CHAPTER 1
Introduction

Logic is about reasoning – about going from premises to a conclusion. As we begin our study of logic, we need to be 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] is *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 reasoning on various topics, both philosophical (like free will and determinism, the existence of God, and the nature of morality) and non-philosophical (like 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 as a useful tool to clarify and evaluate our reasoning – whether on life's deeper questions or on everyday topics.

Why study logic? I can think of three main reasons. First, logic is important because reasoning is important. While you've been reasoning about things all your life, this may be the first time that you try to understand reasoning and become better at it. Reasoning and general analytical skills are important in law, politics, journalism, education, medicine, business, science, mathematics, computer science, and most other areas. This book is crammed with exercises; look at these as puzzles designed to help you think more clearly (so people can better understand what you're saying) and logically (so you better support your conclusions).

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?" or "Can one prove or disprove God's existence?" or "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

[1] Centrally important terms (like "**logic**") are introduced in bold type. Learn each such term and be able to give a definition.

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 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.

1.2 Valid arguments

I begin my basic logic course with a multiple-choice test. The test has ten problems; each problem gives information and asks what conclusion necessarily follows. The problems are easy, but most students get about half 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.[3]

An **argument**, in the sense used in logic, is a set of statements consisting of premises and a conclusion. The **premises** are statements that give supporting evidence; the **conclusion** is what is allegedly supported by these statements. Arguments put into words a possible act of reasoning. Here's an example:

[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. I developed this test to help a psychologist friend put to an experimental test the idea that males are more logical than females; he found, of course, that males and females did equally well on the logic test.

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

[3] Many psychologists think we have two systems for drawing conclusions. Our *intuitive system* rests on feelings and works very quickly. Our *rational system* uses rules and works in a slower, step-by-step manner. Neither is always right. A logic course should develop both systems.

Valid argument ➔

If you overslept, you'll be late.
You aren't late.
∴ You didn't oversleep. ("∴" = *therefore*)

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" 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 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 substitute 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 – backpacking, mathematics, cooking, physics, ethics, or whatever. When you learn logic, you're learning tools of reasoning that can be applied to any subject.

Consider our **invalid** example:

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

Here the second premise denies the *first* part of the if-then; this makes it invalid. Intuitively, you might be late for some other reason – just as, in this 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		If you're reading this, you aren't illiterate.
and true	➔	You're reading this.
premises		∴ You aren't illiterate.

When we try to prove a conclusion, we try to give a *sound* argument. We must make sure that our premises are true and 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: (1) it might have a false premise or (2) its conclusion might not follow from the premises:

First premise false:	*Conclusion doesn't follow:*
All logicians are millionaires.	All millionaires eat well.
Gensler is a logician.	Gensler eats well.
∴ Gensler is a millionaire.	∴ Gensler is a millionaire.

When we criticize an opponent's argument, we try to show that it's *unsound*. We try to show either that one of the premises is false or 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.

Here's another example of an argument. In fall 2008, before Barack Obama

was elected US president, he was far ahead in the polls. But some thought he'd be defeated by the "Bradley effect," whereby many whites *say* they'll vote for a black candidate but in fact don't. Barack's wife Michelle, in a CNN interview with Larry King (October 8), argued that there wouldn't be a Bradley effect:[1]

> Barack Obama is the Democratic nominee.
> If there was going to be a Bradley effect, Barack wouldn't be the nominee [because the effect would have shown up in the primary elections].
> ∴ There isn't going to be a Bradley effect.

Once she gives this argument, we can't just say "Well, my opinion is that there *will* be a Bradley effect." Instead, we have to respond to her reasoning. It's clearly valid – the conclusion follows from the premises. Are the premises true? The first premise was undeniable. To dispute the second premise, we'd have to argue that the Bradley effect would appear in the final election but not in the primaries; but it's unclear how one might defend this. So an argument like this changes the nature of the discussion. (By the way, there was no Bradley effect when the general election took place a month later.)

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

I have two 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."

So far we've seen **deductive** arguments, where the conclusion is claimed to follow with necessity. There also are **inductive** arguments, where the conclusion is claimed to follow only with probability; this claim is either implicit or else expressed by terms like "probably." Consider these examples:

Deductively valid	*Inductively strong*
All who live in France live in Europe.	Most who live in France speak French.
Pierre lives in France.	Pierre lives in France.
∴ Pierre lives in Europe.	This is all we know about the matter.
	∴ Pierre speaks French (probably).

The first argument has a tight connection between premises and conclusion; it would be impossible for the premises to all be true but the conclusion false. The second has a looser premise–conclusion connection. Relative to the premises, the conclusion is only a good guess; it's likely true but could be false (perhaps Pierre is the son of the Polish ambassador and speaks no French).

[1] These premises are Michelle Obama's own words. But often in this book, when I say that an argument is *from* a given thinker, I use my own phrasing.

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, from basic to rather advanced. The remaining chapters are divided into four groups:

- Part One. Chapters 2 to 5 cover syllogistic logic (an ancient branch of logic that focuses on "all," "no," and "some"), informal logic (which deals with meaning, definitions, informal fallacies, and other informal aspects of reasoning), and inductive reasoning.
- Part Two. Chapters 6 to 9 cover classical symbolic logic, which divides into propositional logic (about "if-then," "and," "or," and "not") and quantificational logic (which adds "all," "no," and "some").
- Part Three. Chapters 10 to 14 cover several advanced symbolic systems of philosophical interest: modal logic (about "necessary" and "possible"), deontic logic (about "ought" and "permissible"), belief logic (about consistent believing and willing), and a formalized ethical theory (which features a rigorous proof of the golden rule).
- Part Four. Chapters 15 to 18 introduce further vistas: metalogic (a study of logical systems), history of logic (from ancient times to the present), deviant logics (which question standard assumptions about logic), and philosophy of logic (which raises philosophical questions about logic).

Chapters 2–8 and 10 (and parts of 16 to 18) are suitable for a basic logic course, while the other chapters are more advanced. Since this book is so comprehensive, it has much more material than can 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 companion LogiCola software (see the Preface) a great help in this.

[1] Several chapters presume earlier chapters. Chapters 6 to 14 form a sequence, with each chapter building on previous chapters (except that Chapter 10 depends only on Chapters 6 and 7, and Chapter 11 isn't required for Chapters 12 to 14). Chapter 15 to 18 presume Chapter 6.