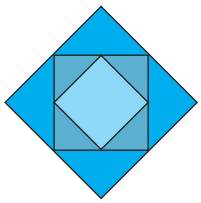


Chapter 1

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

An **argument** is a set of statements, one of which, called the *conclusion*, is affirmed *on the basis* of the others, which are called the *premises*. The premises of an argument are offered as support (or evidence) for the conclusion, and that support (or evidence) may be adequate or inadequate in a given case. But the set of statements counts as an argument as long as one statement is affirmed on the basis of others. Here is an example of an argument:

1. All Quakers are pacifists. Jane is a Quaker. So, Jane is a pacifist.

The word "so" indicates that the conclusion of this argument is "Jane is a pacifist." And the argument has two premises—"All Quakers are pacifists" and "Jane is a Quaker."

An **argument** is a set of statements, one of which, called the *conclusion,* is affirmed *on the basis* of the others, which are called the *premises*.

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

2. Some dogs are collies.
3. No dogs are collies.
4. Some dogs weigh exactly 124.379 pounds.

Statement (2) is true—that is, it describes things as they are. And (3) 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 sentence that has truth value. The truth value of (2) is *true* while the truth value of (3) is *false*, but (2) and (3) are both statements. Is (4) a statement? Yes. You may not know its truth value, and perhaps no one does, but (4) is either true or false, and hence it is a statement.

Are any of the following items statements?

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

Item (5) is a *command*, and one may obey or disobey a command, but it makes no sense to pronounce it true or false. So, although (5) is a sentence, it is not a statement. Item (6) is a *question*, and as such it is neither true nor false; hence, it is not a statement. Finally, item (7) is a *proposal*, and proposals are neither true nor false, so (7) is not a statement.[1]

The **premises** of an argument are the statements on the basis of which the conclusion is affirmed. To put it the other way around, the **conclusion** is the statement that is affirmed on the basis of the premises. In a well-constructed argument, the premises *give good reasons for believing that the conclusion is true*. But a poorly constructed argument is still an argument. For example, compare the following arguments:

8. All uncles are male. Chris is an uncle. Hence, Chris is male.
9. Some uncles are skinny. Chris is an uncle. So, Chris is skinny.

The premises of argument (8) support (or provide a basis for) the conclusion in this sense: If they are true, then the conclusion must be true. But the premises of (9) fail to support the conclusion adequately: Even if true, they do not provide

good reason to believe that the conclusion is true. So, (9) is a bad argument, but it is still an argument.

Arguments are used frequently in our verbal and written interactions with others. And we may use arguments either to *persuade* others or to *discover truth*. For example, we often use arguments to persuade others to believe our political or ethical views. But we also use arguments as tools for *discovering truth*. Suppose a detective is investigating a crime: Who shot Alvin Smith? There are only two suspects, Griggs and Brooks. The detective establishes that Brooks was out of town at the time of the shooting and argues as follows:

10. Either Brooks or Griggs shot Smith. Brooks did not shoot Smith. Therefore, Griggs shot Smith.

In this case, the argument is used to discover truth. Of course, a given argument can be used *both* to discover truth *and* to persuade others to believe the conclusion. Persuasion and truth seeking are often compatible goals. Sometimes, however, one of these goals interferes with the other. For example, in a political campaign, one candidate might try to persuade the voters that his opponent is dishonest even though he knows his opponent is honest.

We now have a preliminary understanding of what logic is. We can gain a deeper understanding by taking a closer look at what it means for the conclusion of an argument to be adequately *based on* or *supported by* the premises. And we can best do this by exploring the basic concepts introduced in the remaining sections of this chapter—concepts such as validity, soundness, argument form, strength, and cogency.

Logic is the study of methods for evaluating whether the premises of an argument adequately support (or provide good evidence for) its conclusion.

1.1 Validity and Soundness

A valid argument is one in which the premises support the conclusion *completely*. More formally, a **valid argument** has this essential feature: 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. We could put this negatively by saying that a valid argument has this characteristic: It is *impossible* for the conclusion to be false assuming that the premises are true. 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 *on the assumption that* its premises are true, its conclusion must be true also. Each of the following arguments is valid:

11. All biologists are scientists. John is not a scientist. So, John is not a biologist.
12. If Alice stole the diamonds, then she is a thief. And Alice did steal the diamonds. Hence, Alice is a thief.
13. 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. Notice that one doesn't have to know whether the premises of an argument actually *are* true in order to determine its validity. One simply has to ascertain that the conclusion must be true *assuming* the premises are true.

In everyday English, the word "valid" is often used simply to indicate one's overall approval of an argument. But logicians focus their attention on the linkage between the premises and the conclusion rather than on the actual truth or falsity of the statements composing the argument. Thus, "valid" has a less precise meaning in ordinary English than it does for logicians.

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:

14. 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 *on the assumption* that the premises are true, the conclusion must be true also. And in the following argument, both premises are false, but the argument is still valid:

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

Although the premises of argument (15) are in fact false, if they *were* true, the conclusion would *have* to be true as well. It is *impossible* for the conclusion to be false *assuming that* the premises are true. So, the argument is valid.

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

16. Some Americans are women. Tom Hanks is an American. Therefore, Tom Hanks is a woman.

The premises here are true, but the conclusion is in fact false. So, obviously, it is *possible* that the conclusion of argument (16) is false while its premises are true; hence, (16) is not valid. Is the following argument valid?

17. Some Americans work in the movie industry. Meryl Streep is an American. Hence, Meryl Streep 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. (Streep could switch to another line of work while remaining an American.) So, even if an argument has true premises and a true conclusion, it isn't necessarily valid, for the premises may not support the conclusion in the right way. (Of course, in many cases, we simply do not know whether the premises of an argument are true or false, and yet we may know that the argument is 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. Does it necessarily have at least one false premise? Yes. If it had true premises, then it would have to have a true conclusion, since 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? It is tempting to answer yes because "error in its own right breeds error—if the first step in an argument is wrong, everything that follows will be wrong."[2] But the correct answer is no. Consider the following argument:

18. All dogs are ants. All ants are mammals. So, all dogs are mammals.

Is argument (18) valid? Yes. It is impossible for the conclusion of (18) 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:

19. All birds are cats. Some dogs are birds. So, some dogs are cats.

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.

A **valid argument** has this essential feature: It is necessary that if the premises are true, then the conclusion is true.

An **invalid argument** has this essential feature: It is *not necessary* that if the premises are true, then the conclusion is true. In other words, even on the

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

20. All dogs are animals. All cats are animals. Hence, all dogs are cats.
21. If Pat is a wife, then Pat is a woman. But Pat is not a wife. So, Pat is not a woman.
22. Bill likes Sue. Therefore, Sue likes Bill.

The premises of argument (20) are in fact true, but its conclusion is false; so, (20) is obviously invalid. Argument (21) is invalid because its premises leave open the possibility that Pat is an unmarried woman. And (22) is invalid because even if Bill does like Sue, that is no guarantee that she likes him. In each of these cases, then, the conclusion could be false while (i.e., assuming that) the premises are true.

An **invalid argument** has this essential feature: It is *not necessary* that if the premises are true, then the conclusion is true.

Validity matters because true premises by themselves do not make good arguments. But we obviously want our arguments to have true premises. A **sound argument** has two essential features: *It is valid, and all its premises are true*. Notice that a sound argument cannot have a false conclusion. Because a sound argument is valid and has only true premises, it must have a true conclusion. Here are two sound arguments:

23. All collies are dogs. All dogs are animals. So, all collies are animals.
24. If Akron is in Ohio, then Akron is in the United States. Akron is in Ohio. Hence, Akron is in the United States.

Valid + All Premises True = Sound

An **unsound argument** falls into one of the following three categories:

It is valid but has at least one false premise.

It is invalid, but all its premises are true.

It is invalid *and* 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. For example, both of the following arguments are unsound:

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

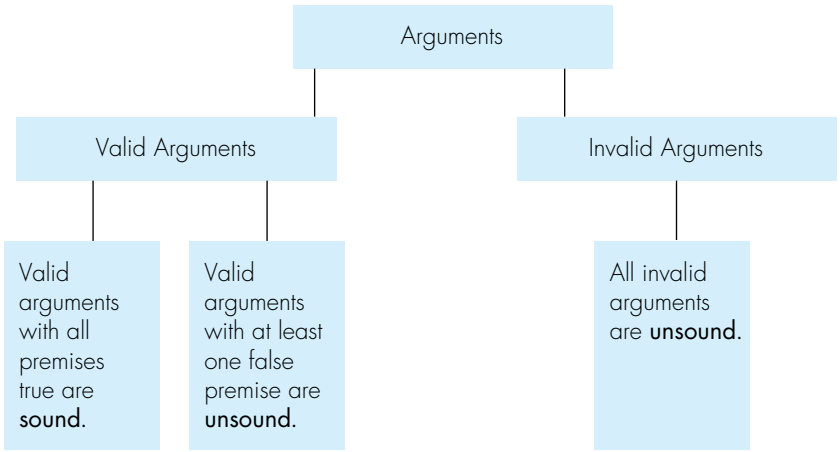
26. All birds are animals. All grizzly bears are animals. So, all grizzly bears are birds.

Argument (25) is unsound, because although it is valid, it has a false (second) premise. And (26) is unsound, because although it has true premises, it is invalid. We can easily construct an unsound argument of the third type—that is, one that both is invalid *and* has at least one false premise—by replacing "birds" in (26) with "trees":

27. All trees are animals. All bears are animals. So, all bears are trees.

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

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



Deductive logic is the part of logic that is concerned with tests for validity and invalidity.[3] And much of this book is devoted to an exploration of deductive logic. In fact, the next two sections will provide us with some initial tests for establishing the validity and invalidity of arguments.

A note on terminology is in order at the close of this section. 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

An **argument** is a set of statements, one of which, called the *conclusion*, is affirmed *on the basis* of the others, which are called the *premises*.

Logic is the study of methods for evaluating whether the premises of an argument adequately support (or provide good evidence for) its conclusion.

A **valid argument** has this essential feature: It is necessary that if the premises are true, then the conclusion is true.

An **invalid argument** has this essential feature: It is *not* necessary that if the premises are true, then the conclusion is true.

A **sound argument** has two essential features: *It is valid, and all its premises are true.*

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

Deductive logic is the part of logic that concerns tests for validity and invalidity.

The following exercises provide you with an opportunity to explore the concepts introduced in this section.

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 wrong.

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.

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, one of which, called the *conclusion,* is affirmed *on the basis* of the others, which are called the *premises*.

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.

Part C: Valid or Invalid? Much of this text concerns methods of testing arguments for validity. While 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?

* **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.