spend with their children "pick up" after them—so the children don't learn to face the consequences of their own choices and actions. Parents who allow their children to fail are showing them greater love and respect.

(Susan J. Peters, Letter to the Editor)

★10. Most of the environmental problems facing us stem, at least in part, from the sheer number of Americans. The average American produces three quarters of a ton of garbage every year, consumes hundreds of gallons of gasoline and uses large amounts of electricity (often from a nuclear power plant, coal burning, or a dam). The least painful way to protect the environment is to limit population growth.

(Craig M. Bradley, Letter to the Editor)

III. Define the following terms:

logic	conclusion	inference
argument	conclusion indicator	proposition
statement	premise indicator	truth value
premise		

IV. Answer "true" or "false" to the following statements:

1. The purpose of the premise or premises is to set forth the reasons or evidence given in support of the conclusion.

2. Some arguments have more than one conclusion.
3. All arguments must have more than one premise.
4. The words "therefore," "hence," "so," "since," and "thus" are all conclusion indicators.
5. The words "for," "because," "as," and "for the reason that" are all premise indicators.
6. In the strict sense of the terms, "inference" and "argument" have exactly the same meaning.
7. In most (but not all) arguments that lack indicator words, the conclusion is the first statement.
8. Any sentence that is either true or false is a statement.
9. Every statement has a truth value.
10. The person usually credited with being the father of logic is Aristotle.

1.2 Recognizing Arguments

Not all passages contain arguments. Because logic deals with arguments, it is important to be able to distinguish passages that contain arguments from those that do not. In general, a passage contains an argument if it purports to prove something; if it does not do so, it does not contain an argument. Two conditions must be fulfilled for a passage to purport to prove something: (1) At least one of the statements must claim to present evidence or reasons. (2) There must be a claim that the alleged evidence or reasons supports or implies something—that is, a claim that something follows from the alleged evidence. As we have seen, the statements that claim to present the evidence or reasons are the premises, and the statement that the evidence is claimed to support or imply is the conclusion. It is not necessary that the premises present actual evidence or true reasons nor that the premises actually support the conclusion. But at least the premises must *claim* to present evidence or reasons, and there must be a *claim* that the evidence or reasons support or imply something.

The first condition expresses a **factual claim,** and deciding whether it is fulfilled usually presents few problems. Thus, most of our attention will be concentrated on whether the second condition is fulfilled. This second condition expresses what is called an **inferential claim.** The inferential claim is simply the claim that the passage expresses a certain kind of reasoning process—that something supports or implies something or that something follows from something. Such a claim can be either explicit or implicit.

An *explicit* inferential claim is usually asserted by premise or conclusion indicator words ("thus," "since," "because," "hence," "therefore," and so on). Example:

> The human eye can see a source of light that is as faint as an ordinary candle from a distance of 27 kilometers, through a nonabsorbing atmosphere. Thus, a powerful searchlight directed from a new moon should be visible on earth with the naked eye.
>
> (Diane E. Papalia and Sally Wendkos Olds, *Psychology*)

The word "thus" expresses the claim that something is being inferred, so the passage is an argument.

An *implicit* inferential claim exists if there is an inferential relationship between the statements in a passage. Example:

> The price reduction [seen with the electronic calculator] is the result of a technological revolution. The calculator of the 1960s used integrated electronic circuits that contained about a dozen transistors or similar components on a single chip. Today, mass-produced chips, only a few millimeters square, contain several thousand such components.
>
> (Robert S. Boikess and Edward Edelson, *Chemical Principles*)

The inferential relationship between the first statement and the other two constitutes an implicit claim that evidence supports something, so we are justified in calling the passage an argument. The first statement is the conclusion, and the other two are the premises.

In deciding whether there is a claim that evidence supports or implies something, keep an eye out for (1) indicator words and (2) the presence of an inferential relationship between the statements. In connection with these points, however, a word of caution is in order. First, the mere occurrence of an indicator word by no means guarantees the presence of an argument. For example, consider the following passages:

> Since Edison invented the phonograph, there have been many technological developments.
>
> Since Edison invented the phonograph, he deserves credit for a major technological development.

In the first passage the word "since" is used in a *temporal* sense. It means "from the time that." Thus, the first passage is not an argument. In the second passage "since" is used in a *logical* sense, and so the passage *is* an argument.

The second cautionary point is that it is not always easy to detect the occurrence of an inferential relationship between the statements in a passage, and the reader may have to review a passage several times before making a decision. In reaching such a decision, it sometimes helps to mentally insert the word "therefore" before the various statements to see whether it makes sense to interpret one of them as following

from the others. Even with this mental aid, however, the decision whether a passage contains an inferential relationship (as well as the decision about indicator words) often involves a heavy dose of interpretation. As a result, not everyone will agree about every passage. Sometimes the only answer possible is a conditional one: "*If* this passage contains an argument, then these are the premises and that is the conclusion."

To assist in distinguishing passages that contain arguments from those that do not, let us now investigate some typical kinds of nonarguments. These include simple noninferential passages, expository passages, illustrations, explanations, and conditional statements.

Simple Noninferential Passages

Simple noninferential passages are unproblematic passages that lack a claim that anything is being proved. Such passages contain statements that could be premises or conclusions (or both), but what is missing is a claim that any potential premise supports a conclusion or that any potential conclusion is supported by premises. Passages of this sort include warnings, pieces of advice, statements of belief or opinion, loosely associated statements, and reports.

A **warning** is a form of expression that is intended to put someone on guard against a dangerous or detrimental situation. Examples:

> Watch out that you don't slip on the ice.
> Whatever you do, never confide personal secrets to Blabbermouth Bob.

If no evidence is given to prove that such statements are true, then there is no argument.

A **piece of advice** is a form of expression that makes a recommendation about some future decision or course of conduct. Examples:

> You should keep a few things in mind before buying a used car. Test drive the car at varying speeds and conditions, examine the oil in the crankcase, ask to see service records, and, if possible, have the engine and power train checked by a mechanic.
>
> Before accepting a job after class hours, I would suggest that you give careful consideration to your course load. Will you have sufficient time to prepare for classes and tests, and will the job produce an excessive drain on your energies?

As with warnings, if there is no evidence that is intended to prove anything, then there is no argument.

A **statement of belief** or **opinion** is an expression about what someone happens to believe or think at a certain time. Examples:

> We believe that our company must develop and produce outstanding products that will perform a great service or fulfill a need for our customers. We believe that our business must be run at an adequate profit and that the services and products we offer must be better than those offered by competitors.
>
> (Robert D. Hay and Edmund R. Gray, "Introduction to Social Responsibility")

> I think a nation such as ours, with its high moral traditions and commitments, has a further responsibility to know how we became drawn into this conflict, and to learn the lessons it has to teach us for the future.
>
> (Alfred Hassler, *Saigon, U.S.A.*)

Because neither of these authors makes any claim that his belief or opinion is supported by evidence, or that it supports some conclusion, there is no argument.

Loosely associated statements may be about the same general subject, but they lack a claim that one of them is proved by the others. Example:

> Not to honor men of worth will keep the people from contention; not to value goods that are hard to come by will keep them from theft; not to display what is desirable will keep them from being unsettled of mind.
>
> (Lao-Tzu, *Thoughts from the Tao Te Ching*)

Because there is no claim that any of these statements provides evidence or reasons for believing another, there is no argument.

A **report** consists of a group of statements that convey information about some topic or event. Example:

> Even though more of the world is immunized than ever before, many old diseases have proven quite resilient in the face of changing population and environmental conditions, especially in the developing world. New diseases, such as AIDS, have taken their toll in both the North and the South.
>
> (Steven L. Spiegel, *World Politics in a New Era*)

These statements could serve as the premises of an argument; but because the author makes no claim that they support or imply anything, there is no argument. Another type of report is the news report:

> A powerful car bomb blew up outside the regional telephone company headquarters in Medellin, injuring 25 people and causing millions of dollars of damage to nearby buildings, police said. A police statement said the 198-pound bomb was packed into a milk churn hidden in the back of a stolen car.
>
> (Newspaper clipping)

Again, because the reporter makes no claim that these statements imply anything, there is no argument.

One must be careful, though, with reports *about* arguments:

> "The Air Force faces a serious shortage of experienced pilots in the years ahead, because repeated overseas tours and the allure of high paying jobs with commercial airlines are winning out over lucrative bonuses to stay in the service," says a prominent Air Force official.
>
> (Newspaper clipping)

Properly speaking, this passage is not an argument, because the author of the passage does not claim that anything is supported by evidence. Rather, the author reports the claim by the Air Force official that something is supported by evidence. If such passages are interpreted as "containing" arguments, it must be made clear that the argument is not the author's but one made by someone about whom the author is reporting.

Expository Passages

An **expository passage** is a kind of discourse that begins with a topic sentence followed by one or more sentences that develop the topic sentence. If the objective is not to prove the topic sentence but only to expand it or elaborate it, then there is no argument. Examples:

> There are three familiar states of matter: solid, liquid, and gas. Solid objects ordinarily maintain their shape and volume regardless of their location. A liquid occupies a definite volume, but assumes the shape of the occupied portion of its container. A gas maintains neither shape nor volume. It expands to fill completely whatever container it is in.
>
> (John W. Hill and Doris K. Kolb, *Chemistry for Changing Times,* 7th ed.)

> There is a stylized relation of artist to mass audience in the sports, especially in baseball. Each player develops a style of his own—the swagger as he steps to the plate, the unique windup a pitcher has, the clean-swinging and hard-driving hits, the precision quickness and grace of infield and outfield, the sense of surplus power behind whatever is done.
>
> (Max Lerner, *America as a Civilization*)

In each passage the topic sentence is stated first, and the remaining sentences merely develop and flesh out this topic sentence. These passages are not arguments because they lack an inferential claim. However, expository passages differ from simple noninferential passages (such as warnings and pieces of advice) in that many of them can also be taken as arguments. If the purpose of the subsequent sentences in the passage is not only to flesh out the topic sentence but also to prove it, then the passage is an argument. Example:

> Skin and the mucous membrane lining the respiratory and digestive tracts serve as mechanical barriers to entry by microbes. Oil gland secretions contain chemicals that weaken or kill bacteria on skin. The respiratory tract is lined by cells that sweep mucus and trapped particles up into the throat, where they can be swallowed. The stomach has an acidic pH, which inhibits the growth of many types of bacteria.
>
> (Sylvia S. Mader. *Human Biology,* 4th ed.)

In this passage the topic sentence is stated first, and the purpose of the remaining sentences is not only to *show how* the skin and mucous membranes serve as barriers

to microbes but to *prove* that they do this. Thus, the passage can be taken as both an expository passage and an argument.

In deciding whether an expository passage should be interpreted as an argument, try to determine whether the purpose of the subsequent sentences in the passage is merely to develop the topic sentence or also to prove it. In borderline cases, ask yourself whether the topic sentence makes a claim that everyone accepts or agrees with. If it does, the passage is probably not an argument. In real life situations authors rarely try to prove something that everyone already accepts. However, if the topic sentence makes a claim that many people do not accept or have never thought about, then the purpose of the remaining sentences may be both to prove the topic sentence as well as to develop it. If this be so, the passage is an argument.

Finally, if even this procedure yields no definite answer, the only alternative may be to say that *if* the passage is taken as an argument, then the first statement is the conclusion and the others are the premises.

Illustrations

An **illustration** consists of a statement about a certain subject combined with a reference to one or more specific instances intended to exemplify that statement. Illustrations are often confused with arguments because many of them contain indicator words such as "thus." Examples:

> Chemical elements, as well as compounds, can be represented by molecular formulas. Thus, oxygen is represented by "O_2," water by "H_2O," and sodium chloride by "NaCl."
>
> Whenever a force is exerted on an object, the shape of the object can change. For example, when you squeeze a rubber ball or strike a punching bag with your fist, the objects are deformed to some extent.
>
> (Raymond A. Serway, *Physics For Scientists and Engineers,* 4th ed.)

These selections are not arguments because they make no claim that anything is being proved. In the first selection, the word "thus" indicates how something is done—namely, how chemical elements and compounds can be represented by formulas. In the second selection, the example cited is intended to give concrete meaning to the notion of a force changing the shape of something. It is not intended primarily to prove *that* a force can change the shape of something.

However, as with expository passages, many illustrations can be taken as arguments. Such arguments are often called **arguments from example.** Here is an instance of one:

> Water is an excellent solvent. It can dissolve a wide range of materials that will not dissolve in other liquids. For example, salts do not dissolve in most common solvents, such as gasoline, kerosene, turpentine and cleaning fluids. But many

> salts dissolve readily in water. So do a variety of nonionic organic substances, such as sugars and alcohols of low molecular weight.
>
> (Robert S. Boikess and Edward Edelson, *Chemical Principles*)

In this passage the examples that are cited can be interpreted as providing evidence that water can dissolve a wide range of materials that will not dissolve in other liquids. Thus, the passage can be taken as both an illustration and an argument, with the second sentence being the conclusion.

In deciding whether an illustration should be interpreted as an argument one must determine whether the passage merely shows how something is done or what something means, or whether it also purports to prove something. In borderline cases it helps to note whether the claim being illustrated is one that practically everyone accepts or agrees with. If it is, the passage is probably not an argument. As we have already noted, in real life situations authors rarely attempt to prove what everyone already accepts. But if the claim being illustrated is one that many people do not accept or have never thought about, then the passage may be interpreted as both an illustration and an argument.

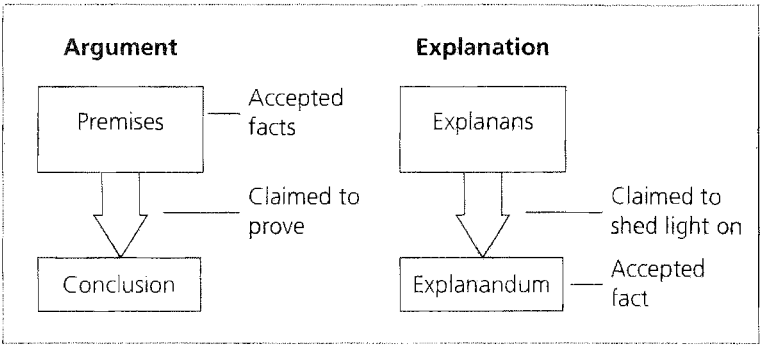
Thus, in reference to the first two examples we considered, most people are aware that elements and compounds can be expressed by formulas—practically everyone knows that water is H_2O—and most people know that forces distort things—that running into a tree can cause a dent in the car bumper. But people may not be aware of the fact that water dissolves many things that other solvents will not dissolve. This is one of the reasons for evaluating the first two examples as mere illustrations and the last one as an argument.

Explanations

One of the most important kinds of nonargument is the explanation. An **explanation** is a group of statements that purports to shed light on some event or phenomenon. The event or phenomenon in question is usually accepted as a matter of fact. Examples:

> The *Challenger* spacecraft exploded after liftoff because an O-ring failed in one of the booster rockets.
>
> The sky appears blue from the earth's surface because light rays from the sun are scattered by particles in the atmosphere.
>
> Cows can digest grass, while humans cannot, because their digestive systems contain enzymes not found in humans.

Every explanation is composed of two distinct components: the explanandum and explanans. The **explanandum** is the statement that describes the event or phenomenon to be explained, and the **explanans** is the statement or group of statements that purports to do the explaining. In the first example above, the explanandum is the



statement "The *Challenger* spacecraft exploded after liftoff," and the explanans is "An O-ring failed in one of the booster rockets."

Explanations are sometimes mistaken for arguments because they often contain the indicator word "because." Yet explanations are not arguments because in an explanation the purpose of the explanans is to shed light on, or to make sense of, the explanandum event—not to prove that it occurred. In other words, the purpose of the explanans is to show *why* something is the case, while in an argument, the purpose of the premises is to prove *that* something is the case.

In the first example above, the fact that the *Challenger* exploded is known to everyone. The statement that an O-ring failed in one of the booster rockets is not intended to prove *that* the spacecraft exploded but rather to show *why* it exploded. In the second example, the fact that the sky is blue is readily apparent. The intention of the passage is to explain *why* it appears blue—not to prove *that* it appears blue. Similarly, in the third example, virtually everyone knows that people cannot digest grass. The intention of the passage is to explain *why* this is true.

Thus, to distinguish explanations from arguments, identify the statement that is either the explanandum or the conclusion (usually this is the statement that precedes the word "because"). If this statement describes an accepted matter of fact, and if the remaining statements purport to shed light on this statement, then the passage is an explanation.

This method works for practically all passages that are either explanations or arguments (but not both). However, as with expository passages and illustrations, there are some passages that can be interpreted as both explanations and arguments. Example:

> Women become intoxicated by drinking a smaller amount of alcohol than men because men metabolize part of the alcohol before it reaches the bloodstream whereas women do not.

The purpose of this passage could be to prove the first statement to those people who do not accept it as fact, and to shed light on that fact to those people who do accept

it. Alternately, the passage could be intended to prove the first statement to a single person who accepts its truth on blind faith or incomplete experience, and simultaneously to shed light on this truth. Thus, the passage can be correctly interpreted as both an explanation and an argument.

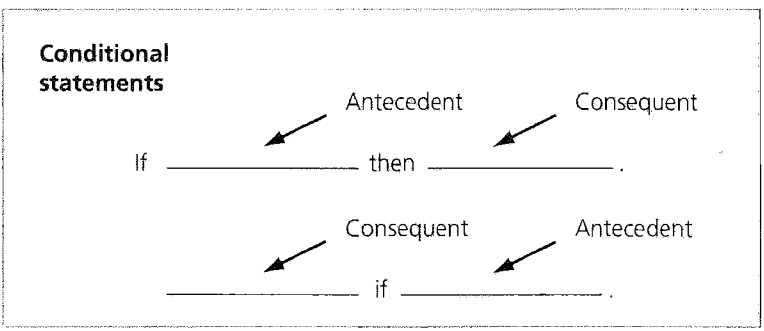
Perhaps the greatest problem confronting the effort to distinguish explanations from arguments lies in determining whether something is an accepted matter of fact. Obviously what is accepted by one person may not be accepted by another. Thus, the effort often involves determining which person or group of people the passage is directed to—the intended audience. Sometimes the source of the passage (textbook, newspaper, technical journal, etc.) will decide the issue. But when the passage is taken totally out of context, this may prove impossible. In those circumstances the only possible answer may be to say that *if* the passage is an argument, then such-and-such is the conclusion and such-and-such are the premises.

Conditional Statements

A **conditional statement** is an "if . . . then . . ." statement; for example:

> If air is removed from a solid closed container, then the container will weigh less than it did.

Every conditional statement is made up of two component statements. The component statement immediately following the "if" is called the **antecedent,** and the one following the "then" is called the **consequent.** (Occasionally, the word "then" is left out, and occasionally the order of antecedent and consequent is reversed.) In the above example the antecedent is "Air is removed from a solid closed container," and the consequent is "The container will weigh less than it did." This example asserts a causal connection between the air being removed and the container weighing less. However, not all conditional statements express causal connections. The statement "If yellow fever is an infectious disease, then the Dallas Cowboys are a football team" is just as much a conditional statement as the one about the closed container.



Conditional statements are not arguments, because they fail to meet the criteria given earlier. In an argument, at least one statement must claim to present evidence, and there must be a claim that this evidence implies something. In a conditional statement, there is no claim that either the antecedent or the consequent presents evidence. In other words, there is no assertion that either the antecedent or the consequent is true. Rather, there is only the assertion that *if* the antecedent is true, then so is the consequent. Of course, a conditional statement as a whole may present evidence because it asserts a relationship between statements. Yet when conditional statements are taken in this sense, there is still no argument, because there is then no separate claim that this evidence implies anything.

Some conditional statements are similar to arguments, however, in that they express the outcome of a reasoning process. As such, they may be said to have a certain inferential content. Consider the following:

> If both Saturn and Uranus have rings, then Saturn has rings.
>
> If iron is less dense than mercury, then it will float in mercury.

The link between the antecedent and consequent of these conditional statements resembles the inferential link between the premises and conclusion of an argument. Yet there is a difference because the premises of an argument are claimed to be true, whereas no such claim is made for the antecedent of a conditional statement. Accordingly, these conditional statements are not arguments.* Yet their inferential content may be reexpressed to form arguments:

> Both Saturn and Uranus have rings.
> Therefore, Saturn has rings.
>
> Iron is less dense than mercury.
> Therefore, iron will float in mercury.

Finally, while no single conditional statement is an argument, a conditional statement may serve as either the premise or the conclusion (or both) of an argument, as the following examples illustrate:

> If cigarette companies publish warning labels, then smokers assume the risk of smoking.
> Cigarette companies do publish warning labels.
> Therefore, smokers assume the risk of smoking.

---

*In saying this we are temporarily ignoring the possibility of these statements being *enthymemes*. As we will see in Chapter 5, an enthymeme is an argument in which a premise or conclusion (or both) is implied but not stated. If, to the second example, we add the premise "Iron is less dense than mercury" and the conclusion "Therefore, iron will float in mercury," we have a complete argument. To decide whether a conditional statement is an enthymeme, we must be familiar with the context in which it occurs.

If banks make bad loans, then they will be threatened with collapse.
If banks are threatened with collapse, then the taxpayer will come to the rescue.
Therefore, if banks make bad loans, then the taxpayer will come to the rescue.

The relation between conditional statements and arguments may now be summarized as follows:

1. A single conditional statement is not an argument.
2. A conditional statement may serve as either the premise or the conclusion (or both) of an argument.
3. The inferential content of a conditional statement may be reexpressed to form an argument.

The first two rules are especially pertinent to the recognition of arguments. According to the first rule, if a passage consists of a single conditional statement, it is not an argument. But if it consists of a conditional statement together with some other statement, then, by the second rule, it *may* be an argument, depending on such factors as the presence of indicator words and an inferential relationship between the statements.

Conditional statements are especially important in logic because they express the relationship between necessary and sufficient conditions. *A* is said to be a sufficient condition for *B* whenever the occurrence of *A* is all that is needed for the occurrence of *B*. For example, being a dog is a sufficient condition for being an animal. On the other hand, *B* is said to be a necessary condition for *A* whenever *A* cannot occur without the occurrence of *B*. Thus, being an animal is a necessary condition for being a dog. These relationships are expressed in the following conditional statements:

If *X* is a dog, then *X* is an animal.
If *X* is not an animal, then *X* is not a dog.

The first statement says that being a dog is a sufficient condition for being an animal and the second that being an animal is a necessary condition for being a dog. However, a little reflection reveals that these two statements say exactly the same thing. Thus each expresses in one way a necessary condition and in another way a sufficient condition. The terminology of sufficient and necessary conditions will be used in later chapters to express definitions and causal connections.

Summary

In deciding whether a passage contains an argument, one should look for three things: (1) indicator words such as "therefore," "since," "because," and so on; (2) an inferential relationship between the statements; and (3) typical kinds of nonarguments. But

remember that the mere occurrence of an indicator word does not guarantee the presence of an argument. One must check to see that the statement identified as the conclusion is intended to be supported by one or more of the other statements. Also keep in mind that in many arguments that lack indicator words, the conclusion is the first statement. Furthermore it helps to mentally insert the word "therefore" before the various statements before deciding that a statement should be interpreted as a conclusion. The typical kinds of nonarguments that we have surveyed are as follows:

warnings	reports
pieces of advice	expository passages
statements of belief	illustrations
statements of opinion	explanations
loosely associated statements	conditional statements

Keep in mind that these kinds of nonargument are not mutually exclusive, and that, for example, one and the same passage can sometimes be interpreted as both a report and a statement of opinion, or as both an expository passage and an illustration. The precise kind of nonargument a passage might be is nowhere near as important as correctly deciding whether or not it is an argument.

After working the exercises in this section, you may, if you wish, proceed directly to Section 1.6 ("Extended Arguments").

EXERCISE 1.2

LC I. Determine which of the following passages are arguments. For those that are, identify the conclusion. For those that are not, attempt to determine the kind of nonarguments.

★1. Women tend to have higher pitched voices than men because they have shorter vocal chords. Shorter vocal chords vibrate at a higher frequency than longer ones.

2. If public education fails to improve the quality of instruction in both primary and secondary schools, then it is likely that it will lose additional students to the private sector in the years ahead.

3. Freedom of the press is the most important of our constitutionally guaranteed freedoms. Without it, our other freedoms would be immediately threatened. Furthermore, it provides the fulcrum for the advancement of new freedoms.

★4. Water is a good solvent for many different substances, and it picks them up as it moves through the environment. Thus, rain water flowing over and under the ground dissolves minerals such as limestone.

(Gilbert Castellan et al., *The World of Chemistry*)

5. It is strongly recommended that you have your house inspected for termite damage at the earliest possible opportunity.
6. Shut the cage door, you fool! The lions are escaping into the streets!
★7. If the earth's magnetic field disappears, then the Van Allen radiation belt will be destroyed. If the Van Allen radiation belt is destroyed, then intense cosmic rays will bombard the earth. Therefore, if the earth's magnetic field disappears, then intense cosmic rays will bombard the earth.
8. Fictional characters behave according to the same psychological probabilities as real people. But the characters of fiction are found in exotic dilemmas that real people hardly encounter. Consequently, fiction provides us with the opportunity to ponder how people react in uncommon situations, and to deduce moral lessons, psychological principles, and philosophical insights from their behavior.

(J.R. McCuen and A.C. Winkler, *Readings for Writers*, 4th edition)

9. I believe that it must be the policy of the United States to support free peoples who are resisting attempted subjugation by armed minorities or by outside pressures. I believe that we must assist free peoples to work out their own destinies in their own way. I believe that our help should be primarily through economic and financial aid, which is essential to economic stability and orderly political processes.

(President Truman, Address to Congress, 1947)

★10. Five college students who were accused of sneaking into the Cincinnati Zoo and trying to ride the camels pleaded no contest to criminal trespass yesterday. The students scaled a fence to get into the zoo and then climbed another fence to get into the camel pit before security officials caught them, zoo officials said.

(Newspaper clipping)

11. Mortality rates for women undergoing early abortions, where the procedure is legal, appear to be as low as or lower than the rates for normal childbirth. Consequently, any interest of the state in protecting the woman from an inherently hazardous procedure, except when it would be equally dangerous for her to forgo it, has largely disappeared.

(Justice Blackmun, *Roe v. Wade*)

12. The pace of reading, clearly, depends entirely upon the reader. He may read as slowly or as rapidly as he can or wishes to read. If he does not understand something, he may stop and reread it, or go in search of elucidation before continuing. The reader can accelerate his pace when the material is easy or less than interesting, and can slow down when it is difficult or enthralling. If what he reads is moving he can put down the book for a few moments and cope with his emotions without fear of losing anything.

(Marie Winn, *The Plug-In Drug*)

★13. Cancer is not one disease, but many. Some forms are particularly susceptible to radiation therapy. Radiation is carefully aimed at the cancerous tissue, and exposure of normal cells is minimized. If the cancer cells are killed by the destructive effects of the radiation, the malignancy is halted.

(John W. Hill and Doris K. Kolb, *Chemistry for Changing Times,* 7th edition)

14. Lions at Kruger National Park in South Africa are dying of tuberculosis. "All of the lions in the park may be dead within ten years because the disease is incurable, and the lions have no natural resistance," said the deputy director of the Department of Agriculture.

(Newspaper clipping)

15. Economics is of practical value in business. An understanding of the overall operation of the economic system puts the business executive in a better position to formulate policies. The executive who understands the causes and consequences of inflation is better equipped during inflationary periods to make more intelligent decisions than otherwise.

(Campbell R. McConnell, *Economics,* 8th edition)

★16. Bear one thing in mind before you begin to write your paper: Famous literary works, especially works regarded as classics, have been thoroughly studied to the point where prevailing opinion on them has assumed the character of orthodoxy.

(J.R. McCuen and A.C. Winkler, *Readings for Writers,* 4th edition)

17. Young people at universities study to achieve knowledge and not to learn a trade. We must all learn how to support ourselves, but we must also learn how to live. We need a lot of engineers in the modern world, but we do not want a world of modern engineers.

(Winston Churchill, *A Churchill Reader,* ed. Colin R. Coote)

18. No business concern wants to sell on credit to a customer who will prove unable or unwilling to pay his or her account. Consequently, most business organizations include a credit department which must reach a decision on the credit worthiness of each prospective customer.

(Walter B. Meigs and Robert F. Meigs, *Accounting*)

★19. For organisms at the sea surface, sinking into deep water usually means death. Plant cells cannot photosynthesize in the dark depths. Fishes and other animals that descend lose contact with the main surface food supply and themselves become food for strange deep-living predators.

(David H. Milne, *Marine Life and the Sea*)

20. Since the 1950s a malady called whirling disease has invaded U.S. fishing streams, frequently attacking rainbow trout. A parasite deforms young fish, which often chase their tails before dying, hence the name.

("Trout Disease—A Turn for the Worse," *National Geographic*)

21. Dachshunds are ideal dogs for small children, as they are already stretched and pulled to such a length that the child cannot do much harm one way or the other.

(Robert Benchley, quoted in *Cold Noses and Warm Hearts*)

★22. Atoms are the basic building blocks of all matter. They can combine to form molecules, whose properties are generally very different from those of the constituent atoms. Table salt, for example, a simple chemical compound formed from chlorine and sodium, resembles neither the poisonous gas nor the highly reactive metal.

(Frank J. Blatt, *Principles of Physics*, 2nd edition)

23. The coarsest type of humor is the *practical joke:* pulling away the chair from the dignitary's lowered bottom. The victim is perceived first as a person of consequence, then suddenly as an inert body subject to the laws of physics: authority is debunked by gravity, mind by matter; man is degraded to a mechanism.

(Arthur Koestler, *Janus: A Summing Up*)

24. If a man holding a belief which he was taught in childhood or persuaded of afterwards keeps down and pushes away any doubts which arise about it in his mind, purposely avoids the reading of books and the company of men that call in question or discuss it, and regards as impious those questions which cannot easily be asked without disturbing it—the life of that man is one long sin against mankind.

(W. K. Clifford, "The Ethics of Belief")

★25. It is usually easy to decide whether or not something is alive. This is because living things share many common attributes, such as the capacity to extract energy from nutrients to drive their various functions, the power to actively respond to changes in their environment, and the ability to grow, to differentiate, and to reproduce.

(Donald Voet and Judith G. Voet, *Biochemistry*, 2nd edition)

26. Words are slippery customers. The full meaning of a word does not appear until it is placed in its context. . . . And even then the meaning will depend upon the listener, upon the speaker, upon their entire experience of the language, upon their knowledge of one another, and upon the whole situation.

(C. Cherry, *On Human Communication*)

27. Haydn developed the string quartet from the eighteenth century *divertimento,* giving more substance to the light, popular form and scoring it for two violins, a viola, and a cello. His eighty-three quartets, written over the course of his creative lifetime, evolved slowly into a sophisticated form. Together they constitute one of the most important bodies of chamber music literature.

(Robert Hickok, *Exploring Music*)

★28. A person never becomes truly self-reliant. Even though he deals effectively with things, he is necessarily dependent upon those who have taught him to do so. They have selected the things he is dependent upon and determined the kinds and degrees of dependencies.

(B. F. Skinner, *Beyond Freedom and Dignity*)

29. There is no doubt that some businessmen conspire to shorten the useful life of their products in order to guarantee replacement sales. There is, similarly, no doubt that many of the annual model changes with which American (and other) consumers are increasingly familiar are not technologically substantive.

(Alvin Toffler, *Future Shock*)

30. If one knows the plant life of an area, certain assumptions can be made about the climate and the animals that will be found there. For example, in grasslands the animal life typically includes large mammalian herbivores, insects, and birds.

(King, Saunders, and Wallace, *Biology: The Science of Life*)

★31. In areas where rats are a problem, it is very difficult to exterminate them with bait poison. That's because some rats eat enough poison to die but others eat only enough to become sick and then learn to avoid that particular poison taste in the future.

(Rod Plotnik, *Introduction to Psychology*, 4th edition)

32. Men are less likely to develop osteoporosis until later in life than women and seldom suffer as severely because they have 30 percent more bone mass on the average and don't undergo the sudden drop in estrogen that occurs with menopause.

(Matt Clark, "The Calcium Craze," *Newsweek*)

33. Newspapers, radio, and television are essential for a democracy. They are the critical link between the people and their government. They provide information and analysis about policy issues, and they also sensitize policymakers to public opinion—which enables them to respond to the needs and desires of the population. Finally, the media play a critical role in reporting and evaluating the decisions of government.

(Stephen J. Wayne et al., *The Politics of American Government*)

★34. Nations are made in two ways, by the slow working of history or the galvanic force of ideas. Most nations are made the former way, emerging slowly from the mist of the past, gradually coalescing within concentric circles of shared sympathies, with an accretion of consensual institutions. But a few nations are formed and defined by the citizens' assent to a shared philosophy.

(George Will, "Lithuania and South Carolina")

35. Although the plane mirror is perhaps the oldest optical instrument known to man, it remains an important element in the modern arsenal of sophisticated

optical devices. For example, the earth-moon laser-ranging experiments, initiated in 1969, rely on high-quality reflectors.

(Frank J. Blatt, *Principles of Physics,* 2nd edition)

LC II. The following selections were originally submitted as letters to the editor of newspapers and magazines. Determine which of them can, with good reason, be considered arguments. In those that can, identify the conclusion.

★1. What this country needs is a return to the concept of swift and certain justice. If we need more courts, judges and prisons, then so be it. And as for capital punishment, I say let the punishment fit the crime. When criminals behave more like humans, then we can start to treat them more humanely. In the meantime, I would like to see the Night Stalkers of our society swiftly executed rather than coddled by our courts and prisons.

(John Pearson)

2. The big problem with computers in elementary schools isn't their minimal educational value but the fact that they often replace science in the budget and curriculum. Our local Parent Teachers Association is throwing away science equipment as fervently as it raises money for more computers. I use computers extensively in the college physics classes I teach, so I appreciate their value in communications and advanced computation. But in elementary schools, too much is being sacrificed so that children can have all those pricey beige boxes.

(Roger G. Tobin)

3. Is there any country in the world that worries more about its kids having fun in school, making lessons exciting and relevant, and then is more disappointed with the result than the United States? We think learning is like buying a car or smoking a cigarette. Just get into the thing or draw a breath and you will be effortlessly transported to lands of pleasure and excitement.

(Charles M. Breinin)

★4. After reading your cover story, I find that cable TV has simply flooded our airwaves with more sex, violence and teen-age punk junk. Now our children can spend even less time studying and we can spend more time in blank-space stares at the idiot box. Cable would be fine with more educational channels—and fewer cheap thrills aimed at narrow-minded bubble brains.

(Jacqueline Murray)

5. In opposing obligatory prayer in the public schools, I am not deserting my god (and I would like to think of myself as a Christian). On the contrary, it is perfectly possible that I am thus serving my god, who I believe wants his children to pray to him of their own free will and not because some legislator, who may or may not be motivated by truly religious considerations, forces them to.

(Philip D. Walker)

6. My own son returned from his public elementary school with a book on dinosaurs loaned to him by his first-grade "science" teacher. It depicted the beasts as fire-breathing dragons and said the Bible informs us they were this way. God help us to achieve an educated and scientifically literate society, because these narrow-minded cretins won't.

(Bruce Strathdee)

★7. The poor quality of parenting and the lack in continuity of adult care provided to many U.S. children contribute to a passivity and a sense of helplessness that hobbles individuals for the remainder of their lives. Their subsequent unemployment, lack of education, and inability to make necessary life-style changes such as quitting an addiction can be attributed, in large part, to the helplessness they learned from childhood.

(William J. McCarthy)

8. Forty-one million Americans cannot afford health insurance in this time of global capitalism. At the same time, nine insurance executives earned more than $10 million last year, according to a recent study. If this is the celebrated triumph of capitalism over other forms of economic organization, what exactly did we win? Have we gained the world at the cost of our souls?

(Jason Reynolds)

9. The suggestion by sociobiologists that stepparent child abuse has evolutionary advantages is superficial. If there were evolutionary advantages to harming one's mate's offspring of a different parent, then by now there probably wouldn't be loving and generous stepparents around—and there are plenty. I know. I have a loving stepparent and am one.

(Ronald Cohen)

★10. The voting public is as full of bull as the politicians. As a result, we get the kind of officeholders we ask for. Show me a politician who will stand up and tell Americans the truth, and I'll show you a person who will never be elected.

(Huie Dixon)

III. The following statements represent conclusions for arguments. Each is expressed in the form of two alternatives. Select one of the alternatives for each conclusion, and then jot down several reasons that support it. Finally, incorporate your reasons into a written argument of at least 100 words that supports the conclusion. Include premise and conclusion indicators in some of your arguments, but not in all of them.

1. A constitutional amendment that outlaws flag burning should/should not be adopted.
2. Street drugs should/should not be legalized.

3. The death penalty should/should not be abolished.
4. Sanctions should/should not be imposed on students for using speech that is offensive to minorities.
5. Free health care should/should not be guaranteed to all citizens.
6. Same-sex marriages should/should not be recognized by the state.
7. The possession, ownership, and sale of handguns should/should not be outlawed.
8. Cigarettes should/should not be regulated as an addictive drug.
9. Affirmative action programs should/should not be abolished.
10. Doctors should/should not be allowed to assist terminally ill patients in committing suicide.

IV. Define the following terms:

argument from example
conditional statement
antecedent
consequent
sufficient condition
necessary condition
explanation
explanandum
explanans
illustration
expository passage

V. Answer "true" or "false" to the following statements:

1. Any passage that contains an argument must contain a claim that something is supported by evidence or reasons.
2. In an argument, the claim that something is supported by evidence or reasons is always explicit.
3. Passages that contain indicator words such as "thus," "since," and "because" are always arguments.
4. In deciding whether a passage contains an argument, we should always keep an eye out for indicator words and the presence of an inferential relationship between the statements.
5. Some expository passages can be correctly interpreted as arguments.
6. Some illustrations can be correctly interpreted as arguments.
7. In deciding whether an expository passage or an illustration should be interpreted as an argument, it helps to note whether the claim being developed or illustrated is one that is accepted by everyone.
8. Some conditional statements can be reexpressed to form arguments.
9. In an explanation, the explanandum usually describes an accepted matter of fact.
10. In an explanation, the explanans is the statement or group of statements that does the explaining.

LC VI. Fill in the blanks with "necessary" or "sufficient" to make the following statements true. After the blanks have been filled in, express the result in terms of conditional statements.

★1. Being a tiger is a _____ condition for being an animal.

2. Being an animal is a _____ condition for being a tiger.

3. Drinking water is a _____ condition for quenching one's thirst.

★4. Having a racquet is a _____ condition for playing tennis.

5. Pulling the cork is a _____ condition for drinking an expensive bottle of wine.

6. Stepping on a cat's tail is a _____ condition for making the cat yowl.

★7. Burning leaves is a _____ condition for producing smoke.

8. Paying attention is a _____ condition for understanding a lecture.

9. Taking a swim in the North Sea is a _____ condition for cooling off.

★10. Opening a door is a _____ condition for crossing the threshold.

VII. Page through a book, magazine, or newspaper and find two arguments, one with indicator words, the other without. Copy the arguments as written, giving the appropriate reference. Then identify the premises and conclusion of each.

1.3 Deduction and Induction

Arguments can be divided into two groups: deductive and inductive. A **deductive argument** is an argument in which the premises are claimed to support the conclusion in such a way that it is *impossible* for the premises to be true and the conclusion false. In such arguments the conclusion is claimed to follow *necessarily* from the premises. On the other hand, an **inductive argument** is an argument in which the premises are claimed to support the conclusion in such a way that it is *improbable* that the premises be true and the conclusion false. In these arguments the conclusion is claimed to follow only *probably* from the premises. Thus, deductive arguments are those that involve *necessary* reasoning, and inductive arguments are those that involve *probabilistic* reasoning. Examples:

> The meerkat is closely related to the suricat.
> The suricat thrives on beetle larvae.
> Therefore, probably the meerkat thrives on beetle larvae.

The meerkat is a member of the mongoose family.
All members of the mongoose family are carnivores.
Therefore, it necessarily follows that the meerkat is a carnivore.

The first of these arguments is inductive, the second deductive.

The distinction between inductive and deductive arguments lies in the strength of an argument's inferential claim. In other words, the distinction lies in how strongly the conclusion is claimed to follow from the premises. Unfortunately, however, in most arguments the strength of this claim is not explicitly stated, so we must use our interpretive abilities to evaluate it. Three factors that influence our decision about this claim are (1) the occurrence of special indicator words, (2) the *actual* strength of the inferential link between premises and conclusion, and (3) the character or form of argumentation the arguer uses.

The occurrence of special indicator words is illustrated in the examples we just considered. The word "probably" in the conclusion of the first argument suggests that the argument should be taken as inductive, and the word "necessarily" in the conclusion of the second suggests that the second argument be taken as deductive. Additional inductive indicators are "improbable," "plausible," "implausible," "likely," "unlikely," and "reasonable to conclude." Additional deductive indicators are "certainly," "absolutely," and "definitely." (Note that the phrase "it must be the case that" is ambiguous; "must" can indicate either probability or necessity).

Inductive and deductive indicator words often suggest the correct interpretation. However, if they conflict with one of the other criteria (discussed shortly), we should probably ignore them. Arguers often use phrases such as "it certainly follows that" for rhetorical purposes to add impact to their conclusion and not to suggest that the argument be taken as deductive. Similarly, some arguers, not knowing the distinction between inductive and deductive, will claim to "deduce" a conclusion when their argument is more correctly interpreted as inductive.

The second factor that bears upon our interpretation of an argument as inductive or deductive is the *actual* strength of the inferential link between premises and conclusion. If the conclusion actually does follow with strict necessity from the premises, the argument is clearly deductive. In such an argument it is impossible for the premises to be true and the conclusion false. On the other hand, if the conclusion does not follow with strict necessity but does follow probably, it is usually best to consider the argument inductive. Examples:

All saleswomen are extroverts.
Elizabeth Taylor is a saleswoman.
Therefore, Elizabeth Taylor is an extrovert.

The vast majority of saleswomen are extroverts.
Elizabeth Taylor is a saleswoman.
Therefore, Elizabeth Taylor is an extrovert.

In the first example, the conclusion follows with strict necessity from the premises. If we assume that all saleswomen are extroverts and that Elizabeth Taylor is a saleswoman, then it is impossible that Elizabeth Taylor not be an extrovert. Thus, we should interpret this argument as deductive. In the second example, the conclusion does not follow from the premises with strict necessity, but it does follow with some degree of probability. If we assume that the premises are true, then based on that assumption it is improbable that the conclusion is false. Thus, it is best to interpret the second argument as inductive.

Occasionally, an argument contains no indicator words, and the conclusion does not follow either necessarily or probably from the premises; in other words, it does not follow at all. This situation points up the need for the third factor to be taken into account, which is the character or form of argumentation the arguer uses. Five examples of argumentation that are typically deductive are arguments based on mathematics, arguments from definition, and categorical, hypothetical, and disjunctive syllogisms. Additional ones will be addressed in later chapters.

An **argument based on mathematics** is an argument in which the conclusion depends on some purely arithmetic or geometric computation or measurement. For example, a shopper might place two apples and three oranges into a paper bag and then conclude that the bag contains five pieces of fruit. Or a surveyor might measure a square piece of land and, after determining that it is 100 feet on each side, conclude that it contains 10,000 square feet. Since all arguments in pure mathematics are deductive, we can usually consider arguments that depend on mathematics to be deductive as well. A noteworthy exception, however, is arguments that depend on statistics. As we will see shortly, such arguments are usually best interpreted as inductive.

An **argument from definition** is an argument in which the conclusion is claimed to depend merely upon the definition of some word or phrase used in the premise or conclusion. For example, someone might argue that because Claudia is mendacious, it follows that she tells lies, or that because a certain paragraph is prolix, it follows that it is excessively wordy. These arguments are deductive because their conclusions follow with necessity from the definitions of "mendacious" and "prolix."

A syllogism, in general, is an argument consisting of exactly two premises and one conclusion. Categorical syllogisms will be treated in greater depth in Chapter 5, but for now we will say that a **categorical syllogism** is a syllogism in which each statement begins with one of the words "all," "no," or "some." Example:

> All lasers are optical devices.
> Some lasers are surgical instruments.
> Therefore, some optical devices are surgical instruments.

Arguments such as these are nearly always best treated as deductive.

A **hypothetical syllogism** is a syllogism having a conditional statement for one or both of its premises. Examples:

If electricity flows through a conductor, then a magnetic field is produced.
If a magnetic field is produced, then a nearby compass will be deflected.
Therefore, if electricity flows through a conductor, then a nearby compass will be deflected.

If quartz scratches glass, then quartz is harder than glass.
Quartz scratches glass.
Therefore, quartz is harder than glass.

Although certain forms of such arguments can sometimes be interpreted inductively, the deductive interpretation is usually the most appropriate.

A **disjunctive syllogism** is a syllogism having a disjunctive statement (i.e., an "either . . . or . . ." statement) for one of its premises. Example:

Either breach of contract is a crime or it is not punishable by the state.
Breach of contract is not a crime.
Therefore, it is not punishable by the state.

As with hypothetical syllogisms, such arguments are usually best taken as deductive. Hypothetical and disjunctive syllogisms will be treated in greater depth in Chapter 6.

Now let us consider some typically inductive forms of argumentation. In general, inductive arguments are such that the content of the conclusion is in some way intended to "go beyond" the content of the premises. The premises of such an argument typically deal with some subject that is relatively familiar, and the conclusion then moves beyond this to a subject that is less familiar or that little is known about. Such an argument may take any of several forms: predictions about the future, arguments from analogy, inductive generalizations, arguments from authority, arguments based on signs, and causal inferences, to name just a few.

In a **prediction,** the premises deal with some known event in the present or past, and the conclusion moves beyond this event to some event in the relative future. For example, someone might argue that because certain meteorological phenomena have been observed to develop over a certain region of central Missouri, a storm will occur there in six hours. Or again, one might argue that because certain fluctuations occurred in the prime interest rate on Friday, the value of the dollar will decrease against foreign currencies on Monday. Nearly everyone realizes that the future cannot be known with certainty; thus, whenever an argument makes a prediction about the future, one is usually justified in considering the argument inductive.

An **argument from analogy** is an argument that depends on the existence of an analogy, or similarity, between two things or states of affairs. Because of the existence of this analogy, a certain condition that affects the better-known thing or situation is concluded to affect the similar, lesser-known thing or situation. For example, someone might argue that because Christina's Porsche is a great handling car, it follows that Angela's Porsche must also be a great handling car. The argument depends on the existence of a similarity, or analogy, between the two cars. The certitude attending such an inference is obviously probabilistic at best.

An **inductive generalization** is an argument that proceeds from the knowledge of a selected sample to some claim about the whole group. Because the members of the sample have a certain characteristic, it is argued that all the members of the group have that same characteristic. For example, one might argue that because three oranges selected from a certain crate were especially tasty and juicy, all the oranges from that crate are especially tasty and juicy. Or again, one might argue that because six out of a total of nine members sampled from a certain labor union intend to vote for Johnson for union president, two-thirds of the entire membership intend to vote for Johnson. These examples illustrate the use of statistics in inductive argumentation.

An **argument from authority** is an argument in which the conclusion rests upon a statement made by some presumed authority or witness. For example, a person might argue that earnings for Hewlett-Packard Corporation will be up in the coming quarter because of a statement to that effect by an investment counselor. Or a lawyer might argue that Mack the Knife committed the murder because an eyewitness testified to that effect under oath. Because the investment counselor and the eyewitness could be either mistaken or lying, such arguments are essentially probabilistic.

An **argument based on signs** is an argument that proceeds from the knowledge of a certain sign to a knowledge of the thing or situation that the sign symbolizes. For example, when driving on an unfamiliar highway one might see a sign indicating that the road makes several sharp turns one mile ahead. Based on this information, one might argue that the road does indeed make several sharp turns one mile ahead. Because the sign might be misplaced or in error about the turns, the conclusion is only probable.

A **causal inference** underlies arguments that proceed from knowledge of a cause to knowledge of the effect, or, conversely, from knowledge of an effect to knowledge of a cause. For example, from the knowledge that a bottle of wine had been accidentally left in the freezer overnight, someone might conclude that it had frozen (cause to effect). Conversely, after tasting a piece of chicken and finding it dry and crunchy, one might conclude that it had been overcooked (effect to cause). Because specific instances of cause and effect can never be known with absolute certainty, one may usually interpret such arguments as inductive.

It should be noted that the various subspecies of inductive arguments listed here are not intended to be mutually exclusive. Overlaps can and do occur. For example, many causal inferences that proceed from cause to effect also qualify as predictions. The purpose of this survey is not to demarcate in precise terms the various forms of induction but rather to provide guidelines for distinguishing induction from deduction.

Keeping this in mind, we should take care not to confuse arguments in geometry, which are always deductive, with arguments from analogy or inductive generalizations. For example, an argument concluding that a triangle has a certain attribute (such as a right angle) because another triangle, with which it is congruent, also has that attribute might be mistaken for an argument from analogy. Similarly, an argument that concludes that all triangles have a certain attribute (such as angles totaling two right

angles) because any particular triangle has that attribute might be mistaken for an inductive generalization. Arguments such as these, however, are always deductive, because the conclusion follows necessarily and with complete certainty from the premises.

One broad classification of arguments not listed in this survey is scientific arguments. Arguments that occur in science can be either inductive or deductive, depending on the circumstances. In general, arguments aimed at the *discovery* of a law of nature are usually considered inductive. Suppose, for example, that we want to discover a law that governs the time required for a falling body to strike the earth. We drop bodies of various weights from various heights and measure the time it takes them to fall. Comparing our measurements, we notice that the time is approximately proportional to the square root of the distance. From this we conclude that the time required for any body to fall is proportional to the square root of the distance through which it falls. Such an argument is best interpreted as an inductive generalization.

Another type of argument that occurs in science has to do with the *application* of known laws to specific circumstances. Arguments of this sort are often considered to be deductive—but only with certain reservations. Suppose, for example, that we want to apply Boyle's law for ideal gases to a container of gas in our laboratory. Boyle's law states that the pressure exerted by a gas on the walls of its container is inversely proportional to the volume. Applying this law, we conclude that when we reduce the volume of our laboratory sample by half, we will double the pressure. Considered purely as a mathematical computation, this argument is deductive. But if we acknowledge the fact that the conclusion pertains to the future and the possibility that Boyle's law may not work in the future, then the argument is best considered inductive.

A final point needs to be made about the distinction between inductive and deductive arguments. There is a tradition extending back to the time of Aristotle which holds that inductive arguments are those that proceed from the particular to the general, while deductive arguments are those that proceed from the general to the particular. (A **particular statement** is one that makes a claim about one or more particular members of a class, while a **general statement** makes a claim about *all* the members of a class.) It is true, of course, that many inductive and deductive arguments do work in this way; but this fact should not be used as a criterion for distinguishing induction from deduction. As a matter of fact, there are deductive arguments that proceed from the general to the general, from the particular to the particular, and from the particular to the general, as well as from the general to the particular; and there are inductive arguments that do the same. For example, here is a deductive argument that proceeds from the particular to the general:

> Three is a prime number.
> Five is a prime number.
> Seven is a prime number.
> Therefore, all odd numbers between two and eight are prime numbers.

And here is one that proceeds from the particular to the particular:

> Gabriel is a wolf.
> Gabriel has a tail.
> Therefore, Gabriel's tail is the tail of a wolf.

Here is an inductive argument that proceeds from the general to the particular:

> All emeralds previously found have been green.
> Therefore, the next emerald to be found will be green.

The other varieties are easy to construct. Thus, the progression from particular to general, and vice versa, cannot be used as a criterion for distinguishing induction from deduction.

In summary, to distinguish deductive arguments from inductive, we look for special indicator words, the actual strength of the inferential link between premises and conclusion, and the character or form of argumentation. If the conclusion follows with strict necessity from the premises, the argument is always deductive; if not, it could be either deductive or inductive depending on the other factors. The deductive and inductive arguments that we have surveyed in this section are as follows:

deductive arguments:	inductive arguments:
arguments based on mathematics	predictions
arguments from definition	arguments from analogy
categorical syllogisms	inductive generalizations
hypothetical syllogisms	arguments from authority
disjunctive syllogisms	arguments based on signs
	causal inferences

EXERCISE 1.3

LC I. Determine whether the following arguments are best interpreted as being inductive or deductive. Also state the criteria you use in reaching your decision (i.e., the presence of indicator words, the nature of the inferential link between premises and conclusion, or the character or form of argumentation).

★1. Because triangle A is congruent with triangle B, and triangle A is isosceles, it follows that triangle B is isosceles.

2. The plaque on the leaning tower of Pisa says that Galileo performed experiments there with falling objects. It must be the case that Galileo did indeed perform those experiments there.

3. The rainfall in Seattle has been more than 15 inches every year for the past thirty years. Therefore, the rainfall next year will probably be more than 15 inches.

★4. No E-mail messages are eloquent creations. Some love letters are eloquent creations. Therefore, some love letters are not E-mail messages.

5. Amoco, Exxon, and Texaco are all listed on the New York Stock Exchange. It must be the case that all major American oil companies are listed on the New York Stock Exchange.

6. The longer a pendulum is, the longer it takes to swing. Therefore, when the pendulum of a clock is lengthened, the clock slows down.

★7. Paying off terrorists in exchange for hostages is not a wise policy, since such action will only lead them to take more hostages in the future.

8. The Matterhorn is higher than Mount Whitney, and Mount Whitney is higher than Mount Rainier. The obvious conclusion is that the Matterhorn is higher than Mount Rainier.

9. Although both front and rear doors were found open after the burglary, there were pry marks around the lock on the rear door and deposits of mud near the threshold. It must be the case that the thief entered through the rear door and left through the front.

★10. The *Encylopaedia Britannica* has an article on symbiosis. The *Encyclopedia Americana,* like the *Britannica,* is an excellent reference work. Therefore, the *Americana* probably also has an article on symbiosis.

11. Cholesterol is endogenous with humans. Therefore, it is manufactured inside the human body.

12. Either classical culture originated in Greece, or it originated in Egypt. Classical culture did not originate in Egypt. Therefore, classical culture originated in Greece.

★13. World-renowned physicist Stephen Hawking says that the condition of the universe at the instant of the Big Bang was more highly ordered than it is today. In view of Hawking's stature in the scientific community, we should conclude that this description of the universe is correct.

14. If Alexander the Great died from typhoid fever, then he became infected in India. Alexander the Great did die from typhoid fever. Therefore, he became infected in India.

15. It seems likely that young people will be at war with old people in another 15 or 20 years. You can see it coming in the numbers. In 1900 only 1 percent of the population was older than 75. Today 4 percent of all Americans are more than 75 years old, and in a few years it's going to be 5 percent . . . 13 million people.

(Newspaper editorial)

★16. Each element, such as hydrogen and iron, has a set of gaps—wavelengths that it absorbs rather than radiates. So if those wavelengths are missing from the spectrum, you know that that element is present in the star you are observing.

(Rick Gore, "Eyes of Science")

17. Because the apparent daily movement which is common to both the planets and the fixed stars is seen to travel from the east to the west, but the far slower single movements of the single planets travel in the opposite direction from west to east, it is therefore certain that these movements cannot depend on the common movement of the world but should be assigned to the planets themselves.

(Johannes Kepler, *Epitomy of Copernican Astronomy*)

18. Reserves of coal in the United States have an energy equivalent 33 times that of oil and natural gas. On a worldwide basis the multiple is about 10. By shifting to a coal-based economy, we could satisfy our energy requirements for at least a century, probably longer.

(William L. Masterson and Emil J. Slowinski, *Principles of Chemistry*)

★19. When the Romans occupied England, coal was burned. Since coal produces quite a bit of soot and sulfur dioxide, there must have been days almost 2000 years ago when the air in the larger towns was badly polluted.

(Stanley Gedzelman, *The Science and Wonders of the Atmosphere*)

20. The graphical method for solving a system of equations is an approximation, since reading the point of intersection depends on the accuracy with which the lines are drawn and on the ability to interpret the coordinates of the point.

(Karl J. Smith and Patrick J. Boyle, *Intermediate Algebra for College Students*)

21. That [the moons of Jupiter] revolve in unequal circles is manifestly deduced from the fact that at the longest elongation from Jupiter it is never possible to see two of these moons in conjunction, whereas in the vicinity of Jupiter they are found united two, three, and sometimes all four together.

(Galileo Galilei, *The Starry Messenger*)

★22. Lenses function by refracting light at their surfaces. Consequently, their action depends not only on the shape of the lens surfaces, but also on the indices of refraction of the lens material and the surrounding medium.

(Frank J. Blatt, *Principles of Physics*, 2nd edition)

23. Given present growth rates in underdeveloped countries, the limited practice of birth control, and the difficulty of slowing the current growth momentum, it can be said with virtual certainty that none of the people now reading this book will ever live in a world where the population is not growing.

(J. John Palen, *Social Problems*)

24. The interpretation of the laws is the proper and peculiar province of the courts. A constitution is, in fact, and must be regarded by the judges, as a fundamental law. It therefore belongs to them to ascertain its meaning, as well as the meaning of any particular act proceeding from the legislative body.

(Alexander Hamilton, *Federalist Papers*, No. 78)

★25. The Simpson incident had shown me that a dog was kept in the stables, and yet, though someone had been in and had fetched out a horse, he had not

barked enough to arouse the two lads in the loft. Obviously the midnight visitor was someone whom the dog knew well.

(A. Conan Doyle, *Memoirs of Sherlock Holmes*)

26. Eternity is simultaneously whole. But time has a before and an after. Therefore time and eternity are not the same thing.

(Thomas Aquinas, *Summa Theologica*)

27. Ordinary things that we encounter every day are electrically neutral. Therefore, since negatively charged electrons are a part of everything, positively charged particles must also exist in all matter.

(James E. Brady and Gerard E. Humiston, *General Chemistry*)

★28. Animals that live on plant foods must eat large quantities of vegetation, and this consumes much of their time. Meat eaters, by contrast, have no need to eat so much or so often. Consequently, meat-eating hominines [early humans] may have had more leisure time available to explore and manipulate their environment; like lions and leopards, they would have time to spend lying around and playing.

(William A. Haviland, *Cultural Anthropology*, 8th edition)

29. [Psychologists] Wirtshafter and Davis noted that the glycerol content of the blood is related to the size of the fat cells [in the body]. Since the size of the fat cells would indicate something about the amount of stored fats, increases in blood glycerol should indicate increases in body weight.

(Herbert L. Petri, *Motivation: Theory and Research*, 2nd edition)

30. Because the moon moves relative to the earth so that it returns to the same position overhead after about 25 hours, there are two high and two low tides at any point every 25 hours.

(Douglas C. Giancoli, *The Ideas of Physics*, 3rd edition)

II. Define the following terms:

deductive argument
inductive argument
argument based on mathematics
argument from definition
categorical syllogism
hypothetical syllogism
disjunctive syllogism
argument from analogy
inductive generalization
prediction
argument from authority
argument based on signs
causal inference
particular statement
general statement

III. Answer "true" or "false" to the following statements:

1. In an inductive argument, it is intended that the conclusion contain more information than the premises.
2. In a deductive argument, the conclusion is not supposed to contain more information than the premises.

3. The form of argumentation the arguer uses may allow one to determine whether an argument is inductive or deductive.
4. The actual strength of the link between premises and conclusion may allow one to determine whether an argument is inductive or deductive.
5. A geometrical proof is an example of an inductive argument.
6. Most arguments based on statistical reasoning are deductive.
7. If the conclusion of an argument follows merely from the definition of a word used in a premise, the argument is deductive.
8. An argument that draws a conclusion about a thing based on that thing's similarity to something else is a deductive argument.
9. An argument that draws a conclusion that something is true because someone has said that it is, is a deductive argument.
10. An argument that presents two alternatives and eliminates one, leaving the other as the conclusion, is an inductive argument.
11. An argument that proceeds from knowledge of a cause to knowledge of an effect is an inductive argument.
12. If an argument contains the phrase "it definitely follows that," then we know for certain that the argument is deductive.
13. An argument that predicts what will happen in the future, based upon what has happened in the past, is an inductive argument.
14. Inductive arguments always proceed from the particular to the general.
15. Deductive arguments always proceed from the general to the particular.

IV. Page through a book, magazine, or newspaper and find two arguments, one inductive and the other deductive. Copy the arguments as written, giving the appropriate reference. Then identify the premises and conclusion of each.

1.4 Validity, Truth, Soundness, Strength, Cogency

This section introduces the central ideas and terminology required to evaluate arguments. We have seen that every argument makes two basic claims: a claim that evidence or reasons exist and a claim that the alleged evidence or reasons support something (or that something follows from the alleged evidence or reasons). The first is a factual claim, the second an inferential claim. The evaluation of every argument centers on the evaluation of these two claims. The most important of the two is the inferential claim, because if the premises fail to support the conclusion (that is, if the reasoning is bad), an argument is worthless. Thus we will always test the inferential

claim first, and only if the premises do support the conclusion will we test the factual claim (that is, the claim that the premises present genuine evidence, or are true). The material that follows considers first deductive arguments and then inductive.

Deductive Arguments

The previous section defined a deductive argument as one in which the premises are claimed to support the conclusion in such a way that it is impossible for the premises to be true and the conclusion false. If the premises do in fact support the conclusion in this way, the argument is said to be valid. Thus, a **valid deductive argument** is an argument such that it is impossible for the premises to be true and the conclusion false. In these arguments the conclusion follows with strict necessity from the premises. Conversely, an **invalid deductive argument** is a deductive argument such that it *is* possible for the premises to be true and the conclusion false. In invalid arguments the conclusion does not follow with strict necessity from the premises, even though it is claimed to.

An immediate consequence of these definitions is that there is no middle ground between valid and invalid. There are no arguments that are "almost" valid and "almost" invalid. If the conclusion follows with strict necessity from the premises, the argument is valid; if not, it is invalid.

To test an argument for validity we begin by assuming that all premises are true, and then we determine if it is possible, in light of that assumption, for the conclusion to be false. Here is an example:

> All television networks are media companies.
> NBC is a television network.
> Therefore, NBC is a media company.

In this argument both premises are actually true, so it is easy to *assume* that they are true. Next we determine, in light of this assumption, if it is possible for the conclusion to be false. Clearly this is not possible. If NBC is included in the group of television networks (second premise) and if the group of television networks is included in the group of media companies (first premise), it necessarily follows that NBC is included in the group of media companies (conclusion). In other words, assuming the premises true and the conclusion false entails a strict *contradiction*. Thus the argument is valid.

Here is another example:

> All automakers are computer manufacturers.
> United Airlines is an automaker.
> Therefore, United Airlines is a computer manufacturer.

In this argument, both premises are actually false, but it is easy to assume that they are true. Every automaker could have a corporate division that manufactures computers. Also, in addition to flying airplanes, United Airlines could make cars. Next, in light of

these assumptions, we determine if it is possible for the conclusion to be false. Again, we see that this is not possible, by the same reasoning as the previous example. Assuming the premises true and the conclusion false entails a contradiction. Thus, the argument is valid.

Another example:

> All banks are financial institutions.
> Wells Fargo is a financial institution.
> Therefore, Wells Fargo is a bank.

As in the first example, both premises of this argument are true, so it is easy to assume they are true. Next we determine, in light of this assumption, if it is possible for the conclusion to be false. In this case it *is* possible. If banks were included in one part of the group of financial institutions and Wells Fargo were included in another part, then Wells Fargo would *not* be a bank. In other words, assuming the premises true and the conclusion false does not involve any contradiction, and so the argument is invalid.

In addition to illustrating the basic idea of validity, these examples suggest an important point about validity and truth. In general, validity is not something that is determined by the actual truth or falsity of the premises and conclusion. Both the NBC example and the Wells Fargo example have actually true premises and an actually true conclusion, yet one is valid and the other invalid. The United Airlines example has actually false premises and an actually false conclusion, yet the argument is valid. Rather, validity is something that is determined by the *relationship* between premises and conclusion. The question is not whether premises and conclusion are true or false, but whether the premises *support* the conclusion. In the examples of valid arguments the premises do support the conclusion, and in the invalid case they do not.

Nevertheless, there is *one* arrangement of truth and falsity in the premises and conclusion that does determine the issue of validity. Any deductive argument having actually true premises and an actually false conclusion is invalid. The reasoning behind this fact is fairly obvious. If the premises are actually true and the conclusion is actually false, then it certainly is *possible* for the premises to be true and the conclusion false. Thus, by the definition of invalidity, the argument is invalid.

The idea that any deductive argument having actually true premises and a false conclusion is invalid may be the most important point in all of deductive logic. The entire system of deductive logic would be quite useless if it accepted as valid any inferential process by which a person could start with truth in the premises and arrive at falsity in the conclusion.

Table 1.1 presents examples of deductive arguments that illustrate the various combinations of truth and falsity in the premises and conclusion. In the examples having false premises, both premises are false, but it is easy to construct other examples having only one false premise. When examining this table, note that the only combination of truth and falsity that does not allow for *both* valid and invalid arguments is

In this argument the premises are actually true and the conclusion is probably false. Thus, if we assume the premises are true, then, based on that assumption, it is not probable that the conclusion is true. Thus, the argument is weak.

Another example:

> During the past fifty years, inflation has consistently reduced the value of the American dollar. Therefore, industrial productivity will probably increase in the years ahead.

In this argument, the premise is actually true and the conclusion is probably true in the actual world, but the probability of the conclusion is in no way based on the assumption that the premise is true. Because there is no direct connection between inflation and increased industrial productivity, the premise is irrelevant to the conclusion and it provides no probabilistic support for it. The conclusion is probably true independently of the premise. As a result, the argument is weak.

This last example illustrates an important distinction between strong inductive arguments and valid deductive arguments. As we will see in later chapters, if the conclusion of a deductive argument is necessarily true independently of the premises, the argument will still be considered valid. But if the conclusion of an inductive argument is probably true independently of the premises, the argument will be weak.

These four examples show that in general the strength or weakness of an inductive argument results not from the actual truth or falsity of the premises and conclusion, but from the probabilistic support the premises give to the conclusion. The dinosaur argument has a true premise and probably true conclusion, and the meteorite argument has a false premise and a probably false conclusion; yet, both are strong because the premise of each provides probabilistic support for the conclusion. The industrial productivity argument has a true premise and a probably true conclusion, but the argument is weak because the premise provides no probabilistic support for the conclusion. Analogously to the evaluation of deductive arguments, the only arrangement of truth and falsity that establishes anything is true premises and probably false conclusion (as in the lighted match argument). Any inductive argument having true premises and a probably false conclusion is weak.

Table 1.2 presents the various possibilities of truth and falsity in the premises and conclusion of inductive arguments. Note that the only arrangement of truth and falsity that is missing for strong arguments is true premises and probably false conclusion. The relationship between the strength of an inductive argument and the truth or falsity of its premises and conclusion, as illustrated in Table 1.2, is summarized as follows:

Premises	Conclusion	Strength
T	prob. T	?
T	prob. F	Weak
F	prob. T	?
F	prob. F	?

Table 1.2 Inductive Arguments

	Strong	Weak
True premise Probably true conclusion	All previous American presidents were men. Therefore, probably the next American president will be a man. [cogent]	A few American presidents were Federalists. Therefore, probably the next American president will be a man. [uncogent]
True premise Probably false conclusion	None exist	A few American presidents were Federalists. Therefore, probably the next American president will be a Federalist. [uncogent]
False premise Probably true conclusion	All previous American presidents were television debaters. Therefore, probably the next American president will be a television debater. [uncogent]	A few American presidents were Libertarians. Therefore, probably the next American president will be a television debater. [uncogent]
False premise Probably false conclusion	All previous American presidents were women. Therefore, probably the next American president will be a woman. [uncogent]	A few American presidents were Libertarians. Therefore, probably the next American president will be a Libertarian. [uncogent]

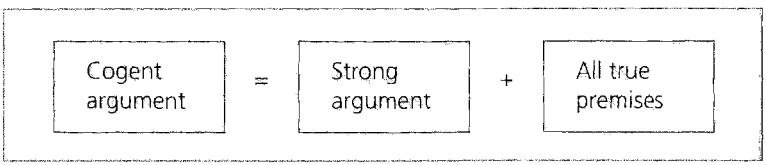
Unlike the validity and invalidity of deductive arguments, the strength and weakness of inductive arguments admit of degrees. To be considered strong, an inductive argument must have a conclusion that is more probable than improbable. In other words, the likelihood that the conclusion is true must be more than 50 percent, and as the probability increases, the argument becomes stronger. For this purpose, consider the following pair of arguments:

> This barrel contains 100 apples.
> Three apples selected at random were found to be ripe.
> Therefore, probably all 100 apples are ripe.
>
> This barrel contains 100 apples.
> Eighty apples selected at random were found to be ripe.
> Therefore, probably all 100 apples are ripe.

The first argument is weak and the second is strong. However, the first is not absolutely weak nor the second absolutely strong. Both arguments would be strengthened or weakened by the random selection of a larger or smaller sample. For example, if the

size of the sample in the second argument were reduced to 70 apples, the argument would be weakened. The incorporation of additional premises into an inductive argument will also generally tend to strengthen or weaken it. For example, if the premise "One unripe apple that had been found earlier was removed" were added to either argument, the argument would be weakened.

A **cogent argument** is an inductive argument that is *strong* and has *all true premises;* if either condition is missing, the argument is uncogent. Thus, an uncogent argument is an inductive argument that is weak, has one or more false premises, or both. A cogent argument is the inductive analogue of a sound deductive argument and is what is meant by a "good" inductive argument without qualification. Because the conclusion of a cogent argument is genuinely supported by true premises, it follows that the conclusion of every cogent argument is probably true.



There is a difference, however, between sound and cogent arguments in regard to the true-premise requirement. In a sound argument it is only necessary that the premises be true and nothing more. Given such premises and good reasoning, a true conclusion is guaranteed. In a cogent argument, on the other hand, the premises must not only be true, they must also not ignore some important piece of evidence that outweighs the given evidence and entails a quite different conclusion. As an illustration of this point, consider the following argument:

> Swimming in the Caribbean is usually lots of fun. Today the water is warm, the surf is gentle, and on this beach there are no dangerous currents. Therefore, it would be fun to go swimming here now.

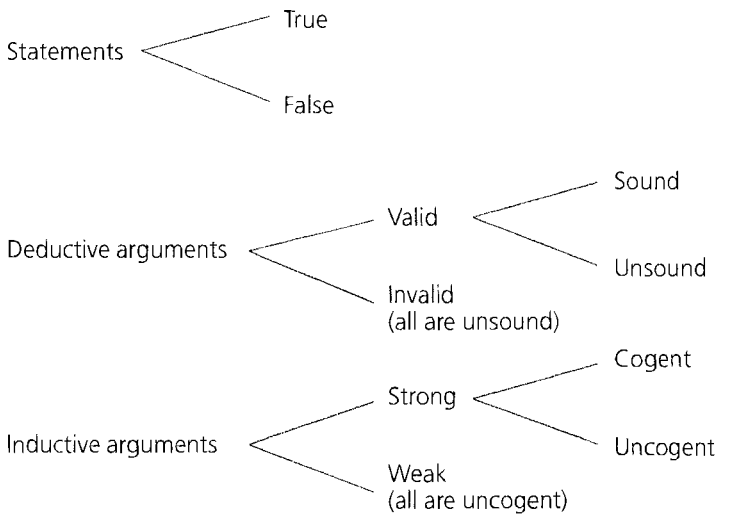
If the premises reflect all the important factors, then the argument is cogent. But if they ignore the fact that several large dorsal fins are cutting through the water, then obviously the argument is not cogent. Thus, for cogency the premises must not only be true but also not overlook some important factor that outweighs the given evidence and requires a different conclusion.

In summary, for both deductive and inductive arguments, two separate questions need to be answered: (1) Do the premises support the conclusion? (2) Are all the premises true?

To answer the first question we begin by *assuming* the premises to be true. Then, for deductive arguments we determine whether, in light of this assumption, it *neces-*

sarily follows that the conclusion is true. If it does, the argument is valid; if not, it is invalid. For inductive arguments we determine whether it *probably* follows that the conclusion is true. If it does, the argument is strong; if not, it is weak. For inductive arguments we keep in mind the requirements that the premises actually support the conclusion and that they not ignore important evidence. Finally, if the argument is either valid or strong, we turn to the second question and determine whether the premises are actually true. If all the premises are true, the argument is sound (in the case of deduction) or cogent (in the case of induction). All invalid deductive arguments are unsound, and all weak inductive arguments are uncogent.

The various alternatives open to statements and arguments may be diagrammed as follows. Note that in logic one never speaks of an argument as being "true" or "false," and one never speaks of a statement as being "valid," "invalid," "strong," or "weak."



EXERCISE 1.4

LC I. The following arguments are deductive. Determine whether each is valid or invalid, and note the relationship between your answer and the truth or falsity of the premises and conclusion. Finally, determine whether the argument is sound or unsound.

★1. Since *Moby Dick* was written by Shakespeare, and *Moby Dick* is a science fiction novel, it follows that Shakespeare wrote a science fiction novel.

2. Since London is north of Paris and south of Edinburgh, it follows that Paris is south of Edinburgh.

3. If George Washington was beheaded, then George Washington died. George Washington died. Therefore, George Washington was beheaded.

★4. The longest river in South America is the Amazon, and the Amazon flows through Brazil. Therefore, the longest river in South Africa flows through Brazil.

5. Since the Spanish American War occurred before the American Civil War, and the American Civil War occurred after the Korean War, it follows that the Spanish American War occurred before the Korean War.

6. The Empire State Building is taller than the Statue of Liberty, and the Statue of Liberty is taller than the Eiffel Tower. Therefore, the Empire State Building is taller than the Eiffel Tower.

★7. All leopards with lungs are carnivores. Therefore, all leopards are carnivores.

8. Chicago is a city in Michigan and Michigan is part of the United States. Therefore, Chicago is a city in the United States.

9. If Galileo invented quantum mechanics, then he was familiar with physics in the twentieth century. Galileo was not familiar with physics in the twentieth century. Therefore, Galileo did not invent quantum mechanics.

★10. Every province in Canada has exactly one city as its capital. Therefore, since there are thirty provinces in Canada, there are thirty provincial capitals.

11. Since the Department of Defense Building in Washington, D.C. has the shape of a hexagon, it follows that it has seven sides.

12. Since Winston Churchill was English, and Winston Churchill was a famous statesman, we may conclude that at least one Englishman was a famous statesman.

★13. Since some fruits are green, and some fruits are apples, it follows that some fruits are green apples.

14. All physicians are individuals who have earned degrees in political science, and some lawyers are physicians. Therefore, some lawyers are persons who have earned degrees in political science.

15. The United States Congress has more members than there are days in the year. Therefore, at least two members of Congress have the same birthday.

LC II. The following arguments are inductive. Determine whether each is strong or weak, and note the relationship between your answer and the truth or falsity of the premise(s) and conclusion. Then determine whether each argument is cogent or uncogent.

★1. The grave marker at Arlington National Cemetery says that John F. Kennedy is buried there. It must be the case that Kennedy really is buried in that cemetery.

2. The ebb and flow of the tides has been occurring every day for millions of years. But nothing lasts forever. Therefore, probably the motion of the tides will die out within a few years.

3. The vast majority of Rose Bowl games (in Pasadena, CA) have been played in freezing cold weather. Therefore, probably the next Rose Bowl game will be played in freezing cold weather.

★4. Franklin Delano Roosevelt said that we have nothing to fear but fear itself. Therefore, women have no reason to fear serial rapists.

5. Most famous movie stars are millionaires. Leonardo Di Caprio is a famous movie star. Therefore, probably Di Caprio is a millionaire.

6. Constructing the great pyramid at Giza required lifting massive stone blocks to great heights. Probably the ancient Egyptians had some antigravity device to accomplish this feat.

★7. People have been listening to rock and roll music for over a hundred years. Probably people will still be listening to it a year from now.

8. Paleontologists have unearthed the fossilized bones of huge reptiles, which we have named dinosaurs. Tests indicate that these creatures roamed the earth more than 50 million years ago. Therefore, probably dinosaurs really did roam the earth at that time.

9. The Declaration of Independence says that all men are endowed by their creator with certain unalienable rights. Therefore it probably follows that a creator exists.

★10. Coca-Cola is an extremely popular soft drink. Therefore, probably someone, somewhere, is drinking a Coke right this minute.

11. Every map of the United States shows that Alabama is situated on the Pacific coast. Therefore, Alabama must be a western state.

12. When Neil Armstrong landed on the moon, he left behind a gold plated Schwinn bicycle, which he used to ride around on the moon's surface. Probably that bicycle is still up there on the moon.

★13. African American athlete Jerome Bettis is able to withstand tremendous impacts on the football field. However, Venus Williams, like Jerome Bettis, is a great African American athlete. Therefore, Venus Williams should be able to withstand tremendous impacts on the football field.

14. Unlike monkeys, today's humans have feet that are not suited for grasping objects. Therefore, a thousand years from now, probably humans will still have feet that are not suited for grasping objects.

15. A random sample of twenty-five famous country and western singers, including Garth Brooks and Dolly Parton, revealed that every single one of them studied music in Afghanistan. Therefore, probably the majority of famous country and western singers studied in Afghanistan.

III. Determine whether the following arguments are inductive or deductive. If an argument is inductive, determine whether it is strong or weak. If it is deductive, determine whether it is valid or invalid.

★1. Since Agatha is the mother of Raquel and the sister of Tom, it follows that Tom is the uncle of Raquel.

2. When a cook can't recall the ingredients in a recipe, it is appropriate that she refresh her memory by consulting the recipe book. Similarly, when a student can't recall the answers during a final exam, it is appropriate that she refresh her memory by consulting the textbook.
3. The sign on the highway leading into Denver, Colorado says that the city's elevation is 5280 feet. It must be the case that Denver is 1 mile high.
★4. Since Christmas is always on a Thursday, it follows that the day after Christmas is always a Friday.
5. This figure is a Euclidean triangle. Therefore, the sum of its angles is equal to two right angles.
6. By accident Karen baked her brownies two hours longer than she should have. Therefore, they have probably been ruined.
★7. After taking LSD, Alice said she saw a flying saucer land in the shopping center parking lot. Since Alice has a reputation for always telling the truth, we must conclude that a flying saucer really did land there.
8. Since Phyllis is the cousin of Denise, and Denise is the cousin of Harriet, it follows necessarily that Harriet is the cousin of Phyllis.
9. The picnic scheduled in the park for tomorrow will most likely be cancelled. It's been snowing for six days straight.
★10. Circle A has exactly twice the diameter of circle B. From this we may conclude that circle A has exactly twice the area of circle B.
11. Robert has lost consistently at blackjack every day for the past several days. Therefore, it is very likely that he will win today.
12. Since John loves Nancy and Nancy loves Peter, it follows necessarily that John loves Peter.
★13. This cash register drawer contains over 100 coins. Three coins selected at random were found to have dates earlier than 1945. Therefore, probably all of the coins in the drawer have dates earlier than 1945.
14. The Japanese attack on Pearl Harbor happened in either 1941 or 1951. But it didn't happen in 1941. Therefore, it happened in 1951.
15. Harry will never be able to solve that difficult problem in advanced calculus in the limited time allowed. He has never studied anything beyond algebra, and in that he earned only a C−.
★16. Since $x + y = 10$, and $x = 7$, it follows that $y = 4$.
17. If acupuncture is hocus pocus, then acupuncture cannot relieve chronic pain. But acupuncture can relieve chronic pain. Therefore, acupuncture is not hocus pocus.
18. If inflation heats up, then interest rates will rise. If interest rates rise, then bond prices will decline. Therefore, if inflation heats up, then bond prices will decline.

★19. Statistics reveal that 86 percent of those who receive flu shots do not get the flu. Jack received a flu shot one month ago. Therefore, he should be immune, even though the flu is going around now.

20. Since Michael is a Pisces, it necessarily follows that he was born in March.

IV. Define the following terms:

valid argument	strong argument
invalid argument	weak argument
sound argument	cogent argument
unsound argument	uncogent argument

V. Answer "true" or "false" to the following statements:

1. Some arguments, while not completely valid, are almost valid.
2. Inductive arguments admit of varying degrees of strength and weakness.
3. Invalid deductive arguments are basically the same as inductive arguments.
4. If a deductive argument has true premises and a false conclusion, it is necessarily invalid.
5. A valid argument may have a false premise and a false conclusion.
6. A valid argument may have a false premise and a true conclusion.
7. A sound argument may be invalid.
8. A sound argument may have a false conclusion.
9. A strong argument may have false premises and a probably false conclusion.
10. A strong argument may have true premises and a probably false conclusion.
11. A cogent argument may have a probably false conclusion.
12. A cogent argument must be inductively strong.
13. If an argument has true premises and a true conclusion, we know that it is a perfectly good argument.
14. A statement may legitimately be spoken of as "valid" or "invalid."
15. An argument may legitimately be spoken of as "true" or "false."

1.5 Argument Forms: Proving Invalidity

The previous section showed that validity is determined by the truth of a deductive argument's inferential claim. If the inferential claim is true, then the conclusion follows with strict necessity from the premises, and the argument is valid. For such an argument, it is impossible for the premises to be true and the conclusion false.

This section shows that the truth of a deductive argument's inferential claim (that is, the correctness of the argument's reasoning) is determined by the form of the argument. In other words, validity is determined by form. For these purposes, consider the following argument:

> All adlers are bobkins.
> All bobkins are crockers.
> Therefore, all adlers are crockers.

Because the words "adlers," "bobkins," and "crockers" are nonsensical, we do not know whether any of the statements in this argument are true or false. Yet, we do know that if we *assume* that the premises are true, it is impossible for the conclusion to be false. That is, if we assume that the adlers, whatever they might be, are included in the bobkins and the bobkins in the crockers, then we must accept the conclusion that the adlers are included in the crockers. According to the definition of validity, therefore, the argument is valid.

This fact is important for understanding the nature of validity because it shows that the validity of an argument has nothing to do with its specific subject matter. Even though we know nothing about adlers, bobkins, and crockers, we still know that the argument is valid. The validity of the argument arises from the way the terms "adlers," "bobkins," and "crockers" are arranged in the statements. If we represent these terms by their first letters, we obtain the following *argument form*. We use a line to separate the premises from the conclusion.

> All *A* are *B*.
> All *B* are *C*.
> ---
> All *A* are *C*.

This is a valid argument form. Its validity rests purely upon the arrangement of the letters within the statements, and it has nothing to do with what the letters might stand for. In light of this fact, we can substitute any terms we choose in place of *A*, *B*, and *C*, and as long as we are consistent, we will obtain a valid argument. For example, we might substitute "daisies" for *A*, "flowers" for *B*, and "plants" for *C* and obtain the following valid argument:

> All daisies are flowers.
> All flowers are plants.
> Therefore, all daisies are plants.

Any argument, such as this, that is produced by uniformly substituting terms or statements in place of the letters in an argument form is called a **substitution instance** of that form.

Let us turn now to the concept of invalidity. Consider the following argument:

All adlers are bobkins.
All crockers are bobkins.
Therefore, all adlers are crockers.

As with the previous argument, we do not know whether the premises and conclusion of this argument are true or false. But if we assume that the premises are true, it is *possible* for the conclusion to be false. It might be the case, for example, that the adlers make up one part of the bobkins, that the crockers make up another part, and that the adlers and the crockers are completely separate from each other. In this case the premises would be true and the conclusion false. The argument is therefore invalid. If we represent the terms in this argument by their first letters, we obtain the following argument form:

All *A* are *B*.
All *C* are *B*.

All *A* are *C*.

This is an invalid form, and any argument that has this form is an invalid argument.

An argument is said to *have* a certain form if it is a substitution instance of that form. In the case of invalid forms, we must add the proviso that an argument has an invalid form only if it is not a substitution instance of any valid form.* The following argument is a substitution instance of the invalid form just discussed and it is not a substitution instance of any valid form. Thus, the following argument has the invalid form just discussed:

All cats are animals.
All dogs are animals.
Therefore, all cats are dogs.

---

*The reason for this proviso is that some substitution instances of invalid forms are actually valid. Example:

All bachelors are persons.
All unmarried men are persons.
Therefore, all bachelors are unmarried men.

This argument is a substitution instance of the invalid form discussed above, but the argument is valid because its conclusion is true by definition. However, because "bachelors" is equivalent in meaning to "unmarried men," the argument is also a substitution instance of the valid form

All *A* are *B*.
All *A* are *B*.

All *A* are *A*.

Thus, by the stated proviso, the bachelors argument does not have the invalid form in question but rather has this valid form. The exercises in this book avoid examples of this sort, where the form of the argument is obscured by the meaning of the terms.

Notice that this substitution instance has true premises and a false conclusion. It is therefore clearly invalid, and it constitutes proof that the original argument is invalid. The reasoning behind this proof is as follows. The substitution instance is invalid because it has true premises and a false conclusion. Therefore, the substitution instance has an invalid form. But the form of the substitution instance is identical to the form of the (second) adler-bobkin argument. Therefore, the adler-bobkin argument is invalid.

A substitution instance having true premises and a false conclusion is called a counterexample, and the method we have just used to prove the adler-bobkin argument invalid is called the **counterexample method.** The counterexample method can be used to establish the invalidity of any invalid argument, but it cannot establish the validity of any valid argument. Thus, before the method is applied to an argument, the argument must be known or suspected to be invalid in the first place. The counterexample method consists in isolating the form of the argument and then constructing a substitution instance having true premises and a false conclusion. Let us apply it to the following invalid categorical syllogism:

> Since some employees are not social climbers and all vice-presidents are employees, we may conclude that some vice-presidents are not social climbers.

This argument is invalid because the employees who are not social climbers might not be vice-presidents. Accordingly, we can *prove* the argument invalid by constructing a substitution instance having true premises and a false conclusion. We begin by isolating the form of the argument:

> Some *E* are not *S*.
> All *V* are *E*.
> ---
> Some *V* are not *S*.

Next, we select three terms to substitute in place of the letters that will make the premises true and the conclusion false. The following selection will work:

> *E* = animals
> *S* = mammals
> *V* = dogs

The resulting substitution instance is:

> Some animals are not mammals.
> All dogs are animals.
> Therefore, some dogs are not mammals.

The substitution instance has true premises and a false conclusion and is therefore, by definition, invalid. Since it has the same form as the original argument, it constitutes proof that the original argument is invalid.

In applying the counterexample method to categorical syllogisms, it is useful to keep in mind the following set of terms: "cats," "dogs," "mammals," "fish," and "animals." Most invalid syllogisms can be proven invalid by strategically selecting three of these terms and using them to construct a counterexample. Because everyone agrees about these terms, everyone will agree about the truth or falsity of the premises and conclusion of the counterexample. Also, in constructing the counterexample, it often helps to begin with the conclusion. First, select two terms that yield a false conclusion, and then select a third term that yields true premises. Another point to keep in mind is that the word "some" in logic always means "at least one." For example, the statement "Some dogs are animals" means "At least one dog is an animal"—which is true. Also note that this statement does not imply that some dogs are not animals.

Not all deductive arguments, of course, are categorical syllogisms. Consider, for example, the following hypothetical syllogism:

> If the government imposes import restrictions, the price of automobiles will rise.
> Therefore, since the government will not impose import restrictions, it follows that the price of automobiles will not rise.

This argument is invalid because the price of automobiles might rise even though import restrictions are not imposed. It has the following form:

> If *G*, then *P*.
> Not *G*.
> ---
> Not *P*.

This form differs from the previous one in that its letters stand for complete statements. *G*, for example, stands for "The government imposes import restrictions." If we make the substitution

> *G* = Abraham Lincoln committed suicide.
> *P* = Abraham Lincoln is dead.

we obtain the following substitution instance:

> If Abraham Lincoln committed suicide, then Abraham Lincoln is dead.
> Abraham Lincoln did not commit suicide.
> Therefore, Abraham Lincoln is not dead.

Since the premises are true and the conclusion false, the substitution instance is clearly invalid. Thus, it constitutes proof that the original argument is invalid.

When applying the counterexample method to an argument having a conditional statement as a premise (such as the one above), it is recommended that the statement substituted in place of the conditional statement express some kind of necessary connection. In the Lincoln example, the first premise asserts the necessary connection between suicide and death. There can be no doubt about the truth of such a statement.

Furthermore, if it should turn out that the conclusion is a conditional statement, note that one sure way of producing a false conditional statement is by joining a true antecedent with a false consequent. For example, the conditional statement "If Lassie is a dog, then Lassie is a cat" is clearly false.

Being able to identify the form of an argument with ease requires a familiarity with the basic deductive argument forms. The first task consists in distinguishing the premises from the conclusion. Always write the premises first and the conclusion last. The second task involves distinguishing what we may call "form words" from "content words." To reduce an argument to its form, leave the form words as they are, and replace the content words with letters. For categorical syllogisms, the words "all," "no," "some," "are," and "not" are form words, and for hypothetical syllogisms the words "if," "then," and "not" are form words. Additional form words for other types of arguments are "either," "or," "both," and "and." For various kinds of hybrid arguments, a more intuitive approach may be needed. Here is an example:

> All movie stars are actors who are famous, because all movie stars who are famous are actors.

If we replace "movie stars," "actors," and "famous" with the letters *M*, *A*, and *F*, this argument has the following form:

> All *M* who are *F* are *A*.
> ---
> All *M* are *A* who are *F*.

Here is one possible substitution instance for this form:

> All humans who are fathers are men.
> Therefore, all humans are men who are fathers.

Because the premise is true and the conclusion false, the argument is invalid.

Using the counterexample method to prove arguments invalid requires a little ingenuity because there is no rule that will automatically produce the required term or statement to be substituted. Any term or statement will work, of course, provided that it yields a substitution instance that has premises that are indisputably true and a conclusion that is indisputably false. Ideally, the truth value of these statements should be known to the average individual; otherwise, the substitution instance cannot be depended upon to prove anything. If, for example, *P* in the earlier hypothetical syllogism had been replaced by the statement "George Wilson is dead," the substitution instance would be useless, because nobody knows whether this statement is true or false.

The counterexample method is useful only for proving invalidity, because the only arrangement of truth and falsity that proves anything is true premises and false conclusion. If a substitution instance is produced having true premises and a true conclusion, it does *not* prove that the argument is valid. Furthermore, the method is only useful

for deductive arguments because the strength and weakness of inductive arguments is only partially dependent on the form of the argument. Accordingly, no method that relates exclusively to the form of an inductive argument can be used to prove the argument weak.

One final comment is needed regarding the form of an argument. It often happens that the form is not explicit and that making it explicit requires an analysis of the meaning of the language. Many of the arguments in Exercise 1.4 were of this sort. Consider the following example:

> This figure is a square.
> Therefore, this figure has four sides.

The conclusion follows necessarily from the premise because every square, by definition, has four sides. To make the form of the argument explicit, a premise must be added stating this fact:

> This figure is a square.
> All squares have four sides.
> Therefore, this figure has four sides.

As this example illustrates, the statement at the beginning of this section that the validity of an argument is concerned not with the subject matter but rather with the form of an argument needs qualification. When the form of an argument is immediately clear, the subject matter is irrelevant to the question of validity. But when the form is not clear, the subject matter may have to be analyzed to determine what the form is.

EXERCISE 1.5

LC I. Use the counterexample method to prove the following categorical syllogisms invalid. In doing so, follow the suggestions given in the text.

★1. All galaxies are structures that contain black holes in the center, so all galaxies are quasars, since all quasars are structures that contain black holes in the center.

2. Some evolutionists are not persons who believe in the Bible, for no creationists are evolutionists, and some persons who believe in the Bible are not creationists.

3. No patents are measures that discourage research and development, and all patents are regulations that protect intellectual property. Thus, no measures that discourage research and development are regulations that protect intellectual property.

★4. Some farm workers are not persons who are paid decent wages, because no illegal aliens are persons who are paid decent wages, and some illegal aliens are not farm workers.

5. Some politicians are persons who will stop at nothing to win an election, and no persons who will stop at nothing to win an election are true statesmen. Hence, no politicians are true statesmen.

6. All meticulously constructed timepieces are true works of art, for all Swiss watches are true works of art and all Swiss watches are meticulously constructed timepieces.

★7. No patrons of fast-food restaurants are health food addicts. Consequently, no patrons of fast-food restaurants are connoisseurs of fine desserts, since no connoisseurs of fine desserts are health food addicts.

8. Some toxic dumps are sites that emit hazardous wastes, and some sites that emit hazardous wastes are undesirable places to live near. Thus, some toxic dumps are undesirable places to live near.

9. All persons who assist others in suicide are persons guilty of murder. Accordingly, some individuals motivated by compassion are not persons guilty of murder, inasmuch as some persons who assist others in suicide are individuals motivated by compassion.

★10. Some school boards are not groups that oppose values clarification because some school boards are not organizations with vision, and some groups that oppose values clarification are not organizations with vision.

II. Use the counterexample method to prove each of the following arguments invalid.

★1. If animal species are fixed and immutable, then evolution is a myth. Therefore, evolution is not a myth, since animal species are not fixed and immutable.

2. If carbon dioxide is present in the atmosphere, then plants have a source of carbon. Hence, since plants have a source of carbon, carbon dioxide is present in the atmosphere.

3. If gene splicing is successful, then disease-resistant livestock will be produced. If genetic defects can be eliminated, then disease-resistant livestock will be produced. Thus, if gene splicing is successful, then genetic defects can be eliminated.

★4. If energy taxes are increased, then either the deficit will be reduced or conservation will be taken seriously. If the deficit is reduced, then inflation will be checked. Therefore, if energy taxes are increased, then inflation will be checked.

5. All homeless people who are panhandlers are destitute individuals: Therefore, all homeless people are destitute individuals.
6. Some diplomats are clever spies, since some diplomats are clever and some diplomats are spies.
★7. All community colleges with low tuition are either schools with large enrollments or institutions supported by taxes. Therefore, all community colleges are institutions supported by taxes.
8. All merchandisers that are retailers are businesses that are inventory rotators. Therefore, all merchandisers are inventory rotators.
9. All diabetes victims are either insulin takers or glucose eliminators. Some diabetes victims are insulin takers. Therefore, some diabetes victims are glucose eliminators.
★10. All reverse mortgages that are FHA loans are either living standard enhancers or home equity depleters. All reverse mortgages are home equity depleters. Therefore, all FHA loans are living standard enhancers.

1.6 Extended Arguments

The logical analysis of extended arguments, such as those found in editorials, essays, and lengthy letters to newspaper editors, involves numerous difficulties. Such arguments are often mixed together with fragments of reports, pieces of expository writing, illustrations, explanations, and statements of opinion. Proper analysis involves weeding out the extraneous material and isolating premises and conclusions. Another problem stems from the fact that lengthy arguments often involve complex arrangements of subarguments that feed into the main argument in various ways. Distinguishing one subargument from another is often a complicated task. And then there are some argumentative passages that involve completely separate strands of argumentation leading to separate conclusions. Again, distinguishing the strands and assigning premises to the right conclusion not only is problematic but often involves an element of creativity on the part of the analyst.

To facilitate the analysis of extended arguments, we will assign numerals to the various statements in the passage and use arrows to represent the inferential links. Example:

> ① The contamination of underground aquifers represents a pollution problem of catastrophic proportions. ② Half the nation's drinking water, which comes from these aquifers, is being poisoned by chemical wastes dumped into the soil for generations.