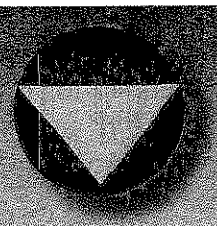
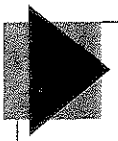


Basic Concepts

Everyone thinks. Everyone reasons. Everyone argues. And everyone is subjected to the reasoning and arguing of others. We are bombarded daily with reasoning from many sources: books, speeches, radio, TV, newspapers, employers, friends, and family.

Some people think well, reason well, and argue well. Some do not. The ability to think, reason, and argue well is partly a matter of natural gifts. But whatever our natural gifts, they can be refined and sharpened. And the study of logic is one of the best ways to refine one's natural ability to reason and argue. Through the study of logic, one learns strategies for thinking well, common errors in reasoning to avoid, and effective techniques for evaluating arguments.

But what is logic? Roughly speaking, logic is the study of methods for evaluating arguments. More precisely, **logic** is the study of methods for evaluating whether the premises of an argument adequately support (or provide good evidence for) its conclusion.



Logic is the study of methods for evaluating whether the premises of an argument adequately support its conclusion.

To get a better grasp of what logic is, then, we need to understand the key concepts involved in this definition: argument, conclusion, premise, and support. This chapter will give you an initial understanding of these basic concepts.

An **argument** is a set of statements where some of the statements are intended to support another. The **conclusion** is the claim to be supported. The **premises** are the statements offered in support. In some arguments the conclusion is *adequately supported* by the premises; in other cases it is not. But a set of

statements counts as an argument as long as some of the statements are intended to support another. Here is an example:

1. Every logic book contains at least one silly example. *The Power of Logic* is a logic book. So, *The Power of Logic* contains at least one silly example.

(*Whew!* We got that out of the way.) The word "so" indicates that the conclusion of this argument is "*The Power of Logic* contains at least one silly example." The argument has two premises—"Every logic book contains at least one silly example" and "*The Power of Logic* is a logic book." Of course, many arguments deal with very serious matters. Here are two examples:

2. If something would have a future of value if it weren't killed, then it is wrong to kill it. Most fetuses would have a future of value if they weren't killed. So, it is wrong to kill most fetuses.
3. If fetuses are not persons, then abortion is not wrong. Fetuses are not persons. So, abortion is not wrong.

As with argument (1), the sentences that precede the word "so" in arguments (2) and (3) are the premises and the sentence that follows the word "so" is the conclusion.

An **argument** is a set of statements where some of the statements, called the *premises*, are intended to support another, called the *conclusion*.

What is a statement? A **statement** is a declarative sentence that is either true or false. For example:

4. Some dogs are collies.
5. No dogs are collies.
6. Some dogs weigh exactly 124.379 pounds.

(4) is true because it describes things as they are. (5) is false because it describes things as other than they are. Truth and falsehood are the two possible **truth values.** So, we can say that a statement is a declarative sentence that has a truth value. The truth value of (4) is true while the truth value of (5) is false, but (4) and (5) are both statements. Is (6) a statement? Yes. No one may know its truth value, but (6) is either true or false, and hence it is a statement.

A **statement** is a declarative sentence that is either true or false.

Are any of the following items statements?

7. Get your dog off my lawn!
8. How many dogs do you own?
9. Let's get a dog.

No. (7) is a *command*, which could be obeyed or disobeyed. But it makes no sense to say that a command is true or false, so it is not a statement. (8) is a *question*, which could be answered or unanswered. But a question cannot be true or false, so it is not a statement. Finally, (9) is a *proposal*, which could be accepted or rejected. But a proposal cannot be true or false, so it also fails to be a statement.

We have said that an argument is a set of statements, where some of the statements (the premises) are intended to support another (the conclusion).[1] We must now distinguish two ways the premises can be intended to support the conclusion, and hence two different kinds of arguments. A **deductive argument** is one in which the premises are intended to *guarantee* the conclusion. An **inductive argument** is one in which the premises are intended to make the conclusion *probable*, without guaranteeing it. The following two examples illustrate this distinction:

10. All philosophers like logic. Ned is a philosopher. So, Ned likes logic.
11. Most philosophers like logic. Ned is a philosopher. So, Ned likes logic.

The premises of argument (10) are intended to support the conclusion in this sense: It is *guaranteed* that, if they are true, then the conclusion is true as well. (10) is an example of a deductive argument. The premises of argument (11) do *not* support the conclusion in this same sense. Even if Ned is a philosopher and even if the majority of philosophers enjoy logic, it is not guaranteed that Ned enjoys logic; he might be among the minority who do not care for logic at all. The premises of (11) support the conclusion in a different sense, however: It is *probable* that if they are true, then the conclusion is true as well. (11) is an example of an inductive argument.

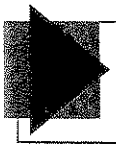
A **deductive argument** is one in which the premises are intended to *guarantee* the conclusion. An **inductive argument** is one in which the premises are intended to make the conclusion *probable,* without guaranteeing it.

Earlier, we said that logic is the study of methods to evaluate arguments. Since there are two kinds of arguments, there are also two areas of logic. **Deductive logic** is the study of methods for evaluating whether the premises of an argument guarantee its conclusion. **Inductive logic** is the study of methods for evaluating

whether the premises of an argument make its conclusion probable, without guaranteeing it.[2] The first three sections of this chapter introduce some of the key elements of deductive logic. The fourth section focuses on inductive logic.

1.1 Validity and Soundness

A deductive argument is one in which the premises are intended to guarantee the conclusion. Of course, one can *intend* to do something without *actually* doing it—just as the best laid plans of mice and men often go awry, so deductive arguments often go wrong. A **valid argument** is a deductive argument in which the premises *succeed* in guaranteeing the conclusion. An *invalid* argument is a deductive argument in which the premises *fail* to guarantee the conclusion. More formally, a valid argument is one in which it is necessary that, if the premises are true, then the conclusion is true.



A **valid argument** is one in which it is necessary that, if the premises are true, then the conclusion is true.

Two key aspects of this definition should be noted immediately. First, note the important word "necessary." In a valid argument, there is a *necessary connection* between the premises and the conclusion. The conclusion doesn't just happen to be true given the premises; rather, the truth of the conclusion is absolutely guaranteed given the truth of the premises. That is, a valid argument is one in which it is absolutely *impossible* for the premises to be true while the conclusion is false. Second, note the conditional (if-then) aspect of the definition. It does not say that the premises and conclusion of a valid argument are in fact true. Rather, the definition says that, necessarily, *if* the premises are true, then the conclusion is true. In other words, if an argument is valid, then it is necessary that, *on the assumption that* its premises are true, its conclusion is true also. Each of the following arguments is valid:

12. All biologists are scientists. John is not a scientist. So, John is not a biologist.

13. If Alice stole the diamonds, then she is a thief. And Alice did steal the diamonds. Hence, Alice is a thief.

14. Either Bill has a poor memory or he is lying. Bill does not have a poor memory. Therefore, Bill is lying.

In each case, it is necessary that if the premises are true, then the conclusion is true. Thus, in each case, the argument is valid.

In everyday English, the word "valid" is often used simply to indicate one's overall approval of an argument. But the methods logicians develop for assessing arguments focus on the link between the premises and the conclusion

rather than on the actual truth or falsity of the statements composing the argument.

The following observations about validity may help prevent some common misunderstandings. First, notice that an argument can have one or more false premises and still be valid. For instance:

15. All birds have beaks. Some cats are birds. So, some cats have beaks.

Here, the second premise is plainly false, and yet the argument is valid, for it is necessary that if the premises are true, the conclusion is true also. And in the following argument, both premises are false, but the argument is still valid:

16. All sharks are birds. All birds are politicians. So, all sharks are politicians.

Although the premises of this argument are in fact false, it is impossible for the conclusion to be false while the premises are true. So, it is valid.

Second, we cannot rightly conclude that an argument is valid simply on the grounds that its premises are all true. For example:

17. Some Americans are women. Brad Pitt is an American. Therefore, Brad Pitt is a woman.

The premises here are true, but the conclusion is false. So, obviously, it is possible that the conclusion is false while the premises are true; hence, (17) is not valid. Is the following argument valid?

18. Some Americans work in the movie industry. Angelina Jolie is an American. Hence, Angelina Jolie works in the movie industry.

Here, we have true premises and a true conclusion. But it is not necessary that, if the premises are true, then the conclusion is true. (Ms. Jolie could switch to another line of work while remaining an American.) So, even if an argument has true premises and a true conclusion, it might not be valid. Thus, the question "Are the premises actually true?" is distinct from the question "Is the argument valid?"

Third, suppose an argument is valid and has a false conclusion. Must it then have at least one false premise? Yes. If it had true premises, then it would have to have a true conclusion because it is valid. *Validity preserves truth;* that is, if we start with truth and reason in a valid fashion, we will always wind up with truth.

Fourth, does validity also preserve falsehood? In other words, if we start with false premises and reason validly, are we bound to wind up with a false conclusion? No. Consider the following argument:

19. All Martians are Republicans. All Republicans are extraterrestrials. So, all Martians are extraterrestrials.

Is this argument valid? Yes. It is impossible for the conclusion to be false *assuming that* its premises are true. However, the premises here are false while the conclusion is true. So, *validity does not preserve falsehood.* In fact, false premises plus valid reasoning may lead to either truth or falsity, depending on the case. Here is a valid argument with false premises and a false conclusion:

> **20.** All highly intelligent beings are from outer space. Some armadillos are highly intelligent beings. So, some armidillos are from outer space.

The lesson here is that although valid reasoning guarantees that we will end up with truth if we start with it, we may wind up with either truth or falsehood if we reason validly from false premises.

Fifth, notice that one can know whether an argument is valid or invalid even if one does not know the truth value of the conclusion and all of the premises. Consider this example:

> **21.** All Schnitzers are BMWs. Emily Larson owns a Schnitzer. So, Emily Larson owns a BMW.

Chances are that you have no idea whether the conclusion and all of the premises are true, but this argument is obviously valid; it is not possible for Emily not to own a BMW on the assumption that she owns a Schnitzer and all Schnitzers are BMWs. Here is another example:

> **22.** All reliabilists are foundationalists. William Alston is a foundationalist. Thus, William Alston is a reliabilist.

You probably haven't the foggiest idea what the truth values of these statements are; indeed, you might not even know what they mean. Nevertheless, you can tell that this argument is invalid because the premises do not rule out the possibility that Alston is a foundationalist of a nonreliabilist stripe.

Earlier, we said that an invalid argument is a deductive argument in which the premises fail to guarantee the conclusion. More formally, an **invalid argument** is one in which it is *not* necessary that, if the premises are true, then the conclusion is true.

An **invalid argument** is one in which it is *not* necessary that, if the premises are true, then the conclusion is true.

In other words, an invalid argument is one in which it is *possible* for the premises to be true while the conclusion is false. Even on the assumption that the

premises are true, the conclusion could still be false. Each of the following arguments is invalid:

23. All dogs are animals. All cats are animals. Hence, all dogs are cats.
24. If Pat is a wife, then Pat is a woman. But Pat is not a wife. So, Pat is not a woman.
25. Phil likes Margo. Therefore, Margo likes Phil.

Since the premises of argument (23) are in fact true but its conclusion is false, it is obviously possible for its premises to be true while its conclusion is false; so, it is invalid. Argument (24) is invalid because its premises leave open the possibility that Pat is an unmarried woman. And (25) is invalid because even if Phil does like Margo, it remains open whether she feels the same way toward him. In each of these cases, then, the conclusion could be false while the premises are true.

The foregoing five points about validity, invalidity, and truth are summarized by the following table:

	Valid argument	**Invalid argument**
True premises True conclusion	1 If Harry loved Dumbledore, then Harry was sad when Dumbledore died. Harry loved Dumbledore. So, Harry was sad when Dumbledore died.	6 Some Americans work in business. Donald Trump is an American. So, Donald Trump works in business.
False premises False conclusion	2 All sharks are birds. All birds are politicians. So, all sharks are politicians.	7 Every genius is a philosopher. Homestar Runner is a philosopher. So, Homestar Runner is a genius.
False premises True conclusion	3 All dogs are ants. All ants are mammals. So, all dogs are mammals.	8 Everything colored is red. Stephen Colbert is a mortician. So, Stephen Colbert is hilarious.
True premises False conclusion	4	9 All dogs are animals. All cats are animals. Hence, all dogs are cats.
Unknown truth value	5 All of the Cappadocians accepted perichoresis. Basil was a Cappadocian. So, Basil accepted perichoresis.	10 Some hylidae are heterophoric. Maggie is heterophoric. So, Maggie is a hylidae.

Notice that validity is not enough all by itself for a *good* deductive argument. A valid argument with false premises can lead to a false conclusion (box 2). Moreover, truth is not enough all by itself for a *good* deductive argument. An invalid argument with all true premises can lead to a false conclusion (box 9). We want our deductive arguments to be valid and to have all true premises. An argument that has both is a *sound argument*. In other words, a valid argument in which all of the premises are true is a **sound argument.**

A **sound argument** is a valid argument in which all of the premises are true.

Because a sound argument is valid and has only true premises, its conclusion will also be true. Validity preserves truth. That's why there is nothing in box 4. The argument in box 1 is sound; here are two more sound arguments:

26. All collies are dogs. All dogs are animals. So, all collies are animals.

27. If Mozart is a composer, then he understands music. Mozart is a composer. Hence, Mozart understands music.

In each case, it is necessary that, if the premises are true, then the conclusion is true; moreover, in each case, all of the premises are true. Thus, each argument is sound.

Valid + All Premises True = Sound

By way of contrast, an *unsound argument* falls into one of the following three categories:

Category 1. It is valid, but it has at least one false premise.

Category 2. It is invalid, but all of its premises are true.

Category 3. It is invalid and it has at least one false premise.

In other words, an **unsound argument** is one that either is invalid or has at least one false premise.

An **unsound argument** is one that either is invalid or has at least one false premise.

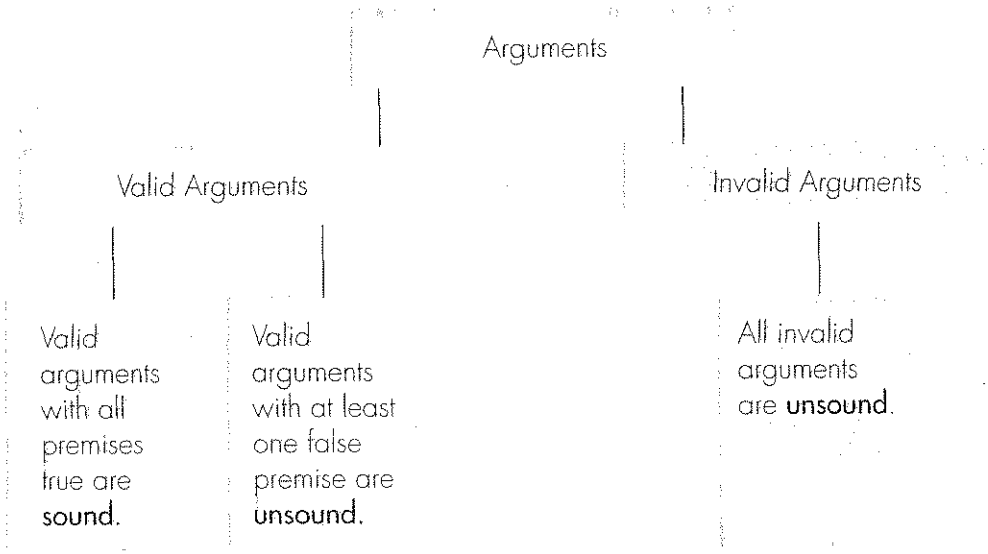
For example, these three arguments are unsound:

28. All birds are animals. Some grizzly bears are not animals. Therefore, some grizzly bears are not birds.

29. All birds are animals. All grizzly bears are animals. So, all grizzly bears are birds.
30. All trees are animals. All bears are animals. So, all bears are trees.

Argument (28) is unsound because, although it is valid, it has a false (second) premise. It is in Category 1. Argument (29) is unsound because, although it has all true premises, it is invalid. It is in Category 2. Argument (30) is unsound because it has a false (first) premise and it is invalid. It is in Category 3. (Which boxes in the previous table contain unsound arguments? To which of the three categories does each unsound argument in the table belong?)

Here is a map of the main concepts we've discussed so far:



We said earlier that we want a deductive argument to be valid and have all true premises. That is, we want a deductive argument to be sound. That is *not* to say, however, that if an argument is sound, it leaves nothing to be desired. A sound argument that had its conclusion as a premise would be useless (see section 4.3 on begging the question). Moreover, a sound argument whose premises were not reasonable for us to accept given our total evidence would hardly be a satisfying, compelling, and useful basis for believing the conclusion. To say the least, then, we want more from a deductive argument than its being sound.

Nevertheless, we want a deductive argument to be sound, and deductive logic plays an indispensable role in assessing whether an argument is sound. For an argument is sound only if it is valid, and as we said earlier, deductive logic is the study of methods for evaluating whether the premises of an argument guarantee its conclusion, that is, deductive logic is the study of methods of evaluating whether or not an argument is valid. In the next two sections we will display some initial methods for determining whether or not an argument is valid, and in the process

we will get a better handle on the basic concepts that we have introduced thus far. But first a note on terminology is in order. Given our definitions, arguments are neither true nor false, but each statement is either true or false. On the other hand, arguments can be valid, invalid, sound, or unsound, but statements cannot be valid, invalid, sound, or unsound. Therefore, a given premise (or conclusion) is either true or false, but it cannot be valid, invalid, sound, or unsound.

Summary of Definitions

Logic is the study of methods for evaluating whether the premises of an argument adequately support its conclusion.

An **argument** is a set of statements where some of the statements, called the *premises,* are intended to support another, called the *conclusion.*

A **statement** is a sentence that is either true or false.

A **deductive argument** is one in which the premises are intended to *guarantee* the conclusion.

An **inductive argument** is one in which the premises are intended to make the conclusion more *probable,* without guaranteeing it.

A **valid argument** is one in which it is necessary that, if the premises are true, then the conclusion is true.

An **invalid argument** is one in which it is *not* necessary that, if the premises are true, then the conclusion is true.

A **sound argument** is a valid argument in which all of the premises are true.

An **unsound argument** is one that either is invalid or has at least one false premise.

The following exercises provide you with an opportunity to explore the concepts introduced thus far.

EXERCISE 1.1

Note: For each exercise item preceded by an asterisk, the answer appears in the Answer Key at the end of the book.

PART A: Recognizing Statements Write "statement" if the item is a statement. Write "sentence only" if the item is a sentence but not a statement. Write "neither" if the item is neither a sentence nor a statement.

* **1.** The sky is blue.

2. Let's paint the table red.

3. Please close the window!

* **4.** Murder is illegal.

5. Abraham Lincoln was born in 1983.
6. If San Francisco is in California, then San Francisco is in the U.S.A.
* 7. It is not the case that Ben Franklin.
8. "Why?" asked Socrates.
9. Table not yes if.
*10. Either humans evolved from apes or apes evolved from humans.
11. Davy Crockett died at the Alamo.
12. How are you?
*13. If seven is greater than six, then six is greater than seven.
14. Let's have lunch.
15. Go!
*16. Shall we dance?
17. Patrick Henry said, "Give me liberty or give me death."
18. If punishment deters crime.
*19. "Stand at attention!" ordered General Bradley.
20. Despite the weather.
21. The longest shark in the Pacific Ocean.
22. Either Heather or Cheri.
23. If there is only one human.
24. Either shut the door or turn off the radio.
25. Do you swear to tell the truth?
26. Having seen all the suffering.
27. Let's stop griping and get to work.
28. Fame is a drug.
29. By faith and love.
30. Either Laura is angry or Edith is depressed.

PART B: True or False? Which of the following statements are true? Which are false?

* 1. All valid arguments have at least one false premise.
2. An argument is a set of statements where some of the statements, called the *premises*, are intended to support another, called the *conclusion*.
3. Every valid argument has true premises and only true premises.
* 4. Logic is the study of methods for evaluating whether the premises of an argument adequately support its conclusion.
5. Some statements are invalid.
6. Every valid argument has true premises and a true conclusion.

* **7.** A sound argument can have a false conclusion.

8. Deductive logic is the part of logic that is concerned with tests for validity and invalidity.

9. If a valid argument has only true premises, then it must have a true conclusion.

* **10.** Some arguments are true.

11. If a valid argument has only false premises, then it must have a false conclusion.

12. Some invalid arguments have false conclusions but (all) true premises.

* **13.** Every sound argument is valid.

14. Every valid argument with a true conclusion is sound.

15. Every valid argument with a false conclusion has at least one false premise.

* **16.** Every unsound argument is invalid.

17. Some premises are valid.

18. If all of the premises of an argument are true, then it is sound.

* **19.** If an argument has (all) true premises and a false conclusion, then it is invalid.

20. If an argument has one false premise, then it is unsound.

21. Every unsound argument has at least one false premise.

* **22.** Some statements are sound.

23. Every valid argument has a true conclusion.

24. Every invalid argument is unsound.

* **25.** Some arguments are false.

26. If an argument is invalid, then it must have true premises and a false conclusion.

27. Every valid argument has this feature: Necessarily, if its premises are true, then its conclusion is true.

* **28.** Every invalid argument has this feature: It is possibly false that if its premises are true, then its conclusion is true.

29. Every sound argument has a true conclusion.

30. Every valid argument has this feature: Necessarily, if its premises are false, then its conclusion is false.

31. A deductive argument is one in which the premises are intended to make the conclusion probable, without guaranteeing it.

32. An inductive argument is one in which the premises are intended to guarantee the conclusion.

33. Inductive logic is the study of methods for evaluating whether the premises of an argument make its conclusion probable, without guaranteeing it.

34. "It's raining outside, so the ground is wet," is best regarded as a deductive argument.

35. "It must be raining outside. After all, if it weren't, then the ground would be dry, but it's soaking wet" is best regarded as an inductive argument.

PART C: Valid or Invalid? Much of this text concerns methods of testing arguments for validity. Although we have not yet discussed any particular methods of testing arguments for validity, we do have definitions of "valid argument" and "invalid argument." Based on your current understanding, which of the following arguments are valid? Which are invalid? (*Hint:* Use the definitions that have been provided.)

* **1.** If Lincoln was killed in an automobile accident, then Lincoln is dead. Lincoln was killed in an automobile accident. Hence, Lincoln is dead.

2. If Lincoln was killed in an automobile accident, then Lincoln is dead. Lincoln was not killed in an automobile accident. Therefore, Lincoln is not dead.

3. If Lincoln was killed in an automobile accident, then Lincoln is dead. Lincoln is dead. So, Lincoln was killed in an automobile accident.

* **4.** If Lincoln was killed in an automobile accident, then Lincoln is dead. Lincoln is not dead. Hence, Lincoln was not killed in an automobile accident.

5. Either 2 plus 2 equals 22 or Santa Claus is real. But 2 plus 2 does not equal 22. Therefore, Santa Claus is real.

6. Either we use nuclear power or we reduce our consumption of energy. If we use nuclear power, then we place our lives at great risk. If we reduce our consumption of energy, then we place ourselves under extensive governmental control. So, either we place our lives at great risk or we place ourselves under extensive governmental control.

* **7.** All birds are animals. No tree is a bird. Therefore, no tree is an animal.

8. Some humans are comatose. But no comatose being is rational. So, not every human is rational.

9. All animals are living things. At least one cabbage is a living thing. So, at least one cabbage is an animal.

* **10.** Alvin likes Jane. Jane likes Chris. So, Alvin likes Chris.

11. All murderers are criminals. Therefore, all nonmurderers are noncriminals.

12. David is shorter than Saul. Saul is shorter than Goliath. It follows that David is shorter than Goliath.

* **13.** It is possible that McGraw will win the next presidential election. It is possible that Lambert will win the next presidential election. Thus, it is possible that both McGraw and Lambert will win the next presidential election.

14. All physicians are singers. Madonna is a physician. Therefore, Madonna is a singer.

15. Samuel Morse invented the telegraph. Alexander Graham Bell did not invent the telegraph. Consequently, Morse is not identical with Bell.

PART D: Soundness Which of the following arguments are sound? Which are unsound? If an argument is unsound, explain why.

* **1.** All cats are mammals. All mammals are animals. So, all cats are animals.

2. All collies are dogs. Some animals are not dogs. So, some animals are not collies.

3. All citizens of Nebraska are Americans. All citizens of Montana are Americans. So, all citizens of Nebraska are citizens of Montana.

* 4. "Let's party!" is either a sentence or a statement (or both). "Let's party!" is a sentence. So, "Let's party!" is not a statement.

5. No diamonds are emeralds. The Hope Diamond is a diamond. So, the Hope Diamond is not an emerald.

6. All planets are round. The earth is round. So, the earth is a planet.

* 7. If the Taj Mahal is in Kentucky, then the Taj Mahal is in the U.S.A. But the Taj Mahal is not in the U.S.A. So, the Taj Mahal is not in Kentucky.

8. All women are married. Some executives are not married. So, some executives are not women.

9. All mammals are animals. No reptiles are mammals. So, no reptiles are animals.

*10. All mammals are cats. All cats are animals. So, all mammals are animals.

11. Wilber Wright invented the airplane. Therefore, Orville Wright did not invent the airplane.

12. All collies are dogs. Hence, all dogs are collies.

*13. William Shakespeare wrote *Hamlet*. Leo Tolstoy is identical with William Shakespeare. It follows that Leo Tolstoy wrote *Hamlet*.

14. If San Francisco is in Saskatchewan, then San Francisco is in Canada. But it is not true that San Francisco is in Saskatchewan. Hence, it is not true that San Francisco is in Canada.

15. Either Thomas Jefferson was the first president of the U.S.A. or George Washington was the first president of the U.S.A., but not both. George Washington was the first president of the U.S.A. So, Thomas Jefferson was not the first president of the U.S.A.

1.2 Forms and Validity

Deductive logic is the study of methods for determining whether or not an argument is valid. This section introduces the concept of an argument form and explains how an understanding of argument forms can help establish the validity of an argument.

Argument Forms

Consider the following two arguments:

31. 1. If Pepé is a Chihuahua, then Pepé is a dog.
    2. Pepé is a Chihuahua.

So, 3. Pepé is a dog.

32. 1. If Clinton is a U.S. president, then Clinton is a U.S. citizen.
2. Clinton is a U.S. president.
So, 3. Clinton is a U.S. citizen.

In each case, lines 1 and 2 are the premises and line 3 is the conclusion. Both of these arguments are valid: It is necessary that, if the premises are true, then the conclusion is true. Moreover, both of these arguments have the same *argument form*, where an **argument form** is simply a pattern of reasoning.

An **argument form** is a pattern of reasoning.

The particular form of reasoning exhibited by arguments (31) and (32) is so common that logicians have given it a special name: ***modus ponens,*** which means "the mode or way of positing." (Notice that, in each of them, the second premise posits or affirms the if-part of the first premise.) This pattern of reasoning can be represented as follows:

Modus Ponens
1. If A, then B.
2. A.
So, 3. B.

Here, the letters A and B are **variables** that stand in for statements. To illustrate how these variables work, suppose that we erase each appearance of A in the form above and write the same statement in both blanks (any statement will do). Next, suppose that we erase each appearance of B and write down the same statement in both blanks. We will then have a *substitution instance* of the argument form *modus ponens*. For example, if we replace each appearance of A with the statement "Pepé is a Chihuahua" and we replace each appearance of B with the statement "Pepé is a dog," we arrive at (31). Similarly, if we substitute "Clinton is a U.S. president" for A and "Clinton is a U.S. citizen" for B, we are left with (32). Thus, both arguments are substitution instances of the argument form *modus ponens*. Generalizing, we can say that a **substitution instance** of an argument form is an argument that results from uniformly replacing the variables in that form with statements (or terms).*

A **substitution instance** of an argument form is an argument that results from uniformly replacing the variables in that form with statements (or terms).

*The reader should ignore the parenthetical comment at this point. We will discuss forms that result from replacing terms, rather than statements, in section 1.3.

We will look at further examples of argument forms and substitution instances in a moment. But let's first use the concepts to understand how an argument's validity can be entirely due to its form.

Consider the following argument:

33. 1. If A.J. Ayer is an emotivist, then A.J. Ayer is a noncognitivist.
2. A.J. Ayer is an emotivist.
So, 3. A.J. Ayer is a noncognitivist.

Argument (33), like (31) and (32), is an instance of *modus ponens* (it results from replacing A with "A.J. Ayer is an emotivist" and B with "A.J. Ayer is a noncognitivist"). Moreover, (33), like (31) and (32), is a valid argument. This much should be clear, even if some of the words in (33) are unfamiliar and even if one has no idea who A.J. Ayer is. Suppose it's true that A.J. Ayer is an emotivist (whatever that is). And suppose it's also true that, if A.J. Ayer is an emotivist, then he is a noncognitivist (whatever that is). Given those assumptions, it must follow that A.J. Ayer is a noncognitivist as well. That is just to say that it is impossible for the premises of (33) to be true while the conclusion is false. So it is valid.

Arguments (31), (32), and (33) illustrate the fact that the validity of an argument that has the form of *modus ponens* is guaranteed by that form alone; its validity does not depend on its subject matter (or content). Hence, every substitution instance of *modus ponens* will be a valid argument no matter what its content happens to be. In this sense, *modus ponens* is a *valid argument form*. More generally, we can say that a **valid argument form** is an argument form in which every substitution instance is a valid argument.

A **valid argument form** is one in which every substitution instance is a valid argument.

(Note that this is a definition of a valid *argument form*, which should not be confused with the definition of a valid *argument* from section 1.1.) The crucial point is this: It is no coincidence that all of the arguments we have looked at so far in section 1.2 are valid. They are valid because each of them is an instance of a valid argument form, namely *modus ponens*. In this sense, each of the arguments we have looked at is a *formally valid argument*, where a **formally valid argument** is one that is valid in virtue of its form.

A **formally valid argument** is one that is valid in virtue of its form.

While most valid arguments in ordinary life are formally valid, not every valid argument is formally valid. That is, some arguments are valid, but they are not valid in virtue of their form. For example, consider the following argument:

34. All philosophers are nerds. So, no squares are circles.

The conclusion of this argument is an example of what philosophers call a "necessary truth," because it *must* be true, that is, it is impossible for anything to be both a square and a circle at once. But if it is impossible for the conclusion to be false, then it is also impossible for the premise to be true while the conclusion is false. That is to say, it is impossible for all philosophers to be nerds while some squares are circles. Argument (34) is, therefore, valid. Its validity, however, has nothing to do with its form and everything to do with the content of its conclusion. Although (34) is unusual, it highlights the fact that an argument can be valid without being formally valid.

Even though an argument can be valid without being formally valid, the crucial point to grasp is that *if an argument is a substitution instance of a valid form, then the argument is valid.* Thus, if we determine an argument's form and tell that the form is valid, we can establish that the argument is valid.

In the remainder of section 1.2, we will begin the task of learning to recognize argument forms, which we will continue in later chapters. For now, we will present five "famous" valid forms and then use them to provide an initial method for determining the validity of arguments. But before we get started, we must pause to make an important observation. If-then statements play an important role in many of the arguments and argument forms we will be looking at in this chapter and beyond. Consequently, it is worthwhile to discuss them in some detail before going on.

Understanding Conditional Statements

Each of the following is a **conditional statement** (an if-then statement, often simply called a "conditional" by logicians):

35. If it is snowing, then the mail will be late.

36. If Abraham Lincoln was born in 1709, then he was born before the American Civil War.

37. If Abraham Lincoln was born in 1947, then he was born after World War II.

Conditionals have several important characteristics. First, note their components. The if-clause of a conditional is called its **antecedent;** the then-clause is called the **consequent.** But the antecedent does not include the word "if." Hence, the antecedent of conditional (35) is "it is snowing," not "If it is snowing." Similarly, the consequent is the statement following the word "then," but

it does not include that word. So, the consequent of (35) is "the mail will be late," not "then the mail will be late."

Second, conditionals are hypothetical in nature. Thus, in asserting a conditional, one does not assert that its antecedent is true. Nor does one assert that its consequent is true. Rather, one asserts that *if* the antecedent is true, *then* the consequent is true. Thus, (36) is true even though its antecedent is false (Lincoln was born in 1809, not 1709). If Lincoln was born in 1709, then, of course, his birth preceded the American Civil War, which began in 1861. And (37) is true even though its consequent is false. If Lincoln was born in 1947, then he certainly was not born *after* World War II.

Third, there are many ways to express a conditional in ordinary English. Consider the following conditional statement:

38. If it is raining, then the ground is wet.

Statements (a) through (f) below are all **stylistic variants** of (38), that is, alternate ways of saying the very same thing[3]:

a. *Given that* it is raining, the ground is wet.
b. *Assuming that* it is raining, the ground is wet.
c. The ground is wet *if* it is raining.
d. The ground is wet *given that* it is raining.
e. The ground is wet *assuming that* it is raining.
f. It is raining *only if* the ground is wet.

Each of (a) through (f) says the very same thing as (38), so (38) can be substituted for each of them in an argument. And as we will see, making such substitutions is an aid to identifying argument forms. Accordingly, a close look at these stylistic variants is warranted. Consider (c). Note that "if" comes not at the beginning but in the middle of the statement. Yet, (c) has the same meaning as (38). And the phrase "given that" in (d) plays a role exactly analogous to the "if" in (c). We might generalize from these examples by saying that "if" and its stylistic variants (e.g., "given that" and "assuming that") *introduce an antecedent*. But we must hasten to add that this generalization does not apply when "if" is combined with other words, notably "only." When combined with "only," as in (f), the situation alters dramatically. Statement (f) has the same meaning as (38), but the phrase "only if" is confusing to many people and bears closer examination.

To clarify the meaning of "only if," it is helpful to consider very simple conditionals, such as the following:

39. Rex is a dog *only if* Rex is an animal.
40. Rex is an animal *only if* Rex is a dog.

Obviously, (39) and (40) say different things. (40) is false. Rex may well be an animal even if Rex isn't a dog but a pet platypus. Thus, (40) says, in effect, that "If Rex is an animal, Rex is a dog." But (39) says something entirely different, and something true—namely, that if Rex is a dog, then Rex is an animal. In general, statements of the form *A only if B* say the same thing as statements of the form *If A, then B*. They do *not* say the same thing as statements of the form *If B, then A*. Another way to generalize the point is to say that "only if" (unlike "if") *introduces a consequent.*

To discern the form of an argument more easily, it is best to convert stylistic variants of conditionals into the standard *if-then* form. This will be our practice as we develop our methods for discerning the validity and invalidity of arguments.

We will have more to say about conditionals in later chapters. But what we have said here is enough to facilitate our discussion of famous valid argument forms and the method they provide for assessing the validity of arguments.

Famous Valid Forms

We have already been introduced to the first of our famous valid forms, *modus ponens*. We must now meet its sibling, *modus tollens*. Consider the following pair of arguments:

41. 1. If it is raining, then the ground is wet.
    2. The ground is not wet.
So, 3. It is not raining.

42. 1. If there is fire in the room, then there is air in the room.
    2. There is no air in the room.
So, 3. There is no fire in the room.

In each case, lines 1 and 2 are the premises and line 3 is the conclusion. Both arguments are clearly valid: It is necessary that, if the premises are true, the conclusion is true also. Moreover, each argument is formally valid: It is valid because it is an instance of the argument form *modus tollens*, which means "the mode or way of removing." (Notice that, in arguments (41) and (42), the second premise removes or denies the truth of the consequent of the first premise.) We can represent **modus tollens** as follows:

Modus Tollens

1. If A, then B.
2. Not B.

So, 3. Not A.

No matter what A and B are, the result will be a valid argument.

Modus tollens is related to *modus ponens*. They both have a premise that is a conditional statement. The key difference lies in the negative nature of the last two lines. "Not A" and "Not B" stand for *negations*. The **negation** of a statement is its denial. For example, in (41), "The ground is not wet" plays the role of Not B and "It is not raining" plays the role of Not A, while in (42), "There is no air in the room" plays the role of Not B and "There is no fire in the room" plays the role of Not A. The negation of a statement can be formed in various ways. For example, each of the following is a negation of the statement "The ground is wet":

a. *It is not the case that* the ground is wet.
b. *It's false that* the ground is wet.
c. *It is not true that* the ground is wet.
d. The ground is *not* wet.

Three general points can be illustrated with *modus ponens* and *modus tollens*. First, whether an argument is an instance of an argument form is not affected by the order of the premises. For example, both of the following count as *modus tollens*:

43. If Shakespeare was a physicist, then he was a scientist. Shakespeare was not a scientist. So, Shakespeare was not a physicist.

44. Shakespeare was not a scientist. If Shakespeare was a physicist, then he was a scientist. So, Shakespeare was not a physicist.

In other words, arguments of the form *Not A; if A, then B; so, Not B* count as examples of *modus tollens*. Similarly, arguments of the form *A; if A, then B; so B* count as examples of *modus ponens*. In the remainder of this chapter, keep in mind that the general point here—that the order of the premises does not matter—applies to all of the argument forms that we will discuss.

Second, the conditionals involved in an argument can be rather long and complex. For example:

45. If every right can be waived in the interests of those who have those rights, then euthanasia is permitted in those cases in which the person to be "euthanized" waives his or her right to life. Moreover, every right can be waived in the interests of those who have those rights. Hence, euthanasia is permitted in those cases in which the person to be "euthanized" waives his or her right to life.

The conditional premise in this argument is relatively long and complex, but the form is still *modus ponens*. "Every right can be waived in the interests of those who have those rights" replaces A; "euthanasia is permitted in those cases in which the person to be euthanized waives his or her right to life" replaces B.

Third, putting an argument into explicit form helps to focus attention on the key issues. For example, according to some physicists who endorse the Big Bang theory, the universe cannot be infinitely old. The second law of thermodynamics tells us that in a closed physical system entropy always tends to increase; that is, energy gets diffused over time. (For instance, the radiant energy of a star will gradually become spread out evenly into the space surrounding it.) According to these physicists, if the physical universe has existed for an infinite period, there are now no concentrations of energy (e.g., no stars or planets). But obviously, there are stars and planets, so the physical universe has not existed for an infinite period. We can put this reasoning explicitly into the *modus tollens* form as follows:

46. 1. If the physical universe has existed for an infinite period, then all the energy in the universe is spread out evenly (as opposed to being concentrated in such bodies as planets and stars).
2. It is not true that all the energy in the universe is spread out evenly (as opposed to being concentrated in such bodies as planets and stars).
So, 3. It is not true that the physical universe has existed for an infinite period.

By putting the argument into explicit form, we are better able to focus our attention on the key issue. There is no debate whatsoever about the second premise of this argument. Stars and planets exist, so energy is not in fact spread out evenly throughout the physical universe. Nor is there any debate about the validity of the argument. Every argument having the form *modus tollens* is valid. The focus of the debate, therefore, must be on the first premise, and that is just where physicists have placed it. For example, some physicists think that the universe oscillates, that is, goes through a cycle of "Big Bangs" and "Big Crunches." And if the universe can oscillate, then its diffuse energy can be reconcentrated into usable forms, in which case the first premise is doubtful.[4]

Our third famous valid form is *hypothetical syllogism*. Consider the following argument:

47. 1. If tuition continues to increase, then only the wealthy will be able to afford a college education.
2. If only the wealthy will be able to afford a college education, then class divisions will be strengthened.
So, 3. If tuition continues to increase, then class divisions will be strengthened.

This is an instance of **hypothetical syllogism,** which we can represent as follows:

Hypothetical Syllogism

1. If A, then B.
2. If B, then C.

So, 3. If A, then C.

The argument form is called *hypothetical syllogism* because it involves only hypothetical (i.e., conditional) statements. *Syllogism* comes from the Greek roots meaning "to reason together" or to put statements together into a pattern of reasoning. Every argument that exemplifies this form is valid. For example:

48. If I am morally responsible, then I can choose between good and evil. If I can choose between good and evil, then some of my actions are free. Therefore, if I am morally responsible, then some of my actions are free.

Note that the conclusion of a hypothetical syllogism is a conditional statement.

Thus far in this section, we have focused on argument forms that involve conditional statements. Not all argument forms are like this. Some use **disjunctions,** that is, statements of the form *Either A or B*, whose parts are called "**disjuncts.**" (For example, the disjuncts of "Either the Second Temple of Jerusalem was destroyed in 70 CE or my memory is failing me" are "the Second Temple of Jerusalem was destroyed in 70 CE" and "my memory is failing me.") Now consider this pair of arguments:

49. 1. Either Pablo Picasso painted *Woman with a Guitar* or Georges Braque painted it.
2. Pablo Picasso did not paint *Woman with a Guitar.*
So, 3. Georges Braque painted *Woman with a Guitar.*

50. 1. Either experimentation on live animals should be banned or experimentation on humans should be permitted (e.g., the terminally ill).
2. Experimentation on humans should not be permitted.
So, 3. Experimentation on live animals should be banned.

Each of these arguments is valid. Each affirms a disjunction, denies one of the disjuncts, and then concludes that the remaining disjunct is true. They are each an instance of **disjunctive syllogism,** which comes in two versions:

Disjunctive Syllogism (in two versions)

1. Either A or B.	1. Either A or B.
2. Not A.	2. Not B.
So, 3. B	So, 3. A.

Argument (49) is an instance of the first version; argument (50) is an instance of the second. All arguments of either version of disjunctive syllogism are valid.

Some brief remarks about disjunctions are in order here. First, we will take statements of the form *Either A or B* to mean *Either A or B (or both)*. This is called the **inclusive** sense of "or." For instance, suppose a job announcement

reads: "Either applicants must have work experience or they must have a bachelor's degree in the field." Obviously, an applicant with *both* work experience *and* a bachelor's degree is not excluded from applying.

Second, some authors speak of an **exclusive** sense of "or," claiming that statements of the form *Either A or B* sometimes mean *Either A or B (but not both)*. For example, in commenting on a presidential election, one might say, "Either Smith will win the election or Jones will win," the assumption being that not both will win. However, it is a matter of controversy whether there really are two different meanings of the word "or" *as opposed to* there simply being cases in which the context indicates that A and B are not both true. Rather than let this controversy sidetrack us, let us simply assume with most logicians that statements of the form *Either A or B* mean *Either A or B (or both)*.

Third, having made this assumption, however, we must immediately add that arguers are free to use statements of the form *Either A or B (but not both)*. This is equivalent to the combination of two statements: *Either A or B, and not both A and B*. Consider the following argument:

51. Either Millard Fillmore was the 13th president of the United States, or Zachary Taylor was the 13th president of the United States (but not both). Millard Fillmore was the 13th president. So, Zachary Taylor was not the 13th president.

We can represent the form of this argument as *Either A or B; not both A and B; A; so, not B*. This form is valid, but notice that it differs from disjunctive syllogism.

Fourth, note that disjunctive syllogism differs from the following form of argument:

52. Either Hitler was a Nazi, or Himmler was a Nazi. Hitler was a Nazi. Therefore, it is not the case that Himmler was a Nazi.

The form of this argument can be best represented as *Either A or B; A; therefore, not B*. As a matter of historical fact, the premises of (52) are true, but its conclusion is false; therefore, this argument form is invalid, unlike disjunctive syllogism.

Let's look at one more famous valid argument form: **constructive dilemma.** It combines both conditional and disjunctive statements. Here is an example:

53. 1. Either Donna knew the information on her tax returns was inaccurate, or her tax preparer made a mistake.
2. If Donna knew the information was inaccurate, she should pay the fine.
3. If her tax preparer made a mistake, then he should pay the fine.

So, 4. Either Donna should pay the fine or her tax preparer should pay the fine.

The form of this argument is as follows:

Constructive Dilemma

1. Either A or B.
2. If A, then C.
3. If B, then D.

So, 4. Either C or D.

Arguments of this form are always valid. The age-old problem of evil can be put in the form of a constructive dilemma:

54. Either God cannot prevent some suffering or God does not want to prevent any of it. If God cannot prevent some suffering, then God is weak. If God does not want to prevent any suffering, then God is not good. So, either God is weak or God is not good.

This dilemma nicely illustrates how logic can be used to formulate a problem in a revealing way. Because argument (54) is valid, it is not possible for all of the premises to be true and the conclusion false. Theists, against whom the argument is directed, can hardly deny the first (disjunctive) premise. (If God can prevent some suffering, then God must not want to do so for some reason.) And the second premise seems undeniable. (After all, even we can prevent some suffering.) Historically, the third premise has been the focus of debate, with theists suggesting that God does not want to eliminate any suffering because permitting it is the necessary means to certain good ends (e.g., the personal growth of free creatures).

The Famous Forms Method

At this point, we have introduced five famous valid argument forms, which are summarized in the following table:

Summary of Famous Valid Forms

Modus ponens: If A, then B. A. So, B.

Modus tollens: If A, then B. Not B. So, Not A.

Hypothetical syllogism: If A, then B. If B, then C. So, if A, then C.

Disjunctive syllogism (in two versions): Either A or B. Not A. So, B.
Either A or B. Not B. So, A.

Constructive dilemma: Either A or B. If A, then C. If B, then D. So, either C or D.

We can now use these forms to determine the validity of many arguments, by employing the following method. Here's how.

Consider the following argument:

55. Tom is old *only if* he is over eighty. But Tom is not over eighty, and so he is not old.

First, we identify the component statements in the argument, uniformly labeling them with capital letters as we have throughout this section. To avoid errors, write the capital letter by each instance of the statement it stands for, taking negations into account, like this:

A *B* *not B* *not A*
55. Tom is old *only if* he is over 80. But Tom is not over 80, and so he is not old.

Second, we rewrite the argument using capital letters instead of English statements and eliminate any stylistic variants (in this case, we replace "only if" with the standard "if . . . , then . . . " construction). The result is this:

1. If A, then B.
2. Not B.

So, 3. Not A.

Third, we check to see whether the form is taken from our list of famous valid forms. In this case, it is *modus tollens*, so we conclude that argument (55) is valid.

Let's call the method just indicated the **famous forms method.** Here it is in action again. Consider the following argument:

56. If Ty knows he has a book in front of him, then he knows he is outside the Matrix. Ty knows he has a book in front of him. So, Ty knows he is outside the Matrix.

First, we identify and label the component statements in the argument, uniformly labeling them as follows:

A *B*
56. If Ty knows he has a book in front of him, then he knows he's outside the Matrix. Ty knows he has a book in front of him. So, Ty knows he's outside the Matrix.
A *B*

Next, we rewrite the argument using capital letters instead of English statements and eliminate any stylistic variants, arriving at this form:

1. If A, then B.
2. A.

So, 3. B.

Finally, we ask whether this form is one of our famous valid forms. In this case, it is *modus ponens*. Thus, argument (56) is valid.

The Famous Forms Method

Step 1. Identify the component statements in the argument, uniformly labeling each with a capital letter.

Step 2. Rewrite the argument using capital letters instead of English statements and eliminate any stylistic variants.

Step 3. Check to see whether the pattern of reasoning is taken from our list of famous forms. If it is, then the argument is valid.

It will be helpful at this time to highlight a complication of the famous forms method. It can be seen by considering the following argument:

57. Frances is a fast runner *if* she can run the mile in under four minutes. Frances can run the mile in under four minutes. Therefore, Frances is a fast runner.
(A = Frances is a fast runner; B = she can run the mile in under four minutes.)

When we rewrite the argument using capital letters and eliminate stylistic variants, we get this form:

1. If B, then A.
2. B.

So, 3. A.

Our labeling results in *If B, then A* rather than *If A, then B*. But this is not a problem. There is no need to try to make the letters appear in alphabetical order. The important thing is that the second premise affirms the antecedent of the conditional premise, while the conclusion affirms the consequent. Thus, we have an instance of *modus ponens*, and the argument is valid.

It is now time to acknowledge two limitations of the famous forms method. The first one can be seen through arguments like this:

58. Fred likes neckerchiefs. Daphne likes neckerchiefs. So, Fred likes neckerchiefs and Daphne likes neckerchiefs.

Even though this argument is trivial, it is formally valid. It is an instance of this valid argument form:

Form 1

1. A.
2. B.

So, 3. A and B.

It is not possible for the conclusion, A and B, to be false while the premises, A and B, are true. The problem is that this valid form is not a famous form from our list, so

the famous forms method does not tell us that (58) is valid. Similarly, in our discussion of these disjunctions, we noted that the form of argument (51) was this:

Form 2

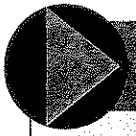
1. Either A or B.
2. Not both A and B.
3. A.

So, 3. Not B.

Form 2 is valid, but it is not on our list. This is a genuine limitation of the famous forms method. Although it is true that *many* valid arguments are instances of our five famous valid forms, there are also many other formally valid arguments, like arguments (51) and (61), that are not. Hence, the fact that the famous forms method does not show that an argument is formally valid does not mean that it is not formally valid. Of course, we could deal with this problem by adding Forms 1 and 2 to our list. While this solution contains a grain of wisdom (in essence, the proof systems we develop later are built on this insight), we would have to add infinitely many forms to cover all the possible valid forms, a daunting task indeed.

A second limitation of the famous forms method is that it does *nothing* to help us show that any invalid argument is invalid. It is concerned only with showing the validity of arguments.

If the famous forms method suffers from these limitations, why bother learning it? Well, despite its limitations, we should not lose sight of the fact that the famous forms method is simple, straightforward, and all that is needed in many cases. Moreover, understanding it and its limitations constitutes an



Summary of Definitions

An **argument form** is a pattern of reasoning.

A **substitution instance** of an argument form is an argument that results from uniformly replacing the variables in that form with statements (or terms).

A **valid argument form** is one in which every substitution instance is a valid argument.

A **formally valid argument** is one that is valid in virtue of its form.

The **negation** of a statement is its denial.

A **conditional statement** is an if-then statement, often simply called a "conditional."

The if-clause of a conditional is its **antecedent.**

The then-clause of a conditional is its **consequent.**

A **disjunction** is an either-or statement.

The statements comprising a disjunction are its **disjuncts.**

important first step toward grasping some basic logical concepts and appreciating more complete methods for assessing arguments.

The following exercise gives you an opportunity to use your knowledge of the famous valid forms to assess the validity of arguments.

EXERCISE 1.2

PART A: True or False? Which of the following statements are true? Which are false?

* **1.** A substitution instance of an argument form is an argument that results from uniformly replacing the variables in that form with statements (or terms).

2. A conditional is an "if-then" statement.

3. The parts of a disjunction are disjuncts.

* **4.** In logic, we treat statements of the form "Either A or B" as saying the same thing as "Either A or B, but not both A and B."

5. The if part of a conditional is the antecedent.

6. A valid argument form is one in which every substitution instance is a valid argument.

* **7.** The consequent of "If it was reported in the *Daily Prophet*, then it's true" is "It was reported in the *Daily Prophet*."

8. In logic, we treat statements of the form "Either A or B" as saying the same thing as "Either A or B, or both A and B."

9. "Either Hermione gets Ron or she gets Harry" is a conditional.

***10.** The inclusive sense of "or" means "Either A or B, or both."

11. "Either Fritz is a philosopher or a gambler" is a disjunction.

12. An argument form is a pattern of reasoning.

***13.** The then part of a conditional is the consequent.

14. If the successful candidate has a PhD in English literature or at least five years of university teaching experience, it follows that the successful candidate does not have both a PhD in English literature and at least five years of university teaching experience.

15. The antecedent of "If Professor Dumbledore died in Book Six, then he won't make an appearance in Book Seven" is "Professor Dumbledore died in Book Six."

***16.** The negation of a statement is its denial.

17. A formally valid argument is one that is valid in virtue of its form.

18. The antecedent of "If Professor Snape was a disciple of Voldemort, then he should be imprisoned in Azkaban" is "He should be imprisoned in Azkaban."

*19. The consequent of "If Dolores Umbrage despises Harry, then she's a disciple of he-who-shall-not-be-named" is "She's a disciple of he-who-shall-not-be-named."

20. A disjunction is an "either-or" statement.

21. "There is no God" is the denial of "There is a God."

*22. The exclusive sense of "or" means "Either A or B, but not both."

23. In determining whether an argument is a substitution instance of an argument form, we must be careful to take the order of the premises into account.

24. The antecedent of "Either humans evolved from amoebas or humans were specially created by God" is "Humans evolved from amoebas."

*25. The antecedent of "The Sonics will move to Oklahoma only if the league permits it" is "The Sonics will move to Oklahoma."

26. The antecedent of "Bill will behave better in the future if Hillary forgives Bill" is "Bill will behave better in the future."

27. The consequent of "There is air in the room if there is fire in the room" is "There is air in the room."

*28. The following argument is a substitution instance of disjunctive syllogism: Jill is in love with Sam or Henry; she is in love with Henry; so Jill is not in love with Sam.

29. Although the famous forms method does not allow us to show that an argument is invalid, it does allow us to show the validity of every valid argument.

30. The consequent of "There is fire in the room *only if* there is air in the room" is "There is air in the room."

PART B: Identify the Forms Identify the forms of the following arguments, using capital letters to stand for statements and eliminating any stylistic variants. If the argument form is one of the "famous" valid forms, give its name. If the argument form is not one of the "famous" valid forms, write "none."

* 1. If the solution turns blue litmus paper red, then the solution contains acid. The solution turns blue litmus paper red. So, the solution contains acid.

2. If the solution turns blue litmus paper red, then the solution contains acid. The solution does not contain acid. So, the solution does not turn blue litmus paper red.

3. Lewis is a famous author only if he knows how to write. But Lewis is not a famous author. Hence, Lewis does not know how to write.

* 4. If Susan is a famous author, then she knows how to write. Moreover, Susan knows how to write. So, she is a famous author.

5. Souls transmigrate. But it is wrong to eat animals if souls transmigrate. Hence, it is wrong to eat animals.

6. Either Jones is an innocent bystander, or Jones fired a shot at the mayor. Jones is not an innocent bystander. Therefore, Jones fired a shot at the mayor.

* 7. Rilke is a dreamer if he is a poet. Therefore, Rilke is a poet.

8. Either you marry young, or you wait. If you marry young, you incur a high risk of divorce. If you wait, the field of available partners grows ever smaller. So, either you incur a high risk of divorce, or the field of available partners grows ever smaller.

9. It is not wrong to kill spiders. But if spiders have eternal souls, then it is wrong to kill them. Thus, it is false that spiders have eternal souls.

* 10. If you study hard, you refine your communication skills. If you refine your communication skills, then your job opportunities increase. Hence, if you study hard, your job opportunities increase.

11. If Mubarak is from Egypt, then he is from Africa. Therefore, if Mubarak is not from Egypt, then he is not from Africa.

12. Ben is a rat. Ben is a rat only if Ben is a mammal. So, Ben is a mammal.

* 13. Sam is wealthy if he has more than a billion dollars. But Sam does not have more than a billion dollars. Therefore, Sam is not wealthy.

14. There is life on Mars given that there is life on Earth. Hence, there is life on Mars.

15. It is true that corrupt institutions are hard to reform. It is false that individuals are totally depraved. Therefore, if corrupt institutions are hard to reform, then individuals are totally depraved.

PART C: More Forms to Identify Identify the forms of the following arguments, using capital letters to stand for statements and eliminating any stylistic variants. If the argument form is one of the "famous" valid forms, give its name. If the argument form is not one of the "famous" valid forms, write "none."

* 1. The sky is blue. The sky is cobalt blue only if it is blue. Hence, the sky is cobalt blue.

2. Abortion in the case of ectopic pregnancy is not wrong. But if it is always wrong to kill an innocent human being, then abortion in the case of ectopic pregnancy is wrong. So, it is not always wrong to kill an innocent human.

3. Kidnapping is wrong if society disapproves of it. Kidnapping is wrong. So, society disapproves of kidnapping.

* 4. Eating meat is unhealthy if meat contains a lot of cholesterol. Meat does contain a lot of cholesterol. Therefore, eating meat is unhealthy.

5. Either the "eye for an eye" principle is interpreted literally, or it is interpreted figuratively. If it is interpreted literally, then the state should torture torturers, maim maimers, and rape rapists. If the "eye for an eye" principle is interpreted figuratively, then it does not necessarily demand death for murderers. So, either the state should torture torturers, maim maimers, and rape

rapists, or the "eye for an eye" principle does not necessarily demand death for murderers.

6. Affirmative action is preferential treatment of disadvantaged groups, and preferential treatment of disadvantaged groups is reverse discrimination. If affirmative action is preferential treatment of disadvantaged groups and preferential treatment of disadvantaged groups is reverse discrimination, then affirmative action is wrong. Hence, affirmative action is wrong.

* 7. If the zygote lacks a brain, then the zygote lacks a soul. If the zygote lacks a soul, then killing the zygote is permissible. So, if the zygote lacks a brain, then killing the zygote is permissible.

8. If Mary is a psychiatrist, then she is a physician. Mary is not a physician. Therefore, Mary is a psychiatrist.

9. If you want to ruin your life, you should take hard drugs. But you don't want to ruin your life. So, you should not take hard drugs.

* 10. Lying causes social discord. Hence, lying is wrong.

11. It is not true that acts are right because God approves them. But either acts are right because God approves them, or God approves of acts because they are right. Therefore, God approves of acts because they are right.

12. If Dracula is a vampire, then he is dangerous. But Dracula is not a vampire. Hence, he is dangerous.

* 13. Either the animals used in research are a lot like humans, or they are not a lot like humans. If the animals are a lot like humans, then experimenting on them is morally questionable. If the animals are not a lot like humans, then experimenting on them is pointless. So, either experimenting on animals is morally questionable, or it is pointless.

14. The state cannot uphold the value of life by taking it. And if the state cannot uphold the value of life by taking it, then the death penalty should be abolished. Therefore, the death penalty should be abolished.

15. If my society approves of genetic engineering, then genetic engineering is right. But my society does not approve of genetic engineering. Hence, genetic engineering is not right.

PART D: Still More Forms to Identify Identify the forms of the following arguments, using capital letters to stand for statements and eliminating any stylistic variants. If the argument form is one of the "famous" valid forms, give its name. If the argument form is not one of the "famous" valid forms, write "none."

* 1. Overeating is foolish only if it causes disease. Overeating does not cause disease. So, overeating is not foolish.

2. Either films depicting graphic violence have caused the increase in violent crime or bad parenting has caused it (or both). Movies depicting graphic

violence have caused the increase in violent crime. Therefore, bad parenting has not caused the rise in violent crime.

3. Corporations contribute huge sums of money to political campaigns. If that is so, then corporations exert undue influence on elections. So, corporations exert undue influence on elections.

* 4. You will win the chess tournament if you are very good at chess. Unfortunately, you are not very good at chess. Hence, you will not win the chess tournament.

5. Either virtue is good for its own sake, or it is good as a means to an end. It is not the case that virtue is good for its own sake. So, virtue is good as a means to an end.

6. You should be an optimist if pessimists are less likely to succeed than optimists. And it is a fact that pessimists are less likely to succeed than optimists. Therefore, you should be an optimist.

* 7. If God can arbitrarily decide what is morally right, then God can make cruelty right. And if God cannot arbitrarily decide what is morally right, then morality is not entirely in God's control. But either God can arbitrarily decide what is morally right, or God cannot arbitrarily decide what is morally right. Therefore, either God can make cruelty right, or morality is not entirely in God's control.

8. The dinosaurs vanished due to a sudden, extreme drop in temperature. The earth must have suffered some sort of cataclysm millions of years ago, assuming that the dinosaurs vanished due to a sudden, extreme drop in temperature. So, the earth must have suffered some sort of cataclysm millions of years ago.

9. Assuming that you treat like cases alike, you are fair. Hence, you are fair only if you treat like cases alike.

*10. The death penalty is inequitably applied to the poor and to minorities. And given that the death penalty is inequitably applied to the poor and to minorities, it is unjust. Therefore, the death penalty is unjust.

11. Philosophy is important if ideas are important. And assuming that ideas change lives, ideas are important. Hence, if philosophy is important, then ideas change lives.

12. If you join the military, you give up a lot of freedom. If you go to college, you incur enormous debts. However, either you join the military, or you go to college. Therefore, either you give up a lot of freedom, or you incur enormous debts.

*13. Mercy killing is morally permissible only if it promotes a greater amount of happiness for everyone affected than the alternatives do. And mercy killing does promote a greater amount of happiness for everyone affected than the alternatives do. Therefore, mercy killing is morally permissible.

14. You must either love or hate. If you love, then you suffer when your loved ones suffer. If you hate, then you suffer when your enemies flourish. Hence,

either you suffer when your loved ones suffer, or you suffer when your enemies flourish.

15. A severe depression will occur given that the economy collapses. The economy collapses if inflation soars. So, inflation soars only if a severe depression will occur.

PART E: Constructing Arguments Construct your own substitution instances for each of the following argument forms: *modus ponens*, *modus tollens*, hypothetical syllogism, disjunctive syllogism, and constructive dilemma. If the substitution instance is not a sound argument, explain why. If you think that it is a sound argument, do you find it satisfying, compelling, or useful? Defend your answer.

1.3 Counterexamples and Invalidity

We have seen that a basic understanding of argument forms can help us identify many valid arguments. Unfortunately, we have also seen that there are many valid arguments left unidentified by the famous forms method. Moreover, although our list of valid forms may help us identify some common valid arguments, it does not help us identify any *in*valid arguments. In this section, we explore a method for uncovering invalid reasoning.

Counterexamples

Consider the following argument:

59. 1. If Paris Hilton is a philosopher, then Paris Hilton is wise.
    2. Paris Hilton isn't a philosopher.
So, 3. Paris Hilton isn't wise.

At first glance, this argument might look like an instance of *modus tollens*:

Modus Tollens

1. If A, then B.
2. Not B.

So, 3. Not A.

But initial appearances can be deceiving, and in this case they are. A *modus tollens* argument denies the *consequent* of its conditional premise, and the conclusion denies the *antecedent*. Argument (59) denies the *antecedent* of its conditional premise, and its conclusion denies the *consequent*. In other words, in (59), lines 2 and 3 have been transposed. So it is *not* an instance of *modus tollens*. It is instead

an instance of what is known as the **fallacy of denying the antecedent,** where a *fallacy* is simply an error in reasoning. We can represent its form as follows:

Fallacy of Denying the Antecedent

1. If A, then B.
2. Not A.

So, 3. Not B.

The fallacy of denying the antecedent is an example of an *invalid argument form*, where an **invalid argument form** is one that has *some* invalid substitution instances.

An **invalid argument form** is one that has some invalid substitution instances.

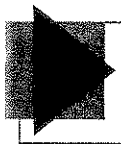
Recall that a *substitution instance* of an argument form is an argument that results from uniformly replacing the variables in that form with statements. Argument (59) is a substitution instance of the fallacy of denying the antecedent because it results from substituting "Paris Hilton is a philosopher" for A and "Paris Hilton is wise" for B. But it is also an *invalid* instance of denying the antecedent, since it is *possible* for the premises to be true and the conclusion false. This fact is easy to miss, however, because many take its conclusion for granted. But consider the following argument:

60. 1. If Paris Hilton is an oil-tycoon, then Paris Hilton is rich.
2. Paris Hilton isn't an oil-tycoon.

So, 3. Paris Hilton isn't rich.

Arguments (59) and (60) are instances of the same form—the fallacy of denying the consequent—but (60) provides a crystal clear demonstration of the invalidity of that form because most readers will immediately recognize that its premises are true and its conclusion is false. It is *clearly* invalid.

We will say that a **counterexample** to an argument form is a substitution instance in which the premises are true and the conclusion is false. A counterexample to the form of an argument shows that the form is not valid by showing that the form does not preserve truth—that is, it shows that it can lead from true premises to a false conclusion.



A **counterexample** to an argument form is a substitution instance in which the premises are true and the conclusion is false.

But not all counterexamples are equally effective. The more obvious it is that the premises are true and the conclusion is false, the more effective it will be. Thus, although argument (60) is a good counterexample to the fallacy of denying the antecedent, the following argument is not:

61. 1. If there are Beefsteaks in Dan's summer garden, then there are tomatoes in it.
2. There are no Beefsteaks in Dan's summer garden.
So, 3. There are no tomatoes in Dan's summer garden.

This argument is not a good counterexample to the fallacy of denying the antecedent because, although it is a counterexample, its premises are not well-known truths and its conclusion is not a well-known falsehood. Argument (60) is a good counterexample, however; most readers will know that oil-tycoons are rich (so that *if* Paris Hilton is an oil-tycoon, then she is rich) and that Paris Hilton is *not* an oil-tycoon (she is a hotel-heiress); moreover, they will know that Paris Hilton *is* rich (by virtue of her inheritance). We will say that a **good counterexample** to an argument form is a substitution instance in which the premises are *well-known* truths and the conclusion is a *well-known* falsehood.

A **good counterexample** to an argument form is a substitution instance in which the premises are well-known truths and the conclusion is a well-known falsehood.

To further illustrate the idea of a counterexample, let's look at a second fallacy. Consider the following argument:

62. 1. If Ryan is a true pop-culture buff, then he reads *Entertainment Weekly* religiously.
2. Ryan reads *Entertainment Weekly* religiously.
So, 3. Ryan is a true pop-culture buff.

One might be tempted to identify the form of this argument as *modus ponens*:

Modus Ponens

1. If A, then B.
2. A.

So, 3. B.

But this would be a case of mistaken identity. A *modus ponens* argument affirms the *antecedent* of its conditional premise and its conclusion affirms the *consequent*.

Argument (62) affirms the *consequent* of its conditional premise and the conclusion affirms the *antecedent*. In (62), lines 2 and 3 have been inverted. So it is not an instance of *modus ponens*. It is instead an instance of what is called the **fallacy of affirming the consequent:**

Fallacy of Affirming the Consequent

1. If A, then B.
2. B.

So, 3. A.

To show that this form of argument is fallacious, consider the following counterexample:

63. 1. If lemons are red, then lemons have a color.
2. Lemons have a color.

So, 3. Lemons are red.

The first premise is obviously true: anything that is red has a color. And it is common knowledge that lemons have a color. Moreover, everyone knows that red and yellow are different colors. So the premises are well-known truths and the conclusion is a well-known falsehood. Argument (63) is, therefore, a good counterexample to the fallacy of affirming the consequent.

The Counterexample Method

Thus far, we have focused on how counterexamples can be used to demonstrate the invalidity of argument *forms*. We will now look at how counterexamples can be used to identify invalid *arguments*.

In section 1.2, we noted that if an argument is an instance of a valid argument form, then it is valid. It is natural to assume that, likewise, if an argument is an instance of an *in*valid argument form, then it is invalid. *If* this assumption is correct, a method for identifying the invalidity of an argument suggests itself: first, we identify the argument's form, and then we construct a counterexample to that form. Let us call this method the *counterexample method*. Until further notice, we will grant that the just-mentioned assumption is correct because it will allow us to simplify our initial explanation of the counterexample method. Later, we will explain why the assumption is false and why, despite its falsity, the counterexample method remains a highly effective technique for discerning invalidity.

Let's begin with an argument:

64. 1. George H.W. Bush was a U.S. president and George H.W. Bush went to Yale.
2. Bill Clinton was a U.S. president.

So, 3. Bill Clinton went to Yale.

As we intimated in the last paragraph, the counterexample method involves two basic steps. The first step is to identify the form of the argument. To do that, we identify the component statements of the argument and replace them with variables just like we did in applying the famous forms method. In the first premise of (64), the component statements are "George H.W. Bush was a U.S. president" and "George H.W. Bush went to Yale." The second premise is a completely different statement, as is the conclusion; thus, they will require different variables. With these points in mind, here is the form of the argument:

Form 3

1. A and B.
2. C.

So, 3. D.

With this form in hand, we can move to the second step: construct a substitution instance whose premises are well-known truths and whose conclusion is a well-known falsehood. Here is an example:

65. 1. George Washington was a U.S. president and George Washington is long dead.
2. Bill Clinton was a U.S. president.

So, 3. Bill Clinton is long dead.

"George Washington was a U.S. president" replaces A in Form 3, "George Washington is long dead" replaces B, "Bill Clinton was a U.S. president" replaces C, and "Bill Clinton is long dead" replaces D. Most readers will know that George Washington and Bill Clinton were both presidents. Moreover, most readers will know that, while Washington is long dead, Clinton is very much alive. Hence, we have a good counterexample to Form 3. Given our assumption that an argument is invalid if it is an instance of an invalid form, argument (64) is invalid.

Argument (65) involves some of the same things in argument (64): Bill Clinton and the presidency. But that is not a requirement for a good counterexample. Here's a counterexample to Form 3 that involves completely different things from (65):

66. 1. John Lennon was a member of the Beatles and Fuji apples are red.
2. Not everyone likes escargots de Bourgogne.

So, 3. The moon is made of limburger.

"John Lennon was a member of the Beatles" replaces A, "Fuji apples are red" replaces B, "Not everyone likes escargots de Bourgogne" replaces C, and "The moon is made of limburger" replaces D. Argument (66) is ridiculous, of course—the conclusion is laughable and the premises have nothing to do with one

another. But remember: all it takes to serve as a good counterexample is for the argument to be an instance of the form in question, and for its premises to be well-known truths and its conclusion to be a well-known falsehood. (66) meets these requirements.

Here is a second illustration of the counterexample method. Consider this argument:

67. 1. If stem-cell research causes harm, then stem-cell research is wrong.
2. If stem-cell research causes harm, then it should be outlawed.
So, 3. If stem-cell research is wrong, it should be outlawed.

First, we identify the component statements of the argument and replace them with capital letters. If we replace "stem-cell research causes harm" with A, "stem-cell research is wrong" with B, and "it is should be outlawed" with C, we arrive at this form:

Form 4
1. If A, then B.
2. If A, then C.
So, 3. If B, then C.

Second, we construct a substitution instance for Form 4 whose premises are well-known truths and whose conclusion is a well-known falsehood. To make the task easier, it is helpful to break the second step into two parts. As a general rule, it is useful to start with a well-known false conclusion and to work backwards from there. For example, we might begin with the following:

68. 1. If A, then B.
2. If A, then C.
So, 3. If Tom Cruise is a mammal, then he is a horse.

Here, "Tom Cruise is a mammal" replaces B in Form 4 and "he is a horse" replaces C. The resulting conclusion is a well-known falsehood because it is well-known that Tom Cruise is a mammal but not a horse. We are constructing a substitution instance, so we must uniformly replace the same letters with the same statements elsewhere in the form. Thus, we have

69. 1. If A, then Tom Cruise is a mammal.
2. If A, then he is a horse.
So, 3. If Tom Cruise is a mammal, then he is a horse.

Now we just need to answer the question: What can we substitute for A that will result in premises that are well-known truths? In other words, what sorts of things are such that it is well known that, *if* Tom Cruise was one of them,

he would be a mammal? And, what sorts of things are such that it is well known that, *if* Tom Cruise was one of them, he would be a horse? Lots of things come to mind, for example, a thoroughbred and a Clydesdale. That is, it is a well-known truth that if Tom Cruise is a thoroughbred, then he is a mammal, and, it is a well-known truth that if he is a Clydesdale, then he is a horse. Thus, we arrive at the following:

70. 1. If Tom Cruise is a thoroughbred, then he is a mammal.
    2. If Tom Cruise is an thorougbred, then he is a horse.
So, 3. If Tom Cruise is a mammal, then he is a horse.

This argument is a substitution instance of Form 4; moreover, its premises are well-known truths and its conclusion is a well-known falsehood. Thus, Form 4 is invalid. Given our assumption that an argument is invalid if it is an instance of an invalid argument form, and since argument (67) is an instance of invalid Form 4, (67) is an invalid argument.

Categorical Statements and Arguments

At this point a problem arises for the counterexample method as we have developed it thus far. The problem arises in connection with arguments that contain *categorical statements*. A **categorical statement** is a statement that relates two classes or categories, where a class is a set or collection of things.

A **categorical statement** is a statement that relates two classes or categories, where a class is a set or collection of things.

The premises and the conclusion of the following argument are categorical statements:

71. 1. All presidents are human beings.
    2. All human beings are mammals.
So, 3. All presidents are mammals.

The first premise of this argument relates the set of presidents to the class of human beings—it says that everything that belongs to the class of presidents belongs to the class of human beings as well. The second premise relates the class of human beings to the class of mammals—it says that everything that belongs to the class of human beings belongs to the class of mammals. The conclusion relates the class of presidents to the class of mammals—it says that everything in the class of presidents is in the class of mammals. Categorical

statements are often signaled by terms like "all," "some," and "no" because they make claims about what all, some, or none of the members of a class are like. Thus, "All Amorites are Canaanites," "Some Canadians are French," and "No Frisians are Tasmanians" count as categorical statements.

We said that arguments that contain categorical statements pose a problem for the counterexample method as we have developed it to this point. To see the problem, notice that argument (71) is simply a series of three statements that, given the way we have identified an argument's form up to this point, should be replaced with capital letters like this:

Form 5

1. A.
2. B.

So, 3. C.

Form 5 is obviously invalid—to construct a good counterexample, simply replace A and B with any two well-known truths and C with a well-known falsehood. Thus, given our assumption that an argument is invalid if it is an instance of an invalid argument form, our counterexample method leads to the conclusion that argument (71) is invalid. But (71) is *obviously* valid. It isn't possible for all presidents to be human beings and for all human beings to be mammals while some presidents are not mammals. Moreover, (71) is valid in virtue of its form; it is formally valid. That is, as a matter of necessity, if all members of one class are members of a second class and all members of the second are members of a third, then all members of the first class are members of the third. What makes matters worse is that argument (71) is not alone. Our counterexample method will count many valid arguments that contain categorical statements as invalid. How can we solve this problem?

The solution involves two steps. First, we must expand our use of variables in our procedure for identifying an argument's form. Second, we must explain how an argument can be valid even if it is an instance of an invalid argument form. If we can do both of these things, then we can sensibly affirm the validity of valid argument (71) while acknowledging that Form 5 is invalid. We will take each step in turn.

So far we have been using variables to stand only for statements. Consequently, we identified the form of argument (71) as the invalid Form 5 even though it is obvious that (71) is formally valid. So let us now use variables to stand for *terms* as well as statements. For the purposes of this chapter, a **term** is a word or phrase that stands for a class of things, like the class of presidents, the class of human beings, or the class of mammals.

A **term** is a word or phrase that stands for a class of things.

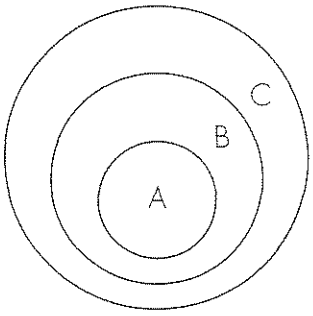
In argument (71), the words "presidents," "human beings," and "mammals" are all terms. If we replace them with A, B, and C, respectively, we have the following argument form:

Form 6

1. All A are B.
2. All B are C.

So, 3. All A are C.

Form 6 is importantly different from the forms that we have seen up to this point since its variables stand for terms, not statements. Nevertheless, Form 6 is an obviously valid form. Its validity is illustrated by the following diagram:



No matter what A and B and C stand for, it will still be the case that, if everything in the A-circle is in the B-circle and everything in the B-circle is in the C-circle, then everything in the A-circle is in the C-circle. For example, if all Autobots (A) are Transformers (B) and if all Transformers (B) are from Cybertron (C), then all Autobots (A) are from Cybertron (C). We can recognize that this conclusion follows from the premises even if we don't know the first thing about robots in disguise.

Earlier, on page 15, we defined a substitution instance of an argument form as "an argument that results from uniformly replacing the variables in that form with statements (or terms)" and, in a footnote, we counseled the reader to ignore the parenthetical remark until further notice. We can no longer ignore it. Since argument (71) results from uniformly replacing the variables in Form 6 with *terms*, (71) is a substitution instance of Form 6. Form 6 is valid, so argument (71) is valid too. It is valid in virtue of its form. Expanding our use of variables to include terms as well as statements helps us to recognize these facts.

Our first step toward a solution to our problem is complete: by allowing variables to stand for terms, we enrich our way of identifying an argument's form so that we can affirm that argument (71) is an instance of a valid argument form. Our solution would be incomplete if we stopped here, however. For, if we stopped here, we would be led to an absurdity. After all, as we just observed, argument (71) is an instance of a valid argument form, Form 6; thus, (71) is a valid

argument. But, (71) is an instance of an invalid argument form as well, Form 5; thus, (71) is an invalid argument, *given our assumption* that an argument is invalid if it is a substitution instance of an invalid form. Therefore, unless we take the second step and deny our assumption, we will have to conclude that argument (71) is both valid and invalid—an absurdity *par excellence*!

But can we sensibly deny our assumption? Yes. For virtually every argument can be an instance of more than one form, some valid and some invalid. Argument (71) is a case in point: it is an instance of Form 6, which is valid, as well as Form 5, which is invalid. So, obviously enough, contrary to our assumption, an argument can be valid even if it is a substitution instance of an invalid argument form. In that case, we do not have to say that argument (71) or any other argument is invalid simply because it is an instance of an invalid argument form. Hence our counterexample method does not lead to absurdity.

Let us summarize our results. Our initial counterexample method faced the problem of counting many valid arguments that contain categorical statements as invalid. We solved the problem by first expanding our use of variables in the identification of an argument's form to include terms as well as statements, and then showing that an argument's being an instance of an invalid form is no guarantee of that argument's invalidity. Our solution is complete.

Although our problem has been solved, a minor concern remains. Suppose we have correctly identified one of the forms of an argument and we show that it is invalid by means of a counterexample. Since being an instance of an invalid form is no guarantee of an argument's invalidity, might it nevertheless, unbeknownst to us, have an additional form that is valid—at least in theory? Yes, that is a theoretical possibility. The counterexample method does not rule it out. Consequently, it yields only provisional results.

But if the counterexample method delivers only provisional results, what good is it then? Well, generally speaking, if we identify the form of an argument *with due sensitivity to its key logical words and phrases*—for example, "all," "some," "no," "if-then," "either-or," "not," "and," and others to be discussed later—and if the form thus identified is invalid, then the argument has no further valid form, and so it is invalid. This is why the counterexample method is a powerful tool for evaluating arguments even though, in theory, it cannot conclusively establish the invalidity of an argument. (It is important to understand that, even though the counterexample method for identifying invalid *arguments* yields provisional results, giving good counterexamples to an argument *form* conclusively establishes its invalidity.)

Let us return to arguments involving categorical statements. Here is one that is formally valid:

72. 1. All emeralds are gems.
2. Some rocks are not gems.
So, 3. Some rocks are not emeralds.

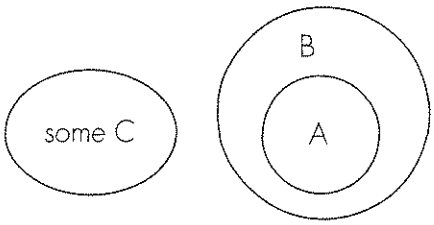
This argument has the following form:

Form 7

1. All A are B.
2. Some C are not B.

So, 3. Some C are not A.

Here, A replaces "emeralds," B replaces "gems," and C replaces "rocks." We can diagram the logic as follows:



Clearly, if all members of class A are members of class B and some members of class C are not members of B, then some members of C are not members of A. This will be the case no matter what A, B, and C stand for. So every instance of Form 7 is valid; thus, Form 7 itself is valid.

Here is another example of a formally valid argument that contains categorical statements:

73. 1. Every sockeye is a member of *Oncorhynchus*.
2. Some sockeye are natives of the Copper River (in south-central Alaska).

So, 3. Some members of *Oncorhynchus* are natives of the Copper River.

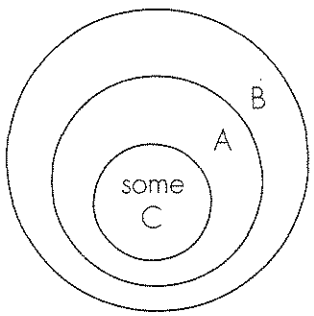
If we replace "sockeye" with A, "member of *Oncorhynchus*" with B, and "natives of the Copper River" with C, we have the following form:

Form 8

1. Every A is a B.
2. Some A are C.

So, 3. Some B are C.

We can diagram the logic as follows:



If every member of class A is a member of class B and some members of A are also members of class C, then some members of B are members of C. This will be the case no matter what A, B, and C stand for. So every instance of Form 8 is valid, as is Form 8 itself.

Of course, not all arguments involving categorical statements are valid. This can be shown by employing a slightly modified version of the counterexample method set out previously. To illustrate, consider the following argument:

74. 1. All logicians are smart people.
2. Some smart people are not stylish people.
So, 3. Some logicians are not stylish people.

First, we identify the pattern of reasoning by uniformly replacing terms in the argument with variables. If we substitute A for "logicians," B for "smart people," and C for "stylish people," we get the following:

Form 9

1. All A are B.
2. Some B are not C.
So, 3. Some A are not C.

Second, we construct a good counterexample to the argument form. As before, it is helpful to work from the conclusion backward and to use terms whose interrelations are well understood—biological terms like "human beings," "mammals," "lions," and "felines" work particularly well, as do geometric terms like "square," "figure," "rectangle," and "circle." We might start with this:

75. 1. All A are B.
2. Some B are not C.
So, 3. Some lions are not felines.

Here, "lions" replaces A and "felines" replaces C. It is a well-known truth that all lions are felines; thus, the conclusion of (75)—some lions are not felines—is a well-known falsehood. We must use the same term for each occurrence of a variable, so we move to this:

76. 1. All lions are B.
2. Some B are not felines.
So, 3. Some lions are not felines.

Now we ask: What can we substitute for B to give us true premises? What category includes all lions, but also includes some things that are not feline?

Several suggest themselves: carnassials, chordata, and atachyons, for example; but carnivores, mammals, and animals are more well-known and thus make for a good counterexample. Thus:

77. 1. All lions are animals.
2. Some animals are not felines.
So, 3. Some lions are not felines.

This is how the counterexample method can be modified to identify invalid categorical arguments.

Let's look at another example. Here's an argument:

78. 1. No movie stars are poor people.
2. Some bankers are not poor people.
So, 3. Some bankers are not movie stars.

Let A stand for "movie stars," B for "poor people," and C for "bankers." Thus we have the following:

Form 10

1. No A are B.
2. Some C are not B.
So, 3. Some C are not A.

If we substitute "squares" for C and "closed plane figures" for A in the conclusion, our counterexample will begin to take shape like this:

79. 1. No A are B.
2. Some C are not B.
So, 3. Some squares are not closed plane figures.

Everyone knows that every square is a closed plane figure, so the conclusion is a well-known falsehood. Next, we uniformly replace C and A in the premises with "squares" and "closed plane figures" resulting in:

80. 1. No closed plane figures are B.
2. Some squares are not B.
So, 3. Some squares are not closed plane figures.

Finally, we ask, what can replace B to result in two true premises? Well, what categories exclude some squares and all closed plane figures? Many categories fit that description: zebus, phenomenologists, and Amalekites, for example; but

candidates more suitable for a good counterexample include walruses, Canadians, and Klingons. Hence, we have this counterexample:

81. 1. No closed plane figures are Klingons.
    2. Some squares are not Klingons.
So, 3. Some squares are not closed plane figures.

One might object that it is false that some squares are not Klingons. After all, *all* squares are not Klingons, or, to put it another way, *no* square is a Klingon. In logic, however, the word "some" means "at least one." Hence, the statement "Some squares are not Klingons" is true: at least one square is not a Klingon. And "Some squares are not Klingons" does *not* imply that some squares are Klingons. All of the following statements are true: "Some squares are not Klingons," "All squares are not Klingons," and "No square is a Klingon."

For easy reference, we summarize the counterexample method in the following box.

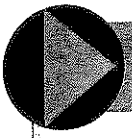
The Counterexample Method

1. Identify the most logically sensitive form of the argument. Use capital letters to stand for statements or terms.
2. Find English statements or terms that, if substituted for the capital letters in the conclusion of the argument form, produce a well-known falsehood.
3. Substitute these English statements or terms for the relevant capital letters uniformly throughout the argument form.
4. Find English statements or terms that, if substituted uniformly for the remaining capital letters in the argument form, produce premises that are well-known truths.
5. Check your work. If you have succeeded, you have shown the argument to be invalid.

We have already mentioned one limitation of the counterexample method: its results are provisional because we might not identify the most logically sensitive form of the argument we are assessing. Another limitation is that, even if we do identify the most logically sensitive form, we might still be unable to construct a counterexample because sometimes it is difficult to think of one. When that happens, one of two things is the case. Either (a) the form is valid, and we cannot construct a counterexample because a valid form cannot have a counterexample, or (b) the form is invalid, and we simply need to be more creative in thinking of substitution instances. Unfortunately, for some argument forms, some of us might not be able to tell which of these alternatives we face. Thus, our inability to discern a counterexample does not guarantee that there is none. This is a second way in

which the results of the counterexample method are provisional. To mitigate this limitation, we might combine the counterexample method with the famous forms method from section 1.2. In that case, if the form we have identified is one of our famous valid forms, then the argument under inspection is valid. But this helps to mitigate the difficulty only somewhat since our list of famous forms is limited.

In later chapters of this book, we will develop methods for discerning the validity and invalidity of arguments that improve on the two methods we have discussed in this chapter. However, the student of logic who has a firm grasp of these two methods will be in a much better position to understand and implement the more rigorous and complete methods to come.



Summary of Definitions

The **fallacy of denying the antecedent** is an invalid argument form: If A, then B; not A; so, not B.

An **invalid argument form** is one that has some invalid substitution instances.

A **counterexample** to an argument form is a substitution instance in which the premises are true and the conclusion is false.

A **good counterexample** to an argument form is a substitution instance in which the premises are well-known truths and the conclusion is a well-known falsehood.

The **fallacy of affirming the consequent** is an invalid argument form: If A, then B; B; so, A.

A **categorical statement** is a statement that relates two classes or categories, where a class is a set or collection of things.

A **term** is a word or phrase that stands for a class of things.

The following exercise gives you the opportunity to develop your grip on the counterexample method and the famous forms method.

EXERCISE 1.3

PART A: Counterexamples Try to identify the most logically sensitive forms of the following arguments, using capital letters to stand for *statements* and eliminating any stylistic variants. Then, construct a good counterexample to the form to show that it is invalid. You might already have identified the forms in this Part because these arguments are all of the invalid ones from Exercise 1.2, Parts B, C, and D.

1. Lewis is a famous author only if he knows how to write. But Lewis is not a famous author. Hence, Lewis does not know how to write.

* 2. If Susan is a famous author, then she knows how to write. Moreover, Susan knows how to write. So, she is a famous author.

* **3.** Rilke is a dreamer if he is a poet. Therefore, Rilke is a poet.

4. If Mubarak is from Egypt, then he is from Africa. Therefore, if Mubarak is not from Egypt, then he is not from Africa.

* **5.** Sam is wealthy if he has more than a billion dollars. But Sam does not have more than a billion dollars. Therefore, Sam is not wealthy.

6. There is life on Mars given that there is life on Earth. Hence, there is life on Mars.

7. It is true that corrupt institutions are hard to reform. It is false that individuals are totally depraved. Therefore, if corrupt institutions are hard to reform, then individuals are totally depraved.

* **8.** The sky is blue. The sky is cobalt blue only if it is blue. Hence, the sky is cobalt blue.

9. Kidnapping is wrong if society disapproves of it. Kidnapping is wrong. So, society disapproves of kidnapping.

10. If Mary is a psychiatrist, then she is a physician. Mary is not a physician. Therefore, Mary is a psychiatrist.

11. If you want to ruin your life, you should take hard drugs. But you don't want to ruin your life. So, you should not take hard drugs.

* **12.** Lying causes social discord. Hence, lying is wrong.

13. If Dracula is a vampire, then he is dangerous. But Dracula is not a vampire. Hence, he is dangerous.

14. If my society approves of genetic engineering, then genetic engineering is right. But my society does not approve of genetic engineering. Hence, genetic engineering is not right.

15. Either films depicting graphic violence have caused the increase in violent crime or bad parenting has caused it (or both). Movies depicting graphic violence have caused the increase in violent crime. Therefore, bad parenting has not caused the rise in violent crime.

* **16.** You will win the chess tournament if you are very good at chess. Unfortunately, you are not very good at chess. Hence, you will not win the chess tournament.

17. Assuming that you treat like cases alike, you are fair. Hence, you are fair only if you treat like cases alike.

18. Philosophy is important if ideas are important. And assuming that ideas change lives, ideas are important. Hence, if philosophy is important, then ideas change lives.

* **19.** Mercy killing is morally permissible only if it promotes a greater amount of happiness for everyone affected than the alternatives do. And mercy killing does promote a greater amount of happiness for everyone affected than the alternatives do. Therefore, mercy killing is morally permissible.

PART B: More Counterexamples Try to identify the most logically sensitive forms of the following arguments, using capital letters to stand for *terms*. Then, construct a good counterexample to the form to show that the form is invalid. Remember, it is usually best to employ terms whose interrelations are well known, such as "dog," "cat," "collie," "animal," and "mammal."

* **1.** No genuine Americans are communist spies. Some Oregonians are not communist spies. Therefore, some Oregonians are genuine Americans.

2. All dogmatists are hypocrites. All dogmatists are bigots. So, all bigots are hypocrites.

3. All who seek public office are noble. Some who seek public office are not wise persons. So, some wise persons are not noble.

* **4.** No rock is sentient. Some mammals are sentient. Hence, no mammal is a rock.

5. All fatalists are determinists. Some predestinarians are not fatalists. So, some predestinarians are not determinists.

6. All vegetarians who refuse to eat animal products are vegans. No vegetarians who refuse to eat animal products are cattle ranchers. Hence, no vegans are cattle ranchers.

* **7.** Some intelligent people are highly immoral. All highly immoral people are unhappy. Therefore, some unhappy people are not intelligent.

8. No perfect geometrical figures are physical entities. No physical entities are circles. Therefore, no circles are perfect geometrical figures.

9. All Fabians are socialists. Some socialists are not communists. So, some Fabians are not communists.

***10.** All trespassers are persons who will be prosecuted. Some trespassers are not criminals. So, some criminals are not persons who will be prosecuted.

11. All observable entities are physical entities. Some quarks are not observable entities. Therefore, some quarks are not physical entities.

12. No wines are distilled liquors. Some beers are not distilled liquors. So, some beers are not wines.

***13.** All statements that can be falsified are scientific. All empirical data are scientific. Hence, all statements that can be falsified are empirical data.

14. All diligent persons are individuals who deserve praise. Some students are individuals who deserve praise. So, some students are diligent persons.

15. All black holes are stars that have collapsed in on themselves. All black holes are entities that produce a tremendous amount of gravity. So, every entity that produces a tremendous amount of gravity is a star that has collapsed in on itself.

***16.** Every rock musician is cool. No nerd is a rock musician. Hence, no nerd is cool.

17. All miracles are highly improbable events. Some highly improbable events are cases of winning a lottery. So, some cases of winning a lottery are miracles.

18. No positrons are particles with a negative charge. No neutrons are particles with a negative charge. Therefore, some positrons are neutrons.

*__19.__ All people who despise animals are neurotic. No veterinarian is a person who despises animals. Hence, no veterinarian is neurotic.

20. All destructive acts are evil. Some wars are evil. So, some wars are destructive acts.

1.4 Strength and Cogency

At the beginning of this chapter, we drew a distinction between deductive and inductive arguments: A deductive argument is one in which the premises are intended to *guarantee* the truth of the conclusion, while an inductive argument is one in which the premises are intended to make the conclusion *probable*, without guaranteeing its truth. So far we have focused on the first kind of argument; we now turn our attention to the second.

The goal of a deductive argument is for the premises to guarantee the truth of the conclusion, and a valid argument is one that succeeds in this sense—it is one in which it is necessary that, if the premises are true, then the conclusion is true. Since the goal of an inductive argument is for the premises to make the conclusion probable (without guaranteeing its truth), it will succeed if it is probable (but not necessary) that, if the premises are true, then the conclusion is true. A **strong argument** is one in which it is probable (but not necessary) that, if the premises are true, then the conclusion is true.

A **strong argument** is one in which it is probable (but not necessary) that, if the premises are true, then the conclusion is true.

We could put the point negatively by saying that a strong argument is one in which it is possible, but improbable, that the conclusion is false, given the assumption that the premises are true.

We should immediately note the potential for terminological confusion: According to the definition of a strong argument, *no valid arguments are strong and no strong arguments are valid.* To say that no valid argument is strong is not to say that valid arguments are inferior to strong arguments. Rather, it is simply to note that a valid argument is one in which the conclusion follows *necessarily* from the premises whereas a strong argument lacks this feature by definition. Deductive and inductive arguments are different kinds of arguments, and it is helpful to have some terms that apply to one but not the other. "Valid" and "strong" are such terms.