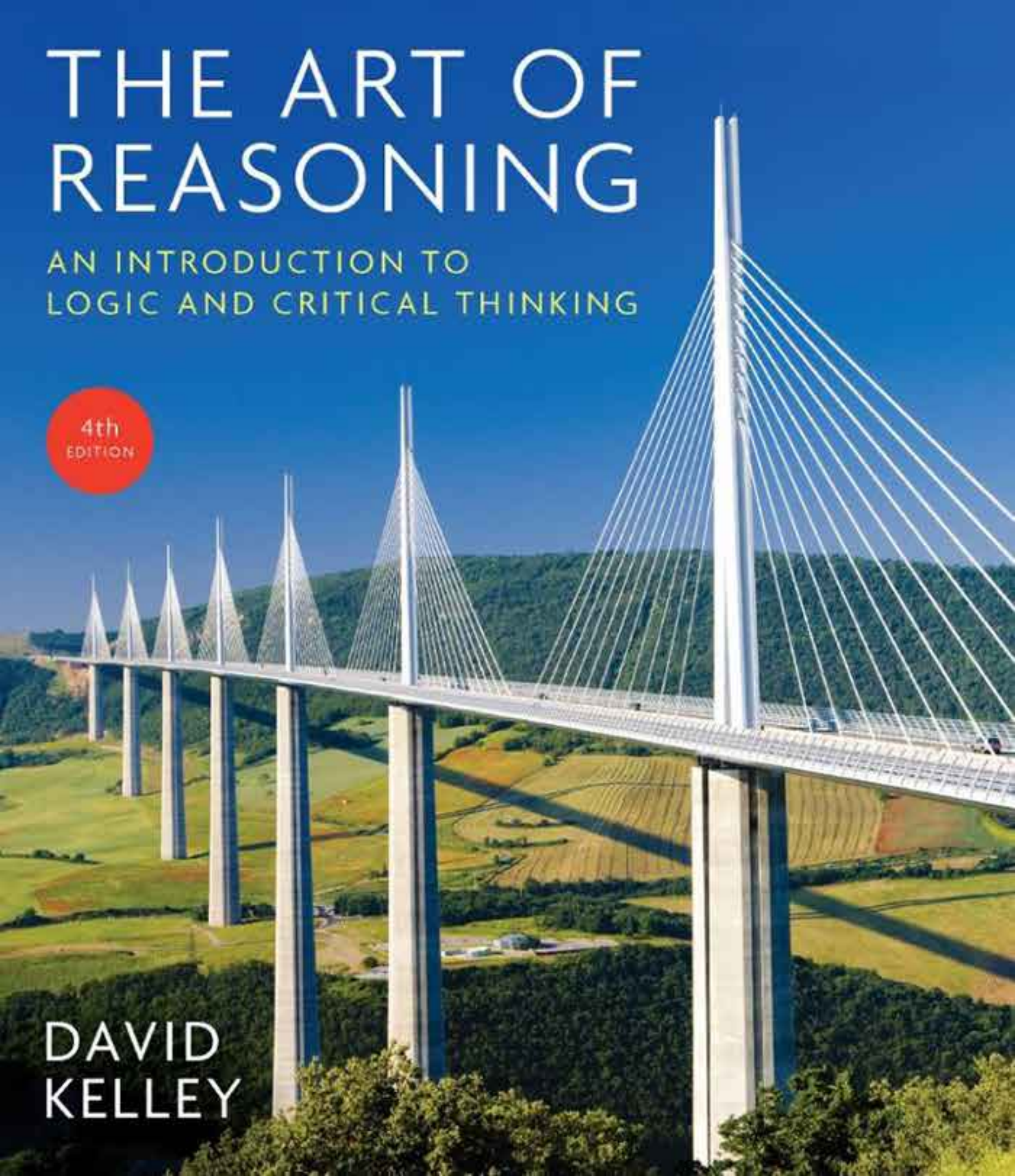


THE ART OF REASONING

AN INTRODUCTION TO LOGIC AND CRITICAL THINKING

4th
EDITION

DAVID
KELLEY



The Art of Reasoning

FOURTH EDITION

An Introduction to Logic and Critical Thinking

DAVID KELLEY



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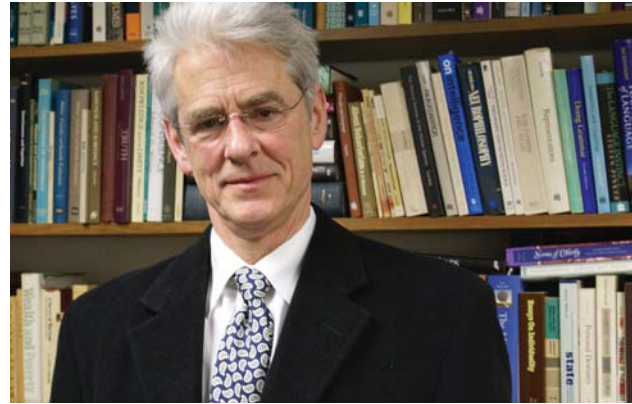
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Students whose professors have decided to assign online homework will be able to access the online homework from StudySpace, the student web site that accompanies this textbook.

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Preface

The *Art of Reasoning* is a textbook designed for courses in introductory logic or critical thinking. In addition to the elements of formal deductive logic, it includes classification and definition, basic argument analysis, fallacies, and inductive reasoning.

My goal in the book is to make it a valuable resource for the classroom instructor. Based on my own experience as a teacher, I believe the most important means to that end is to write in a way that will hold the interest of students. Otherwise, they are not likely to do the reading assignments; they will not come to class prepared; and instructors will have to spend valuable class time reviewing the basics. I have therefore tried to explain the standards of good thinking in a clear, engaging, conversational style. On each topic, I have tried to follow an arc of learning: beginning with a clear, straightforward example; then extracting the relevant concept or principle; and then moving on to further implications, qualifications, and more complex or borderline examples. And I have kept theoretical discussion to a minimum, including only those points necessary to make the standards and techniques intelligible.

Organization

Part 1, Language and Reasoning, covers the basic linguistic tools required for thinking clearly and the basic elements of argument analysis and evaluation. The material on classification (Chapter 1) is rarely covered in other texts, but I find that a clear understanding of genus–species hierarchies makes it much easier for students to master other topics, especially definitions (Chapter 2), categorical syllogisms (Chapters 6–8), inductive gener-

alization (Chapter 12), and statistical reasoning (Chapter 14). In addition, Chapter 3, which discusses propositions as assertions, gives students the preparatory work they need to identify the premises and conclusions of arguments.

Chapter 4 (Argument Analysis) begins the treatment of arguments and introduces key logical concepts: premise and conclusion; deduction and induction; and validity, soundness, strength, and cogency. This material has been substantially expanded for the fourth edition, including a new section on deductive and inductive arguments. The chapter presents a simple diagramming technique that can be used with arguments of any type and any degree of complexity, and it gives students guidelines on identifying assumed premises. Chapter 5 (Fallacies) focuses on the fallacies most often encountered in everyday thought and speech and indicates the contexts in which each fallacy is most likely to be committed. (This edition contains new sections on the fallacies of accident and slippery slope.)

Part 2 covers both traditional and modern deductive logic. Chapters 6 and 7 deal with categorical propositions and syllogisms. The treatment of Venn diagrams has been expanded to give students more help in diagramming propositions, immediate inferences, and syllogisms. Chapter 8 begins with the traditional versions of disjunctive and hypothetical syllogisms. It goes on to show how to identify and analyze deductive arguments as they typically occur in ordinary language, including complex arguments that involve combinations of categorical, hypothetical, and disjunctive syllogisms. The chapter will be useful for instructors who do not plan to cover the modern propositional and predicate logic.

For instructors who *do* cover modern symbolic logic, the next three chapters deal with propositional (Chapters 9 and 10) and predicate (Chapter 11) logic. For the fourth edition, these chapters have been significantly expanded in response to comments by reviewers. I have added more explanations to help students understand the connectives, truth tables, and proofs. The text breaks processes down into small sections with explanations at each step. The exercises have many real-language applications of the logic—everything from arguments in science, religion, and law to Robert Frost’s poetry—and are balanced to test the items students need to master, with roughly equal representation of each method, inference rule, etc.

Chapter 9 includes a new section on tautology, contradiction, and consistency. Chapter 11 now introduces proofs in predicate logic early on. It treats rules, restrictions, and strategies contextually, moving from basic proofs, to those involving conditional and *reductio* proofs, to relational predicates and multiple quantification. For the three chapters on modern logic, moreover, I have doubled the number of exercises.

Part 3, finally, covers inductive reasoning. In addition to material on rules for inductive generalization and Mill’s methods for causal inference (Chapter 12) and argument by analogy (Chapter 13), I have devoted a chapter to statistical reasoning (Chapter 14), offering students the basic concepts and standards for evaluating the kinds of statistical arguments they will frequently encounter in the media. Chapter 15 deals with the analysis and evaluation of explanations. Among other things, it shows how the same diagramming technique used for arguments can easily be extended to explanatory structures. And Chapter 16, new to this edition, covers the basics of probability.

Pedagogical Features

Throughout the book, elements of design help students assimilate the material:

- *Strategy* sidebars highlight procedures to follow, including heuristics and tips.
- *Summaries* at the end of each chapter condense the essential material in each chapter.
- *Key terms* following each end-of-chapter Summary give definitions of concepts introduced in the chapter and are compiled in the Glossary at the back of the book.

Each chapter also contains abundant exercises of different types and levels of difficulty. Following most sections of each chapter are exercises to let students test their understanding of the material before proceeding to the next section. Answers to every third item of these exercises and to every third item of the Additional Exercises are included at the back of the book. At the end of each chapter, Additional Exercises integrate the material in the chapter by asking students to use their skills in many different combinations on different sorts of task. There are creative exercises asking students to come up with their own definitions, arguments, and explanations, as well as critical exercises in which they evaluate those of others. Examples are drawn from works in many different disciplines—politics, science, literature, and history—so that all students will encounter at least some material from fields with which they are familiar. I have tried to use examples and exercises that have the flavor of reality to help students see how the standards of thinking apply to the sorts of issues they actually encounter in their everyday experience, in political debate, and in the other courses they take across the curriculum.

For this fourth edition of *The Art of Reasoning*, I have substantially revised the examples used in the text and exercises and have added more than 600 new exercises. In the end, however, I think variety is more important than sheer abundance. There are diminishing returns from performing the same task over and over on material of the same kind. I have tried to give students an imaginative variety of tasks that, like finger exercises for pianists, will exercise their mental muscles in different combinations, sounding different chords of understanding.

- *Summary* sidebars pull together important definitions, principles, and rules.

Custom Options

The Art of Reasoning has a basically modular design, allowing individual chapters to be used in various combinations, but there are a number of integrating links (such as diagrams for classification and for argument structure), and most chapters provide some exercises that ask students to use skills they have learned in earlier chapters. There is more material in the book than can be covered in a one-semester course, even at the brisk pace of a chapter a week, and many different selections are possible.

- A course in *informal logic and critical reasoning*, emphasizing basic skills in analyzing language and reasoning, might cover the five chapters in Part 1 (Language and Reasoning), Chapters 6–8 (traditional categorical logic), and Chapters 12–14 (inductive logic).
- A course in *introductory logic*, including traditional syllogistic and modern logic, might begin with Chapter 1 (Classification), Chapter 3 (Propositions), Chapter 4 (Argument Analysis), and Chapter 5 (Fallacies); and then move on to Chapters 6 and 7 (traditional syllogism), Chapters 9 and 10 (propositional logic), and Chapter 12 (Inductive Generalizations).
- A course in *modern formal logic* might include Chapter 4 (Argument Analysis) and then move on to Part 2 (Deductive Logic), including Chapter 6 (Categorical Propositions) and Chapters 9–11 (propositional and predicate logic).

These three selections are available as standard custom editions from W. W. Norton. Many other combinations are possible on request.

Supplements

In addition to the text, *The Art of Reasoning* comes with supplemental materials designed to make the instructor's job easier and to improve learning outcomes:

- *Study Space*: The companion student Web site (wwnorton.com/studyspace) includes flashcards of key terms, chapter summaries, and feature boxes, including a complete list of the rules of inference.
- *Online Homework*: A comprehensive online homework system that students can access through StudySpace gives students feedback and guidance as they work through problems. Access to this system is free with every new copy purchased of *The Art of Reasoning*. Instructors should go to wwnorton.com/logic to learn more or to set up a course.
- *Test Bank*: Extensively revised by Andrew Hill (Xavier University) and Richard Shedenhelm (University of Georgia), the test bank now includes more than 2,600 questions, all keyed and categorized according to question type and difficulty level.
- *Solutions Manual*: In this resource for instructors, I have provided solutions to all 2,400 problems found in the book, and the problems are rated by difficulty.
- *Lecture PowerPoint Slides*: These lecture slides, written by Dr. Ray Peace (Valdosta State University), are completely new to the fourth edition. With more than 30 slides per chapter (more than 500 total), these PowerPoint slides offer clear, detailed outlines to help professors prepare for lectures. Where applicable, we have included figures and diagrams from the textbook.

Instructors should contact their local W. W. Norton representative or go to wwnorton.com/logic for more information or to request access to these supplemental materials.

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Needless to say, none of the people I have mentioned is responsible for the use I have made (or failed to make) of their comments, which in many cases were highly critical.

Any book is a collaboration between author and publisher, and I have been particularly fortunate in that regard. During the years I have worked on *The Art of Reasoning*, I have come to rely on the enthusiasm and professionalism of the staff at W. W. Norton. For the fourth edition, I am particularly indebted to Ken Barton, Cliff Landesman, and Peter Simon for the extraordinary thought, care, and patience they have devoted to this project. The team that worked with them to publish this edition—Kim Yi (managing editor, College Digital Media), Rachel Mayer (project editor), Christopher Curioli (copy editor), Quynh Do (assistant editor), Conor Sullivan (assistant editor), Nicole Sawa (ancillary editor), Carson Russell (ancillary editor), Zach Miller (editorial assistant), Stefani Wallace (electronic media editorial assistant), Debra Morton Hoyt (art director), Rubina Yeh (design director), and Megan Jackson (permissions manager)—was stellar. Thank you all.

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Introduction

This is a book about thinking. It's a book about *how* to think.

In a broad sense, the word “thinking” refers to anything that goes on in our minds. When I say “a penny for your thoughts,” I want to know what’s on your mind—whether it’s a feeling, a memory, a question, an anxiety, a problem you’re trying to solve, or a daydream. As long as you are conscious, there is always something going on up there. In *this* sense, you can’t help thinking. You don’t need this book. You just have to stay awake. In a narrower sense, however, thinking is a particular *kind* of mental activity, the kind involved in solving a problem, planning an action, studying for a test, or defending your position on a controversial issue. This is still a pretty broad concept, but we have excluded some things.

In the first place, we can distinguish thinking from feeling. Thinking is a cognitive process we use in the attempt to gain knowledge or to understand something, as distinct from our emotional responses to things. This distinction does not mean, as people too often assume, that someone with strong emotions is necessarily illogical or that a logical person must be unemotional. On the contrary, there is no reason we cannot have both: clear, logical minds and passionate feelings. But thinking and feeling do have different roles to play, different jobs to do, in our mental lives.

Second, thinking is purposive. It differs from activities such as daydreaming and fantasizing in which we simply let our minds wander where they will. Thinking is something we have to *do*, usually with some degree of effort. And because it aims at a goal, it is something that can be done with varying degrees of success. You may or may not succeed in solving a problem, forming a plan, grasping something you read, or proving your case. In this way, too, it differs from daydreaming, where the concepts of success and failure don’t really apply. Thinking is a skill. It’s a skill that everyone has in some degree, but it is also a skill that everyone can improve.

How can we improve this skill? Let’s consider an analogy with the game of tennis. If we want to improve our skill at tennis, we need to do two things. We need to learn more about the rules and strategies of the game. And we need to practice the moves that implement those rules and strategies—to practice serving, volleying, rushing the net, and so forth. The same is true for the activity of thinking. There are certain rules and strategies of thinking, certain standards that tell us when we have achieved a clear understanding of some subject or succeeded in proving a case. Our first task is to learn what these standards are and to understand why they are correct. Our second task is

to practice applying these standards to a variety of examples drawn from everyday life, from politics, and from the different subjects one studies in school. The more practice we get, the more effectively we can incorporate the standards of logic into our habits of thought. That's why this book has a lot of exercises.

Before we begin, let's get an overview of the range of standards and techniques that we're going to be learning about.

Reasoning

When we engage in thought, our goal is normally to find out something. We are trying to answer a question, solve a problem, prove a conclusion, or learn a body of material. We want to know why the car will not start, or which candidate to vote for, or what is the cheapest way to get home for the holidays, or what the man or woman of our dreams really feels about us. In all these cases, we can't acquire this knowledge by direct observation. We have to do some reasoning. Reasoning is a process of thought in which we make inferences: starting with information we already have, an inference draws some further conclusion based on that information. For example, if your car will not start but the lights still work, you can infer that the problem is not a dead battery.

Logic is the study of the methods and standards of inference. Throughout this book, we will be talking about different kinds of inferences and about which ones to use in which sorts of situations. We will study rules for evaluating inferences and learn to distinguish good inferences from bad ones. As a preview, let's look at a particular case.

Some states have passed laws requiring that seat belts be used in cars. Supporters of the law say that those who wear seat belts have a better chance, statistically, of surviving an accident than those who don't. Opponents often point to particular cases in which someone survived because he was *not* wearing a seat belt. Which is the better sort of evidence? Are the opponents making too much of the exceptions? Are the supporters making proper use of the statistics? Let's assume, just for the sake of discussion, that wearing seat belts really is safer. Is that enough to justify the law? No—not by itself. The greater safety of seat belts would justify the law only if we take the position that the government should require us to do what is safe. Some people defend that position. Others say we should be free to decide these things for ourselves. So there are really two issues here: the safety of seat belts and the proper role of government. Can the second one be settled by statistical evidence? If not, then what sort of evidence *is* relevant?

The purpose of logic is to answer the sort of questions I raised in the last paragraph. Logic alone won't tell you whether to support mandatory seat belt laws. It *will* give you a method to follow in making that decision and backing it up. It will show you how to break an issue down into subissues, so that you can be sure to consider all the relevant points. It will give you standards for deciding what sort of evidence is appropriate to a particular issue. And it will give you standards for determining how much weight to give a piece of evidence.

The value of these logical standards is not limited to political arguments. In many college courses, students are presented with competing ideas or theories and asked to discuss them critically. In a philosophy class, the issue might be the existence of free will; in literature, it might be different interpretations of *Hamlet*. Whatever the subject,

discussing ideas critically means presenting reasons for or against them. Even in our personal lives we all have choices to make, major ones or minor, and here too we need to weigh the reasons on each side and try to consider all the relevant issues.

Logic can also help us develop other, more subtle skills. Most of us have been in discussions that were frustrating because they kept going around in circles. That often happens when people “talk past each other”—when they are not really addressing the same issue. Suppose someone argues that it’s wrong to treat abortion merely as a medical procedure, like removing an appendix, because the fetus is a potential person. Someone else might argue that a woman should have the right to make decisions concerning her own body. These two people are both dealing with the topic of abortion, but they may not be addressing quite the same issue. The first person may be trying to show that abortion is morally wrong, while the second is denying that it should be made illegal. Whether abortion is right or wrong in moral terms and whether it should be legal or illegal are different issues. They are related (which is why they are easily confused), but not identical.

If the two people could identify the difference, they might find that they don’t disagree after all. The one who says that abortion should be legal might be willing to agree that abortion is nevertheless a serious action that would be wrong to take without an equally serious reason. And the one who says that abortion is morally wrong might be willing to agree that it’s still a decision that a woman should be legally free to make on her own. Of course, the argument might not work out so neatly. But we’ll never know until we try, and we can’t try until we know how to distinguish one issue from another. That’s a skill that logic can help us develop.

In this particular case, the problem of talking past each other would be fairly easy to fix because the two different issues are signaled by two different words: “immoral” versus “illegal.” A more difficult problem occurs when two people are using the same word but with two different meanings. Suppose there is an argument over whether student work should be graded. If one person is referring specifically to letter grades, while the other is referring to *any* form of evaluation, they are probably going to talk past each other. If we take the different meanings of the word into account, we would have to say that here again the people are not debating the same issue. But the problem is harder to fix because the difference in meaning lies below the surface of the language. And “grade” is a fairly concrete word. Think of the possibilities for miscommunication in words like “democracy,” “freedom,” “love,” or “art.”

This brings us to another area of logic: concepts and definitions. People often talk past each other when they use words with different meanings. Even when that is not a problem, it is always valuable to make the meaning of our words as clear and explicit as possible. Some concepts, such as “democracy,” are extremely hard to define, and great minds have spent lifetimes in the effort. Logic won’t guarantee success, but it can give us a method to follow, and the method will pay immediate dividends in the clarity and precision of our thinking. It will also make it easier to master new concepts and words that are introduced in most courses at school.

So far we have talked about skills involved in taking ideas apart: breaking an issue down into its components, distinguishing between closely related ideas, and analyzing the meaning of a word. But we also need to put our ideas together again. Thinking involves synthesis as well as analysis, integration as well as differentiation. To understand a line of reasoning, we need to break it down into its parts, but we also need to

put it in its wider context. In working on a problem, the most creative solutions often come when we notice similarities to problems in other areas. In a college course, it's important to understand each component of the material, but it's equally important to organize the material as a whole into a logically coherent framework.

Indeed, we can often integrate ideas from different courses. In a religion or ethics class, for example, you might discuss the idea that love of money is the root of all evil. How does that relate to the economist's description of money as a medium of exchange? In a political science class on democracy, you might discuss the idea that people are capable of governing themselves. Is that supported or contradicted by what you've learned in psychology, history, and philosophy? As these examples illustrate, integration means the awareness of logical relations on a larger scale. An idea in one area may provide evidence for an idea in another, quite different area. Or the two ideas may contradict each other—in which case they cannot both be right. An understanding of logic will help you spot these relationships.

Objectivity

As you can see from our discussion so far, thinking is a complex skill. It has many component activities, each with its own methods and standards. But these methods and standards have a purpose: to help us be *objective*. Objectivity in this context means staying aligned with the facts, guiding our thought processes by a concern for truth. To some extent, objectivity is a matter of choice: the choice not to indulge in wishful thinking, not to let bias or prejudice distort our judgment, and so forth. But there's more to it than that. Objectivity also involves a skill. Even with the best will in the world, we can't really be objective unless we know how to use our cognitive equipment: how to follow and evaluate the arguments we hear, how to isolate the relevant issues clearly, how to avoid ambiguity and vagueness in the words we use.

The essence of objectivity is the ability to step back from our train of thought and examine it critically. This is a virtue because it is the only way to avoid jumping to conclusions, the only way to check the results of our thinking, the only way to make sure that we are in touch with the facts. The results of our thinking cannot be any better than the processes by which we arrive at them. There is no Book of Life with answers in the back where we can see whether we got it right. Good thinking is a self-directed, self-correcting process, and you are the only one who can take responsibility for steering your own mind in the right direction. The methods and standards we discuss in this book will give you a compass.

Objectivity also has a social aspect. It means not only presenting your own ideas logically but also listening to what others say. Objectivity does not require that you be neutral, nonpartisan, or indifferent to the issue. It does require that you try to look at the matter from the other person's perspective. Even if your view is right, it is rare that any single perspective reveals the *whole* truth. Objectivity requires that you give a fair hearing to the evidence and arguments for the other side. Even if you reject them in the end, knowing *why* you reject them will give you a better understanding of your own position.

Another aspect of objectivity is especially important in communicating with others. To get our ideas across successfully, we have to take account of the other person's context. A point so obvious to me that it hardly seems worth mentioning may not be obvious to someone else, and if I fail to mention it, he may not understand what I am saying. Objectivity is the ability to step back from our own thinking so that we can see it critically, through the eyes of someone who does not share our outlook, our context of knowledge, our preferences, or our idiosyncrasies. All that we can reasonably ask of our audience is the ability to follow logical connections. In this respect, logic, like language, is a shared framework without which we could not communicate.

This sort of objectivity is especially important in writing, where readers are not present to ask questions if the message isn't getting through. If I fail to make clear what issue I am addressing, or if I use terms in new or ill-defined ways, readers can't interrupt to ask what I am talking about. They are stuck with what I've put down on paper. If my presentation is vague, or fails to consider a relevant alternative, or makes a questionable assumption, they can't stop me to ask for an elaboration. In writing, therefore, we have to be on our best behavior, logically speaking. Many writing problems are really problems in logical thinking. Conversely, writing exercises are one of the best ways to practice the techniques of logic, and you will find many such exercises in this book.

Speaking of exercises, I want to offer a final word of advice and encouragement. There are two kinds of exercises in each of the chapters in this book. At the ends of most sections within a chapter, you will find regular Exercises. Even if you feel you understood the material in a given section as I explained it, you don't know for sure whether you have mastered the thinking skills until you try doing them yourself. That's what the Exercises are for. At the end of each chapter is a longer set of Additional Exercises that call on all the skills you learned in the chapter. These exercises ask you to use thinking skills in different combinations; they often involve "real-life" examples; and they are a bit more challenging than the in-chapter exercises. Answers for exercises with stars next to them can be found at the back of the book.

It's going to take a certain amount of effort to improve your thinking skills and to build the muscles of your mind. As the ads for health clubs used to say, "No pain, no gain." But the process can also be fun. The exercises in this book are designed to make the effort enjoyable. And you can expect to take pleasure and pride in the results of your efforts: the sense of mental clarity and mastery you will get from the ability to organize your thoughts, to make logical connections, to understand the world around you, to see past the blinders of little minds and enjoy the company of great ones.

Language & Reasoning

Part 1 is concerned with the basic elements and standards of reasoning. Later sections will deal with the details of specific forms of reasoning, but here we will cover the elements and standards that pertain to reasoning in general and that will be of value in all your studies as well as everyday life.

Language is the medium in which we think, communicate, and reason. Words expand the range of our senses, bring order to our experiences, allow us to learn from the experiences of others, and preserve the thoughts of preceding generations. In learning to speak, each of us has acquired an amazingly powerful and versatile set of tools. But the tools will not do what we want unless we know how to use them properly. So before we turn to reasoning *per se*, we need to master these tools, and that will be the focus of the first five chapters.

One of the major functions of language is to divide the world up into categories. Except for proper names, most nouns stand for *groups* of things: tigers, tables, tests, and so forth. Organizing a set of things into groups is called *classification*,

and a word that stands for such a group expresses a *concept*. Chapter 1 is concerned with concepts and classification. We will learn the rules for classifying things in the most effective way, and we'll see how concepts can be arranged in hierarchies of *species* and *genus*.

To use concepts with precision and to understand the relationships among different concepts, we need to *define* them. In Chapter 2, we will learn how to evaluate and construct definitions.

Finally, we use words to make statements about things. In logic, we analyze statements in terms of the *propositions* they assert. In Chapter 3, we'll see how to identify propositions and how to tell whether two statements assert the same or different propositions.

Propositions are the units of reasoning, which is concerned with the *truth* of propositions. Its goal may be to *discover* whether a given proposition is true, or to *justify* one's belief that it is true, or to *persuade* someone else of its truth. In all of these cases, reasoning makes use of logical relationships among propositions, and we analyze and evaluate reasoning by identifying those relationships.

Chapter 4 will introduce the basic unit of reasoning, which in logic is called an *argument*. We'll learn how to identify the premises and the conclusion of an argument and begin our study of how to analyze and then evaluate its logical structure. Chapter 5 is concerned with fallacies—spurious

arguments in which the premises may appear to support the conclusion but do not really support it. We are going to review some of the more common fallacies and learn how to spot them in everyday thought and speech.

Classification

Suppose that I ask you to classify the courses you've taken in college. You might classify them by subject matter: art, biology, history, etc. Or you might classify them by level: introductory, intermediate, advanced. Whichever way you choose, you are grouping together courses that have something in common and distinguishing them from other courses. In effect you are creating a set of file folders in your mind and then putting each course into the proper folder.

Classifying things together into groups is something we do all the time, and it isn't hard to see why. Imagine trying to shop in a supermarket where the food was arranged in random order on the shelves: tomato soup next to the white bread in one aisle, chicken soup in the back next to the 60-watt light bulbs, one brand of cream cheese in front and another in aisle 8 near the Oreos. The task of finding what you want would be time consuming and extremely difficult, if not impossible.

In the case of a supermarket, someone had to design the system of classification. But there is also a ready-made system of classification embodied in our language. The word "dog," for example, groups together a certain class of animals and distinguishes them from other animals. Such a grouping may seem too obvious to be called a classification, but this is only because you have already mastered the word. As a child learning to speak, you had to work hard to learn the system of classification your parents were trying to teach you. Before you got the hang of it, you probably made mistakes, like calling the cat a dog. If you hadn't learned to speak, the whole world would seem like the unorganized supermarket; you would be in the position of an infant, for whom every object is new and unfamiliar. In learning the principles of classification, therefore, we'll be learning about the structure that lies at the core of our language.

CHAPTER OUTLINE

- 1.1 Concepts and Referents
- 1.2 Rules of Classification
- 1.3 Levels of Organization

1.1 Concepts and Referents

Whenever we classify, we make use of concepts—ideas that represent classes of things we have grouped together. In classifying your courses, you used concepts such as ART,