CHAPTER 1
Introduction

Logic is about reasoning—about going from premises to a conclusion. As we begin our study of logic, we need to get clearer on what logic is and why it's important. We also need to learn some concepts (like "valid" and "argument") that are central to the study of logic.

1.1 Logic

Logic[1] can be defined as *the analysis and appraisal of arguments*. When you do logic, you try to clarify reasoning and separate good from bad reasoning. As you work through this book, you'll examine philosophical reasoning on topics like free will and determinism, the existence of God, and the nature of morality. You'll also study reasoning on backpacking, water pollution, football, Supreme Court decisions, and the Bible. You'll come to see logic not as an irrelevant game with funny symbols, but rather as a useful tool to clarify and evaluate our reasoning—whether on everyday topics or on life's deeper questions.

Why study logic? I can think of three main reasons. First, logic can be fun. Doing logic is like playing a game or doing puzzles; logic will challenge your thinking processes in new ways. The rigor of logical systems will likely fascinate you. Most people find logic enjoyable.

Second, logic can deepen your understanding of philosophy. **Philosophy** can be defined as *reasoning about the ultimate questions of life*. Philosophers ask questions like "Why accept or reject free will?," "Can one prove or disprove God's existence?," and "How can one justify a moral belief?" If you don't know any logic, you'll have only a vague grasp of such issues; and you'll lack the tools needed to understand and evaluate philosophical reasoning. If you've studied philosophy, you'll likely recognize many of the pieces of philosophical reasoning in this book. If you haven't studied philosophy, you'll find this book a good introduction to the subject. In either case, you should get better at recognizing, understanding, and appraising philosophical reasoning.

Finally, logic can improve your analytical skills. While you've been reasoning about things all your life, this may be the first time that you focus on what reasoning is and try to become better at it. In most areas, it's a big advantage to be able to reason clearly; logic promotes intellectual skills that are important in law, business, medicine, and any other area that involves thinking and reasoning. This book is crammed with exercises; look at these as puzzles designed to help you think more clearly and logically.

[1] Important terms (like **"logic"**) are introduced in bold type. Learn each such term and be able to give a definition. The Glossary at the end of the book has a collection of definitions.

1.2 Valid arguments

I begin my basic logic course with a multiple-choice test. The test has ten problems, each giving information **(premises)** and asking what **conclusion** necessarily follows. The problems are easy, but most students get almost half of them wrong.[1]

Here are two of the problems—with the right answers boxed:

If you overslept, you'll be late. You aren't late. Therefore: (a) You did oversleep. **(b) You didn't oversleep.** (c) You're late. (d) None of these follows.	If you overslept, you'll be late. You didn't oversleep. Therefore: (a) You're late. (b) You aren't late. (c) You did oversleep. **(d) None of these follows.**

While almost everyone gets the first problem right, many students wrongly pick "(b)" for the second problem. Here "You aren't late" doesn't necessary follow, since you might be late for some other reason; maybe your car didn't start. Most students, once they grasp this point, will see that (b) is wrong.[2]

Untrained logical intuitions are often unreliable. But logical intuitions can be developed; yours will likely improve as you work through this book. You'll also learn special techniques for testing arguments.

An **argument,** in the sense used in logic, is a set of statements consisting of premises and a conclusion; normally the premises give evidence for the conclusion. Arguments put into words a possible act of reasoning. Here's an example of a valid argument ("∴" is for *therefore*):

Valid argument ➔

If you overslept, you'll be late.
You aren't late.
∴ You didn't oversleep.

An argument is **valid** if it would be contradictory (impossible) to have the premises all true and conclusion false. In calling an argument *valid,* we aren't saying whether the premises are true. We're just saying that the conclusion *follows from* the premises—that if the premises were all true, then the conclusion also would have to be true. In saying this, we implicitly assume that there's no shift in the meaning or reference of the terms; hence we must use "overslept," "late," and "you" in the same way throughout the argument.

Our argument is valid because of its **logical form**—its arrangement of logical notions (like "if-then" and "not") and content phrases (like "You overslept" and "You're late"). We

[1] The Web has my pretest at http://www.jcu.edu/philosophy/gensler/logic.htm in an interactive format. I suggest that you try it.

[2] These two arguments were taken from Matthew Lipman's fifth-grade logic textbook: *Harry Stottlemeier's Discovery* (Caldwell, NJ: Universal Diversified Services, 1974).

can display an argument's form by using words or symbols for logical notions, and letters for content phrases:

If you overslept, you'll be late.	If A then B **Valid**
You aren't late.	Not-B
∴ You didn't oversleep.	∴ Not-A

Our argument is valid because its *form* is correct. If we take another argument of the same form, but substituting other ideas for "A" and "B," then this second argument also will be valid. Here's an example:

If you're in France, you're in Europe.	If A then B **Valid**
You aren't in Europe.	Not-B
∴ You aren't in France.	∴ Not-A

Logic studies forms of reasoning. The content can deal with anything—back-packing, mathematics, cooking, physics, ethics, or whatever. When you learn logic, you're learning tools of reasoning that can be applied to any subject.

In our invalid example, the second premise denies the *first* part of the if-then (instead of the *second*); this small change makes all the difference:

If you overslept, you'll be late.	If A then B **Invalid**
You didn't oversleep.	Not-A
∴ You aren't late.	∴ Not-B

Intuitively, you might be late for some other reason—just as, in the following similar argument, you might be in Europe because you're in Italy:

If you're in France, you're in Europe.	If A then B **Invalid**
You aren't in France.	Not-A
∴ You aren't in Europe.	∴ Not-B

1.3 Sound arguments

Logicians distinguish *valid* arguments from *sound* arguments:

> An argument is **valid** if it would be contradictory to have the premises all true and conclusion false.
>
> An argument is **sound** if it's valid and has every premise true.

Calling an argument "valid" says nothing about whether its premises are true. But calling it "sound" says that it's valid (the conclusion follows from the premises) *and* has true premises. Here's an example of a *sound* argument:

Valid and true premises ➔

If you're reading this, you aren't illiterate.
You're reading this.
∴ You aren't illiterate.

When we try to prove a conclusion, we try to give a *sound* argument. We must make sure of two things: (a) that our premises are true, and (b) that our conclusion follows from our premises. If we have these two things, then our conclusion has to be true. The conclusion of a sound argument is always true.

An argument could be unsound in either of two ways; it might have a false premise or it might be invalid:

first premise false:

All logicians are millionaires.
Gensler is a logician.
∴ Gensler is a millionaire.

Conclusion doesn't follow:

All millionaires eat well.
Gensler eats well.
∴ Gensler is a millionaire.

When we criticize an opponent's argument, we try to show that it's *unsound.* We try to show: (a) that one of the premises is false, or (b) that the conclusion doesn't follow. If the argument has a false premise or is invalid, then our opponent hasn't proved the conclusion. But the conclusion still might be true—and our opponent might later discover a better argument for it. To show a view to be false, we must do more than just refute an argument for it; we must invent an argument of our own that shows the view to be false.

Besides asking whether premises are true, we could ask how certain they are, to ourselves or to others. We'd like our premises to be certain and obvious to everyone. We usually have to settle for less than this; our premises are often educated guesses or personal convictions. Our arguments are only as strong as their premises. This suggests a third strategy for criticizing an argument; we could try to show that one or more of the premises are very uncertain.

An argument often, especially in philosophy, leads to further arguments. Consider this argument against belief in God from St Thomas Aquinas (who mentioned it in order to show that it's unsound):[1]

The belief that there's a God is unnecessary to explain our experience.
All beliefs unnecessary to explain our experience ought to be rejected.
∴ The belief that there's a God ought to be rejected.

The argument is valid—the conclusion follows from the premises. Are the premises true? Aquinas might have clarified and then rejected the second premise as self-refuting; is this premise itself needed to explain our experience? Instead he rejected the first premise. He gave further arguments to show that belief in God is needed to explain our experience (of motion, causality, and so on). Are Aquinas's further arguments sound? We must leave debate on this to the philosophy of religion. Logic, however, can clarify the discussion. It

[1] In this book, I often say that an argument is *from* a given philosopher. I mean that the person's writings contain or suggest the ideas in the argument; the phrasing is usually mine.

can help us to express reasoning clearly, to determine whether a conclusion follows from the premises, and to focus on key premises to defend or criticize. Logic, while not itself resolving substantive issues, gives us intellectual tools to reason better about such issues.

I have two final points on terminology. We'll call statements *true* or *false* (not *valid* or *invalid*). And we'll call arguments *valid* or *invalid* (not *true* or *false*). While this is conventional usage, it pains a logician's ears to hear "invalid statement" or "false argument."

1.4 The plan of this book

This book, being an introduction, starts simply and doesn't presume any previous study of logic. It covers a broad range of topics in logic, from basic ones to rather advanced ones.

Chapter 2 covers syllogistic logic, an ancient branch of logic that focuses on "all," "no," and "some." Chapters 3 to 6 cover the classical systems of modern symbolic logic:

Propositional logic: about "if-then," "and," "or," and "not."
Quantificational logic: adding "all," "no," and "some."

Chapter 7 to 10 cover advanced (and increasingly more controversial) systems of philosophical interest:

Modal logic: about "necessary" and "possible."
Deontic logic: about "ought" and "permissible."
Belief logic: about consistent believing and willing.

Chapters 11 and 12 cover further advanced topics: an ethical formalization (featuring the golden rule) and metalogic (a study of logical systems with a view toward proving consistency and completeness). Chapter 13 covers inductive arguments (in which, at best, it's only highly probable that if the premises are true, then so is the conclusion). Chapter 14 covers meaning and definitions. Chapter 15 covers informal fallacies and further aspects of argumentation. In general, Chapters 2–5, 7, and 13–15 are suited for a basic logic course, while Chapters 6 and 8–12 are more advanced. Since this book is so comprehensive, there is much more material than could be covered in a one-term course.[1]

Logic requires careful reading. While I've tried to explain things as clearly and concisely as possible, some points are difficult—especially for a beginner; you may sometimes have to read an explanation a few times before the ideas sink in. Since logic is so cumulative (with one idea building on another), it's especially important to keep up with the work; and "keeping up" involves being able to work out the problems yourself. You'll find the accompanying LogiCola software (see the Appendix) a great help in this.

[1] Several chapters presume an understanding of earlier chapters. Chapter 4 builds on 3. Chapter 5 builds on 3 and 4. Chapter 6 builds on 3–5. Chapter 7 builds on 3 and 4. Chapter 8 builds on 3–7. Chapter 9 builds on 3–7. Chapter 10 builds on 3–7 and 9. Chapter 11 builds on 3–7 and 9–10. And Chapter 12 builds on 3 and 4.