

LOGIC COACH II
CD-ROM ENCLOSED

LOGIC & PHILOSOPHY

A MODERN INTRODUCTION

EIGHTH EDITION



PAUL TIDMAN

HOWARD KAHANE

Logic and Philosophy *A Modern Introduction* *Eighth Edition*

Paul Tidman

Mount Union College

Howard Kahane

University of Maryland
Baltimore County



Wadsworth Publishing Company

I(T)P® An International Thomson Publishing Company

Belmont, CA • Albany, NY • Boston • Cincinnati • Johannesburg • London • Madrid • Melbourne
Mexico City • New York • Pacific Grove, CA • Scottsdale, AZ • Singapore • Tokyo • Toronto

Philosophy Editor: Peter Adams
Assistant Editor: Kerri Abdinoor
Editorial Assistant: Kelly Bush
Marketing Manager: Dave Garrison
Production Editor: Hal Lockwood
Accuracy Checker: Patricia Blanchette
Print Buyer: Stacey Weinberger
Permissions Editor: Robert Kauser
Interior Designer: Paula Goldstein
Copy Editor: Jennifer Gordon
Cover Designer: Jeanne Calabrese
Cover Photo: Steve McAlister/Image Bank
Compositor: Thompson Type
Printer: Maple-Vail Press

COPYRIGHT © 1999 by Wadsworth Publishing Company
A Division of International Thomson Publishing Inc.
ITP® The ITP logo is a registered trademark under license.



*This book is printed on
acid-free, recycled paper.*

Printed in the United States of America
2 3 4 5 6 7 8 9 10

For more information, contact Wadsworth Publishing Company, 10 Davis Drive, Belmont, CA 94002,
or electronically at <http://www.wadsworth.com>

International Thomson Publishing Europe
Berkshire House
168-173 High Holborn
London, WC1V 7AA, United Kingdom

Nelson ITP, Australia
102 Dodds Street
South Melbourne
Victoria 3205 Australia

Nelson Canada
1120 Birchmount Road
Scarborough, Ontario
Canada M1K 5G4

International Thomson Publishing Southern Africa
Building 18, Constantia Square
138 Sixteenth Road, P.O. Box 2459
Halfway House, 1685 South Africa

International Thomson Editores
Seneca, 53
Colonia Polanco
11560 México D.F. México

International Thomson Publishing Asia
60 Albert Street #15-01
Albert Complex
Singapore 189969

International Thomson Publishing Japan
Hirakawa-cho Kyowa Building, 3F
2-2-1 Hirakawa-cho, Chiyoda-ku
Tokyo 102, Japan

All rights reserved. No part of this work covered by the copyright hereon may be reproduced or used in any form or by any means—graphic, electronic, or mechanical, including photocopying, recording, taping, or information storage and retrieval systems—without the written permission of the publisher.

Library of Congress Cataloging-in-Publication Data

Tidman, Paul

Logic and philosophy: a modern introduction / Paul Tidman, Howard
Kahane.—8th ed.

p. cm.

Includes bibliographical references and index.

ISBN 0-534-52614-4

1. Logic. I. Tidman, Paul. II. Title.

BC108.K3 1998

160—dc21

98-13674

Preface to the Eighth Edition

This new edition of *Logic and Philosophy* is designed to build on the strengths that have made the book one of the most widely used formal logic texts in the discipline for nearly thirty years. Three strengths are especially notable:

1. Clean, accurate exposition coupled with well-designed examples and a wide array of exercises
2. Rules for predicate logic that are both technically rigorous and accessible to the beginning student
3. Comprehensive coverage that goes beyond a bare-bones treatment of sentential and predicate logic, allowing instructors maximum flexibility in course design

The purpose of this book, as in previous editions, is to provide students with a clear and comprehensible introduction to a complete system for sentential and first-order predicate logic and other systems of logic.

- **Help for the Logic-Averse:** This edition is designed to be useful for those students who struggle with logic. There are predictable stumbling points in the typical logic course. For example, in sentential logic students commonly have difficulties with forms, with complex translations involving connectives like “unless,” and “only if,” and with proofs that require the use of distribution, addition, or assumed premises. Special attention has been paid to these trouble spots. Explanations have been expanded, there are more examples and more basic-level exercises, and the discussion of strategy has been substantially increased.
- **“Walk-Through” Sections:** For crucial exercises there are “how-to” sections, where the student is walked step by step through a moderately difficult sample problem.
- **Organization:** Each chapter is devoted to one basic theme. Related material is not spread out over several chapters.
- **Expanded Coverage of Basic Concepts:** Beginning with the first chapter, more attention is paid to the topic of consistency. The fundamental concept of an interpretation is used to provide a unified explanation of such basic concepts as validity, consistency, logical equivalence, and logical implication in both sentential and predicate logic.
- **Error Checking:** The eighth edition has undergone rigorous error checking throughout

development and during the production process. We've been especially cognizant of the difficulties that errors can cause in the classroom, and we hope you'll find this edition to be a vast improvement.

Changes in the Eighth Edition

The changes we have introduced attempt to preserve prior-edition strengths while making the text even more user-friendly. These changes have been motivated by classroom experiences gained while teaching the basic course in formal logic at the University of Delaware and Mount Union College, and from the comments of colleagues and reviewers. Here are some highlights:

Part One

The discussion of sentence forms and substitution instances has been expanded, and a new exercise on this topic has been added. Forms are now introduced at the end of Chapter 3, after truth tables and just before the discussion of argument forms in Chapter 4. The short truth table technique is now introduced in the chapter on truth tables (Chapter 3) instead of following the discussion of proofs in Chapter 5, where it seemed a bit out of place.

In Chapter 4 the exercises on proofs have been carefully reordered so as to move more gradually from the easiest to the most difficult. A new exercise has been added to this chapter in which students must supply missing premises and lines of the proof by working backwards from the last lines of the proof.

There are also a few helpful new diagrams. There is one in the first chapter that explains how any test of consistency can be modified to test for validity as well. In Chapter 5 there are diagrams that label the essential parts of proofs that make use of assumptions and the rules of Conditional Proof (**CP**) and Indirect Proof (**IP**).

Finally, there is a new section that briefly introduces a few of the basic concepts of metatheory, including the distinction between syntax and semantics and an explanation of what makes a logical system like sentential logic both sound and complete. This discussion sets up an improved explanation of how the truth conditions for the horseshoe are constrained by accepting Modus Ponens (**MP**) as a valid inference rule.

Part Two

There are fewer changes to Part Two of the book. We altered the order of the chapters so that the chapter that reviews the rationale for the predicate logic rules now immediately follows the chapter on relational predicate logic. The exercises on showing invalidity and consistency in predicate logic have been expanded, and we wrote a new discussion of invalidity in relational predicate logic. In Chapter 7 a new exercise lets students get their feet wet with predicate logic proofs before having to master all of the restrictions that follow. The treatment of predicate logic truth trees has been changed so that each individual step is now numbered, making these trees much easier to read.

Part Three

As in the seventh edition, the changes to Part Three have largely consisted of cutting and consolidating in order to keep the size (and thus the cost) of the text within bounds. The chapter on informal fallacies has been eliminated entirely, and the chapters on inductive logic and probability have been consolidated into a single chapter. We found that the chapter on fallacies was rarely used, and there are many excellent, inexpensive paperback treatments of the subject. It is very hard for textbook authors to eliminate large sections. Thus many textbooks grow larger and larger with each progressive edition and students are left to shoulder the burden (both literally and figuratively!). By contrast, this eighth edition of *Logic and Philosophy*, like the seventh, substantially expands the treatment of sentential and predicate logic while at the same time reducing the total number of pages.

In addition to these more general changes, there are many small changes throughout the book. Individual passages have been clarified. There are many new exercise items. As mentioned above, the text has undergone the most careful error checking in the book's history. Any errors found will be posted on the website <http://www.muc.edu/~tidmanpa/>.

Nelson Pole's LogicCoach software is now bundled with the book. An expanded study guide with many additional practice exercises is also available. The end result, hopefully, is a text genuinely more useful to both students and their instructors.

We would like to thank the reviewers of this eighth edition—Sidney Luckenbach, California State University, Northridge; Dr. Gilbert T. Null, University of Wisconsin, Green Bay; Robert Weingard, Rutgers, The State University of New Jersey, New Brunswick; and Jon Wulff, Bellevue Community College—as well as the prerevision reviewers: Harold Baldwin, University of South Alabama; John David Eatman, Xavier University of Louisiana; Robert Weingard, Rutgers, The State University of New Jersey; Roderick M. Stewart, Austin College; Walter H. O'Briant, University of Georgia; Nancy A. Stanlick, University of South Florida; Katherine Shamey, Santa Monica College; and Vincente Medina, Seton Hall University. We also want to thank our proof checker: Patricia Blanchette, University of Notre Dame.

We would also like to thank many students at the University of Delaware and Mount Union College for all of their suggestions.

Contents

<i>Preface</i>	xiii
Part One: Sentential Logic	1
Chapter One: Introduction	1
1. <i>The Elements of an Argument</i>	1
2. <i>Deduction and Induction</i>	4
3. <i>Argument Forms</i>	6
4. <i>Truth and Validity</i>	8
5. <i>Soundness</i>	11
6. <i>Consistency</i>	11
7. <i>Consistency and Validity Compared</i>	12
8. <i>Contexts of Discovery and Justification</i>	14
<i>Key terms</i>	15
Chapter Two: Truth-Functions	16
1. <i>Atomic and Compound Sentences</i>	16
2. <i>Truth-Functions</i>	17
3. <i>Conjunctions</i>	18
4. <i>Variables and Constants</i>	20
5. <i>Negations</i>	21
6. <i>Parentheses and Brackets</i>	23
7. <i>Disjunctions</i>	24
8. <i>“Not Both” and “Neither . . . Nor”</i>	27
9. <i>Material Conditionals</i>	29
10. <i>Material Biconditionals</i>	31
11. <i>“Only If” and “Unless”</i>	33
12. <i>Symbolizing Complex Sentences</i>	35
<i>Key terms</i>	41
Chapter Three: Truth Tables	43
1. <i>Computing Truth-Values</i>	43
2. <i>Tautologies, Contradictions, and Contingent Sentences</i>	48

3.	<i>Logical Equivalences and Conditionals</i>	53
4.	<i>Truth Table Test of Validity</i>	56
5.	<i>Truth Table Test of Consistency</i>	58
6.	<i>Validity and Consistency</i>	59
7.	<i>The Short Truth Table Test for Invalidity</i>	60
8.	<i>The Short Truth Table Test for Consistency</i>	64
9.	<i>Sentence Forms and Substitution Instances</i>	65
10.	<i>Truth Tables and Forms</i>	70
	<i>Key terms</i>	72

Chapter Four: Proofs 73

1.	<i>Argument Forms</i>	73
2.	<i>Modus Ponens and Modus Tollens</i>	75
3.	<i>Disjunctive Syllogism and Hypothetical Syllogism</i>	77
4.	<i>Simplification and Conjunction</i>	80
5.	<i>Addition and Constructive Dilemma</i>	81
6.	<i>Principles of Strategy</i>	83
7.	<i>Double Negation and DeMorgan's Theorem</i>	90
8.	<i>Commutation, Association, and Distribution</i>	92
9.	<i>Contraposition, Implication, and Exportation</i>	93
10.	<i>Tautology and Equivalence</i>	94
11.	<i>More Principles of Strategy</i>	97
12.	<i>Common Errors in Problem Solving</i>	101
	<i>Key terms</i>	107

Chapter Five: Conditional and Indirect Proofs 108

1.	<i>Conditional Proofs</i>	108
2.	<i>Indirect Proofs</i>	116
3.	<i>Strategy Hints for Using Conditional Proof and Indirect Proof</i>	121
4.	<i>Theorems</i>	122
5.	<i>Proving Premises Inconsistent</i>	123
6.	<i>Adding Valid Argument Forms</i>	124
7.	<i>The Completeness of Sentential Logic</i>	125
8.	<i>Material Implication and Valid Argument Forms</i>	127
	<i>Key terms</i>	130

Part Two: Predicate Logic 131

Chapter Six: Predicate Logic Symbolizations 131

1.	<i>Individuals and Properties</i>	131
2.	<i>Quantifiers and Free Variables</i>	135
3.	<i>Universal Quantifiers</i>	136
4.	<i>Existential Quantifiers</i>	140
5.	<i>Basic Predicate Logic Symbolizations</i>	141
6.	<i>The Square of Opposition</i>	143

7. Common Pitfalls in Symbolizing with Quantifiers	144
8. Expansions	147
9. Symbolizing “Only,” “None But,” and “Unless”	149
Key terms	151
Chapter Seven: Predicate Logic Invalidity	153
1. Interpretations in Predicate Logic	153
2. Proving Invalidity	154
3. Using Expansions to Prove Invalidity	157
4. Consistency in Predicate Logic	159
5. Validity and Inconsistency in Predicate Logic	160
Key terms	160
Chapter Eight: Predicate Logic Proofs	161
1. Proving Validity	161
2. The Four Quantifier Rules	162
3. The Five Main Restrictions	168
4. Precise Formulation of the Four Quantifier Rules	172
5. Mastering the Four Quantifier Rules	174
6. Quantifier Negation (QN)	179
Key terms	184
Chapter Nine: Relational Predicate Logic	185
1. Relational Predicates	185
2. Symbolizations Containing Overlapping Quantifiers	187
3. Expansions and Overlapping Quantifiers	188
4. Places and Times	190
5. Symbolizing “Someone,” “Somewhere,” “Sometime,” and So On	192
6. Invalidity and Consistency in Relational Predicate Logic	197
7. Relational Predicate Logic Proofs	198
8. Strategy for Relational Predicate Logic Proofs	205
9. Theorems and Inconsistency in Predicate Logic	207
10. A Simpler Set of Quantifier Rules	210
Chapter Ten: Rationale Behind the Precise Formulation of the Four Quantifier Rules	213
1. Cases Involving the Five Major Restrictions	213
2. One-to-One Correspondence Matters	216
3. Accidentally Bound Variables	220
Chapter Eleven: Identity and Philosophical Problems of Symbolic Logic	225
1. Identity	225
2. Definite Descriptions	231

3. <i>Properties of Relations</i>	233
4. <i>Higher-Order Logics</i>	236
5. <i>Limitations of Predicate Logic</i>	238
6. <i>Philosophical Problems</i>	241
7. <i>Logical Paradoxes</i>	249
<i>Key terms</i>	255

Chapter Twelve: Truth Trees 258

1. <i>The Sentential Logic Truth Tree Method</i>	258
2. <i>The Truth Tree Rules</i>	259
3. <i>Details of Tree Construction</i>	266
4. <i>Rationale Behind the Tree Method</i>	272
5. <i>Putting Truth Trees to Work</i>	274
6. <i>The Predicate Logic Truth Tree Method</i>	275
7. <i>Infinite Trees</i>	280
<i>Key terms</i>	282

Part Three: Other Systems of Logic 283

Chapter Thirteen: Syllogistic Logic 283

1. <i>Categorical Propositions</i>	283
2. <i>Existential Import</i>	286
3. <i>The Square of Opposition</i>	286
4. <i>Conversion, Obversion, Contraposition</i>	290
5. <i>Syllogistic Logic—Not Assuming Existential Import</i>	293
6. <i>Venn Diagrams</i>	295
7. <i>Syllogisms</i>	298
8. <i>Determining Syllogism Validity</i>	300
9. <i>Venn Diagram Proofs of Validity or Invalidity</i>	301
10. <i>Five Rules for Determining Validity or Invalidity</i>	306
11. <i>Syllogistics Extended</i>	309
12. <i>Enthymemes</i>	312
13. <i>Sorites</i>	313
14. <i>Technical Restrictions and Limitations</i>	315
<i>Key terms</i>	318

Chapter Fourteen: Inductive Logic 321

1. <i>A Mistaken View of Induction and Deduction</i>	321
2. <i>Kinds of Inductive Arguments</i>	323
3. <i>Cause and Effect</i>	333
4. <i>Mill's Methods</i>	336
5. <i>Inductive Probability</i>	343
6. <i>The Probability Calculus</i>	344
7. <i>Bayes' Theorem</i>	346

8. <i>Induction Is Unjustified—The Old Riddle of Induction</i>	348
9. <i>Not All Instances of Theories Confirm Them—The New Riddle of Induction</i>	351
<i>Key terms</i>	354
Chapter Fifteen: Axiom Systems	356
1. <i>The Nature of an Axiom System</i>	356
2. <i>Interpreted and Uninterpreted Systems</i>	357
3. <i>Properties of Axiom Systems</i>	358
4. <i>Outline of an Axiom System for Sentential Logic</i>	361
5. <i>Axiom Systems for Predicate Logic</i>	366
6. <i>Other Kinds of Axiom Systems</i>	367
7. <i>Objections to Axiom Systems</i>	368
<i>Key terms</i>	368
Chapter Sixteen: Alternative Logics	370
1. <i>Modal Logic</i>	370
2. <i>Strict Implication</i>	371
3. <i>Modal Axioms</i>	373
4. <i>Modal Theorems</i>	374
5. <i>Modal Paradoxes</i>	375
6. <i>A Philosophical Problem</i>	375
7. <i>Modal Predicate Logic</i>	376
8. <i>Epistemic Logic: The Logic of Knowledge and Belief</i>	378
9. <i>Epistemic Theorems</i>	381
10. <i>Deontic Logic</i>	382
11. <i>Problems with Deontic Systems</i>	383
<i>Key terms</i>	385
Answers to Even-Numbered Exercise Items	387
Bibliography	449
Special Symbols	453
Index	455

1

The Elements of an Argument

Consider the following simple example of reasoning:

Identical twins often have different IQ test scores. Yet such twins inherit the same genes. So environment must play some part in determining IQ.

Logicians call this kind of reasoning an *argument*. (But they don't have in mind shouting or fighting. Rather, their concern is *arguing for* or presenting reasons for a conclusion.) In this case, the argument consists of three statements:

1. Identical twins often have different IQ test scores.
2. Identical twins inherit the same genes.
3. So environment must play some part in determining IQ.

The first two statements in this argument give *reasons* for accepting the third. In logic talk, they are said to be **premises** of the argument, and the third statement is called the argument's **conclusion**. An **argument** can be defined as a series of statements, one of which is the conclusion (the thing argued for) and the others are the premises (reasons for accepting the conclusion).

In everyday life, few of us bother to explicitly label premises or conclusions. We usually don't even bother to distinguish one argument from another. But good writing provides clues that signal the presence of an argument. Such words as *because*, *since*, and *for* usually indicate that what follows is a premise. And words like *therefore*, *hence*, *consequently*, and *so* usually signal a conclusion. Similarly, certain expressions like "It has been observed that . . .," "In support of this . . .," and "The relevant data . . ." generally introduce premises, whereas other expressions such as "It follows that . . .," "The result is . . .," "The point of all this is . . .," and "The implication is . . ." usually signal conclusions. Here is a simple example:

Since it's wrong to kill a human being, *it follows that* abortion is wrong, *because* abortion takes the life of (kills) a human being.

In this example, the words *since* and *because* signal premises offered in support of the conclusion signaled by the phrase “it follows that.” Put into textbook form, the argument reads:

1. It’s wrong to kill a human being.
2. Abortion takes the life of (kills) a human being.
- ∴ 3. Abortion is wrong.

The symbol “∴” represents the word *therefore* and indicates that what follows is a conclusion. This particular argument has two premises, but an argument may have any number of premises and may be surrounded by or embedded in other arguments.

Not just any group of sentences makes an argument. The sentences in an argument must express statements, that is, say something that is either true or false. Many sentences are used for other purposes: to ask questions, to issue commands, or to give vent to emotions. In ordinary contexts none of the following express statements:

Open the door. (*command*)

Who’s the boss here? (*question*)

Thank goodness! (*expression of emotion*)

Of course, sometimes nondeclarative sentences are indeed used to make statements. “Who’s the boss here?” *can* be used to make a statement, particularly if it is the boss who is talking. In this case the boss is not really asking a question at all, but rather is saying “I am the boss here,” thus declaring a fact under the guise of asking a question.

But even if every sentence in a group of sentences expresses a statement, the result is not necessarily an argument. The statements must be related to one another in the appropriate way. There must be something argued for (the conclusion), and there must be reasons for accepting the conclusion. Thus, mere bald assertions are not arguments, anecdotes generally are not arguments, nor are most other forms of exposition or explanation. It’s important to understand the difference between rhetoric that is primarily expository or explanatory and rhetoric that is basically argumentative. A passage that contains only exposition gives us no reason to accept the “facts” in it other than the authority of the writer or speaker, whereas passages that contain arguments give reasons for some of their claims (conclusions) and call for a different sort of evaluation than merely an evaluation of the authority of the writer.

Examples

Only two of the following groups of statements constitute arguments. These examples also illustrate that although the words “therefore” and “because” usually signal the presence of an argument, this is not always the case.

1. I believe in God because that is how I was raised. (This is biography, not an argument. “Because” is used here to cite the cause of the speaker’s belief—to give an explanation—not to signal a premise.)

2. I believe in God because life has meaning. If there is no God, life would be meaningless. (This is an argument. The speaker is advancing a reason to believe that God exists.) Here is the argument put into textbook form:

1. Life has meaning.
2. If there were no God, life would be meaningless.
- ∴ 3. God exists

(Notice that in this case the word “because” does signal that a premise is to follow.)

3. Biff was obviously afraid of making a commitment to a long-term relationship. Therefore, Susie was not surprised when they eventually broke up. (This is not an argument. This is an explanation of why Susie was not surprised.)
4. We’ll get a tax break if we marry before the end of the year. Therefore, I think we should move our wedding date up and not wait until January. (This is an argument):
 1. We’ll get a tax break if we marry before the end of the year.
 - ∴ 2. We should move our wedding date up and not wait until January.

Exercise 1-1

Here are twelve passages (the first six are from student papers and exams, modestly edited). Determine which contain arguments and which do not. Label the premises and conclusions of those that do, and explain your answers. Paraphrase if that makes things clearer. (The answers for even-numbered items in most exercise sets are provided at the back of the book.)

1. I don’t like big-time college football. I don’t like pro football on TV either. In fact, I don’t like sports, period.
2. My summer vacation was spent working in Las Vegas. I worked as a waitress at the Desert Inn and made tons of money. But I guess I got addicted to the slots and didn’t save too much. Next summer my friend Hal and I are going to work in Reno, if we can find jobs there.
3. Well, I have a special reason for believing in big-time college football. After all, I wouldn’t have come here if Ohio State’s football team hadn’t gone to the Rose Bowl, because that’s how I heard about this place to begin with.
4. At the present rate of consumption, the oil will be used up in 20 to 25 years. And we’re sure not going to reduce consumption in the near future. So we’d better start developing solar power, windmills, and other “alternative energy sources” pretty soon.
5. The abortion issue is blown all out of proportion. How come we don’t hear nearly as much about the evils of the Pill? After all, a lot more potential people are “killed” by the Pill than by abortion.
6. I’ve often wondered how they make lead pencils. Of course, they don’t use lead—they use graphite. But, I mean, how do they get the graphite into the wood? That’s my problem. The only thing I can think of is maybe they cut the lead into long round strips and then cut holes in the wood and slip the lead in.

7. Punishment, when speedy and specific, may suppress undesirable behavior, but it cannot teach or encourage desirable alternatives. Therefore, it is crucial to use positive techniques to model and reinforce appropriate behavior that the person can use in place of the unacceptable response that has to be suppressed. (Walter and Harriet Mischel, *Essentials of Psychology*)
8. There was no European language that Ruth could not speak at least a little bit. She passed the time in the concentration camp, waiting for death, by getting other prisoners to teach her languages she did not know. Thus did she become fluent in Romany, the tongue of the gypsies. (Kurt Vonnegut, *Jailbird*)
9. The death of my brother was another instance in which I realized the inadequacy of the superstition of progress in regard to life. A good, intelligent, serious man, he was still young when he fell ill. He suffered for over a year and died an agonizing death without ever understanding why he lived and understanding even less why he was dying. No theories could provide any answers to these questions, either for him or for me, during his slow and painful death. (Leo Tolstoy, *Confession*)
10. To be sustained under the Eighth Amendment, the death penalty must “[comport] with the basic concept of human dignity at the core of the Amendment”; the objective in imposing it must be “[consistent] with our respect for the dignity of [other] men.” Under these standards, the taking of life “because the wrongdoer deserves it” surely must fail, for such a punishment has as its very basis the total denial of the wrongdoer’s dignity and worth. (Justice Thurgood Marshall, dissenting opinion in *Gregg v. Georgia*)
11. If God were all good he would want his creatures to always be happy. If God were all powerful he would be able to accomplish anything he wants. Therefore, God must be lacking in either power or goodness or both.
12. Every event must have a cause. Since an infinite series of causes is impossible, there must be a first uncaused cause of everything: God.

2

Deduction and Induction

Deduction and induction are commonly thought to be the cornerstones of good reasoning. The fundamental logical property of a deductively **valid argument** is this: If all of its premises are true, then its conclusion must be true. In other words, *an argument is valid just in case it is impossible for all of its premises to be true and yet its conclusion be false*. The truth of the premises of a valid argument guarantees the truth of its conclusion.

In order to determine whether or not an argument is valid, one must ask whether there are any possible circumstances under which the premises could all be true and yet the conclusion be false. If not, the argument is valid. If it is possible for the premise to be true and the conclusion false, the argument is invalid. An **invalid argument** is simply an argument that is not valid.

The question naturally arises as to why it is impossible for the conclusion of a valid argument to be false if all of its premises are true. Why do its premises, if true, “guarantee” the truth of its conclusion? Unfortunately, there are no simple or generally accepted answers to questions of this kind. However, it is revealing to notice that in a typical case the

information contained in the conclusion of a deductively valid argument is already “contained” in its premises. We tend not to notice this fact because it is usually contained in the premises implicitly (along with other information not contained in the conclusion). Indeed, cases in which the conclusion is explicitly mentioned in a premise tend to be rather trivial.

Examples

Here is an example of a deductively valid argument whose conclusion is implicitly contained in its premises:

1. All wars are started by miscalculation.
2. The Korean conflict was a war.
- ∴ 3. The Korean conflict was started by miscalculation.

Having said in the first premise that all wars are started by miscalculation and in the second that the Korean conflict was a war, we have implicitly said that the Korean conflict was started by miscalculation. And this is what is asserted by the argument’s conclusion.

Here is another example:

1. If Bonny has had her appendix taken out, then she doesn’t have to worry about getting appendicitis.
2. She has had her appendix taken out.
- ∴ 3. She doesn’t have to worry about getting appendicitis.

The first premise states that if Bonny has had her appendix out, then she doesn’t have to worry about appendicitis, and the second, that she has in fact had her appendix out, which implicitly asserts the conclusion that she doesn’t have to worry about appendicitis.

And here is a trivial case in which the conclusion is explicitly stated in the argument’s premise:

1. Shakespeare wrote *Othello*, and Chaucer wrote *The Canterbury Tales*.
- ∴ 2. Shakespeare wrote *Othello*.

In addition to deductive arguments, there are also **inductive arguments**. Arguments of this kind differ from deductively valid arguments in having conclusions that go beyond what is contained in their premises. Good inductive arguments are said to be **inductively strong**. The crucial difference between inductive strength and deductive validity is that it is possible for the premises of a strong inductive argument to be true and yet the conclusion be false. Whereas true premises in a valid argument *guarantee* the truth of the conclusion, true premises in a strong inductive argument make the conclusion *likely* or *probable*. The basic idea behind inductive reasoning is that of *learning from experience*. We notice *patterns*, *resemblances*, or other kinds of *regularities* in our experiences, some quite simple (sugar sweetens coffee), some very complicated (objects move according to Newton’s laws), and project them onto other cases.

We use inductive reasoning so frequently in everyday life that the inductive nature of this kind of conclusion drawing generally goes unnoticed. It's a bit like being told that we've been speaking prose all our lives only to discover that we've been drawing perfectly good inductive inferences (and some stinkers) since an early age. By the age of five, the use of induction has taught us a great many of the basic truths that guide everyday behavior. We have learned, for instance, that some foods taste good and some don't, the sun is going to rise tomorrow morning and every morning after that, very hot things burn the skin, some people are good and some aren't, you can't hold your breath for more than a minute or two, and so on. Our reasoning to the belief that the sun will rise tomorrow, as an example, can be expressed in this way:

1. The sun has always risen every morning so far.
- ∴ 2. The sun will rise tomorrow (or every morning).

The great virtue of inductive reasoning is that it provides us with a way of reasoning to genuinely new beliefs, and not just to psychologically new ones that were implicit in what we already knew, as in the case of valid deductions. However, this benefit is purchased at the cost of an increase in the possibility of error. The truth of the premises of a deductively valid argument guarantees the truth of its conclusion, but a strong induction may contain all true premises and yet have a false conclusion. Even the best "inductive leap" may lead us astray, because the pattern noticed in our experiences may not turn out to be true in other cases. For example, in 1986 after the success of the *Star Wars* movies, it was a pretty safe bet that the next film produced by George Lucas would be a box office hit. So moviegoers in 1986 could have constructed the following inductively strong argument:

1. All of the movies produced in recent years by George Lucas have been successful.
- ∴ 2. The latest film produced by Lucas will be successful.

Unfortunately, the film turned out to be *Howard the Duck*.

Although an inductively strong argument does not guarantee that if its premises are true then its conclusion also will be true, it does make its conclusion more probable (one reason why the expression "probability argument" is sometimes applied to inductive arguments). And, of course, the more and the better the evidence, the higher the probability that its conclusion will in fact turn out to be true. Unlike validity, inductive strength comes in degrees. It makes no sense to speak of one argument as being more valid than another. All arguments are either valid or invalid. But it does make sense to describe one argument as being inductively stronger than another. This fact alone makes inductive logic much more complex and controversial. Induction is treated in greater detail in Chapter 14.

3 *Argument Forms*

Consider the following argument:

1. Art is an Abadab or he's a Glubphlab.
2. It's not true that Art is an Abadab.
- ∴ 3. He's a Glubphlab.